Regular BOE Meeting

Wednesday, May 1, 2013 7:00 PM
Auditorium, 129 Church Street, Bristol, CT 06010

I. **Call to Order, Pledge of Allegiance, Moment of Silence**

II. **Student/Teacher Recognition**

III. **Staff Awards**

IV. **Approval of Minutes**

V. **Committee Reports**

VI. **Superintendent Report**

VII. **Consent Agenda**

VII.A. Personnel

VII.A.1. Teacher Retirement - Effective June 30, 2013

VII.A.2. Teacher Resignation - Effective April 9, 2013

VII.A.3. Teacher Request for an Unpaid Leave of Absence - Effective 2013-2014 School Year

VII.B. Grants

VII.B.1. Improvement Project (PIP) - Federal Grant to Supplement Adult Basic Education

VIII. **Public Comment**

IX. **Deliberated Items**

IX.A. BCHS Trip to Italy - November 2013

IX.B. Elementary and Secondary Summer School Offerings - Summer 2013

IX.C. Enrollment Update

IX.D. Teacher Evaluation Report

IX.E. Teacher and Administrator Evaluation Plans

X. **Curriculum Revision**

X.A. Algebra, Geometry and Algebra 2 Curriculum Revision - Second Reading

X.B. French 2 Curriculum - Second Reading

XI. **Textbook Adoption**

XI.A. French 2 Textbook - First Reading

XII. **Policy Revision**

XII.A. Revision to Policy 6145.2 - Co-Curricular Activities/Athletics - First Reading

XIII. **Old Business**

XIV. **New Business**

XV. **Information**

XVI. **Adjournment**

BOARD OF EDUCATION
Bristol, Connecticut
SPECIAL BOARD OF EDUCATION MEETING
Thursday, April 18, 2013

A special meeting of the Bristol Board of Education was held on Thursday, April 18, 2013 at 6:00 p.m. at the Board of Education Administration Building, 129 Church Street, Bristol, Connecticut in the Auditorium.

Present: Commissioners: Lawrence Amara, Karen Bourassa, Genard Dolan, Jill Fitzgerald, Karen Hintz, Jeffrey Morgan, Thomas O'Brien (6:45), Karen Vibert, and Christopher Wilson. **Also present:** Dr. Ellen Solek, Superintendent of Schools; Dr. Susan Kalt Moreau, Deputy Superintendent of Schools; Dennis Bieu, Director of Human Resources and Gary Franzi, Supervisor of Budgeting & Accounting.

1. Call to order
Chairman Wilson called the meeting to order at 6:03 p.m.

Chairman Wilson explained the purpose of the meeting: To consider possible outsourcing for cafeteria operations.

2. Convene Into Executive Session

On a motion by Commissioner Morgan and seconded by Commissioner Dolan, it was unanimously
Voted: to convene into Executive Session at 6:05 p.m. to discuss a statement of strategy with respect to collective bargaining.

3. Reconvene Into Public Session

On a motion by Commissioner Vibert and seconded by Commissioner Hintz, it was unanimously
Voted: to reconvene into Public Session at 6:51 p.m.

Commissioner Wilson explained that because privatizing the cafeteria might be part of the collective bargaining process they will not be able to answer questions but will take public comments into account before the final vote on this issue.

On a motion by Commissioner O'Brien and seconded by Commissioner Amara, it was unanimously
Voted: That the Board of Education authorized the Superintendent to negotiate and execute a contract with Whitsons Culinary Group to assume responsibility for cafeteria food service operation for the Bristol Public Schools commencing with the 2013-2014 school year in accordance with Whitsons' final response to the related Request for Proposal (RFP) issued by the Board, such contract to contain any conditions or precedent that may be required by law or that the Superintendent may otherwise determine to be appropriate.

4. Public Comment

Tracy Beland - 33 Fall Mountain Road, works as lead at Bristol Eastern Cafeteria and was hired in 2009. She enjoys her job and feels part of an extended family as a BOE employee. The cafeteria workers know the students and staff. She feels the decision to outsource to a large hospitality company is turning your backs on fellow town people. She has worked for a large hospitality company before and feels it would be detrimental to our children. Structure, continuity and support will be loss. She asks that BOE commissioners and administration visit the cafeterias in the schoosl and ask the staff questions. She is pleading that before making any decision, to think about your own children and about her, her husband and son, Cole.

Patti Lavoie – 47 Park Hill Road, has worked in the cafeteria for 20 years and is currently the lead at West Bristol. She remembers herself going through the lunch line, she felt at home and comfortable. The café know the children on a personnel basis. The children mean so much to all of them and can't see them getting as much care and attention from a large company. They know their students allergies and special needs. She feels heartbroken for all the kids if the company comes in because the current café staff is like family, they have a connection.

Dorothy Chambers - 1327 Stafford Avenue, she is disappointed in the discussion to hold the meeting tonight and that the Board of Education has not sat down with the Union to discuss privatizing the cafeteria. She is also disappointed that public comment wasn't allowed until after the vote. The cafeteria is not the problem; they are part of the solution. Privatization is not the answer. The cafe was privatized many years ago and it didn't last. The Board of Education had to hire back the cafeteria ladies. Look at the faces in the audience, they provide service to students and staff. They know them by name, give support, they are someone to talk to, or provide a shoulder to cry on. Many have lived in Bristol all their lives. The goal is to work with the Board of Education to keep the current cafeteria intact. They want to be part of the solution. She spoke in behalf of the 2267 café women who this discussion affects.

Nancy Champagne – 59 Lakeview Road, Terryville, has work in the cafeteria for 27 years. She is retiring but would have stayed three (3) more years except a lot is going on. Other cafeteria workers don't have that option. The café girls are the best!

Paul Keegan – 80 Sims Road, he is disappointed in the decision to privatize. The cafeteria workers are neighbors and friends. He finds it hard to believe that it would be a significant savings. He realizes that with the budget, the Board of Education has their back to the wall. Show support to the café workers and not privatize. This is just the beginning and hopes for a better end.

5. Adjournment

On a motion by Commissioner Dolan and seconded by Commissioner O'Brien, the meeting was adjourned at 7:15 pm.

Respectfully Submitted,

Nancy Fandozzi

Nancy Fandozzi

BOARD OF EDUCATION
Bristol, Connecticut
Regular Meeting – April 3, 2013

The regular monthly meeting of the Bristol Board of Education was held on Wednesday, April 3, 2013 at 7:00 p.m., at the Board of Education Administration Building, 129 Church Street, Bristol, Connecticut.

PRESENT: Commissioners: Lawrence Amara, Karen Bourassa, Genard Dolan, Jill Fitzgerald (7:04), Karen Hintz, Jeffrey Morgan, Thomas O'Brien, Karen Vibert, Christopher Wilson; Ellen W. Solek, Superintendent of School, Susan Kalt Moreau, Deputy Superintendent of Schools, Dennis Bieu, Director of Human Resources and David Mills, City Council Liaison

CALL TO ORDER, PLEDGE OF ALLEGIANCE
Chairman Wilson called the meeting to order at 7:01 p.m. and invited the audience to join him in reciting the Pledge of Allegiance.

Chairman Wilson thanked Commissioner Vibert for running the March meeting in his absence.

APPROVAL OF MINUTES

VOTE: That the minutes of the March 6, 2013 Regular Meeting be approved as written.
Chairman Wilson declared the minutes **APPROVED** with eight commissioners in favor of the approved, and Commissioner Wilson abstaining.

STAFF AND STUDENT RECOGNITION
Principal David Huber presented teachers and Grade 4 and 5 students from Mountain View who were present to perform an excerpt from a musical they are putting on. The students had the opportunity to audition for a role in the musical based on the novel, The Phantom Tollbooth, By Norton Juster**.** By combining gifted and talented funds and writing a successful Bristol Business Foundation mini-grant, the group was able to purchase the script and supplies to perform the show. Beginning in December, the group met twice a week to first read the book and discuss the very difficult figurative language. In January, the group switched gears and began to rehearse for the musical. **The efforts of the following students: Leah Policarpio, Madison Collin, Surya Singh, Emilie Feivelson, Emma Getto, Agmed Abdelhady, Devan Jacques, Isabella Torres, Jenesis Villar, Tyna Lyons, Lydia Bishop, Annika Fitzgerald, Kallie Candelaria, Aidan Dyer, Isabello Rubio, Sara Stadnicki, Angelina Khut, Vanda Horvath, Zayda Greer, Taylor Fitzsimons, Emilee Bleau, Jenna Sforza and the volunteer efforts of Mrs. Barrieau, Mr. Chris, Miss Lavore, and Mrs. Pratt** make our school a better place to learn.

Following their performance the students handed out tickets to Board Members for them to attend the performance of The Phantom Tollbooth, Jr. on April 26th and invited anyone that was interested to purchase ticket to their performance.

Chairman Wilson called for a break to allow students and their families the chance to leave.

MOMENT OF SILENCE
Chairman Wilson asked the audience to join him in a moment of silence in observance of Vito Colapinto, Carpenter – District Wide from 12/77 to 10/90, Estella Dyer, Grade 2 Teacher at South Side School from 9/68 to 6/88 and Donna LeBlanc, Special Education Aide at John J. Jennings School from 2/87 to 6/89.

COMMITTEE REPORTS

Finance
Commissioner Vibert reported that the committee met earlier this evening and received an update of our current years budget from Gary Franzi. Through the efforts of our Administrators being frugal with their spending, and fewer Special Education costs than anticipated; we are looking at a surplus. We may be able to transfer some of those funds to purchase needed technology and Teaching and Learning textbooks that we have needed for quite some time. The Finance Committee will be meeting again within the next 10 days to discuss the list and see what we can accomplish.

STAFF AND STUDENT RECOGNITION - *continued*
Dr. Moreau recently attended the Wade's World Foundation dinner. At that dinner she presented them with a check in the amount of $3,183 which was the amount raised at the March Dress Down Day for the organization. Wade's World is Bristol's "Make A Wish Foundation" where they grant wishes of children who are ill or children who cannot afford certain things for special events, they have given away astronomical amounts of money, since their inception. That evening Dr. Moreau also accepted a plaque from the foundation on behalf of the Board of Education in recognition of the Board of Education's ongoing Dress Down donations. The plaque will be displayed in the Superintendent Office.

Chairman Wilson ask that she pass on our thanks and appreciation to the staff and faculty for their support. Commissioner Vibert noted that Wade's World is named after Wade Botteon who was a student at Mountain View and Northeast who lost his battle with cancer; however his legacy lives on through his parents and this organization.

SUPERINTENDENT REPORT
Dr. Solek reported on the following topics: Open Choice Workshop and the newly configured program with various incentives for districts; Safety Committee Meeting and their progress; PTO meetings; recent Budget forum held at Bristol Eastern; Teacher and Administrator Evaluations and pending deadlines; March Parent Advisory Meeting; the Robotics Regional's held in Hartford this past weekend; a visit by Senator Blumenthal to West Bristol School to access the safety measures put in place since the Sandy Hook incident and his promise to support our district in regards to safety and security; Call in show that will air every other Thursday from 7:30 p.m. to 8:30 p.m., and the next show will air April 11th with Greg Boulanger as her guest.

Councilman Mills commented on his past attendance at the robotics competition, it quite impressive, and it would be nice to see something like that here.

CONSENT AGENDA

PERSONNEL

Teacher Retirement – Effective June 30, 2013
On motion of Commissioner Vibert seconded by Commissioner Dolan, it was unanimously

VOTED: That the Board of Education approve the following Retirement – Effective June 30, 2013: Jean Gustafson – EPH – Grade 1

Teacher Resignations from an Unpaid Leave of Absence - Effective June 30, 2013
On motion of Commissioner Vibert seconded by Commissioner Dolan, it was unanimously

Teacher Resignations from an Unpaid Leave of Absence - Effective June 30, 2013 – con't

VOTED: That the Board of Education approve the following Teacher Resignations from an Unpaid Leave of Absence - Effective June 30, 2013:
Caryn Brannen – BEHS – Special Education (from an unpaid leave of absence)
Michelle Carriere – GH – Wellness (from an unpaid leave of absence)
Erin Ferrell – EPH – Grade 4 (from an unpaid leave of absence)
Katie Manfre – EPH – Kindergarten (from an unpaid leave of absence)
Caitlin Martin – STAF – Instructional Support

New Teacher Hired - Effective March 18, 2013
On motion of Commissioner Vibert seconded by Commissioner Dolan, it was unanimously

VOTED: That the Board of Education approve the following New Teacher Hire:
Jeffrey Papazian – BCHS – Special Education

A-3 Teacher Appointments
On motion of Commissioner Vibert seconded by Commissioner Dolan, it was unanimously

VOTED: That the Board of Education approve the following A-3 Teacher Appointments
Carrie Jackson – EPH – Science Co-Leader - Effective February 26, 2013
Tami Raspansi – EPH – Science Co-Leader - Effective February 26, 2013
Debra Rogan – MTV – Elementary Enrichment Summer School Director - Effective March 1, 2013

Teacher Request for an Unpaid Leave of Absence
On motion of Commissioner Vibert seconded by Commissioner Dolan, it was unanimously

VOTED: That the Board of Education approve the following Teacher Request for an Unpaid Leave of Absence:
Janet Blauvelt – ID/MTV – Instructional Support – Effective March 11, 2013 through June 30, 2013

Coaching Appointments
On motion of Commissioner Vibert seconded by Commissioner Dolan, it was unanimously

VOTED: That the Board of Education approve the following Coaching Appointments:
Richard Block - Head Boys Tennis Coach - BCHS, effective 3/18/13
Kenneth Boudreau - Head Boys Lacrosse Coach - BEHS, effective 3/18/13
Kelly Buikus - Head Girls Lacrosse - CO-OP BCHS/BEHS, effective 3/18/13
Gregory Diaz - Assistant Boys Lacrosse Coach - BEHS, effective 3/18/13
Toni Minelli - Assistant Girls Lacrosse - CO-OP BCHS/BEHS, effective 3/18/13
Shawn Mirmina - Assistant Boys Baseball Coach, BCHS, effective 3/18/13

PUBLIC COMMENT

No members of the public wished to address the Board.

DELIBERATED ITEMS

High School Graduation Date and End of Year Closing Date
Dennis Bieu presented the High School Graduation Date and End of Year Closing Date. Traditionally the closing day of school has been set at the April meeting along with the high school graduation date.

High School Graduation Date and End of Year Closing Date – con't

Promotional exercises at the middle schools take place in the morning of the last day of school, Tuesday, June 25, 2013.

High school graduation will be scheduled for the evening of Tuesday, June 25, 2013.

Summary of Closing Information to Date
School Closed: 10/29, 10/30, 11/8, 1/16, 2/8, 2/11, 2/12, 2/13, 2/14, 3/8
Late Openings: 2/15, 3/19
Early Dismissals: 11/7, 1/9 ID only, 1/28

On motion of Commissioner Fitzgerald, seconded by Commissioner Bourassa it was unanimously

VOTED: That the Board of Education approve that the high school graduation be scheduled for the evening of Tuesday, June 25, 2013, following completion of the 181th day of school. The closing date for K-5, middle, and high schools be scheduled at the end of the school session on Tuesday, June 25, 2013. This date will be subject to change in the event additional emergency closing days are required in the interim to the end of the school year.

Questions followed regarding April vacation.

Parent Conference Schedules and marking Period Close Dates for 2013-2014
Denise Carabetta presented the Parent Conference Schedules and marking Period Close Dates for 2013-2014. Parent-teacher conferences are scheduled for the fall and spring at the elementary, middle and high school levels.

The school year is divided into three marking periods for the elementary and middle school students and four marking periods for high school students. This creates marking periods of approximately 60 days and 45 days for grades K-8 and 9-12 respectively.

On motion of Commissioner Dolan, seconded by Commissioner Bourassa it was unanimously

VOTED: That the Board of Education approve the parent conference schedule and marking period closing dates for the 2013-2014.

POLICY REVISION

Policy 3156.5 - Sexual Offenders on School Property (*Second Reading*)

On motion of Commissioner Fitzgerald, seconded by Commissioner Hintz it was unanimously

VOTED: That the Board of Education approve the adoption of Policy 3156.5 - Sexual Offenders on School Property.

OLD BUSINESS
There was no Old Business to come before the board.

NEW BUSINESS
There was no New Business to come before the board.

INFORMATION

Commissioner Vibert reported that she attended the Bristol Eastern Light fundraiser. It was a lot of fun. She also attended the National Honor Society induction ceremony at Bristol Central, where 60 students were inducted.

Commissioner Fitzgerald reported that Northeast Middle School performed at the Arts Slam held at the Capitol, the Express singers came and the clarinet group, they were very good. Following their performance they got a chance to walk around the Capitol.

Commissioner Dolan reported that he also attended the Bristol Eastern dinner; he enjoyed it very much and he thanked Commissioner Hintz for the donation of two tickets. He also heard it was very successful.

Chairman Wilson reported that the Board of Education presentation to the Finance Board will take place on Monday, April 8th at 6:00 p.m.; the Board could use community support and commissioners that can attend. We have been level funded for four years, but we still need to make a case for public education. For the graduation exercises to be held on June 25th he will be making remarks on behalf of the Board at Bristol Eastern and Vice Chairman Vibert will be at Bristol Central. If any commissioner would like to help hand out diplomas, please let him know. He will also be attending the National School Board meeting in San Diego, as a representative of CREC, he learns a lot at the convention. Odyssey of the Mind Statewide Competition will be held at Stafford and Bristol Eastern, commissioners received notification regarding the competition. He has been appointed to the Moore Commission; the Board of Education subcommittee at the State level. The group is looking at topics such as regionalization/regionalism across the State, looking at things such as common calendar, shared services, and cooperative buying.

Councilman Mills reported that he attended the Bristol Sports Hall of Fame Scholar Athlete Dinner on Monday; there were over 300 people in attendance and three (3) $1,000 scholarships were given out to students. Those honored were students who had an 88 average throughout their career and lettered in at least three (3) varsity sports. The following morning a leadership program was held for next year's class, where juniors or potential captains are invited; the guest speaker was Matt Smith, from Yarde Metals; he was excellent.

ADJOURNMENT:

On motion of Commissioner Vibert seconded by Commissioner Bourassa it was unanimously

VOTED: That the Board of Education meeting be adjourned. (7:38 p.m.)

Respectfully Submitted:

Susan P. Everett

Susan P. Everett
Executive Secretary
Bristol Board of Education

Ellen Solek, Ed.D.
Superintendent of Schools

Susan Kalt Moreau, Ph.D.
Deputy Superintendent of Schools

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BOARD OF EDUCATION
SPECIAL MEETING OF THE OPERATIONS COMMITTEE
WEDNESDAY, APRIL 24, 2013

Minutes

Present: Karen Bourassa, Genard Dolan, Karen Hintz, Karen Vibert, and Christopher Wilson. Also present were Peter Fusco, Rochelle Schwartz and Ellen Solek.

Excused: Jill Fitzgerald

1. The meeting was called to order at 6:30 p.m. by Genard Dolan.

2. On a motion by Karen Hintz and seconded by Karen Bourassa, minutes of the February 27, 2013 Operations Committee were approved unanimously.

3. Consideration of the donation and installation of a play scape at Hubbell School.

Mrs. Schwartz provided the committee with information regarding the Hubbell School PTA's efforts to raise fund for the construction of a new playscape. She provided design information that indicates future expansion capacity. These drawings have been approved by the City insurance carrier as acceptable when installed according to manufacturers' specification. Peter Fusco will arrange for the 12" of certified mulch that is required under the playscape once installed.

On a motion by Genard Dolan and seconded by Karen Hintz, the committee unanimously granted Mrs. Schwartz permission to proceed with installation of a playscape at Hubbell School, funded by the Hubbell School PTA.

4. Adjournment at 6:52

Respectfully submitted:
Susan Kalt Moreau, Ph.D.

Ellen W. Solek, Ed.D.
Superintendent of Schools

Susan Kalt Moreau, Ph.D.
Deputy Superintendent of Schools

BRISTOL BOARD OF EDUCATION
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BOARD OF EDUCATION
PERSONNEL COMMITTEE
Tuesday, April 23, 2013

Minutes

1. Call to Order – 3:30

2. On a motion by Commissioner Vibert and seconded by Commissioner O'Brien, the minutes from the April 11, 2013 meeting were approved unanimously.

3. Having reviewed 14 nominations, the following staff members will be recognized for Staff Awards:

   Jonathan Horan – Technology Educator – Bristol Central High School
   Jennifer O'Donnell – Grade 2 teacher – Edgewood School
   Amy DiNoia – Grade 6 Social Studies teacher – Chippens Hill Middle School
   Dr. Brenda O'Leary – School Psychologist – Northeast Middle School
   Jennifer Wollman – Instructional Technologist – City-Wide

   Career Achievement Award:
   Dr. David Bittel – Physics – Bristol Eastern High School

   Special Board Recognition:
   Dr. Susan Kalt Moreau – Deputy Superintendent of Schools

4. Having no other business, the meeting adjourned at 4:10.

Respectfully submitted,
Susan Kalt Moreau, Ph.D.

III.APPENDICES

APPENDIX A

APPLICATION COVER
FOR 2013 –14 ADULT EDUCATION PROGRAM IMPROVEMENT PROJECTS
Bureau of Health/Nutrition, Family Services and Adult Education

Title Of Grant: Building Bridges for Success

Applicant Organization:
Bristol Adult Education Center
210 Redstone Hill Rd
Bristol, CT 06010

Initiated By:
Maria Groody, Director-Adult Education
860-585-4368
mariagroody@ci.bristol.ct.us

Project Director: Same as above

Submitted By:
Ellen W. Solek, Ed.D.
Superintendent of Schools
860-584-7002

Signature of Superintendent of Schools or Chief Executive Officer of Agency: _____

Priority Area	**Code**	**Funds Requested**	**Matching Funds**
Transition: Preparing for 21st Century Careers– *Elementary ESL and ABE/GED*	**AE-13-1E**		
Transition: Preparing for 21st Century Careers - *Secondary*	**AE-13-1S**		
Family Literacy – *Elementary ESL and ABE/GED*	**AE-13-2E**		
Family Literacy- *Secondary*	**AE-13-2S**		
Nontraditional Adult Education Instruction and Services	**AE-13-3**		
Expansion of the National External Diploma Program	**AE-13-4**	**$30,000**	**$ 7,500**
Transition: Post-Secondary Education and Training	**AE-13-5**	**$35,000**	**$ 8,750**
Transition: Integrated Basic Education and Skills Training (I-BEST)	**AE-13-6**		
English Language Acquisition/ Civics Education	**AE-13-7**	**$25,000**	**$ 6,250**
CT Adult Virtual High School	**AE-13-8**		
Total Funds Requested		**$90,000**	**$22,500**

Date Submitted: **April 23, 2013**	**Date of Board/Agency Approval:**

Elementary Summer Enrichment Program 2013

Summer Fun!

July 8 to August 2

A place to learn, be active, make friends and have a great time!
For students entering K-6
Classes held at
Ivy Drive Elementary School
160 Ivy Drive

Debra Rogan, Director

Purpose

The summer enrichment program provides students with opportunities to challenge themselves academically, physically, creatively and intellectually.

Who Can Attend

The program is open to all Bristol public and parochial students entering Kindergarten through grade 6. Non-residents are also welcome to attend. Children must be 5 before 1/1/2014.

Program Costs/ Payment/ Attending

Students may attend classes on a week by week basis or for the entire four weeks.

$35.00 per week for one class, $70.00 per week for two classes. **Payment must be made at time of registration.** *Cash or Checks payable to Bristol Summer School.* Checks can be mailed to the address below. *Special programs are priced differently and may have limited space.

Registering

Mail: Detach the registration form and mail to:

Greene Hills School
ATTN: Mimi Meehan
718 Pine Street
Bristol, CT 06010

Web Register

http://www.bristol.k12.ct.us

or

Email your course selections to

ElementarySummerEnrichment@ci.bristol.ct.us

Special Needs

The summer program is designed to meet the needs of all students. Please contact Debra Rogan with any special requests or inquiries.

Contact information:

Phone Number **before** June 30th 860-584-7726 ext.102
Phone Number **as of** July 8th 860-584-7844 ext. 131

***We do not confirm registrations.**

Arts, Science, Technology and Mathematics

PRINTMAKING: Students will explore a variety of printmaking methods and materials as they create a beautiful portfolio of unique designs. Kids–this is your big chance to express yourself and create amazing art from the heart! **K-5**

CLAY SCULPTURE: Who doesn't love working with clay? Basic methods of creating sculptures will be explored with various media. **K-5 Space is limited.**

FUTURE ARTISTS: This class is for the primary students interested in rolling up their sleeves and exploring the world of art. Watercolors, painting, drawing and more. **K-2**

FASHION DESIGN: Students will draw and sketch concepts, designs, and learn the fundamentals of design techniques. **K-5**

LIGHTS,CAMERA,ACTION: So you want to be an actor? Students will build drama skills as they explore and perform scenes from favorite stories, bringing magical characters to life using pantomime, movement, simple props and costumes. *This is a two-session class. **2-5**

HEAR THE BEAT: For students entering K-1, this class takes students through the first steps in music education, including songs, movements, fingerplays, and beats. *This is a two-part class (weeks 1 & 2). **K-1**

JOIN THE BAND: Learn the basics of instrumental music by learning to play songs on a recorder. Students may bring their own recorders or one will be provided, if needed. *This is a two-part class (weeks 3 & 4). **4-5**

LEGO ROBOTICS: The Lego education construction set is an easy-to-use set that introduces young students to robotics. Children build LEGO models featuring working motors and sensors. **K-5 Space is limited.**

CAMP INVENTION: July 15-19, 8:30-3pm The Camp Invention program instills vital 21st century life skills, such as problem-solving and teamwork, through hands-on fun! (**$245** for the week) **K-5**

CONNECTICUT SCIENCE CENTER OUTREACH: Each day is a new and exciting class that requires you to be a scientist for the day. Topics range from worms to parachutes. Two classes: **K-2, 3-5**

LITTLE SCIENTISTS: Students will enjoy getting messy with this class. Children will explore science by making many fun projects that include gak, bubbles, oobleck, playdough and volcanoes! **K-2**

CRIME LAB INVESTIGATION: Decode fingerprints, examine soil, and analyze ink composition. It's up to you to use the clues to solve the crime. **3-5**

MINDGAMES: Students will reinforce both reading and math skills while engaging in fun, interactive computer games that provide immediate feedback. **K-2 Space is limited.**

LEARN TO TYPE: Students will use a variety of online and gaming resources to learn keyboarding skills and appropriate hand/finger positioning. **3-5 Space is limited.**

TOUCHDOWN MATH: Students will use a variety of sports situations as their guide to explore and apply several mathematical concepts and discover the importance of math in the sports they love to play. **3-5**

Literacy, Intellectual and Social

BRINGING BOOKS TO LIFE: Read some of your favorite stories and then roll up your sleeves and do crafts and projects related to the book. **K-2**

BOOK COOKS: Reading and recipes for the little ones. How much fun! Students read and are read to, then make fun food and learn to "cook". **K-2**

POETRY SLAM: Welcome poets, rappers, performers. Join this class to share, learn, listen and perform all types of poetry. **3-5**

STOP THE PRESSES: Students will learn the skills needed to plan and write news stories, feature articles, and editorial pieces. Students will also learn to lay out the articles in an organized manner to develop a news magazine and/or newspaper. *This is a two-session class. **3-5**

WHO LOVES A MYSTERY?: Students will learn about the characteristics of a mystery by reading a variety of popular mysteries (Nate the Great, Cam Jansen, etc.). Students will then have the opportunity to write and publish their own mystery story. *This is a two-session class. **3-5**

KNIGHTS OF BRISTOL: This chess class is open to beginners, experts and all in between. Learn the game played by kings. This helps with concentration, focus, problem-solving and thinking! Boards and pieces provided, but you can bring your own too! **K-5**

GAMES WE PLAY: Who likes to play board games? This class is a fun and innovative way for kids to develop vocabulary, spelling, math and spatial relation skills through games such as $S_1C_4R_1A_1B_4B_4L_2E_1$, Yahtzee, Wordopoly, Bingo, and more. **K-5**

OLD SCHOOL GAMES: Outdoor and indoor games from past and present. Activities to strengthen thinking and social skills. Guaranteed fun! **K-5**

GETTING READY FOR KINDERGARTEN: This is a great class for your child to work on writing, coloring, socializing, and listening. Taught by experienced and wonderful primary grade teachers!

AMERICAN SIGN LANGUAGE: Children will learn the basics of American Sign Language, including letters, numbers, and simple vocabulary. **K-5**

JUDGE AND JURY: So you think you want to be a lawyer or a detective? Join this class of mystery, debate and procedures. Try your hand at mock trials and solving mysteries like Sherlock Holmes. **2-5**

JUNIOR ACHEIVEMENT:

Our Community Explore workers in a community, the work they perform and how communities work. Students will be able to identify a variety of jobs in a community, make informed decisions and recognize how money flows through a community's economy. **K-2**

Our Region Learn about entrepreneurship and how entrepreneurs use resources to produce goods and services in a community. Students will understand how entrepreneurs work with each other to produce goods and services and be able to recognize the skills an entrepreneur must master to start a successful business. **3-5**

Physical Activities

CHEERLEADING: This is an exciting class that requires a lot of energy, spirit and concentration. Learn steps, moves, and simple stunts. Beginner and Intermediate levels (must have knowledge of arm movements and jumps). Open to boys and girls. **K-5**

HIP HOP DANCE: Learn some of today's latest steps and moves in this fast-paced, fun class. Dress comfortably and wear sneakers or your dance shoes. Open to boys and girls. Two classes: **K-2, 3-5**

T-BALL: What a great way to learn the basics of baseball. Classes will be held outside, so remember to dress appropriately and wear sunscreen. **K-2**

FLAG FOOTBALL: The safe way to enjoy the game! Run, pass, and have fun. **K-5**

SPORTS AND GAMES: Get out and get up! Try your hand at exciting games in a fun environment. Students are grouped by age/ability. **K-5**

HOOP IT UP BASKETBALL: Focusing on the FUNdamentals of basketball. Emphasis given to shooting and dribbling. Improve your game! **K-5**

BASEBALL CLINIC: Improve your skills in this fun and intense course. Players should bring a glove. Class will be outside. Open to boys only. **4-5**

SOFTBALL CLINIC: This course is similar to BASEBALL CLINIC, but for girls only. Players should bring a glove and dress appropriately for outdoor weather. **4-5**

SOCCER SKILLS: Improve your skills in this fun and intense course. Open to beginners too! **K-5**

July-August 2013

Sun	Mon	Tue	Wed	Thu	Fri	Sat
30	1	2	3	4	5	6
7	8 *Program Starts*	9	10	11	12	13
14	15 *Camp Invention*	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2 *Program Ends*	3

8:30 a.m. to 10:00 a.m.

Week 1: July 8-12
LEGO Robotics (K-5)
Poetry Slam (3-5)
Little Scientists (K-2)
Hear the Beat (K-1)
Printmaking (K-5)
Bringing Books to Life (K-2)
Beginner Cheerleading (K-5)
Sports and Games (K-5)

Week 2: July 15-19
American Sign Language (K-5)
Mindgames (K-2)
Who Loves a Mystery? (3-5)*
Hear the Beat-Part 2 (K-1)
Hoop It Up (K-5)
Knights of Bristol (K-5)
Getting Ready for Kindergarten
Junior Achievement (3-5)
Camp Invention (K-5) *See description

Week 3: July 22-26
Hip Hop Dancing (K-2)
Clay Sculpture (K-5)
Join the Band (4-5)
Lights, Camera, Action (2-5)*
Learn to Type (3-5)
Touchdown Math (3-5)
Baseball Clinic (4-5)
Book Cooks (K-2)

Week 4: July 29-Aug 2
Old School Games (K-5)
Crime Lab Investigation (3-5)
Stop the Presses (3-5)*
LEGO Robotics (K-5)
Softball Clinic (4/5)
Fashion Design (K-5)
Join the Band-Part 2 (4-5)
CT Science Outreach (K-2)

10:15 a.m. to 11:45 a.m.

Week 1: July 8-12
Clay Sculpture (K-5)
Touchdown Math (3-5)
Crime Lab Investigation (3-5)
Old School Games (K-5)
Knights of Bristol (K-5)
Book Cooks (K-2)
Intermediate Cheerleading (K-5)
Baseball Clinic (4/5)

Week 2: July 15-19
Little Scientists (K-2)
Learn to Type (3-5)
Who Loves a Mystery (3-5)*
Games We Play (K-5)
Soccer (K-5)
Softball Clinic (4-5)
Lego Robotics (K-5)
Junior Achievement (K-2)
Camp Invention (K-5) *See description

Week 3: July 22-26
Hip Hop Dancing (3-5)
T-Ball (K-2)
Printmaking (K-5)
Lights, Camera, Action (2-5)*
Poetry Slam (3-5)
Mindgames (K-2)
Bringing Books to Life (K-2)
LEGO Robotics (K-5)

Week 4: July 29-Aug 2
Future Artists (K-2)
Judge and Jury (2-5)
Stop the Presses (3-5)*
American Sign Language (K-5)
Getting Ready for Kindergarten
Flag Football (K-5)
Soccer (K-5)
CT Science Outreach (3-5)

***Indicates that the class runs through both sessions (8:30-11:45), pricing is for two classes**
Please note that grade levels are recommendations and not final. Contact me with any inquires.
The students have a supervised break from 10:00 to 10:15. You may send them with a snack.
The students are escorted from session 1 to session 2 and then to the café after classes.
Parents are to pick up their children inside the cafeteria (signs will be posted).

Children are always supervised

Registration 2013 Elementary Summer Enrichment

Personal Information

Student Name	
Student # 2	
Parent Name	
Home address	
Phone (Home)	
Phone (Cell)	
Grade entering	
Child's School	
Email	

Other adults authorized to pick up child

Class Selection

	8:30	10:15
Week 1 Choices		
Student # 2		
Week 2 Choices		
Student # 2		
Week 3 Choices		
Student # 2		
Week 4 Choices		
Student # 2		

Emergency and Medical Information

In case of emergency, contact	
Emergency contact's phone	
Medical conditions/concerns	

Registration 2013 Elementary Summer Enrichment

Personal Information

Student Name	
Student # 2	
Parent Name	
Home address	
Phone (Home)	
Phone (Cell)	
Grade entering	
Child's School	
Email	

Other adults authorized to pick up child

Class Selection

	8:30	10:15
Week 1 Choices		
Student # 2		
Week 2 Choices		
Student # 2		
Week 3 Choices		
Student # 2		
Week 4 Choices		
Student # 2		

Emergency and Medical Information

In case of emergency, contact	
Emergency contact's phone	
Medical conditions/concerns	

Summer School

Rules & Regulations

All Bristol Public School rules apply during the Summer School session. Summer School students are prohibited from smoking on school property and from wearing hats in the building. Violation of any school rules will result in consequences up to and including withdrawal from school without refund or credit. Any suspensions from summer school will count as an absence. Serious violations, such as fighting, theft, vandalism, or the use of alcohol or drugs may result in immediate withdrawal as well as police referral. All students must enter and exit the building through the auditorium entrance.

Attendance Policy

Students who receive more than two absences may be removed from the class. Tardiness will also impact your enrollment in a class. Every three tardies will result in one absence. Tardiness to class of more than 15 minutes will be considered an absence. Remember, you're completing a one year course in five weeks, so attendance is very important.

To Receive a Passing Grade, Students Must

- ◊ Meet the attendance policy.
- ◊ Receive a passing grade, defined as 65 or higher. The summer school grade consists of 20% assessment and 80% course work.
- ◊ The summer school grade is not averaged with the final course grade for the full year course.

I have read and reviewed the rules and regulations for summer school and agree to follow all of them.

_____ _____
Student Signature Date

_____ _____
Parent Signature Date

Registration Information

IN-PERSON REGISTRATION:

Bristol Eastern High School
632 King Street, Bristol;
Auditorium Entrance

Tuesday July 2, 8am-12pm
Wednesday July 3, 2-6pm,

What you need to register:

1 This brochure's registration information completed
2 This brochure's *Rules and Regulations* panel signed
3 Cash or a check made payable to :

City of Bristol

ONLINE REGISTRATION

Easy, Convenient and quick:

To register online all you need is the course you want to take and 5 minutes. Avoid the lines and register online.

www.bristol.k12.ct.us/msss

What you need to register:

1. The name or names of the courses you wish to register for.
2. Five minutes to complete the online registration page.
3. A valid credit card if payment is required.

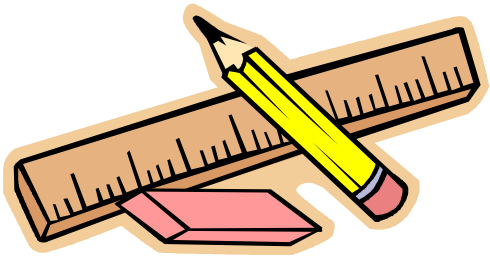
Bristol Summer School
2013

Bristol Public Schools

Middle School Summer School 2013

July 08 – Aug 09

Monday– Friday



"Committed to Excellence"

Bristol Eastern High School
632 King Street
Bristol, CT 06010
Phone: 860.584.7735
ext. 223
Or online at
www.bristol.k12.ct.us/msss
Email questions to:
Secondarysummerschool @ci.bristol.ct.us

Course Descriptions

Social Studies

Grade 6 Time: 9:20 am. –10:20am
Students will learn about ancient countries customs and cultures, while actively engaging in reading nonfiction texts and writing.

Grade 7 Time 8:15am-9:15am
Students will take a geographical walk though Europe, Asia, and Africa. They will read about the cultures as well as do research on the countries.

Grade 8 Time 11:35am-12:35am
Students will discover American History from colonization through the Civil War using a variety of reading and writing strategies. They will engage in discussions of how America's history impacts us today.

Middle School Math

Grade 6 Time: 10:30am-11:30am
The emphasis for students is placed on improving computational skills with decimals, fractions, ratios, proportions, percents, and integers. Concepts in geometry/measurement and statistics/probability are taught.

Grade 7 Time: 11:35am-12:35pm
The emphasis for students is placed on improving computational skills with integers, exponents, fractions, proportions and percents. Algebraic reasoning skills, geometry and measurement, and statistics and probability are also taught.

Grade 8 Time: 8:15am-9:15am
The emphasis for students is placed on improving algebraic reasoning skills, computational skills with real numbers and exponents, geometry/ measurement, statistics/probability, patterns/ functions and proportion and percent.

Language Arts

Grade 6 8:15am-9:15am
Students will explore several texts as they develop strategies to improve their ability and desire to read and write.

Grade 7 9:20am-10:20am
Students will explore several texts as they develop strategies to improve their ability and desire to read and write.

Grade 8 10:30am-11:30pm
Students will explore several texts as they develop strategies to improve their ability and desire to read and write.

Grade 8 Spanish I

Students who want to recover credit or to gain more support before studying Spanish 2 will develop greater proficiency, reviewing the present tense in reading, writing, speaking, and listening. This course will require a fee of $175

Middle School Science

Grade 6 11:35am-12:35pm
Students will review content and inquiry skills, including Properties of Matter, Energy and Ecosystems, Weather, and Water Resources.

Grade 7 10:30am-11:30am
Students will review content and inquiry skills, including Energy and Work, Human Body Systems, the Earth's Interior and Surface, and Food Preservation.

Grade 8 9:20am-10:20am
Students will review the content and inquiry skills, including Forces and Motion, Genetics, the Solar System, and Bridge Structure.

Engineering Explorations 101

Digital Videography & TV Production

For more information on these new programs go to www.bristol.k12.ct.us/msss

Summer School Registration Form

First Course's Title/Time:_____

Second Course's Title/Time :_____

Third Course's Title/Time: _____

Tuition per class

Bristol Residents: No Fee (Spanish $175)

Non-Bristol Residents: $225

Engineering & Videography $97.50

Book Deposit

All students are required to submit a **$25 security deposit for each book** on or before the first day of class. This deposit will be returned upon return of all textbooks at the completion of summer school.. If you register online please bring your book deposit on the first day.

Make Checks Payable to:

_____
Student's Name

_____
Parent/Guardian's Name

_____
Address

_____
Emergency Contact **Phone Number**

_____
Current school and Grade

Amount Paid _____ Check # _____

Book Deposit _____ Check # _____

Email questions to:
Secondarysummerschool @ci.bristol.ct.us

Bristol Public Schools

Summer Spanish I

BRISTOL SECONDARY SUMMER SCHOOL 2013

¡Pasa El Verano Con Nosotros!

Spanish I

This course is designed to reinforce the skills essential for success in Spanish II. Emphasis will be on developing proficiency in reading, writing, speaking, and listening. This course is appropriate for students in both middle and high school Spanish 1. It is designed for students who want to recover credit or simply want to strengthen the skills taught in Spanish 1.

Bristol Secondary Summer School
DATES:
July 08—August 09
Bristol Eastern High School
632 King Street
Bristol, Connecticut

When: July 08 thru August 09 Monday to Friday 8:00—9:50

Where: Bristol Eastern High School, 632 King Street, Bristol

Cost:: $175 for Bristol residents, $225 for non-Bristol residents with a book deposit of $25 for everyone

In-Person Registration

In person registration will be held at Bristol Eastern High School's Auditorium entrance on: ***Tuesday July 2, 8:00 -12:00*** *and* ***Wednesday July 3 2:00-6:00***

All you need to *bring is two (2) separate checks, one for the class and one for the book deposit.* ***Make checks payable to:***

City of Bristol

For More Information:
SPEAK
TO
YOUR
SPANISH
TEACHER

REGISTRATION

Easy, Convenient and quick:
To register online all you need is the course you want to take and 5 minutes. Avoid the lines and register online.
www.bristol.k12.ct.us/hsss

Phone: 860.584.7735 ext. 223
email: Secondarysummerschool
@ci.bristol.ct.us

Bristol Public Schools

Summer **STEM** Institute

- **Calling all students entering grades 8 -10**
- **New summer experiences in Science, Technology, Engineering & Mathematics (STEM)**
- **12 days of hands-on lab activities and fun**
- **2 exciting enrichment experiences to choose from:**

Engineering Explorations 101

Engineers use their knowledge of science, math, and logic to find solutions to everyday problems. This summer, students will explore and utilize the same design process as engineers to create unique solutions to given problems. Students will apply both science and math while developing their designs.

Students will experience fun and exciting hands-on learning activities. Using computers, tools and CAD software, students will create 3-D models, construct prototypes that employ a variety of materials and explore robotics and electronics.

This experience will help students better understand the world of engineering and the educational requirements for success in this field.

