Curriculum Committee Meeting

Thursday, December 12, 2013 4:30 PM
Curriculum Committee, L.P. Wilson Community Center, Room 17, 601 Matianuck Avenue, Windsor, CT 06095

1. **Call to Order, Pledge of Allegiance, Moment of Silence**
2. **Welcome and Introductions**
3. **Audience to Visitors**
4. **Program of Studies Update**
5. **Curriculum Framework Overview for New Members**
6. **Childhood Development**
7. **Zoology**
8. **Civics**
9. **Pre-calculus**
10. **Calculus**
11. **ST Math**
12. **Adjournment**

WINDSOR HIGH SCHOOL
Requested Changes to Program of Studies
2014-2015

❖ NEW EXPLANATIONS OF COURSE LEVEL EXPECTATIONS

	Student skills necessary to enter each level		
	College	Honors	High Honors/ AP
Critical Thinking	▪ Students develop critical thinking skills with frequent help from teacher	▪ Students develop critical thinking skills with some guidance from teacher	▪ Students independently generate original, higher-level thinking
Reading Comprehension	▪ Students read critically with ongoing assistance	▪ Students read critically and independently with some assistance	▪ Students read critically and independently, and use mostly their own strategies to understand very complex texts
Writing Skills	▪ Students can develop the ability to write accurate, well-crafted, effective essays with highly structured writing instruction. ▪ Students need to develop correct grammar and vocabulary skills	▪ Students can write clear and well-planned essays using both teacher-directed independent methods ▪ Students apply correct grammar and vocabulary skills	▪ Students write expressive, insightful, well-crafted essays that demonstrate logical progressions of ideas and a consistently masterful use of grammar and vocabulary
Academic Responsibility And Expectations	▪ Students develop the ability to work and think independently ▪ Students can use class time and independent time to complete guided assignments ▪ Students participate actively in classroom discussions and develop the ability to initiate these discussions ▪ Students complete college preparatory work with substantial assistance from the teacher	▪ Students work and think independently with support. ▪ Students use independent time to complete assignments ▪ Students initiate and sustain academic discussions ▪ Students complete college preparatory work with moderate amount of assistance from the teacher.	▪ Students work independently to generate insightful, accurate, and expressive ideas ▪ Students extend learning beyond the classroom by conducting further study or research ▪ Students demonstrate the willingness to take academic risks by posing questions and asking for clarification ▪ Students initiate and sustain insightful, analytical, and reflective discussions on a regular basis ▪ Students complete college-level work with minimal teacher assistance

WINDSOR HIGH SCHOOL
Requested Changes to Program of Studies
2014-2015

❖ **DEPARTMENT – ENGLISH**

- **Remove English 9 for 2 credits.**
- **Update English 12 to reflect full year course.**
- **Electives will be available for all students (no grade-level requirement).**
- **Remove Advanced Composition**
- **Remove Literature of a Global Society**
- **Add Access 9 & 10**

ACCESS 9
ACCESS 10 **College**
.5 credit. Teacher recommendation.
Students take this course in addition to their English requirement. This half-year literacy course is designed to provide support to selected students. Daily lessons emphasize reading, thinking and learning strategies, and writing practice. Students read various texts and engage in tasks designed to increase reading comprehension, writing fluency, and vocabulary development.

- **Change course names - Western Lit HH = English 9 HH and World Lit HH = English 10 HH**

- **Course description changes:**

ENGLISH 9 **High Honors, Honors, College**
1.0 credit
This Common Core State Standards-aligned course provides students with the foundational language skills and content knowledge necessary for mastering secondary-level reading, writing and communicating for a variety of purposes. Students will read literature and literary non-fiction or examine visual texts to analyze themes and topics, and to write informative and explanatory texts based on the material. *Conceptual units include*: the search for identity, coming of age, family, heroes and courage, Shakespeare, and the search for utopia.

ENGLISH 10 **High Honors, Honors, College**
1.0 credit
This Common Core State Standards-aligned course focuses on analyzing and writing about texts from various world cultures. Students will study different genres of literature and literary non-fiction to make cultural connections. Expository, analytical and persuasive writing are emphasized. *Conceptual units include*: many places…many voices, clash of cultures and values, …and justice for all, a question of truth, stirrings of the imagination, and crossing borders.

ENGLISH 11 **Honors, College**
1.0 credit
This Common Core State Standards-aligned course emphasizes the writing of informational, persuasive, and expository essays in conjunction with the study of American writers, their ideas, styles, and historical significance. Students will learn major topics and themes of American literature, and will further develop their vocabulary and research techniques. A research paper is required. *Conceptual units include*: foundations of the American Dream, fear- power-and the American way, individualism and the American voice, social justice, violence-war-loss, and the disintegration of the American Dream.

ENGLISH 12 **Honors, College**
1.0 credit
This Common Core State Standards-aligned course is designed to strengthen students' critical reading and writing skills. Students will prepare for college-level work by studying complex literary texts and

contemporary non-fiction selections. In completing the requirements for this course, students will prepare a comprehensive reading and writing project that incorporates research, revision, and presentation. Students will also be responsible for completing several summative writing assessments, in which they will learn to plan, draft, and proofread a formal, multi-page document. *Conceptual units include*: the journey, ourselves among others, ethics and morality, the role of gender and personal identity, tragedy in literature and life, and the senior biography project.

❖ **DEPARTMENT – MATH**

- **Drop Linear Algebra**
- **Add Multivariable Calculus**

Multivariable Calculus **High Honors**

1.0 credit. Prerequisite: 3 or better on the BC Calculus exam.
This course is an extension of calculus to more than one variable with a strong emphasis on theory and proofs. By the end of the course students will know how to differentiate and integrate functions of several variables. Topics to be covered in this course include Green's Theorem, Stokes' Theorem, and Gauss' Divergence Theorem.

- **Course description changes:**

Geometry **High Honors, Honors, College**

1.0 credit. Prerequisite: Algebra 1
This course is designed to integrate algebraic concepts with the study of geometric relationships, transformations, and proofs. Topics covered in this course include segments, lines, angles, polygons, circles, area, volume, and constructing proofs.

Pre-Calculus **High Honors, Honors, College**

1.0 credit. Prerequisite: Algebra 2. It is recommended that students receive a C average or higher in Algebra 2.
This course begins with defining and analyzing circular and trigonometric functions. Additional topics include conic sections, polar and parametric equations, sequences and series, and an introduction to the concept of limit. Emphasis is also placed on modeling problems using graphing calculators as a tool for analysis. This course is designed to prepare students for Calculus and other advanced math courses.

AB Calculus AP **AP**

1.0 credit. Prerequisite: Pre-Calculus. It is recommended that students receive a C average or higher in Pre-Calculus Honors.
This is an introductory course in differential and integral calculus with strong emphasis on applications in the field of business, social science and life sciences. Topics covered include functions, limits, rates of change, differentiation, maxima and minima problems, integration techniques and applications. There is extensive use of the graphing calculator and other hands-on activities. Additional topics to be covered include: volumes of revolution; differential equations and slope fields. Students are required to take the AP exam at no cost.

BC Calculus **AP**

1.0 credit. Prerequisite: Pre-Calculus. It is recommended that students receive a B average or higher in Pre-Calculus High Honors.

This is a faster pace college-level course that covers the AB Calculus curriculum as well as additional topics including sequences and series and polar, parametric, and vector functions. It is essential that the students enrolled in this course have had outstanding mathematical achievement in previous math courses. Students are required to take the AP exam at no cost. Qualifies for University of Connecticut Early College Experience.

❖ **DEPARTMENT – SCIENCE**

- **Remove Medical Emergencies 2**
- **Course description changes:**

Anatomy and Physiology **College**

1.0 credit. This course examines the human body systems, the form in which they exist, and how they function and interact with one another. Topics include exploration of each body system structure and function, including protection and thermoregulation, support and movement, communication, control and integration, transportation and defense, environmental exchange, and reproduction. Dissections, demonstrations and outside reading are integral parts of the course.

❖ **DEPARTMENT – SOCIAL STUDIES**

- **Department name change to Social Studies and History**
- **Remove Future Problem Solving**
- **Grade recommendations: B- or better in all AP courses**
- **Course name change: US History & the American Military to US Military History**
- **Addition to grade 10 electives = Psychology, Ethnic Studies**
- **Civics – honors and college levels change to "Non-Leveled" (college credit)**
- **Update to Early Global Studies description – add:**
  The college and honors version of this course will serve as a foundation to sophomore year Modern Global Studies; the high honors level will serve as a foundation for Advanced Placement World History in 10th grade.

❖ **DEPARTMENT – FAMILY & CONSUMER SCIENCE**

- **Course description changes**

Fashion Merchandising

1.0 Credit Prerequisite: Fashion and Clothing I

This year-long course will give students an in-depth view of the textile/apparel/retail soft goods chain. Prior to creating their own boutique, students will explore the many aspects which influence a fashion business, along with how to create a business plan and how to manage a business. In addition, students will be introduced to the apparel manufacturing process as well as analyze an array of career opportunities. Fashion Merchandising, by its nature, is interdisciplinary and calls for the application of 21st century skills and concepts in fashion, marketing, accounting, entrepreneurship as well as a range of researching, reading, writing and presentation skills. The culminating project for this course will allow

students to experience the world of fashion merchandising through the creation and maintenance of an e-commerce boutique.

Child Development I
Child Development I provides an introduction to the field of child care. Students will examine both the theoretical and practical process of development. Prior to operating a preschool for children ages 3 and 4, students will explore the key aspects of growth and development; including physical, cognitive, emotional and social development and demonstrate their application of content knowledge in both written and performance-based activities. In addition, students will be utilizing 21st century work skills to apply interdisciplinary concepts from child development, biology, and psychology.

❖ **DEPARTMENT – BUSINESS**

- **Rename Business Principles to Principles of Business Management**
- **Add E-Commerce** **Honors**
  .5 credit. Prerequisite: Entrepreneurship
  The increased commercial use of the internet makes it essential for students to understand the fundamental concepts that make electronic commerce possible. This course provides students with the opportunity to explore the realities and implications of e-commerce from a marketer's perspective. Creating an online presence, branding, responsible use of social media and the fundamentals of completing online transactions will be addressed through the establishment of a web-based school store.

- **Course description changes**

Principles of Business Management
This course is designed to provide a basic understanding of the essential elements of management. The course will introduce the student to the fundamental management functions including planning, organizing, leading, and controlling from a historical and contemporary perspective. These management functions will encompass practical applications of management theory. The course is designed with a skills based approach and focuses on the following 21st century skills: communication (oral, written, and listening), problem solving, teamwork, decision making, conflict resolution, critical analysis and ethical reasoning. Students will be introduced to work related situations that will help foster the management skills necessary for a successful future.

Personal Finance
Personal Finance is a semester course designed to help students understand the impact of individual choices on occupational goals and future earnings potential. Using simulations such as Virtual Business Personal Finance students will experience real world scenarios and use strategies covered in the course to help them make sound financial decisions. Students will design personal and household budgets; simulate use of checking and saving accounts; demonstrate knowledge of finance, debt, and credit management; evaluate and understand 1040ez tax returns. This course will provide a foundational understanding for making informed personal financial decisions.

❖ **DEPARTMENT – TECHNOLOGY /SCIENCE**

- **Add Aviation and Flight**

Aviation and Flight **College**
Recommendation: passed Algebra I. Open to all grades.

This one semester course will introduce student to a wide range of topics in the exciting field of aviation. Areas of study will include the theory of flight, the flight environment, aviation safety, aerodynamics, and aircraft performance. Flight and navigation principles also will be explored with the use of flight simulators. Field trips and speakers will be utilized to acquaint students with the many opportunities available in this career pathway. Computation as well as working with basic algebra and science concepts will be integral parts of the course.

❖ DEPARTMENT – SEMINAR

- **Program update:**

Participation in the Seminar program requires **above average ability in at least one core academic area** and a teacher recommendation citing **high degrees of self- motivation and creative thinking**. This is based on the model from Dr. Joseph Renzulli and Dr. Sally Reis out of the NEAG Gifted program at UCONN, an internationally acclaimed model. All 3 components- above average ability, high task commitment, and creativity are important for success in the program. Creativity is interpreted in terms of creative innovation and can happen within any field. For example, research in science can lead to new concepts which guide problem solving within that field. High honors and seminar support each other in terms of encouraging the high ability learner. The purpose of the Seminar components is to directly involve students in their own talent development through experiences that present and apply concepts and skills known to be best practices in the field of gifted education and applicable to all subject areas. Seminar I is strongly recommended and Seminar II and III are optional but encouraged as students evolve through the program. Students must maintain a "C" average to continue in the program. A gifted education specialist teaches the Seminar component classes. All courses correlate to the 21st Century skills adopted by WHS.

- **Course description changes**

Seminar I **HH**
.50 credits Required for 9th grade students taking a high honors core course.
This course focuses on: in-depth study of critical and creative thinking, an introduction to university quality research skills, personal talent development through self-evaluation of interests, learning styles, motivation, and conceptual blocks, and development and time management of a long term individual project.

Seminar II **HH**
.50 credits. Strongly recommended for students after taking Seminar I
This course focus on the continuation of skills taught in Seminar I as well as leadership and group collaboration techniques. Students create a major group product or service done using professional leadership strategies and based on the student's interest. Students extend inquiry based learning into studies of character in leadership, ethics, and analysis of leadership and group process.

Seminar III **HH**
.50 credits. This is individualized based on students who have gone through Seminar I and II
This is an individualized or group focused on continuation or new creation of an in depth study from Seminar I and/or II. This option may also evolve into national programs connected with problem solving.

Attributes of a Significant Task

- Encompasses a timeframe of 2-7 days of work
  - If the task can be done in one day it is a lesson plan.

- Includes the Standard Objective (Why) and the Instructional Process (How)
  - An instructional narrative linking many lessons together
  - Not a performance based task-name "significant task" is misleading

- Links to the standards

- Includes meaningful writing whenever possible

- Describes what the students are doing

- Narrates how are students learning
  - "in whole class discussion, students examine…"
  - "working individually, students identify…."
  - "in small groups, students discuss…"

- Defines what the students produce but with flexibility for the teacher
  - "**such** as a slideshow presentation or I Movie"

- Includes enough information for the teacher to plan lessons
  - "textbook problems"
  - "supplemental materials"
  - "applets, demonstrations, simulations, websites"

- Consumes in total 60% of instructional time in a unit

- Provides for effective use of technology for student learning or providing evidence of student learning

- Ensures only successful completion occurs as a result of new learning

Windsor High School School Wide Rubrics

1. Use Technological and Traditional Research Tools to access and evaluate information ethically.

Item		*Insufficient – 1*	*Sufficient - 2*	*Proficient - 3*	*Excellent - 4*
1.	**Uses technological and traditional resources as tools to access research information.**	**Needs** help to find resources and apply search strategies. Accessed and collects limited information from 1 source. **Some** information collected is irrelevant and/or contains factual errors. Some sources are documented. **Little** original interpretation. Paraphrased some research into own words. Few facts are incorporated and essential ideas may be altered.	**Needs** some help to find resources and apply search strategies. Accessed and collects information from (when appropriate) at least 3 sources. **Adequate** and mostly relevant information is collected. Most sources are documented. **Mostly** original interpretation. Paraphrased most research into own words and contains an adequate number of correct and essential facts.	**Applies** effective search strategies (keywords, synonyms, subject searches) to access and collect information from (when appropriate) at least 4 sources to retrieve information in varying formats **Information** collected is relevant. All sources are documented. **Original** interpretation. Paraphrased research into own words and contains correct and essential facts.	**Applies** effective and efficient search strategies (keywords, synonyms, subject searches) to access and collect information from (when appropriate) a wide selection (4 or more) of appropriate sources in a variety of formats. **Information** collected is relevant and detailed. All sources are documented. **Original** interpretation. Effectively paraphrased research into own words and contains all significant and essential facts.
2.	**Use of standard source criteria of:** **authority** (qualifications of author) **objectivity** (free from bias) **currency** (recentness of content) **coverage** (scope and level of detail)	**Sources** are chosen but based on little if any criteria *.	**Sources** are chosen based on some criteria *.	**Sources** are chosen based on most criteria *.	**Sources** are chosen based on all criteria: authority, objectivity, currency, and coverage criteria *.
3.	**Evaluates information critically and competently.** **(Critically:** application of rational and logical thinking**)**	**Critical** evaluation of information is weak. **Comparison** of facts is limited with little criteria.	**Critically** evaluates an adequate amount of the information researched. **Compares** some facts from at least 2 sources to judge information accuracy.	**Critically** evaluates most information researched. **Compares** facts from a variety of sources to judge information based on some criteria.	**Critically** and competently evaluates all information researched. **Compares** facts from a variety of sources to judge information based on criteria * authority, objectivity, currency, and coverage.
4.	**Documents sources used for Footnotes (In-Text) and Bibliography (Works Cited)**	**Source** content is mostly undocumented or has multiple citation errors **Multiple** sources used are missing from the bibliography and there are	**Most** source content is fully documented but has several citation errors. **Most** sources used are documented in the bibliography and there are	**All** source content is fully documented and has few citation errors. **All** sources used are documented in the bibliography and most are cited accurately.	**All** source content is fully documented and cited accurately. **All** sources used are documented in the bibliography and are cited accurately.

		multiple citation errors.	several citation errors.		

Windsor High School School Wide Rubrics

2. Works collaboratively to accomplish group goals

Item		*Insufficient – 1*	*Sufficient - 2*	*Proficient - 3*	*Excellent - 4*
1.	**Assumes shared responsibility for collaborative work.**	**Minimally** fulfills specific individual tasks as they pertain to the group. **Contributes** little information toward the achievement of group goals. **Behavior** or attitude may interfere with group dynamics.	**Adequately** understands group task and fulfills specific individual tasks as they pertain to the group. **Contributes** some information and opinions toward the achievement of group goals. **Will** help others if asked.	**Understands** group task and fulfills specific individual tasks as they pertain to the group. **Actively** contributes information, opinions and skills toward the achievement of group goals. **Willing** to help others to achieve goals.	**Understands** group task, consistently stays focused, follows through on and fulfills specific individual tasks as they pertain to the group. **Consistently** and activity contributes information, opinions and skills toward the achievement of group goals. **Supportive** of others and aids others to achieve goals.
2.	**Listens actively and is an asset to the group in achieving their goals.**	**Has** difficulty listening and/or tends to dominate discussion with focus on own opinion . **May** be argumentative and unwilling to consider others opinion. **Does** little to help group progress. Shows little respect for the group process.	**Listens** and interacts with most group members in an appropriate manner. Minimal focus on own opinion. **Own** discussion stays focused on group goals the majority of the time. **Will** do what is asked of him/her.	**Listens** and interacts with all group members in an appropriate manner **Helps** to maintain focus to achieve group goals. **Maintains** a positive, helpful attitude.	**Listens** and interacts with all group members in a thoughtful and respectful manner. **Redirects** discussion to help maintain focus to achieve group goals. **Maintains** a positive attitude and respectful demeanor. Helps to assure all have a chance to contribute to the group.