Digital Videography & TV Production

Students will employ computers, video cameras, lighting equipment and other technologies to produce video and television programming. Hands-on experiences will help students learn the operating principles of video communication systems and modern television studios. Students will explore the physics and math that explain how video and other communications technologies work.

This experience will help students better understand the world of TV production and the educational pathway required for success in this field.

- **STEM classes begin on July 8 and end on July 23**
- **Cost: $97.50 (includes lab fee for supplies)**
- **Note: minimum enrollment of 10 required to run courses**
- **To register go to: www.bristol.k12.ct.us/hsss or call 860-584-7735 ext 223**

BRISTOL PUBLIC SCHOOLS

ENROLLMENT FIGURES
Quarterly Report May 2013

As of April 18, 2013

Elem.School	Pre-K	Kgn.	1	2	3	4	5	Total	Total Prev. Yr.	DIFF.
Edgewood		20	17	21	16	25	26			
		21	19	21	17	25	26			
		20	18	22	20	26				
Total	**0**	**61**	**54**	**64**	**53**	**76**	**53**	**361**	**392**	**-31**
Greene-Hills	15	18	20	22	23	21	25			
	15	19	22	22	23	20	26			
		19	22	21	24	21	26			
		20	21	23	26	21				
		20		22		21				
Total	**30**	**96**	**85**	**110**	**96**	**104**	**77**	**598**	**346**	**252**
Hubbell	13	17	19	16	22	20	26			
	13	17	20	18	20	21	27			
	11	16	21	17	21	21				
	12	17	20	17						
Total	**49**	**67**	**80**	**68**	**63**	**62**	**53**	**442**	**565**	**-123**
Ivy Drive	30	20	17	18	22	24	20			
	individuals	21	17	18	23	24	20			
	speech	22	16	19	20	24	19			
			16	19						
Total	**30**	**63**	**66**	**74**	**65**	**72**	**59**	**429**	**424**	**5**
Mt. View	16	19	21	20	18	18	23			
	15	20	21	20	18	19	25			
	15	19	20	18	18	19				
	15									
	15									
	15									
Total	**91**	**58**	**62**	**58**	**54**	**56**	**48**	**427**	**381**	**46**
West Bristol	15	17	22	18	25	23	21			
	15	17	22	19	25	23	22			
		17	21	19	25	24	22			
		17	21	20	24	24	20			
		18	21	20			21			
				20					CTO	

BRISTOL PUBLIC SCHOOLS

ENROLLMENT FIGURES
Quarterly Report May 2013

Total	**30**	**86**	**107**	**116**	**99**	**94**	**106**	**638**	**359**	**279**

Elem.School	**Pre-K**	**Kgn.**	**1**	**2**	**3**	**4**	**5**	**Total**	**Total Prev. Yr.**	**DIFF.**
South Side	15	19	21	18	21	19	21			
	15	19	22	21	22	19	22			
		16	22	19	22	21	22			
		14		18	24	20	21			
Total	**30**	**68**	**65**	**76**	**89**	**79**	**86**	**493**	**591**	**-98**
Stafford	6	20	21	12	25	21	24			
	13	20	23	18	25	21	23			
	13	21	20	20	24	21	23			
	9	21	21	16		20				
	12									
	11									
Total	**64**	**82**	**85**	**66**	**74**	**83**	**70**	**524**	**494**	**30**
Jennings									**387**	
TOTALS	**324**	**581**	**604**	**632**	**593**	**626**	**552**	**3912**	**3939**	**-27**
Total K - 5		**581**	**604**	**632**	**593**	**626**	**552**	**3588**	**3648**	**-60**

NESDEC		0	0	0	0	0	0	**0**		**0**
PROWDA		598	585	645	594	637	559	**3618**		**-30**

Elementary Class Size Averages

Pre-K	**Kgn.**	**1**	**2**	**3**	**4**	**5**
14.7	**18.7**	**20.1**	**19.2**	**22.0**	**21.6**	**23.0**

Range	6-15	14-22	16-23	12-23	16-26	18-26	19-27

excludes
Ivy Drive

BRISTOL PUBLIC SCHOOLS

ENROLLMENT FIGURES
Quarterly Report May 2013

Mid. School	6		7		8			Total	Total Prev. Yr.	DIFF.
Chippens Hill	270		226		251			**747**	**820**	**-73**
Northeast	135		180		186			**501**	**553**	**-52**
Greene-Hills	107		102		94			**303**	**0**	**303**
West Bristol	91		98		102			**291**	**0**	**291**
Mem. Blvd.									**511**	
Total	**603**		**606**		**633**			**1842**	**1884**	**-42**

NESDEC	0		0		0			**0**		**0**
PROWDA	623		589		640			**1852**		**-10**

High School	9		10		11		12	Total	Total Prev. Yr.	DIFF.
BCHS	371		294		326		270	**1261**	**1289**	**-28**
BEHS	353		276		311		280	**1220**	**1271**	**-51**
Total	**724**		**570**		**637**		**550**	**2481**	**2560**	**-79**
Community/Vocational Program								**13**	**14**	**-1**
								2494	**2574**	**-80**

West Woods Academy included in high school numbers.

NESDEC	0		0		0		0	**0**		**0**
PROWDA	751		622		632		596	**2601**		**-107**

	Number Attending	Total to Date	Total Prev. Yr.	DIFF.
	Total PreK-5	**3912**	**3939**	**-27**
	Total Gr. 6-8	**1842**	**1884**	**-42**
	Total Gr. 9-12	**2494**	**2574**	**-80**
	Sub Total	**8248**	**8397**	**-149**
Special Education Program: Citywide	**ASEP**	**25**	**24**	**1**
	Sub Total	**8273**	**8421**	**-148**

BRISTOL PUBLIC SCHOOLS

ENROLLMENT FIGURES
Quarterly Report May 2013

Bristol Students Enrolled But Not Attending A Bristol Public School: And Counted in the State Report	**Special Ed. Out Pl.**	**71**	**71**	**0**
	BTEC	**34**	**28**	**6**
	Sub Total	**105**	**99**	**6**
	Gr. Total Enrolled	**8378**	**8520**	**-142**

M E M O R A N D U M

TO: Dr. Ellen Solek, Superintendent of Schools

FROM: Dennis Bieu, Director of Human Resources

SUBJECT: Annual Teacher Evaluation Report for the 2012-2013 School Year

> **Sec. 10-151b. Evaluation by superintendents of certain educational personnel.** (a) The superintendent of each local or regional board of education shall, in accordance with guidelines established by the State Board of Education for the development of evaluation programs and such other guidelines as may be established by mutual agreement between the local or regional board of education and the teachers' representative chosen pursuant to section 10-153b, continuously evaluate or cause to be evaluated each teacher. An evaluation pursuant to this subsection shall include, but need not be limited to, strengths, areas needing improvement and strategies for improvement. The superintendent shall report the status of teacher evaluations to the local or regional board of education on or before June first of each year. For purposes of this section, the term "teacher" shall include each professional employee of a board of education, below the rank of superintendent, who holds a certificate or permit issued by the State Board of Education.

The teacher evaluation program was revised in 2001-2002. The program has a process for non-tenured and tenured teachers. The non-tenured process is an intensive observation and evaluation schedule (Professional Performance Instrument, PPI) that takes place from the start of the school year through February 15th of the school year. The tenured process is a six-year cycle including one year of intense observation (PPI) and evaluation and five years of professional growth plans (Professional Growth Plan, PGP).

During this school year the number of teachers involved in each phase is as follows:

PPI Non-Tenured	53
PPI Tenured	111
PGP 1	99
PGP 2	86
PGP 3	104
PGP 4	92
PGP 5	84
TOTAL	629

Professional Growth Plans (PGP's) submitted by teachers establish goals that will have a positive impact on student achievement. The goals are aimed at teacher's expanding their skills to improve their students' achievement. A sample of PGP's include using literacy circles at the high school, developing a new lab course and increase knowledge in skills related to improving reading, writing, and math skills of students. All PGP's are measurable.

The teacher evaluation process continues to assist in promoting improvement in teacher performance. It also continues to assist in the decision making process of non-renewal or resignation of teachers who do not meet the standards set by the Bristol Public Schools.

Administrators are also evaluated yearly. As you know, the evaluation for administrators was revised in January 2004. The total number of administrators evaluated was 33.

DB/nf

Bristol Public Schools
Office of Teaching & Learning

DEPARTMENT: Mathematics

COURSE: Algebra 2

COURSE DESCRIPTION: Building on their work with linear, quadratic, and exponential functions, students extend their repertoire of functions to include polynomial, rational, and radical functions.2 Students work closely with the expressions that define the functions, and continue to expand and hone their abilities to model situations and to solve equations, including solving quadratic equations over the set of complex numbers and solving exponential equations using the properties of logarithms. The Mathematical Practice Standards apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations.

Unit Organization:	Instruction focuses on four critical areas:
Unit 1 – Functions and Inverse Functions Unit 2 – Polynomial Functions Unit 3 – Rational Expressions and Functions Unit 4 – Trigonometric Functions Unit 5 – Exponential and Logarithmic Functions Unit 6 – Inferences and Conclusions from Data	Critical Area 1: Students develop the structural similarities between the system of polynomials and the system of integers. Students draw on analogies between polynomial arithmetic and base-ten computation, focusing on properties of operations, particularly the distributive property. Students connect multiplication of polynomials with multiplication of multi-digit integers, and division of polynomials with long division of integers. Students identify zeros of polynomials, including complex zeros of quadratic polynomials, and make connections between zeros of polynomials and solutions of polynomial equations. A central theme is that the arithmetic of rational expressions is governed by the same rules as the arithmetic of rational numbers. Critical Area 2: Building on their previous work with functions, and on their work with trigonometric ratios and circles in Geometry, students now use the coordinate plane to extend trigonometry to model periodic phenomena. Critical Area 3: Students synthesize and generalize what they have learned about a variety of function families. They extend their work with exponential functions to include solving exponential equations with logarithms. They explore the effects of transformations on graphs of diverse functions, including functions arising in an application, in order to abstract the general principle that transformations on a graph always have the same effect regardless of the type of the underlying function. They identify appropriate types of functions to model a situation, they adjust parameters to improve the model, and they compare models by analyzing appropriateness of fit and making judgments about the domain over which a model is a good fit. The description of modeling as "the *process of choosing and using mathematics and statistics to analyze empirical situations, to understand them better, and to make decisions"* is at the heart of this. The narrative discussion and diagram of the modeling cycle should be

	considered when knowledge of functions, statistics, and geometry is applied in a modeling context. Critical Area 4: Students see how the visual displays and summary statistics they learned in earlier grades relate to different types of data and to probability distributions. They identify different ways of collecting data— including sample surveys, experiments, and simulations—and the role that randomness and careful design play in the conclusions that can be drawn.

DEPARTMENT PHILOSOPHY

The philosophy of the mathematics department is to develop mathematically literate and productive students who can effectively and efficiently apply mathematics in their lives to make informed decisions about the world around them. To be mathematically literate, one must understand major mathematics concepts, possess computational facility and have the ability to apply these understandings to situations in daily life. Making connections between mathematics and other disciplines is key to the appropriate application of mathematics skills and concepts to solve problems. The ability to read, discuss and write within the discipline of mathematics is an integral skill that supports mathematical understanding, reasoning and communication. The opportunity to think critically and creatively to solve problems is important to deepen mathematical knowledge and foster innovation. A rich mathematical experience is essential to provide the foundational knowledge and skills that prepare students to be mathematically literate, productive citizens.

The Bristol mathematics curriculum focuses on high expectations for **all** students and provides a balanced approach to mathematics education, placing equal importance on conceptual understanding, computational and procedural fluency and problem solving through the use of a variety of strategies, tools and technologies. The mathematics curriculum is responsive to the individual needs of students. While providing a structure tied to the Common Core State Standards in Connecticut, it allows for classroom experiences, additional supports and enrichment ensuring students' access to the content at an appropriate level of challenge.

DEPARTMENT GOALS

Through a planned, sequential curriculum, the Bristol Public schools strive to educate each student according to the standards outlined in the Common Core State Standards for Mathematics in Connecticut including these conceptual categories:

- Number and Quantity
- Algebra
- Functions
- Geometry
- Modeling
- Statistics and Probability

As part of these standards, teachers will support students in developing the following mathematical practices[1]:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

[1.] The mathematical practices listed are those found in the Common Core State Standards in Connecticut.

PHILOSOPHY OF INSTRUCTION

Based on our department philosophy and goals, math teachers will:

- provide a safe, supportive and respectful classroom environment conducive to learning, where students are encouraged to take risks and share ideas;
- have a deep understanding of the mathematical concepts and skills in the curriculum and strong pedagogical content knowledge;
- use the BOE approved textbook and a variety of resources to have students read about, explore and reinforce curriculum concepts and skills;
- build upon students' prior knowledge and experience, and real-world events, to foster connections and make learning relevant and meaningful;
- provide students with developmentally appropriate opportunities to question, explore, observe, synthesize and draw conclusions based on their mathematics understanding;
- use high-level questions and rich tasks to facilitate classroom discourse, both oral and written, to encourage student-student, student-teacher and teacher-student communication;
- incorporate and highlight key mathematical vocabulary during instruction and require students to use this vocabulary appropriately in their communications;
- model and have students use manipulatives, tools and technology to actively explore and build understanding of mathematical concepts;
- structure learning experiences that utilize a variety of grouping strategies to encourage collaborative problem solving; and
- differentiate instruction to meet the needs of a variety of learners based on student readiness, interest, and learning style and provide supplemental mathematics intervention or enrichment as needed.

Note: The instructional strategies recommended in our resource document are specific examples of these expectations in practice. They serve as a starting point for planning and implementing instruction that will develop our students as thinkers. Teachers may create new instructional strategies and activities as they continue to grow professionally and as they develop an understanding of each student's unique strengths, weaknesses, and interests.

PHILOSOPHY OF ASSESSMENT

Based on our department philosophy and goals, math teachers will:

- align assessments with instruction;
- use a variety of formative and summative assessment throughout each unit of instruction;
- design and use assessments that include questions at varied levels of cognitive demand;
- analyze results and plan or modify instruction based on the results;
- provide specific, constructive feedback for students; and
- collaborate with colleagues and use scoring rubrics to evaluate student work as appropriate.

Unit 1 – Functions and Inverse Functions

Unit 1 – 15 classes
Major Topics in this Unit:

- Functions and key characteristics
- Translations of functions
- Representing and solving equations
- Finding inverses

Common Core State Standards in Connecticut

CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CC.9-12.F.IF.7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

CC.9-12.F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function*.*

CC.9-12.F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

CC.9-12.F.BF.1 Write a function that describes a relationship between two quantities.*

CC.9-12.F.BF.4 Find inverse functions.

CC.9-12.F.BF.4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) =2(x^3)$ for $x > 0$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$ (x not equal to 1).

CC.9-12.F.BF.4b (+) Verify by composition that one function is the inverse of another.

Unit 1 – Functions and Inverse Functions

CC.9-12.F.BF.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.

CC.9-12.F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Rational and radical equations
  ○ One variable
  ○ Extraneous solutions
• Functions
  ○ Functions expressed symbolically
  ○ Key features of the graph
  ▪ By hand
  ▪ Technology
  ○ Zeros
  ○ End behavior
	• SOLVE (rational and radical equations)
	• GRAPH (functions)
	• SHOW (key features of the graph)
	• IDENTIFY (zeros)
	• SHOW (end behavior)

Big Ideas

Student's statements of enduring ideas

1. Functions are situations where one quantity determines another.
2. The multiple representations could help us to identify the following characteristics of a function:
   Domain, range, intercepts, maximum, minimum, end behavior, asymptotes and symmetry.
3. Varying the parameters of an equation will result in dilations, translations or reflections.

Essential Questions

Teacher's guiding questions

1. What are functions?
2. How do the multiple representations of a function connect to its key characteristics?
3. How does varying the parameters of the equation of a function affect its graph?

Critical Area 1; Math Practices 2, 4, 5, 8

Unit 1 – Functions and Inverse Functions			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* CC.9-12.F.IF.7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases	Compare functions and non-functions from multiple representations.	Build on students'understanding of functions from Algebra 1. Begin with linear, exponential and quadratic and extend to square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. Include real world scenarios such as students and grades, weight of a package and price for shipping, etc. Have students complete a Frayer Model (template attached) – definition, example,non-example, and characteristics. Have students give examples and non-examples using multiple representations. Utilize function notation throughout the unit.	Writing: Give an example of a function and non-function and explain how to determine from the multiple representations (graph, context, table) whether it is a function or not.
	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes,	Domain and range are key topics and are constantly revisited throughout the unit. Have students look at functions represented in multiple ways. *Quantitative relationships are those presented in context.For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.**	
	Graph functions and identify its key characteristics.	Include linear, quadratic, polynomial, exponential, rational, trigonometric, step-wise, piece-wise, absolute value, square root, cube root, etc. By hand for simple cases and using technology (graphing calculator and spreadsheets) for more complicated cases.	

<table>
<tr><th colspan="4">Unit 1 – Functions and Inverse Functions</th></tr>
<tr><td rowspan="3">and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
CC.9-12.F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*
CC.9-12.F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an</td><td></td><td>Key characteristics include domain, range, intercepts, maximum, minimum, end behavior, asymptotes and symmetry. Also include recognizing even and odd functions from their graphs.</td><td></td></tr>
<tr><td>Write a function that describes a relationship between two quantities.</td><td>Relate to real-life situations

Examples may include:

You buy a $10,000 car with an annual interest rate of 6 percent compounded annually and make monthly payments of $250. Express the amount remaining to be paid off as a function of the number of months, using a recursion equation.

A cup of coffee is initially at a temperature of 93º F. The difference between its temperature and the room temperature of 68º F decreases by 9% each minute. Write a function describing the temperature of the coffee as a function of time.

The radius of a circular oil slick after t hours is given in feet by $r = 10t^2 - 0.5t$, for $0 \leq t \leq 10$. Find the area of the oil slick as a function of time.</td><td>MAT.HS.CR.2.0ASSE.A.005_V1.pdf</td></tr>
<tr><td>Compare characteristics of two functions in different representations.</td><td>Have students explore and make connections between all representations of functions; equation, graph, verbal descriptions and table of values. Throughout the unit.</td><td>Functions and Everyday Situations Lesson http://map.mathshell.org/materials/download.php?fileid=1259</td></tr>
</table>

<table>
<tr><th colspan="4">Unit 1 – Functions and Inverse Functions</th></tr>
<tr>
<td>algebraic expression for another, say which has the larger maximum.
CC.9-12.F.BF.1 Write a function that describes a relationship between two quantities.*
CC.9-12.F.BF.4 Find inverse functions.</td>
<td>Make connections between parent functions and translations, dilations and reflections.</td>
<td>Provide parent functions (equation and graph) for students

For Translations activity – differentiate for small groups by assigning more or less challenging functions. You may include linear or trig or others depending on the number of groups and levels.
Graphs of Parent Functions PDF</td>
<td>Translations of Parent Graphs Exploration – Appendix

Small Group Exit Ticket – Transformations Problem (link to Trans problem)</td>
</tr>
<tr>
<td>CC.9-12.F.BF.4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2(x^3)$ for $x > 0$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$ (x not equal to 1).

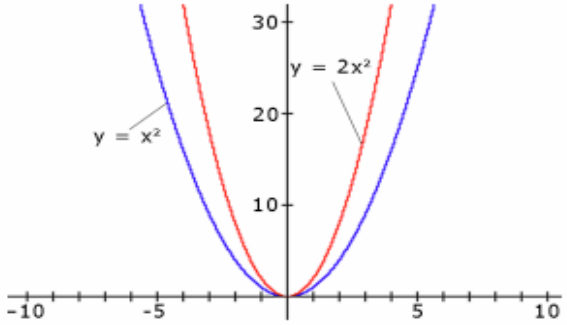
Consider for Accelerated (+):
CC.9-12.F.BF.4b (+) Verify by composition that one function is the inverse of another.
CC.9-12.F.BF.4c (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.

CC.9-12.F.IF.9 Compare properties of two functions each represented in a</td>
<td>Create equations in two or more variables when given graphs or verbal descriptions of transformations.</td>
<td>By hand for simple cases and using technology (graphing calculator and spreadsheets) for more complicated cases.

This standard will be addressed in more specificity in later units.

Examples may include:

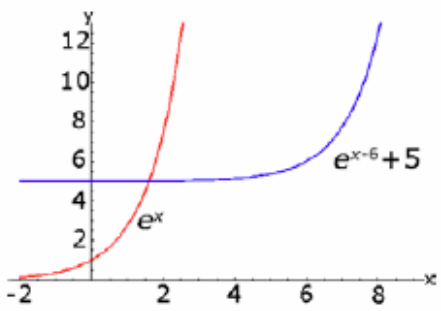
Compare the shape and position of the graphs of $f(x) = x^2$ and $g(x) = 2x^2$, and explain the differences in terms of the algebraic expressions for the functions.

Describe effect of varying the parameters a, h, and k have on the shape and position of the graph of $f(x) = a(x-h)^2 + k$.</td>
<td></td>
</tr>
</table>

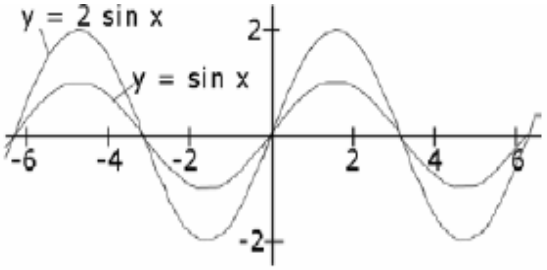
different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.

Compare the shape and position of the graphs of $f(x) = e^x$ to $g(x) = e^{x-6} + 5$, and explain the differences, orally or in written format, in terms of the algebraic expressions for the functions.



Describe the effect of varying the parameters *a, h,* and *k* on the shape and position of the graph $f(x) = ab^{(x+h)} + k$., orally or in written format. What effect do values between 0 and 1 have? What effect do negative values have?

Compare the shape and position of the graphs of $y = \sin x$ to $y = 2 \sin x$.



Unit 1 – Functions and Inverse Functions			
	Solve an equation in the form f(x)=c to calculate the input from a given output	Include contextual examples. Examples may include: F=9/5C+32 Given temp in F, solve for C.	
	Solve simple rational and radical equations in one variable	Examples may include: $\sqrt{x}=5$ $7/8\sqrt{(2x-5)}=21$ $\sqrt{(3x-7)}=-4$ Give examples showing how extraneous solutions may arise.	
	Write the inverse of a function, if it exists, and determine the domain of the inverse.	Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to model functions. See lesson Appendix A. Provide examples of inverses that are not purely mathematical to introduce the idea. For example, given a function that names the capital of a state, *f*(Ohio) = Columbus. The inverse would be to input the capital city and have the state be the output, such that *f*-1(Denver) = Colorado. For academic students focus on using a table to graph the inverse and using simple linear, quadratic (no b term) and square root functions to write the equation for the inverse. Examples may include For the function $h(x) = (x - 2)^3$, defined on the domain of all real numbers, find the inverse function if it exists or explain why it doesn't exist. Have students graph $h(x)$ and $h^{-1}(x)$ and explain how they relate to each other graphically.	MAT.HS.TE.2.00FBF.B.046_V1.pdf Writing: Describe how to find the inverse of a function two different ways. Unit Assessment

Unit 1 – Functions and Inverse Functions			
		Accelerated: Find a domain for f(x) = $3x^2 + 12x - 8$ on which it has an inverse. Explain why it is necessary to restrict the domain of the function	

Additional Resources:

- Translations and parent graphs
- http://www.lessonplanet.com/lesson-plans/algebra-ii
- http://education.ti.com/calculators/downloads/US/Activities/Detail?ID=6604&MICROSITE=ACTIVITYEXCHANGE
- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

Unit 2 – Polynomial Functions

Unit 2 – 20 classes
Major Topics in this Unit:

- Quadratic functions
- Polynomials & polynomial functions
- Complex numbers
- Fundamental Theorem of Algebra

Common Core State Standards in Connecticut

CC.9-12.N.CN.7 Solve quadratic equations with real coefficients that have complex solutions.

CC.9-12.N.CN.1 Know there is a complex number *i* such that $i^2 = \sqrt{-1}$, and every complex number has the form $a + bi$ with *a* and *b* real.

CC.9-12.N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

CC.9-12.N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers *a* and *b.*

CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

CC.9-12.A.REI.4 Solve quadratic equations in one variable.

CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers *a* and *b.*

CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CC.9-12.F.IF.7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

Unit 2 – Polynomial Functions

CC.9-12.A.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.

CC.9-12.A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

CC.9-12.A.APR.2 Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x – a$ is $p(a)$, so $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$.

CC.9-12.A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

CC.9-12.A.APR.4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

CC.9-12.N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

CC.9-12.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

CC.9-12.F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Complex Numbers
  ○ number i
  ○ a + bi form
  ○ $i^2 = -1$
  ○ commutative property
  ○ associative property
  ○ distributive property
  ○ + Polynomial Identities
• Quadratic Equations
  ○ Real coefficients
	• KNOW (complex numbers)
	• USE (properties with complex numbers)
	  ○ ADD (complex numbers)
	  ○ SUBTRACT (complex numbers)
	  ○ MULTIPLY (complex numbers)
	• + EXTEND (complex numbers to polynomial identities)
	• SOLVE (Quadratic equations)
	• + KNOW (Fundamental Theorem of Algebra is true

Unit 2 – Polynomial Functions

- Complex solutions
- + Fundamental Theorem of Algebra

- Structure of expression
- Polynomials
  - System analogous to the integers
  - Closed system
    - Operation of addition
    - Operation of subtraction
    - Operation of multiplication
- Remainder Theorem
  - Remainder on division by $x - a$ is p(a)
  - p(a) = 0 if and only if (x – a) is a factor of p(x)
- Zeros of polynomials
  - Suitable factorizations
  - Rough graph of a polynomial function
- Polynomial identities
  - Numerical relationships
- Binomial Theorem
  - Expansion of $(x + y)^n$
  - Powers of x and y
  - Positive integer n
  - x and y are any numbers
  - Coefficients
- Functions
  - Functions expressed symbolically
  - Key features of the graph
    - By hand
    - Technology
  - Zeros
  - End behavior

for Quadratic Equations)

- USE (structure of expression)
  - REWRITE (expressions)
- UNDERSTAND (closed system under operations)
  - ADD (polynomials)
  - SUBTRACT (polynomials)
  - MULTIPLY (polynomials)
- KNOW (remainder theorem)
- APPLY (remainder theorem)
- IDENITFY (zeros of polynomials)
- CONSTRUCT (rough graph)
  - USE (zeros)
- PROVE (polynomial identities)
- DESCRIBE (numerical relationships)
  - USE (polynomial identities)
- KNOW (binomial theorem)
- APPLY (binomial theorem)
- GRAPH (functions)
- SHOW (key features of the graph)
- IDENTIFY (zeros)
- SHOW (end behavior)

Unit 2 – Polynomial Functions

Big Ideas
Student's statements of enduring ideas

1. By the Fundamental Theorem of Algebra, the degree of the polynomial determines the number of roots. The real roots are represented on the graph by x-intercepts.
2. Complex numbers extend our number system, help us find all the solutions to a problem, they can be added, subtracted, multiplies and divided and these numbers are important in mathematics and applied sciences.

Essential Questions
Teacher's guiding questions

1. What is the relationship between the nature and number of roots of a polynomial equation, the graph of the related function?
2. Why are complex numbers important extensions of our number system?

Critical Area 1; Math Practices 2, 4, 5, 8

CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
CC.9-12.N.CN.7 Solve quadratic equations with real coefficients that have complex solutions. CC.9-12.N.CN.1 Know there is a complex number *i* such that $i^2 = \sqrt{-1}$, and every complex number has the form *a* + *bi* with *a* and *b* real. CC.9-12.N.CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	Graph quadratic functions and identify their key characteristics.	Review and introduce terminology including vertex, axis of symmetry, zeros, parabola, increasing, decreasing, maximum, minimum. Look at examples and make comparisons between vertex and standard form. Have students graph simple cases by hand and using technology for more complicated cases.	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews) Forming Quadratics: http://map.mathshell.org/materials/lessons.php
	Relate the Fundamental Theorem of Algebra to the number of real and complex solutions to a polynomial.	Provide students with graphical representations of quadratic functions. Limit to quadratic functions, the Fundamental Theorem of Algebra will be revisited throughout the unit.	

Unit 2 – Polynomial Functions			
CC.9-12.N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for x^2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b. CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. CC.9-12.A.REI.4 Solve		Stress two real or two complex solutions.	
	Multiply binomial expressions.	Review the concept of using the distributive property to multiply integer expressions and binomials as an introduction to the reverse process of factoring. Derive the identity $(x - y)^2 = x^2 - 2xy + y^2$ from $(x + y)^2 = x^2 + 2xy + y^2$ by replacing y by $-y$. ‘ Examples may include: Use the distributive law to explain why $x^2 - y^2 = (x - y)(x + y)$ for any two numbers x and y. Use an identity to explain the pattern $2^2 - 1^2 = 3$ $3^2 - 2^2 = 5$ $4^2 - 3^2 = 7$ $5^2 - 4^2 = 9$ [Answer: $(n + 1)^2 - n^2 = 2n + 1$ for any whole number n.]	
	Perform operations with complex numbers.	Define *i such that* $i = \sqrt{-1}$ and $i^2 = -1$ *Review how to multiply using the distributive property with integer and variable binomial expressions.* Use the operations of addition, subtraction and multiplication and justify with the commutative, distributive and associative properties. Examples may include: $(3 - 2i)(-7 + 4i)$ $3(-7 + 4i) - 2i(-7 + 4i)$ Distributive Property $-21 + 12i + 14i - 8i^2$ Distributive Property $-21 + (12i + 14i) - 8i^2$ Associative Property	

<table>
<tr>
<td rowspan="2">quadratic equations in one variable.

CC.9-12.A.REI.4b Solve quadratic equations by inspection (e.g., for x^2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*
CC.9-12.F.IF.7c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
CC.9-12.A.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a</td>
<td></td>
<td>$-21 + i(12 + 14) - 8i^2$ Distributive Property
$-21 + 26i - 8i^2$ Computation
$-21 + 26i - 8(-1)$ $i^2 = -1$
$-21 + 26i + 8$ Computation
$-21 + 8 + 26i$ Commutative Property
$-13 + 26i$ Computation</td>
<td></td>
</tr>
<tr>
<td>Solve quadratic equations that have real and complex solutions.</td>
<td>Solve by the following methods: square root, completing the square, quadratic formula and factoring.

Relate to Fundamental Theorem of Algebra.

Students should relate the value of the discriminant to determine the most appropriate method for solving.

Use zero product property when solving by factoring. Include the use of technology.

Examples may include:
Within which number system can $x^2 = -2$ be solved? Explain how you know.

Solve $x^2 + 2x + 2 = 0$ over the complex numbers.

Find all solutions of $2x^2 + 5 = 2x$ and express them in the form $a + bi$.
<table>
<tr><th>Value of Discriminant</th><th>Nature of Roots</th><th>Nature of Graph</th></tr>
<tr><td>$b^2 - 4ac = 0$</td><td>1 real roots</td><td>intersects x-axis once</td></tr>
<tr><td>$b^2 - 4ac > 0$</td><td>2 real roots</td><td>intersects x-axis twice</td></tr>
<tr><td>$b^2 - 4ac < 0$</td><td>2 complex roots</td><td>does not intersect x-ax</td></tr>
</table>
Are the roots of $2x^2 + 5 = 2x$ real or complex? How many roots does it have? Find all solutions of the equation.</td>
<td></td>
</tr>
</table>

difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$. CC.9-12.A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. CC.9-12.A.APR.2 Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x – a$ is $p(a)$, so $p(a) = 0$ if and only if $(x – a)$ is a factor of $p(x)$. CC.9-12.A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial. CC.9-12.A.APR.4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$		What is the nature of the roots of $x^2 + 6x + 10 = 0$? Solve the equation using the quadratic formula and completing the square. How are the two methods related?	
	Write a function that describes a relationship between two quantities.	Limit to linear and quadratic. Include examples of modeling where students must interpret real-world significance of the key characteristics of the function Examples may include: • Given that the following trapezoid has area 54 cm^2, set up an equation to find the length of the base, and solve the equation. • Lava coming from the eruption of a volcano follows a parabolic path. The height *h* in feet of a piece of lava *t* seconds after it is ejected from the volcano is given by $h(t) = -t^2 + 16t + 936$. After how many seconds does the lava reach its maximum height of 1000 feet?	http://www.iitgn.ac.in/mcm/cd/Mathematical%20Modelling%20Handbook/pdf/08_Narrow_Corridor.pdf MAT.HS.PT.4.CANSB.A.051_V1.pdf
	Graph polynomial functions and identify their key characteristics.	By hand in simple cases and using technology for more complicated cases. Key characteristics include but are not limited to maxima, minima, intercepts, symmetry, end behavior, and asymptotes. Examples may include: • Compare the graphs of $y = 3x^2$ and $y = 3x^3$. • Let $f(x) = 5x^3 – x^2 – 5x + 1$. Graph the function and identify end behavior and any intervals of	

can be used to generate Pythagorean triples. CC.9-12.N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. CC.9-12.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* CC.9-12.F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.		constancy, increase, and decrease.	
	Analyze the structure of a polynomial expression to rewrite it in factored form	Examples may include: • $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$. • Factor $x^3 – 2x^2 – 35x$ • Factor $x^4 – 3x^2 – 4$	
	Add, subtract, and multiply polynomials.	Make a connection between integers and polynomial expressions to show the operations of addition, subtractions and multiplication are closed.	Manipulating Polynomials - http://map.mathshell.org/materials/lessons.php?taskid=437&subpage=concept (manipulating polynomials)
	Use the Remainder Theorem to evaluate the polynomial at a number *a* and determine whether the expression (x–*a*) is a factor.	The Remainder theorem says that if a polynomial $p(x)$ is divided by $x – a$, then the remainder is the constant $p(a)$. That is, $p(x)=q(x)(x-a)+p(a)$. So if p(a) = 0 then p(x) = q(x)(x-a). Let $p(x)=x^5-3x^4+8x^2-9x+30$. Evaluate p(-2). What does your answer tell you about the factors of p(x)? [Answer: p(-2) = 0 so x+2 is a factor.] Use this idea as a tool to help us solve by following up with synthetic division. For academic limit to resulting quadritics that are easily factorable.	

Unit 2 – Polynomial Functions			
	Relate the standard form of a polynomial to its factored form, using the graph and zeros.	Graphing calculators or programs can be used to generate graphs of polynomial functions. Examples may include: Factor the expression $x^3 + 4x^2 - 59x - 126$ and explain how your answer can be used to solve the equation $x^3 + 4x^2 - 59x - 126 = 0$. Explain why the solutions to this equation are the same as the x-intercepts of the graph of the function $f(x) = x^3 + 4x^2 - 59x = 126$. Use a graphing calculator to analyze the intercepts.	Representing Polynomials - http://map.mathshell.org/materials/lessons.php?taskid=436&subpage=concept
	Relate the Fundamental Theorem of Algebra to the number of real and complex solutions to a polynomial.	Revisit this idea with polynomials of different degrees. Provide students with graphical representations of polynomial functions. Stress the connection between the nature of the roots to the number of x-intercepts.	
	Model a relationship between two quantities, utilizing multiple representations.	Focus on real-world situations. Examples may include: A rocket is launched from 180 feet above the ground at time $t = 0$. The function that models this situation is given by $h = -16t2 + 96t + 180$, where t is measured in seconds and h is height above the ground measured in feet. • What is a reasonable domain restriction for t in this context? • Determine the height of the rocket two seconds after it was launched. • Determine the maximum height obtained by the rocket. • Determine the time when the rocket is 100 feet above the ground. • Determine the time at which the rocket hits the ground.	 MAT.HS.ER.3.0AAPR.F.045_V1.pdf

<table>
<tr><th colspan="4">Unit 2 – Polynomial Functions</th></tr>
<tr><td></td><td></td><td>• How would you refine your answer to the first question based on your response to the second and fifth questions?
It started raining lightly at 5am, then the rainfall became heavier at 7am. By 10am the storm was over, with a total rainfall of 3 inches. It didn't rain for the rest of the day. Sketch a possible graph for the number of inches of rain as a function of time, from midnight to midday.</td><td></td></tr>
<tr><td></td><td>Compare the growth of polynomial vs. exponential functions using tables and graphs.</td><td>Examples may include:

Contrast the growth of the $f(x)=x^3$ and $f(x)=3^x$ Focus on real-world situations.</td><td> 
MAT.HS.ER.3.0AAPR.F.045_V1.pdf

Unit Assessment
Mid Year Assessment</td></tr>
<tr><td colspan="4">Additional Resources:
• Translations and parent graphs
• http://www.lessonplanet.com/lesson-plans/algebra-ii
• http://education.ti.com/calculators/downloads/US/Activities/Detail?ID=6604&MICROSITE=ACTIVITYEXCHANGE
• http://map.mathshell.org/materials/index.php
• http://ccssmath.org/
• www.ccsstoolbox.org
• http://insidemathematics.org/
• High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
• http://www.illustrativemathematics.org/standards/hs
• http://education.ti.com/calculators/downloads/US/Activities/Search/
• http://learnzillion.com/
• http://www.uen.org/core/math/7-12.shtml
• http://illuminations.nctm.org/
• http://www.khanacademy.org/
• http://blog.mrmeyer.com/
• http://www.dlt.ncssm.edu/stem/math-secondary</td></tr>
</table>

Unit 3 – Rational Expressions and Functions

Unit 3 – 12 classes
Major Topics in this Unit:

- Rational functions
- Representing and solving rational equations
- Representing and solving systems of equations and inequalities

Common Core State Standards in Connecticut

CC.9-12.A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

CC.9-12.A.SSE.1 Interpret expressions that represent a quantity in terms of its context.*

CC.9-12.A.SSE.1b Interpret complicated expressions by viewing one or more of their parts as a single entity.

CC.9-12.A.APR.6 Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

CC.9-12.A.APR.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

CC.9-12.A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CC.9-12.F.IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

CC.9-12.A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

Unit 3 – Rational Expressions and Functions

CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Quantity in terms of context
  ○ Expressions and parts of expressions
  ○ Terms
  ○ Factors
  ○ Coefficients
• Rational expressions
  ○ a(x)/b(x) = q(x) + r(x)/b(x), where a(x), b(x), q(x) and r(x) are polynomials with the degree of r(x) less than the degree of b(x)
  ○ inspection
  ○ long division
  ○ computer algebra system
  ○ + System analogous to the rational numbers
  ▪ Closed system
  • Addition
  • Subtraction
  • Multiplication
  • Division by a nonzero rational expression
• Rational and radical equations
  ○ One variable
  ○ Extraneous solutions
• Equations
  ○ Intersection of graphs
  ○ x-coordinates of the point of intersection
  ○ y = f(x) and y = g(x)
  ○ f(x) = g(x)
  ○ Solutions
  ▪ Technology to graph the functions
  ▪ Tables of values
  ▪ Successive approximations
  ○ Linear
	• SOLVE (Quadratic equations)
	• INTERPRET (quantity in terms of context)
	  ○ VIEW (one or more parts of complicated expressions)
	• REWRITE (rational expressions)
	• WRITE (a(x)/b(x) = q(x) + r(x)/b(x))
	• USE (inspection, long division and computer algebra system)
	• + UNDERSTAND (rational expressions)
	  ○ ADD (rational expressions)
	  ○ SUBTRACT (rational expressions)
	  ○ MULTIPLY (rational expressions)
	  ○ DIVIDE (rational expressions)
	• SOLVE (rational and radical equations)
	• EXPLAIN (why intersections of graphs are solutions)
	• FIND (solutions)
	• GRAPH (functions)
	• SHOW (key features of the graph)
	• IDENTIFY (zeros)
	• SHOW (end behavior)

Unit 3 – Rational Expressions and Functions

- Polynomial
- Rational
- Absolute value
- Exponential
- Logarithmic

- Functions
  - Functions expressed symbolically
  - Key features of the graph
    - By hand
    - Technology
  - Zeros
  - End behavior

Big Ideas
Student's statements of enduring ideas

1. The graphs of rational functions are not continuous whereas polynomial functions are continuous.
2. Rational functions are the ratios of two polynomials. Although there are many similarities in solving, the extraneous solutions are caused by the fact that the denominator cannot be zero.

Essential Questions
Teacher's guiding questions

1. How do the graphs of rational functions compare to the graphs of polynomial functions?
2. Why do rational equations have extraneous solutions?

Critical Area 1 & 3; Math Practices 2, 3, 5, 7, 8

Unit 3 – Rational Expressions and Functions			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
CC.9-12.A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. CC.9-12.A.SSE.1 Interpret expressions that represent a quantity in terms of its context.* CC.9-12.A.SSE.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. CC.9-12.A.APR.6 Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.	Interpret rational functions as a ratio of two polynomials.	Provide examples and non-examples	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)
	Solve simple rational and radical equations in one variable	Examples may include: $\sqrt{(x+2)}=5$ $7/8\sqrt{(2x-5)}=21$ $(x+2)/(x+3)=2$ $\sqrt{(3x-7)}=-4$ Give examples showing how extraneous solutions may arise. Use inspection, long division or technology	Illustrative Math Task: Radical Equations - http://www.illustrativemathematics.org/illustrations/391
	Rewrite simple rational expressions in different forms	Write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$ Expressing a rational expression in this form allows one to see different properties of the graph, such as horizontal asymptotes. Examples may include: Find the quotient and remainder for the rational expression $(x^3-2x^2+x-6)/(x^2+2)$ and use them to write	https://kentoncountymdc.wikispaces.com/file/view/l40_manipulating+radicals_complete.pdf Illustrative Math Task Increasing or Decreasing: http://www.illustrativemathematics.org/illustrations/167

Unit 3 – Rational Expressions and Functions			
Consider for Accelerated (+): CC.9-12.A.APR.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* CC.9-12.A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints*		the expression in a different form. Express f(x) = (2x+1)/(x-1) in a form that reveals the horizontal asymptote of its graph. [Answer: f(x) = (2x+1)/(x-1)=(2(x-1)+2)/(x-1)=2+2/(x-1), so the horizontal asymptote is y=2.]	
	Graph rational functions and identify its key characteristics.	Key characteristics include but are not limited to maxima, minima, intercepts, symmetry, end behavior, and asymptotes By hand in simple cases, use technology in more difficult cases	
	Solve rational equations using multiple representations.	Students need to understand that numerical solution methods (data in a table used to approximate an algebraic function) and graphical solution methods may produce approximate solutions, and algebraic solution methods produce precise solutions that can be represented graphically or numerically. Students may use graphing calculators or programs to generate tables of values, graph, or solve a variety of functions	
	Make connections between the parent function of a rational function and translations, dilations and reflections.		
	Create equations and inequalities in one variable and use them to solve problems	Include applications of linear, quadratic, simple rational, and exponential Compare two different types of functions.	Refrigerator Problem: http://www.google.com/url?sa=t&rct=j&q=rationaql%20functions%20and%20applications&source=web

Unit 3 – Rational Expressions and Functions			
on combinations of different foods. CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* CC.9-12.F.IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. CC.9-12.A.REI.11 Explain why the *x*-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* CC.9-12.F.BF.3 Identify the effect on the graph of		Equations can represent real world and mathematical problems. Include equations and inequalities that arise when comparing the values of two different functions, such as one describing linear growth and one describing exponential growth.	&cd=2&cad=rja&ved=0CDwQFjAB&url=http%3A%2F%2Fwww.dlt.ncssm.edu%2Falgebra%2F15_applications_of_rationals%2FApplications_of_Rational_Functions.doc&ei=b_wkUYH4I6aE0QGC_oG4Cg&usg=AFQjCNHyRXvdGm5ph2g1B0qYg8JSa70Pag&bvm=bv.42661473,d.dmQ
	Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context.	Include examples of modeling where students must interpret real-world significance of the key characteristics of the function	Mid Year Common Assessment

<table>
<tr><th colspan="4">Unit 3 – Rational Expressions and Functions</th></tr>
<tr><td>replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.</td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Additional Resources:
GeoGebra
GSP
TI-Inspire
The Refrigerator: How much does it really cost?
http://www.eren.doe.gov/consumerinfo/energy_savers/appliancesbody.html
http://www.lessonplanet.com/lesson-plans/algebra-ii
http://map.mathshell.org/materials/index.php
http://ccssmath.org/
www.ccsstoolbox.org
http://insidemathematics.org/
High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
http://www.illustrativemathematics.org/standards/hs
http://education.ti.com/calculators/downloads/US/Activities/Search/
http://learnzillion.com/
http://www.uen.org/core/math/7-12.shtml
http://illuminations.nctm.org/
http://www.khanacademy.org/
http://blog.mrmeyer.com/
http://www.dlt.ncssm.edu/stem/math-secondary</td></tr>
</table>

Unit 4 – Trigonometric Functions

Unit 4– 12 classes
Major Topics in this Unit:

- Radian and degree measure
- Trig functions and periodic phenomena
- Pythagorean identity
- Trigonometric ratios

Common Core State Standards in Connecticut

CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CC.9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude

CC.9-12.F.1F.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them

CC.9-12.F.TF.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

CC.9-12.F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

CC.9-12.F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

CC.9-12.F.TF.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π - x, π + x, and 2π - x in terms of their values for x, where x is any real number

CC.9-12.F.TF.8 Prove the Pythagorean identity $(\sin A)^2 + (\cos A)^2 = 1$ and use it to calculate trigonometric ratios.

CC.9-12.F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.*

CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Unit 4 – Trigonometric Functions

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Functions
  ○ Functions expressed symbolically
  ○ Key features of the graph
  ▪ By hand
  ▪ Technology
  ○ Zeros
  ○ End behavior
• Trigonometric functions
  ○ Extension to all real numbers
  ○ Unit circle in the coordinate plane
  ▪ Radian measures of angles traversed counterclockwise
• Radian measure of an angle
  ○ Length of the arc on the unit circle
• Pythagorean identity
  ○ $\sin^2(\theta) + \cos^2(\theta) = 1$
  ○ Periodic phenomena
  ○ Amplitude
  ○ Frequency
  ○ Midline
  ○ $\sin(\theta)$, $\cos(\theta)$, $\tan(\theta)$
	• GRAPH (functions)
	• SHOW (key features of the graph)
	• IDENTIFY (zeros)
	SHOW (end behavior)
	• EXPLAIN (trigonometric functions)
	• INTERPRET (radian measures)
	• MODEL (periodic phenomena)
	  ○ CHOOSE (trigonometric functions)
	• UNDERSTAND (radian measure)
	• PROVE (Pythagorean identity)
	• FIND($\sin(\theta)$, $\cos(\theta)$, $\tan(\theta)$)
	  ○ USE ($\sin^2(\theta) + \cos^2(\theta) = 1$)

Big Ideas

Student's statements of enduring ideas

1. Trigonometry is based on the relationships between sides of a right triangle. Every point on a unit circle is a vertex of a right triangle and can help us to define and relate the sine, cosine and tangent functions and extend the domain to all real numbers.
2. Periodic phenomena and trigonometric functions are repetitive and cyclical. Both include concepts of period, amplitude and midline.

Essential Questions

Teacher's guiding questions

1. How can the unit circle in the coordinate plane extend the ideas of trigonometric functions?
2. How can periodic phenomena be modeled in mathematics?

Critical Area 2; Math Practices 2, 4, 5, 8

Unit 4 – Trigonometric Functions			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* CC.9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude CC.9-12.F.1F.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums;	Interpret radian measures as a ratio of intercepted arc to radius.		Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)
	Convert between degree and radian measure.		
	Compare the ratios from special right triangles to evaluating trigonometric functions.	Have students explore the unit circle and trigonometric functions using applets and animations to make connections and identify exact values.. Students may explain (orally or in written format) their understanding.	http://map.mathshell.org/materials/lessons.php?taskid=427&subpage=concept (ferris wheel)
	Describe how counterclockwise rotation of a point on a unit circle allows us to interpret trigonometric functions beyond 2π.		http://www.nctm.org/uploadedFiles/Journals_and_Books/Books/FHSM/RSM-Task/Tidal_Waves.pdf (tidal waves)
	Compare and contrast sine and cosine functions and their graphs.	Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to model trigonometric functions and periodic phenomena. Students need to how the parameters of y = asinb(x-c)+d affects the graph.	http://www.iitgn.ac.in/mcm/cd/Mathematical%20Modelling%20Handbook/pdf/20_Sunrise.pdf (sunrise, sunset)

<table>
<tr><th colspan="4">Unit 4 – Trigonometric Functions</th></tr>
<tr><td rowspan="4">symmetries; end behavior; and periodicity.*

CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them

Consider for Accelerated (+):
CC.9-12.F.TF.4 (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

CC.9-12.F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

CC.9-12.F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.</td><td>Identify and write functions for sine and cosine functions to model periodic phenomena with specified amplitude, frequency, and midline.</td><td>Include examples of modeling where students must interpret real-world significance of the key characteristics of the function</td><td></td></tr>
<tr><td>Solve problems involving periodic phenomena using technology.</td><td>Example: The temperature of a chemical reaction oscillates between a low of 20° C and a high of 120° C. The temperature is at its lowest point when $t = 0$ and completes one cycle over a six hour period.
a. Sketch the temperature, T, against the elapsed time, t, over a 12 hour period.
b. Find the period, amplitude, and the midline of the graph you drew in part a).
c. Write a function to represent the relationship between time and temperature.
d. What will the temperature of the reaction be 14 hours after it began?
e. At what point during a 24 hour day will the reaction have a temperature of 60° C?</td><td>Illustrative Math Task – Foxes and Rabbits - http://www.illustrativemathematics.org/illustrations/816</td></tr>
<tr><td>Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$.</td><td>When proving the Pythagorean identity, have students make connections to angles in standard position.</td><td></td></tr>
<tr><td>Find sin (θ), cos (θ), or tan (θ), given sin (θ), cos (θ), or tan (θ), and the quadrant of the angle.</td><td>Students may go back to triangles or use the Pythagorean identity.</td><td>Unit Assessment</td></tr>
</table>

Unit 4 – Trigonometric Functions			
CC.9-12.F.TF.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4 and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π - x, π + x, and 2π - x in terms of their values for x, where x is any real number CC.9-12.F.TF.8 Prove the Pythagorean identity $(\sin A)^2 + (\cos A)^2 = 1$ and use it to calculate trigonometric ratios. CC.9-12.F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.* CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales			
Additional Resources: • http://map.mathshell.org/materials/index.php • http://ccssmath.org/ • http://www.lessonplanet.com/lesson-plans/algebra-ii • www.ccsstoolbox.org • http://insidemathematics.org/ • High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf • http://www.illustrativemathematics.org/standards/hs • http://education.ti.com/calculators/downloads/US/Activities/Search/			

Unit 4 – Trigonometric Functions
• http://learnzillion.com/ • http://www.uen.org/core/math/7-12.shtml • http://illuminations.nctm.org/ • http://www.khanacademy.org/ • http://blog.mrmeyer.com/ • http://www.dlt.ncssm.edu/stem/math-secondary

Unit 5 – Exponential and Logarithmic Functions

Unit 5– 16 classes
Major Topics in this Unit:

- Representing and interpreting exponential equations
- Translations of exponential and logarithmic functions
- Inverses
- Geometric series
- Solving exponential equations

Common Core State Standards in Connecticut	Explanations and Examples*

CC.9-12.F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

CC.9-12.F.IF.8b Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{(t/10)}$, and classify them as representing exponential growth or decay

CC.9-12.A.SSE.1 Interpret expressions that represent a quantity in terms of its context.*

CC.9-12.A.SSE.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P

CC.9-12.A.SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.*

CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

CC.9-12.F.BF.1 Write a function that describes a relationship between two quantities.*

CC.9-12.F.BF.1b Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model

CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

CC.9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude

CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate

axes with labels and scales.

CC.9-12.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*

CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them

CC.9-12.A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*

CC.9-12.F.LE.4 For exponential models, express as a logarithm the solution to $ab^{(ct)} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

CC.9-12.F.BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

● Equivalent forms of expression
● Properties of exponents
● Exponential growth or decay
• Quantity in terms of context
  ○ Expressions and parts of expressions
  ○ Terms
  ○ Factors
  ○ Coefficients
• Sum of a finite geometric series
  ○ Formula
  ○ Common ratio is not 1
  ○ Problems
● Functions (expressed symbolically)
	● Write (function to model)
	● Use (properties of exponents)
	● Interpret / Classify (grown or decay)
	• INTERPRET (quantity in terms of context)
	  ○ VIEW (one or more parts of complicated expressions)
	• DERIVE (sum of a finite geometric series)
	  ○ SOLVE (problems)
	● Graph
	● SHOW (key features of the graph)
	● IDENTIFY (zeros)
	● SHOW (end behavior

Unit 5 – Exponential and Logarithmic Functions

- Exponential
- Logarithmic
- Function expressed symbolically
- Key Features of the graph
  - By hand
  - Technology
- Zeros
- End behavior

- Key Features
  - Intercepts
  - intervals
    - increasing or decreasing
    - positive or negative
  - end behavior / asymptotes
- Technology (graphing complicated functions)
- Equations
  - Intersection of graphs
  - x-coordinates of the point of intersection
  - y = f(x) and y = g(x)
  - f(x) = g(x)
  - Solutions
    - Technology to graph the functions
    - Tables of values
    - Successive approximations
  - Linear
  - Polynomial
  - Rational
  - Absolute value
  - Exponential
  - Logarithmic
- Exponential / logarithmic form
- Logarithm

- Show (key features / intercepts / end behavior)
- Use (technology)
- EXPLAIN (why intersections of graphs are solutions)
- FIND (solutions)
- Express (as logarithm)
- Evaluate (logarithm)

Unit 5 – Exponential and Logarithmic Functions

Big Ideas

Student's statements of enduring ideas

1. Linear functions have a constant rate of change, the degree is one, and the graph is a straight line. Exponential functions have a constant percent change, the variable is the exponent, and the graph is a growth or decay curve. Quadratic functions have a constant second difference, the degree is two, and the graph is a parabola with a relative maximum or minimum.
2. Exponential and logarithmic functions are inverses of each other and are used in the process of solving equations.

Essential Questions

Teacher's guiding questions

1. How do you distinguish between a linear, exponential, or quadratic function given various representations?
2. What is the relationship between logarithmic and exponential functions?

Critical Area 3; Math Practices 1, 3, 4, 5, 7

CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
CC.9-12.F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. CC.9-12.F.IF.8b Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{(t/10)}$, and classify them as representing exponential	Use equivalent forms of exponential equations to explain key characteristics of the function.	Students should understand the vocabulary for the parts that make up the whole expression and be able to identify those parts and interpret there meaning in terms of a context. Example: 2.02^x vs (1+.02)^x extend example Systems and inequalities need to be included throughout.	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)
	Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the	Examples may include: In February, the Bezanson family starts saving for a trip to Australia in September. The Bezanson's expect their vacation to cost $5375. They start with $525. Each month they plan to deposit 20% more than the previous month.	Illustrative Math Task – Course of Antibiotics http://www.illustrativemathematics.org/illustrations/805

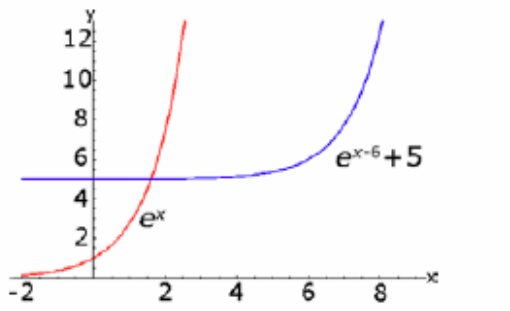
growth or decay CC.9-12.A.SSE.1 Interpret expressions that represent a quantity in terms of its context.* CC.9-12.A.SSE.1b Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P CC.9-12.A.SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.* CC.9-12.A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* CC.9-12.F.BF.1 Write a function that describes a relationship between two quantities.* CC.9-12.F.BF.1b Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling	formula to solve problems.	Will they have enough money for their trip? Calculate mortgage payments	
	Create equations and inequalities in one variable and use them to solve problems.	Equations can represent real world and mathematical problems. Include equations and inequalities that arise when comparing the values of two different functions, such as one describing linear growth and one describing exponential growth.	
	Write a function that describes a relationship between two quantities.	Students will analyze a given problem to determine the function expressed by identifying patterns in the function's rate of change. They will specify intervals of increase, decrease, constancy, and, if possible, relate them to the function's description in words or graphically. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to model functions. Include examples of modeling where students must interpret real-world significance of the key characteristics of the function Examples may include: You buy a $10,000 car with an annual interest rate of 6 percent compounded annually and make monthly payments of $250. Express the amount remaining to be paid off as a function of the number of months, using a recursion equation. A cup of coffee is initially at a temperature of 93º F. The difference between its temperature and the room temperature of 68º F decreases by 9% each minute. Write a function describing the temperature of the coffee as a function of time.	MAT.HS.CR.1.00FIF.L.614_V1.pdf

<table>
<tr><th colspan="4">Unit 5 – Exponential and Logarithmic Functions</th></tr>
<tr><td>body by adding a constant function to a decaying exponential, and relate these functions to the model.

CC.9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*
CC.9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude
CC.9-12.A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
CC.9-12.F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal</td><td></td><td>The radius of a circular oil slick after t hours is given in feet by $r = 10t^2 - 0.5t$, for $0 \leq t \leq 10$. Find the area of the oil slick as a function of time.</td><td></td></tr>
<tr><td>Graph exponential functions and identify its key characteristics.</td><td>Key characteristics include domain, range, y-intercept, end behavior, and asymptotes.

Students may use technology for graphing more complicated cases.</td><td>Multiplying Cells: http://map.mathshell.org/materials/tasks.php?taskid=268&subpage=apprentice</td></tr>
<tr><td>Make connections between parent functions and translations, dilations and reflections.</td><td>Examples may include:

Compare the shape and position of the graphs of $f(x) = e^x$ to $g(x) = e^{x-6} + 5$, and explain the differences, orally or in written format, in terms of the algebraic expressions for the functions

Describe the effect of varying the parameters a, h, and k on the shape and position of the graph $f(x) = ab^{(x+h)} + k$., orally or in written format. What effect do values between 0 and 1 have? What effect do negative values have?</td><td></td></tr>
</table>

description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* CC.9-12.F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them CC.9-12.A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value,	Solve exponential equations using multiple representations	Students need to understand that numerical solution methods (data in a table used to approximate an algebraic function) and graphical solution methods may produce approximate solutions, and algebraic solution methods produce precise solutions that can be represented graphically or numerically. Students may use graphing calculators or programs to generate tables of values, graph, or solve a variety of functions	
	Rewrite exponential models as a logarithm as a means of solving. .	Illustrate and have students explore multiple examples that logs and exponentials are inverses. Limit to base 2, 10 or *e.* Extend beyond for Accelerated students. For example, students should be able to estimate that $\log_2 10$ is between 3 and 4. Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to analyze exponential models and evaluate logarithms. Include applications of modeling that are solved using logarithms. Examples may include: Solve $200\,e^{0.04t} = 450$ for t. Solution: We first isolate the exponential part by dividing both sides of the equation by 200. $e^{0.04t} = 2.25$ Now we take the natural logarithm of both sides. $ln\ e^{0.04t} = ln\ 2.25$ The left hand side simplifies to $0.04t$, by logarithmic identity 1. $0.04t = ln\ 2.25$ Lastly, divide both sides by 0.04 $t = ln\ (2.25) / 0.04$ $t \approx 20.3$	Journal: Explain how exponentials and logs are related. Include an example to illustrate. Unit Assessment

exponential, and logarithmic functions.* CC.9-12.F.LE.4 For exponential models, express as a logarithm the solution to $ab^{(ct)} = d$ where *a*, *c*, and *d* are numbers and the base *b* is 2, 10, or *e*; evaluate the logarithm using technology. CC.9-12.F.BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.			

Additional Resources:

- Half-life and Doubling Time
- http://www.dlt.ncssm.edu/algebra/HTML/19.htm
- Purchasing a Used Car
- http://www.dlt.ncssm.edu/algebra/HTML/19_20.htm
- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- http://www.lessonplanet.com/lesson-plans/algebra-ii
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

Unit 6 – Inferences and Conclusions from Data

Unit 5– 16 classes
Major Topics in this Unit:

- Data distributions
- Probability distributions
- Randomization

Common Core State Standards in Connecticut	Explanations and Examples*

CC.9-12.S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

HS.S-IC.1. Understand statistics as a process for making inferences to be made about population parameters based on a random sample from that population.

HS.S-IC.2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

HS.S-IC.3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

HS.S-IC.4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

HS.S-IC.5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

HS.S-IC.6. Evaluate reports based on data.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Distribution of data
  ○ Mean
  ○ Standard deviation of data
  ○ Normal distribution
  ○ Population percentages
  ○ Areas under the normal curve
	• USE (mean and standard deviation of data)
	• FIT (data to a normal distribution)
	• ESTIMATE (population percentages)
	• RECOGNIZE (limitations of data)
	• USE (calculators, spreadsheets and tables)
	  ○ ESTIMATE (areas under the normal curve)

• Statistics on populations
  ○ Random sample
• Modeling
  ○ Consistency of results
  ○ Data-generating process
• Results of studies
  ○ Inferences
  ○ Conclusions
  ○ Sample survey
  ○ Experiments
  ○ Observational studies
  ○ Randomization
  ○ Population mean
  ○ Proportion
  ○ Margin of error
  ○ Simulation models for random sampling
  ○ Treatments
• Probability of outcomes
	• UNDERSTAND (statistics about population parameters)
	• DECIDE (consistency of model)
	• RECOGNIZE (purposes and differences among studies)
	  ○ EXPLAIN (randomization)
	• USE (data)
	  ○ ESTIMATE (population mean or proportion)
	  ○ DEVELOP (margin of error)
	  ○ COMPARE (treatments)
	  ○ USE (simulations)
	• EVALUATE (reports based on data)
	• USE (probabilities)
	  ○ MAKE (fair decisions)
	• ANALYZE (decisions and strategies)
	• USING (probability concepts)

Big Ideas

Student's statements of enduring ideas

1. Collecting data from random samples allows us to draw valid conclusions about the population or make fair comparisons between treatments.
2. It's important so that we can be critical consumers of statistical reports and make informed decisions based on those reports.

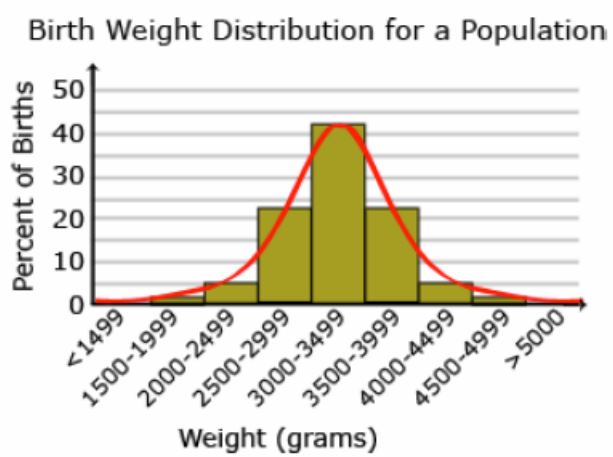
Essential Questions

Teacher's guiding questions

1. Why is randomization important?
2. Why is knowing about statistics and probability important?

Critical Area 4; Math Practices 2, 3, 4, 5, 6

CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:

CC.9-12.S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	Construct, interpret and use normal curves based on mean and standard deviation to solve problems.	Key characteristics of the normal curve: Mean and standard deviation Examples may include: The bar graph below gives the birth weight of a population of 100 chimpanzees. The line shows how the weights are normally distributed about the mean, 3250 grams. Estimate the percent of baby chimps weighing 3000-3999 grams. 	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)
	Identify data sets as approximately normal or not.	Determine which situation(s) is best modeled by a normal distribution. Explain your reasoning. Annual income of a household in the U.S. Weight of babies born in one year in the U.S.	
	Estimate and interpret area under curves using the Empirical Rule.	Empirical Rule: 68-95-99.7 (percent) In any Normal distribution, approximately: • 68% of the observations fall within one standard deviation of the mean. • 95% of the observations fall within two standard deviations of the mean. • 99.7% of the observations fall within three standard deviations of the mean.	

HS.S-IC.1. Understand statistics as a process for making inferences to be made about population parameters based on a random sample from that population. HS.S-IC.2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?* HS.S-IC.3. Recognize the purposes of and differences among sample surveys, experiments, and		Example: Suppose a typical driver is in an accident every five years. Make a small paper bag with 20 beans for each student, each with a different ratio of black and white beans. The black beans represent a car accident. Without looking in the bags, have all students sample with replacement 20 times, counting how many car accidents that they had. Does their bag represent a typical driver? Discuss their decision and compare data. Simulation Applets at http://nlvm.usu.edu Statistics Applets at www.math.usu.edu/~schneit/CTIS/	**Problem Task:** Create a model for obtaining a sample and defend why the model will generate consistent results.
	Distinguish between the various sampling methods and select the appropriate method for a given situation.	Sampling methods include: Simple random sampling, convenience sampling, stratified sampling, cluster sampling, systematic sampling.	http://www.shawnee.edu/acad/ms/ENABLdocs/MarchFollowuppdfs/Go%20Fish%20lesson%20plan.pdf
	Explain why a sample may or may not represent the population.	Example: Suppose a typical driver is in an accident every five years. Make a small paper bag with 20 beans for each student, each with a different ratio of black and white beans. The black beans represent a car accident. Without looking in the bags, have all students sample with replacement 20 times, counting how many car accidents that they had. Does their bag represent a typical driver? Discuss their decision and compare data. Simulation Applets at http://nlvm.usu.edu Statistics Applets at www.math.usu.edu/~schneit/CTIS/	http://map.mathshell.org/materials/lessons.php?taskid=217&subpage=problem
	Examine theoretical and experimental results to evaluate the effectiveness of a treatment.		Module 1 http://www.nsa.gov/academia/_files/collected_learning/high_school/statistics/probability_simulation.pdf

observational studies; explain how randomization relates to each. HS.S-IC.4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. HS.S-IC.5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. HS.S-IC.6. Evaluate reports based on data.	Design, conduct and interpret the results of simulations.	Possible data-generating processes include (but are not limited to): flipping coins, spinning spinners, rolling a number cube, and simulations using the random number generators. Students may use graphing calculators, spreadsheet programs, or applets to conduct simulations and quickly perform large numbers of trials. Example: ● Have multiple groups flip coins. One group flips a coin 5 times, one group flips a coin 20 times, and one group flips a coin 100 times. Which group's results will most likely approach the theoretical probability?	Modules 2 & 3 http://www.nsa.gov/academia/_files/collected_learning/high_school/statistics/probability_simulation.pdf
	Explain and use the Law of Large Numbers.	The law of large numbers states that as the sample size increases, the experimental probability will approach the theoretical probability. Comparison of data from repetitions of the same experiment is part of the model building verification process.	http://education.ti.com/xchange/US/Math/ProbabilityStatistics/4238/ExploringMath_Probability_Act3.pdf http://education.ti.com/xchange/US/Math/ProbabilityStatistics/4236/ExploringMath_Probability_Act2.pdf http://www.haystack.mit.edu/edu/pcr/Data/pdf/Using.Spreadsheets.pdf
	Compare and contrast sample surveys, experiments and observational studies including how randomization is used in each.	Students should be able to explain techniques/applications for randomly selecting study subjects from a population and how those techniques/applications differ from those used to randomly assign existing subjects to control groups or experimental groups in a statistical experiment. In statistics, an observational study draws inferences about the possible effect of a treatment on subjects, where the assignment of subjects into a treated group versus a control group is outside the control of the investigator (for example, observing data on academic achievement and socio-economic status to see if there is a relationship	Interpreting Statistics: A Case of Muddying the Waters - http://map.mathshell.org/materials/lessons.php?taskid=217&subpage=problem

		between them). This is in contrast to controlled experiments, such as randomized controlled trials, where each subject is randomly assigned to a treated group or a control group before the start of the treatment. Given a variety of examples of research from various media, determine if the study was a survey, an experiment, or an observational study. If possible, determine whether or not results were obtained using random samples. Examples: http://www.illustrativemathematics.org/standards/hs under Statistics & Probability S-IC: "Strict Parents"	
	Estimate a population mean or proportion based on data from a sample.	Students may use computer generated simulation models based upon sample surveys results to estimate population statistics and margins of error. Explanations can include but are not limited to sample size, biased survey sample, interval scale, unlabeled scale, uneven scale, and outliers that distort the line-of-best-fit. In a pictogram the symbol scale used can also be a source of distortion. As a strategy, collect reports published in the media and ask students to consider the source of the data, the design of the study, and the way the data are analyzed and displayed.	http://www.nctm.org/uploadedFiles/Journals_and_Books/Books/FHSM/RSM-Task/Old_Faithful.pdf
	Interpret margins of error that estimate a population mean or proportion using sample survey results.	The margin of error refers to the expected range of variation in a poll if it were to be conducted multiple times under the same procedures. The margin of error is greater when the population has more variability. Gather a variety of surveys and polls and discuss how researchers and pollsters use margin of error to interpret their results. Source for survey results: www.gallup.com Sample Formative Assessment Tasks	Journal: Describe how variability impacts margin of error. Use verbal descriptions and models to demonstrate your understanding.

	Determine whether the results of two treatments are significantly different.	Students may use computer generated simulation models to decide how likely it is that observed differences in a randomized experiment are due to chance. Treatment is a term used in the context of an experimental design to refer to any prescribed combination of values of explanatory variables. For example, one wants to determine the effectiveness of weed killer. Two equal parcels of land in a neighborhood are treated; one with a placebo and one with weed killer to determine whether there is a significant difference in effectiveness in eliminating weeds.Use simulation results to compare two treatments and discuss whether or not differences are significant. Compare and contrast different simulations to show examples and non-examples of significant differences. Have students consider if there is a difference in distracted driving rates between talking on cell phones and talking to a passenger. Refer to the Distracted Driving activity listed in Resources. Have students perform and analyze the simulation activity (#4-8). Compare student results to the original experiment. Distracted Driving http://courses.ncssm.edu/math/, Statistics Institutes, 2007	
	Evaluate the validity of research designs, analyses, and conclusions in published reports.	Explanations can include but are not limited to sample size, biased survey sample, interval scale, unlabeled scale, uneven scale, and outliers that distort the line-of-best-fit. In a pictogram the symbol scale used can also be a source of distortion. As a strategy, collect reports published in the media and ask students to consider the source of the data, the design of the study, and the way the data are analyzed and displayed. Example: • A reporter used the two data sets below to calculate the mean housing price in Arizona as $629,000. Why is this calculation not representative of the typical housing price in Arizona? o King River area {1.2 million, 242000, 265500, 140000, 281000, 265000, 211000} o Toby Ranch homes {5million, 154000, 250000, 250000, 200000, 160000, 190000}	**Final Exam**

Additional Resources:

http://www.cpm.org/pdfs/standards/stats/Stats%20Unit%208%20TV.pdf

- http://www.cpm.org/pdfs/standards/stats/Stats%20Unit%208%20TV.pdf
- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- http://www.lessonplanet.com/lesson-plans/algebra-ii
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

Appendix A

TRANSLATIONS OF GRAPHS

Your group will be assigned a function to present to the class using the Activity Center. Your group will need to explain how the position of the number included in the function affects the graph of the function.

Use graphing software to explore these graphs and others as needed. Groups will present their findings to the class

	Group 1:	Group 2:	Group 3:	Group 4:	Group 5:
Function	Absolute Value	Greatest Integer	Squared	Cubed	Square root
f(x)	$y = \|x\|$	$y = [x]$	$y = x^2$	$y = x^3$	$y = \sqrt{x}$
f(x) + c	$y = \|x\| + 2$	$y = [x] + 2$	$y = x^2+2$	$y = x^3 + 2$	$y = \sqrt{x} + 2$
f(x) – c	$y = \|x\| - 2$	$y = [x] - 2$	$y = x^2 - 2$	$y = x^3 - 2$	$y = \sqrt{x} - 2$
f(x+c)	$y = \|x+2\|$	$y = [x+2]$	$y = (x + 2)^2$	$y = (x+2)^3$	$y = \sqrt{(x+2)}$
f(x-c)	$y = \|x-2\|$	$y = \|x-2\|$	$y = (x - 2)^2$	$y = (x-2)^3$	$y = \sqrt{(x-2)}$
c f(x)	$y = 2\|x\|$	$y = 2[x]$	$y = 2x^2$	$y = 2x^3$	$y = 2\sqrt{x}$
1/c f(x)	$y = ½\|x\|$	$y = ½[x]$	$y = ½x^2$	$y = ½x^3$	$y = ½\sqrt{x}$
- f(x)	$y = -½\|x\|$	$y = -½[x]$	$y = -½x^2$	$y = -½x^3$	$Y = -½\sqrt{x}$

After completing the study of all of these graphs, describe how these shifts affect the original graphs.

f(x) + c	
f(x) – c	
f(x+c)	
f(x-c)	
c f(x)	
1/c f(x)	
- f(x)	

Lesson Title	Introduction to Inverse Functions
Connecticut CONTENT Standards (CCSSM)	**F.BF.4 Find inverse functions** **F.BF.4a Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2(x^3)$ for $x > 0$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$ (x not equal to 1).**
Connecticut PRACTICE Standards (CCSSM)	2: Reason abstractly and quantitatively 7: Look for and make sense of structure
Lesson Objectives in Language Students will Understand	Students will be able to… • discover that inverses are reflections about the identity function and that not all inverses are functions • predict when a function will have an inverse that is also a function • describe the domain and range of an inverse • write an expression for the inverse. BIG IDEA: Functions have inverses, which are reflections about the identity function. The domain and range of the inverse are the reverse of the function.
Timeline	2 – 4 40-minute periods
Description of Learning Tasks/ Activities	See below
Materials, Resources, Technology Needed	Internet access for applets (classroom demonstrations) http://www.ltcconline.net/greenl/java/IntermedCollegeAlgebra/Inverse/inverse1.html http://www.analyzemath.com/Inverse-Function-Definition/Inverse-Function-Definiti.html Graphing calculators
Prior Learning, Connections, Student Needs or Interests, Common Misconceptions	Prior knowledge: • F-IF 1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. • F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. • A-CED 4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. Common misconceptions: • Students easily confuse inverses and reciprocals. A follow-up discussion could be to have students compare/contrast the two terms. Connections for students: • Students are familiar with inverses from geometry. They have used inverse trigonometry in order to calculate the angle in a right triangle

	when given two sides. The domain of that inverse determine the reasonableness of their answers.
Instructional Strategies/ Grouping	Strategies are described within each task.
Modifications/ Extensions	Described within the tasks.
Cross disciplinary Connections	Using inverses in general: http://mathforum.org/library/drmath/view/54605.html Conversions in science (ie: ^{o}C to ^{o}F and back again) www.illustrativemathematics.org/illustrations/364 www.illustrativemathematics.org/illustrations/501
Formative Assessment processes (including student self-assessment)	Pre- The warm-up allows the teacher to ensure that all students are ready for the key ideas of inverses by recalling facts about domain and range. Post- Each task includes opportunities for the students to record their understanding and compare with others. These responses allow the teacher to assess if students understand the main concepts. Task 4 allows the teacher to see if students understand the skill of finding inverses as they work in groups on simple equations. The closure activity allows the teacher to see if students understand the implications of inverses and their domain/range by observing the group discussions.

Inverse Functions Lesson Plan

OBJECTIVE: Students will understand what an inverse of a function is graphically, numerically and algebraically.

WARM-UP: Ask students to do a couple of problems that review domain and range. This ensures that students understand a fundamental concept for inverses.

PART 1: The goal of this task is for students to discover that inverses are reflections about the identity function and that not all inverses are functions. Students will also begin to develop an understanding of the domain and range of inverses.

Instructional Strategy: Whole-class discussion
Estimated time: 20-40 minutes

- Show to the entire class http://www.ltcconline.net/greenl/java/IntermedCollegeAlgebra/Inverse/inverse1.html
- This applet shows various functions and the identity function.
    - When you click "Start Inverse" the applet will animate the process of reflecting the function.
    - When you click "New Random Function" a new function to reflect will appear.
- Have students observe quietly as you demonstrate various functions and their inverses.
    - You may want to ask students to suggest functions to try. They can be entered in the box at the bottom. (Directions are available at that website above.)
- Ask students to share their observations. Record on the board.
    - They should easily notice that the inverse is a reflection. Ask them to be precise, recognizing that we are reflecting about the identity function.
    - If that's all they notice, you may want to prompt their thinking by asking the following questions…
        - Were all of the inverses functions?
        - What is the domain/range of the original function? What is the domain/range of the inverse?
        - What happened to the x- and y-coordinates? (Although you may want to save this question for during part 2, where it is more obvious.)
    - Expect general ideas only at that point and expect some ideas that are way off-track. These are ok because the rest of the lesson will help students identify what is true about inverses.
    - If students are not offering many ideas, you may need to return to the applet and show some of the functions again.
- Ask students to consider if there is a way to predict whether the inverse will be a function or not.
    - Repeat the initial demonstration, but before you do the animation ask how many students believe the inverse will be a function.
    - After a few demonstrations, have students explain how they were able to predict if the inverse will be a function. They should be able to verbalize the horizontal line test at this point. Record on the board.

- MODIFICATION: For students having difficulties visualizing this reflection, have them do a pencil-rubbing…
    - Sketch a function on graph paper using pencil. Make it very dark.
    - Fold the paper along the line y = x. Keep it folded.
    - Scribble heavily over the area covering the graph.
    - Open the paper – the inverse will show lightly on the paper.

PART 2: The goal of this task is for students to describe an inverse when given a set of coordinates.

Instructional strategy: Students working in pairs in the computer lab or with personal devices, but could also be done as whole-class (like task 1) if needed. A student worksheet ("Understanding Inverses from the Coordinates") is included for this part, or you could follow the outline below.
Estimated time: 10 – 20 minutes

If you don't use the student worksheet…

- Open the applet found at http://www.analyzemath.com/Inverse-Function-Definition/Inverse-Function-Definiti.html
- Have students observe and record their ideas for the following…
    - Using f(x), which should be the first function shown, select a point on the graph. A red point will appear in the inverse's location and both coordinates will show in the upper left corner. (Ask students to record the coordinates for both the red and blue points.)
    - Repeat for several points on this function.
- Ask students to record their observations.
    - Students should recognize that the x- and y-coordinates are "swapped" in the inverse.
    - Ask students to state the domain/range of f(x) and its inverse. Students should realize that these also get "swapped".
- Select function g.
    - Have students copy g(x) on graph paper and predict the location of the inverse coordinates by recording them on the graph as well. (Colored pencils suggested so g(x) is in one color and $g^{-1}(x)$.)
    - Repeat the procedure used with f(x).
    - Ask students to explain all similarities and differences between their predictions and the actual results from the applet.
    - Ask students if g's inverse is a function (it's not).
    - Ask students if there is a way to predict this based only on the set of coordinates.
- Discuss observations as a class.

PART 3: The goal of this task is for students to formalize their descriptions of characteristics of an inverse and when an inverse is a function.

Instructional strategy: Think-pair-share
Estimated time: 10-15 minutes

- Have students think about their observations, write a description of what an inverse is and how to predict if the inverse will be a function, and share with a partner.

- Student descriptions should include…
    - It's a reflection about the identity function
    - The domain of an inverse is the range of the function; the range of an inverse is the domain of the function.
    - Not all inverses are functions – they may describe how to tell by using a horizontal line test or by explaining that each y-value can only have one x-value (one-to-one).

PART 4: The goal of this task is to have students able to express an inverse algebraically.

Instructional strategy: Small group with some whole-class discussion
Estimated time: 30 – 45 minutes

The following is also available as a student handout ("Understanding Inverses Algebraically")

- Write on the board the following equations: $y = 4x + 1$ and $x = 4y + 1$.
    - MODIFICATION: These can be replaced with one-step functions.
- Ask students to graph each equation on their calculators. They should look at both the graphs and the tables.
    - They will need to solve the second equation for y before they can graph it.
- Ask students to sketch the graphs and record the tables in their notes.
- In their notes, ask students to determine if the two equations are inverses and to justify their answers using the descriptions written earlier. They may use a graph or a table in their justifications.
- Ask students to compare and contrast the original equations $y = 4x + 1$ and $x = 4y + 1$.
    - Students will quickly recognize that the variables switched places. State that this is a hypothesis (which the next bullet will test).
- Have students work in groups of 3 (mixed ability) and give them the equation $y = 3x^2 + 2$.
    - Have the group select seven points that lie on this graph with at least three of the x-values being less than zero.
    - Have one student create a table of the x- and y-values for this function then create another table with those values "swapped".
    - Have one student sketch the graph of this function and its inverse. (NOTE: A few students may be able to do this directly, but it would probably be easier for them to do a pencil rubbing as described in part 1.)
    - Have one student swap the variables and solve for y algebraically.
    - Once each student it finished, the trio should compare their results. Have students answer the question, "How do the graph and table help us understand how to find the inverse equation algebraically?"
    - MODIFICATION: This can be easily modified to meet the needs of your students. For example…
        - You may want to have students do all three tasks to see the progression from numeric representation of the inverse to the algebraic.
        - You may want to have students work in pairs, one doing the table and the other the graph then both working on the algebraic representation.
        - You may want to give a linear equation instead.

If you used the student worksheet, bring the class back together at this point…

- Most students in the previous exercise will have algebraic equations that express only "half" of the actual inverse's parabola, even though when they found the inverse numerically and graphically (question 7) they realized that the inverse is a complete side-ways parabola. Have a whole-class discussion about the differences and how to reconcile the inverse algebraic equation with what they should have…
    - Lucky teachers will have a few students who realize that the inverse equation should be expressed as a piece-wise function or with a +/- designation. These students should be invited to express their reasoning.
        - Follow-up questions for the rest of the class may include returning to the idea that the domain and range get "swapped" with inverses and how that affects the inverse of a quadratic function.
    - Not-so-lucky teachers may want to remind students about the square roots of 4, 9, 25, etc. As students recall that there are two square roots for each number, they will likely realize they need two possibilities (+ and -) with their inverse equation.

CLOSURE: Students will apply their understanding of inverses and their domains/ranges in order to recognize and explain why their ideas for the inverses of $\sqrt{x}$ did not match the results from the applet.

Instructional strategy: whole-class then groups
Estimated time: 20 – 30 minutes

- Have students in small groups find the inverse of y = $\sqrt{x}$ algebraically. They should also complete a table and sketch a graph of the function and inverse.
- Have students enter the original function and the inverse equation they found into their calculators and ask them to look at the graphs.
- Return the entire class' attention to the site we began with: http://www.ltcconline.net/greenl/java/IntermedCollegeAlgebra/Inverse/inverse1.html and enter "sqrt(x)" in the space at the bottom. Click on the inverse button and ask students if the graph on their calculator resembles the graph on the applet.
    - Students should recognize that the inverse of $\sqrt{x}$ is not the complete graph of x^2. Students should copy this into their notes for discussion.
- Have students get back in their groups to discuss the differences and what they need to consider with the inverse of $\sqrt{x}$.
    - Students should notice that the inverse is half of a parabola. Encourage them to discuss the domain/range of $\sqrt{x}$ and how that is reflected in the inverse. Ask them to find a way to write the inverse function so that it includes the restricted domain. (A possible answer could be $y = x^2$ when $x \geq 0$.)

FOLLOW-UP: Students will verify that the line of reflection is the identity function.

- Using the graph of $y = 3x^2 + 2$, have students

- Connect the points from the pre-image to the image (this terminology should be familiar to them from geometry),
- Find the midpoint for each connection,
- Plot the midpoints,
- Describe and write an equation for the resulting line that connects the midpoints.

CHALLENGE: Ask students to express the inverse of y = |x| graphically and algebraically.

- Graphically: Students will need to reflect a figure when part of it lies on the line of reflection. This should be familiar to them because of geometry.
- Algebraically: There are multiple approaches to this problem. Students may write the piece-wise function based on the graph OR students may express |x| piece-wise to begin with and work from there.

TEACHER NOTES FOR SURROUNDING LESSONS:

- Prior lessons may want to address standards F.IF.7 (graphing functions), F.IF.3 (function transformations), F.IF.5 (domain and range), and F.IF.1b (composition).
- The lesson after the one described here should introduce the notation $f^{-1}(x)$ and re-enforce the algebraic skills introduced here.
    - This lesson also provides a natural bridge to several of the "extra" standards listed in the CCSS. Most notably F.BF.4b (verifying inverses through composition) and F.BF.4d (writing inverses by restricting the domain).

Bristol Public Schools
Office of Teaching & Learning

DEPARTMENT: Mathematics

COURSE: Algebra

COURSE DESCRIPTION
The fundamental purpose of this course is to formalize and extend the mathematics that students learned in the middle grades. Because it is built on the middle grades standards, this is a more ambitious version of Algebra Ithan has generally been offered. The critical areas, called units, deepen and extend understanding of linear and exponential relationships by contrasting them with each other and by applying linear models to data that exhibit a linear trend, and students engage in methods for analyzing, solving, and using quadratic functions. The Mathematical Practice Standards apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations.