Windsor High School School Wide Rubrics

3. Effectively Communicates Information for a variety of purposes

Item		*Insufficient – 1*	*Sufficient - 2*	*Proficient - 3*	*Excellent - 4*
1.	**Oral Communication** **Articulates thoughts and ideas effectively using oral communication skills**	**Loses** place several times **Errors** in sentence formation. Word choices are limited and may create confusion. **Voice** is weak and pace has multiple hesitations. **Delivery** somewhat distracting.	**Mainly** shows poise **Adequate** sentence formation and flow. Word choices are also adequate. **Voice** is acceptable but pace may be rushed at times with some hesitations. **Delivery** acceptable with minor distractions.	**Shows** poise and comfort **Very** good sentence formation and flow. Word choices are strong and effective. **Voice** is audible and pace may be rushed at times with some hesitations. **Delivery** effective.	**Shows** poise and confidence **Excellent** sentence formation and smooth flow. Word choices are precise and accurate. **Voice** is audible and pace is appropriate for each situation. **Delivery is Natural** and highly effective.
2.	**Visual Communication** **Articulates thoughts and ideas effectively using visual (graphs, tables, diagrams, pictures etc.) communication skills in a variety of forms and contexts**	**No Clear Connection** between the visual communication (PowerPoint, charts, examples, etc.) used and content. **Mechanics of Visuals** including: grammar, spelling and data have a **multiple errors** that interfere with meaning	**Minimal Connection** between the visual communication (PowerPoint, charts, examples, etc.) used and content. **Mechanics of Visuals** including: grammar, spelling and data have **some errors** that minimally interfere with meaning.	**Clear Connection** between the visual communication (PowerPoint, charts, examples, etc.) used and content. **Mechanics of Visuals** including: grammar, spelling and data have **minor errors**, however they do not interfere with meaning.	**Clear Connection** between the visual communication (PowerPoint, charts, examples, etc.) used and content that **optimally** supports information. **Mechanics of Visuals** including: grammar, spelling and data are **free of errors** to best communicate meaning.
3.	**Presentation of Content/Information**	**Content is lacking organization** with no clear flow of information. Thinking is unclear. **Few** supporting ideas relate to the central theme. Content reflects a general **lack of understanding** of information presented. **Audience is not able** to follow reasoning and the content is mostly confusing. .	**Content is somewhat organized**. Thinking can be followed, though with some difficulty. **Supporting** ideas relate to the central theme. Content reflects a **shallow understanding** of information presented. **Audience struggles** to follow line of reasoning due to the content being confusing at times, but in the end gains some understanding.	**Content is organized** so the flow of information is evident. **Supporting** ideas relate to the central theme. Content reflects an **understanding** of information presented. **Audience** can follow line of reasoning and the content can be understood.	**Content is highly organized** so the clear flow of information is explicit and concise. **Supporting** ideas relate to the central theme. Content reflects **key details** and a clear understanding of information. **Audience** clearly follows line of reasoning and the content is easily understood.

Windsor High School School Wide Rubrics

4. Critical Analysis/Thinking

Item		*Insufficient – 1*	*Sufficient - 2*	*Proficient - 3*	*Excellent - 4*
1.	**Identifies, defines and explains task(s) to be addressed**	**Task**(s) is stated however is ambiguous or lacks clear definition. **Limited** understanding of the task(s) is shown.	**Task**(s) is stated and adequately described. **Understanding** of the context of the task(s) is evident however shallow.	**Task**(s)) is clearly identified and described. **Understanding** of the context of the task(s) is clear.	**Task**(s) is clearly identified and comprehensibly described. All aspects are clearly explained. **A** deep understanding of the context of the task(s) is demonstrated.
2.	**Collects and analyzes quantitative information and data**	**Inadequate** measurable information and data is collected to address task. **The** validity and relevance of the information is limited. Limited analysis occurs.	**Adequate** measurable information and data is collected. **The** validity and relevance of the information and data is basically evaluated and analyzed.	**The** majority of measurable information and data is collected. **The** validity and relevance of the information and data is fully evaluated and analyzed.	**All** measurable information and data is collected. **The** validity and relevance of the information and data is rigorously evaluated and analyzed in depth.
3.	**Interprets findings, draws conclusions/addresses task(s) and communicates results**	**Organizes** and presents an inadequate interpretation of findings. **Provides** a solution to the task(s) with no data.	**Organizes** and presents an adequate interpretation of findings. **Provides** a solution to the task(s) that includes some data.	**Organizes** and presents a clear and logical interpretation of findings. **Provides** a solution to the task(s) that includes some data.	**Effectively** organizes and presents a logical and substantial interpretation of findings. **Provides** a clear solution to the task(s) that includes data. **Alternative** solutions are also offered.

Windsor High School School Wide Rubrics

5. Problem Solving

Item		*Insufficient – 1*	*Sufficient - 2*	*Proficient - 3*	*Excellent - 4*
1.	**Understanding the Problem or Issue** (Necessary Information - includes missing or not needed info and ability to identify the unknowns)	Understanding of Problem is **Confused** evidenced by: **An inability** to restate the problem in own words or defines the problem incorrectly	Understanding of Problem is **Shallow** evidenced by: **Struggling** to restate the problem in own words, despite prompting **Obtaining** limited information from problem	Problem is **Mostly Understood** as evidenced by: **Ability** to restate problem in own words with minimal prompting **Obtaining** most necessary information from problem	Problem is **Clearly Understood** as evidenced by: 4 **Ability** to confidently restate problem in own words **Obtaining ALL** necessary information from problem
2.	**Devising a Strategy** (*Creates/Applies a specific framework for solving the problem for example: diagram, written information, formula, equation, model, table, etc.)	Devises a **poor strategy** to as evidenced by: **Incorrectly** identifying facets of problem **Not** applying previous knowledge to current problem **Unwilling** to review another relevant problem/historical occurrence **Not** identifying steps to solution or applying a framework for solving the problem	Devises a **weak strategy** to solve the problem as evidenced by: **Identifies** minimal facets of problem **Limited** application of previous knowledge to current problem **Minimally** Identifying/Researching another relevant problem/historical occurrence **Identifies** confusing steps to solution and creates a vague framework for solving the problem	Devises an **acceptable strategy** to solve the problem as evidenced by: **Identifies** most facets of problem **Working** to apply previous knowledge to current problem **Identifying/Researching** another relevant problem/historical occurrence **Identifies** steps to solution and applies a specific framework for solving the problem	Devises a **strong strategy** to solve the problem as evidenced by: **Identifying** all facets of problem **Effectively** applying previous knowledge to current problem **Identifying/researching** another relevant problem/historical occurrence and integrating it with information gathered **Clearly** identifies all steps to solution and **creates/applies** a specific framework for solving the problem*
3.	**Solves the Problem**	**Does Not** solve the problem as evidenced by: -**Blank** records **No** consideration of the constraints of the problem/situation **The** solution is incorrect with no other information shown.	**Weakly** solves the problem as evidenced by: **An** inaccurate/incomplete record of working through the problem/issue **Limited** consideration of the constraints of the problem/situation **Limited** evaluating & revising **The** solution is generally correct, though there is little to no evidence to show how the solution was arrived at	**Acceptably** solves the problem as evidenced by: **Keeping** an accurate record of working through the problem/issue **Consideration** of most constraints of the problem/situation **Evaluating** & revising as needed **The** solution is correct, though there is a mistake due to a minor computational or copy error	**Successfully** solves the problem as evidenced by: **Keeping** an accurate & specific record of working through the problem/issue **Consideration of** all constraints of the problem/situation **Evaluating** & revising as needed **The** solution and all relevant work is correct

Windsor High School School Wide Rubrics

4.	**Reflection: Evaluating Solutions**	**Poorly** evaluates solution as evidenced by: **Struggles** to connect the results to the original problem **No** ability to articulate how the answer is a reasonable solution, despite prompting **No** understanding on if the results could have been derived differently ***Struggling*** to discuss relevance of applications of problem solving techniques	**Weakly** evaluates solution as evidenced by: **Limited** ability to connect the results to the original problem **Struggling** to articulate how the answer is a reasonable solution, despite prompting **Confused** on *if* the results could have been derived differently **Limited** ability to discuss relevance of applications of problem solving techniques	**Acceptably** evaluates solution as evidenced by: -**Checking** the results against the original problem **Articulating** how the answer is a reasonable solution (w/ prompting) **Identifying** if the results could have been derived differently **Generally** identifying other or related problems which the strategy/solution could be applied	**Critically** evaluates solution as evidenced by: **Checking** the results against the original problem **Confidently articulating** how the answer is a reasonable solution **Identifying** if & how the results could have been derived differently **Specifically identifying** other or related problems which the strategy/solution could be applied

Windsor High School School Wide Rubrics

6. Demonstrate Personal Responsibility and Character to self and community

Item	*Insufficient – 1*	*Sufficient - 2*	*Proficient - 3*	*Excellent - 4*
Arrives to class on time	**Has difficulty:** **Arriving** to class on time	**Mostly:** **Arrives** to class on time	**Except on rare occasions:** **Arrives** to class on time	**Always:** **Arrives** to class on time
Demonstrates responsible behaviors	**Has difficulty:** **Maintaining** appropriate physical and verbal behaviors; self-control **Maintaining** behaviors conducive to self-learning and the learning of others **Accepting** responsibility for personal behaviors; never blames others for own actions	**Mostly:** **Maintains** appropriate physical and verbal behaviors; self-control **Maintains** behaviors conducive to self-learning and the learning of others **Accepts** responsibility for personal behaviors; never blames others for own actions	**Except on rare occasions:** **Maintains** appropriate physical and verbal behaviors; self-control **Maintains** behaviors conducive to self-learning and the learning of others **Accepts** responsibility for personal behaviors; never blames others for own actions	**Always:** **Maintains** appropriate physical and verbal behaviors; self-control **Maintains** behaviors conducive to self-learning and the learning of others **Accepts** responsibility for personal behaviors; never blames others for own actions
Demonstrates respect for all members of the community	**Has difficulty:** **Treating** others (peers and adults) with respect and dignity. Is courteous and aware of how her/his behaviors affect others **Accepting** diversity within the community	**Mostly:** **Treats** others (peers and adults) with respect and dignity. Is courteous and aware of how her/his behaviors affect others **Accepts** diversity within the community	**Except on rare occasions:** **Treats** others (peers and adults) with respect and dignity. Is courteous and aware of how her/his behaviors affect others **Accepts** diversity within the community	**Always:** **Treats** others (peers and adults) with respect and dignity. Is courteous and aware of how her/his behaviors affect others **Accepts** diversity within the community
Demonstrates respect for all personal and community property	**Has on several occasions** abused or damaged personal or community property **Has difficulty:** **Helping** to clean-up/maintain personal and community workspace	**Has only once** abused or damaged personal or community property **Mostly:** **Helps** to clean-up/maintain personal and community workspace	**Never** abuses or damages personal or community property **Except on rare occasions:** **Helps** to clean-up/maintain personal and community workspace	**Never** abuses or damages personal or community property **Always:** **Helps** to clean-up/maintain personal and community workspace

Windsor High School School Wide Rubrics

Completes at least 25 hours of community service	**Completed** some community service forms **Completes** less than 20 hours of community service prior to senior year	**Completed** all appropriate community service forms **Completes** 20 hours of community service prior to senior year	**Completed** all appropriate community service forms **Completes** 25 hours of community service prior to senior year	**Completed** all appropriate community service forms **Completes** 30 hours of community service prior to senior year

Windsor Public Schools
Curriculum Map
Course Title

Purpose of the Course:

Name of the Unit:	Length of the unit:
Purpose of the Unit:	

Common Core State Standards Addressed in the unit: (Provide the link to the specific standards.)

Big Ideas:	Essential Questions:
Students will know: Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science	Students will be able to: Refer to the links below: Depth of Knowledge LA Depth of Knowledge Math/Science

Significant task 1: (Include links for differentiated tasks.)

Timeline:
Key vocabulary:
Resources:

Significant task 2:
(Include links for differentiated tasks.)

Timeline:
Key vocabulary:
Resources:

Significant task 3:
(Include links for differentiated tasks.)

Timeline:
Key vocabulary:
Resources:

Common learning experiences:

Common assessments including the end of unit summative assessment:
(Provide link to assessments and rubrics.)

Consider the 21st Century Learning Framework when designing common assessments.

Teacher notes:

Windsor Public Schools
Curriculum Map for the Secondary Level
Child Development I

Purpose of the Course: Child Development I provides an introduction to the field of child care. Students will examine the theoretical and practical process of development. Prior to operating a preschool for children ages 3 and 4, students will explore the key aspects of growth and development; including physical, cognitive, emotional, and social development. In addition, students will be utilizing 21st century work skills to apply interdisciplinary concepts from child development, biology, and psychology. This semester course will provide the opportunity to demonstrate application of content knowledge in written and performance based activities.

Name of the Unit: The Study of Children Unit 1	Length of the unit: 11 blocks (86 minutes)
Purpose of the Unit: This unit introduces students to the science of development. Students will create a "tool kit" for academic success while dispelling myths about how we become the people we are. The focus of the unit is how we can use theoretical knowledge to maximize human development. Students will focus on the interaction of heredity and environment as well as Erik Erikson's theory of lifespan development.	

FACS Standards addressed in the unit:
Explain physical, emotional, social, and intellectual development B.6
Describe interrelationships among physical, emotional, social, and intellectual aspects of human growth and development during childhood B.7
Describe the impact of heredity and environment on human growth and development during childhood C.8
Describe the effects of life events during childhood on an individual's physical and emotional development C.11

Common Core State Standards Addressed in the unit:
Text Types and Purposes 10.W.2: writing informative/explanatory text to examine and convey complex ideas
Research to Build and Present Knowledge 10.W.7:Conduct short as well as more sustained research projects to answer questions(including self-generated questions) or solve a problem, narrow or broaden the inquiry when appropriate, demonstrating understanding of the subject under investigation
Comprehension and Collaboration 10.SL.1: initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on topics, texts and issues.
Presentation of Knowledge and Ideas 10.SL.4: Present information findings and supporting evidence, clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance and style are appropriate to purpose, audience and tasks.
Conventions of Standard English 10.L.1: Demonstrate command of the conventions of standard English and usage when writing or speaking
Vocabulary Acquisition and Use 10.L.4: Determine or clarify the meaning of unknown and multiple meaning words and phrases based on reading and context

Big Ideas:	Essential Questions:
Each person is responsible for their own success. Development continues throughout life. Heredity and environment are two key influences on development.	What do successful athletes, successful students, and successful adults have in common? Why is early childhood and old age similar? What makes you unique?
Students will know: • Personal success is the result of behavior, accountability, and repeated effort • Their personal learning style and how it works with other learning styles to enhance collaboration • The crisis stages of Erik Erikson's theory of lifespan development • The five primary principles of growth and development • The four primary ways humans develop; physical, cognitive, emotional, and social	Students will be able to: • Design an online course portfolio • Collaborate to solve a team challenge • Identify and analyze Erikson's stages of development from birth through adolescences • Compare the process of human development to another sequenced process • Develop a personal plan to maintain balance in each area of development

Significant task 1: Benefits of studying children

Each student will create a personal collage in their online portfolio. In the collage the student will respond to questions about themselves as a child and now, their personal reasons for taking this course, and their views of why child development is a field of study. Individual students will share their collages with the whole group. While each student presents their collage, the class will write down how the presenter will benefit from learning about children. After all members of the class have presented, in small groups the students will group the benefits of learning about children. As a whole class students will work to group the benefits into the four primary benefits of learning about children. While working independently, students will create a personalized CUPP (Career, Understand ourselves, Parenting skills, and to Protect kids) in their journal to visually express the benefits of taking a child development course.

Timeline: 4 blocks (86 minutes)
Key vocabulary: Development, Child Development
Resources: Collage assignment, computers/iPads, Smart Board, interactive notebook for journaling, CUPP cutout for journal.

Significant task 2: Factors of Development (Erikson's Playlist)

In small groups students will analyze the childhood profiles of people with notoriety. Each group will make predictions about the types of grownups the profiled person may become. Student groups will underline the key factors they are using to determine the outcomes. As a whole group the students will discover the identities of each person that was profiled. The class will discuss the factors that influence our personal growth and development. As individuals each student will journal to explain their understanding of the factors that work to make us individuals. Students will take formal notes on

Erikson's Psychosocial theory of development from a Smart Board lecture. Working as individuals each student will create a playlist based on Erikson's theory. The students will explain each stage of development; identify a song that connects to the stage, and explicitly state in writing how the two connect.

Timeline: 3 blocks (86 minutes)
Key vocabulary: Nature/Heredity, Nurture/Environment, Crisis
Resources: Celebrity childhood profiles, interactive notebooks for journaling, Erikson's Psychosocial Theory Power Point, Smart Board, Erikson's Playlist worksheet, iPads/iPods for seeking music

Significant task 3: Principals of Development (Wellness Wheel)

As a whole class, students will be introduced to the four key areas of development by making guesses at what they see when they look at a picture of a child playing, this will serve as a hook into discussing the ways to describe a child's development. The students will take notes of the key principles of development based on an Interactive PowerPoint presentation. The students will ask and respond to questions. As a whole class; the students will compare and contrast the principals of growth and development to the process of creating an omelet. Students will work in small groups to use the principles of growth and development to create another analogy to present to the class. Working as individuals, students will journal their belief of what would happen if these principles of development were not in place.

As a whole class, students will select a piece of the P.I.E.S. (Physical, Intellectual, Emotional and Social) Development. Each piece of P.I.E.S. will be labeled with one of the key areas of development. The students will describe this aspect of their life. As a whole class students will discuss how this area of their life has changed and how they anticipate the changes that will take place in the future. Each student will take notes about how each person has an impact on their physical, intellectual, emotional, and social development. Individually, each student will create a wellness wheel describing each aspect of their development and provide suggestions for how they can develop balance in all areas of life.

Timeline: 4 blocks (86 minutes)
Key vocabulary: Developmental Tasks, Physical Development, Intellectual (Cognitive) Development, Emotional Development, Social Development
Resources: Principals of Growth and Development PowerPoint, compare and contrast chart, interactive journals, P.I.E.S. slices, Smart Board, Wellness Power Point, Colored pencils, circles, paper

Common learning experiences:

- Take part in a team building icebreaker to demonstrate collaboration. This activity is used as a point of reference through the course.
- Use 21st century technology to create online portfolios.
- Create a web based personal collage to share personal views and beliefs regarding childhood and the study of children.
- Create predications of notorious people in history based on a profile of their childhood experiences.
- Synthesize the stages of development and interest of music into Erikson's Playlist by identifying and explaining how a song (of the student's selection) connects with each of the eight stages

explained in Erikson's theory of psychosocial development.
- Work in small groups to create an analogy for the process of human growth and development based on the key principles of growth and development.
- Create a personal wellness wheel and describe specific ways a person can increase their personal growth in each area of development.