Unit Organization:	Instruction focuses on four critical areas:
Unit 1 – Relationships between Quantities and Reasoning with Equations **Unit 2 – Linear and Exponential Relationships** **Unit 3 – Descriptive Statistics** **Unit 4 – Expressions and Equations** **Unit 5 – Quadratic Functions and Modeling**	Critical Area 1: By the end of eighth grade, students have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. Now, students analyze and explain the process of solving an equation. Students develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities, and using them to solve problems. They master the solution of linear equations and apply related solution techniques and the laws of exponents to the creation and solution of simple exponential equations. Critical Area 2: In earlier grades, students define, evaluate, and compare functions, and use them to model relationships between quantities. In this unit, students will learn function notation and develop the concepts of domain and range. They explore many examples of functions, including sequences; they interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change. Students explore systems of equations and inequalities, and they find and interpret their solutions. They interpret arithmetic sequences as linear functions and geometric sequences as exponential functions. Critical Area 3: This unit builds upon prior students' prior experiences with data, providing students with more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

	Critical Area 4: In this unit, students build on their knowledge from unit 2, where they extended the laws of exponents to rational exponents. Students apply this new understanding of number and strengthen their ability to see structure in and create quadratic and exponential expressions. They create and solve equations, inequalities, and systems of equations involving quadratic expressions. Critical Area 5: In this unit, students consider quadratic functions, comparing the key characteristics of quadratic functions to those of linear and exponential functions. They select from among these functions to model phenomena. Students learn to anticipate the graph of a quadratic function by interpreting various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. Students expand their experience with functions to include more specialized functions—absolute value, step, and those that are piecewise-defined.

DEPARTMENT PHILOSOPHY

The philosophy of the mathematics department is to develop mathematically literate and productive students who can effectively and efficiently apply mathematics in their lives to make informed decisions about the world around them. To be mathematically literate, one must understand major mathematics concepts, possess computational facility and have the ability to apply these understandings to situations in daily life. Making connections between mathematics and other disciplines is key to the appropriate application of mathematics skills and concepts to solve problems. The ability to read, discuss and write within the discipline of mathematics is an integral skill that supports mathematical understanding, reasoning and communication. The opportunity to think critically and creatively to solve problems is important to deepen mathematical knowledge and foster innovation. A rich mathematical experience is essential to provide the foundational knowledge and skills that prepare students to be mathematically literate, productive citizens.

The Bristol mathematics curriculum focuses on high expectations for **all** students and provides a balanced approach to mathematics education, placing equal importance on conceptual understanding, computational and procedural fluency and problem solving through the use of a variety of strategies, tools and technologies. The mathematics curriculum is responsive to the individual needs of students. While providing a structure tied to the Common Core State Standards in Connecticut, it allows for classroom experiences, additional supports and enrichment ensuring students' access to the content at an appropriate level of challenge.

DEPARTMENT GOALS

Through a planned, sequential curriculum, the Bristol Public schools strive to educate each student according to the standards outlined in the Common Core State Standards for Mathematics in Connecticut including these conceptual categories:

- Number and Quantity
- Algebra
- Functions
- Geometry
- Modeling
- Statistics and Probability

As part of these standards, teachers will support students in developing the following mathematical practices[1]:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

[1.] The mathematical practices listed are those found in the Common Core State Standards in Connecticut.

PHILOSOPHY OF INSTRUCTION

Based on our department philosophy and goals, math teachers will:

- provide a safe, supportive and respectful classroom environment conducive to learning, where students are encouraged to take risks and share ideas;
- have a deep understanding of the mathematical concepts and skills in the curriculum and strong pedagogical content knowledge;
- use the BOE approved textbook and a variety of resources to have students read about, explore and reinforce curriculum concepts and skills;
- build upon students' prior knowledge and experience, and real-world events, to foster connections and make learning relevant and meaningful;
- provide students with developmentally appropriate opportunities to question, explore, observe, synthesize and draw conclusions based on their mathematics understanding;
- use high-level questions and rich tasks to facilitate classroom discourse, both oral and written, to encourage student-student, student-teacher and teacher-student communication;
- incorporate and highlight key mathematical vocabulary during instruction and require students to use this vocabulary appropriately in their communications;
- model and have students use manipulatives, tools and technology to actively explore and build understanding of mathematical concepts;
- structure learning experiences that utilize a variety of grouping strategies to encourage collaborative problem solving; and
- differentiate instruction to meet the needs of a variety of learners based on student readiness, interest, and learning style and provide supplemental mathematics intervention or enrichment as needed.

Note: The instructional strategies recommended in our resource document are specific examples of these expectations in practice. They serve as a starting point for planning and implementing instruction that will develop our students as thinkers. Teachers may create new instructional strategies and activities as they continue to grow professionally and as they develop an understanding of each student's unique strengths, weaknesses, and interests.

PHILOSOPHY OF ASSESSMENT

Based on our department philosophy and goals, math teachers will:

- align assessments with instruction;
- use a variety of formative and summative assessment throughout each unit of instruction;
- design and use assessments that include questions at varied levels of cognitive demand;
- analyze results and plan or modify instruction based on the results;
- provide specific, constructive feedback for students; and
- collaborate with colleagues and use scoring rubrics to evaluate student work as appropriate.

Unit 1 – Relationships between Quantities and Reasoning with Equations

Unit Overview: By the end of eighth grade students have learned to solve linear equations in one variable and have applied graphical and algebraic methods to analyze and solve systems of linear equations in two variables. This unit builds on these earlier experiences by asking students to analyze and explain the process of solving an equation. Students develop fluency writing, interpreting, and translating between various forms of linear equations and inequalities, and using them to solve problems. They master the solution of linear equations and apply related solution techniques and the laws of exponents to the creation and solution of simple exponential equations. All of this work is grounded on understanding quantities and on relationships between them.

Major Topics:
Dimensional analysis
Writing expressions, equations and inequalities in one variable
Writing linear equations and inequalities
Solving equations

Unit 1: 20 classes

Common Core State Standards in Connecticut

Reason quantitatively and use units to solve problems.

N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.
N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Interpret the structure of expressions.

A.SSE.1 Interpret expressions that represent a quantity in terms of itscontext.*
- a. Interpret parts of an expression, such as terms, factors, and coefficients.
- b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P (1+r)n as the product of P and a factor not depending on P.*

Create equations that describe numbers or relationships.

A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*
A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Understand solving equations as a process of reasoning and explain the reasoning.

Unit 1 – Relationships between Quantities and Reasoning with Equations

A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Solve equations and inequalities in one variable.

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Units
  ○ Solutions of multi-step problems
  ○ Formulas
  ○ Scale
  ○ Origin in graphs
  ○ Data displays
• Quantities
  ○ Descriptive modeling
• Level of Accuracy.
  ○ Limitations on measurement
• Expressions that represent a quantity
  ○ Terms
  ○ Factors
  ○ Coefficients
• Equations and Inequalities in one variable
  ○ Linear
  ○ Exponential
• Equations in two or more variables.
  ○ Coordinate axes
  ○ Labels
  ○ Scales
• Constraints by equations or inequalities.
• Constraints by systems of equations and inequalities.
  ○ Solutions as viable and non-viable options.
• Formulas to highlight a quantity of interest.
• Step in solving simple equation
  ○ The equality of numbers
  ○ Viable arguments
  ○ Solution method
• Linear equations and inequalities in one variable
  ○ Coefficients represented by letters
	• USE units
	• UNDERSTAND problems
	• GUIDE solutions
	• CHOOSE / INTERPRET units
	• DEFINE quantities
	• CHOOSE level of accuracy
	• INTERPRET expressions
	• CREATE equations and inequalities
	• SOLVE problems
	• GRAPH equations
	• REPRESENT constraints
	• REARRANGE formulas
	• EXPLAIN steps
	• CONSTRUCT viable arguments
	• JUSTIFY
	• SOLVE

Unit 1 – Relationships between Quantities and Reasoning with Equations

Big Ideas
Student's statements of enduring ideas

1. To understand the context of problem it is important to know the units involved and the unit or measurement of the solution. Coming up with a reasonable solution involves making an initial prediction, identifying whether the solutions needs to be an estimate, approximation or an exact answer and looking back to examine the reasonableness of the answer in the context of the problem.
2. Real world scenarios can be represented using equations, graphs, tables, and verbal statements.
3. We can justify our solutions by stating the inverse operations and properties of algebra used to transform equivalent equations and inequalities.

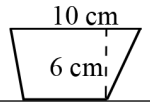
Essential Questions
Teacher's guiding questions

1. What helps us to understand the context of a problem and come up with a reasonable solution?
2. How can real world scenarios involving a relationship between two or more quantities be modeled?
3. How can you justify your steps to solve or transform an equation or an inequality?

Critical Area 1; Math Practices 3,5,6, 7

CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Reason quantitatively and use units to solve problems. N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. N.Q.2 Define appropriate quantities for the purpose of descriptive modeling. N.Q.3 Choose a level of	a. Apply the order of operations.	Pre-requisite knowledge Include identifying units in real world situations and in formula calculations. Example: • An archaeologist discovered a lower leg bone believed to be from tyrannosaurus. She estimated the height of the dinosaur by using the formula, $h = 2.97x + 73.57$ where *h* represents the height of the dinosaur in centimeters, and *x* represents the length of the bone in centimeters. If the length of the bone is 1.63 meters, what was the height of the dinosaur?	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)
	b. Make decisions about quantities and precision and evaluate the reasonableness of solutions. (N.Q.2 – 3)	Students need to develop sound mathematical reasoning skills and forms of argument to make reasonable judgments about their solutions. They should be able to decide whether a problem calls for an estimate, for an approximation, or for an exact answer. To accomplish this goal, teachers should provide students with a broad range of contextual problems	

accuracy appropriate to limitations on measurement when reporting quantities.		that offer opportunities for performing operations with quantities involving units. These problems should be connected to science, engineering, economics, finance, medicine, etc. Examples: • What type of measurements would one use to determine their income and expenses for one month? • What a good measure for high way safety? Propose and debate various measures. • What is a reasonable answer for cost of gas when the cost of gas is $\frac{\$3.479}{gallon}$? Why?	
	c. Interpret and use units to solve multi-step problems. (N.Q.1)	Include word problems where quantities are given in different units, which must be converted to make sense of the problem. For example, a problem might have an object moving 12 feet per second and another at 5 miles per hour. To compare speeds, students convert 12 feet per second to miles per hour: $24000\ \text{sec} \bullet \frac{1\text{min}}{60\,\text{sec}} \bullet \frac{1\text{hr}}{60\,\text{min}} \bullet \frac{1\text{day}}{24\text{hr}}$ which is more than 8 miles per hour. Additional Resources: Leaky Faucet - http://map.mathshell.org/materials/tasks.php?taskid=267&subpage=apprentice Front Load Washing Machine Fastest Runner Exchange Rate	Problem: A fuel oil dealer buys 20,000 gallons of heating oil at $2.65 per gallon and another 14,000 gallons at $3.00 per gallon. (The oil is the same grade and quality, but the price varies due to the market.) He has a contract to sell up to 35,000 gallons of oil next month at $3.25 per gallon, but wants to use as much cash as possible immediately for future investments. To raise cash, he can sell some of his oil to another distributor, who will pay $2.75 per gallon now. How much investment money can the dealer raise now by selling oil and still be able to break even after selling the remainder next month?
Interpret the structure of	d. Determine and interpret units and scale in graphs and data displays. (N.Q.1)	Graphical representations and data displays include, but are not limited to line graphs, circle graphs, histograms, multi-line graphs, scatterplots, and multi-bar graphs. Additional Resources: Interpreting Graphs Hang Gliding	Hot Air Balloon

Unit 1 – Relationships between Quantities and Reasoning with Equations			
expressions. A.SSE.1 Interpret expressions that represent a quantity in terms of itscontext.* a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P(1+r)n as the product of P and a factor not depending on P.* **Create equations that describe numbers or relationships.** A.CED.1 Create equations and inequalities in one variable and use them to solve problems. A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. *For example,*	e. Identify and interpret parts of an expression using proper mathematical vocabulary. (A.SSE.1)	Students should understand the vocabulary for the parts that make up the whole expression Using such terms as factors, coefficients, etc. Use a word wall and hold students accountable for academic vocabulary as they speak and when they write.	
	f. Identify the different parts of the expression and explain their meaning within the context of a problem. (A.SSE.1)	Interpret complicated expressions by viewing one or more of their parts separately. For example, interpret $P(1 + r)^n$ as the product of P and a factor used n times.	Cell phone bill
	g. Write equations and inequalities to in one variable and use them in a contextual situation to solve problems. (A.CED.1)	Equations can represent real world and mathematical problems. Include equations and inequalities that arise when comparing the values of two different functions, such as one describing linear growth and one describing exponential growth. Limit situations to linear and exponential (with integer inputs.) Later in the year extend to quadratics. Examples: • Given that the following trapezoid has area 54 cm^2, set up an equation to find the length of the base, and solve the equation. 	Puzzle book functions WS (oven temperature increases by 2 degrees vs. 2% per minute)
	h. Write and graph equations with two or more variables to represent a relationship between the quantities. (A.CED.2)	Provide examples of real-world problems that can be solved by writing an equation, and have students explore the graphs of the equations on a graphing calculator to determine which parts of the graph are relevant to the problem context. Examples: Write an equation for the cost of a photo book from an online store. A standard sized book has a base price of $20 and $1.20 per page. Write and graph an equation to represent the relationship between cost (y) and number of pages (x). The formula for the surface area of a cylinder is given by V =	Solving Linear Equations in Two Variables - http://map.mathshell.org/materials/lessons.php?taskid=209&subpage=concept

<table>
<tr><th colspan="4">Unit 1 – Relationships between Quantities and Reasoning with Equations</th></tr>
<tr><td rowspan="3">represent inequalities describing nutritional and cost constraints on combinations of different foods.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law V = IR to highlight resistance R.

Understand solving equations as a process of reasoning and explain the reasoning.

A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Solve equations and inequalities in one variable.

A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.</td><td></td><td>πr2h, where r represents the radius of the circular cross-section of the cylinder and h represents the height. Choose a fixed value for h and graph V vs. r.

Then pick a fixed value for r and graph V vs. h. Compare the graphs. What is the appropriate domain for r and h? Be sure to label your graphs and use an appropriate scale.</td><td></td></tr>
<tr><td>i. Write and use a system of equations and/or inequalities to represent constraints and solve real world problems. (A.CED.3)</td><td>Provide opportunities to discuss the difference between the mathematical solution versus the contextual solution.

Examples:
A club is selling hats and jackets as a fundraiser. Their budget is $1500 and they want to order at least 250 items. They must buy at least as many hats as they buy jackets. Each hat costs $5 and each jacket costs $8.

• Write a system of inequalities to represent the situation.
• Graph the inequalities.
• If the club buys 150 hats and 100 jackets, will the conditions be satisfied?
• What is the maximum number of jackets they can buy and still meet the conditions?

Represent inequalities describing nutritional and cost constraints o combinations of different foods.</td><td>Plumbing Woes</td></tr>
<tr><td>j. Solve literal equations for a specified variable. (A.CED.4)</td><td>Give students formulas, such as area and volume (or from science or business), and have students solve the equations for each of the different variables in the formula as a starting point for writing literal equations. Limit examples to formulas which are linear in the variable of interest.

Example:
Motion can be described by the formula below, where t = time elapsed, u=initial velocity, a = acceleration, and s = distance traveled

$s = ut+\frac{1}{2}at^2$

○ Why might the equation need to be rewritten in terms of a?
Rewrite the equation in terms of a.</td><td>Creating Equations (Algebra I Stations Activities p. 70-80)</td></tr>
</table>

Unit 1 – Relationships between Quantities and Reasoning with Equations			
		The Pythagorean Theorem expresses the relation between the legs *a* and *b* of a right triangle and its hypotenuse *c* with the equation $a^2 + b^2 = c^2$. o Why might the theorem need to be solved for c? o Solve the equation for *c* and write a problem situation where this form of the equation might be useful.	
	k. Justify the steps to solving equations by identifying the mathematical property used at each step in the solution process. (A.REI.1)	Use vocabulary included, but not limited to, addition property of equality, distributive property, etc. Properties of operations can be used to change expressions on either side of the equation to equivalent expressions. In addition, adding the same term to both sides of an equation or multiplying both sides by a non-zero constant produces an equation with the same solutions. Other operations, such as squaring both sides, may produce equations that have extraneous solutions. Examples Explain why the equation $x/2 + 7/3 = 5$ has the same solutions as the equation $3x + 14 = 30$. Does this mean that $x/2 + 7/3$ is equal to $3x + 14$?	Writing Prompt: Explain why the equation $x/2 + 7/3 = 5$ has the same solutions as the equation $3x + 14 = 30$. Does this mean that $x/2 + 7/3$ is equal to $3x + 14$?
	l. Analyze the structure of equations/inequalities to accurately perform the steps to solve. (A.REI.3)	Include equations with coefficients represented by letters and simple exponential equations that rely on the laws of exponents Examples: • $-\frac{7}{3}y - 8 = 111$ • $3x > 9$ • $ax + 7 = 12$ • $\frac{3+x}{7} = \frac{x-9}{4}$ • $2/3x + 9 < 18$ • $5^x = 125$ • $2^x = ¼$	Unit Assessment

Unit 1 – Relationships between Quantities and Reasoning with Equations
Additional Resources: • http://map.mathshell.org/materials/index.php • http://ccssmath.org/ • www.ccsstoolbox.org • http://insidemathematics.org/ • High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf • http://www.illustrativemathematics.org/standards/hs • http://education.ti.com/calculators/downloads/US/Activities/Search/ • http://learnzillion.com/ • http://www.uen.org/core/math/7-12.shtml • http://illuminations.nctm.org/ • http://www.khanacademy.org/ • http://blog.mrmeyer.com/ • http://www.dlt.ncssm.edu/stem/math-secondary

Unit 2 – Linear and Exponential Relationships

Unit Overview: In earlier grades, students define, evaluate, and compare functions, and use them to model relationships between quantities. In this unit, students will learn function notation and develop the concepts of domain and range. They move beyond viewing functions as processes that take inputs and yield outputs and start viewing functions as objects in their own right. They explore many examples of functions, including sequences; they interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. They work with functions given by graphs and tables, keeping in mind that, depending upon the context, these representations are likely to be approximate and incomplete. Their work includes functions that can be described or approximated by formulas as well as those that cannot. When functions describe relationships between quantities arising from a context, students reason with the units in which those quantities are measured. Students explore systems of equations and inequalities, and they find and interpret their solutions. Students build on and informally extend their understanding of integer exponents to consider exponential functions. They compare and contrast linear and exponential functions, distinguishing between additive and multiplicative change. They interpret arithmetic sequences as linear functions and geometric sequences as exponential functions.

Major Topics:
Exponents and Exponentials
Functions
Systems of Linear Equations and Inequalities
Comparison of Linear and Exponentials

Unit 2: 25 classes

Common Core State Standards in Connecticut

Extend the properties of exponents to rational exponents.

N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5.*
N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Solve systems of equations.

A.REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.
A.REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically.

A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*
A.REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Understand the concept of a function and use function notation.

Unit 2 – Linear and Exponential Relationships

F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y = f(x)*.
F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.*

Interpret functions that arise in applications in terms of a context.

F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.**
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.**
F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

Analyze functions using different representations.

F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
b. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

Build a function that models a relationship between two quantities.

F.BF.1 Write a function that describes a relationship between two quantities.*

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.
b. Combine standard function types using arithmetic operations.

For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

F.BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.*

Build new functions from existing functions.

F.BF.3 Identify the effect on the graph of replacing *f(x)* by *f(x) + k, k f(x), f(kx),* and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*

Unit 2 – Linear and Exponential Relationships

Construct and compare linear, quadratic, and exponential models and solve problems.

F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
- **a**. Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals.
- **b**. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
- **c**. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Interpret expressions for functions in terms of the situation they model.

F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Properties of exponents
  ○ Rational exponents
  ▪ Radical notation
  ○ Integer
  ○ Expressions
  ▪ Radical
  ▪ Rational
• Systems of equations in two variables
  ○ Substitution
  ○ Elimination
  ○ Graph
• Graph of an equation in two variables
  ○ Set of solutions
  ▪ Coordinate plane
  ▪ Line vs Curve
• Solutions
  ○ Equation in two variables
  ▪ X-coordinate of the points
  ▪ Intersection
  ▪ Technology
  • Graph
  • Table of values
  • Approximations
  ○ Linear inequality in two variables
  ▪ Half plane
	• EXPLAIN
	• REWRITE expressions
	• PROVE
	• SOLVE
	• REPLACE equation
	• UNDERSTAND solutions
	• EXPLAIN coordinates of points as solutions
	• FIND
	• GRAPH
	• UNDERSTAND functions
	• USE function notation
	• EVALUATE functions
	• INTERPRET statements
	• RECOGNIZE sequences
	• INTERPRET key features
	• RELATE
	• CALCULATE/ESTIMATE/INTERPRET rate of change
	• GRAPH functions
	• SHOW key features
	• USE technology
	• COMPARE properties of functions
	• WRITE a function
	• DESCRIBE a relationship
	• DETERMINE an explicit expressions

Unit 2 – Linear and Exponential Relationships	
▪ Boundary ▪ Strict inequality ○ System of linear inequalities in two variables ▪ Intersection of corresponding half planes • Function ○ Domain/Input ○ Range/Output ○ Function notation ○ Recursive sequence • Modeling relationships between two quantities ○ Graphs ▪ Intercepts ▪ Increasing/Decreasing ▪ Domain ○ Tables ○ Verbal description ○ Rate of change • Functions representations ○ Algebraically ○ Graphically ○ Numerically ○ Verbally • Relationships between two quantities ○ Explicit ○ Recursive ○ Arithmetic ○ Geometric • Effects of translations on graphs ○ Even ○ Odd ○ Vertical translation ○ Horizontal translation ○ Vertical Stretch ○ Vertical Compressions • Comparison of linear and exponential functions ○ Equal differences vs equal factors ○ Constant rate vs constant percent rate ○ Arithmetic vs geometric ▪ Graph ▪ Table	• COMBINE functions • WRITE arithmetic and geometric sequences • IDENTIFY effects of translations • DISTINGUISH between models • PROVE • RECOGNIZE situations • CONSTRUCT functions • OBSERVE using graphs and tables • INTERPRET parameters

Unit 2 – Linear and Exponential Relationships

Big Ideas
Student's statements of enduring ideas

1. Functions can be used to model real world situations, make predictions, and solve problems by using function notation and analyzing the key features of graphs and tables.
2. Linear functions have a constant rate of change, the degree is one, and the graph is a straight line. Exponential functions have a constant multipier, the variable is the exponent, and the graph is a growth or decay curve.
3. You can find and interpret the solution(s) of a system of equations or inequalities symbolically, algebraically, graphically, numerically, and through verbal statements.

Essential Questions
Teacher's guiding questions

1. How can functions be used to model real world situations, make predictions, and solve problems?
2. How do determine between a linear or exponential function given various representations?
3. How do you find and interpret the solution(s) to a system of equations or inequalities?

Critical Area 1; Math Practices 3,5,6, 7

CCSS Standards	Objectives The students will be able to:	Instructional Strategies Based on our department philosophy for student learning, mathematics teachers will:	Common Learning Experiences and Assessments Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Exponents: **Extend the properties of exponents to rational exponents.** N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define 51/3 to be the cube root of 5 because we*	a. Identify and use the denominator *n* in a rational exponent as the *nth* root. (A.N.RN.1)	Extend work from 8th grade with positive and negative exponents and properties of exponents to connect rational exponents to negative exponents and roots. Students extend the properties of exponents to justify that $(5^{1/2})^2 = 5$ Develop vocabulary by having students explain that the denominator of the rational exponent is the root index and the numerator is the exponent of the radicand. Have students explore a common problem such as bacteria doubling every hour and examine what happens every hour and then in shorter intervals (every 20 minutes, every ½ hour etc.) to make sense of rational exponents. Look at a table, graph and create an equation for the situation.	

<table>
<tr><th colspan="4">Unit 2 – Linear and Exponential Relationships</th></tr>
<tr><td>want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5.
N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Functions:</td><td>b. Simplify expressions with negative and rational exponents using the properties of exponents. (A.N.RN.2)</td><td>Examples:
• $\sqrt[3]{5^2} = 5^{\frac{2}{3}}$; $5^{\frac{2}{3}} = \sqrt[3]{5^2}$
• Rewrite using fractional exponents: $\sqrt[5]{16} = \sqrt[5]{2^4} = 2^{\frac{4}{5}}$
• Rewrite $\frac{\sqrt{x}}{x^3}$ in at least three alternate forms. Solution: $x^{-\frac{3}{2}} = \frac{1}{x^{\frac{3}{2}}} = \frac{1}{\sqrt{x^3}} = \frac{1}{x\sqrt{x}}$
• Rewrite $\sqrt[4]{2^{-4}}$ using only rational exponents.
• Rewrite $\sqrt[3]{x^3+3x^2+3x+1}$ in simplest form.</td><td>Ponzi Pyramid Scheme - http://map.mathshell.org/materials/download.php?fileid=808</td></tr>
<tr><td>Understand the concept of a function and use function notation.

F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x).
F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain</td><td>c. Determine relationships that are or are not functions based on the idea that a function assigns exactly one output (range, f(x)) to each input (domain, x). (F.IF.1)</td><td>Provide applied contexts in which to explore functions. For example, examine the amount of money earned when given the number of hours worked on a job, and contrast this with a situation in which a single fee is paid by the “carload” of people, regardless of whether 1, 2, or more people are in the car.

Use diagrams to help students visualize the idea of a function machine. Students can examine several pairs of input and output values and try to determine a simple rule for the function.

Rewrite sequences of numbers in tabular form, where the input represents the term number (the position or index) in the sequence, and the output represents the number in the sequence.

Help students to understand that the word “domain” implies the set of all possible input values and that the integers are a set of numbers made up of {…-2, -1, 0, 1, 2, …}.

Distinguish between relationships that are not functions and those that are functions (e.g., present a table in which one of the input values results in multiple outputs to contrast with a functional relationship). Examine graphs of functions and non-functions, recognizing that if a vertical line passes through at least two points in the graph, then y (or the quantity on the vertical axis) is not a function of x (or the quantity on the horizontal axis).

Use the definition of a function to determine whether a</td><td>Functions in Everyday Life: http://map.mathshell.org/materials/lessons.php?taskid=426&subpage=concept</td></tr>
</table>

<table>
<tr><th colspan="4">Unit 2 – Linear and Exponential Relationships</th></tr>
<tr><td rowspan="3">is a subset of the integers. For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.

Interpret functions that arise in applications in terms of a context.

F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain</td><td></td><td>relationship is a function given a table, graph or words. Given the function f(x), identify x as an element of the domain, the input, and f(x) is an element in the range, the output. The domain of a function given by an algebraic expression, unless otherwise specified, is the largest possible domain. Know that the graph of the function, f, is the graph of the equation y = f(x).
Students should experience a variety of types of situations modeled by functions. Detailed analysis of any particular class of functions in Algebra 1 is not advised. Draw examples from linear, quadratic and exponential functions.</td><td></td></tr>
<tr><td>d. Write and describe rules using function notation.
(F.IF.2)</td><td>Have students consider various contexts.

Example:

You put a yam in the oven. After 45 minutes, you take it out. Let f be the function that assigns to each minute after you placed the yam in the oven, its temperature in degrees Fahrenheit.

a. Write a sentence explaining what $f(0)=65$ means in everyday language
b. Write a sentence explaining what $f(5)<f(10)$ means in everyday language.
c. Write a sentence explaining what $f(40)=f(45)$ means in everyday language
d. Write a sentence explaining what $f(45)>f(60)$ means in everyday language.</td><td></td></tr>
<tr><td>e. Evaluate functions.
(F.IF.2)</td><td></td><td></td></tr>
</table>

Unit 2 – Linear and Exponential Relationships			
*for the function.** **Linear and Exponential Functions:** F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.* **Analyze functions using different representations.** F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* a. Graph linear and quadratic functions and show intercepts, maxima, and minima. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of*	f. Describe the domain of a linear or exponential function and the restrictions based on the graph and the real world context. (F.IF.5)	Use this as a lead in to a more specific exploration of both linear and exponential functions. Have students explain the relationship between the domain of a function, the graph and the context. For the journal, have students select a problem from a number of situations. Examples: A hotel has 10 stories above ground and 2 levels in its parking garage below ground. What is an appropriate domain for a function. $T(n)$ that gives the average number of times an elevator in the hotel stops at the nth floor each day? Oakland Coliseum, home of the Oakland Raiders, is capable of seating 63,026 fans. For each game, the amount of money that the Raiders' organization brings in as revenue is a function of the number of people, n, in attendance. If each ticket costs $30, find the domain and range of this function.	Journal: Describe the practical domain and range of a function as it relates to __.
	g. Graph linear and exponential functions expressed symbolically and show key features of the graph. (F.IF.7) (A.REI.10)	Simple cases by hand, more complicated cases using technology. This objective focuses on the connections between the equations and their graphs. What part of the equation shows the y-intercept? Etc. Stress the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. Given a graph, does the equation match?	Taxi - http://www.illustrativemathematics.org/illustrations/243
	h. Compare multiple representations of functions and the characteristics of functions. (F.IF.4, F.IF.9, F.LE.3)	Focus on linear and exponential functions. Give students graphs to interpret or produce graphs from expressions or tables for the function either by hand or using technology. Key features include intercepts; intervals where the function is increasing, decreasing, positive, or negative; and end behavior. This objective focuses on the graph and tables, not just equations. Examples: Compare the graphs of $y = 3x^2$ and $y = 3x^3$.	Warming and Cooling - http://www.illustrativemathematics.org/illustrations/639

Unit 2 – Linear and Exponential Relationships			
one quadratic function and an algebraic expression for another, say which has the larger maximum. **Build a function that models a relationship between two quantities.** F.BF.1 Write a function that describes a relationship between two quantities.* a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* F.BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.* **Build new functions from existing functions.** F.BF.3 Identify the effect		It started raining lightly at 5am, then the rainfall became heavier at 7am. By 10am the storm was over, with a total rainfall of 3 inches. It didn't rain for the rest of the day. Sketch a possible graph for the number of inches of rain as a function of time, from midnight to midday.	
	i. Calculate the average rate of change from multiple representations and understand that the rate of change can be positive, negative, or zero. (F.IF.6)	Given a table of values, such as the height of a plant over time, students can estimate the rate of plant growth. Also, if the relationship between time and height is expressed as a linear equation, students should explain the meaning of the slope of the line. Finally, if the relationship is illustrated as a linear or non-linear graph, the student should select points on the graph and use them to estimate the growth rate over a given interval. Begin with simple, linear functions to describe features and representations, and then move to more advanced functions, including non-linear situations. Make explicit connections to finding the slope for linear situations. Have students collect and examine their own data. Have student make comparisons between average rate of change for linear functions vs. exponential functions for two different intervals.	Comparing Investments - http://map.mathshell.org/materials/lessons.php?taskid=426&subpage=concept
	j. Identify the effects of the transformation of a graph and its equation. (F.BF.3)	Focus on vertical translations of graphs of linear and exponential functions - relate the translation to the y-intercept.	
	k. Recognize a linear relationship versus an exponential and write an appropriate algebraic model. (F.LE.1,2)		

<table>
<tr><th colspan="4">Unit 2 – Linear and Exponential Relationships</th></tr>
<tr><td rowspan="2">on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Construct and compare linear, quadratic, and exponential models and solve problems.

F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.
    a. Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals.
    b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
    c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
F.LE.2 Construct linear</td><td>l. Interpret the parameters in a linear or exponential function in terms of a context. (F.LE.5)</td><td>Use real-world contexts to help students understand how the parameters of linear and exponential functions depend on the context. For example, a plumber who charges $50 for a house call and $85 per hour would be expressed as the function y = 85x + 50, and if the rate were raised to $90 per hour, the function would become y = 90x + 50. On the other hand, an equation of y = 8,000(1.04)x could model the rising population of a city with 8,000 residents when the annual growth rate is 4%. Students can examine what would happen to the population over 25 years if the rate were 6% instead of 4% or the effect on the equation and function of the city's population were 12,000 instead of 8,000.
Graphs and tables can be used to examine the behaviors of functions as parameters are changed, including the comparison of two functions such as what would happen to a population if it grew by 500 people per year, versus rising an average of 8% per year over the course of 10 years.
Provide students with opportunities to research raw data on the Internet (such as increases in gasoline consumption
Students may use graphing calculators or programs, spreadsheets, or computer algebra systems to model and interpret parameters in linear, quadratic or exponential functions.
Examples:

The total cost for a plumber who charges $50 for a house call and $85 per hour would be expressed as the function y = 85x + 50. If the rate were raised to $90 per hour, how would the function change?

The equation y = 8,000(1.04)^x models the rising population of a city with 8,000 residents when the annual growth rate is 4%. What would be the effect on the equation if the city's population were 12,000 instead of 8,000? What would happen to the population over 25 years if the growth rate were 6% instead of 4%?</td><td>Population of Lynchville</td></tr>
<tr><td>m. Write and interpret explicit and recursive formulas or functions for arithmetic and geometric sequences and situations. (F.IF.3 & F.BF.1-2 & F.LE.2)</td><td>Emphasize arithmetic and geometric sequences as examples of linear and exponential functions.
Students should be able to explain that a recursive formula tells how a sequence starts and how to use the previous value(s) to generate the next element of the sequence.
Students should be able to explain that an explicit formula allows them to find any element of a sequence without knowing the element before it (e.g., If I want to know the</td><td></td></tr>
</table>

<table>
<tr><th colspan="4">Unit 2 – Linear and Exponential Relationships</th></tr>
<tr><td>and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Interpret expressions for functions in terms of the situation they model.

F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.</td><td></td><td>11th number on the list, I substitute the number 11 into the explicit formula). Students need to be able to distinguish between explicit and recursive formulas for sequences. Hands-on materials (e.g., paper folding, building progressively larger shapes using pattern blocks, etc.) can be used as a visual source to build numerical tables for examination.

Additional Resources:
Skeleton Tower MAP Task - http://map.mathshell.org/materials/tasks.php?taskid=279&subpage=expert
Patchwork - http://map.mathshell.org/materials/download.php?fileid=754

For situations, provide a real-world example (e.g., a table showing how far a car has driven after a given number of minutes, traveling at a uniform speed), and examine the table by looking “down” the table to describe a recursive relationship, as well as “across” the table to determine an explicit formula to find the distance traveled if the number of minutes is known.

Examples:
A cup of coffee is initially at a temperature of 93º F. The difference between its temperature and the room temperature of 68º F decreases by 9% each minute.

Given $a1$ = 4 and an = an−1 + 3, write the explicit formula.</td><td></td></tr>
<tr><td></td><td>n. Combine linear and exponential functions using arithmetic operations.
I. (F.BF.1)</td><td>Provide examples of when functions can be combined, such as determining a function describing the monthly cost for owning two vehicles when a function for the cost of each (given the number of miles driven) is known. Cost, profit and income are also good contexts for this.</td><td>Linear and Exponential Assessment</td></tr>
<tr><td>Solve systems of equations.

A.REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum</td><td>o. Write a system of equations to represent a problem in context. (F.LE.1)</td><td>Example:
A restaurant serves a vegetarian and a chicken lunch special each day. Each vegetarian special is the same price. Each chicken special is the same price. However, the price of the vegetarian special is different from the price of the chicken special. On Thursday, the restaurant collected $467 selling 21 vegetarian specials and 40 chicken specials. On Friday,</td><td></td></tr>
</table>

Unit 2 – Linear and Exponential Relationships			
of that equation and a multiple of the other produces a system with the same solutions. A.REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. **Represent and solve equations and inequalities graphically**. A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations *y = f(x)* and y = g(x) intersect are the solutions of the equation f(x) = g(x); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f(x)* and/or *g(x)* are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.* A.REI.12 Graph the solutions to a linear		the restaurant collected $484 selling 28 vegetarian specials and 36 chicken specials. Write and solve a system of equations for this situation. What is the cost of each lunch special?	
	p. Identify systems of linear equations as having one, zero, or infinite solutions. (A.REI.5, A.REI.11)	Students can discover these cases as they graph systems of linear equations and solve them algebraically. Relate this to the point of intersection, an overlap of the graphs (and same equation) or parallel lines .	
	q. Solve systems of linear equations by graphing, substitution, and by elimination. (A.REI.5 A.REI.6)	The focus of this standard is to provide mathematics justification for the addition (elimination) and substitution methods of solving systems of equations that transform a given system of two equations into a simpler equivalent system that has the same solutions as the original. Build on student experiences in graphing and solving systems of linear equations from middle school to focus on justification of the methods used. Include cases where the two equations describe the same line (yielding infinitely many solutions) and cases where two equations describe parallel lines (yielding no solution); connect to GPE.5 when it is taught in Geometry, which requires students to prove the slope criteria for parallel lines. Make connections to the idea of replacing an equation with a multiple of that equation (infinite solutions), yields the same system and thus giving us the rationale to be able to use this technique.	
	r. Solve systems of equations involving both linear and exponential equations. (A.REI.11)		

Unit 2 – Linear and Exponential Relationships			
inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes	s. Graph an inequality in two variables. (A.REI.12)		
	t. Interpret the solutions of inequalities mathematically and contextually. (A.REI.12)	Investigate real-world examples of two-dimensional inequalities. For example, students might explore what the graph would look like for money earned when a person earns *at least* \$6 per hour. (The graph for a person earning *exactly* \$6/hour would be a linear function, while the graph for a person earning at least \$6/hour would be a half-plane including the line and all points above it.)	Fishing Adventure - http://www.illustrativemathematics.org/illustrations/644
	u. Graph a system of linear inequalities and recognize the solution set as the intersection of two half planes, (A.REI.12)	Students may use graphing calculators, programs or applets to model and find solutions for inequalities or systems of inequalities. **Examples:** Graph the solution: $y < 2x + 3$. A publishing company publishes a total of no more than 100 magazines every year. At least 30 of these are women's magazines, but the company always publishes at least as many women's magazines as men's magazines. Find a system of inequalities that describes the possible number of men's and women's magazines that the company can produce each year consistent with these policies. Graph the solution set.	Systems Performance Task Midterm Exam

Additional Resources:

- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/

Unit 2 – Linear and Exponential Relationships
• http://www.uen.org/core/math/7-12.shtml • http://illuminations.nctm.org/ • http://www.khanacademy.org/ • http://blog.mrmeyer.com/ • http://www.dlt.ncssm.edu/stem/math-secondary

Unit 3 – Descriptive Statistics

Unit 3 Overview: Experience with descriptive statistics began as early as Grade 6. Students were expected to display numerical data and summarize it using measures of center and variability. By the end of middle school they were creating scatter- plots and recognizing linear trends in data. This unit builds upon that prior experience, providing students with more formal means of assessing how a model fits data. Students use regression techniques to describe approximately linear relationships between quantities. They use graphical representations and knowledge of the context to make judgments about the appropriateness of linear models. With linear models, they look at residuals to analyze the goodness of fit.

Major Topics:
Single variable data displays
Measures of center and spread
Two variable data displays
Regression models
Correlation and causation

Unit 3: 12 Classes

Common Core State Standards in Connecticut

Summarize, represent, and interpret data on a single count or measurement variable.

S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).
S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.

a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Uses given functions or choose a function suggested by the context. Emphasize linear and exponential models.*
b. Informally assess the fit of a function by plotting and analyzing residuals.
c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models.

S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.
S.ID.9 Distinguish between correlation and causation.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:
• Plots on the real number line ○ Dot plots	• REPRESENT data • COMPARE statistics

Unit 3 – Descriptive Statistics

○ Histograms ○ Box plots • Statistic ○ Center ▪ Median ▪ Mean ○ Spread ▪ Interquartile range ▪ Standard deviation ○ Outliers	• INTERPRET differences
• Data displays ○ Relative frequency table ▪ Joint frequency ▪ Marginal frequency ▪ Conditional relative frequency ○ Associations and trends in the data ○ Scatter-plot ▪ Residuals ▪ Linear association • Linear Models ○ Slope (rate of change) ○ Constant term ○ Correlation coefficient ○ Causation	• SUMMARIZE categorical data • INTERPRET relative frequencies • RECOGNIZE associations and trends • REPRESENT data • DESCRIBE relationships • FIT a function to data • USE functions • SOLVE problems • ASSESS the fit • INTERPRET linear models • COMPUTE/INTERPRET correlation coefficient • DISTINGUISH correlation vs. causation

Big Ideas
Student's statements of enduring ideas

1. One variable data is described using measures of center (mean and median), spread (interquartile range and standard deviation), and can be displayed using a histogram, dot plot, or box plot. Two variable data is described using the correlation coefficient or joint, marginal, and conditional relative frequencies and can be displayed using a two-way table or a scatter-plot.
2. The correlation coefficient measures the direction and strength of how well the linear model fits the data.
3. Two variables can have a strong correlation. However, correlation does not necessarily imply causation.

Essential Questions
Teacher's guiding questions

1. What are the differences between analyzing and displaying one-variable data versus two-variable data?
2. How does the correlation coefficient explain the relationship between two variables?
3. What is the relationship between correlation and causation?

Critical Area 1; Math Practices 3,5,6,7

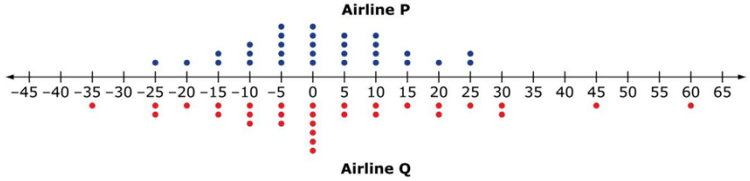
Unit 3 – Descriptive Statistics			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Summarize, represent, and interpret data on a single count or measurement variable. S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots). S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	a. Represent and analyze numerical data using dot plots, histograms or box plots. (S.ID.1)	A statistical process is a problem-solving process consisting of four steps: 1. formulating a statistical question that anticipates variability and can be answered by data 2. designing and implementing a plan that collects appropriate data. 3. analyzing the data by graphical and/or numerical methods. 4. interpreting the analysis in the context of the original question. Use technology to support this work. While this is about numerical data, discuss other plots of categorical data.	Representing Data 1: Using Frequency Graphs - http://map.mathshell.org/materials/lessons.php?taskid=404&subpage=concept
	b. Analyze strengths and weaknesses of each type of plot using different plots of the same data. (S.ID.1)	Example: On the midterm math exam, students had the following scores: 95, 45, 37, 82, 90, 100, 91, 78, 67, 84, 85, 85, 82, 91, 93, 92, 76, 84, 100, 59, 92, 77, 68, and 88. What are the strengths and weaknesses of presenting this data in a certain type of plot for: o Students in a class? o Parents? o The school board?	