Common assessments:
- Course vocabulary pretest
- Personal Collage
- CUPP graphic
- Wellness wheel
- Unit Test (Includes unit vocabulary)

Common rubrics:
- School-wide rubric #2 Collaboration
- School-wide rubric #3 Communication
- School-wide rubric #4 Problem Solving

Teacher notes:
Students will create an online portfolio using Google sites.

Students will supplement their online portfolio through a handwritten portfolio such as an interactive spiral notebook. Within the notebook students are instructed to use a formal note taking process such as Cornell Notes.

CUPP is the acronym for Career Skills, Understand yourself, Protect children, and Parenting skills

P.I.E.S. is the acronym for Physical Development, Intellectual Development, Emotional Development, and Social Development

Name of the Unit: Pregnancy, Labor, and Delivery Unit 2	Length of the unit: 7 blocks (86 minutes)

Purpose of the Unit: The overarching theme of this unit is physical development. Students explore the process of life beginning with conception. The study of conception and gestation will include the impact of technological advances on fertility, pregnancy, gestation, and labor and delivery. Over the course of this unit, the students will create an interactive web-based timeline to chronicle key milestones from conception to birth.

FACS Standards addressed in the unit:
Describe the impact of technology on individual and family resources as related to child development, parenting education, and early childhood education and services A.2
Identify biological processes related to prenatal development, birth, and health of child, mother, and father H.26
Describe biological and environmental factors that affect the health of the child and parents H.27
Identify alternatives to biological parenthood H.29
Describe legal and ethical technological advances from conception to birth H.30

Common Core State Standards Addressed in the unit:
Text Types and Purposes 10.W.2: writing informative/explanatory text to examine and convey complex ideas
Research to Build and Present Knowledge 10.W.7: Conduct short as well as more sustained research projects to answer questions (including self-generated questions) or solve a problem, narrow or broaden the inquiry when appropriate, demonstrating understanding of the subject under investigation
Comprehension and Collaboration 10.SL.1: initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on topics, texts and issues.
Presentation of Knowledge and Ideas 10.SL.4: Present information findings and supporting evidence, clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance and style are appropriate to purpose, audience and tasks.
Conventions of Standard English 10.L.1: Demonstrate command of the conventions of standard English and usage when writing or speaking
Vocabulary Acquisition and Use 10.L.4: Determine or clarify the meaning of unknown and multiple meaning words and phrases based on reading and context

Big Ideas:	Essential Questions:
Conception is a biological act that takes place when two cells join. The largest gains in physical development take place while a child is in utero. The foundation of the future is established early in life.	When does human life begin? In what ways do environmental and genetic factors shape adolescent and adult development of a fetus?
Students will know: • The process of human development from conception through birth • Technological advances have increased the likelihood of infertile couples becoming parents • Technology has allowed us to know more about prenatal development • Parents' environmental factors have a profound effect on the future development of their children	Students will be able to: • Utilize technology to develop an interactive timeline to document the major milestones of conception through birth • Identify and explain alternative methods of parenthood • Explain the effects of nutrition and other environmental factors on fetal development

Significant task 1: Conception and alternatives

As a whole class, students will observe a short video on the Smart Board of the biological process of conception. This will serve as the hook into the topic of conception. After a whole class discussion about the methods for avoiding pregnancy, each student will identify and label the major organs in the reproductive system. In groups of two, students will trace the ova's path to the uterus. Each student will access the dipity website and begin a timeline to demonstrate the process of conception. Students will listen to a guest speaker discuss their journey from infertility to parenthood. After the guest

speaker, the students will research methods for becoming a parent through means other than traditional conception. Each student then will create links on their dipity timeline to include their findings. Student research will focus on the use of technology to increase the likelihood of pregnancy and/or parenting.

Timeline: 3 blocks (86 minutes)
Key vocabulary: Conception, ova, sperm, infertility, adoption, uterus, in vitro fertilization,
Resources: computers, access to website www.dipity.com, interactive timeline project page, images of the female and male reproductive system to label, Smart Board, video of the biological process of conception

Significant task 2: Pregnancy and Gestation

As a whole class, students will use the Smart Board to sort a list of environmental influences into the grouping of hazardous to baby and safe for baby. This will serve as the catalyst for small group discussion about the factors that may affect the health of a fetus or the mother. Within their groups, students will collaborate to answer questions such as, "How can a mother protect herself and her baby from the environmental hazards she may encounter during pregnancy?" "How does the timing of the environmental factors influence the health of the baby?" and "How would a woman's body change during pregnancy once the ovum is implanted in the uterus?" Students will convene as a whole group to debrief their findings.

Working individually, each student will access their dipity timeline to research and document findings regarding the major changes that take place during each trimester of pregnancy and each stage of prenatal development (zygote, embryo, and fetus).

Timeline: 2 blocks (86 minutes)
Key vocabulary: nausea/morning sickness, prenatal development, pregnancy, trimester, gestation, amniotic sac, amniotic fluid, umbilical cord, amniocentesis, environmental hazard, lightening/dropping, quickening, fetus, zygote, embryo, miscarriage, stillbirth, placenta
Resources: computer/iPad, access to dipity timeline, Smart Board

Significant task 3: Labor and Delivery

In small groups, students will share their findings from the birth interview they completed as homework. As a whole class we will tally the number of vaginal births and cesarean births. Students will take notes on their observations of short videos that include a cesarean birth, natural hospital child birth, and a natural home child birth. After viewing the videos, each student will complete a semantic feature analysis to compare and contrast each of the three births they observed. To synthesize their observations, students will research aspects of giving birth; including labor and delivery, pain management, at home preparation for delivery, and/or the process of the hospital birth for their dipity timeline.

Timeline: 2 blocks (86 minutes)
Key vocabulary: natural birth, intervention, Pitocin, obstetrician, pediatrician, birth canal, contraction, postpartum depression, toxemia, episiotomy, cesarean, lochia, crowning, anesthetic, breech, ultra sound, labor
Resources: computer/iPad, access to dipity timeline, Smart Board

Common learning experiences:

- Do now to dispel the myths of conception
- Labeling a diagram of the male and female anatomy and tracing the ova's path from ovary to implantation in the uterus
- Recreate a diagram of the fetus in utero with an label and explanation of the vocabulary
- Interview a woman who has delivered a baby
- Develop an ad to remind a first time mother to about potential hazards to the baby
- Recreate the image of a fetus in utero
- Write a journal entry to describe the "most influential" stage of prenatal development
- Create a live "commercial" to demonstrate the importance key safety precautions during birth
- Create an interactive timeline of pregnancy and gestation using www.dipity.com

Common assessments:

- Pregnancy, Labor, and Delivery vocabulary quiz
- Labeled male and female anatomy diagram
- Pregnancy, labor and delivery timeline rubric
- Unit test

Common rubrics:

- Timeline, project rubric
- School-wide rubric #1 Research
- School-wide rubric #2 Collaboration
- School-wide rubric #4 Problem Solving

Teacher notes:
Dipity is a free website students can use to create an interactive timeline. www.dipity.com

Guest speaker will include a person that has used nontraditional methods to become a parent, such as an adoption, surrogate, or IVF.

Name of the Unit: The Brain Unit 3	Length of the unit: 7 blocks (86 minutes)
Purpose of the Unit: The overarching theme of this unit is cognitive development. We will explore the function and process of brain growth while identifying strategies and activities designed to promote cognitive growth in young children. Students will focus on the process of intellectual development through the lens of Piaget's Theory of Cognitive Development.	

FACS Standards addressed in the unit:
Describe interrelationships among physical, emotional, social, and intellectual aspects of human growth and development during childhood B.7
Describe the impact of heredity and environment on human growth and development during childhood C.8
Describe the effects of life events during childhood on an individual's physical and emotional development C.11
Explain the role of nurturance on the growth and development of children D.12

Explain the role of communication on the growth and development of children D.13

Common Core State Standards Addressed in the unit:
Text Types and Purposes 10.W.2: writing informative/explanatory text to examine and convey complex ideas
Comprehension and Collaboration 10.SL.1: initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on topics, texts and issues.
Presentation of Knowledge and Ideas 10.SL.4: Present information findings and supporting evidence, clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance and style are appropriate to purpose, audience and tasks.
Conventions of Standard English 10.L.1: Demonstrate command of the conventions of standard English and usage when writing or speaking
Vocabulary Acquisition and Use 10.L.4: Determine or clarify the meaning of unknown and multiple meaning words and phrases based on reading and context

Big Ideas:	Essential Questions:
Structures of the brain are designed to perform specific tasks. Young children learn through experiences. Intellect develops in stages based on overall development.	How is the brain like a computer? Can parents increase their child's intelligence? How can our physical, emotional, and social development work to develop our intellect?
Students will know: • The structures of the brain and the corresponding information processed there • Piaget's Cognitive Development Theory explains that intellect develops in stages • Caregivers and parents can use specific strategies for promoting growth and development • Our interactions with young children have an impact on their development	Students will be able to: • Evaluate programs designed to promote cognitive growth in young children (Your baby can read, Baby Einstein, etc.) • Identify regions of the brain, its parts and functions • Create a webpage for parents informing them of the strategies they can use to promote cognitive development in young children

Significant task 1: A tour of the brain

As a whole class, students will view a short YouTube clip introducing the brain. This will serve as the hook into the topic of the brain and intellectual development. Following the brain video clip the students will complete a fact or fiction non- graded quiz about how the brain functions and develops across our lifetime. Independently, students will use iPads to view an interactive presentation about the brain, its parts, and how it functions. Students will complete a color-coded diagram of the brain (brain map) and paste images that describe how they use each structure of the brain during their day. Working in teams of 2-3, students will research one complication that can occur within the brain (such as Alzheimer's, stroke, and tumors) and analyze strategies for promoting and protecting brain function. Each small group will present brain activities to the class.

Timeline: 2 blocks (86 minutes)
Key vocabulary: neurons, plasticity, window of opportunity, parietal lobe, frontal lobe, temporal lobe, brain, brain stem, cerebellum, occipital lobe
Resources: Ipad, The Brain app, YouTube, fact or fiction quiz, brain diagram (brain map)

Significant task 2: Piaget's Cognitive Development Theory

As individuals, students will free- write about how they learned to do an activity (for example, this may be ride a bike, read a book, or use a computer). This will introduce a class discussion about how we learn. As a whole class, students will take notes from a presentation about Piaget's Cognitive Development Theory. Individual students will be asked to analyze each stage of cognitive development and accurately label the stage of development that allowed them to learn the task from their free- write. Working in groups of two, students will develop a role play for teaching or explaining rules to children in an assigned stage of development. The students will demonstrate their understanding through the use of role plays. Working as individuals, each student will create a web page designed to teach parents how they can promote intellectual growth in their preschool and elementary school aged children.

Timeline: 5 blocks (86 minutes)
Key vocabulary: cognition, experiences, sensorimotor stage, preoperational stage, concrete operational stage, formal operational stage, schemata (schema), assimilation, accommodation, equilibrium, egocentric

Resources: Computers, iPads, Personal website

Common learning experiences:

- Fact or fiction Brain Quiz
- Vocabulary games
- Developing a brain map
- Piaget Matching Game
- Stages of development pop quiz (self-assessment)
- Parenting Web Page
- Develop and perform a role play based on teaching a rule to a preschool child.

Common assessments including the end of unit summative assessment:

- Brain Map
- Results of Piaget Matching Game
- Piaget Pop Quiz (self-assessment)
- Unit Test

Common rubrics:

- School-wide rubric #1 Research
- School-wide rubric #2 Collaboration
- School-wide rubric #4 Problem Solving

Teacher notes:
Pinky and the Brain- YouTube clip. http://www.youtube.com/watch?v=snO68aJTOpM
Random brain facts- http://facts.randomhistory.com/human-brain-facts.html
Great information on the brain- http://www.nea.org/tools/lessons/51122.htm

Name of the Unit: Nursery School Unit 4	Length of the unit: 20 blocks (86 minutes)
Purpose of the Unit: The focus of this unit is the demonstration of the 21st century work skills. Students will operate a functional nursery school program designed for children between the ages of three and four. Each week the high school students will rotate between implementing play activities and taking on the role of observer/researcher. The students will focus on identifying the key areas of development (Physical, Intellectual/Cognitive, Emotional and Social) as they appear in a nursery school child. At the completion of this unit each student will create a documentary- style movie of one child's total development based on research and observations.	

FACS Standards addressed in the unit: **Explain the role of nurturance on the growth and development of children** D.12 **Explain the role of communication on the growth and development of children** D.13 **Explain the role of support systems on the growth and development of children** D.14 **Describe methods to manage physical space to maintain a safe and healthy learning environment** L.44 **Describe and implement strategies to teach children health, safety, and sanitation habits** L.45 **Establish developmentally appropriate guidelines for behavior** M.50 **Identify interpersonal skills that promote positive and productive relationships with children (and families)** M.52 **Determine methods for communicating information to parents** M.53 Common Core State Standards Addressed in the unit: **Text Types and Purposes** 10.W.2: writing informative/explanatory text to examine and convey complex ideas **Research to Build and Present Knowledge** 10.W.7:Conduct short as well as more sustained research projects to answer questions(including self-generated questions) or solve a problem, narrow or broaden the inquiry when appropriate, demonstrating understanding of the subject under investigation **Comprehension and Collaboration** 10.SL.1: initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on topics, texts and issues. **Presentation of Knowledge and Ideas** 10.SL.4: Present information findings and supporting evidence, clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance and style are appropriate to purpose, audience and tasks. **Conventions of Standard English** 10.L.1: Demonstrate command of the conventions of standard English and usage when writing or speaking **Vocabulary Acquisition and Use** 10.L.4: Determine or clarify the meaning of unknown and multiple meaning words and phrases based on reading and context	
Big Ideas: Care-giving practices can maximize early human growth and development. Informed decision making is a process that requires the collection and evaluation of information before making decisions. There are identifiable conditions that impact the well-being of children and families.	Essential Questions: How does understanding the characteristics of development help to make us better parents/caregivers? How do we establish realistic expectations for young children? How do we foster a positive learning environment for young children?
Students will know:	Students will be able to:

• Physical, Intellectual (Cognitive), emotional, and social developmental areas work together to promote growth • Key milestones are used as a guide to determine the rate of development • There are specific care-giving practices that support positive growth and development in young children	• Demonstrate employability skills • Work collaboratively as a team to operate a preschool for 3 to 4 year old children • Complete objective observations of children in a preschool setting • Research common challenges involved in caring for preschool children • Employ a variety of positive guidance techniques to communicate expectations with young children • Reflect critically on observations and research

Significant task 1: Operating a nursery school

Each student will be provided a copy of the nursery school information packet to review. After reviewing the document, students will develop a list of questions that arise regarding nursery school (these questions range from how many children will be attending to the work expectations). This activity provides a transition into discussing the expectations for the 6 weeks of nursery school. As a whole class the teacher will lead the students through a "practice day of nursery school" which includes a circle time activity, modeling of providing directions, and a collaborative task. Individually, students will take notes while watching the teacher develop a nursery school lesson plan using classroom print and web resources. The students then will be divided into two groups (assigned by teacher to ensure a balance of skills and abilities). Each group will research, analyze, and plan nursery school activities for the assigned weekly themes. After completing the plans for one activity, each group will conference with the teacher about strategies for planning a full day. At the conclusion of planning, students will develop/obtain the resources needed to implement their planned lessons. Each week during the 6 week nursery school lab experience, students will work collaborate in their assigned teams to implement all planned activities, while employing 21st century work skills (especially critical thinking and problem solving)

Timeline: 10 blocks (86 minutes)

Key vocabulary: lesson, routines, developmentally appropriate practices, expectations, guiding behavior, resources, informed decision

Resources: nursery school information packet, child development 1 lesson planner, group nursery school day planner.

Significant task 2: Observations

Working individually, each student will complete a 5 minute observation of the classroom teacher performing ordinary classroom tasks. The students will not be provided direction during this time. The 5 minute observation will serve as a pre-assessment of observational skills. As a whole class, the students will take notes during a prezi on the "Art of Observation". Following the presentation, students will work in teams of 4 to review teacher- created observations and label them as subjective or objective. For homework, each student will complete an anecdotal report based on an observation of a populated space (mall, cafeteria, library, etc.). Over the course of nursery school, each student will

observe one nursery school student to determine their current developmental state. The observations will be supplemented with a photograph of the child, weekly blog style updates, and document research in each area of development. After the conclusion of nursery school, students will work in the library compiling a documentary style movie to demonstrate the overall development of the child they observed.

Timeline: 10 blocks (86 minutes)
Key vocabulary: subjective observation, objective observation, observation, observable behavior, antidotal report
Resources: The Art of Observation Prezi, preschool assessment frameworks (CT State Department of Ed-Flip Chart Preschool Assessment Framework, Performance Standards and Descriptions of Benchmarks for 2 ½ - 6 year old children)

Common learning experiences:

- Develop practice lesson plans
- Working collaboratively to plan activities for nursery school
- Implementing established activities
- PhotoStory Project

Common assessments including the end of unit summative assessment:

- Nursery school lesson plans
- Observation during planning and conferences
- Operation of nursery school
- Photo Story Project

Common rubrics:

- School-wide rubric #1 Research
- School-wide rubric #2 Collaboration
- School-wide rubric #4 Critical Analysis/Thinking
- School-wide rubric #5 Problem Solving
- School-wide rubric #6 Personal Responsibility

Teacher notes:
When students work on activities the teacher must check after the group has completed one activity to ensure they document the area of development the activity will address.

Windsor Public Schools
Curriculum Map
Zoology

Purpose of the Course:
This course examines a survey of the animal kingdom with emphasis on diversity, evolutionary relationships, functional adaptations, and environmental interactions. Each phylum is examined through a variety of characteristics including comparative anatomy, physiology, biochemistry, ecology, taxonomy, and husbandry.

Name of the Unit 1: History and General Anatomy	Length of the unit: 5 Blocks (86-minutes each)
Purpose of the Unit: Students will examine evolutionary micro and macro principles. Students will investigate the concepts of zoology and related careers. The ethical issue of the use of animals in research will be investigated focusing on student debate and defense of student position on the topic.	

Common Core State Standards Addressed in the unit:
CT Science Frameworks – Enrichment Standard: Evolution- Evolution is the result of genetic changes that occur in constantly changing environments. NGSS: HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. HS-LS4-5. Evaluate the evidence supporting claims that changes in the environmental conditions may result in: (1) increase in the number of individuals of some species. (2) The emergence of new species over time, and (3) the extinction of other species. College and Career Ready Attributes: Students will demonstrate independence, strong content knowledge, respond to the varying demands of audience, task, purpose, and discipline, and comprehend as well as critique, value evidence, and use technology and digital media strategically and capably.

Big Ideas:	Essential Questions:
• Animals have evolved over time which has led to animal diversity. • Scientists group animals based on shared characteristics. • Every species has a specific fundamental or realized niche depending on its interactions with their community ecology. • The hierarchal organization of complexity and body plans of species change over time during evolutionary descent.	• What makes the animal kingdom diverse? • How can the animal kingdom be organized for ease of study? • Why should we study animals?

Students will know:	Students will be able to:
• Characteristics of animals • The modern system of classification • How animals impact each other • How animals interact with their environment	• List and explain characteristics of animals • Apply proper laboratory and handling techniques while interacting with specimens • Utilize microscopy and other lab techniques in the identification of animal specimens • Apply the modern system of classification to the animal kingdom • Defend positions on the ethical use of animals in research

Significant task 1:
Introduction to Zoology: In whole class discussion, the teacher will provide an overview of the major principles of zoology, including how organisms in the Animal Kingdom compare to organisms in the other classification Kingdoms (Plants, Fungi, Archaebacteria, Eubacteria), the characteristics that distinguish animals from other organisms, and how animals are safely researched and studied. Students will engage in a think-pair-share activity in which they create a concept map demonstrating zoological concepts. Individual students will create a draft of a concept map, and then pairs of students will share their maps with the whole class and the teacher will record a class concept map on the whiteboard. Students will revise their own concept maps based on class discussion. The final product will summarize concepts, career opportunities, examples of classification characteristics, and various components of zoology.
The teacher will pose the following questions: What is an animal? How do you know something is an animal? How do you study animals? Students will individually generate a list of 10 animals, using the teacher questions to prompt their thinking. They will also identify the criteria that they used to identify an organism as an animal. Students will then compare their lists and identify similarities and differences among the criteria they used to classify their animals. In a whole class discussion, the class will compile a concrete list of criteria for determining the classification of animals.
The teacher will display samples of animals and other organisms, and using the criteria that the class generated, students will categorize the sample organisms into the Animal Kingdom versus other Kingdoms and record their identifications on a table or other graphic organizer. The class will then discuss, and the teacher will demonstrate, the proper handling of a variety of animals. Students will practice these techniques with various live specimens in small groups and demonstrate to the class how to handle their animals. A whole class discussion will ensue about the knowledge of animals, misinformation, and fear of animals.

Timeline: 2 blocks
Key vocabulary: Zoology, Husbandry, science, Evolution, diversity
Resources: class living specimens, graphic organizers and whiteboard

Significant task 2:
Animal Rights: Students will be assigned to read Tp6, The Animal Rights Controversy from their *Animal Diversity* text. An annotation guide will be introduced and sticky notes provided (unless text is photocopied) for annotating a structured response they must write defending their position on animal research. Students will be allotted a research period to investigate their specific position on using animals in research. They will utilize the library and media specialists to assist in compiling current and appropriate resources to defend their position. They will be required to complete a graphic organizer in

preparation for an in class debate (rubric and requirements will be distributed). The organizer must include a minimum of three credible resources and five supporting details on their position of animal research. Students will be broken into two groups- *pro animal research and against animal research* based on their structured response. Their research organizer must also be used to record three opposing reasons by the defending position debate group. A short debate rubric will be used to access student discourse and student ability to defend their position. Based on strength and group scores, the teacher will make a finding whether the pro or con side has a stronger case based on student performance.

Timeline: 3 blocks
Key vocabulary: research, cruelty, animal care
Resources: Several articles from both sides of the issue from their library and Internet guided research, The Animal Rights Controversy from their *Animal Diversity* text, Library resources especially point/counterpoint websites : http://vet.tufts.edu/hoarding, http://www.aavs.org, http://www.awic.nal.usda.gov

Common learning experiences:

- Direct instruction and practice handling live specimens
- Think-pair-share on taxonomy
- Small group presentation
- Exit slips
- Taxonomic classification simulation with the class
- Taxonomic key classification activity and class discussion

Common assessments including the end of unit summative :

- Debate on animal rights
- Concepts maps of animal classification
- Group work on graphic organizers
- Presentation/demonstration
- Taxonomic key classification comparison

Teacher notes:

- Year-long portfolio is a collection of student-selected artifacts that demonstrate mastery of selected big ideas and essential questions.
- School wide rubrics #1 and #3 should be used in the assessment of significant task #2.

Windsor Public Schools
Curriculum Map
Zoology

Purpose of the Course:
This course examines a survey of the animal kingdom with emphasis on diversity, evolutionary relationships, functional adaptations, and environmental interactions. Each phylum is examined through a variety of characteristics including comparative anatomy, physiology, biochemistry, ecology, taxonomy, and husbandry.

Name of the Unit 2: Classification and Phylogeny of Simpler Invertebrates	Length of the unit: 10 blocks (86-minutes each)
Purpose of the Unit: Students continue exploring the hierarchical organization of animal complexity. They will now start investigating how and why animals are classified in relationship to their body plans. Evolutionary relationships and Metazoan body components will be analyzed while complexity and body size are examined. As species are classified and phylogeny is constructed, traditional evolutionary phylogeny is determined. The focus of this unit lies with invertebrate body plans of Acoelomate and Psuedocoelomates.	

Common Core State Standards Addressed in the unit: CT Science Frameworks – Enrichment Standard: Evolution- Evolution is the result of genetic changes that occur in constantly changing environments. NGSS: HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. College and Career Ready Attributes: Students will demonstrate independence, strong content knowledge, respond to the varying demands of audience, task, purpose, and discipline, and comprehend as well as critique, value evidence, and use technology and digital media strategically and capably.

Big Ideas: • Invertebrate organisms have varied body plans • Invertebrate organisms are classified by the type of body cavity present • Simpler invertebrates can be examined based on some basic characteristics	Essential Questions: • Why are invertebrates classified as they are? • How do these animals impact each other?
Students will know: • The current classification and phylogeny criteria used to categorize animals. • Basic theories of taxonomy • The major divisions of life and subdivisions of the Animal Kingdom	Students will be able to: • Demonstrate how to classify animals according to their characteristics • Explain basic theories of taxonomy • Classify the major divisions and subdivisions of the Animal Kingdom

• Ecological relationships of Acoelomate and Pseudocoelomate • Form and Function of Acoelomate and Pseudocoelomate body plans	• Compare and contrast the relationships, body plans, niches, and biological contributions of protozoans, Acoelomates and Pseudocoelomates • Compare and contrast the form and function of protozoans, Acoelomate and Pseudocoelomate body plans • Demonstrate proper lab safety when working with specimens

Significant task 1:
Protozoans: Through teacher direction in a whole class group students will be introduced to the group of organisms known as protozoans. Basic body plans will be discussed. Students will form small groups and research in the computer lab the expected local species of protozoans they expect to find in a local pond. They will generate a list of expected animals to find. Students in pairs or small groups will compare and contrast organisms from a local pond source in order to identify them. Student groups will generate a list of organisms found and share with other groups through slide exchange their findings. The 2 digital microscopes will be used to project onto computer screens some of the more unusual finds. A class discussion will follow about the findings.

Timeline:3 blocks
Key vocabulary protozoan, microscope
Resources: computers, collecting materials, local pond specimens, digital microscopes.

Significant task 2:
Acoelomates and Psuedocoelomates: Student pairs will be assigned an acoelomate or psuedocoelomate to present to the class. All pairs will have the same criteria including but not limited to taxonomy, morphology, biochemistry, reproduction and human impact. They will create a one sheet poster (using the large post it note paper in the class) or some other visual to represent the information they have collected. The students will then present their findings to the class in a gallery walk. Each student will walk around the room in gallery format to review their classmates' presentations. They will be expected to ask questions and offer constructive critique of the peers' presentations. Students will categorize each of the organisms as either an acoelomate or psuedocoelomate based on their gallery walk findings.

Timeline:4 blocks
Key vocabulary: acoelomates, psuedocoelomates
Resources: computer lab, text, poster paper

Significant task 3:
Investigating porifera and cnidarian: Examples of various the phylum porifera will displayed. In groups of 2 or 3, students will separate the different species into 3 major groups. The student groups will then write an explanation regarding their criteria used to form these porifera groups. A teacher led discussion and informational presentation will follow covering the basic anatomy, physiology and ecology of the phylum porifera. Student discussion will follow to determine the accuracy of their initial groupings of the porifera. A final consensus will be reached about the groupings. The class will then move onto to the cnidarians and ctenophores. A series of pictures and video clips will be shown of the cnidarians and ctenophores. Students will then be asked why we cannot examine cnidarians and ctenophores in class. Students will share and comment on each other's previous experiences and knowledge of these animals. Through group discussion and concept mapping the class will compile the

information about the anatomy, physiology and ecology of these animals.

Timeline 3 blocks
Key vocabulary: cnidarian, ctenophore, canals, nematocysts
Resources: animal samples, computer, projector

Common learning experiences:

- Instruction and practice of collection techniques
- Microscope use
- Computer lab research
- Peer evaluation knowledge of vocabulary

Common assessments including the end of unit summative assessment:

- Peer evaluation /Gallery Walk (acoelomates/psuedocoelomates)
- Observation and identification of protozoans
- Written assessment of acoelomates

Teacher notes: Students will choose 1 artifact to include in their portfolio that demonstrates mastery of the big idea or one essential question.
Usually acoelomates are found in the pond as well which leads discussion into our next significant task.

Windsor Public Schools
Curriculum Map
Zoology

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Name of the Unit 3: Eucoelomates- Mollusks, Annelids, and Echinoderms	Length of the unit: 9 blocks (86 minutes each)
Purpose of the Unit: As students gain insight into the hierarchal investigations they have been studying, the development of a coelom and a dramatically more complex development of a metameric body plan in invertebrates continue to show how evolution is driven by environmental adaptation and need to survive and reproduce. Students investigate the coelom serving as the first type of efficient hydrostatic skeleton with circular and longitudinal body wall linings, more stable organs, and less crowding. As they compare this to a continual divide along the taxonomic classification system, annelids produce a highly refined metamerism allowing for greater complexity in structure, effective borrowing, independent and separated movement of body segments, redundancy if a part of the system failed. The mollusks and echinoderms have other variations in the body plan to exemplify other advances in the eucolemate organisms.	

Common Core State Standards Addressed in the unit:
Evolution- Evolution is the result of genetic changes that occur in constantly changing environments. NGSS: HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. College and Career Ready Attributes: Students will demonstrate independence, strong content knowledge, respond to the varying demands of audience, task, purpose, and discipline, and comprehend as well as critique, value evidence, and use technology and digital media strategically and capably.

Big Ideas:	Essential Questions:
• Development and variation in a coelom lead to differentiation in the various phylums of invertebrates • The presence of true coelom adds to the survivability of these organisms	• How are evolutionary trends evident among organisms/animals?
Students will know:	Students will be able to:
• The classes of Mollusks • The classes of segmented worms	• Explain the differences between different classes of Mollusca and the significance of

• Explain how Mollusca and Segmented worms provide credence for evolutionary trends • The different classes of Echinoderms • The similarities and differences between the Mollusca, Annelids and Echinoderms	these differences • Explain the differences between different classes of annelids • Demonstrate a direct relationship between the similarities and differences between Mollusca, Annelids, and Echinoderms as it pertains to evolution • Demonstrate competency in identifying body parts of specimens • Compare and contrast the anatomy and physiology of classes of mollusks • Compare and contrast the anatomy and physiology of classes of segmented worms

Significant task 1:

Mollusca: The students will examine live and preserved specimens of Mollusca and determine both common and differentiating characteristics in small groups recording their observations on a graphic organizer. They will be given information regarding the phylum Mollusca and how the evolutionary development of a coelom helped to advance this phylum of animals.

A teacher directed class discussion/ informational presentation about the various classes of Mollusca will introduce the phylum Mollusca. The discussion will include the anatomy, physiology, ecological impact and importance of Mollusks. A dissection of a mollusk will be done in class to give the students a hands-on look at the inside of a representative mollusk. Discussion of things like food allergies, red tide and economics of Mollusks as a food source will be brought into the discussion.

Bivalves Mollusks Case Study

Students will be familiar with scallops being bivalve mollusks that live in the seabed. Being that this method of living leaves scallops susceptible to predation, this case study examines the scallop's evolved the ability to escape by swimming. Students will be divided into groups of 4-5 as they enter the class (this may be formal assigned heterozygous lab groups predetermined) and are given Part I- The Scallop from the case study How Do Scallops Move? In their small groups, they are to silently read the assignment, using previously instructed annotation strategies (annotation poster on wall for reminders). Groups are to individually answer the discussion questions and as a group, create two higher order thinking questions (level 4, 5 or 6) written on a small whiteboard or poster paper to be answered by another group. When the teacher instructs them to do so, groups will exchange questions and answer them on the media they were given. Eliminating similar or overlapping questions, the class will discuss the group created questions and answers.

Part II- Swimming will be distributed that outlines an initial drawing of the layout of the brain on the overhead, showing the motor neurons to the striated adductor muscle. Students will read the material on the handout as a class, diagram the possible layout of nerves and muscles involved in scallop swimming. The teacher will guide students through proper placement on the overhead diagram and students will record their own in their notebook. A short 5-10 minute clip (discovery education or comparable) demonstrating mollusks swimming in action, specifically the scallop. In their small groups, students will develop a hypothesis to explain the observation that swimming involves a rhythmic series of striated muscle contractions. Probing questions specific to the role of motor neurons, striated muscle movement, action potential, and muscle contractions involved in swimming will focus student thinking. Students will receive Part III of the case study- How Are Rhythmic Contractions Controlled? Students will

read and interpret the diagram showing shell movements and striated muscle EMGs recorded from a tethered swinging scallop. The discussion questions will be examined, answered, and discussed as a group. The teacher will bring the initial drawing of the brain diagram back on the overhead to add to initial drawing. The discussion will be guided by the reading questions and student thought process thus far. If applicable, as a class or in their small groups, a modified hypothesis explaining the pattern of muscle contractions can be devised.
Part IV & V- Can the Frequency of Swimming Be Changed? And How Is the Swimming Sequence Started and Stopped?
In small groups, students will read a short article on scallop locomotion and generate synthesis, analysis and evaluation questions pertaining to scallop locomotion. In a whole class setting questions can be shared and answered.
Students will devise an experiment to test their hypothesis explaining the pattern of muscle contractions seen during scallop swimming. The students will individually write a formal lab report.

Timeline: 5 blocks
Key vocabulary: physiology, dissection, mantle, locomotion, scallop
Resources: Computers, marine bio tank (for clams), http://www.sciencecases.lib.buffalo.edu/cs, poster paper, mini whiteboards, dry erase markers, computer, projector

Common learning experiences:

- Case Study Analysis
- Vocab reinforcement through crossword puzzles and class discussion
- Direct instruction and class discussion on the phylum Annelida
- Group collaboration on classification of Annelids into major groups
- Echinodermata classification activity and discussion
- Whole class determination of characteristics to identify Echinoderms

Common assessments including the end of unit summative assessment:

- Formal Lab Report from the case study
- Informational paper on an Annelid
- Classification of Annelid and Echinoderm activities

Teacher notes:
Students will choose 1 artifact to include in their portfolio that demonstrates mastery of one big idea or one essential question.
School wide Rubric #5

Windsor Public Schools
Curriculum Map
Zoology

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Name of the Unit 4: Arthropods	Length of the unit: 10 blocks (86-minutes each)
Purpose of the Unit: Students will investigate the concept that Insects far outnumber all other species of animals in the world combined. Some scientists believe there to be over 200 million insects for every human alive today. Insects have an unmatched ability to adapt to all land environments and to virtually all climates. Insects and crustaceans also inhabit most of the aquatic environments on Earth. Arthropods have a combination of valuable structural and physiological adaptations, including a versatile exoskeleton, metamerism, an effective respiratory system, and the ability to survive caustic environments to survive. These adaptations, the key to evolution and survival, are explored in this unit.	

Common Core State Standards Addressed in the unit: Evolution- Evolution is the result of genetic changes that occur in constantly changing environments. NGSS: HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. College and Career Ready Attributes: Students will demonstrate independence, strong content knowledge, respond to the varying demands of audience, task, purpose, and discipline, and comprehend as well as critique, value evidence, and use technology and digital media strategically and capably.

Big Ideas: • Arthropods have characteristics that allow for survival in diverse ecosystems	Essential Questions: • What makes arthropods successful survivalists? • How do arthropod exoskeleton supports differ from other invertebrates and vertebrates? • How do arthropods interact with each other and human beings?
Students will know: • The classes and subphylums of Arthropods • How to effectively and safely collect insects and related organisms.	Students will be able to: • Differentiate between various members of the phylum Arthropoda • Identify a variety of members of the

• How to identify various types of insects and related organisms • The basic anatomy of the phylum Arthropoda • How to identify the external anatomy of a shrimp or crawfish and describe the function of important external features • The major internal organs of a shrimp or crawfish and their functions related to swimming, digestion, and respiration	subphylums Uniramia and Chelicerata • Write a descriptive paragraph describing the basic anatomy of an Arthropod • Correctly label an anatomical diagram of a representative member of the subphylum crustacean • Explain the major internal organs of a shrimp or crawfish and their functions related to swimming, digestion and respiration

Significant task 1:
Collection of subphylum Uniramia and chelicerata:In small groups of 2 or 3, students will research in the computer lab the types of chelicerates and uniramia they will expect find in the local area. Student groups will generate a pictoral file to use as a reference as they research Uniramia. Groups will collect and identify orders of uniramia and chelicerata. Students will be assessed by a collection that is diverse in composition and rich in numbers of organisms found and identified. Groups will organize their organisms into a format suitable for class presentation and present them to their peers for peer review and assessment.

This case study "A Deadly Passion: Sexual Cannibalism in the Australian Redback Spider", encompasses a case study and response clicker system to analyze Arthropod behavior and evolutionary basis. The presentation includes a combination of text, questions, and photos. Each student is given a set of a graphic organizer set of PPT student notes to complete throughout the study. Throughout this behavior study of arthropods, topics such as the nature of proximate questions about behavior and ultimate causation. How mechanisms have evolved and explanations of ecological functions of a behavior and its evolutionary basis are examined. Students also look at evolutionary fitness and adaptive behaviors as they take notes and answer probing questions using the clicker system, "Choose a proximate explanation for why red-crowned cranes bread in spring and early summer." Students are then asked to choose an ultimate explanation for the same natural history fact.