<table>
<tr><th colspan="4">Unit 3 – Descriptive Statistics</th></tr>
<tr><td rowspan="3">Summarize, represent, and interpret data on two categorical and quantitative variables.

S.ID.5 Summarize categorical data for two</td><td>c. Compare center and spread of two or more different data sets.
(S.ID.2)</td><td>Guide students to use appropriate statistics based on the data center – median, mean
spread – interquartile range, standard deviation
shape – skewed left or right, bell, uniform, symmetric

Measures of center and spread for data sets without outliers are the mean and standard deviation, whereas median and interquartile ranges are better measures for data sets with outliers.

Introduce the formula of standard deviation by reviewing the previously learned MAD (mean absolute deviation). The MAD is very intuitive and gives a solid foundation for developing the more complicated standard deviation measure.</td><td>Representing Data 2: Using Boxplots - http://map.mathshell.org/materials/lessons.php?taskid=404&subpage=concept</td></tr>
<tr><td>d. Determine the effect of extreme data points or outliers on the center, spread and the shape of a data set and use this to determine whether to keep or remove them.
(S.ID.3)</td><td>Students may use spreadsheets, graphing calculators and statistical software to statistically identify outliers and analyze data sets with and without outliers as appropriate.

Example:
The dot plots below compare the number of minutes 30 flights made by two airlines arrived before or after their scheduled arrival times.
 

o Negative numbers represent the minutes the flight arrived before its scheduled time.
o Positive numbers represent the minutes the flight arrived after its scheduled time.
o Zero indicates the flight arrived at its scheduled time.

Based on these data, from which airline will you choose to buy your ticket? Use the ideas of center and spread to justify your choice.</td><td></td></tr>
<tr><td>e. Distinguish between numerical data and categorical data and appropriate displays for each.
(S.ID.5)</td><td></td><td></td></tr>
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<tr>
<td rowspan="2">categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.
a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Uses given functions or choose a function suggested by the context. Emphasize linear and exponential models.
b. Informally assess the fit of a function by plotting and analyzing residuals.
c. Fit a linear function for a scatter plot that suggests a linear association.

Interpret linear models.

S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
S.ID.8 Compute (using</td>
<td>f. Create and analyze two-way frequency tables from two categorical variables.
(S.ID.5)</td>
<td>In the categorical case, begin with two categories for each variable and represent them in a two-way table with the two values of one variable defining the rows and the two values of the other variable defining the columns. (Extending the number of rows and columns is easily done once students become comfortable with the 2x2 case.) The table entries are the joint frequencies of how many subjects displayed the respective cross-classified values. Row totals and column totals constitute the marginal frequencies.
Example:
A two-way frequency table is shown below displaying the relationship between age and baldness. We took a sample of 100 male subjects, and determined who is or is not bald. We also recorded the age of the male subjects by categories.

<table>
<tr><th colspan="4">Two-Way Frequency Table</th></tr>
<tr><td>Bald</td><td colspan="2">Age</td><td>Total</td></tr>
<tr><td></td><td>Younger than 45</td><td>45 or older</td><td></td></tr>
<tr><td>No</td><td>35</td><td>11</td><td>46</td></tr>
<tr><td>Yes</td><td>24</td><td>30</td><td>54</td></tr>
<tr><td>Total</td><td>59</td><td>41</td><td>100</td></tr>
</table>

The total row and total column entries in the table above report the marginal frequencies, while entries in the body of the table are the joint frequencies.</td>
<td></td>
</tr>
<tr>
<td>g. Calculate joint, marginal, and conditional relative frequencies.
(S.ID.5)</td>
<td>Dividing joint or marginal frequencies by the total number of subjects define relative frequencies (and percentages), respectively. Conditional relative frequencies are determined by focusing on a specific row or column of the table. They are particularly useful in determining any associations between the two variables.

Example:

<table>
<tr><th colspan="4">Two-Way Relative Frequency Table</th></tr>
<tr><td>Bald</td><td colspan="2">Age</td><td>Total</td></tr>
<tr><td></td><td>Younger than 45</td><td>45 or older</td><td></td></tr>
<tr><td>No</td><td>0.35</td><td>0.11</td><td>0.46</td></tr>
<tr><td>Yes</td><td>0.24</td><td>0.30</td><td>0.54</td></tr>
<tr><td>Total</td><td>0.59</td><td>0.41</td><td>1.00</td></tr>
</table>
</td>
<td></td>
</tr>
</table>

Unit 3 – Descriptive Statistics			
technology) and interpret the correlation coefficient of a linear fit. S.ID.9 Distinguish between correlation and causation.	h. Create scatterplots from two quantitative variables and identify them as independent or dependent. (S.ID.6)	In this cluster, the key is that two quantitative variables are being measured on the same subject. The paired data should be listed and then displayed in a scatterplot. If time is one of the variables, it usually goes on the horizontal axis. That which is being predicted goes on the vertical; the predictor variable is on the horizontal axis. See (S.ID.7) for more information.	
	i. Describe the relationship between two variables in terms of form, strength and direction. (S.ID.6)		
	j. Recognize linear and exponential situations and fit an appropriate model to the data. (S.ID.6)	Students may use spreadsheets or graphing calculators to create representations of data sets and create models.	
	k. Create and analyze a residual plot to determine fit. (S.ID.6)	The residual in a regression model is the difference between the observed and the predicted y for some x (y the dependent variable and x the independent variable). So, if we have a model $y = ax + b$, and a data point (, yi) the residual for this point is: $ri = yi - (axi + b)$. Students may use spreadsheets, graphing calculators, and statistical software to represent data, describe how the variables are related, fit functions to data, perform regressions, and calculate residuals. Example: Measure the wrist and neck size of each person in your class and make a scatter plot. Find the least squares regression line. Calculate and interpret the correlation coefficient for this linear regression model. Graph the residuals and evaluate the fit of the linear equations.	
	l. Determine an equation for the line of best fit for a set of data points. (S.ID.6)	Students may use spreadsheets or graphing calculators to create representations of data sets and create linear models.	
	m. Interpret the slope and the intercept of a linear model in the context of the data. (S.ID.7)	Note that unlike a two-dimensional graph in mathematics, the scales of a scatterplot need not be the same, and even if they are similar (such as SAT Math and SAT Verbal), they still need not have the same spacing. So, visual rendering of slope makes no sense in most scatterplots, i.e., a 45 degree line on a scatterplot need not mean a slope of 1. Often the interpretation of the intercept (constant term) is not meaningful in the context of the data. For example, this is the case when the zero point on the horizontal is of considerable	

Unit 3 – Descriptive Statistics			
		distance from the values of the horizontal variable, or in some case has no meaning such as for SAT variables. Noting that a correlated relationship between two quantitative variables is not causal (unless the variables are in an experiment) is a very important topic and a substantial amount of time should be spent on it. Example: Collect power bills and graph the cost of electricity compared to the number of kilowatt hours used. Find a function that models the data and tell what the intercept and slope mean in the context of the problem.	
	n. Compute and interpret the correlation coefficient of a linear fit. (S.ID.8)	Developing a measure of relationship between two quantitative variables was introduced in middle school. The focus here is on the development of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9. Explain that the correlation coefficient must be between □1 and 1 inclusive and explain what each of these values means. Have students determine whether the correlation coefficient shows a weak positive, strong positive, weak negative strong negative, or no correlation.	Devising a Measure for Correlation - http://map.mathshell.org/materials/lessons.php?taskid=420&subpage=problem
	o. Distinguish between correlation and causation. (S.ID.9)	Discuss data that has correlation but no causation (height vs. foot length). Discuss data that has correlation and causation (number of M&Ms in a cup vs. weight of the cup). Find and share examples of data leads observers to believe that there is a cause and effect relationship when a strong relationship is observed. Let students discuss. Students should be careful not to assume that correlation implies causation. Discuss how the determination that one thing causes another requires a controlled randomized experiment. **Example:** Diane did a study for a health class about the effects of a student's end-of-year math test scores on height. Based on a graph of her data, she found that there was a direct relationship between students' math scores and height. She concluded that "doing well on your end-of-course math tests makes you tall." Is this conclusion justified? Explain any flaws in Diane's reasoning.	Coffee and Crime - http://www.illustrativemathematics.org/illustrations/1307

Unit 3 – Descriptive Statistics

Additional Resources:

- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

Unit 4 – Expressions and Equations

Unit 4 Overview: In this unit, students build on their knowledge from unit 2, where they extended the laws of exponents to rational exponents. Students apply this new understanding of number and strengthen their ability to see structure in and create quadratic and exponential expressions. They create and solve equations, inequalities, and systems of equations involving quadratic expressions.

Major Topics:
Operations with polynomials
Quadratic expressions and equations
Exponential expressions and equations
Systems of Equations

Unit 4: 18 Classes

Common Core State Standards in Connecticut

Interpret the structure of expressions.
A.SSE.1 Interpret expressions that represent a quantity in terms of its context.*

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.*

A.SSE.2 Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*

Write expressions in equivalent forms to solve problems.
A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*

a. Factor a quadratic expression to reveal the zeros of the function it defines.

b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.

c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*

Perform arithmetic operations on polynomials.
A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials

Create equations that describe numbers or relationships.
A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.
A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.*

Solve equations and inequalities in one variable.
A.REI.4 Solve quadratic equations in one variable.

a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as

appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Solve systems of equations.
A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.*

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:
• INTERPRET expressions • REWRITE expressions • PRODUCE equivalent form • EXPLAIN properties • FACTOR quadratic expressions • COMPLETE the square • TRANSFORM expressions • PERFORM operations on polynomials ▪ CREATE equations and inequalities ▪ SOLVE problems ▪ REPRESENT relationships between quantities ▪ GRAPH equations ▪ REARRANGE Formulas ▪ SOLVE quadratic equations ▪ DERIVE the quadratic formula ▪ TRANSFORM quadratic equations ▪ SOLVE non-linear systems	• INTERPRET expressions • REWRITE expressions • PRODUCE equivalent form • EXPLAIN properties • FACTOR quadratic expressions • COMPLETE the square • TRANSFORM expressions • PERFORM operations on polynomials ▪ CREATE equations and inequalities ▪ SOLVE problems ▪ REPRESENT relationships between quantities ▪ GRAPH equations ▪ REARRANGE Formulas ▪ SOLVE quadratic equations ▪ DERIVE the quadratic formula ▪ TRANSFORM quadratic equations ▪ SOLVE non-linear systems

Big Ideas
Student's statements of enduring ideas

1. You can solve a quadratic equation by using square roots, factoring, completing the square, using the quadratic formula, and graphing.
2. You can find and interpret the solution(s) of a system of non-linear equations algebraically, graphically, and numerically.

Essential Questions
Teacher's guiding questions

1. How can you solve a quadratic equation?
2. How do you find and interpret the solution(s) to a non-linear system of equations?

Unit 4 – Expressions and Equations			
Critical Area 1; Math Practices 3,5,6, 7			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Interpret the structure of expressions. A.SSE.1 Interpret expressions that represent a quantity in terms of its context.* **a.** Interpret parts of an expression, such as terms, factors, and coefficients. **b.** Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P(1+r)n as the product of P and a factor not depending on P.* A.SSE.2 Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 – y^2)(x^2 + y^2)$.* **Write expressions in equivalent forms to solve problems**. A.SSE.3 Choose and	a. Identify and interpret parts of an expression using proper mathematical vocabulary. (A.SSE.1)	Revisited from Unit 1. Development and proper use of mathematical language is an important building block for future content. Using real-world context examples, the nature of algebraic expressions can be explored**.**	
	b. Identify the different parts of the expression and explain their meaning within the context of a problem. (A.SSE.1)	Example: $P(1+r)^n$ is the product of P and a factor not depending on P.	
	c. Add, subtract, and multiply polynomials. (A.APR.1)	Limit to linear and quadratic polynomials. Have students discuss the result of these operations with polynomials to come to the conclusion that the result is also a polynomial.	
	d. Create an equivalent form of an expression using the properties of mathematics and the properties of exponents. (A.SSE.2)	See $4x^2 – 9y^2$ as $(2x)^2 – (3y)^2$ (difference of squares) Limit to linear, quadratic and exponential expressions Have students create their own expressions that meet specific criteria (e.g., number of terms factorable, difference of two squares, etc.) and verbalize how they can be written and rewritten in different forms. Additionally, pair/group students to share their expressions and rewrite one another's expressions. Hands-on materials, such as algebra tiles, can be used to establish a visual understanding of algebraic expressions and the meaning of terms, factors and coefficients. Technology may be useful to help a student recognize that two different expressions represent the same relationship.	

<table>
<tr><th colspan="4">Unit 4 – Expressions and Equations</th></tr>
<tr><td rowspan="5">produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.*
a. Factor a quadratic expression to reveal the zeros of the function it defines.
b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.
c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression 1.15t can be rewritten as (1.151/12)12t ≈ 1.01212t to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.*
Perform arithmetic operations on polynomials.

A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials</td><td></td><td>For example, since $(x – y)(x + y)$ can be rewritten as $x^2 – y^2$, they can put both expressions into a graphing calculator (or spreadsheet) and have it generate two tables (or two columns of one table), displaying the same output values for each expression.</td><td></td></tr>
<tr><td>e. Factor a quadratic expression to reveal the zeros of the function.
(A.SSE.3)</td><td>Recognize that perfect square quadratics produce graphs which are tangent to the x-axis at the vertex.</td><td>Example Quadratic Problem</td></tr>
<tr><td>f. Apply the Zero Product Property to solve quadratic equations.
(A.SSE.3)</td><td></td><td></td></tr>
<tr><td>g. Identify the connection between the factors, zeros and x-intercepts of a graph or function.
(A.SSE.3)</td><td>Examples:
Given a quadratic function explain the meaning of the zeros of the function. That is if $f(x) = (x – c)(x – a)$ then $f(a) = 0$ and $f(c) = 0$.

Given a quadratic expression, explain the meaning of the zeros graphically. That is for an expression;
$(x – a)(x – c)$, a and c correspond to the x-intercepts (if a and c are real).</td><td></td></tr>
<tr><td>h. Complete the square of a quadratic expression to reveal the vertex form and find the maximum and minimum value.
(A.SSE.3)</td><td>Factoring methods that are typically introduced in elementary algebra and the method of completing the square reveals attributes of the graphs of quadratic functions, represented by quadratic equations.
The solutions of quadratic equations solved by factoring are the x – intercepts of the parabola or zeros of quadratic functions.
A pair of coordinates (h, k) from the general form $f(x) = a(x – h)^2 + k$ represents the vertex of the parabola, where h represents a horizontal shift and k represents a vertical shift of the parabola $y = x^2$ from its original position at the origin.
A vertex (h, k) is the minimum point of the graph of the quadratic function if $a > 0$ and is the maximum point of the graph of the quadratic function if $a < 0$. Understanding an algorithm of completing the square provides a solid foundation for deriving a quadratic formula.</td><td>Seeing Dots - http://www.illustrativemathematics.org/illustrations/21</td></tr>
</table>

Unit 4 – Expressions and Equations			
Solve equations and inequalities in one variable. A.REI.4 Solve quadratic equations in one variable. **a.** Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. **b**. Solve quadratic equations by inspection (e.g., for $x2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers *a* and *b*. **Create equations that describe numbers or relationships.** A.CED.1 Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*. A.CED.2 Create equations in two or more variables to	i. Compare and contrast the different forms of a quadratic function. (A.SSE.3)	Translating among different forms of expressions, equations and graphs helps students to understand some key connections among arithmetic, algebra and geometry. The reverse thinking technique (a process that allows working backwards from the answer to the starting point) can be very effective. Have students derive information about a function's equation, represented in standard, factored or general form, by investigating its graph.	Profit - http://www.illustrativemathematics.org/illustrations/434
	j. Recognize and create different forms of literal equations involving squared variables. (A.REI.4)	Include deriving the Quadratic Formula.	
	k. Solve a quadratic equation using a variety of methods. (A.REI.4)	Discuss the most appropriate method. Model the use of graphing, square roots, factoring, completing the square and the quadratic formula to solve.	
	l. Describe a quadratic equation as having one double solution, two unique solutions, or no real solutions using the value of the discriminant. (A.REI.4)		
	m. Use properties of exponents to write equivalent forms of an exponential function. (A.SSE.3)	Offer multiple real-world examples of exponential functions. For instance, to illustrate an exponential decay, students need to recognize that in the equation for an automobile cost $C(t) = 20{,}000(0.75)t$, the base is 0.75 and between 0 and 1 and the value of $20,000 represents the initial cost of an automobile that depreciates 25% per year over the course of *t* years. Similarly, to illustrate exponential growth, in the equation for the value of an investment over time $A(t) = 10{,}000(1.03)t$, where the base is 1.03 and is greater than 1; and the $10,000 represents the value of an investment when increasing in value by 3% per year for *x* years. • Write the expression below as a constant times a power of *x* and use your answer to decide whether the expression gets larger or smaller as *x* gets larger. $\frac{(2x^3)^2(3x^4)}{(x^2)^3}$ • If *x* is positive and $x \neq 0$, simplify $\frac{\sqrt{x}}{x^8}$	

Unit 4 – Expressions and Equations			
represent relationships between quantities; graph equations on coordinate axes with labels and scales. A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R.* **Solve systems of equations.** A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line y = –3x and the circle $x^2 + y^2 = 3$.*	n. Distinguish between linear, quadratic and exponential relationships given the verbal, numeric and/or graphic representations in one or two variables. (A.CED.1,2)	Examples: Lava coming from the eruption of a volcano follows a parabolic path. The height *h* in feet of a piece of lava *t* seconds after it is ejected from the volcano is given by . After how many seconds does the lava reach its maximum height of 1000 feet? The value of an investment over time is given by the equation $A(t) = 10{,}000(1.03)^t$. What does each part of the equation represent?	
	o. Graph exponential and quadratic functions using key points. (A.CED.1,2)		
	p. Solve systems of linear and quadratic equations in two variables algebraically and graphically. (A.REI.7)	Example: Two friends are driving to the Grand Canyon in separate cars. Suzette has been there before and knows the way but Andrea does not. During the trip Andrea gets ahead of Suzette and pulls over to wait for her. Suzette is traveling at a constant rate of 65 miles per hour. Andrea sees Suzette drive past. To catch up, Andrea accelerates at a constant rate. The distance in miles (*d*) that her car travels as a function of time in hours (*t*) since Suzette's car passed is given by $d = 3500t^2$. Write and solve a system of equations to determine how long it takes for Andrea to catch up with Suzette.	A Quadratic and a Line - http://www.illustrativemathematics.org/illustrations/576

Unit 4 – Expressions and Equations

- Resources for supplemental materials:
  - http://map.mathshell.org/materials/index.php
  - http://ccssmath.org/
  - www.ccsstoolbox.org
  - http://insidemathematics.org/
  - High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
  - http://www.illustrativemathematics.org/standards/hs
  - http://education.ti.com/calculators/downloads/US/Activities/Search/
  - http://learnzillion.com/
  - http://www.uen.org/core/math/7-12.shtml
  - http://illuminations.nctm.org/
  - http://www.khanacademy.org/
  - http://blog.mrmeyer.com/
  - http://www.dlt.ncssm.edu/stem/math-secondary

Unit 5 – Quadratic Functions and Modeling

Unit 5 Overview: In preparation for work with quadratic relationships students explore distinctions between rational and irrational numbers. They consider quadratic functions, comparing the key characteristics of quadratic functions to those of linear and exponential functions. They select from among these functions to model phenomena. Students learn to anticipate the graph of a quadratic function by interpreting various forms of quadratic expressions. In particular, they identify the real solutions of a quadratic equation as the zeros of a related quadratic function. Students learn that when quadratic equations do not have real solutions the number system must be extended so that solutions exist, analogous to the way in which extending the whole numbers to the negative numbers allows x+1 = 0 to have a solution. Formal work with complex numbers comes in Algebra II. Students expand their experience with functions to include more specialized functions—absolute value, step, and those that are piecewise-defined.

Major Topics:
Real numbers
Comparing families of functions
Modeling with functions
Absolute value, step and piecewise defined functions

Unit 5: 15 Days

Common Core State Standards in Connecticut

Use properties of rational and irrational numbers.

N.RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Interpret functions that arise in applications in terms of a context.

F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.**
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*★
F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

Analyze functions using different representations.

F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.*

- **a.** Graph linear and quadratic functions and show intercepts, maxima, and minima.
- **b.** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

- **a.** Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
- **b**. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as*

Unit 5 – Quadratic Functions and Modeling

y = (1.02)t, y = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth or decay.

F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

Build a function that models a relationship between two quantities.

F.BF.1 Write a function that describes a relationship between two quantities.*

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

b. Combine standard function types using arithmetic operations.

For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.

Build new functions from existing functions.

F.BF.3 Identify the effect on the graph of replacing *f(x)* by *f(x) + k, k f(x), f(kx),* and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*

F.BF.4 Find inverse functions.

a. Solve an equation of the form *f(x) = c* for a simple function *f* that has an inverse and write an expression for the inverse. *For example, f(x) = 2 x3 or f(x) = (x+1)/(x-1) for x ≠ 1.*

Construct and compare linear, quadratic, and exponential models and solve problems

F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:
• Properties of rational and irrational numbers	• EXPLAIN properties of rational and irrational numbers

• Key features of graphs and tables
  ○ Intercepts
  ○ Intervals: Increasing, decreasing, +, -
  ○ Max and Min
  ○ Symmetry
  ○ End behavior
  ○ Domain
  ○ Rate of change
	• INTERPRET key features of graphs and tables
	• SKETCH graphs
	• RELATE domain to graph
	• CALCULATE/INTERPRET/ESTIMATE average rate of change

• Representations of functions
  ○ Linear and Quadratic
  ▪ Intercepts
  ▪ Maxima and Minima
  ○ Square root
	• GRAPH functions
	• SHOW key features of graphs
	• WRITE a function

○ Cube root ○ Piecewise functions ▪ Step functions ▪ Absolute functions ○ Equivalent forms ▪ Quadratics: factoring, completing the square • Zeros • Extreme values • Symmetry ▪ Exponential • Growth • Decay • Percent rate of change ○ Representations: Algebraically, Graphically, Numerically, and Verbally • Relationships between two quantities ○ Explicit ○ Recursive • Effects of translations on graphs ○ Even ○ Odd ○ Vertical translation ○ Horizontal translation ○ Vertical Stretch ○ Vertical Compressions Polynomials vs Exponentials	• SHOW properties of functions • USE Properties • COMPARE properties of functions ▪ WRITE a function ▪ COMBINE function type ▪ IDENTIFY translations COMPARE linear, exponential, and quadratic growth

Big Ideas

Student's statements of enduring ideas

1. Linear functions have a constant rate of change, the degree is one, and the graph is a straight line. Exponential functions have a constant percent change, the variable is the exponent, and the graph is a growth or decay curve. Quadratic functions have a constant second difference, the degree is two, and the graph is a parabola with a relative maximum or minimum.
2. Changing the parameters of a function can result in vertical or horizontal shifts (translations) or a stretch or shrinking of a graph (dilations).

Unit 5 – Quadratic Functions and Modeling			
Essential Questions Teacher's guiding questions			
1. How do determine between a linear, exponential, or quadratic function given various representations? 2. What are the effects on the graph when changing the parameters of a function?			
Critical Area 1; Math Practices 3,5,6, 7			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Use properties of rational and irrational numbers. N.RN.3 Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. **Interpret functions that arise in applications in terms of a context.** F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.**	a. Perform operations on both rational and irrational numbers and use the results to make generalizations. (N.RN.3)	Have students explore and generalize the effects of adding or multiplying rational and irrational numbers.	Operations with Rational or Irrational Numbers - http://www.illustrativemathematics.org/illustrations/690
	b. Translate between various representations of quadratic functions and identify key features using the various representations. (F.IF.4)	Key features include intercepts; intervals where the function is increasing, decreasing, positive, or negative; maximums and minimums; symmetries; and end behavior. The expectation at the Algebra I level is for F.IF.4 and F.IF.5 to focus on linear and exponential functions. Later in the year, focus on quadratic functions and compare them with linear and exponential functions.	
	c. Compare and contrast quadratic representations to linear and exponential representations. (F.IF.9)	Build on concepts from Unit 2 throughout this unit by comparing quadratics with both linear and exponential functions. Provide contexts for functions examined throughout this unit. Look at situations, graphs, tables and equations when making comparisons.	

Unit 5 – Quadratic Functions and Modeling			
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*★ F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.* **Analyze functions using different representations.** F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.* **a.** Graph linear and quadratic functions and show intercepts, maxima, and minima. **b.** Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. **a.** Use the process of factoring and completing the square in a quadratic function to show zeros, extreme	d. Describe the domain of a quadratic function and the restrictions based on real world context. (F.IF.5)	Provide contexts for functions examined throughout this unit.	
	e. Identify and interpret the average rate of change from a quadratic function given an interval. (F.IF.6)	Table, graph, or contextual situation This represents the slope of the line that connects the given interval. Average rate of change = $\frac{f(b)-f(a)}{b-a}$ Interpret the rate of change over a specified interval based on the context.	
	f. Graph quadratic functions and show intercepts, maximums, and minimums. (F.IF.7)		
	g. Make connections between factoring and completing the square of a quadratic function and zeros, extreme values, symmetry and contextual situations for quadratic relationships. (F.IF.8)		
	h. Describe how parameters alter the graph of a parent function. (F.IF.7)	Have students make comparisons between parameter changes on different families of functions.	Building a Quadratic - http://www.illustrativemathematics.org/illustrations/741 Medieval Archer - http://www.illustrativemathematics.org/illustrations/695

<table>
<tr><th colspan="4">Unit 5 – Quadratic Functions and Modeling</th></tr>
<tr><td rowspan="4">values, and symmetry of the graph, and interpret these in terms of a context.
b. Use the properties of exponents to interpret expressions for exponential functions. *For example identify percent rate of change in functions such as y = (1.02)t, y = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth or decay.*
F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*
Build a function that models a relationship between two quantities.

F.BF.1 Write a function that describes a relationship between two quantities.*
a. Determine an explicit expression, a recursive process, or steps for calculation from a context.
b. Combine standard function types using arithmetic operations.
For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.
Build new functions from existing functions.

F.BF.3 Identify the effect on the graph of replacing *f(x)* by *f(x) + k, k f(x), f(kx),* and *f(x + k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs.</td><td>i. Graph piecewise-defined, step, and absolute value functions and compare them to linear, exponential and quadratic functions.
(F.IF.7)</td><td></td><td></td></tr>
<tr><td>j. Describe key characteristics of piecewise and step functions including limitations to the domain and range.
(F.IF.7)</td><td>Explore real world situations.</td><td></td></tr>
<tr><td>k. Describe similarities and differences in the properties of two different types of functions represented in a different way.
(F.IF.9)</td><td>Have students compare algebraic, graphic, numeric in tables or verbal descriptions of the same and different functions.</td><td>Functions Task - http://map.mathshell.org/materials/tasks.php?taskid=255&subpage=apprentice</td></tr>
<tr><td>l. Write an algebraic representation of a quadratic function or combinations of functions from a contextual situation.
(F.BF.1)</td><td>Example:

Flu Clinic - http://www.illustrativemathematics.org/illustrations/671</td><td>Culminating Project

Final Exam</td></tr>
</table>

Unit 5 – Quadratic Functions and Modeling			
Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* F.BF.4 Find inverse functions. **a**. Solve an equation of the form *f(x) = c* for a simple function *f* that has an inverse and write an expression for the inverse. *For example, f(x) = 2 x3 or f(x) = (x+1)/(x-1) for x ≠ 1.* **Construct and compare linear, quadratic, and exponential models and solve problems** F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function			

Additional Resources:

- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

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Bristol Public Schools
Office of Teaching & Learning

DEPARTMENT: Mathematics

COURSE: Geometry

COURSE DESCRIPTION
The fundamental purpose of the course in Geometry is to formalize and extend students' geometric experiences from the middle grades. Students explore more complex geometric situations and deepen their explanations of geometric relationships, moving towards formal mathematical arguments. Important differences exist between this Geometry course and the historical approach taken in Geometry classes. For example, transformations are emphasized early in this course. Close attention should be paid to the introductory content for the Geometry conceptual category found in the high school CCSS. The Mathematical Practice Standards apply throughout each course and, together with the content standards, prescribe that students experience mathematics as a coherent, useful, and logical subject that makes use of their ability to make sense of problem situations.

Unit Organization:	Instruction focuses on six critical areas:
Unit 1 – Congruence, Proof and Constructions **Unit 2 – Similarity, Proof and Trigonometry** **Unit 3 – Extending to Three Dimensions** **Unit 4 – Connecting to Algebra and Geometry through Coordinates** **Unit 5 – Circles with and without Coordinates** **Unit 6 – Probability**	Critical Area 1: In previous grades, students were asked to draw triangles based on given measurements. They also have prior experience with rigid motions: translations, reflections, and rotations and have used these to develop notions about what it means for two objects to be congruent. In this unit, students establish triangle congruence criteria, based on analyses of rigid motions and formal constructions. They use triangle congruence as a familiar foundation for the development of formal proof. Students prove theorems using a variety of formats and solve problems about triangles, quadrilaterals, and other polygons. They apply reasoning to complete geometric constructions and explain why they work. Critical Area 2: Students apply their earlier experience with dilations and proportional reasoning to build a formal understanding of similarity. They identify criteria for similarity of triangles, use similarity to solve problems, and apply similarity in right triangles to understand right triangle trigonometry, with particular attention to special right triangles and the Pythagorean theorem. Students develop the Laws of Sines and Cosines in order to find missing measures of general (not necessarily right) triangles, building on students' work with quadratic equations done in the first course. They are able to distinguish whether three given measures (angles or sides) define 0, 1, 2, or infinitely many triangles. Critical Area 3: Students' experience with two-dimensional and three-dimensional objects is extended to include informal explanations of circumference, area and volume formulas. Additionally, students apply their knowledge of two-dimensional shapes to consider the shapes of cross-sections and the result of rotating a two-dimensional object about a line.

	Critical Area 4: Building on their work with the Pythagorean theorem in 8th grade to find distances, students use a rectangular coordinate system to verify geometric relationships, including properties of special triangles and quadrilaterals and slopes of parallel and perpendicular lines, which relates back to work done in the first course. Students continue their study of quadratics by connecting the geometric and algebraic definitions of the parabola. Critical Area 5: In this unit students prove basic theorems about circles, such as a tangent line is perpendicular to a radius, inscribed angle theorem, and theorems about chords, secants, and tangents dealing with segment lengths and angle measures. They study relationships among segments on chords, secants, and tangents as an application of similarity. In the Cartesian coordinate system, students use the distance formula to write the equation of a circle when given the radius and the coordinates of its center. Given an equation of a circle, they draw the graph in the coordinate plane, and apply techniques for solving quadratic equations, which relates back to work done in the first course, to determine intersections between lines and circles or parabolas and between two circles. Critical Area 6: Building on probability concepts that began in the middle grades, students use the languages of set theory to expand their ability to compute and interpret theoretical and experimental probabilities for compound events, attending to mutually exclusive events, independent events, and conditional probability. Students should make use of geometric probability models wherever possible. They use probability to make informed decisions.

DEPARTMENT PHILOSOPHY

The philosophy of the mathematics department is to develop mathematically literate and productive students who can effectively and efficiently apply mathematics in their lives to make informed decisions about the world around them. To be mathematically literate, one must understand major mathematics concepts, possess computational facility and have the ability to apply these understandings to situations in daily life. Making connections between mathematics and other disciplines is key to the appropriate application of mathematics skills and concepts to solve problems. The ability to read, discuss and write within the discipline of mathematics is an integral skill that supports mathematical understanding, reasoning and communication. The opportunity to think critically and creatively to solve problems is important to deepen mathematical knowledge and foster innovation. A rich mathematical experience is essential to provide the foundational knowledge and skills that prepare students to be mathematically literate, productive citizens.

The Bristol mathematics curriculum focuses on high expectations for **all** students and provides a balanced approach to mathematics education, placing equal importance on conceptual understanding, computational and procedural fluency and problem solving through the use of a variety of strategies, tools and technologies. The mathematics curriculum is responsive to the individual needs of students. While providing a structure tied to the Common Core State Standards in Connecticut, it allows for classroom experiences, additional supports and enrichment ensuring students' access to the content at an appropriate level of challenge.

DEPARTMENT GOALS

Through a planned, sequential curriculum, the Bristol Public schools strive to educate each student according to the standards outlined in the Common Core State Standards for Mathematics in Connecticut including these conceptual categories:

- Number and Quantity
- Algebra
- Functions
- Geometry
- Modeling
- Statistics and Probability

As part of these standards, teachers will support students in developing the following mathematical practices[1]:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

[1.] The mathematical practices listed are those found in the Common Core State Standards in Connecticut.

PHILOSOPHY OF INSTRUCTION

Based on our department philosophy and goals, math teachers will:

- provide a safe, supportive and respectful classroom environment conducive to learning, where students are encouraged to take risks and share ideas;
- have a deep understanding of the mathematical concepts and skills in the curriculum and strong pedagogical content knowledge;
- use the BOE approved textbook and a variety of resources to have students read about, explore and reinforce curriculum concepts and skills;
- build upon students' prior knowledge and experience, and real-world events, to foster connections and make learning relevant and meaningful;
- provide students with developmentally appropriate opportunities to question, explore, observe, synthesize and draw conclusions based on their mathematics understanding;

- use high-level questions and rich tasks to facilitate classroom discourse, both oral and written, to encourage student-student, student-teacher and teacher-student communication;
- incorporate and highlight key mathematical vocabulary during instruction and require students to use this vocabulary appropriately in their communications;
- model and have students use manipulatives, tools and technology to actively explore and build understanding of mathematical concepts;
- structure learning experiences that utilize a variety of grouping strategies to encourage collaborative problem solving; and
- differentiate instruction to meet the needs of a variety of learners based on student readiness, interest, and learning style and provide supplemental mathematics intervention or enrichment as needed.

Note: The instructional strategies recommended in our resource document are specific examples of these expectations in practice. They serve as a starting point for planning and implementing instruction that will develop our students as thinkers. Teachers may create new instructional strategies and activities as they continue to grow professionally and as they develop an understanding of each student's unique strengths, weaknesses, and interests.

PHILOSOPHY OF ASSESSMENT

Based on our department philosophy and goals, math teachers will:

- align assessments with instruction;
- use a variety of formative and summative assessment throughout each unit of instruction;
- design and use assessments that include questions at varied levels of cognitive demand;
- analyze results and plan or modify instruction based on the results;
- provide specific, constructive feedback for students; and
- collaborate with colleagues and use scoring rubrics to evaluate student work as appropriate.

Unit 1 – Congruence, Proof, and Constructions

Unit Overview: In previous grades, students were asked to draw triangles based on given measurements. They also have prior experience with rigid motions: translations, reflections, and rotations and have used these to develop notions about what it means for two objects to be congruent. In this unit, students establish triangle congruence criteria, based on analyses of rigid motions and formal constructions. They use triangle congruence as a familiar foundation for the development of formal proof. Students prove theorems using a variety of formats and solve problems about triangles, quadrilaterals, and other polygons. They apply reasoning to complete geometric constructions and explain why they work.

Unit 1 – 35 classes

Common Core State Standards in Connecticut

Experiment with transformations in the plane.

G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

G.CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

G.CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

G.CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

G.CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

Understand congruence in terms of rigid motions.

G.CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.

G.CO.7 Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.

G.CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.

Prove geometric theorems.

G.CO.9 Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.*

G.CO.10 Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.*

G.CO.11 Prove theorems about parallelograms. *Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.*

Unit 1 – Congruence, Proof, and Constructions

Make geometric constructions.
G.CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.*
G.CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• precise definitions
  ○ angle
  ○ circle
  ○ perpendicular line
  ○ parallel line
  ○ line segment
• undefined notions
  ○ point
  ○ line
  ○ distance along a line
  ○ distance around a circular arc
• transformations in the plane
  ○ as functions
  ▪ points as inputs and outputs
  ○ that do or do not preserve distance and angle
• rotations and reflections that carry onto itself
  ○ rectangle
  ○ parallelogram
  ○ trapezoid
  ○ regular polygon
• definitions in terms of angles, circles, perpendicular lines, parallel lines, line segments
  ○ rotations
  ○ reflections
  ○ translations
• transformed figure
  ○ given a rotation, reflection, or translation
	• KNOW
	  ○ (precise definitions)
	  ○ (undefined notions)
	• REPRESENT (transformations)
	• DESCRIBE (transformations)
	• COMPARE (transformations)
	• DESCRIBE (rotations and reflections)
	• DEVELOP (definitions)
	• DRAW (transformations)
	• SPECIFY (sequence of transformations)
	• USE (geometric descriptions)
	• PREDICT (effect of rigid motion)
	• USE (congruence)
	• EXPLAIN (triangle congruence)
	• PROVE (theorems)
	• MAKE (constructions)

- sequence of transformations that carry a given figure onto another
- rigid motions
  - geometric descriptions
  - effect of rigid motion
  - decide if figures are congruent
- definition of triangle congruence
  - corresponding sides and angles
  - in terms of rigid motions
- theorems
  - lines and angles
  - triangles
  - parallelograms
- formal geometric constructions
  - inscribed in a circle
    - equilateral triangle
    - square
    - regular hexagon

Big Ideas

Student's statements of enduring ideas

1. Analysis of rigid motions, formal constructions, and proof can be used to establish triangle congruence.
2. Basic definitions and postulates/theorems help us describe geometric figures and establish relationships.
3. Proofs are methods to establish logical arguments in order to justify conclusions.

Essential Questions

Teacher's guiding questions

1. What are ways in which we can establish triangle congruence?
2. Why is it important to know the basic definitions and postulates/theorems of Geometry?
3. Why is proof important in mathematics and real-life?

Critical Area 1; Math Practices 3, 5, 6, 7

Unit 1 – Congruence, Proof, and Constructions			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Unit 1 Part 1 – Geometric Terminology & Transformations – 15 classes **Experiment with transformations in the plane.** G.CO.1 Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. G.CO.2 Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch). G.CO.3 Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. G.CO.4 Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines,	Define and use geometric terminology.	Guide the development of precise definitions of: angle, circle, perpendicular lines, parallel lines, line segment based on the undefined notions of point, line, distance along a line, and distance around a circular arc. Review geometric shapes including rectangles, parallelograms, trapezoids, regular polygons and triangles. Have students make and assess each other using flashcards. Create and use word walls by holding students accountable for content specific vocabulary.	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)
	Define and perform transformations.	Guide the development of precise definitions of: rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. Use geometry software and/or manipulatives to model and compare transformations.	Writing: Perform a rotation, reflection, and translation with a given polygon and give a written explanation of how each step meets the definitions of each transformation using correct mathematical terms.
	Compare rigid transformations and those that are not.	Use geometry software and/or manipulatives to model and compare transformations. May use M.C. Escher pictures to compare and contrast rigid and non-rigid transformations.	
	Represent and compare transformations geometrically and algebraically.	Build on previous objective to now look at algebraic representations of transformations on the coordinate plane and illustrate them as functions that take points in the plane as inputs and give other points as outputs and compare. Apply transformations (rotations, reflections, translations,	

Unit 1 – Congruence, Proof, and Constructions			
parallel lines, and line segments. G.CO.5 Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.		dilations) to figures in the coordinate plane. Recognize rules that map points onto other points and classify rules as particular transformations. Examples may include: Which of the following preserves distance and which does not? (x, y) → (x+1, y+2) (x, y) → (x^2, y+2) Use geometry software and/or manipulatives to model and compare transformations.	
	Interpret and perform the result of the composition of transformations.	Have students investigate whether the composition of transformations is commutative or not. Use geometry software and/or manipulatives to model and compare transformations.	Culminating Activity: Follow the Figure
	Predict the effect of a given rigid motion on the orientation and location of a figure.	Use graph paper, tracing paper, physical models and geometry software to verify predictions.	
	Describe the sequence of transformations that will carry a given figure onto another or onto itself.	Model with rectangles, parallelograms, trapezoids, or regular polygons. Describe and identify lines and points of symmetry (use mirrors or a reflective device to help visualize). Given a pre-image and image, work backwards to discover the sequence of transformations that led to the image. Use geometry software and/or manipulatives to model and compare transformations.	http://illustrativemathematics.org/illustrations/707 (seven circles 1) http://illustrativemathematics.org/illustrations/708 (seven circles 2)
Unit 1 – Part 2 – Constructions – 5 Classes **(Can be done in conjunction with or after Congruence & Proof)** **Make geometric constructions.**	Make formal geometric constructions.	Model and have students use a variety of tools/methods including: compass and straightedge, string, reflective devices, paper folding, geometry software, etc. Constructions to include: copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a	http://illustrativemathematics.org/illustrations/31 (reflected triangles)

Unit 1 – Congruence, Proof, and Constructions			
G.CO.12 Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). *Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.* G.CO.13 Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle. **Unit 1 Part 3 – Congruence & Proof - 15 Classes** **Understand congruence in terms of rigid motions.** G.CO.6 Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent. G.CO.7 Use the definition of		line segment; and constructing a line parallel to a given line through a point not on the line. Extension – explore the orthocenter, circumcenter and centroid of a triangle using GSP and have students discover the Euler line (http://mathforum.org/library/drmath/view/57665.html)	Extension Activity- http://illustrativemathematics.org/illustrations/508 (placing a fire hydrant—come up with a new context)
	Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.		Performance Task – Construct Your Own Logo & Explain the Steps
	Use the definition of congruence as a test to see if two figures are congruent.	Make sure to define congruence in terms of rigid motions.	
	Recognize that two triangles are congruent if one can be exactly superimposed on the other by a rigid motion.	Emphasize knowledge of vocabulary (corresponding parts) and the connection to the given triangles. Have students measure angles and side lengths of triangles resulting from rigid transformations by selecting from a variety of technology and paper based methods (e.g., patty paper).	
	Explain why particular combinations of corresponding parts establish congruence and why others do not.	Lead students to discover SSS, SAS, and ASA using properties of rigid motion. Use geometry software and/or manipulatives to model and compare transformations.	Analyze Congruency Proofs Lesson: http://map.mathshell.org/materials/lessons.php?taskid=452&subpage=concept

Unit 1 – Congruence, Proof, and Constructions			
congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. G.CO.8 Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions. **Prove geometric theorems.** G.CO.9 Prove theorems about lines and angles. *Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.* G.CO.10 Prove theorems about triangles. *Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.* G.CO.11 Prove theorems about parallelograms. *Theorems include: opposite sides are*	Apply and inductive and deductive reasoning to justify conclusions.	Build the idea of deductive proof as statements following logically from agreed upon assumptions and proven facts. (It is not necessary to introduce formal logic rules.)	Proof Activity - http://mathforum.org/sanders/exploringandwritinggeometry/extracredit.htm
	Prove theorems about lines and angles.	Prerequisite knowledge: transitive property, reflexive property, substitution property, supplementary, complementary, vertical, and adjacent angles Theorems include: vertical angles are congruent, when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent, points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints. Build up students potential to completing their own proofs – consider filling in blanks, organizing a series of statements, etc. Share models of exemplary proofs in various forms. Use small group work to have students complete proofs on their own. Encourage multiple ways of writing proofs (two column, paragraph, diagrams or flow chart). Students should be encouraged to focus on the validity of the underlying reasoning while exploring a variety of formats for expressing that reasoning.	Smarter Balanced Item: MAT.HS.SR.1.00GCO.O.224 MAT.HS.TE.1.00GCO.O.470
	Prove theorems about triangles.	Theorems include: measures of interior angles of a triangle sum to 180 degrees; base angles of isosceles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point. Use parallel lines and alternate interior angles to prove sum of the angles of a triangle = to 180 degrees. Encourage multiple ways of writing proofs (two column, paragraph, or flow chart).	

Unit 1 – Congruence, Proof, and Constructions			
congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.	Prove theorems about parallelograms.	Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. Encourage multiple ways of writing proofs (two column, paragraph, or flow chart).	

Additional Resources:

- http://illuminations.nctm.org (symmetries 2)
- http://whistleralley.com/construction/reference.htm (basic construction instructions)
- http://www.mathopenref.com/tocs/constructionstoc.html (constructions to demonstrate)
- Performance Task D & E: http://insidemathematics.org/problems-of-the-month/pom-betweenthelines.pdf
- Utah Education Network -http://www.uen.org/core/core.do?courseNum=5600
- Real world proof project - http://teachers2.wcs.edu/high/fhs/nancys6/Lists/Announcements/Attachments/12/Real-World%20Proof%20(2).pdf
- Geometric Constructions with GSP - http://mathforum.org/sanders/geometry/NCTMposters.html
  - http://map.mathshell.org/materials/index.php
  - http://ccssmath.org/
  - www.ccsstoolbox.org
  - http://insidemathematics.org/
  - High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
  - http://www.illustrativemathematics.org/standards/hs
  - http://education.ti.com/calculators/downloads/US/Activities/Search/
  - http://learnzillion.com/
  - http://www.uen.org/core/math/7-12.shtml
  - http://illuminations.nctm.org/
  - http://www.khanacademy.org/
  - http://blog.mrmeyer.com/
  - http://www.dlt.ncssm.edu/stem/math-secondary

Unit 2 – Similarity, Proof, and Trigonometry

Unit Overview: Students apply their earlier experience with dilations and proportional reasoning to build a formal understanding of similarity. They identify criteria for similarity of triangles, use similarity to solve problems, and apply similarity in right triangles to understand right triangle trigonometry, with particular attention to special right triangles and the Pythagorean theorem. Students develop the Laws of Sines and Cosines in order to find missing measures of general (not necessarily right) triangles. They are able to distinguish whether three given measures (angles or sides) define 0, 1, 2, or infinitely many triangles.
Unit 2 – 16 classes (10 classes before Midyear, 6 classes after)

Common Core State Standards in Connecticut

Understand similarity in terms of similarity transformations.
G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor.
a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.
G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.
G.SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Prove theorems involving similarity.
G.SRT.4 Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity*.
G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.

Define trigonometric ratios and solve problems involving right triangles.
G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.
G.SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.
G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.*

Apply geometric concepts in modeling situations.
G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*
G.MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).*
G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).*

Apply trigonometry to general triangles.
G.SRT.9 (+) Derive the formula $A = 1/2\ ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
G.SRT.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems.
G.SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Unit 2 – Similarity, Proof, and Trigonometry	
Unwrapped Performance Standards	
Concepts: Need to know about:	**Skills:** Need to be able to:

• Properties of dilations
  ○ By center
  ○ By scale factor
• Similarity
  ○ Definition (in terms of transformations)
  ○ Triangles
  ▪ Equality of corresponding angles (of similar triangles)
  ▪ Similarity of corresponding sides (of similar triangles)
  ▪ AA criterion (using properties of similarity transformations)
• Theorems about triangles
• Congruence and similarity criteria for triangles
• Right triangles
  ○ Side ratios (as properties of angles)
  ○ Definitions of trigonometric ratios
  ○ Relationship between sine and cosine of complementary angles
  ○ Pythagorean Theorem
• Geometric Shapes (to describe objects)
  ○ Measures
  ○ Properties
• Density (based on area and volume)
• Design problems
• (+) Area of a triangle formula: A=1/2absin(c)
  ○ auxiliary line from a vertex
• (+) Law of Sines and Cosines
  ○ (+) Unknown measurements in right and non-right triangles
	• VERIFY (experimentally)
	• USE
	  ○ (Definition of similarity)
	  ○ (Properties of similarity transformations)
	  ○ (Criteria for triangles(
	  ○ (Relationship between sine and cosine of complementary angles(
	  ○ (Trigonometric ratios - in applied problems)
	  ○ (Pythagorean Theorem - in applied problems)
	• DECIDE (if figures are similar)
	• EXPLAIN
	  ○ (Meaning of similarity for triangles)
	  ○ (Relationship between sine and cosine of complementary angles)
	• ESTABLISH (AA criterion)
	• PROVE
	  ○ (Theorems about triangles)
	  ○ (Relationships in geometric figures)
	  ○ (+) (Law of Sines and Cosines)
	• SOLVE (problems in geometric figures)
	• DESCRIBE (objects modeled by geometric shapes)
	• APPLY
	  ○ (concepts of density in modeling situations)
	  ○ (Geometric methods to solve design problems)
	  ○ (+) (Law of Sines and Cosines)
	• (+) UNDERSTAND
	  ○ (Properties of angles)
	  ○ (Law of Sines and Cosines)
	• (+) DERIVE [A=1/2absin(c)]
	• (+) FIND (unknown measurements in right and non-right triangles)

Unit 2 – Similarity, Proof, and Trigonometry

Big Ideas
Student's statements of enduring ideas

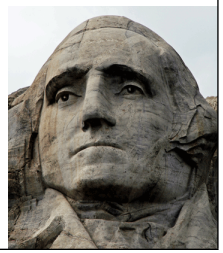
1. Congruent corresponding angles, corresponding sides that are in proportion, and combinations of transformations (rigid motion and dilation) can be used to determine similarity.
2. The Pythagorean Theorem, special right triangles, similarity, and trigonometry can be used to find the missing measurement in an object.
3. All right triangles with a given acute angle are similar because of AA similarity, and thus the sides are proportional. We describe the side ratios as sine, cosine, and tangent.

Essential Questions
Teacher's guiding questions

1. What are ways in which we can determine similarity?
2. What methods can be used to find a missing measurement in an object?
3. How are similarity and trigonometry related?

Critical Area 2; Math Practices 1, 3, 4, 5, 7

CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Understand similarity in terms of similarity transformations. G.SRT.1 Verify experimentally the properties of dilations given by a center and a scale factor. **a**. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged. **b.** The dilation of a line segment is	Analyze the properties of dilations.	Have students begin with dilating line segments through and not through the center to determine the effects on length and position in relationship to the pre-image. Draw analogy of dilation to zoom in or zoom out of a camera. Use geometry software and/or manipulatives to model and compare transformations.	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews) Dilation experiment.

Unit 2 – Similarity, Proof, and Trigonometry			
longer or shorter in the ratio given by the scale factor. G.SRT.2 Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. G.SRT.3 Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar. **Prove theorems involving similarity.** G.SRT.4 Prove theorems about triangles. *Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity*. G.SRT.5 Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures. **Define trigonometric ratios and solve problems involving right triangles.** G.SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. G.SRT.7 Explain and use the relationship between the sine and cosine of complementary angles. G.SRT.8 Use trigonometric ratios and	Describe the results of dilations based on position of an object in relation to the center and the scale factor.	Build on students' 8th grade knowledge of similarity and dilations. Use geometry software and/or manipulatives to model and compare transformations.	
	Evaluate if two figures are similar.	Have students initially determine similarity based on the properties of dilations and lead them to ideas around corresponding pairs of angles and proportionality.	
	Explain why particular combinations of corresponding parts of triangles establish similarity and why others do not.	Lead students to establish AA~, SAS~, and SSS~ as a sequence of transformations. Use geometry software to explore properties of similarity.	
	Prove theorems about triangles.	Theorems include: a line parallel to one side of a triangle divides the other two sides proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity. Use geometry software and/or manipulatives.	Proofs of the Pythagorean Theorem: http://map.mathshell.org/materials/lessons.php?taskid=419&subpage=concept
	Solve problems using congruence and similarity of triangles.	Problems can be given in verbal or pictorial form. Ex. Shadow, mirror, indirect measurement problems. Encourage students to use triangles and set up proportions to model situations.	The length of George Washington's face at Mt. Rushmore is 60 feet. Describe a method for determining the length of his nose using similar triangles. Justify your reasoning. Midyear Assessment 

Unit 2 – Similarity, Proof, and Trigonometry			
the Pythagorean Theorem to solve right triangles in applied problems.* **Apply geometric concepts in modeling situations.** G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).* G.MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).* G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).* ***Consider for Accelerated Only:*** **Apply trigonometry to general triangles.** G.SRT.9 (+) Derive the formula *A* = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side. G.SRT.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems. G.SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).	Recognize that the ratio of two sides in one triangle is equal to the ratio of the corresponding two sides in all other similar triangles.	Use special triangles to develop the concept of trigonometric ratios. Use geometry software and/or manipulatives.	
	Define sine, cosine, and tangent as the ratio of sides in a right triangle.		
	Explain the relationship between sine and cosine.	Use geometry software and/or manipulatives. Have students explore the relationship in the acute angles of a right triangle and in complementary angles.	
	Use the Pythagorean Theorem and trigonometric ratios to find missing measures in triangles in contextual situations.	Demonstrate and solve problems using angles of elevation and depression.	http://map.mathshell.org/materials/download.php?fileid=1257 (floodlights)
	Solve complex problems using geometric models.		http://map.mathshell.org/materials/download.php?fileid=1254 (rolling cups) Unit assessment

Unit 2 – Similarity, Proof, and Trigonometry

Additional Resources:
MAP Task - Hopewell Geometry: http://map.mathshell.org/materials/tasks.php?taskid=127&subpage=apprentice

- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

Unit 3 – Extending to Three Dimensions

Unit Overview: Students' experience with two-dimensional and three-dimensional objects is extended to include informal explanations of circumference, area and volume formulas. Additionally, students apply their knowledge of two-dimensional shapes to consider the shapes of cross-sections and the result of rotating a two-dimensional object about a line.
Unit 3 – 8 classes

Common Core State Standards in Connecticut

Explain volume formulas and use them to solve problems.
G.GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.
G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*

Visualize the relation between two-dimensional and three-dimensional objects.
G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Apply geometric concepts in modeling situations.
G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Informal argument for formulas
  ○ Circumference of a circle
  ○ Area of a circle
  ○ Volume of a cylinder
  ○ Volume of a pyramid
  ○ Volume of a cone
• Volume formulas
  ○ Cylinders
  ○ Pyramids
  ○ Cones
  ○ Spheres
• Three-dimensional objects
  ○ Two-dimensional cross-sections
  ○ From rotations of two-dimensional objects
• Geometric shapes
  ○ Measures
  ○ Properties
  ○ Model objects
	• GIVE (informal argument)
	• USE (volume formulas)
	• SOLVE (problems)
	• IDENTIFY
	  ○ (cross-sections)
	  ○ (three-dimensional objects)
	• USE (geometric shapes)
	• DESCRIBE (objects)

Unit 3 – Extending to Three Dimensions

Big Ideas
Student's statements of enduring ideas

1. To solve problems involving 3-dimensional objects we can break an object down into shapes (dissections and cross sections) we are already familiar with, create/use formulas (circumference, area, volume), or compare to known figures that are similar.
2. We can use geometric shapes, their measures, and their properties to describe objects in the real world.

Essential Questions
Teacher's guiding questions

1. How can we solve problems involving 3-dimensional objects?
2. How can we use Geometry to model objects in the real world?

Critical Area 3; Math Practices 1, 2, 4

CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Explain volume formulas and use them to solve problems. G.GMD.1 Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments. G.GMD.3 Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.*	Develop informal arguments for the formulas for circumference and area of a circle, volume of a cylinder, pyramid and cone.	Use dissection arguments, Archimedes' argument, Cavalieri's principle, and informal limit arguments. Derive the formula for area of a circle using http://www.geogebratube.org/student/m279	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews) Pi Filling, Archimedes Style!: http://illuminations.nctm.org/LessonDetail.aspx?ID=U179
	Find the volume of cylinders, pyramids, cones, and spheres in contextual problems.	Provide opportunities for students to measure objects with the given characteristics. Include regular and irregular objects. Compute the volume of the objects.	Given a three-dimensional object, compute the effect on volume of doubling or tripling one or more dimension(s). (For example, how is the volume of a cone affected by doubling the height?) http://www.figurethis.org/challe

Unit 3 – Extending to Three Dimensions			
Visualize the relation between two-dimensional and three-dimensional objects. G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. **Apply geometric concepts in modeling situations.** G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*			nges/c03/challenge.htm http://map.mathshell.org/materials/tasks.php?taskid=288&subpage=expert
	Identify the shape of cross-sections of three-dimensional figures.	Builds on 7th grade standards. Use geometry software and/or manipulatives. Consider modeling or having students experiment with various sliceable objects.	
	Predict the shape of a three-dimensional figure generated by the rotation of a two-dimensional figure.	Use geometry software, manipulatives, video or 3-d representations.	
	Solve complex problems using geometric models.	Emphasize the connections between two- and three-dimensional objects.	http://illuminations.nctm.org/LessonDetail.aspx?ID=U175 http://alex.state.al.us/lesson_view.php?id=8979 Culminating project: Unit assessment

Additional Resources:

MAP Fun Size Cans http://map.mathshell.org/materials/tasks.php?taskid=252&subpage=apprentice
MAP Propane Tanks http://map.mathshell.org/materials/download.php?fileid=828

- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml

Unit 3 – Extending to Three Dimensions
• http://illuminations.nctm.org/ • http://www.khanacademy.org/ • http://blog.mrmeyer.com/ • http://www.dlt.ncssm.edu/stem/math-secondary

Unit 4 – Connecting Algebra and Geometry Through Coordinates

Unit Overveiw: Building on their work with the Pythagorean theorem in 8th grade to find distances, students use a rectangular coordinate system to verify geometric relationships, including properties of special triangles and quadrilaterals and slopes of parallel and perpendicular lines. Students continue their study of quadratics by connecting the geometric and algebraic definitions of the parabola.
Unit 4 – 10 Classes

Common Core State Standards in Connecticut

Use coordinates to prove simple geometric theorems algebraically.

G.GPE.4 Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*
G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and uses them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*

Translate between the geometric description and the equation for a conic section.

G.GPE.2 Derive the equation of a parabola given a focus and directrix.

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Geometric theorems (using coordinates)
• Slope criteria for parallel and perpendicular lines
• Directed line segment between two given points
• Distance formula
  ○ Perimeters of polygons
  ○ Area
  ▪ Triangles
  ▪ Rectangles
• Equation of a parabola (given focus and directrix)
	• USE
	  ○ (coordinates)
	  ▪ to prove simple geometric theorems algebraically
	  ▪ to compute perimeters and areas using distance formula
	  ○ (slope criteria for parallel and perpendicular lines to solve geometry problems)
	• PROVE (slope criteria for parallel and perpendicular lines to solve geometric problems)
	• FIND (point on a directed line segment that partitions the segment in a given ratio)
	• DERIVE (equation of parabola)

Unit 4 – Connecting Algebra and Geometry Through Coordinates			
Big Ideas Student's statements of enduring ideas			
1. The coordinate plane helps us to identify locations in space and verify and describe geometric relationships using these locations and algebraic properties.			
Essential Questions Teacher's guiding questions			
1. Why do we use a coordinate plane in Geometry?			
Critical Area 4; Math Practices 2, 3, 4, 8			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Use coordinates to prove simple geometric theorems algebraically. G.GPE.4 Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).* G.GPE.5 Prove the slope criteria for parallel and perpendicular lines and uses them to solve geometric problems (e.g.,	Prove simple geometric theorems algebraically using coordinates, focusing on lines, segments, and angles.	Prerequisite knowledge: properties of polygons, Pythagorean Theorem to determine distance, slope, equations of lines, relationship between parallel and perpendicular lines. Explore properties of geometric figures plotted on a coordinate plane using graphing technology. Provide examples, such as: prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle, parallelogram, prove or disprove that triangle ABC with coordinates A(-1, 2), B(1, 5), C (-2, 7) is an isosceles right triangle, etc…	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews) Proving a quadrilateral is a Square http://map.mathshell.org/materials/tasks.php?taskid=270&subpage=apprentice
	Prove the slope criteria for parallel and perpendicular lines informally.	Allow students to explore and make conjectures about relationships between lines and segments using a variety of methods. Give students rectangles, parallelograms and other shapes on a coordinate plane to explore slopes. Relate work on parallel lines to systems of equations having no solution or infinitely many solutions. Provide examples using lesson: Finding equations of parallel	

Unit 4 – Connecting Algebra and Geometry Through Coordinates			
find the equation of a line parallel or perpendicular to a given line that passes through a given point). G.GPE.6 Find the point on a directed line segment between two given points that partitions the segment in a given ratio. G.GPE.7 Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.*		and perpendicular lines http://map.mathshell.org/materials/lessons.php?taskid=226	
	Solve geometric problems using slope criteria for parallel and perpendicular lines.	Provide examples such as: given a triangle, use slopes to verify that the length and height are perpendicular.	
	Write the equation of a line parallel or perpendicular to a given line, passing through a given point.	Use slope-intercept form. Provide examples, such as: find an equation of a line perpendicular to y = 3x – 4, that passes through (3, 4). Make connections to parallelograms and contextual problems.	
	Determine the point that divides a segment into a given ratio.	Provide examples, such as: Given A(3, 2) and B(6, 11), find the point that divides the line segment AB two-thirds of the way from A to B; find the coordinates of the midpoint of a line segment.	
	Compute perimeters of polygons and areas of triangles and rectangles in the coordinate plane.	Establish the connection between the distance formula and the Pythagorean Theorem. Provide examples, such as: calculate the area of triangle ABC with altitude $\overline{CD}$, given A (-4,-2), B (8,7), C (1,8) and D (4,4).	Project: Find the area and perimeter of a real-world shape using a coordinate grid and Google Earth. Select a shape (your yard, a parking lot, the school, etc.). Use the tool menu to overlay a grid. Use coordinates to find the perimeter and area of the shape you've selected. Determine the scale factor of the picture as related to the actual real-life view. Then find the actual perimeter and area.

Unit 4 – Connecting Algebra and Geometry Through Coordinates			
Consider for Accelerated Only: **Translate between the geometric description and the equation for a conic section.** G.GPE.2 Derive the equation of a parabola given a focus and directrix.	Derive the equation of a parabola given a focus and directrix.	Finding the Equation of a Parabola given Focus and Directrix: http://hotmath.com/hotmath_help/topics/finding-the-equation-of-a-parabola-given-focus-and-directrix.html Use geometry software and/or manipulatives.	Unit assessment

Additional Resources:

- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

Unit 5 – Circles With and Without Coordinates

Unit Overview: In this unit, students prove basic theorems about circles, with particular attention to perpendicularity and inscribed angles, in order to see symmetry in circles and as an application of triangle congruence criteria. They study relation-ships among segments on chords, secants, and tangents as an application of similarity. In the Cartesian coordinate system, students use the distance formula to write the equation of a circle when given the radius and the coordinates of its center. Given an equation of a circle, they draw the graph in the coordinate plane, and apply techniques for solving quadratic equations to determine intersections between lines and circles or parabolas and between two circles.

Unit 5 – 10 classes

Common Core State Standards in Connecticut

Use coordinates to prove simple geometric theorems algebraically.

Understand and apply theorems about circles.

G.C.1 Prove that all circles are similar.

G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.*

G.C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.

G.C.4 (+) Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles.

G.C.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Translate between the geometric description and the equation for a conic section.

G.GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Use coordinates to prove simple geometric theorems algebraically.

G.GPE.4 Use coordinates to prove simple geometric theorems algebraically. *For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2).*

Apply geometric concepts in modeling situations.

G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*

Unit 5 – Circles With and Without Coordinates

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

• Circles
  ○ Similarity
  ○ Relationships among:
  ▪ Inscribed angles
  ▪ Radii
  ▪ Chords
  ○ Of triangles
  ▪ Inscribed
  ▪ Circumscribed
• Properties of angles for a quadrilateral inscribed in a circle
• (+) Tangent lines from a point outside a given circle to the circle
• Arc intercepted by an angle
• Radian measure of an angle
• Area of a sector
• Equation of a circle
  ○ Completing the square
  ○ Pythagorean Theorem
• Geometric theorems
• Geometric Shapes (to describe objects)
  ○ Measures
• Properties
	• PROVE
	  ○ (all circles are similar)
	  ○ (properties of angles for a quadrilateral inscribed in a circle)
	  ○ (geometric theorems algebraically using coordinates)
	• IDENTIFY (relationships among inscribed angles, radii, and chords)
	• DESCRIBE
	  ○ (relationships among inscribed angles, radii, and chords)
	  ○ (objects modeled by geometric shapes)
	• CONSTRUCT
	  ○ (inscribed and circumscribed circles of a triangle)
	  ○ (tangent line to a circle)
	• DERIVE
	  ○ (arc length is proportional to the radius of a circle)
	  ○ (formula for the area of a sector)
	  ○ (equation of a circle)
	• DEFINE (radian measure as constant of proportionality)

Big Ideas

Student's statements of enduring ideas

1. Since all circles are similar, all corresponding parts are proportional. Proportional reasoning can be used to find missing parts and solve problems.
2. We can derive the equation of a circle by using the Pythagorean Theorem (given a center and a radius).

Essential Questions

Teacher's guiding questions

1. How can the relationships among parts of circles help us to solve problems?
2. How can we derive the equation of a circle?

Critical Area 5; Math Practices 1, 2, 3, 5, 7

Unit 5 – Circles With and Without Coordinates			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Understand and apply theorems about circles. G.C.1 Prove that all circles are similar. G.C.2 Identify and describe relationships among inscribed angles, radii, and chords. *Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.* G.C.3 Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	Prove that all circles are similar.	Employ multiple strategies to prove all circles are similar; dilating the radius, construct similar triangles in two different circles in which one vertex is at the center of the circle and the other two vertices are on the circle. Provide examples, such as: Given a circle of a radius of 3 and another circle with a radius of 5, compare the ratios of the two radii, the two diameters, and the two circumferences.	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)
	Calculate the measures of central, inscribed, and circumscribed angles of a circle by using circle relationships.	Provide examples, such as: Given the measure of a central angle of a circle is 100 degrees, find the measures of an inscribed angle that intersects the circle at the same points as the central angle Use geometry software to explore relationships.	
	Demonstrate that the measure of the inscribed angle on a diameter is a right angle by using circle relationships.	Use geometry software to explore relationships.	
	Demonstrate that the radius of a circle is perpendicular to a tangent line where the radius intersects the circle by using circle relationships.	Use geometry software to explore relationships.	Two Wheels and a Belt http://illustrativemathematics.org/illustrations/621

<table>
<tr><th colspan="4">Unit 5 – Circles With and Without Coordinates</th></tr>
<tr><td rowspan="5">Consider for Accelerated Only:
G.C.4 (+) Construct a tangent line from a point outside a given circle to the circle.

Find arc lengths and areas of sectors of circles.
G.C.5 Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.

Translate between the geometric description and the equation for a conic section.
G.GPE.1 Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.

Use coordinates to prove simple geometric theorems algebraically.
G.GPE.4 Use coordinates to prove simple geometric theorems algebraically.</td><td>Inscribe a circle in a triangle.</td><td></td><td>Circles in Triangles Lesson
http://map.mathshell.org/materials/tasks.php?taskid=256&subpage=apprentice</td></tr>
<tr><td>Circumscribe a circle about a triangle.</td><td></td><td></td></tr>
<tr><td>Prove that opposite angles in a quadrilateral inscribed in a circle are supplementary.</td><td>Use geometry software to measure the angles of several quadrilaterals inscribed in circles in order to find any relationships between the angles.</td><td></td></tr>
<tr><td>Draw conclusions about the relationship between arc length intercepted by a central angle and the radius using the concept of similarity.</td><td>Provide opportunity for students to construct a circle of any size, and cut a pipe cleaner equal to the length of the radius. Measure portions of the circumference of the circle using the pipe cleaner radians.</td><td></td></tr>
<tr><td>Define the measure of the central angle in radians as the constant of proportionality.</td><td>Develop the definition of radians as a unit of measure by relating to arc length.

Guide students in the completion of the table and consider the ratio of arc length to radius for different radii.
<table>
<tr><th>Angle</th><th>Radius</th><th>Arc length</th><th>Arc length/ radius</th></tr>
<tr><td>60°</td><td>3 inches</td><td></td><td></td></tr>
<tr><td>60°</td><td>4 inches</td><td></td><td></td></tr>
<tr><td>60°</td><td>5 inches</td><td></td><td></td></tr>
<tr><td>60°</td><td>6 inches</td><td></td><td></td></tr>
</table></td><td></td></tr>
</table>

Unit 5 – Circles With and Without Coordinates			
For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point (1, √3) lies on the circle centered at the origin and containing the point (0, 2). **Apply geometric concepts in modeling situations.** G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).*	Derive the formula for the area of a sector.	Provide examples, such as Setting up Sprinklers http://illustrativemathematics.org/illustrations/607	Setting up Sprinklers
	Derive the equation of a circle using the Pythagorean theorem.	Provide examples that give the center of the circle and the radius. Provide examples using the lesson http://learnzillion.com/lessons/280-derive-the-equation-of-a-circle-using-the-pythagorean-theorem	Journal: How are equations of circles related to the Pythagorean theorem?
	Find the center and radius of a circle given its equation.	Model using completing the square.	
	Prove simple geometric theorems about circles algebraically using coordinates.	For example, prove or disprove that the point (1, $\sqrt{3}$) lies on the circle centered at the origin and containing the point (0, 2). Provide examples using the lesson http://learnzillion.com/lessons/286-prove-whether-a-point-is-on-a-circle Include simple proofs involving circles.	
	Solve complex problems using geometric models.		Unit assessment

Unit 5 – Circles With and Without Coordinates

Additional Resources:

Circles in Triangles Performance Task http://map.mathshell.org/materials/download.php?fileid=764

- http://map.mathshell.org/materials/index.php
- http://ccssmath.org/
- www.ccsstoolbox.org
- http://insidemathematics.org/
- High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
- http://www.illustrativemathematics.org/standards/hs
- http://education.ti.com/calculators/downloads/US/Activities/Search/
- http://learnzillion.com/
- http://www.uen.org/core/math/7-12.shtml
- http://illuminations.nctm.org/
- http://www.khanacademy.org/
- http://blog.mrmeyer.com/
- http://www.dlt.ncssm.edu/stem/math-secondary

Unit 6 – Applications of Probability

Unit Overview: Building on probability concepts that began in the middle grades, students use the languages of set theory to expand their ability to compute and interpret theoretical and experimental probabilities for compound events, attending to mutually exclusive events, independent events, and conditional probability. Students should make use of geometric probability models wherever possible. They use probability to make informed decisions.
Unit 6 - 7 classes +

Common Core State Standards in Connecticut

Understand independence and conditional probability and use them to interpret data.
S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").
S.CP.2 Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
S.CP.3 Understand the conditional probability of *A* given *B* as *P(A* and *B)/P(B)*, and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*.
S.CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*
S.CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.*

Use the rules of probability to compute probabilities of compound events in a uniform probability model.
S.CP.6 Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model.
S.CP.7 Apply the Addition Rule, *P(A* or *B) = P(A) + P(B) – P(A* and *B)*, and interpret the answer in terms of the model.
S.CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, *P(A* and *B) = P(A)P(B|A) = P(B)P(A|B)*, and interpret the answer in terms of the model.
S.CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

Use probability to evaluate outcomes of decisions.
S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Unit 6 – Applications of Probability

Unwrapped Performance Standards

Concepts: Need to know about:	**Skills:** Need to be able to:

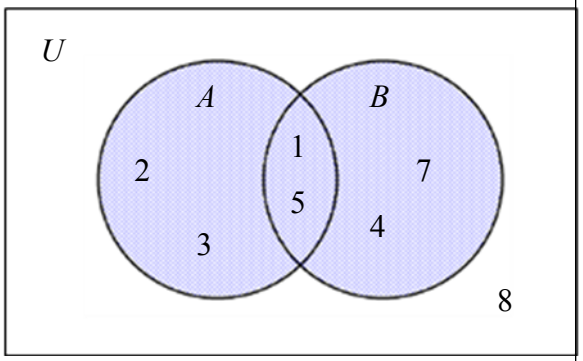
• Events as subsets of a sample space
  ○ Characteristics of the outcomes
  ○ Unions, intersections, or complements of other events
• Independent events
  ○ Probability of A and B occurring together
  ▪ Equals product of their probabilities
  ○ Determine independence
• Conditional probability
  ○ Everyday language and situations
• Independence
  ○ Everyday language and situations
• Two-way frequency tables
  ○ As a sample space
  ○ Independent events
  ○ Conditional probabilities
• Conditional probability
  ○ as the fraction of B's outcomes that also belong to A
• Addition Rule
• Multiplication Rule (+)
• Permutations and Combinations (+)
  ○ Compound events
• Outcomes (+)
  ○ Fair decisions
	• DESCRIBE (events)
	• USE (characteristics)
	• UNDERSTAND
	  ○ (independent events)
	  ○ (conditional probability)
	• INTERPRET (independence)
	• CONSTRUCT, INTERPRET and USE (two-way tables)
	• DECIDE (independence)
	• APPROXIMATE (conditional probabilities)
	• RECOGNIZE and EXPLAIN (conditional probability and independence)
	• FIND / COMPUTE
	• APPLY / INTERPRET
	  ○ (Addition Rule)
	  ○ (Multiplication Rule)
	• USE / COMPUTE
	  ○ (permutations and combinations)
	• EVALUATE (outcomes)
	• ANALYZE (decisions)

Big Ideas
Student's statements of enduring ideas

1. If two events are independent, one event does not affect the outcome of the other. If two events are conditional, the outcome of the second event depends on the outcome of the first event.
2. Understanding probability helps us to analyze situations, make predictions about events and make informed decisions.

Essential Questions
Teacher's guiding questions

1. What is the difference between independent and conditional probability?
2. Why is it important to understand probability?

Unit 6 – Applications of Probability			
Critical Area6; Math Practices 1, 5, 6			
CCSS Standards	**Objectives** The students will be able to:	**Instructional Strategies** Based on our department philosophy for student learning, mathematics teachers will:	**Common Learning Experiences and Assessments** Through these assessments/experiences, students will demonstrate mastery of the learning objectives. Teachers will assess and provide feedback to students about the following:
Understand independence and conditional probability and use them to interpret data. S.CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").	Identify sets and subsets within a sample space using correct set notation, with appropriate symbols and words.	Prerequisite knowledge: Two-way tables from algebra 1 Have students perform chance experiments, such as rolling dice or tossing coins, to generate sample spaces and identify events within the sample spaces. Model how to use Venn Diagrams to show relationships between sample spaces and events. Intersection: The **intersection** of two sets *A* and *B* is the set of elements that are common to both set *A* **and** set *B*. It is denoted by $A \cap B$ and is read '*A* intersection *B*'. • $A \cap B$ in the diagram is {1, 5} • this means: BOTH/AND  Union: The **union** of two sets *A* and *B* is the set of elements, which are in *A* **or** in *B* **or** in both. It is denoted by $A \cup B$ and is read '*A* union *B*'.	Formative assessments to determine student understanding, (e.g., pre-assessments, journal prompts, exit tickets, spiral reviews)

Unit 6 – Applications of Probability			
		• *A* ∪ *B* in the diagram is {1, 2, 3, 4, 5, 7} • this means: EITHER/OR/ANY • *could* be both Complement: The **complement of the set *A* ∪*B*** is the set of elements that are members of the universal set U but are not in *A* ∪*B*. It is denoted by (*A* ∪ *B*)' (*A* ∪ *B*)' in the diagram is {8}	
	Use probability notation and calculate probabilities for individual events and the intersection of events (joint probability).	Have students use various methods including converting frequencies from Venn diagrams, two-way frequency tables, etc.	
S.CP.2 Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.	Recognize that independent events satisfy the relationship $P(A) \cdot P(B) = P(A \cap B)$.	Have student compare the product of probabilities for individual events (P(A)·P(B)) with their joint probability $(P(A \cap B))$ for several events (both independent and dependent). Guide students to generate and use a two-way frequency table to describe characteristics of your class (ex. gender and eye color). Use the table to determine if eye color and gender are independent.	
S.CP.3 Understand the conditional probability of *A* given *B* as *P(A* and *B)/P(B)*, and interpret independence of *A* and *B* as saying that the	Describe conditional probability and how it applies to real-life events.	This means: if A is people who passed the test and B is people who studied, then A/B is people who passed the test given that they studied.	Modeling Conditional Probabilities 1: Lucky Dip http://map.mathshell.org/materials/lessons.php?taskid=409&subpage=problem

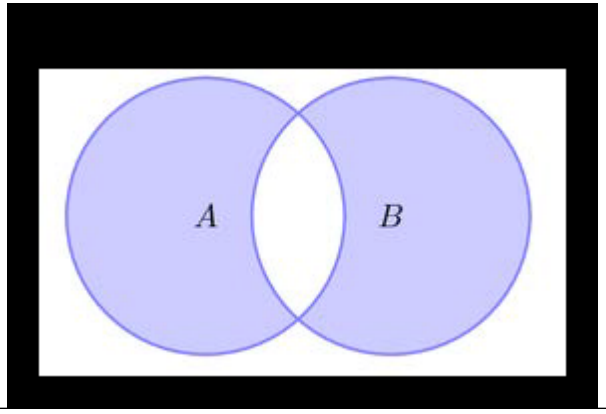
<table>
<tr><th colspan="4">Unit 6 – Applications of Probability</th></tr>
<tr>
<td rowspan="3">conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.

S.CP.4 Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.

S.CP.5 Recognize and explain the concepts of conditional probability and</td>
<td>Calculate conditional probabilities using $P(A/B) = \frac{P(A \cap B)}{P(B)}$.</td>
<td>Example:
At Johnson Middle School, the probability that a student takes computer science and French is 0.062. The probability that a student takes computer science is 0.43. What is the probability that a student takes French given that the student is taking computer science?</td>
<td>Titanic:
http://www.illustrativemathematics.org/illustrations/949</td>
</tr>
<tr>
<td>Apply the definition of independence to a variety of chance and real-life events.</td>
<td>Note, events A and B are independent if and only if they satisfy P(A/B)=P(A) or satisfy P(B/A) = P(B).

Example:
What is the probability of drawing a heart from a standard deck of cards on a second draw, given that a heart was drawn on the first draw and not replaced? Are these events independent or dependent? Why or why not?

Have students use venn diagrams, two-way frequency tables and other models to investigate this fact.</td>
<td></td>
</tr>
<tr>
<td>Construct and analyze two-way frequency tables.</td>
<td>Have students analyze the tables to determine independence and compute conditional probabilities.
Example:
<table>
<tr><th>Gender</th><th>Summer School</th><th>Summer Job</th><th>Total</th></tr>
<tr><td>Girls</td><td>25</td><td>20</td><td></td></tr>
<tr><td>Boys</td><td>35</td><td>20</td><td></td></tr>
<tr><td>Total</td><td></td><td></td><td></td></tr>
</table>
Construct two-way tables based on data from news media.
Resources:
Two Way Tables: http://stattrek.com/statistics/two-way-table.aspx
Data and Story Library (DASL): http://lib.stat.cmu.edu/cgi-bin/dasl.cgi?query=Contingency+table&submit=Search!&metaname=methods&sort=swishrank</td>
<td>Problem Task:
Life is like a box of chocolates. Suppose your box of 36 chocolates have some dark and some milk chocolate, divided into cream or nutty centers. Out of the dark chocolates, 8 have nutty centers. Out of the milk chocolates, 6 have nutty centers. One-third of the chocolates are dark chocolate. What is the probability that you randomly select a chocolate with a nutty center? Given that it has a nutty center, what is the probability you chose a dark chocolate? Show how you determined your answers.</td>
</tr>
</table>

Unit 6 – Applications of Probability			
independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* **Use the rules of probability to compute probabilities of compound events in a uniform probability model.** S.CP.6 Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model. S.CP.7 Apply the Addition Rule, *P(A* or *B) = P(A) + P(B) – P(A* and *B)*, and interpret the answer in terms of the model. ***Consider for Accelerated Only:*** S.CP.8 (+) Apply the general Multiplication Rule in a uniform probability model, *P(A* and *B) = P(A)P(B|A) = P(B)P(A|B)*, and interpret the answer in terms of the model. S.CP.9 (+) Use	Compare compound and conditional probabilities.	Use models and real-life events to make comparisons.	Journal: How are compound and conditional probabilities similar? How are they different?
	Define the probability of event (A or B) as the probability of their union.	Students could use graphing calculators, simulations, or applets to model probability experiments and interpret the outcomes. Example: • In a math class of 32 students, 18 are boys and 14 are girls. On a unit test, 5 boys and 7 girls made an A grade. If a student is chosen at random from the class, what is the probability of choosing a girl or an A student?	
	Apply the formula P(A or B) = P(A) + P(B) – P(A and B) and interpret the result.	Illustrate the addition rule pictorially. Sally shaded the following Venn diagram to illustrate the Addition Rule. What was wrong with her reasoning? How could you represent the addition rule pictorially? 	Unit assessment

<table>
<tr><th colspan="4">Unit 6 – Applications of Probability</th></tr>
<tr><td>permutations and combinations to compute probabilities of compound events and solve problems.

Use probability to evaluate outcomes of decisions.
S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).
S.MD.7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).</td><td></td><td></td><td>Final Exam</td></tr>
<tr><td colspan="4">Additional Resources:

Modeling Conditional Probabilities 2: http://map.mathshell.org/materials/lessons.php
Shodor Interactivate Venn Diagram Shape Sorter: http://www.shodor.org/interactivate/activities/ShapeSorter/
Cut the Knot – Conditional Probability and Independent Events:
http://www.cut-the-knot.org/Curriculum/Probability/ConditionalProbability.shtml
Texas A&M – Conditional Probability Applet: http://www.stat.tamu.edu/~west/applets/Venn1.html
• http://map.mathshell.org/materials/index.php
• http://ccssmath.org/
• www.ccsstoolbox.org
• http://insidemathematics.org/
• High School Flip Book - http://katm.org/wp/wp-content/uploads/flipbooks/High-School-CCSS-Flip-Book-USD-259-2012.pdf
• http://www.illustrativemathematics.org/standards/hs
• http://education.ti.com/calculators/downloads/US/Activities/Search/
• http://learnzillion.com/
• http://www.uen.org/core/math/7-12.shtml
• http://illuminations.nctm.org/</td></tr>
</table>

Unit 6 – Applications of Probability
• http://www.khanacademy.org/ • http://blog.mrmeyer.com/ • http://www.dlt.ncssm.edu/stem/math-secondary

Bristol Public Schools
Office of Teaching & Learning

DEPARTMENT: World Languages

COURSE: French 2

COURSE DESCRIPTION:
French 2 continues the development of the basic skills begun in the first year. The comprehension and speaking skills are stressed, but with more attention being given to reading and writing. The study of geography, history and culture of francophone world is continued.

PREREQUISITES: French 1

DEPARTMENT PHILOSOPHY: Our primary goal is to help all students develop linguistic proficiency and cultural sensitivity in a second language of their choice.
We believe that all students can benefit from second language instruction. We recognize that not everyone learns at the same rate or in the same way; nevertheless, we believe that all students should have the opportunity to acquire language proficiency to a degree commensurate with their individual abilities.
In the 21st century, the need for effective communication and sensitivity to other cultures has become even more important. We believe that the study of more than one language is essential to meeting these global needs.

DEPARTMENT GOALS:

Through a planned, sequential curriculum, Bristol Public schools strives to educate each student in conjunction with the State Standards for World Languages education. Students should be able to demonstrate skills and knowledge in each of the following standards:

- Communicate in at least one language other than English;
- Gain knowledge and understanding of other cultures;
- Make connections with other areas of study and acquire information;
- Understand the nature of language and cultures through comparisons; and
- Participate in multilingual communities within a variety of contexts.

COURSE GOALS:

Academic and Accelerated Objectives:

Standards are taught in academic and accelerated classes. The coursework is differentiated in content, teaching process, and student products, as seen in lesson objectives, assessments, pacing and performance, with an expectation that accelerated students speak and read with greater independence and fluency. Accelerated students are expected to meet all objectives for the course as well as those that go beyond the academic level and are printed in ***bold*** and ***italicized.*** Differentiation strategies, assessments and activities for accelerated students are also written in ***bold*** and ***italicized.*** Essential questions and learning objectives align by categorization (i.e. culture-related essential questions are aligned with culture-related learning objectives)

World Languages: French Level 2

TOPIC: HOME and CHORES

Connecticut Frameworks Content Standards (CSDE)

CONTENT STANDARD 1: Communication (Interpersonal Mode)
CONTENT STANDARD 2: Communication (Interpretive Mode)
CONTENT STANDARD 3: Communication (Presentational Mode)
CONTENT STANDARD 4: Culture
CONTENT STANDARD 5: Connections (Interdisciplinary Mode)
CONTENT STANDARD 6: Connections (Interdisciplinary Mode)
CONTENT STANDARD 7: Comparisons Among Languages
CONTENT STANDARD 8: Comparisons Among Cultures
CONTENT STANDARD 9: Communities

1.2.1 Exchange information with peers and the teacher (both face-to-face and in writing) about events in their everyday lives and experiences from their past.
1.3.3 Participate in culturally appropriate exchanges that reflect social amenities such as expressing gratitude, extending and receiving invitations, apologizing and communicating preferences.
2.1.7 Comprehend the principal message of highly illustrated texts in which cognates are used, including stories, newspaper articles and advertisements.
3.1.3 Write short informal notes in which they describe or provide information about themselves, their friends and families and their school activities.
4.1.4 Participate in age-appropriate cultural activities, such as games, songs, birthday celebrations, storytelling, dramatizations or role-playing of the target culture.
4.2.5 Observe, identify and discuss patterns of behavior or interaction that are typical of their peer group in the target culture.
5.2.3 Use new information and critical thinking gained through world language study to expand their personal knowledge.
7.2.1 Understand how idiomatic expressions affect communications and reflect culture.
8.1.5 Use new information and cultural awareness to compare and contrast their experiences with those of their peers in the target culture(s) and to identify with and respect peers in the target culture(s).
9.2.1 Discuss their families, school experiences, free-time activities and current events in the target language in oral or written form.