Sexual cannibalism is introduced through guided student note taking and the PPT presentation. Students are asked to predict what the ultimate advantage of such extreme behaviors in such cases as the male praying mantis, scorpion, and Australian Redback Spider. Students will record the preliminary predictions to the answers to the questions; "Is sexual cannibalism adaptive for the female?' Can self-sacrifice possibly be adaptive to the male, or is he simply unable to escape predation by his hungry mate?" There will be a "think-pair-share" discussion around initial student answers before the study continues. Further slides examine Australian Redback Spider courtship, extreme dimorphism, feeding habits during reproductive cycles, reproductive success rates, reproductive organs of these arthropods, courtship. The teacher will play Dr. Andrade's movie clip of a male somersaulting and being eaten by a female (http://www.utsc.utornto.ca/~mandrade/index_files/Page332.htm). Three hypotheses for this cannibalism are examined through use of the PPT clickers, Dr. Adrade's research, and clicker questions that students answer. The questions are centralized around each hypothesis, what the research evidence/results are, and what evidence supports each hypothesis. This is an excellent model for real case study science- background knowledge, hypotheses, experimentation, and analysis. Students are now asked to revisit their two questions from the start of the case study, "Is sexual cannibalism adaptive for the female?' Can self-sacrifice possibly be adaptive to the male, or is he simply unable to escape predation by his hungry mate?" Subsequent slides and questioning illicit results of research associated with two of Dr. Adrade's hypotheses, "Paternal Investment" and "Nuptial Gift". Students are asked to provide what evidence from the research supports a piece of each of these hypotheses through clicker

questioning. Instead of displaying the final analysis and conclusion on slide 37, students are tasked with compiling their own conclusion for Australian Redback Cannibalism based on Dr. Andrade's research. In their conclusion, they must also discuss what their predictions were in their initial two questions, how their initial answers compared with their final conclusions and provides the evidence from the research which supports their final conclusions. The teacher will use the clicker questions which are electronically stored to provide an assessment grade for the clicker case.

Timeline: 6 blocks
Key vocabulary: Uniramia, Chelicerata, Diplopoda, Chilopoda, Insecta, Arachnida, Cannibalism, sexual cannibalism, fitness, behavior
Resources: computers, text, identification books, nets, collecting devices, http://www.utsc.utornto.ca/~mandrade/index_files/Page332.htm, clickers, power point, computer, projector

Common learning experiences:

- Case Study Analysis
- Crustacean KWL chart
- Collection techniques of uniramia
- Virtual dissection/compare and contrast anatomies of lobster, shrimp, crab and crayfish
- Vocab reinforcement through discussion and relation to similar terms found in their daily lives
- Clicker questioning strategies

Common assessments including the end of unit summative assessment:

- Clicker Response Assessment
- Peer evaluation of individual collections of uniramia
- Research of Australian red back spider responses
- KWL prior knowledge chart on anatomy of lobster, shrimp, crab and crayfish
- Shrimp lab quiz
- Exit slip after virtual dissection

Teacher notes:
Students will choose 1 artifact to include in their portfolio that demonstrates mastery of one big idea or one essential question.
school wide rubric #5 for analysis of case study
http://irrec.ifas.ufl.edu/teachaquaculture/curriculum/_files/modules/2_generalbiology/Crustaceans/Activity/Anatomy_of_shrimp-crawfish.pdf,

Windsor Public Schools
Curriculum Map
Zoology

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Name of the Unit 5: Vertebrates: Fish, Amphibians, and Reptiles	Length of the unit: 9 blocks (86-minutes each)
Purpose of the Unit: Students will become familiar with the concept that the phylum of Chordata exhibits distinctive hallmarks- 10 dorsal, tubular nerve cord overlying 2) a supportive notochord 3) pharyngeal slits 4) endostyle for filter feeding, and 5) a post anal tail for propulsion. The further study of aquatic fish with distinctive gills, appendages, and if present in the form of fins, skin with scales of dermal origin. Fish are defined in the evolutionary sense as all vertebrates that are not tetrapods. The evolutionary transition between water to land leaves a series of alteration cumulatively fitted to vertebrate life on land. Amphibians have the only recorded transition from water to land in both their ontogeny and phylogeny. They are considered quasiterrestrial. Amphibians, with well-developed limbs, redesigned sensory and respiratory systems, and modifications of the postcranial skeleton for supporting the body in air, have completed the conquest to land. Though with the development of shell less eggs and gill-breathing larvae, they are still tied to the water for their life cycle.	

Common Core State Standards Addressed in the unit: Evolution- Evolution is the result of genetic changes that occur in constantly changing environments. NGSS: HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. College and Career Ready Attributes: Students will demonstrate independence, strong content knowledge, respond to the varying demands of audience, task, purpose, and discipline, and comprehend as well as critique, value evidence, and use technology and digital media strategically and capably.

Big Ideas:	Essential Questions:
• Animals have evolved over time which has led to animal diversity • Scientists group animals based on shared characteristics • Every species has a specific fundamental or realized niche	• How do structural differences in animals function to meet similar needs? • How do vertebrates vary from invertebrates physiologically and anatomically?

Students will know:	Students will be able to:
• The characteristics that define a vertebrate • The differences between the two major classes of fish • The differences between amphibians and reptiles	• Explain characteristics that differentiate vertebrates from invertebrates • Differentiate between the classes of vertebrates • Explain the importance of Amphioxus • Explain the difference between venomous and poisonous

Significant task 1:

A teacher led discussion will be done first to inform the students about the major classes of fish and their characteristics. A research task involving careers where fish are the basis of the career will be researched in the library. Each student will research an occupation involving fish, find a job opening for that occupation, write a resume to allow this student to apply for this job and then present the occupation to the class covering a list of criteria. A written test about fish will be given at the end of the significant task.

Students will be handed their own copy of Handout 1 from the case study; A Strange Fish Indeed: The "Discovery" of a Living Fossil and the first diary entry from Marjorie Courtenay-Latimer. Before the progressive disclosure formatted case study begins, the teacher will ask students to examine the specimen on the handout. Students will be asked to group with their assigned lab partners and record observations. Students will be asked to specifically detail any unusual or familiar characteristics they observe. The teacher will direct the students to read the diary entry and be prepared for a large group discussion to address the two questions (more by teacher discretion). The teacher will have supporting PPT slides as the discussion progresses which outline the diary entries and picture. Further slides support the discussion questions as the inquiry progresses. The PPT will also direct students who need concrete probing to answer some multiple choice questions to direct "next steps" for the discovery. The students will be given Part II with the next diary entry and probing discussion questions. The groups will do a "popcorn" report out when each question is discussed. The teacher will support the session with further photographs and multiple choice questions through the PPT. The teacher will post a graphic overview of vertebrate evolution with an associated handout for students to highlight the position of the coelacanth and relatives on the evolutionary tree. Here, the teacher will stress that the discovery is also a living example of one of our most distant evolutionary relatives. The last handout provides further images of the coelacanth where students will record in their small groups actual anatomical features of the skeleton (in particular pectoral, pelvic, and caudal fin bone structure). The recent photograph of a living coelacanth is also a topic for comparison- anatomical body plan vs. skeletal evidence. The evolutionary relationships of the groupings shown on handout II highlights members of the Class Sarcopterygii- African and South American Lung Fishes and four-legged terrestrial vertebrates are also placed here. There will be an open opportunity for students to discuss more "fun facts" about the current research and scientific discoveries surrounding the coelacanth provided by the teacher. Students will be asked to submit a written explanation of how the study of coelacanths helps researchers and students to learn about the intermediate forms in the evolution and the appearance of new classes, families, and species.

Students will be assigned a research project examining in depth the current status of global coelacanth populations, the evolutionary history of fishes, other current "living fossil" discoveries or illusive species that have been discovered for further study. A project rubric and student report options such as written report, poster, brochure, or photo essay will be provided. Students will report out to the class in 5 minute presentations.

Timeline: 5 blocks
Key vocabulary: chondrichthyes, osteichthyes, vertebrate evolution, coelacanth, pectoral, pelvic, and caudal fins, terrestrial, class, family, species
Resources: library, teacher PowerPoint, internet, DOL, http://www.utsc.utornto.ca/~mandrade/index_files/Page332.htm, computer, projector

Significant task 2:
In small groups, students will classify live as well as preserved specimens into either the amphibian or reptile class. Student groups will generate a list of criteria/characteristics they used to make the determination. Student groups will share out and a class list of characteristics will be generated. A second set of specimens will then be presented and students will debate, using the characteristics generated previously by the class, to determine the class of each specimen. Students will individually choose an amphibian or reptile to complete a research project on. Students will teach their peers about the animal they choose, incorporating visuals such pictures, videos, artwork and or live specimens as well as details about the animal's habitat, anatomy, physiology, behavior, etc.

Timeline: 2 blocks
Key vocabulary: venomous, poisonous
Resources: Iinternet, teacher PowerPoint

Common learning experiences:

- Small group collaboration on vertebrate characteristics
- Identification of vertebrates into 10 major categories
- Safe handling techniques of amphibians and reptiles
- Research experiences in the computer lab and library
- Presentations

Common assessments including the end of unit summative assessment:

- Written defense and debate of amphioxus –vertebrate or non- vertebrate
- Amphibian/reptile research and presentation
- Coelacanth presentation

Teacher notes:
Students will choose 1 artifact to include in their portfolio that demonstrates mastery of one big idea or one essential question.
School wide rubrics will be used to assess use of technology, group collaboration, and presentation.

Windsor Public Schools
Curriculum Map
Zoology

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This course examines a survey of the animal kingdom with emphasis on diversity, evolutionary relationships, functional adaptations, and environmental interactions. Each phylum is examined through a variety of characteristics including comparative anatomy, physiology, biochemistry, ecology, taxonomy, and husbandry.

Name of the Unit 6: Vertebrates: Birds and Mammals	Length of the unit: 6 Blocks (86-minutes each)
Purpose of the Unit: Students will become familiar with the concept that the vertebrate class, Aves, there are over 9000 species and outnumber all other vertebrates except fishes. These animals are known to inhabit every continent and climate. Birds unique feature that distinguishes them from all other animals are feathers. Despite over 150 million years of evolution, they have proliferated and adapted to specialized niches and ways of life. In addition to feathers, birds have forelimbs modified into wings and hind limbs specialized for walking, swimming, and perching. A bird's entire anatomy is organized around flight. They afford a rapidly adjusting digestive system to process energy-rich diets and a high pressure circulatory system and finely tuned nervous system. Culminating the study of Earth's organisms, Mammals, with their highly developed nervous system and numerous adaptations, occupy every environment on Earth that supports life. This class, Mammalia, are essentially adaptive, but have been influenced by humans along their evolutionary tract. This class will be studied from origin and evolution of structural and functional adaptations, migration, reproduction, and populations.	

Common Core State Standards Addressed in the unit: Evolution- Evolution is the result of genetic changes that occur in constantly changing environments. NGSS: HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. College and Career Ready Attributes: Students will demonstrate independence, strong content knowledge, respond to the varying demands of audience, task, purpose, and discipline, and comprehend as well as critique, value evidence, and use technology and digital media strategically and capably.

Big Ideas:	Essential Questions:
• Mammals and birds have evolved over time which allows for greater success in survival • Mechanisms of speciation have led to greater diversity of vertebrates	• What characteristics influence survival rate?

• Every species has a specific fundamental or realized niche	
Students will know: • The principles of evolution and classification • The concept of species • The evidence for evolution • Learn skull anatomy and technical terminology	Students will be able to: • Apply knowledge to develop a common name for a fictitious species of mammals and apply the rules of binomial classification to provide specific evidence • Apply concepts of micro- and macro- evolution to produce an evolutionary story for the fictitious animal • Interpret simple data sets and make inferences and conclusions from that data • Practice making primary observations on archaeologically observed phenomena • Make logical arguments linking present-day observations on objects to past behaviors • Understand the definition of domestication and the difference between captive and domestic animals • Differentiate between observations and interpretations

Significant task 1: Trouble in Paradise: A Case for Speciation:This case study if offered through Finger lakes Community College for Biology 2 students. The system is referred to as "Biolink". It gives students the opportunity to the principles of evolution learned in class in an open-ended application of their knowledge. Department faculty can be used as judges for the contest and the winning submission will take poster format and be displayed. Various submissions for evaluation and assessment include magazine cover stories, lab notebook that documents findings, interactive web site for completing data collection and presentation. The perfect group size for this contest is groups of 3-4 students. Selection for these groups is at the discretion of the instructor. Stress to students that individual tasks within the group shall be assigned by their strengths. There will be a great deal of coverage on the principles of evolution and the case study may be distributed to encourage these large and small group discussions. Scientific articles and selections can be distributed to expose students about specific scenarios or findings. These include but are not limited to, "Research Project Uncovers New Species" by John Newhouse and "The Mystery of the New Rodent" by Omara Afzal. To be successful, students must be familiar with Biogeography, the fossil record, Comparative Anatomy, Comparative Embryology, and Molecular Biology. Employ Ernst Mayr's 1942 biological species concept for discussion. Students will be able to produce an individual evolutionary based speciation study presented with evidence of decent, habitat, body form and function, etc. Timeline: 2 blocks Key vocabulary: evolution, speciation, comparative embryology, comparative anatomy Resources:: http://www.utsc.utornto.ca/~mandrade/index_files/Page332.htm
Significant task 2: "Man's Best Friend? Using Animal Bones to Solve an Archaeological Mystery"

This study examines a new archaeological find (Part 1) determined by a broad set of issues from human past domestication and the nature of humans and Neanderthals.
Advance readings on dogs and domestication will frontload the class discussions in both large and small group format. The collection of data and observations will dominate the first part of this case study. Not only must they collect data, they must start to also categorize and organize data in a usable format (graphic organizers, drawings, tables).Handout 1- Canid skull anatomy, handout 2 non-anatomical terms can be distributed at this time.
Have students read through the narrative for Part 1 and distribute both models and pictures of domesticated and wild dog skulls for examination by student groups. Students will work through comprehension questions in Part 2 together before continuing to part 3. The teacher will visit groups and work through any misconceptions or advanced questioning strategies. Lastly, the unknown skull is distributed. Here, students will evaluate the Grotte Mestiche Canid Skull and advance through guided questioning to make a determination.
Part 4 looks at the implications and explanations of the morphology between these specimens.

Timeline: 2 blocks
Key vocabulary: natural selection, selection pressure, artificial selection, genetic drift, growth and development, phenotype, genotype, morphology, neoteny, pedomorphism, domestication, adaptation
Resources: http://skullsunlimited.com, http://www.boneclones.com , canid skull anatomy

Significant task 3:
"Not Necessarily on Purpose: Domestication and Speciation in the Candidae Family"
This case study is a "clicker case." It combines the use of student personal response systems (clickers) with case teaching methods and formats. The case is presented in class using a series of PowerPoint slides punctuated by questions (called "clicker questions") that students respond to before moving on to the next slide. In this way, students work through the material to understand (and usually also solve) the problem presented in the case. Specifically designed for the method integrates lecture material, case storylines, student discussion, (clicker) questions, clarification of answers to those questions, more lecture, and data. The case is designed to follow a course unit on the basics of natural selection and is intended as an application of the concepts presented in that unit. Thus, it is assumed that students have already been exposed to the concepts of natural selection, artificial selection, and ancestry.
The case also introduces students to phylogenetic diagrams. Even if a course does not spend an entire lecture period on phylogeny, the application of the natural selection aspect of this case may be useful.
The idea for the case came from a PBS special on dog evolution, "Dogs and More Dogs", and a book by Coppinger and Coppinger titled, *Dogs: A New Understanding of Canine Origin, Behavior and Evolution* (see Resources).
The case is based on the idea from the Coppinger and Coppinger (2001) book that the domestication of the dog was not likely an intentional event in human history. Rather, the dog as we know it was likely a result of a natural selection event(s), and then, much later, intentional selective breeding events formed the many breeds. The case then challenges a preconception most students have that the dog comes from intentional domestication. Most students are familiar with dogs, and may be more accepting of ideas of the evolution and speciation of animals than of humans. The storyline is not complicated and does not require any handouts or pre-class reading. A fair amount of the case is lecture-based, but this is interrupted by clicker questions and active-learning, in-class assignments. It is strongly recommended that before anyone runs this case that they at least look through some of the reference and source materials to familiarize themselves with the supporting data.

Timeline:2 blocks
Key vocabulary: Candidae, domestication, speciation, canine, phylogeny/phylogenetic, natural selection,

artificial selection, ancestry
Resources: PBS Dogs: A New Understanding of Canine Behavior, clickers

Common learning experiences:

- Small and large group collaboration on concept maps about birds and mammals
- Analysis and evaluation of data on birds and mammals
- Literacy incorporation to understand terms about birds and mammals
- Writing
- Judged scientific conclusion for presentation
- Examining bone morphology

Common assessments including the end of unit summative assessment:

- Summative Story for Sig Task 1
- Clicker assessment domestic and speciation of Canididae case study
- Formative questioning through case study
- Bird/mammal concept map
- Bird/mammal analysis and conclusion questions

Teacher notes:

Students will choose 1 artifact to include in their portfolio that demonstrates mastery of one big idea or one essential question.
Schoolwide rubrics #2,4,5

Windsor Public Schools
Curriculum Map
12th Grade Civics
BOE Approved: (Insert Date)

Purpose of the Course: This course focuses on the role of government in America in a semester-long course. Students will engage in lessons and activities that emphasize the role and responsibility of citizens in a democratic society. Students will examine the organization and function of government at the local, state and national levels. Emphasis will be on the history and function of government, along with the frequent examination of current events.	
Unit 1: Foundations of American Democracy	Length of the unit: 3-4 weeks (7-9 84-minute Blocks)
Purpose of the Unit: As the foundation of the course, students will understand the historical background of democracy by looking at the different forms of government globally and historically, and examining the idea of the social contract as theorized by Hobbes and Locke. Through analysis of the Articles of Confederation, the subsequent Constitutional Conventions and various compromises, the students will learn how difficult it was to forge a new and acceptable government, setting the stage for citizen and representational participation and compromise that continue through our government's history.	
Common Core State Standards Addressed in the unit: (Provide the link to the specific standards.) • NCSS C3 Framework for Civics D2.Civ.8 9-12. Evaluate social and political systems in different contexts, times, and places, that promote civic virtues and enact democratic principles. • NCSS C3 Framework for Civics D2.Civ 1. 9-12. Distinguish the powers and responsibilities of local, state, tribal, national, and international civic and political institutions. • NCSS C3 Framework for Civics D2. Civ. 4 9-12 Explain how the U.S. Constitution establishes a system of government that has powers, responsibilities, and limits that have changed over time and that are still contested. • CCSS.ELA-Literacy.RH.11-12.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas. • CCSS.ELA-Literacy.RH.11-12.5 Analyze in detail how a complex primary source is structured, including how key sentences, paragraphs, and larger portions of the text contribute to the whole. • CCSS.ELA-Literacy.RH.11-12.9 Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources	

Big Ideas:	Essential Questions:
• Although democracy in the U.S. reflects various European Enlightenment thinkers, U.S. democracy is unique. • U.S. democracy reflects the tension between citizens' need for independence	• What influenced the United States formation of government? • How can government be structured to balance power? • Were compromises good and necessary or a detriment to the highest principles of

and their need for governance. • U.S. democracy is the result of hard-forged compromises, failures, and successes.	democracy?
Students will know: • Various forms of government and the early theories of the social contract. • The founding principles of the American democratic experiment, including popular sovereignty and the purpose of government. • Both the short and long term consequences of the Articles of Confederation, Shay's Rebellion and Constitutional Conventions and the major compromises. • The role compromise played in the formation of government including; the Federalist/Anti-Federalist Essays, the Great Compromise, 3/5 Compromise and the Bill of Rights in the eventual ratification of The Constitution.	Students will be able to: • Compare forms of government, using graphic organizers and notes, to understand the origins of democracy as the foundation for U.S. government. • Read closely, interpret, and analyze various primary and secondary source documents regarding the origins of American Democratic principles. • Synthesize information from diverse sources, both primary and secondary, to develop a coherent understanding of multiple viewpoints regarding the creation of a federal government. • Demonstrate an ability to participate in social studies discourse through informed discussion, debate, and effective oral presentation. • Find information from a variety of primary and secondary sources including electronic media to substantiate thesis-driven presentations and analyses.

Significant task 1: *Origins of Government and Democratic Theory*

Following interactive teaching, where teachers present material and elicit questions and comments from the class, and encourage class discussion on the different forms of government, students will participate in a small group activity (from a selection of individual teacher designed activities, i.e. "Teenage World", "Windsor High School Experiment", etc.) that require the students to develop an understanding on the necessity and difficulty of creating functional government structures and effective leaders. Following small group discussion, students will present their beliefs to the class facilitating a whole class discussion on the purpose of government.

Students will then be assigned John Locke's "Concerning Civil Government, Second Essay": An Essay Concerning the True Original Extent and End of Civil Government" to read independently and respond to essential questions about Locke's attempt to create an effective government structure.

Following teacher directed class discussion on Locke, students will independently research both authoritarian and non-authoritarian political systems formulating opinions on which systems they believe creates the most functional example of government. Their responses will be a formal 1-2 page thesis-driven (using the thesis and projected organization writing format) assignment which

incorporates class notes, John Locke and independent research. Responses will be scored using the building-wide NEASC rubric #4 “Critical Analysis/Thinking”.

Timeline: 2-3 classes

Key vocabulary: Social Contract, John Locke, Thomas Hobbes, Government, Republic, Democracy, Popular Sovereignty, Oligarchy, Monarchy, Autocracy, Capitalism, Socialism, Laissez-faire, Communism

Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- John Locke - "Concerning Civil Government, Second Essay": An Essay Concerning the True Original Extent and End of Civil Government"

[Insert pdf of rubric here]

Significant task 2: *Critical Readings of Core Text(s)*

Students will independently read one or more of the resources listed below taking reading notes (annotating or outlining using various forms) on key topics assigned by the teacher ahead of time. The teacher will establish a specific procedure for reviewing reading notes and facilitating class discussions around key topics, points of interest and/or student generated questions.

After completing the text(s), the teacher will review the requirements for completing a document-based-question essay. Students will be required to write a Document Based Question (DBQ) essay regarding the role of compromise in the foundation of American Democracy as part of their end-of-unit summative assessment. The department DBQ Rubric will be used to grade the essay.

Timeline: 2-3 classes

Key vocabulary: Social Contract, Government, Republic, Democracy, Popular Sovereignty, Separation of Powers, Articles of Confederation, The Federalist Papers, Ratification, The Great Compromise, 3/5 Compromise, Unicameral, Bicameral

Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- “How Dumb Are We?”, Newsweek, 2011.
- Declaration of Independence
- Bill of Rights
- Articles of Confederation
- “Common Sense” – Thomas Paine
- Federalist Essays - #10, #51
- Excerpts from Correspondence—Thomas Jefferson

[Insert pdf of rubric here]

Common learning experiences:

- Compare forms of government through the use of graphic organizers and notes
- Class discussion, direct and interactive instruction
- Critical reading assignments
- Formulate norms for class discussions and/or debates
- Note taking and discussion about "Creating a Constitution" – Video Segment (20 Minutes), Annenberg Foundation
- Vocabulary building lessons, such as word walls, close reading, and developing definitions collaboratively (using root words, dictionary, prior knowledge, context)

Common assessments including the end of unit summative assessment:

1. Pre-Assessment: U.S. Citizenship Test
2. John Locke – Homework Responses to gauge understanding of foundations of democracy (add link)
3. 1-2 Page Formal Response – Functional Government Systems to fulfill NEASC Rubric #4
4. Quizzes on vocabulary, concepts, and critical reading and writing as interval formative assessments
5. End of Unit Summative Assessment with a common Compromise DBQ –using Dept. DBQ Rubric

Teacher notes:

Core Text Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- "How Dumb Are We?", Newsweek, 2011.

Historical Documents:

- John Locke - "Concerning Civil Government, Second Essay": An Essay Concerning the True Original Extent and End of Civil Government"
- Declaration of Independence
- Bill of Rights
- Articles of Confederation
- Common Sense – Thomas Paine
- Federalist Essays - #10, #51
- Thomas Jefferson – Excerpts from Correspondence

Media:

"Creating a Constitution" – Video Segment (20 Minutes), Annenberg Foundation:
http://www.annenbergclassroom.org/pages.aspx?name=key-constitutionalconcepts

- **Key Terms:**
- Social Contract
- Locke
- Government
- Republic
- Democracy
- Popular Sovereignty
- Oligarchy

- Monarchy
- Autocracy
- Capitalism
- Socialism
- Laissez-faire
- Communism
- Separation of Powers
- Articles of Confederation
- The Federalist Papers
- Shay's Rebellion
- Ratification
- Great Compromise (CT Compromise)
- 3/5 Compromise
- Unicameral
- Bicameral
- Bill of Rights

Windsor Public Schools
Curriculum Map
12th Grade Civics

Unit 2*:* Three Branches of Government	Length of the unit: 5 weeks (10-13 86-minute Blocks)

Purpose of the Unit:
This unit will establish an understanding of the function and purpose of the three branches of the U.S. government; legislative, executive and judicial. In previous units, students analyzed the compromises necessary to develop the U.S. Constitution and, in this unit, they will analyze how the branches of government have evolved and the mechanisms put into place to prevent one branch or person from obtaining too much power.

Common Core State Standards Addressed in the unit: (Provide the link to the specific standards.)

- NCSS C3 Framework for Civics D2.Civ.4. 9-12. Explain how the U.S. Constitution establishes a system of government that has powers, responsibilities, and limits that have changed over time and that are still contested.
- NCSS D2.Civ.14. 9-12 Analyze historical, contemporary, and emerging means of changing societies, promoting the common good and protecting rights.
- CCSS.ELA-Literacy.RH.11-12.1 Cite specific textual evidence to support analysis of primary and secondary sources, connecting insights gained from specific details to an understanding of the text as a whole.
- CCSS.ELA-Literacy.RH.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

- CCSS.ELA-Literacy.RH.11-12.10 By the end of grade 12, read and comprehend history/social studies texts in the grades 11–CCR text complexity band independently and proficiently

Big Ideas:	**Essential Questions:**
• The U.S. Constitution establishes checks and balances that are dynamic and evolutionary. • Government has many powers, but each branch and the entirety has limits.	• How have the powers of the three branches of government evolved over time? • How have checks and balances worked through history to prevent despotism?
Students will know: • The distribution of power through the three branches of government and how each branch has the ability to check the power of the other. • The evolution of the Legislative Branch. • The evolution of the Judicial Branch in response to Marbury v. Madison, giving the Supreme Court the power of judicial review. • The evolution of the Executive Branch. • How the Constitution can be changed.	Students will be able to: • Analyze a series of primary and secondary source documents about each branch and write a thesis-driven essay about which branch has the most power. • Describe the process of how a bill becomes a law and how the three branches affect laws. • Drawing from current events, students will evaluate the legislative process. • Evaluate, interpret and write a thesis-driven essay about the ability of the judicial branch to establish policy and law within American society. • Analyze the role of the executive branch and analyze how the formal roles of the president have been expanded. • Describe how the United States Constitution may be changed and analyze the impact of specific changes.

Significant task 1: ***House Seat Distribution***

In a whole class arrangement, students will first be led in an interactive teaching and discussion about the reapportionment process, redistricting and gerrymandering. Students will then break up into pairs, using the social studies department laptops, and attempt to redistrict an area without gerrymandering using the Redistricting Game: www.redistrictinggame.org

Students will view the film Gerrymandering which will bring in historical issues involving Gerrymandering. Students will complete a graphic organizer, collecting notes on its beginnings, examples of it in history, and the implications of Gerrymandering.

Students will then research and analyze the redistricting process in their own town of Windsor. Students will write a thesis-driven essay about purpose behind the change and the impacts it will have in their town.

Timeline: 3 blocks

Key vocabulary:

- Reapportionment
- Redistricting
- Gerrymandering
- Partisan
- Bipartisan
- Bill
- Census
- Incumbent

Resources:

- Redistricting Game: www.redistrictinggame.org
- Windsor Patch Article: Windsor Has Been Redistricted.pdf
- State Senate Map: http://www.cga.ct.gov/red2011/documents/2011/senate_map.pdf
- Gerrymandering Film: http://www.snagfilms.com/films/title/gerrymandering

Significant task 2: The Supreme Court

In a whole class arrangement, students will first be led in an interactive teaching and discussion about the evolution of the Judicial Branch, the Supreme Court's power of judicial review, and how the courts have made policy and law in the United States.

Students will then complete an exploration of the Supreme Court's website through the use of a graphic organizer in order to evaluate the current justices, the current court docket, and the broad range of topics currently being heard by the Court.

Students will choose a current Supreme Court decision and analyze the majority opinion and the dissenting opinion. Students will then write a thesis-driven essay on the relevance of the case and what implications it may have.
Timeline: 2-3 blocks

Key vocabulary:

- Opinion
- Dissent
- Original Jurisdiction

- Appellate Jurisdiction
- Due Process Clause
- Precedent
- Grand Jury

Resources:

Supreme Court Website – www.supremecourt.gov

Common learning experiences:

- Direct instruction and interactive teaching about the powers and evolution of each branch of the federal government
- Thesis-Driven essay on which branch of power has the most power
- Marbury v. Madison Reading for Information - Civics Resources\Marbury vs. Madison Reading for Information.doc
- Analysis of George Washington's Farewell Address
- *New York Times, Upfront Magazine*: "10 Supreme Court Cases Every Student Should Know."
- Interactive teaching and discussion about the mechanisms for changing the U.S. Constitution
- Interactive teaching and discussion about the role of the president and the evolution of the executive branch

Common assessments including the end of unit summative assessment:
(Provide link to assessments and rubrics.)
Comprehension Checks

Complete multiple comprehension checks of the major topics (the powers of each branch of government and their evolution) studied in class. The teacher can design these quick assessments, but multiple choice and / or short answer are recommended.

Timeline: 2-3 checks in 6-8 blocks

- Executive Branch Quiz
- Legislative Branch Quiz
- Judicial Branch Quiz
- Thesis-driven essay: Discuss the importance of checks and balances and how it maintains the concept of limited government within the United States."

Key vocabulary:

- Reapportionment
- Redistricting
- Gerrymandering
- Partisan
- Bipartisan
- Bill
- Census
- Incumbent

- Expressed Powers
- Implied Powers
- Enumerated Powers
- Elastic Clause
- Necessary and Proper Clause
- Session
- Appropriations
- Inter-state commerce
- Impeachment
- Veto
- Pocket Veto
- Executive Agreement
- Presidential Succession
- Electoral College
- Elector
- Opinion
- Dissent
- Original Jurisdiction
- Appellate Jurisdiction
- Due Process Clause
- Precedent
- Grand Jury

Teacher notes:

Windsor Public Schools
Curriculum Map
12th Grade Civics

Unit 3: Federal, State and Local Government	Length of the unit: 5 weeks (13-14 84-minute Blocks)

Purpose of the Unit:
As students better understand the background of the American system of Federalism, as delineated by The Constitution, they will examine and analyze the division of power, and the attendant historical and current tensions between the federal, state and local governments. Students will investigate and analyze Connecticut's state government structure as well as the local municipal structure of Windsor, and assess their effectiveness.

Common Core State Standards Addressed in the unit: (Provide the link to the specific standards.)
- NCSS D2.Civ.1. 9-12 Distinguish the powers and responsibilities of local, state, tribal, national, and international civic and political institutions.
- NCSS D2. Civ. 12. 9-12 Analyze how people use and challenge local, state, national, and

international laws to address a variety of public issues.

- CCSS.ELA-Literacy.RH.11-12.5 Analyze in detail how a complex primary source is structured, including how key sentences, paragraphs, and larger portions of the text contribute to the whole.
- CCSS.ELA-Literacy.RH.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem

Big Ideas:	Essential Questions:
• The American Federal System is evolutionary and dynamic. • The daily lives of Americans are affected by the three levels of government, and they can affect the three levels of government.	• What role does compromise play in the creation and operation of federal, state, and local governments? • How have the roles of federal, state, and local governments evolved from controversy and compromise? • How do the three levels of government affect the lives of citizens and how do citizens shape those governments?
Students will know: • The roles, responsibilities and daily functions of federal, state and local governments. • The varying formats of local government across the U.S. and which system is specific to the town of Windsor. • Their duties and responsibilities as a citizen within all three levels of our federal system. • Controversial issues concerning Federalism.	Students will be able to: • Evaluate various explanations for the creation of a federal system and determine through primary and secondary sources where each level of government derives their power. • Integrate information from local town media outlets, to develop a coherent understanding of Windsor's municipal structure. • Use evidence to identify, design and implement effective local community service. • Research and take a stance on a controversial issue in order to design a persuasive argument (PSA).

Significant task 1: *Municipal Budget Activity*

Following direct and interactive instruction regarding the forms of municipal government, students will investigate and evaluate the effectiveness of Windsor's government. Students will use the town's website, http://www.townofwindsorct.com/pages/departments/departments.php, specifically the

"Town Department" page to investigate and evaluate the effectiveness of different town departments, using a graphic organizer.

Following a class discussion regarding the Town Departmental ratings, students will analyze the town budget through the use of "Budget in Brief", determining whether or not they feel the town's resources are adequately and fairly allocated. Based on their conclusions, students will have the ability to alter or revise the town budget through the towns' "Build-A-Budget" program.

Students will prepare a brief (3-4 minute presentation) to their peers, recommending changes to the existing town budget structure. Teachers will use NEASC rubric #3 – Effective Oral Communication

Timeline: 2-3 (84 Minute Blocks)

Resources:

- Town officials' visits to WHS

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- Town Departments - http://www.townofwindsorct.com/pages/departments/departments.php
- "Budget in Brief" - http://www.townofwindsorct.com/finance/budget/2014/budget-in-brief.pdf?i=5
- "Build-A-Budget" - http://budget.townofwindsorct.com/

Significant task 2: *Public Service Announcement*

Through interactive teaching, students will be introduced to concepts of public service announcements as a form of civic persuasion. Students will then be assigned to groups of 2 to 3 students and select a controversial topic within contemporary American society to research. Through that research, they will take a side on the issue and produce individual research papers and a group-produced 1 minute PSA video. Students will be graded on the quality of the information they put together, the creativity of the performance, and the overall persuasiveness of their "public service announcement," and their presentation of the completed project.

Timeline:

Day 1: Groups named, topics selected, project overview given and public service announcement examples shown.

Day 2: In class research day. (PSA planning and research guide attached)

Day 3: Students turn in a two page research paper on their topic. Research paper must show both sides of the argument and have the latest, credible research on the issue. Students are required to submit the paper using **www.turnitin.com**

Days 4 and 5: Students will create their storyboards together in class.

Days 6 and 7: Students film the PSA and upload content to laptops.

Day 8: Students edit PSA using the software provided.

Day 9: Student presentations of PSA videos to peers in class. Students vote using the project rubric for the top two videos. There will be a grade-wide assembly in the spring for the top two videos from each course, both fall and spring semesters will be presented. Awards will be given to the top three from the entire year in May.

Timeline: 9 (84 Minute Blocks – In-class & Independent)

Key vocabulary: all (see "Teacher Notes")

Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- www.turnitin.com
- www.procon.org
- Opposing Viewpoints – WHS Library Media Center – GALE GROUP
- District Oral Communication, Technology, and Collaboration Rubrics
- Social Studies Department PSA Rubric

Common learning experiences:

- Direct Instruction and class discussion about the division of power in federalism
- Critical Reading assignments
- Direct instruction about eminent domain and *Kelo v. City of New London* Analysis
- Classroom visit by local town official(s)
- PSA – Research Paper
- Designing and implementing a community service project
- Vocabulary building exercises, such as word walls, close reading, collaborative discussion about definitions, using root words, dictionaries, Word Splash, etc.

Common assessments including the end of unit summative assessment:

1. Municipal Budget Brief
2. Public Service Announcement – Formal Research Paper (Individual)
3. Public Service Announcement – Video Project (Group)

Teacher notes:

Core Text Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- Opposing Viewpoints – WHS Library Media Center – GALE GROUP

Historical Documents:

- *Kelo v. New London, Connecticut (04-108)* – Case Summary
- *Kelo v. New London, Connecticut (04-108)* – O'Connor Dissenting Opinion
- *Kelo v. New London, Connecticut (04-108)* – Stevens Court Decision
- Boulard, Gary. *"Eminent Domain – For the Great Good?* State Legislatures. 2006

Media:

- Town Departments - http://www.townofwindsorct.com/pages/departments/departments.php
- "Budget in Brief" - http://www.townofwindsorct.com/finance/budget/2014/budget-in-brief.pdf?i=5
- "Build-A-Budget" - http://budget.townofwindsorct.com/
- www.turnitin.com
- www.procon.org

Key Terms:

- County
- County Board
- Township
- Municipality
- Special District
- Incorporation
- Referendum
- Initiative
- Constitutional Convention
- Constitutional Commission
- Article
- Jurisdiction
- Supremacy Clause
- Amendment
- Federalism
- Separation of Powers
- Checks and Balances
- Veto
- Line Item Veto
- Judicial Review
- Eminent domain
- Delegated Powers
- Expressed Powers
- Implied Powers
- Inherent Powers

- Elastic Clause
- Enabling Clause
- Extradite
- Pork Barrel

Windsor Public Schools
Curriculum Map
Civics

Unit 4: Political Ideology, Parties and the Media	Length of the unit: 4 weeks (10 86-minute Blocks)
Purpose of the Unit: As students better understand the background of American political culture and ideology they will examine and analyze the development and functions of our party system and understand the platforms of major political parties. Students will investigate various media outlets and will analyze the influence both media and public opinion have on the American political process.	

Common Core State Standards Addressed in the unit: (Provide the link to the specific standards.)