Connecticut Frameworks Performance Standards (CSDE)
1.2.1, 1.3.3, 2.1.7, 3.1.3, 4.1.4, **4.2.5**, 5.2.3, **7.2.1, 8.1.5, 9.2.1**

Common Core State Standards for English Language Arts

In mastering the following standards in French, students are expected to reinforce their understanding of such skills in English.
SPEAKING AND LISTENING STANDARD: SL
LANGUAGE STANDARD: L
SL 9.1.c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
L 9.2 Demonstrate command of the conventions of standard capitalization, punctuation, and spelling when writing.
L 9.2.c. Spell correctly.
L 4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades

World Languages: French Level 2

TOPIC: HOME and CHORES

9-10 reading and content, choosing flexibly from a range of strategies.
L 4.a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
L 4 b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g., analyze, analysis, analytical; advocate, advocacy).
L 4.c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology.
L 4 d Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).
L 5 Demonstrate understating of figurative language, word relationships, and nuances in word meanings.
L 5 a. Interpret figures of speech (e.g., euphemism, oxymoron) in context and analyze their role in the text.
L 5 b. Analyze nuances in the meaning of words with similar denotations.
L 6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

UNWRAPPED PERFORMANCE STANDARDS

Skills *What students need to be able to do*	*Concepts* *What students need to know about*
Exchange	**Information (home, chores, furniture)**
Describe	**Activities (chores)**
Describe	**House plans**
Compare and contrast	**Past tenses**
Discuss	**Everyday activities in the past**
Identify	**Rooms and furniture in a home**
Comprehend	**Short conversations (chores)**
Comprehend	**Main ideas (listening)**
Give	**Simple oral reports (home, chores etc.)**
Write	**Short notes (home, chores etc.)**
Recognize	**Different past tenses**
Use	Multimedia sources
Exhibit	**Awareness (phonetics, writing)**
Demonstrate, compare & contrast	**Knowledge of behavior (common vacation spots)**
Analyze	**Authentic cultural experiences**
Evaluate	**French homes (culture)**
Formulate	**Conclusions (culture)**
Create	**Floor plans**

World Languages: French Level 2
TOPIC: HOME and CHORES

Big Ideas

Student's statements of enduring ideas

1. Communicating in languages other than English by engaging in conversations, understanding and interpreting spoken and written language, and presenting information enables one to fully participate as a citizen of the world.
2. The ability to acknowledge and understand of other cultures is gained through examining the products, practices, and perspectives of those cultures.
3. Language is a tool that can be used to connect with other disciplines and acquire information.
4. By comparing languages and cultures, students develop insights into their own language and culture.
5. The study of a foreign language allows students to participate in multilingual communities at home and around the world.

Essential Questions

Teacher's guiding questions

1. What does it mean to communicate and how do I communicate in my target language?
2. What is culture and how do I learn more about other cultures?
3. How can I use my foreign language to increase my understanding of other disciplines?
4. Why is it important to make cultural and linguistic comparisons?
5. Where can I use my foreign language outside of the classroom?

Bristol Public Schools
World Languages
French Level 2

World Languages: French Level 2 **TOPIC: HOME and CHORES**	
Unit Essential Questions	**Learning Objectives** The students will be able to:
Communication: A. How do I identify rooms and furniture in a home? B. How do I talk about actions that took place repeatedly in the past versus actions that were completed in the past? C. What information do I need to be able to talk about chores? D. How do I identify important appliances in a home? E. How do I talk about things/people that I know?	**Communication:** A. Identify rooms and furniture in a home. B. Compare and contrast the uses of the **passé composé** and **l'imparfait** to discuss actions in the past B. Infer conclusions about the 2 past tenses in the target language. C. Discuss chores. D. Identify and recognize key appliances in a home. E. Distinguish between the uses of **savoir** and **connaître**.
Culture: A. What are the different types of housing in France and the French-speaking world? B. How is the interior of French homes set up? C. What are some idiomatic expressions used in the target culture to describe a home or a room? D. How do I talk about famous homes in the Francophone world?	**Culture:** A. Identify different housing types in the French-speaking world. B. Discuss the set up of the interior of French homes. C. Use idiomatic expressions to talk about conditions in a home or room. D. Discuss famous residences in the Francophone world.
Comparisons: A. What are the differences and similarities between types of housing in the United States and in France? B. How is the interior of houses in France similar to or different from the interior of houses in the United States?	**Comparisons:** A. Compare and contrast types of housing in the United States and France. B. Compare and contrast the interior of homes in France with the interior of homes in the United States.
Connections: A. What information do I need to be able to create an authentic floor plan of a French home? B. How do I talk about actions in the past? C. What prior knowledge do I have of practices in New Orleans?	**Connections:** A. Create an authentic French home floor plan. B. Discuss the use of the past tense to talk about actions completed or actions that were done habitually in the past. C. Activate prior knowledge of New Orleans.
Communities: A. How does socioeconomic status affect housing and architecture?	**Communities:** A. Identify different architectural styles in the local community. A. Examine the effect of socioeconomic status on the types of housing available in the local community. B.

World Languages: French Level 2

TOPIC: HOME and CHORES

INSTRUCTIONAL STRATEGIES: ***Based on our philosophy for student learning in World Languages and our knowledge of effective instruction, teachers will:***

- Model vocabulary, grammar and idiomatic expressions.
- Incorporate video or audio segments from target cultures.
- Facilitate classroom discussions that examine and compare cultural differences. ***Accl: Accelerated students play the roles of facilitators during classroom discussions. Students can also be assigned group discussion topics, with the goal of presenting discussion results to the class.***
- Create and utilize communicative activities.
- Support peer teaching. ***Accl: Students create mini lessons based on an assigned topic, after self teaching to teach the rest of the class. In split classes, accelerated students also can have the opportunity to act as a peer teacher, after self teaching.***
- Design various practice activities for vocabulary acquisition and retention. ***Accl: Students are given additional vocabulary and higher level Depth of Knowledge practice activities.***
- Use readings from textbook. ***Accl: Students are given more target language readings especially in the culture segments of the unit.***
- Design and utilize PowerPoint/SMART board presentations ***Accl: lessons differ in structure and in delivery. Accelerated students are introduced to material (especially grammar concepts) in a way to require them to develop logical conclusions with less teacher guidance.***
  - Complete online exercises.
  - Scaffold prior vocabulary.
  - Utilize peer editing to further enhance writing skills.
  - Require students to access program Internet activities including but not limited to current news clips
  - Invite classroom speakers from target culture.
  - Make interdisciplinary (i.e.: Math, Social Sciences, English) connections to reinforce learning
  - Require students to participate in teacher-created web-based activities.
- Create Total Physical Response (TPR) activities.

Assessments:
In order to understand the strengths and weaknesses of our students, teachers will assess and provide feedback to students about the following:

- Writing prompts in the target language ***Accl: Rubrics adjusted to include more requirements demonstrating independent use of the language***
- Dialogues and role-play activities in the target language ***Accl: Memorization of dialogues***
- Reading and listening comprehension activities
- Vocabulary and structure quizzes
- Cloze activities
- Summative performance assessments (oral or in writing)
- Technology based activities (i.e. Power Point, Voice Thread, Voki and Wikis)
- Culture comparison charts ***Accl: Creation of multiple charts that document cultural similarities and differences.***
- ***Assessments will be modified through the use of word banks and models for Academic classes***

World Languages: French Level 2

TOPIC: HOME and CHORES

Resources: In order to provide students with the best language outcome, teachers will employ the following resources, available from both teacher materials and the Internet:

- *D'accord*! 2, Unité préliminaire (also, *D'accord* 1, Unité 8)
- Student materials (Student book, workbooks)
- ***Accl: Maestro SuperSite (cahier intéractif, audio, video & practice)***
- Teacher materials: DVDs (Roman-photo, flash culture, Maestro SuperSite)
- Audio CDs (testing and audio program)
- Depth of Knowledge (Webb's Depth of Knowledge tools)

World Languages: French Level 2
TOPIC: FOOD

Connecticut Frameworks Content Standards (CSDE)

CONTENT STANDARD 1: Communication (Interpersonal Mode)
CONTENT STANDARD 2: Communication (Interpretive Mode)
CONTENT STANDARD 3: Communication (Presentational Mode)
CONTENT STANDARD 4: Culture
CONTENT STANDARD 5: Connections (Interdisciplinary Mode)
CONTENT STANDARD 6: Connections (Interdisciplinary Mode)
CONTENT STANDARD 7: Comparisons Among Languages
CONTENT STANDARD 8: Comparisons Among Cultures
CONTENT STANDARD 9: Communities

Connecticut Frameworks Performance Standards (CSDE)

1.1.2 Describe various objects and people found at home and school.
1.1.4 Exchange basic information about events such as classes, meetings and meals.
1.1.5 Describe their favorite activities at home and school.
1.1.6 Express their likes and dislikes regarding various people, objects, categories and events present in their everyday environments.
2.1.1 Identify people and objects in their environments, based on oral and written descriptions.
2.1.2 Comprehend short conversations among peers and familiar adults on well-known topics, including their favorite activities at home or school.
3.1.1 Give simple oral reports or presentations about family members and friends, objects, or common school and home activities in their everyday environments.
3.1.3 Write short informal notes in which they describe or provide information about themselves, their friends and families, and their school activities.
7.1.2 Demonstrate an awareness of the target language's phonetic and writing systems and how they differ from the phonetic and writing systems in the English language.
9.1.2 Identify different types of employment in which target language skills are an asset.

Connecticut Frameworks Performance Standards (CSDE)

1.1.2, 1.1.4, 1.1.5, 1.1.6, 2.1.1, 2.1.2, 3.1.1, *3.1.3,* ***7.1.2, 9.1.2***

Common Core State Standards for English Language Arts

In mastering the following standards in French, students are expected to reinforce their understanding of such skills in English

SPEAKING AND LISTENING STANDARD: SL
LANGUAGE STANDARD: L

SL 9.1.c. Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.
L 9.2 Demonstrate command of the conventions of standard capitalization, punctuation, and spelling when writing.
L 9.2.c. Spell correctly.
L 4. Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9-10 reading and content, choosing flexibly from a range of strategies.
L 4.a. Use context (e.g., the overall meaning of a sentence, paragraph, or text; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.
L 4 b. Identify and correctly use patterns of word changes that indicate different meanings or parts of speech (e.g.,

World Languages: French Level 2

TOPIC: FOOD

analyze, analysis, analytical; advocate, advocacy).
L 4.c. Consult general and specialized reference materials (e.g., dictionaries, glossaries, thesauruses), both print and digital, to find the pronunciation of a word or determine or clarify its precise meaning, its part of speech, or its etymology.
L 4 d Verify the preliminary determination of the meaning of a word or phrase (e.g., by checking the inferred meaning in context or in a dictionary).
L 5 Demonstrate understating of figurative language, word relationships, and nuances in word meanings.
L 5 a. Interpret figures of speech (e.g., euphemism, oxymoron) in context and analyze their role in the text.
L 5 b. Analyze nuances in the meaning of words with similar denotations.
L 6 Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

UNWRAPPED PERFORMANCE STANDARDS

Skills *What students need to be able to do*	*Concepts* *What students need to know about*
Exchange	***Information (food, meals)***
Comprehend	***Main ideas through technology (videos, DVDS, films, television programs or websites***
Indicate	***Understanding of cultural practices (eating)***
Distinguish	***Differences in verbs and their usage***
Comprehend	*Short conversations (food and meals)*
Compare	***Nouns and verbs (comparatives)***
Demonstrate	***Knowledge of idiomatic expressions***
Compare and contrast	*Everyday activities (French-speaking world)*
Exhibit	*Correct pronunciation (accents, liaisons etc)*
Give	*Short descriptions of self and others/oral reports*
Write	***Short notes/conversations***
Express	***Likes and dislikes using negation***
Distinguish	***Differences in the usage of the 12- and 24-hour clocks.***

Bristol Public Schools
World Languages
French Level 2

Big Ideas

Student's statements of enduring ideas

1. Communicating in languages other than English by engaging in conversations, understanding and interpreting spoken and written language, and presenting information enables one to fully participate as a citizen of the world.
2. The ability to acknowledge and understand of other cultures is gained through examining the products, practices, and perspectives of those cultures.
3. Language is a tool that can be used to connect with other disciplines and acquire information.
4. By comparing languages and cultures, students develop insights into their own language and culture.
5. The study of a foreign language allows students to participate in multilingual communities at home and around the world.

Essential Questions

Teacher's guiding questions

1. What does it mean to communicate and how do I communicate in my target language?
2. What is culture and how do I learn more about other cultures?
3. How can I use my foreign language to increase my understanding of other disciplines?
4. Why is it important to make cultural and linguistic comparisons?
5. Where can I use my foreign language outside of the classroom?

Unit Essential Questions	**Learning Objectives** The students will be able to:
Communication: A. How do I talk about foods and meals in the target language? B. How do I talk about dining in a restaurant? C. What do I need to know to be able to talk about shopping for food? D. How do I talk about events that took place very recently? E. How do I talk about something that happened at a certain time in the past? F. How do I talk about things that I must do, want to	**Communication:** A. Discuss food items and meals. B. Discuss setting the table and eating in a restaurant. C. Recognize and categorize specific food stores. D. Use the verb ***venir*** (and similar verbs) to talk about events that just happened. E. Relate activities that happened at a certain time in the past, using time

do and can do? G. What do I need to do know to be able to make comparisons using adjectives and adverbs in the target language? H. What do I need to know to be able to avoid repetition?	expressions (***depuis, il y a*** etc). F. Distinguish between the verbs ***vouloir, pouvoir*** and ***devoir***. G. Form comparatives and superlatives of adjectives and adverbs. H. Replace nouns with direct and indirect object pronouns, while identifying patterns and sequencing.
Culture: A. From where do the French get their groceries? B. What are some foods that are specific to French-speaking regions? C. What do I need to know to be able to talk about dining and meals in France? D. What do I need to know in order to be culturally polite in some French-speaking territories? ***E. How popular is food from other cultures in France?***	**Culture:** A. Discuss grocery shopping in France. B. Distinguish between typical foods found in New Orleans and France. B. Categorize French cheeses. C. Differentiate between the meals that a French person eats. C. Develop a logical argument about French eating patterns. D. Assess the different manners, while dining, in France and French-speaking parts of North Africa. ***E. Predict, using a reading in the target language, what are some common foods from North Africa that are popular in France.***
Comparisons: A. How is grocery shopping in France similar to or different from grocery shopping in the United States? B. How do manners differ among French-speaking territories **and** the United States?	**Comparisons:** A. Compare and contrast grocery shopping patterns. A. Cite evidence to demonstrate how grocery shopping is different in France from the United States. B. Apply concepts of and critique the dining mannerisms of France and French speaking North Africa **and** the United States.
Connections: A. How can I use my knowledge of other subject areas to help me better understand food, meals and dining in France? B. What would I need to know an authentic French meal?	**Connections:** A. Discuss food items that are of a French origin that are a part of authentic dining experiences. B. Design a typical French meal. ***B. Create a typical French meal.***
Communities: A. What are some typical dining mannerisms used in restaurants in the community?	**Communities:** A. Evaluate concepts of dining and proper dining mannerisms in the United States.

Bristol Public Schools
World Languages
French Level 2

INSTRUCTIONAL STRATEGIES
Based on our philosophy for student learning in World Languages and our knowledge of effective instruction, teachers will:

- Model vocabulary, grammar and idiomatic expressions
- Incorporate video or audio segments from target cultures
- Facilitate classroom discussions that examine and compare cultural differences. ***Accl: Accelerated students play the roles of facilitators during classroom discussions. Students can also be assigned group discussion topics, with the goal of presenting discussion results to the class.***
- Create and utilize communicative activities
- Support peer teaching. ***Accl: Students create mini lessons based on an assigned topic, after self teaching to teach the rest of the class. In split classes, accelerated students also can have the opportunity to act as a peer teacher, after self teaching.***
- Design various practice activities for vocabulary acquisition and retention. ***Accl: Students are given additional vocabulary and higher level Depth of Knowledge practice activities.***
- Use readings from textbook. ***Accl: Students are given more target language readings especially in the culture segments of the unit.***
- Design and utilize PowerPoint/SMART board presentations ***Accl: lessons differ in structure and in delivery. Accelerated students are introduced to material (especially grammar concepts) in a way to require them to develop logical conclusions with less teacher guidance.***
  - Complete online exercises
  - Scaffold prior vocabulary
  - Utilize peer editing to further enhance writing skills.
  - Require students to access program Internet activities including but not limited to current news clips
  - Invite classroom speakers from target culture
  - Make interdisciplinary (i.e.: Math, Social Sciences, English) connections to reinforce learning
  - Require students to participate in teacher-created web-based activities
- Create Total Physical Response (TPR) activities

Assessments:
In order to understand the strengths and weaknesses of our students, teachers will assess and provide feedback to students about the following:

- Writing prompts in the target language ***Accl: Rubrics adjusted to include more requirements demonstrating independent use of the language***
- Dialogues and role-play activities in the target language ***Accl: Memorization of dialogues***
- Reading and listening comprehension activities
- Vocabulary and structure quizzes
- Cloze activities
- Summative performance assessments (oral or in writing)
- Technology based activities (i.e. Power Point, Voice Thread, Voki and Wikis)
- Culture comparison charts ***Accl: Creation of multiple charts that document cultural similarities and differences.***
- ***Assessments will be modified through the use of word banks and models for Academic classes***

Resources:
In order to provide students with the best language outcome, teachers will employ the following resources, available from both teacher materials and the Internet:

World Languages: French Level 1

TOPIC: Health

Connecticut Frameworks Content Standards (CSDE)

CONTENT STANDARD 1: Communication (Interpersonal Mode)
CONTENT STANDARD 2: Communication (Interpretive Mode)
CONTENT STANDARD 3: Communication (Presentational Mode)
CONTENT STANDARD 4: Culture
CONTENT STANDARD 5: Connections (Interdisciplinary Mode)
CONTENT STANDARD 6: Connections (Interdisciplinary Mode)
CONTENT STANDARD 7: Comparisons Among Languages
CONTENT STANDARD 8: Comparisons Among Cultures
CONTENT STANDARD 9: Communities

Connecticut Frameworks Performance Standards (CSDE)

1.1.2 Describe various objects and people found at home and school.
1.1.4 Exchange basic information about events such as classes, meetings and meals.
1.1.5 Describe their favorite activities at home and school.
1.1.6 Express their likes and dislikes regarding various people, objects, categories and events present in their everyday environments.
1.1.8 Recognize that there are often multiple ways to express an idea in the target language.
2.1.1 Identify people and objects in their environments, based on oral and written descriptions.
2.1.2 Comprehend short conversations among peers and familiar adults on well-known topics, including their favorite activities at home or school.
2.1.3 Comprehend the main ideas contained in videos, DVDs, films, television programs or websites on familiar topics.
3.1.1 Give simple oral reports or presentations about family members and friends, objects, or common school and home activities in their everyday environments.
3.1.3 Write short informal notes in which they describe or provide information about themselves, their friends and families, and their school activities.
4.1.6 Recognize simple themes, ideas or perspectives of the target culture.
7.1.2 Demonstrate an awareness of the target language's phonetic and writing systems and how they differ from the phonetic and writing systems in the English language.
8.1.2 Demonstrate knowledge of the patterns of behavior across cultures that are related to recreation and celebrations.
8.1.5 Use new information and cultural awareness to compare and contrast their experiences with those of their peers in the target culture(s) and to identify with and respect peers in the target culture(s).

Connecticut Frameworks Performance Standards (CSDE)

1.1.2, 1.1.4, 1.1.5, 1.1.6, 1.1.8, **2.1.1, 2.1.2, 2.1.3, 3.1.1, 3.1.3, 4.1.6, 7.1.2, 8.1.2,** 8.1.5

UNWRAPPED PERFORMANCE STANDARDS

Skills *What students need to be able to do*	*Concepts* *What students need to know about*
Exchange	**Information (classes, schedules)**
Comprehend	**Main ideas through technology (videos, DVDS, films, television**

World Languages: French Level 1	
TOPIC: Health	
	programs or websites
Indicate	**Understanding of cultural practices**
Skills *What students need to be able to do*	*Concepts* *What students need to know about*
Describe	**Activities (home, school)**
Describe	**People, objects (home, school, professions)**
Exchange	**Basic information (events, classes, meals, etc.)**
Express	**Likes & dislikes**
Recognize, express	Ideas
Identify	**Family members, pets, professions**
Comprehend	**Short conversations (home, school)**
Comprehend	**Main ideas (listening)**
Give	**Simple oral reports (family, friends, marital status etc.)**
Write	**Short notes (friends, family, home, school)**
Recognize	**Themes, ideas, perspectives (culture)**
Demonstrate, compare & contrast	**Knowledge of behavior (French family)**
Compare & contrast	Experiences (culture)
Demonstrate	**Possession, knowledge of numbers**

Bristol Public Schools
World Languages
French Level 2

Big Ideas

Student's statements of enduring ideas

1. Communicating in languages other than English by engaging in conversations, understanding and interpreting spoken and written language, and presenting information enables one to fully participate as a citizen of the world.
2. The ability to acknowledge and understand of other cultures is gained through examining the products, practices, and perspectives of those cultures.
3. Language is a tool that can be used to connect with other disciplines and acquire information.
4. By comparing languages and cultures, students develop insights into their own language and culture.
5. The study of a foreign language allows students to participate in multilingual communities at home and around the world.

Essential Questions

Teacher's guiding questions

1. What does it mean to communicate and how do I communicate in my target language?
2. What is culture and how do I learn more about other cultures?
3. How can I use my foreign language to increase my understanding of other disciplines?
4. Why is it important to make cultural and linguistic comparisons?
5. Where can I use my foreign language outside of the classroom?

Unit Essential Questions	**Learning Objectives** The students will be able to:
Communication: A. What do I need to know to be able to talk about my daily routine? B. How do I use certain expressions to communicate? C. How do I talk about illnesses and medical conditions? D. What do I need to know to be able to talk about treatments for medical issues? E. How do I talk about things that have happened in the past? F. How do I avoid repetition?	**Communication:** A. Identify and discuss body parts and daily routines. A. Talk about personal hygiene. A. ***Associate objects with body parts.*** A. Use reflexive verbs to talk about daily occurrences. B. Construct phrases using idiomatic expressions from reflexive verbs. C. Discuss illnesses and medical conditions.

	D. Formulate and recommend treatments for medical conditions. E. Use the past tense of reflexive verbs to talk about things that have happened in the past. F. Use the pronouns ***y*** and ***en*** to replace nouns to avoid repetition.
Culture: A. What do the French do when they do not feel well? ***B. What are some informal terms used by the French in everyday conversation to parts of the body?*** ***C. What are some typical health habits of French people?*** D. How do I use idiomatic expressions about the body in French? E. What is a popular brand of health products in France? F. What is the national healthcare system like in France? ***G. How do I talk about common maladies in French?*** ***H. Who are some francophone medical pioneers?*** I. Why is L'hôtel des Invalides important?	**Culture:** A. Discuss typical medical services and pharmacies in France. ***B. Discuss informal terms used by the French to talk about body parts.*** ***C. Interpret typical health habits of French people.*** D. Employ the use of some idiomatic expressions from some French-speaking countries. E. Discuss the brand L'Occitane's origin and popularity in France and the world. F. Discuss how France's healthcare system works. ***G. Describe common health problems in French.*** ***H. Recognize several francophone pioneers in medicine.*** ***I.*** Discuss the importance of the French monument L'hôtel des Invalides.
Comparisons: A. How are idiomatic expressions in the target language similar to or different from idiomatic expressions in English? B. What are the differences between medical services and pharmacies in France and the United States? C***. What are the differences between national healthcare systems in France versus the United States?*** D. What is a historically important monument in the United States?	**Comparisons:** A. Compare and contrast commonly used idiomatic expressions in French with commonly used idiomatic expressions in English. B. Differentiate between medical services in France and the United States. B. Differentiate between pharmacies in France and the United States. ***C. Analyze differences between the French healthcare system and the healthcare system in the United States.*** D. Recognize or identify a historically

	important monument in the United States.
Connections: A. How do I use Venn diagrams to show comparisons? B. Why are some buildings considered historically important?	**Connections:** A. Create Venn diagrams that show grammatical and cultural comparisons. B. Prove why some buildings are historically important.
Communities: A. What are some popular healthy and beauty stores locally?	**Communities:** A. Discuss local health and beauty stores. ***A. Investigate local health and beauty stores.***

INSTRUCTIONAL STRATEGIES
Based on our philosophy for student learning in World Languages and our knowledge of effective instruction, teachers will:

- Model vocabulary, grammar and idiomatic expressions
- Incorporate video or audio segments from target cultures
- Facilitate classroom discussions that examine and compare cultural differences. ***Accl: Accelerated students play the roles of facilitators during classroom discussions. Students can also be assigned group discussion topics, with the goal of presenting discussion results to the class.***
- Create and utilize communicative activities
- Support peer teaching. ***Accl: Students create mini lessons based on an assigned topic, after self teaching to teach the rest of the class. In split classes, accelerated students also can have the opportunity to act as a peer teacher, after self teaching.***
- Design various practice activities for vocabulary acquisition and retention. ***Accl: Students are given additional vocabulary and higher level Depth of Knowledge practice activities.***
- Use readings from textbook. ***Accl: Students are given more target language readings especially in the culture segments of the unit.***
- Design and utilize PowerPoint/SMART board presentations ***Accl: lessons differ in structure and in delivery. Accelerated students are introduced to material (especially grammar concepts) in a way to require them to develop logical conclusions with less teacher guidance.***
    - Complete online exercises
    - Scaffold prior vocabulary
    - Utilize peer editing to further enhance writing skills.
    - Require students to access program Internet activities including but not limited to current news clips
    - Invite classroom speakers from target culture
    - Make interdisciplinary (i.e.: Math, Social Sciences, English) connections to reinforce learning
    - Require students to participate in teacher-created web-based activities

Create Total Physical Response (TPR) activities

Bristol Public Schools
World Languages
French Level 2

Assessments:
In order to understand the strengths and weaknesses of our students, teachers will assess and provide feedback to students about the following:

- Writing prompts in the target language ***Accl: Rubrics adjusted to include more requirements demonstrating independent use of the language***
- Dialogues and role-play activities in the target language ***Accl: Memorization of dialogues***
- Reading and listening comprehension activities
- Vocabulary and structure quizzes
- Cloze activities
- Summative performance assessments (oral or in writing)
- Culture comparison charts ***Accl: Creation of multiple charts that document cultural similarities and differences.***
- Technology based activities (i.e. Power Point, Voice Thread, Voki and Wikis)
- ***Assessments will be modified through the use of word banks and models for Academic classes***

Resources:
In order to provide students with the best language outcome, teachers will employ the following resources, available from both teacher materials and the Internet:

- *D'accord*! 2, Unité 2
- Student materials (Student book, workbooks)
- ***Accl: Maestro SuperSite (cahier intéractif, audio, video & practice)***
- Teacher materials: DVDs (Roman-photo, flash culture, Maestro SuperSite)
- Audio CDs (testing and audio program)
- Depth of Knowledge (Webb's Depth of Knowledge tools)

World Languages: French Level 2

TOPIC: TECHNOLOGY

Connecticut Frameworks Content Standards (CSDE)

CONTENT STANDARD 1: Communication (Interpersonal Mode)
CONTENT STANDARD 2: Communication (Interpretive Mode)
CONTENT STANDARD 3: Communication (Presentational Mode)
CONTENT STANDARD 4: Culture
CONTENT STANDARD 5: Connections (Interdisciplinary Mode)
CONTENT STANDARD 6: Connections (Interdisciplinary Mode)
CONTENT STANDARD 7: Comparisons Among Languages
CONTENT STANDARD 8: Comparisons Among Cultures
CONTENT STANDARD 9: Communities

Connecticut Frameworks Performance Standards (CSDE)

1.1.2 Describe various objects and people found at home and school.
1.1.4 Exchange basic information about events such as classes, meetings and meals.
1.1.5 Describe their favorite activities at home and school.
1.1.6 Express their likes and dislikes regarding various people, objects, categories and events present in their everyday environments.
1.1.8 Recognize that there are often multiple ways to express an idea in the target language.
2.1.1 Identify people and objects in their environments, based on oral and written descriptions.
2.1.2 Comprehend short conversations among peers and familiar adults on well-known topics, including their favorite activities at home or school.
2.1.3 Comprehend the main ideas contained in videos, DVDs, films, television programs or websites on familiar topics.
3.1.1 Give simple oral reports or presentations about family members and friends, objects, or common school and home activities in their everyday environments.
3.1.3 Write short informal notes in which they describe or provide information about themselves, their friends and families, and their school activities.
6.1.1 Use multimedia resources to access information regarding the target culture(s).
7.1.1 Give examples of words borrowed from one language and used in another, and develop an understanding of the process of borrowing.
4.1.6 Recognize simple themes, ideas or perspectives of the target culture.
7.1.2 Demonstrate an awareness of the target language's phonetic and writing systems and how they differ from the phonetic and writing systems in the English language.
8.1.2 Demonstrate knowledge of the patterns of behavior across cultures that are related to recreation and celebrations.

Connecticut Frameworks Performance Standards (CSDE)

1.1.2, 1.1.4, 1.1.5, 1.1.6, 1.1.8, **2.1.1, 2.1.2, 2.1.3, 3.1.1, 3.1.3, 4.1.6,** 6.1.1, 7.1.1, **7.1.2, 8.1.2**

UNWRAPPED PERFORMANCE STANDARDS

Skills *What students need to be able to do*	*Concepts* *What students need to know about*
Exchange	**Information (food and pastimes)**
Describe	**Activities (leisure time)**

World Languages: French Level 2	
TOPIC: TECHNOLOGY	
Describe	**People, objects (places around town, café)**
Synthesize	**Verbs and food items**
Express	**Likes & dislikes**
Recommend	**Ideas (things to do, places to go)**
Identify	**People, objects**
Comprehend	**Short conversations (home, school)**
Comprehend	**Main ideas (listening)**
Give	**Simple oral reports (family, friends, school, etc.)**
Write	**Short notes (friends, family, home, school)**
Recognize	**Themes, ideas, perspectives (culture)**
Use	Multimedia sources
Recognize	**Words borrowed from other languages**
Exhibit	**Awareness (phonetics, writing)**
Demonstrate, compare & contrast	**Knowledge of behavior (recreation, celebrations)**
Analyze	**Authentic cultural experiences**
Evaluate	**Importance of cafés (culture)**
Formulate	**Conclusions (culture)**

World Languages: French Level 2
TOPIC: TECHNOLOGY

Big Ideas

Student's statements of enduring ideas

1. Communicating in languages other than English by engaging in conversations, understanding and interpreting spoken and written language, and presenting information enables one to fully participate as a citizen of the world.

2. The ability to acknowledge and understand of other cultures is gained through examining the products, practices, and perspectives of those cultures.

3. Language is a tool that can be used to connect with other disciplines and acquire information.

4. By comparing languages and cultures, students develop insights into their own language and culture.

5. The study of a foreign language allows students to participate in multilingual communities at home and around the world.

Essential Questions

Teacher's guiding questions

1. What does it mean to communicate and how do I communicate in my target language?

2. What is culture and how do I learn more about other cultures?

3. How can I use my foreign language to increase my understanding of other disciplines?

4. Why is it important to make cultural and linguistic comparisons?

5. Where can I use my foreign language outside of the classroom?

Unit Essential Questions	**Learning Objectives** The students will be able to:
Communication: A. What information do I need to talk about technology? B. What pronunciation skills do I need to pronounce final consonants in the target language? C. What do I need to know to be able to use multiple verbs in a sentence? D. How do I talk about shared and reciprocal actions between more than one person?	**Communication:** A. Use terms for electronics products. A. Employ Internet terms B. Differentiate between the pronunciations of final consonants in the target language. C. Create infinitive constructions with and without prepositions. D. Formulate sentences using reciprocal reflexives. E. Use terms for cars and driving. E. Use terms for car maintenance and repair. F. Differentiate between the pronunciations of the

World Languages: French Level 2 **TOPIC: TECHNOLOGY**	
E. What information do I need to talk about cars and driving? F. What pronunciation skills do I need to pronounce the letter **x** in the target language? G. How do I talk about everyday activities? H. How do I express what I would do or what would happen in certain circumstances? I. How do I make requests politely? J***. How do I express future actions in a past tense?***	letter **x** in the target language. G. Use the irregular verbs **ouvrir** and **offrir** to talk about opening and offering. H. Talk about what they would or would not do using the conditional tense. I. Make polite requests using the conditional tense. J. ***Talk about what someone said or thought would happen.***
Culture: A. How do the French use technology? B. How has technology use in France changed over the years? C. How is France involved in the "conquest" of space? D. What are some driving habits in France? E. What is a popular brand of French cars?	**Culture:** A. Analyze how people in France use technology. B. Discuss the changing use of technology in France since 1996. C. Discuss France's role in space programs, specifically the use of their launcher, ***Ariane.*** D. Critique French driving habits. E. Research and discuss ***Citroën***, and its fusion with France's biggest automobile production company, Peugeot.
Comparisons: A. How does technology in the United States differ from technology in France? B. ***How does France's presence in space similar to or different from the presence of the United States.*** C. How do driving rules and laws differ in French-speaking territories and the United States? D. How do cars in France compare to cars in the United States? E. Where are parking meters located?	**Comparisons:** A. Compare and contrast technology habits in the United States with technology habits in France. B. ***Research and analyze the space program in the United States and the space program in France.*** C. Compare and contrast rules that govern driving in the United States with rules that govern driving in French-speaking countries. D. Discuss French and American made cars. E. Compare and contrast the location of parking meters in the United States and in France.
Connections: A. ***How does Internet usage and frequency impact student performance?*** B. How do I tell the origin country of internet addresses based on their end codes? C. How would I know how much gas I	**Connections:** ***A. Research the correlation between Internet usage and student performance.*** B. Identify and categorize Internet addresses based on their end codes. C. Convert from gallons to liters.

World Languages: French Level 2	
TOPIC: TECHNOLOGY	
need if I lived in France?	
Communities: A. Where can I find a French made car in my local community?	**Communities:** A. Research locations that may sell French-made cars.

INSTRUCTIONAL STRATEGIES
Based on our philosophy for student learning in World Languages and our knowledge of effective instruction, teachers will:

- Model vocabulary, grammar and idiomatic expressions
- Incorporate video or audio segments from target cultures
- Facilitate classroom discussions that examine and compare cultural differences. ***Accl: Accelerated students play the roles of facilitators during classroom discussions. Students can also be assigned group discussion topics, with the goal of presenting discussion results to the class.***
- Create and utilize communicative activities
- Support peer teaching. ***Accl: Students create mini lessons based on an assigned topic, after self teaching to teach the rest of the class. In split classes, accelerated students also can have the opportunity to act as a peer teacher, after self teaching.***
- Design various practice activities for vocabulary acquisition and retention. ***Accl: Students are given additional vocabulary and higher level Depth of Knowledge practice activities.***
- Use readings from textbook. ***Accl: Students are given more target language readings especially in the culture segments of the unit.***
- Design and utilize PowerPoint/SMART board presentations ***Accl: lessons differ in structure and in delivery. Accelerated students are introduced to material (especially grammar concepts) in a way to require them to develop logical conclusions with less teacher guidance.***
  - Complete online exercises
  - Scaffold prior vocabulary
  - Utilize peer editing to further enhance writing skills.
  - Require students to access program Internet activities including but not limited to current news clips
  - Invite classroom speakers from target culture
  - Make interdisciplinary (i.e.: Math, Social Sciences, English) connections to reinforce learning
  - Require students to participate in teacher-created web-based activities

Create Total Physical Response (TPR) activities

Assessments:
In order to understand the strengths and weaknesses of our students, teachers will assess and provide feedback to students about the following:

- Writing prompts in the target language ***Accl: Rubrics adjusted to include more requirements demonstrating independent use of the language***
- Dialogues and role-play activities in the target language ***Accl: Memorization of dialogues***
- Reading and listening comprehension activities

World Languages: French Level 2

TOPIC: TECHNOLOGY

- Vocabulary and structure quizzes
- Cloze activities
- Summative performance assessments (oral or in writing)
- Culture comparison charts ***AccI: Creation of multiple charts that document cultural similarities and differences.***
- Technology based activities (i.e. Power Point, Voice Thread, Voki and Wikis)
- ***Assessments will be modified through the use of word banks and models for Academic classes***

Resources:
In order to provide students with the best language outcome, teachers will employ the following resources, available from both teacher materials and the Internet:

- *D'accord*! 2, Unité 3
- Student materials (Student book, workbooks)
- ***AccI: Maestro SuperSite (cahier intéractif, audio, video & practice)***
- Teacher materials: DVDs (Roman-photo, flash culture, Maestro SuperSite)
- Audio CDs (testing and audio program)
- Depth of Knowledge (Webb's Depth of Knowledge tools)

World Languages: French Level 2

TOPIC: SHOPPING in TOWN

Connecticut Frameworks Content Standards (CSDE)

CONTENT STANDARD 1: Communication (Interpersonal Mode)
CONTENT STANDARD 2: Communication (Interpretive Mode)
CONTENT STANDARD 3: Communication (Presentational Mode)
CONTENT STANDARD 4: Culture
CONTENT STANDARD 5: Connections (Interdisciplinary Mode)
CONTENT STANDARD 6: Connections (Interdisciplinary Mode)
CONTENT STANDARD 7: Comparisons Among Languages
CONTENT STANDARD 8: Comparisons Among Cultures
CONTENT STANDARD 9: Communities

Connecticut Frameworks Performance Standards (CSDE)

1.1.2 Describe various objects and people found at home and school.
1.1.4 Exchange basic information about events such as classes, meetings and meals.
1.1.5 Describe their favorite activities at home and school.
1.1.6 Express their likes and dislikes regarding various people, objects, categories and events present in their everyday environments.
1.1.8 Recognize that there are often multiple ways to express an idea in the target language.
2.1.1 Identify people and objects in their environments, based on oral and written descriptions.
2.1.2 Comprehend short conversations among peers and familiar adults on well-known topics, including their favorite activities at home or school.
2.1.3 Comprehend the main ideas contained in videos, DVDs, films, television programs or websites on familiar topics.
3.1.1 Give simple oral reports or presentations about family members and friends, objects, or common school and home activities in their everyday environments.
3.1.3 Write short informal notes in which they describe or provide information about themselves, their friends and families, and their school activities.
6.1.1 Use multimedia resources to access information regarding the target culture(s).
7.1.1 Give examples of words borrowed from one language and used in another, and develop an understanding of the process of borrowing.
4.1.6 Recognize simple themes, ideas or perspectives of the target culture.
7.1.2 Demonstrate an awareness of the target language's phonetic and writing systems and how they differ from the phonetic and writing systems in the English language.
8.1.2 Demonstrate knowledge of the patterns of behavior across cultures that are related to recreation and celebrations.

Connecticut Frameworks Performance Standards (CSDE)

1.1.2, 1.1.4, 1.1.5, 1.1.6, 1.1.8, **2.1.1, 2.1.2, 2.1.3, 3.1.1, 3.1.3, 4.1.6,** 6.1.1, 7.1.1, **7.1.2, 8.1.2**

World Languages: French Level 2	
TOPIC: SHOPPING in TOWN	
UNWRAPPED PERFORMANCE STANDARDS	
Skills *What students need to be able to do*	*Concepts* *What students need to know about*
Exchange	**Information (sports and leisure activities)**
Describe	**Activities (sports and leisure)**
Describe	**Weather**
Synthesize	**Sports activities and irregular verbs**
Use	**Numbers above 100**
Recommend	**Ideas (sports)**
Identify	**Seasons and months**
Comprehend	**Short conversations (home, school)**
Comprehend	**Main ideas (listening)**
Give	**Simple oral reports (sports and activities etc.)**
Write	**Short notes (sports and activities etc.))**
Recognize	**Themes, ideas, perspectives (culture)**
Use	Multimedia sources
Give	**Dates**
Exhibit	**Awareness (phonetics, writing)**
Demonstrate, compare & contrast	**Knowledge of behavior (sports and leisure activities)**
Analyze	**Authentic cultural experiences**
Evaluate	**Importance of particular sports (culture)**
Formulate	**Conclusions (culture)**

Big Ideas

Student's statements of enduring ideas

1. Communicating in languages other than English by engaging in conversations, understanding and interpreting spoken and written language, and presenting information enables one to fully participate as a citizen of the world.
2. The ability to acknowledge and understand of other cultures is gained through examining the products, practices, and perspectives of those cultures.
3. Language is a tool that can be used to connect with other disciplines and acquire information.
4. By comparing languages and cultures, students develop insights into their own language and culture.
5. The study of a foreign language allows students to participate in multilingual communities at home and around the world.

Essential Questions

Teacher's guiding questions

1. What does it mean to communicate and how do I communicate in my target language?
2. What is culture and how do I learn more about other cultures?
3. How can I use my foreign language to increase my understanding of other disciplines?
4. Why is it important to make cultural and linguistic comparisons?
5. Where can I use my foreign language outside of the classroom?