- D2.Civ.5.9-12. Evaluate citizens' and institutions' effectiveness in addressing social and political problems at the local, state, tribal, national, and/or international level.
- D2.Civ.8.9-12. Evaluate social and political systems in different contexts, times, and places, that promote civic virtues and enact democratic principles.
- D2.Civ.10.9-12. Analyze the impact and the appropriate roles of personal interests and perspectives on the application of civic virtues, democratic principles, constitutional rights, and human rights.
- CCSS.ELA-Literacy.RH.11-12.2 Determine the central ideas or information of a primary or secondary source; provide an accurate summary that makes clear the relationships among the key details and ideas.
- CCSS.ELA-Literacy.RH.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem

Big Ideas:	Essential Questions:
• Trends in both American society and America's political framework affect political, economic and social policy. • Political parties are an essential part of the American political system.	• What trends can be seen in American society and how do these trends affect politics? • What are the main differences in how Americans view the governments' role in creating economic and social policy? • Why are political parties an essential part

• Forces outside of government can influence political decisions.	of the American political system? • How do lobbyists and special interest groups change policy? • How do the media influence politics and political opinion?
Students will know: • Factors that contribute to the formulation of political culture and ideology and how that determines Americans' views on the Government's role in creating economic and social policy. • The origins, evolution and platforms of America's major political parties. • The characteristics of media outlets, interest groups and Political Action Committees. • The role polling and public opinion have on dictating policy.	Students will be able to: • Evaluate various explanations for the creation of political ideology and determine through primary and secondary sources how political ideology and culture define one's view on the functions of government. • Integrate information from a variety of primary and secondary sources to develop a coherent understanding of the history and role of America's political party system. • Use evidence to identify and evaluate the effectiveness of interest groups and media outlets on influencing politics. • Design, implement and analyze the results of a public opinion poll, strengthening their understanding of the use of polling within America's political landscape.

Significant task 1: *Political Spectrum*

Following teacher direct and interactive instruction regarding the formation of political ideology and culture, students will investigate and reflect upon their own political ideologies. Students will participate in a political spectrum survey use the website, http://www.politicalspectrum.org , which will provide the students with a four-quadrant breakdown of their ideological tendencies, including comparisons to famous individuals to whom they closely scored.

Following a class discussion regarding different ideologies and political cultural beliefs along the spectrum, students will analyze their own results developing an in-depth written reflection on their political ideologies, including which political parties they may be most closely aligned as well as hypothesizing the origins of their political culture and beliefs.

Timeline: 2 (84 Minute Blocks)

Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- Political Spectrum Survey – http://www.politicalspectrum.org

Significant task 2: "Polling for a Better Tomorrow" – Opinion Poll Design & Implementation

Following teacher direct and interactive instruction regarding the role of media, public opinion and polling, students will design, implement and analyze the results of their own public opinion poll. Following the initial discussion, students will spend the remainder of the block formulating a topic of interest for their poll. Once their teacher approves the topic, students will use the following block to develop both questions and a form of measurement to adequately implement their poll to at least 50 peers prior to the next class.

Following the students' implementation of their poll, they will be required to tabulate their results, taking into account bias, sample size and representation. Students will present their findings to the class during the 3rd block of this activity.

Timeline: 3 (86 Minute Blocks)

Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.

Common learning experiences:

- Direct Instruction and class discussion on the American political party system, media outlets, interest groups and political action committees and how they have evolved
- Critical Reading assignments: See Core Texts
- *Citizens United v. Federal Election Commission* Analysis
- *"Big Sky, Big Money"* – Frontline, PBS. October 30, 2012.
- Political Ideology Survey
- Evolution the Television Campaign
- "Polling for a Better Tomorrow" – Opinion Poll Design & Implementation

Common assessments including the end of unit summative assessment:

1. *Political Ideology Survey Reflection*
2. Are Corporations People? – *Citizens United v. Federal Election Commission* Reflection
3. "Polling for a Better Tomorrow" – Reflection

Teacher notes:

Core Text Resources:

- Barbour, Christine and Gerald C. Wright. American Government: Citizenship and Power. EMC Publishing, St. Paul, MN. 2010.
- Aldrich, John H. Why Parties? The Origin and Transformation of Political Parties in America. University of Chicago Press, Chicago. 1995.

Historical Documents:

- *McConnell v. Federal Election Commission (2003)*
- *Citizens United v. Federal Election Commission (2008)*

Media:

- www.census.gov
- www.uscis.gov
- www.opensecrets.org
- www.pew.org
- www.democrats.org
- www.rnc.org
- www.livingroomcandidate.org
- www.politicalspectrum.org
- *"Big Sky, Big Money"* – Frontline, PBS. October 30, 2012.
- *www*.oyez.org

Key Terms:

- Political Culture
- Political Party
- Ideologies
- Partisanship
- Third Party
- Independent
- Liberal
- Conservative
- Moderate
- Libertarian
- Caucus
- National Convention
- Closed primary
- Open primary
- Plurality
- Party Platform
- Interest group
- Lobbyist
- Free Rider Problem
- PACs (Political Action Committees)
- Public Opinion

- Mass media
- Political Culture
- Political Socialization
- Sample – Biased, Representative, Random
- Pundit

Windsor Public Schools
Curriculum Map
Pre-Calculus

<table>
<tr><td colspan="2">Purpose of the Course: This is a rigorous course where circular and trigonometric functions are defined and their properties analyzed. Emphasis is also placed on modeling problems using graphing calculators as a tool for their analysis. Conics sections are investigated in an analytical sense. Elementary functions will be analyzed and the concept of limit will be introduced. The use of graphing calculators is integrated throughout the curriculum to prepare students for calculus and other advanced mathematics courses.</td></tr>
<tr><td>Unit 1 Introduction to Trigonometry</td><td>Length of the unit: 11 blocks</td></tr>
<tr><td colspan="2">Purpose of the Unit: This unit builds on the skills developed in Algebra and Geometry on Pythagorean Theorem and basic right triangle trigonometry. This unit extends to the relationships between all six trigonometric functions and their applications.</td></tr>
<tr><td colspan="2">Common Core State Standards Addressed in the unit:

• HSG-SRT.C.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.
• HSG-SRT.C.7 Explain and use the relationship between the sine and cosine of complementary angles.
• HSG-SRT.C.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.
• HSG-SRT.D.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.
• HSG-SRT.D.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems.
• HSG-SRT.D.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).</td></tr>
<tr><td>Big Ideas:
1. Trigonometric functions describe triangular relationships.
2. Right triangles can be applied to solve a variety of problems.
3. The Law of Sines and the Law of Cosines can be used to solve oblique triangles.</td><td>Essential Questions:
1. How can trigonometric functions be used to solve problems that can be represented by right triangles?
2. How can the two trigonometric laws be used to solve oblique triangles and their applications?
3. How can a visual model be useful when solving a problem?</td></tr>
<tr><td>Students will know:
1. trigonometric ratios for 30-45-60 degree function values
2. Pythagorean Theorem</td><td>Students will be able to:
1. evaluate trigonometric functions
2. solve right triangle application problems
3. evaluate trigonometric functions with the use of a calculator
4. solve oblique triangles and their applications using the Law of Sines and Cosines to find the area of an oblique triangle using the appropriate formula</td></tr>
</table>

Significant task 1: Right Triangle Trigonometry

This task is designed to reactive prior knowledge and also focus on application with a clinometer. The first half class should be used to activate prior knowledge regarding the six trigonometric ratios given any right triangle. During the second half of class, students will work in pairs to build a clinometer and measure the height of objects. Students will use the clinometers to measure the height of Windsor High School, the flag pole, an object of choice at Windsor High School (must be more than 5m), their house, and two objects of choice at home (must be more than 5m). Students will collaborate with other groups in the class to analyze their results and compare them with the actual heights. Groups will produce a written document explaining the procedure and the results of their calculations. Students will also explain any discrepancies within their calculations. Students will discover that slight differences in angle measures do not significantly affect the height of an object and will present their results to the class.

This task directly targets the following standards: C.6, C.7, C.8

Timeline: 2 blocks

Key vocabulary: sine, cosine, tangent, cosecant, secant, cotangent, hypotenuse, angle of elevation, angle of depression, Pythagorean theorem

Resources: Clinometer activity, right triangle application activity

Materials: protractors, straw, string, weight

Significant task 2: Law of Sines/Law of Cosines

Students will work collaboratively on a guided deductive investigation to derive the formulas for Law of Sines and Law of Cosines. Students will also investigate the ambiguous case for the Law of Sines (2 blocks). During the next two instructional blocks, students will complete guided practice which will include solving any oblique triangle and its' applications. At the conclusion of the four day introduction to the Law of Sines and the Law of Cosines, students will next develop and solve their own oblique triangle problems and application problems for the two laws.

This task directly targets the following standards: D.10, D.11

Timeline: 7 blocks

Key vocabulary: Law of Sines, Law of Cosines, oblique triangle, SAS, AAS, SSS, SSA, ASA

Resources: illuminations: Law of Sines and Law of Cosines

Materials needed: Law of Sines and Law of Cosines activity sheet, ruler

Common learning experiences:

- Each significant task has exit slips & journal entries which are found in the resource folder.

- Warm-ups should focus on computing square root problems, rationalizing the denominator, and simplifying fractions.
- One additional block should be spent on finding the area of an oblique triangle using Heron's formula and the area of an oblique triangle formula.

Common assessments including the end of unit summative assessment:

- End-unit Test

Teacher notes:

- Process standards to highlight through instruction: make sense of problems and persevere in solving them, model with mathematics, attend to precision.
- Students may have a difficult time remembering such as:
  (1) rationalizing the denominator,
  (2) simplifying and finding square roots,
  (3) simplifying fractions,
  (4) the relationship between 30-45-60 degree triangles.
- Some students may have difficulty solving for an angle measure using the Law of Cosines because of possible weak Algebra skills. Teachers should be prepared to complete examples with students in class before guided practice on Law of Cosines. During significant task 2, teachers can provide some small group instruction for students who need support with their Algebra skills.
- Students may have difficulty determining which angle to use when given a problem that includes the angle of elevation and angle of depression. Teachers should encourage students draw pictures to help in the visualization of the application that uses the angle of elevation and the angle of depression.

Windsor Public Schools

Curriculum Map

Pre-Calculus

Purpose of the Course: This is a rigorous course where circular and trigonometric functions are defined and their properties analyzed. Emphasis is also placed on modeling problems using graphing calculators as a tool for their analysis. Conics sections are investigated in an analytical sense. Elementary functions will be analyzed and the concept of limit will be introduced. The use of graphing calculators is integrated throughout the curriculum to prepare students for calculus and other advanced mathematics courses.

Unit 2 Trigonometric Functions/Angles and Measures	Length of the unit: 11 blocks

Purpose of the Unit: The purpose of this unit is to introduce students to the relationship between degrees and radians and their relationship with the unit circle. Building on these concepts, students will be able to solve application problems involving linear and angular velocity.

Common Core State Standards Addressed in the unit:

- HSF-TF.A.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- HSF-TF.A.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.
- HSF-TF.A.3 (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for x, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.

Big Ideas:	Essential Questions:
1. Linear and angular speeds are used to describe motion in a circular path. 2. Unit circles are used to define trigonometric functions of real numbers. 3. Special triangles and the unit circle can be used to find values for trigonometric functions of specific angles.	1. What is the relationship between radian and degree measure of an angle and why are both measures used? 2. How are the trig functions defined on the unit circle and how can they be related to other definitions? 3. Why are their infinitely many co-terminal angles for every given angle?
Students will know:	Students will be able to:
1. formulas to convert radian and degree measure 2. dimensional analysis for linear and angular velocity problems 3. the properties of the unit circle 4. trigonometric functions and exact values from the unit circle and right triangles	1. recognize and use the vocabulary of angles 2. convert between degrees and radians 3. evaluate the length of a circular arc and its area 4. find the co-terminal angle of any given angle 5. determine the exact values of

	trigonometric functions

Significant task 1: Angles and Measures

This task begins with building vocabulary for radians and degrees through direct instruction. This should take no more than 20 minutes. Include in the discussion the conversion between radians and degrees. Next, students will work in pairs to complete the paper plate radians investigation. Students will fold a paper plate to find the degree measures of the quandrantal angles and special angles. Using register tape students will find the circumference of a circle in radians, which measures approximately 2π. Students will then fold the receipt tape to the corresponding degree measures from the paper plate yielding the radian measures for each angle. Students will verify the accuracy of each other's work. Students will follow up with guided practice to find the exact values of trigonometric functions using the unit circle and special right triangles.

Students will then work collaboratively on a guided deductive investigation to derive the formulas for arc length and the area of a sector with guided practice.

This task directly targets the following standards: HSF-TF.A.1, HSF-TF.A.2

Timeline: 3 blocks

Key vocabulary: ray, half-line, angle, initial side, terminal side, positive angle, negative angle, vertex, terminal side, initial side, quandrantal angle, arc length, degrees, radians, co-terminal angles, sectors, clockwise, counter-clockwise, unit circle, exact values

Resources: Student activity sheets: Sector Area and Arc Length, Paper Plate Radians

Materials: paper plates, receipt paper strip, four different colored writing utensils

Significant task 2: Angular and Linear Velocity

During the first half of class, students will be going outside to complete "Trig Whips" which is an investigation where students actively explore the distance travelled in a circle as one moves farther from the center of that circle. Students will discover that the further one is from the center, the further and faster one moves. Upon returning to class, students will compare and contrast linear and angular velocity through a whole class discussion.

Students will then complete guided practice, solving various linear and angular velocity problems over two days.

This task directly targets the following standards: HSF-TF.A.1

Timeline: 3 blocks

Key vocabulary: linear speed/velocity, angular speed/velocity

Resources: “Trig Whip” activity sheet, practice problems

Materials needed: measuring tapes, stop watches

Common learning experiences:

- Each significant task has exit slips & journal entries which are found in the resource folder.
- Warm-ups should focus on dimensional analysis, practice finding exact values of trigonometric functions

Common assessments including the end of unit summative assessment:

- End of unit test which will include student choice linear and angular velocity questions.

Teacher notes:

- Process standards to highlight through instruction: make sense of problems and persevere in solving them, model with mathematics, look for and make use of structure.
- Students will have difficulty differentiated between linear and angular velocity. Teachers should debrief the “Trig Whip” investigation thoroughly allowing the students to comprehend the significant differences.
- Using formative assessment, teachers should focus the warm-ups on the topics that students may have a difficult time remembering such as dimensional analysis and finding exact values of trigonometric functions. During significant task 2, if students had difficulty completing the warm-ups, teachers can provide some small group instruction for students who need support with this skill.

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<tr><td>Unit 3 Circular Functions</td><td>Length of the unit: 12 blocks</td></tr>
<tr><td colspan="2">Purpose of the Unit: The purpose of this unit is to build on prior knowledge of translations of functions from Algebra 2. Students will also use their knowledge of exact values from unit two to help them graph the trigonometric functions.</td></tr>
<tr><td colspan="2">Common Core State Standards Addressed in the unit:

• HSF-TF.B.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.</td></tr>
<tr><td>Big Ideas:

4. The periodic nature of the trig functions effects their analytical values and graphical representations.

5. The sine and cosine functions may be used to model real world problems that are periodic in nature.</td><td>Essential Questions:

1. What are the characteristics of the graphs of the six trig functions?

2. What are the parameters of the sine and cosine functions and how can they be used to model real world problems?</td></tr>
<tr><td>Students will know:

1. the exact values of trigonometric function

2. the domain and range of each of trigonometric function</td><td>Students will be able to:

1. graph trigonometric functions in their standard position

2. translate the graphs of trigonometric functions from standard position

3. solve application problems using the graphs of trigonometric functions

4. develop the equations from a graph for sine and cosine functions</td></tr>
</table>

Significant task 1: Graphs and translations of the sine and cosine functions

During the first half of the block, students will be conducting the Illuminations activity "Graphs from the Unit Circle in Radians." Students will construct the sine and cosine graph using their unit circle, spaghetti, and twine. Students will work in pairs, constructing the sine and cosine curve using spaghetti. When finished, students will complete a reflection paper to describe each graph.

With guided practice students, using the equations, will predict the translation(s) from the sine and cosine graphs in standard form. Then, students will verify their graphs by plotting points.

As an extension honors and high honors students will construct graphs and translations of tangent, cosecant, secant, and cotangent functions.

This task directly targets the following standards: HSF-TF.B.5

Timeline: 5 - 7 blocks

Key vocabulary: amplitude, period, phase shift, vertical shift, domain, range, minimum, maximum

Resources: Illuminations activity "Graphs from the Unit Circle in Radians", table for transformations, characteristic sheet

Materials: paper, spaghetti, tape, unit circle

Significant task 2: Writing trigonometric equations from graphs and applications

This task begins with direct instruction on writing sine and cosine functions from a graph. Class discussion revolves around how students can best determine the equation of the trigonometric graph. Students will discover that more than one equation can be written for each graph. Building on this learning, students will then solve a variety of application problems that involve trigonometric functions and graphs. As an extension honors and high honors students will solve more application problems that have an increased difficulty that also involve writing trigonometric equations.

This task directly targets the following standards: HSF-TF.B.5

Timeline: 3 – 5 blocks

Key vocabulary: no new vocabulary

Resources: none

Materials: practice problems

Common learning experiences:

- Each significant task has exit slips & journal entries which are found in the resource folder.
- Warm-ups should focus on prior learning from Algebra 2 regarding graphs of functions and their translations.

Common assessments including the end of unit summative assessment:

- End of unit test
- **Performance Assessment: Trip of a Lifetime** Students will write an itinerary for their trip around the world. Students will find the average monthly temperatures for at least two cities. Students will construct a sinusoidal curve and write an equation reflecting the data. Students will use their equations to determine temperatures at specific times of the year. After answering specific questions students will present their final product in an open-ended format such as a power point presentation, pamphlet, poster board, etc. Criteria for successful completion are: accurate graphs, accurate equations, correct answers to temperature questions, and the quality of their final product. Students will be graded according to the school wide rubric for critical analysis thinking.

Teacher notes:

- Process standards to highlight through instruction: construct viable arguments and critique the reasoning of others, model with mathematics, attend to precision.
- Students will have difficulty with finding common denominators involved with completing the tables for translations of the trigonometric functions. Using formative assessment, teachers should focus the warm-ups on multiplying and adding fractions.

Purpose of the Course: This is a rigorous course where circular and trigonometric functions are defined and their properties analyzed. Emphasis is also placed on modeling problems using graphing calculators as a tool for their analysis. Conics sections are investigated in an analytical sense. Elementary functions will be analyzed and the concept of limit will be introduced. The use of graphing calculators is integrated throughout the curriculum to prepare students for calculus and other advanced mathematics courses.

Unit 4 Analytic Trigonometry	Length of the unit: 12 blocks

Purpose of the Unit: The purpose of this unit is to build on prior knowledge (from Algebra 2) of inverse functions. Students will be defining inverse trigonometric functions, proving trigonometric identities, and solving trigonometric equations.