Unit Essential Questions	**Learning Objectives** The students will be able to:
Communication: A. What information do I need to talk about banking? B. What information do I need to talk about the post office? C. How do I talk about different business establishments? D. What pronunciation skills do I need to pronounce the letter **h** in the target language? E. How do I talk about everyday	**Communication:** A. Employ terms that apply to banking. B. Use terms that apply to going to the post office. C. Discuss different business establishments. D. Differentiate between the pronunciations of the letter **h** in the target language. E. Use the irregular verbs **voir, croire, recevoir,** and **apercevoir** to talk about seeing, believing, receiving and catching sight of. F. Construct sentences using negative and affirmative expressions.

activities? F. What do I need to know to be able to express negation and affirmation? G. How do I ask for and give directions? H. How do I know if a something is capitalized or not in the target language? I. What information do I need to talk about the centers of French cities and towns? J. How do I talk about what will happen?	G. Classify expressions related to asking for and giving directions. H. Differentiate between the different times capitalization is used or not used in the target language. I. Organize different landmarks in French cities and towns. J. Construct sentences using the future tense.
Culture: What are the methods of payment in France? B. ***What would I need in order to open a bank account as a resident in France?*** C. What do I need to know in order to talk about the metro? D. Where are some places to shop in the francophone world? E. Who is the French "Spiderman"? ***F. What cities in France are divided into districts?*** ***G. How do I know what district something is located in?*** H. How do I talk about small shops and businesses in the francophone world?	**Culture:** A. Research the methods of payment in France. ***B. Research what is required in order to open a bank account as a resident in France.*** C. Employ terms that apply to the metro. D. Compare and contrast some different places to shop in the francophone world. E. Research Alain Robert the French "Spiderman". ***F. Research what cities in France are divided into districts.*** ***G. Research how to find out what district something is in.*** H. Predict the names of different small shops and businesses in the francophone world. I. Compare and contrast important places in the hearts of several francophone cities. J. Discuss how and why Baron Georges Eugène Haussmann is historically important to France.
Comparisons: A. How is shopping different in France from the United States? B. How do the methods of payment differ between France and the United States? C. How does my town center compare to a town or city center in France? ***D. Who is a historically important person in the United States?***	**Comparisons:** A. Compare and contrast the difference between shopping in France and in the United States. B. Compare and contrast the difference between methods of payment in France and in the United States. C. Distinguish the difference between Bristol Center and the center of a French town or city. D. ***Recognize or identify a historically important person in the United States.***

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French Level 2

Connections: A. Why are some people considered historically important? B. What is some information I need to know in order to read or draw a map? C. ***What are some popular places to shop in francophone countries?***	**Connections:** A. Prove why some people are considered historically important. B. Activate prior knowledge of maps. ***C. Analyze popular places to shop in francophone countries***
Communities: A. . What does my city center look like? B. What would a map of my city look like compared to Paris?	**Communities:** A. Discuss Bristol city center. ***A. Explore Bristol city center.*** B. Design map of Bristol and Paris.

INSTRUCTIONAL STRATEGIES
Based on our philosophy for student learning in World Languages and our knowledge of effective instruction, teachers will:

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- Incorporate video or audio segments from target cultures
- Facilitate classroom discussions that examine and compare cultural differences. ***Accl: Accelerated students play the roles of facilitators during classroom discussions. Students can also be assigned group discussion topics, with the goal of presenting discussion results to the class.***
- Create and utilize communicative activities
- Support peer teaching. ***Accl: Students create mini lessons based on an assigned topic, after self teaching to teach the rest of the class. In split classes, accelerated students also can have the opportunity to act as a peer teacher, after self teaching.***
- Design various practice activities for vocabulary acquisition and retention. ***Accl: Students are given additional vocabulary and higher level Depth of Knowledge practice activities.***
- Use readings from textbook. ***Accl: Students are given more target language readings especially in the culture segments of the unit.***
- Design and utilize PowerPoint/SMART board presentations ***Accl: lessons differ in structure and in delivery. Accelerated students are introduced to material (especially grammar concepts) in a way to require them to develop logical conclusions with less teacher guidance.***
  - Complete online exercises
  - Scaffold prior vocabulary
  - Utilize peer editing to further enhance writing skills.
  - Require students to access program Internet activities including but not limited to current news clips
  - Invite classroom speakers from target culture
  - Make interdisciplinary (i.e.: Math, Social Sciences, English) connections to reinforce learning
  - Require students to participate in teacher-created web-based activities

Create Total Physical Response (TPR) activities

Assessments:
In order to understand the strengths and weaknesses of our students, teachers will assess and provide feedback to students about the following:

- Writing prompts in the target language ***AccI: Rubrics adjusted to include more requirements demonstrating independent use of the language***
- Dialogues and role-play activities in the target language ***AccI: Memorization of dialogues***
- Reading and listening comprehension activities
- Vocabulary and structure quizzes
- Cloze activities
- Summative performance assessments (oral or in writing)
- Culture comparison charts ***AccI: Creation of multiple charts that document cultural similarities and differences.***
- Technology based activities (i.e. Power Point, Voice Thread, Voki and Wikis)
- ***Assessments will be modified through the use of word banks and models for Academic classes***

Resources:
In order to provide students with the best language outcome, teachers will employ the following resources, available from both teacher materials and the Internet:

- *D'accord*! 2, Unité 4
- Student materials (Student book, workbooks)
- ***AccI: Maestro SuperSite (cahier intéractif, audio, video & practice)***
- Teacher materials: DVDs (Roman-photo, flash culture, Maestro SuperSite)
- Audio CDs (testing and audio program)
- Depth of Knowledge (Webb's Depth of Knowledge tools)

World Languages: French Level 2

TOPIC:
OUR FUTURE

Connecticut Frameworks Content Standards (CSDE)

CONTENT STANDARD 1: Communication (Interpersonal Mode)
CONTENT STANDARD 2: Communication (Interpretive Mode)
CONTENT STANDARD 3: Communication (Presentational Mode)
CONTENT STANDARD 4: Culture
CONTENT STANDARD 5: Connections (Interdisciplinary Mode)
CONTENT STANDARD 6: Connections (Interdisciplinary Mode)
CONTENT STANDARD 7: Comparisons Among Languages
CONTENT STANDARD 8: Comparisons Among Cultures
CONTENT STANDARD 9: Communities

Connecticut Frameworks Performance Standards (CSDE)

1.1.1 Greet others and exchange essential information, including names, addresses, birthplaces, telephone numbers and email addresses.
1.1.2 Describe various objects and people found at home and school.
1.1.4 Exchange basic information about events such as classes, meetings and meals.
1.1.5 Describe their favorite activities at home and school.
1.1.6 Express their likes and dislikes regarding various people, objects, categories and events present in their everyday environments.
2.1.1 Identify people and objects in their environments, based on oral and written descriptions.
2.1.2 Comprehend short conversations among peers and familiar adults on well-known topics, including their favorite activities at home or school.
2.1.3 Comprehend the main ideas contained in videos, DVDs, films, television programs or websites on familiar topics.
4.1.6 Recognize simple themes, ideas or perspectives of the target culture.
5.1.3 Use new information and interdisciplinary awareness gained through world language study to expand their personal knowledge.
6.1.1 Use multimedia resources to access information regarding the target culture(s).
7.1.1 Give examples of words borrowed from one language and used in another, and develop an understanding of the process of borrowing.
7.1.2 Demonstrate an awareness of the target language's phonetic and writing systems and how they differ from the phonetic and writing systems in the English language.
8.1.2 Demonstrate knowledge of the patterns of behavior across cultures that are related to recreation and celebrations.
9.1.3 Review materials and/or media from the target language and culture for enjoyment and/or entertainment.

Connecticut Frameworks Performance Standards (CSDE)

1.1.1, 1.1.2, 1.1.4, 1.1.5, 1.1.6, 2.1.1, 2.1.2, 2.1.3, 4.1.6, 5.1.3**, 6.1.1,** 7.1.1**, 7.1.2, 8.1.2,** 9.1.3

World Languages: French Level 2	
TOPIC: **OUR FUTURE**	
UNWRAPPED PERFORMANCE STANDARDS	
Skills *What students need to be able to do*	*Concepts* *What students need to know about*
Exchange	**Information (celebrations, clothing, shopping, colors)**
Describe	**Activities (shopping)**
Describe	**Celebrations**
Synthesize	**Two parts to form a tense (passé compose)**
Discuss	**Everyday activities**
Recommend	**Ideas (shopping and gifts)**
Identify	**Indirect object pronouns and demonstratives**
Comprehend	**Short conversations (celebrations and shopping)**
Comprehend	**Main ideas (listening)**
Give	**Simple oral reports (sports and activities etc.)**
Write	**Short notes (sports and activities etc.)**
Recognize	**Word families**
Use	Multimedia sources
Exhibit	**Awareness (phonetics, writing)**
Demonstrate, compare & contrast	**Knowledge of behavior (holiday celebrations)**
Analyze	**Authentic cultural experiences**
Evaluate	**Importance of fashion industry (culture)**
Formulate	**Conclusions (culture)**
Activate	**Prior knowledge (fashion)**

Big Ideas

Student's statements of enduring ideas

1. Communicating in languages other than English by engaging in conversations, understanding and interpreting spoken and written language, and presenting information enables one to fully participate as a citizen of the world.
2. The ability to acknowledge and understand of other cultures is gained through examining the products, practices, and perspectives of those cultures.
3. Language is a tool that can be used to connect with other disciplines and acquire information.
4. By comparing languages and cultures, students develop insights into their own language and culture.
5. The study of a foreign language allows students to participate in multilingual communities at home and around the world.

Essential Questions

Teacher's guiding questions

1. What does it mean to communicate and how do I communicate in my target language?
2. What is culture and how do I learn more about other cultures?
3. How can I use my foreign language to increase my understanding of other disciplines?
4. Why is it important to make cultural and linguistic comparisons?
5. Where can I use my foreign language outside of the classroom?

Unit Essential Questions	**Learning Objectives** The students will be able to:
Communication: A. What do I need to know to be able to talk about the workplace? B. What do I need to know to be able to successfully interview for a job? C. How do I make and receive phone calls? D. How do I talk about actions using both the future tense and the present tense? E. How do I ask questions without repeating something that has already been said? F. What do I need to know to be able to talk about professions?	**Communication:** A. Discuss terms for the workplace. B. Discuss terms used for interviewing. C. Make and answer telephone calls. D. Use the ***futur simple*** witrh the present tense to talk about something that is going to happen in the future. E. Use the interrogative pronoun ***lequel*** and all its forms to ask about something that has already been mentioned. F. Classify professions and discuss them. G. Hypothesize using ***si*** clauses about current

G. How do I talk about an event which is dependent upon another event? H. What do I need to know to be able to form more complex sentences?	and possible events. H. Create complex sentences by using relative pronouns.
Culture: A. What information do I need to know to be able to use the phone in France? B. What are some common terms used by the French while text messaging? C. What are some well-paying jobs in the French-speaking world? D. Who are ***les artisans***? E. What role do unions play in the workplace in France? F. How are strikes carried out in France? G. How many vacation days do workers in Francophone countries get? H. What are civil servants and what role do they play in the working population in France?	**Culture:** A. Discuss phone usage in France. B. Research, share and discuss commonly used French text messaging terms. C. Discuss well-paying jobs in the French speaking world and compare them to well-paying jobs in the United States. D. Discuss the importance of artisans and artisanal work in France. E. Discuss the role of unions in the French workplace. F. Research and discuss strikes in the French workplace. G. Discuss days off in Francophone countries. H. Discuss the importance of civil servants in France.
Comparisons: A. What are the similarities and differences between text messaging in France and text messaging in the United States? B. How are well paying jobs in Francophone countries similar to or different from well paying jobs in the United States? C. How are strikes and unions in France similar to strikes and unions in the United States? D. How does telephone service and usage in France compare to the United States?	**Comparisons:** A. Compare and contrast text messaging terms in the United States with text messaging terms in France. B. Compare and contrast well paying jobs in Francophone countries with well paying jobs in the United States. C. Compare and contrast strikes and unions in France with strikes and unions in the United States. D. Read and draw conclusions about telephone usage in the United States and in France.
Connections: A. What information do I need to be able to talk about activities that will take place in the future? B. What do I know about federal civil service employees in the United States? C. What are relative pronouns and how are they used in English?	**Connections:** A. Discuss the use of the future tense. B. Research and discuss civil service employees in the United States. C. Develop a logical argument about the use of relative pronouns in English.

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Communities: A. What are some unions that can be found in the local community?	**Communities:** A. Research local unions.

INSTRUCTIONAL STRATEGIES
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- Model vocabulary, grammar and idiomatic expressions
- Incorporate video or audio segments from target cultures
- Facilitate classroom discussions that examine and compare cultural differences. ***Accl: Accelerated students play the roles of facilitators during classroom discussions. Students can also be assigned group discussion topics, with the goal of presenting discussion results to the class.***
- Create and utilize communicative activities
- Support peer teaching. ***Accl: Students create mini lessons based on an assigned topic, after self teaching to teach the rest of the class. In split classes, accelerated students also can have the opportunity to act as a peer teacher, after self teaching.***
- Design various practice activities for vocabulary acquisition and retention. ***Accl: Students are given additional vocabulary and higher level Depth of Knowledge practice activities.***
- Use readings from textbook. ***Accl: Students are given more target language readings especially in the culture segments of the unit.***
- Design and utilize PowerPoint/SMART board presentations ***Accl: lessons differ in structure and in delivery. Accelerated students are introduced to material (especially grammar concepts) in a way to require them to develop logical conclusions with less teacher guidance.***
  - Complete online exercises
  - Scaffold prior vocabulary
  - Utilize peer editing to further enhance writing skills.
  - Require students to access program Internet activities including but not limited to current news clips
  - Invite classroom speakers from target culture
  - Make interdisciplinary (i.e.: Math, Social Sciences, English) connections to reinforce learning
  - Require students to participate in teacher-created web-based activities
  - Create Total Physical Response (TPR) activities

Assessments: In order to understand the strengths and weaknesses of our students, teachers will assess and provide feedback to students about the following:

- Writing prompts in the target language ***Accl: Rubrics adjusted to include more requirements demonstrating independent use of the language***
- Dialogues and role-play activities in the target language ***Accl: Memorization of dialogues***
- Reading and listening comprehension activities
- Vocabulary and structure quizzes
- Cloze activities
- Summative performance assessments (oral or in writing)
- Culture comparison charts ***Accl: Creation of multiple charts that document cultural similarities and differences.***
- Technology based activities (i.e. Power Point, Voice Thread, Voki and Wikis)
- ***Assessments will be modified through the use of word banks and models for Academic classes***

Bristol Public Schools
World Languages
French Level 2

Resources: In order to provide students with the best language outcome, teachers will employ the following resources, available from both teacher materials and the Internet:
• *D'accord*! 2, Unité 5 • Student materials (Student book, workbooks) • ***Accl: Maestro SuperSite (cahier intéractif, audio, video & practice)*** • Teacher materials: DVDs (Roman-photo, flash culture, Maestro SuperSite) • Audio CDs (testing and audio program) • Depth of Knowledge (Webb's Depth of Knowledge tools)

Textbook Recommendation to the Board of Education

Subject/Course: French 2 ***Grade Level***: high school

First Presentation BOE Meeting Date: May 1, 2013 ***Second Presentation BOE Meeting Date***: request for waiver of 2nd reading

Describe need for the textbook/materials:
The French 2 curriculum was recently revised, and approved by the Board of Education's Student Achievement Committee, to provide more rigorous course work for students. The previous textbook has become outdated and no longer meets the demands to support the course.

Listed below are textbooks/materials evaluated by the Textbook Selection Committee:

Subject/ Course	Title of Book	Author(s)	Copyright Date	Publisher	Rubric Score Total	Readability
French 2	D'accord	José A. Blanco	2011	Vista Higher Learning	41	Level 2
French 2	Bon Voyage	J. Schmitt, Katia Brillié Lutz	2008	Glencoe	39	Level 2
French 2	C'est à toi	Karla Winther Fawbush, Toni Thiesen, Dianne B. Hopen, Sarah Vaillancourt	2007	EMC	41	Level 2

The following textbook(s)/materials are recommended by the Textbook Selection Committee

Subject/ Course	Title of Book	Author(s)	Edition	Copyright Date	Publisher	City, State Of Publisher	Publisher Website
French 2	D'accord	Vista Higher Learning		2011	José A. Blanco	Boston, MA	www.vistahigherlearning.com

Reasons for recommendation (include information on match to curriculum concepts and skills):
See last page.

Textbook Recommendation to the Board of Education

Student Materials Needed				
Quantity	**Item Name**	**Cost Per Item**	**Total Cost**	**Distribution: #Texts per School**
136	Level 2 Student Edition w/ Supersite code	$79.00	$10,744	91 BCHS, 45 BEHS

Teacher Materials Needed				
Quantity	**Item Name**	**Cost Per Item**	**Total Cost**	**Distribution: # per School**
3	Complete teacher resource kit	$317	$0 ($951 value gratis)	2 to BCHS
				1 to BEHS

TOTAL COST	
Total Cost for Student Texts/Materials	$10,744
Total Cost for Teacher Materials	$0 ($951 value gratis)
Shipping & handling 7%	$818.65
GRAND TOTAL	$11,562.65

Textbook Selection Committee		
Staff member	**School**	**Grade/Course Taught**
Anya Rochester	Bristol Central High School	French 9-12
Kelly Lynne Thibodeau	Bristol Eastern High School	French 9-12
Also, 6 French students		

French Textbook Selection
Present: Kelly Lynne Thibodeau, Anya Rochester; 6 French students
Materials used:

- 3 French texts
- Textbook evaluations
- Pacing/vocabulary comparison
- CT State Frameworks
- CT Common Core
- Bristol Power Standards
- Bristol Curriculum
- Notes from textbook presentations
- Student comments from textbook presentations
- Personal notes from textbook review
- National French Contest Specifications (by level) for 2012; this will help to maintain the rigor in our program and a competitive edge

What are we looking for in a textbook?

- Level-appropriate
- Finish each level in 1 year
- More rigor than prior years; the textbook needs more material and faster pacing
- Appropriate articulation of vocabulary, structures, and concepts; no "forced units."
- We also want more of key structures, such as the past tense, to be introduced sooner than it is in the current curriculum and the textbook
- Meet district guidelines
- Book that appeals to students (we will use the student feedback)
- Up to date materials
- One book per year, per level

Initial/thoughts and comparisons

C'est à Toi (EMC)	D'accord (Vista)	Bon Voyage (Glencoe)
• We liked the paired practice and materials that are actually in the textbook; she liked how there were cartoons, and some of the personal prompts were suited to student needs • It seemed like the culture was not as appealing as the other books; it was "boring." • There were not as many prompts that helped students to connect to their own culture • We have the Spanish version of this text,	• **We all liked this book best.** • **Is the text too overwhelming visually? Is that why many of our students didn't like it?** • **We really liked the visuals – modern, lots of pictures – doesn't look too old.** • **We liked the videos, which used real videos, not just contrived situations (which are also there).** • **We really liked the structure of the book.** • **Is the material in this book too dense?**	• The representative told us that students will "learn all the grammar they need to know in the first two books." This philosophy makes it seem like the grammar is overwhelming; there is too much, and it seems forced. • The books look old. • Most of the students found this book to be visually more appealing; although it had less online, the students found this text to be less overwhelming and more structured. They really liked that this

C'est à Toi (EMC)	D'accord (Vista)	Bon Voyage (Glencoe)
which Anya does not like. They have similar structures. • Etre is not in the first few chapters; it is later. We feel this is a critical item to come sooner. • We liked some of the other items that were introduced sooner. • The online resources are phenomenal, with amazing resources for contemporary culture. • The layout is "childish;" students found it to be not appealing. • It looks "skimpy" in terms of how things are shared. • The text in this (as compared to the Spanish text, which follows a similar structure), there is a disconnectedness to the materials. The units don't seem cohesive. • No level 4 book offered in this series, and no suggestions or books sold by the same publisher for level 4.	• **We like that the textbook is available online, as well as the videos; however – we would have to pay an additional fee for access to online workbooks, which there is not for "C'est à Toi."** • **The book is divided into manageable pieces.** • **There is a level four for this (a choice of two), but they are not officially in the series.** • **Anya did like the structure and pacing; she liked that être is at the beginning of the book.** • **What is taught in level 1 in this book is what we teach through level 3 in terms of grammatical concepts.** • **How much is the workbook for online access? How much is that paid?** • **What is the difference in price between the paper copy of the workbook and the online?** • **How complicated is the online stuff?** • **We really liked the units in level 3.** • **Vista has the least amount of ancillary materials.**	textbook seemed to be a resource unto itself. • We really liked the assessments at the end of each chapter. • Foldables, tips, etc., very usable in the teacher edition. The book seems to have many resources. • They really liked the images. • We liked that in the teacher's edition, it tells that the books are structured to help to meet the needs of a variety of levels – half of the activities are "required" and half are extras. The extras are readings, and could be used to differentiate between ACA/ACC. • 14 chapters – very long! Would this put is in the same situation as now, where we don't accomplish the entire book in one year? • Has PowerPoint presentations already made. • Has Level 4 text that is different from the series, but one is offered.

Final decision:
Based on the CT frameworks, the articulation, the pacing, the focus on higher-order thinking, and authentic materials, the national standards, the district curriculum, the variety of materials, we choose **Vista's D'accord.**

Concerns/Questions about Vista:

1. What do the level 4 books look like? Will we want to purchase those? Anya is going to request copies of those.

COST PROPOSAL

Quote Prepared On Jun 20, 2021
Quote Valid Through Jul 11, 2013
Payment Terms Net 30 Days
Quote No. 13040684

Prepared For
Pamela Brisson Bristol Public School District 129 Church Street Bristol CT, 06010

Prepared By
Shannon DiStefano sdistefano@vistahigherlearning.com Vista Higher Learning 500 Boylston St, Suite 620 Boston, MA 02116-3736

Daccord 1e

Qty	Item Number	Description	Unit Price	Total Value	Total Cost
136	978-1-60576-781-9	Daccord *L2 SE + SS	$79.00	$10,744.00	$10,744.00
3	978-1-60576-613-3	Daccord *Level 2 Teacher Resource Box	$317.00	$951.00	$0.00
				Total Value	$11,695.00
				Total Gratis	$951.00
				Total Cost	$10,744.00
				Est. Shipping (7%)	$818.65
				Est. Grand Total Cost	**$11,562.65**

Special Instructions

To Order Contact Customer Service
Phone (800) 269-6311 ext. 1 | **Fax** (617) 426-5215
Email info@vistahigherlearning.com
Vista Higher Learning
500 Boylston St. Suite 620 Boston, MA 02116

Thank you for your business!

Policy 6145.2

Co-Curricular Activities/Athletics

Comparison of Current Policy and Proposed Changes

Current Policy 8.17.2011	Proposed Changes 4.5.2013
High School Full Extra-Curricular Eligibility - Scholarship	
	Proposed ADD: ***Marking period grades will be used to determine eligibility during the school year. Student eligibility is determined no later than the fourteenth (14) calendar day following the end of the marking period***. [CIAC has a 14 calendar day rule]
1. At the end of the previous marking period, the student must pass all subjects.	1. ***Proposed CHANGE:*** At the end of the previous marking period, the student is eligible when he/she: 1. Passes all courses ***OR*** ***2. Fails one class with a grade no lower than 60 and has a current weighted GPA of 2.0 or higher. The student must achieve a grade of 65 or higher in that failed course by the date of progress reporting of the marking period following the marking period in which the failure occurred.***
2. To be eligible for fall sports, student must have received credit toward graduation at the close of the school year preceding the contest in all full year and second semester courses.	***2.Proposed CHANGE:*** To be eligible for fall ***extra-curricular*** activities, the student must have received ***a minimum of six (6) credits*** toward graduation ***by the beginning of the following school year*** in all full year and second semester courses.
3. Students entering grade 9 from grade 8 have full eligibility.	3. NO Change
4. Student cannot represent a school unless taking a minimum of five and a half (5.5) academic credits plus ½ physical education credit at the end of the regular marking period next preceding the contest.	4. ***Proposed CHANGE:*** Student cannot represent a school unless taking a minimum of five and a half (5.5) academic credits plus ½ physical education credit at the end of the regular marking period next preceding the contest***/event***.

Current Policy 8.17.2011	Proposed Changes 4.5.2013
High School Partial Extra-Curricular Eligibility - Scholarship	
	Proposed ADD: ***<u>Marking period grades will be used to determine eligibility during the school year. Student eligibility is determined no later than the fourteenth (14) calendar day following the end of the marking period.</u>*** [CIAC has a 14 calendar day rule]
1. Be carrying a full academic load; the load for all students is a minimum of five and a half (5.5) academic credits plus ½ physical education credit per year.	1. NO Change
2. Fails no more than 1 subject at the end of the previous marking period. For the first marking period, must not have failed more than 1 full year or second semester subject during the previous year. In the event that a student fails a first semester course, which cannot be repeated the second semester, the student will be placed on Partial Extra-Curricular Eligibility for the third marking period and must be passing all subjects at the midpoint of the said marking period.	2. ***Proposed CHANGE:*** ~~Fails no more than 1 subject at the end of the previous marking period~~. For the first marking period of the school year, a student must not have failed (***<u>defined as a grade lower than 65)</u>*** more than ***<u>2</u>*** full year or ***<u>2</u>*** second semester subjects during the previous year. For the current school year, fails ***<u>(defined as a grade lower than 65)</u>*** no more than ***<u>2</u>*** subjects at the end of the previous marking period. In the event that a student fails a first semester course, which cannot be repeated the second semester, the student will be placed on Partial Extra-Curricular Eligibility for the third marking period and must be passing all subjects with a ***<u>current weighted GPA of 2.0</u>*** at the midpoint of the said marking period.
3. Partial Extra-Curricular Eligibility will be offered to a student only once per academic year. The period of Partial Extra-Curricular Eligibility will extend to the midpoint of the marking period following the marking period in which the failure occurred.	***3.Proposed CHANGE*** NO Change in language. Moved to the beginning of the section. The period of Partial Extra-Curricular Eligibility will extend to the ***<u>date of progress reporting</u>*** of the marking period following the marking period in which the failure occurred.

A student on Partial Extra-Curricular Eligibility must attain a minimum grade of “70” in the subject that was failed.	NO Change
Partial Extra-Curricular Eligibility will be extended in the event that Bristol Summer School offerings are not available to make-up the academic failure.	NO Change
In the event that Partial Extra-Curricular Eligibility is granted for the first marking period, the student must be passing all subjects at the midpoint of the marking period.	In the event that Partial Extra-Curricular Eligibility is granted for the first marking period, the student must be passing all subjects ***with a current weighted GPA of 2.0*** at the midpoint of the marking period.
4. [No current wording regarding try-outs]	***4.Proposed ADDITION:*** ***Students, who qualify under the Partial Eligibility Rule during a try-out period, may try-out for extracurricular activities, with the understanding that the Partial Eligibility Rule goes into effect immediately should he/she make the cut.***
5. Any student receiving a grade of “incomplete” shall be placed on Partial Extra-Curricular Eligibility until a letter grade is submitted by the teacher or at the midpoint of the marking period.	***5.Proposed CHANGE*** Any student receiving a grade of “incomplete” shall be placed on Partial Extra-Curricular Eligibility until a ~~***letter***~~ grade is submitted by the teacher or at the midpoint of the marking period.

Current Policy 8.17.2011	Proposed Changes 4.5.2013
Middle School Co-Curricular and Extra-Curricular Eligibility	
1. Middle School Extra-Curricular eligibility is determined by a student's overall performance in the five (5) core subject and three (3) unified arts subjects.	1. ***Proposed CHANGE*** Middle School ***Co and*** Extra-Curricular eligibility is determined by a student's overall performance in ***all*** ~~the five (5)~~ core subject***s*** and ***all*** ~~three (3) unified arts~~ ***encore*** subjects.
2. Students are issued a subject and conduct grade for each subject and these 16 grades are considered.	***2. Proposed CHANGE:*** Students are issued a subject and conduct grade for each subject and these ~~***16***~~ grades are considered.
3. For students who take band and instrumental music, one academic grade and one conduct grade are reported; this is not counted towards co-curricular eligibility. Chorus during flex time is not graded but choral performances are considered co-curricular activities.	3. ***Proposed CHANGE:*** ***Delete this section. Band and chorus now occur during the ENCORE period rather than during the FLEX period.*** [Participation in band and chorus performances as co-curricular activities is already addressed on page 4 of the policy.]
4. All extra-curricular activities occurring outside of the school day are included in these eligibility guidelines (such as sports, cheerleading, dances, school organized clubs and/or events, etc.).	4. ***Proposed CHANGE:*** All extra-curricular activities occurring outside of the school day are included in these eligibility guidelines (such as sports***/intramurals***, cheerleading, dances, school organized clubs and/or events, etc.).
Middle School Full Extra-Curricular Eligibility	
1. At the end of the first and second trimester, the student must pass all 8 subjects with a grade of 65 or higher.	1. ***Proposed CHANGE:*** At the end of the first and second trimester, the student must pass all ~~***8***~~ subjects with a grade of 65 or higher. [deleted "8"]
2. At the end of the first and second trimester, a student must have no more than one grade of 60 in conduct in different subject	2. ***Proposed CHANGE:*** At the end of the first and second trimester, a student must have no more than one grade of ~~60~~ ***X*** in conduct. ~~in different subjects~~.
3. A student placed on academic restriction will not participate in extra-curricular activities; a student on academic restriction will not be able to represent the school in any type of extra-curricular competition, performance, etc. (for example, sports, a school play, adjudications, ensembles).	***3. Proposed CHANGE:*** A student placed on academic restriction will not participate in extra-curricular activities; a student on academic restriction will not be able to represent the school in any type of extra-curricular competition, performance, etc. (for example, sports***/intramurals***, a school play, adjudications, ensembles).

4. A student has more than one grade of 60 in conduct in different subjects.	4. ***Proposed CHANGE:*** A student has more than one grade of ~~60~~ ***X*** in conduct. ~~in different subjects~~.

Proposed Policy Revision 4.5.2013
Proposed revisions in bold and italics

Policy

6145.2(a)

Instruction

Co-Curricular Activities are extensions of curricular courses which occur during the school day. Students participate in the course during the school day and participation in the co-curricular activity is required as part of the course. Examples of co-curricular activities are orchestra, band, or choral performances outside of the school day when the courses take place during the school day.

Extra-Curricular Activities are not-for-credit activities, for which there is no curriculum, and these activities take place outside of the school day. Examples include athletic teams, intramurals, clubs, and performances in plays.

Middle School and High School Extra-Curricular Activities /Athletics

District participation in interscholastic athletics shall be subject to approval by the Board. This shall include approval of membership in any leagues, associations, or conferences, of rules for student participation.

It is the Board's policy to provide students interscholastic athletic competition in a variety of sports. Qualified personnel shall be provided for coaching and supervising individual sports. In addition, it is the policy of the Board to provide intramural athletic activities as an outgrowth of class instruction in physical education commensurate with the grade level of the students involved.

Each student who chooses to participate in an interscholastic athletic program is required to have on file, in the offices of the building nurse, a certificate of consent, which is signed by the parent or legal guardian. No student may start practice for any athletic team until he or she has been examined and approved by a medical doctor. This certificate of consent shall be in effect for each student as specified in Sec. 5141.31.

The purpose of school athletics is both educational and recreational. The athletic program should encourage participation by as many students as possible and should be carried on with the best interests of the participants as the prime consideration. Participation should be without unreasonable interference with other obligations in the school, community and home.

It is recognized that a well-organized and well-conducted athletic program is a potent factor in the morale of a student body and an important phase of good community-school relations.

Every possible effort shall be made to offer equal opportunities for both sexes in sports and activities that shall include life sports that a student can carry through adulthood.

Instruction

Middle School and High School Extra-Curricular Activities /Athletics

In addition, the student participating on an interscholastic team agrees:

1. Not to participate on another team outside of school in the same sport while on the school's team (applicable to high school student-athletes only)
2. Not to receive any personal economic gain based upon athletic skill.
3. To participate under his or her own name.
4. Not to participate in any post season or individual contests as a representative of the Bristol Public Schools without the school's explicit and expressed permission.

The failure of one (1) team member to abide by all of the eligibility rules will result in the forfeiture of all contests for the team while the individual was ineligible.

Students participating in interscholastic athletics assume a special responsibility. They serve as models for much of the student body and are representatives of our school district to other school districts and the communities served by our schools.

Student athletes are expected to behave in a manner that will bring credit to themselves and their schools. It is our expectation that students involved in the athletic program will refrain from smoking and the use of alcohol or any other behavior-altering drug.

Failure to comply with the school's expectations may result in removal from the activity and/or in disciplinary action being taken.

Students who are absent or suspended from school may not participate in an extra-curricular activity. Any student who is not present for a minimum of three periods must receive administrative approval to participate in a co-curricular activity held that day.

Extra-Curricular Activities/Athletics - Change in High School District Residency

When a student under 18 years of age leaves the residency of a legal guardian in one Bristol public high school district to reside with friends or relatives in another Bristol public high school district, having filed forms provided by the Board of Education for that purpose, that student will not be eligible to participate in interscholastic athletics at the receiving school in any sport the student previously participated in at the sending school for three hundred sixty-five (365) calendar days of continuous enrollment from the date of the first allowable play date following the date of enrollment (first day of attending classes) in the receiving school, or the first contest after the date of enrollment, if entry is after the first allowable play date at the receiving school.

Parents/legal guardians authorizing the minor student to change residence (i.e., leave home) will be required to provide the Board of Education with legal documentation, on request, to establish their current legal custody of the minor involved.

Instruction

Extra-Curricular Activities/Athletics - Change in High School District Residency

Students and/or their parents/legal guardians may file a waiver request with the Superintendent of Schools within thirty (30) days of change of residency, seeking exemption from this policy because the change in residency is required for compelling personal reasons unrelated to athletics, such as illness or incapacity of family members. The Superintendent of Schools shall consult with the two high school principals and the Supervisor of Physical Education, Health and Athletics and make a recommendation to the Board regarding the request. Should the Superintendent recommend against the waiver, the student and/or parents/legal guardian may appear before the Board, which shall issue the final decision regarding the requested waiver.

Extra-Curricular Activities/Athletics - High School Request for Pupil Transfer within the Bristol Public School System With No Change in Residency

Any student who is granted an out of area transfer request that results in attendance at the non-resident high school is ineligible for interscholastic athletics for thirty (30) calendar days from the date of the first allowable play date following the date of enrollment (first day of attending classes) in the receiving school, or the first contest after the date of enrollment, if entry is after the first allowable play date in any sport the student participated in at the previous school.

Students and/or their parents legal guardians may file a waiver request with the Superintendent of Schools within thirty (30) days of notification of denial of the out of area request, seeking exemption from this policy because the out of area request is required for compelling personal reasons unrelated to athletics/ such as illness or incapacity of family members. The Superintendent of Schools shall consult with the two high school principals and/or the Supervisor of Physical Education, Health and Athletics and make a recommendation to the Board regarding the request. Should the Superintendent recommend against the waiver, the student and/or parents/legal guardian may appear before the Board, which shall issue the final decision regarding the requested waiver.

Instruction

Extra-Curricular and Co-Curricular Activities

Middle and High School Co-Curricular Eligibility

An activity which occurs outside of the school day as an extension of curricula courses is a co-curricular activity. Students participate in the course during the school day and participation in the co-curricular activity is required as part of the course. This pertains specifically to student participation in band, orchestra and/or choral performances which are required for participation in the course. Students will be allowed to participate in such required performances even when on academic restriction (middle school level) or partial eligibility (high school level) for extra-curricular activities.

Middle School and High School Extra-Curricular Eligibility

Extra curricular eligibility policy pertains to not-for-credit activities which take place outside of the school day. This includes athletic teams, intramurals, clubs, performances in plays, adjudications, community concerts, and any other activity which takes place outside of the school day as a course requirement..

High School Full Extra-Curricular Eligibility

Marking period grades will be used to determine eligibility during the school year. Student eligibility is determined no later than the fourteenth (14) calendar day following the end of the marking period.

In order to be eligible to participate in all aspects of an extra-curricular activity, a student must meet the following criteria:

I. Scholarship

1. A student cannot at any time represent a school unless taking a minimum of five and a half (5.5) academic credits plus ½ physical education credit at the end of the regular marking period next preceding the contest***/event.***

2. ~~At the end of the previous marking period, the student must pass all subjects~~ ***a minimum of 4 credits, have no grades lower than 60, have no more than one grade between 60 and 65; and a current weighted GPA of 2.0 or higher. All grades must be 70 or higher by the midpoint of the next marking period***. ~~To be eligible for fall sports, the student must have received credit toward graduation at the close of the school year preceding the contest in all full year and second semester courses. However, students entering grade 9 from grade 8 have full eligibility~~.

Instruction

Extra-Curricular and Co-Curricular Activities

Middle and High School Co-Curricular Eligibility

2 At the end of the previous marking period, the student is eligible when he/she:

1. Passes all courses OR

2. ***Fails one class with a grade no lower than 60 and has a current weighted GPA of 2.0 or higher. The student must achieve a grade of 65 or higher in that failed course by the date of progress reporting of the marking period following the marking period in which the failure occurred.***

3 To be eligible for fall extra-curricular activities, the student must have received ***a minimum of 6*** credits toward graduation by the beginning of the following school year ~~preceding the contest~~ in all full year and second semester courses. However, students entering grade 9 from grade 8 have full eligibility.

II. Student Eligibility

1. The student should be a member of that school in grade 9, 10, 11, 12.

2. The student shall not have reached his or her nineteenth (19) birthday, except that a player who reaches his or her nineteenth (19) birthday on or after July 1, shall be eligible to compete during the ensuing school year if he or she is otherwise eligible (CIAC eligibility regulation Section II B).

3. Any student who has been enrolled in grades 10, 11, 12 inclusive in any school (member or non-member) shall not participate in the same branch of athletics for more than (3) seasons. A student, upon enrolling in grade nine (9) shall have 4 continuous or uninterrupted years to complete his or her athletic eligibility.

Instruction

High School Full Extra-Curricular Eligibility

High School Partial Extra-Curricular Eligibility

A student placed on Partial Extra-Curricular Eligibility would be granted limited participation but will not be able to represent the school in any type of competition, performance, etc. (i.e., athletic, drama, musical etc.).

Partial Extra-Curricular Eligibility will be offered to a student only once per academic year. ***(Note: moved from below.)***

To gain Partial Extra -Curricular Eligibility, a student must meet the following criteria:

1. Be carrying a full academic load; the load for all students is a minimum of five and a half (5.5) academic credits plus ½ physical education credit per year.

2. ~~Fails no more than 1 subject at the end of the previous marking period~~. For the first marking period ***of the school year, a student*** must not have failed ***(defined as a grade lower than 65)*** more than ~~1~~ ***2*** full year or ~~a~~ ***2*** second semester subject***s*** during the previous year.

3. ***For the current school year, fails (defined as a grade lower than 65) no more than 2 subjects at the end of the previous marking period.*** In the event that a student fails a first semester course, which cannot be repeated the second semester, the student will be placed on Partial Extra-Curricular Eligibility for the third marking period and must be passing all subjects ***with a current weighted GPA of 2.0*** at the midpoint of the said marking period.

4. ~~Partial Extra-Curricular Eligibility will be offered to a student only once per academic year.~~ ***(Note: this crossed out sentence is moved to the beginning of the section.)*** The period of Partial Extra-Curricular Eligibility will extend to the ***date of progress reporting*** ~~midpoint~~ of the marking period following the marking period in which the failure occurred***.*** A student on Partial Extra-Curricular Eligibility must attain a minimum average of "70" in the subject that was failed. Partial Extra-Curricular Eligibility will be extended in the event that Bristol Summer School offerings are not available to make up the academic failure. In the event that Partial Extra-Curricular Eligibility is granted for the first marking period, the student must be passing all subjects ***with a current weighted GPA of 2.0*** by the date of progress reporting of the marking period.

5. ***Students, who qualify under the Partial Eligibility Rule during a try-out period, may try-out for extracurricular activities, with the understanding that the Partial Eligibility Rule goes into effect immediately should he/she make the cut.***

6. Any student receiving a grade of "incomplete" shall be placed on Partial Extra-Curricular Eligibility until a ~~letter~~ grade is submitted by the teacher or by the date of progress reporting of the marking period.

6145.2(f)

Instruction

High School Full Extra-Curricular Eligibility

7. Transfer students' grades are interpreted by the standards of the previously attended school.

8. By July 1 of the previous year, be less than nineteen (19) years old for athletic participation. (CIAC Regulation)

Middle School Co-Curricular and Extra-Curricular Eligibility

Middle School ***Co and*** Extra-Curricular eligibility is determined by a student's overall performance in ***all*** ~~the five (5)~~ core subject***s*** and ***all*** ~~three (3) unified arts~~ ***encore*** subjects. Students are issued a subject and conduct grade for each subject and these ~~16~~ grades are considered. ~~For students who take band and instrumental music, one academic grade and one conduct grade are reported; this is not counted towards co-curricular eligibility. Chorus during flex time is not graded but choral performances are considered co-curricular activities.~~ Incomplete grades constitute a failing grade of below 65 until incomplete grades are made up.

At the start of each school year, all students attending middle school, who were promoted to the next grade, are eligible for participation in extra-curricular activities for the first trimester. Students who were retained are not eligible for participation in extra-curricular activities for the first trimester. Student eligibility will be reviewed at the conclusion of the first and second trimesters.

All extra-curricular activities occurring outside of the school day are included in these eligibility guidelines (such as sports***/intramurals***, cheerleading, dances, school organized clubs and/or events, etc.). Band and chorus activities occurring outside of the school day are considered co-curricular activities; students will participate in the school band and/or choral performances required when enrolled in band and/or chorus during the school day. When on academic restriction, students will not participate in band or chorus performances, such as adjudications, community concerts, etc., that are not required as part of enrollment in band or chorus.

6145.2(g)

Instruction

Middle School Full Extra-Curricular Eligibility

In order to be eligible to participate in all aspects of an extra-curricular activity, a student must meet the following criteria:

1. Scholarship
    a. At the end of the first and second trimester, the student must pass all ~~8~~ subjects with a grade of 65 or higher.

2. Conduct
    a. At the end of the first and second trimester, a student must have no more than one grade of ~~60~~ ***X*** in conduct. ~~in different subjects~~.

Middle School Academic Restriction for Extra-Curricular Activities

A student placed on academic restriction will not participate in extra-curricular activities; a student on academic restriction will not be able to represent the school in any type of extra-curricular competition, performance, etc. (for example, sports***/intramurals***, a school play, adjudications, ensembles).

A student will be placed on academic restriction for the second and/or third trimester when the following occur:

1. Scholarship
    a. A student fails one or more subjects (grade of 64 or lower) in the first and/or second trimester.
    OR
2. Conduct
    b. A student has more than one grade of ~~60~~ ***X*** in conduct. ~~in different subjects~~.

A student on academic restriction may not remain in school after the school day ends unless the student is under teacher supervision for make-up work, extra help, or detention.

Academic restriction will be removed upon successful completion of the second and/or third trimester, defined as the student meeting the requirements for full extra-curricular eligibility.

6145.2(h)

Instruction

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