Common Core State Standards Addressed in the unit:

- HSF-TF.B.7 (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.
- HSF-TF.C.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
- HSF-TF.C.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Big Ideas:	Essential Questions:
1. Algebraic manipulations allow for one side of a trigonometric identity to be identical to the other side 2. Trigonometric identities can be used to determine exact values. 3. Inverse functions and identities help to solve trigonometric functions.	1. How do identities relate the six trigonometric functions? 2. How are the inverses of trigonometric functions defined? 3. What techniques can be used to verify identities? 4. How does solving algebraic and trigonometric equations compare?
Students will know:	Students will be able to:
1. Pythagorean theorem 2. strategies to algebraically demonstrate that two identities are equal 3. properties of the sine, cosine and tangent	1. prove basic identities, double angle, half-angle and sum and difference identities 2. evaluate inverse function

functions	3. solve trigonometric equations

Significant task 1: Inverse functions

During the first half of class, students will work in pairs to complete the "Inverses of Trigonometric Functions" investigation. In this investigation students will use a table and graph to determine the inverse of the sine and cosine function. Students will be able to determine any restrictions of the domain and range. Students will interpret why restricting the domain and range is necessary in finding the inverse of trigonometric functions. Students will refer to this activity to find exact values throughout the unit.

As an extension for Honors and High Honors students will further analyze the other four trigonometric functions.

Students will follow up on this activity with guided practice using the unit circle to determine the exact value of the inverse (angle measures).

This task directly targets the following standards: HSF-TF.B.7

Timeline: 3 – 4 blocks

Key vocabulary: inverse, composite functions, domain and range

Resources: "Inverses of Trigonometric Functions" activity

Materials: highlighter

Significant task 2: Trigonometric Identities

Students will be given trigonometric identities and subsequently prove them, collaboratively, using inductive reasoning. College level students will focus on the Pythagorean identities; honors will also prove the double angle formulas; high honors will prove all identities including half-angle, sum and difference formulas.

Students will use basic identities, Pythagorean identities, double angle and half-angle identities and sum and difference identities to verify trigonometric equations (identities). Students will work in groups to complete guided practice. It is suggested that teachers make this a jigsaw activity and students will present their results to the class. While completing guided practice, students will use the strategies learned in this task to find the exact values of the trigonometric expressions using sum and difference identities and double angle and half-angle identities.

This task directly targets the following standards: HSF-TF.C.8, HSF-TF.C.9

Timeline: 7 – 11 blocks

Key vocabulary: even/odd properties, basic identities, Pythagorean identities, double angle identities, half-angle identities, sum and difference identities

Resources: various example worksheets for independent practice

Materials needed: none

Common learning experiences:

- Through a teacher directed lesson, students will find the exact value of composite functions using properties of inverse trigonometric functions with right triangle trigonometry. This task is to be completed after significant task 1.
- At the conclusion of the previous two tasks, teachers should plan on spending 2 additional blocks focused on solving trigonometric equations. Students will be using inverse properties and trigonometric identities to solve. Teachers may want to introduce this practice session with a review of solving algebraic equations.
- Each significant task has exit slips & journal entries which are found in the resource folder.
- Warm-ups should focus on factoring trinomials, proving topics from geometry

Common assessments including the end of unit summative assessment:

- End of unit test

Teacher notes:

- Process standards to highlight through instruction: make sense of problems and persevere in solving them, construct viable arguments and critique the reasoning of others, look for and express regularity in repeated reasoning.
- Using formative assessment, teachers should focus the warm-ups on the topics that students may have a difficult time remembering such as:
    1. finding angle measures given exact values

2. practice proving topics from geometry

- Some students may have difficulty factoring. Teachers should be prepared to complete examples with students in class before guided practice on solving trigonometric equations. During significant task 2, teachers can provide some small group instruction for students who need support with their factoring skills.
- Teachers should be prepared with extra examples for those students who struggle with verifying trigonometric equations.

Windsor Public Schools

Curriculum Map

Pre-Calculus

Purpose of the Course: This is a rigorous course where circular and trigonometric functions are defined and their properties analyzed. Emphasis is also placed on modeling problems using graphing calculators as a tool for their analysis. Conics sections are investigated in an analytical sense. Elementary functions will be analyzed and the concept of limit will be introduced. The use of graphing calculators is integrated throughout the curriculum to prepare students for calculus and other advanced mathematics courses.

Unit 4 Analytic Trigonometry	Length of the unit: 12 blocks

Purpose of the Unit: The purpose of this unit is to build on prior knowledge (from Algebra 2) of inverse functions. Students will be defining inverse trigonometric functions, proving trigonometric identities, and solving trigonometric equations.

Common Core State Standards Addressed in the unit:

- HSF-TF.B.7 (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.
- HSF-TF.C.8 Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
- HSF-TF.C.9 (+) Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

Big Ideas:	Essential Questions:
1. Algebraic manipulations allow for one side of a trigonometric identity to be identical to the other side 2. Trigonometric identities can be used to determine exact values. 3. Inverse functions and identities help to solve trigonometric functions.	1. How do identities relate the six trigonometric functions? 2. How are the inverses of trigonometric functions defined? 3. What techniques can be used to verify identities? 4. How does solving algebraic and trigonometric equations compare?
Students will know:	Students will be able to:
1. Pythagorean theorem 2. strategies to algebraically demonstrate that two identities are equal 3. properties of the sine, cosine and tangent functions	1. prove basic identities, double angle, half-angle and sum and difference identities 2. evaluate inverse function 3. solve trigonometric equations

Significant task 1: Inverse functions

During the first half of class, students will work in pairs to complete the "Inverses of Trigonometric Functions" investigation. In this investigation students will use a table and graph to determine the inverse of the sine and cosine function. Students will be able to determine any restrictions of the domain and range. Students will interpret why restricting the domain and range is necessary in finding the inverse of trigonometric functions. Students will refer to this activity to find exact values throughout the unit.

As an extension for Honors and High Honors students will further analyze the other four trigonometric functions.

Students will follow up on this activity with guided practice using the unit circle to determine the exact value of the inverse (angle measures).

This task directly targets the following standards: HSF-TF.B.7

Timeline: 3 – 4 blocks

Key vocabulary: inverse, composite functions, domain and range

Resources: "Inverses of Trigonometric Functions" activity

Materials: highlighter

Significant task 2: Trigonometric Identities

Students will be given trigonometric identities and subsequently prove them, collaboratively, using inductive reasoning. College level students will focus on the Pythagorean identities; honors will also prove the double angle formulas; high honors will prove all identities including half-angle, sum and difference formulas.

Students will use basic identities, Pythagorean identities, double angle and half-angle identities and sum and difference identities to verify trigonometric equations (identities). Students will work in groups to complete guided practice. It is suggested that teachers make this a jigsaw activity and students will present their results to the class. While completing guided practice, students will use the strategies learned in this task to find the exact values of the trigonometric expressions using sum and difference identities and double angle and half-angle identities.

This task directly targets the following standards: HSF-TF.C.8, HSF-TF.C.9

Timeline: 7 – 11 blocks

Key vocabulary: even/odd properties, basic identities, Pythagorean identities, double angle identities, half-angle identities, sum and difference identities

Resources: various example worksheets for independent practice

Materials needed: none

Common learning experiences:

- Through a teacher directed lesson, students will find the exact value of composite functions using properties of inverse trigonometric functions with right triangle trigonometry. This task is to be completed after significant task 1.
- At the conclusion of the previous two tasks, teachers should plan on spending 2 additional blocks focused on solving trigonometric equations. Students will be using inverse properties and trigonometric identities to solve. Teachers may want to introduce this practice session with

a review of solving algebraic equations.

- Each significant task has exit slips & journal entries which are found in the resource folder.
- Warm-ups should focus on factoring trinomials, proving topics from geometry

Common assessments including the end of unit summative assessment:

- End of unit test

Teacher notes:

- Process standards to highlight through instruction: make sense of problems and persevere in solving them, construct viable arguments and critique the reasoning of others, look for and express regularity in repeated reasoning.
- Using formative assessment, teachers should focus the warm-ups on the topics that students may have a difficult time remembering such as:
    3. finding angle measures given exact values
    4. practice proving topics from geometry
- Some students may have difficulty factoring. Teachers should be prepared to complete examples with students in class before guided practice on solving trigonometric equations. During significant task 2, teachers can provide some small group instruction for students who need support with their factoring skills.
- Teachers should be prepared with extra examples for those students who struggle with verifying trigonometric equations.

Purpose of the Course: This is a rigorous course where circular and trigonometric functions are defined and their properties analyzed. Emphasis is also placed on modeling problems using graphing calculators as a tool for their analysis. Conics sections are investigated in an analytical sense. Elementary functions will be analyzed and the concept of limit will be introduced. The use of graphing calculators is integrated throughout the curriculum to prepare students for calculus and other advanced mathematics courses.

Unit 6 Polar and Parametric Equations	Length of the unit: 10 blocks

Purpose of the Unit: Paths traced by rotating objects can be modeled by coordinates in which the independent variable is an angle measure and the dependent variable is a directed distance from the origin. These polar coordinates give a method to find equations for things such as the involute of a circle.

Common Core State Standards Addressed in the unit:

- HSN-CN.B.4 (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.

Big Ideas:	Essential Questions:
1. Polar and rectangular equations are converted using formulas derived from right triangle trigonometry 2. The characteristics and graph of a polar equation are determined by its form and coefficients. 3. Parametric and rectangular equations are converted using parameters and substitution 4. Parametric equations are graphed by writing rectangular coordinates as a function of a parameter	1. How is right triangle trigonometry related to polar and rectangular equations? 2. Why are functions and relations represented by polar and parametric equations? 3. How are polar and parametric equations graphed?
Students will know:	Students will be able to:
1. meaning of (r, ϑ) and how to represent them on a polar coordinate graph 2. equations and graphs for conic	1. plot polar coordinate and graphs using the point-plotting method or the symmetry method on polar graph

sections 3. procedures and properties with complex numbers 4. parameters can be eliminated before conversion	paper 2. transform polar equations of conic sections into rectangular coordinates 3. graph ellipse, parabola and a hyperbola on a polar coordinate system 4. operate with complex numbers in polar form 5. plot complex numbers in a complex plane 6. convert complex numbers to polar and rectangular numbers 7. graph and identify polar and parametric equations by converting to rectangular equations

Significant task 1: Background of Polar Coordinates, Equations and Graphs

In this task students will discover how to plot points using polar coordinates, where points are located by an angle θ and a distance *r* from the origin. Graphs have been plotted in the Rectangular coordinate system using *x*- and *y*-coordinates. A more natural way to plot some graphs is to locate points by an angle θ in standard position and a displacement *r* from the origin. First students will make a number line ruler out of paper or index card and mark it off with the same scale as the polar coordinate paper. Students will then draw different rays that represent degrees. Students will discover that by rotating around the pole they will find co-terminal angles. Next, students will convert between polar and rectangular coordinates and describe the relationships between the two coordinate systems through a small group activity. Afterwards, students will participate in guided practice.

Through direct instruction students will convert equations from rectangular to polar and polar to rectangular. Students will then participate in investigations on graphing polar equations using the point-plotting method and the symmetry method. Students will complete guided practice on graphing polar equations using both methods. Finally, students will investigate the three special polar equations of limaćons, rose curves and lemniscates in small groups to present to the class.

This task directly targets the following standards: This task goes beyond CCSS standards but is prerequisite knowledge for Calculus.

Timeline: 3 – 7 blocks

Key vocabulary: polar coordinates, pole, polar axis, rectangular coordinates, polar equations, limaćons , rose curves, lemniscates, rectangular equations

Resources: Activity sheets

Materials: polar graph paper, ruler

Significant task 2: Complex numbers in polar form & DeMoivre's Theorem

Through direct instruction, students will learn how to write complex numbers in polar form, which makes it significantly easier to find powers and roots. Then students work in teams of two to present properties of imaginary numbers to the class. Subsequently, students will complete various small group activities for plotting complex numbers in a complex plane and combining two complex numbers given in polar form. Finally, students will learn that raising the modulus to the power and multiplying the argument by the exponent is known as DeMoivre's Theorem. DeMoivre's Theorem can be used to find the roots of a complex number.

This task directly targets the following standards: HSN-CN.B.4

Timeline: 4 blocks

Key vocabulary: modulus, argument, real axis, imaginary axis, complex plane, complex number, absolute value, rectangular form, DeMoivere's Theorem

Resources: Activity Sheets

Materials: Complex Plane graphs, polar graphs

Significant task 3: Parametric Equations

In this task, students will investigate the relationship between a plane curve and a parametric curve. Students will plot points in the rectangular coordinate system then graph a curve defined by parametric equations. Students will then work on guided practice. Next, students will discover that infinitely many pairs of parametric equations can represent the same plane curve, followed by a whole class discussion.

In the second part of this task, trigonometry and physics are integrated to develop a model of projectile motion using parametric equations. Working in small groups students will be given a set of data and will generate the parametric equations for x and y that models the movement of a projectile. A graphing calculator will be used to facilitate the model development. At the end of this activity select a few examples to be shared with the entire class.

This task directly targets the following standards: This task goes beyond CCSS standards but is prerequisite knowledge for Calculus.

Timeline: 4 blocks

Key vocabulary: parameters, parametric equations, plane curves, domain

Resources: activity sheets

Materials: graph paper

Common learning experiences:

- Each significant task has exit slips & journal entries which are found in the resource folder.
- Warm-ups should focus on graphing parabolas.
- Using the dynamic Pre-Calculus exploration at www.keymath.com/precalc students will explore polar equations of conic sections.

Common assessments including the end of unit summative assessment:

- End of unit test
- **Performance Assessment: Will They Crash?** Students will work in cooperative teams to complete a task where to determine whether two ships will collide. Students are provided with a scenario with two ships traveling in foggy conditions. Students will determine if the two ships will collide and must confirm their conclusion thru analytic explanation or with a description of how technology was used to solve the problem. Students will also prepare a graph to illustrate the situation. This task will be evaluated using the problem solving school – wide rubric.

Teacher notes:

- Process standards to highlight through instruction: construct viable arguments and critique the reasoning of others, model with mathematics, use appropriate tools strategically.
- It is suggested that teachers may want to place students in small groups for jigsaw activities for significant task 2 and significant task 4.
- Using formative assessment, teachers should focus the warm-ups on the topics that students may have a difficult time remembering such as:
    - addition, subtraction, multiplication and division of complex numbers
    - equations of parabolas, hyperbolas, and ellipses
- Teachers should emphasize the importance of making a sketch.
- Students may not have learned how to graph imaginary numbers and additional time should be spent reviewing how to do so.
- Teachers should be aware that the notation used for complex numbers can be confusing to

students.

- Teachers should point out that ϑ is an independent variable and so it appears in the first column of the table, while *r*, the dependent variable appears second.

Windsor Public Schools

Curriculum Map

Pre-Calculus

Purpose of the Course: This is a rigorous course where circular and trigonometric functions are defined and their properties analyzed. Emphasis is also placed on modeling problems using graphing calculators as a tool for their analysis. Conics sections are investigated in an analytical sense. Elementary functions will be analyzed and the concept of limit will be introduced. The use of graphing calculators is integrated throughout the curriculum to prepare students for calculus and other advanced mathematics courses.	
Unit 7 Sequences and Series	Length of the unit: 8 blocks
Purpose of the Unit: An understanding of convergent series and familiarity with sigma notation are crucial for understanding the definite integral, one of the two foundational concepts encountered in the first year of calculus. Building on compound interest learned in Algebra 2, students will expand their knowledge to include value of annuity.	
Common Core State Standards Addressed in the unit: • HSA-SSE.B.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.* • 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. • F-IF 3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.	
Big Ideas: 1. Sequences may be defined by recursion or explicit formulas. 2. Sequence of patterns may have patterns that are arithmetic or geometric in nature.	Essential Questions: 1. What is the difference between recursive and explicit rules? 2. What is the difference between arithmetic and geometric sequences? 3. How is a limit related to an infinite

3. Series are sums of sequences.	geometric series?
Students will know: 1. procedures to find sums and partial sums of given sequence 2. procedures to find the formula for the general term of an arithmetic or geometric sequence 3. procedures to find the sum of each infinite geometric series 4. strategies to find the value of annuities	Students will be able to: 1) find sums and partial sums of a given sequence 2) discover the formula for the general term of an arithmetic or geometric sequence 3) find the sum of each infinite geometric series 4) find the value of annuities

Significant task 1: Introduction to Sequences

Through a teacher directed lesson, students will evaluate factorials, define a recursive sequence and determine terms of a sequence. Students will explore how to use a graphing calculator to list the terms of sequences.

Students will work in pairs to match specific properties of sequence summation (not arithmetic/geometric) to the appropriate examples. This will include student presentation of the explanations. Students will then complete guided practice using the properties.

This task directly targets the following standards: F-BF 2., F-IF 3.

Timeline: 2 blocks

Key vocabulary: sigma notation, factorial notation, recursive sequence, nth term

Resources: Exploration "How Does It Work?" activity sheet, practice problems, property list

Materials: glue sticks, paper, scissors

Significant task 2: Arithmetic Sequences and Series

Through an investigation, students discover the properties of arithmetic sequences and series through the use of manipulatives. Students will develop formulas to describe the nature of the sequences and series. Students will also graph the sequences to portray the nature of inputs and outputs of the function. This investigation concludes with real-life applications of arithmetic sequences and series such as tile floors and brick stairs. Students will then complete guided practice.

This task directly targets the following standards: F-BF 2., F-IF 3.

Timeline: 2 blocks

Key vocabulary: sigma notation, arithmetic, recursive sequence, nth term, partial sum, common difference

Resources: "Arithmetic Sequences & Series" investigation sheet

Materials needed: deck of cards, paper, marker, graph paper

Significant task 3: Geometric Sequences and Series

Through a teacher directed lesson, students will determine if a sequence is geometric and find a formula for a geometric sequence. As an extension for Honors and High Honors, students will prove the formula for the sum of a geometric sequence. Students will investigate the infinite geometric series which will introduce the concept of limits informally. To conclude, students will solve application problems which include annuities and mortgage payments.

This task directly targets the following standards: HSA-SSE.B.4, F-BF 2., F-IF 3.

Timeline: 3 – 4 blocks

Key vocabulary: finite and infinite sums, fractal, geometric sequence and series, limit, common ratio, annuities

Resources: "Investigating infinite geometric series" activity sheet

Materials: none

Common learning experiences:

- After significant task three, students will complete a fractal investigation. Students will find the formula and area of the un-shaded regions of each fractal.
- Each significant task has exit slips & journal entries which are found in the resource folder.
- Warm-ups should focus on using patterns to write explicit rules to solve problems

Common assessments including the end of unit summative assessment:

- End Unit Test
- **Performance Assessment: One-to-One Financial Planning** Students are placed in the role of a financial planning team member and will determine which salary option for their client provides the most amount of money over a six-year contract. Students will

produce a written report and will present their findings to the class. Students will evaluate presenters work to determine if their findings are accurate. Students will be graded using the school wide rubric for Problem Solving.

Teacher notes: • Process standards to highlight through instruction: reason abstractly and quantitatively, model with mathematics, use appropriate tools strategically. • Teacher should post the summation properties in classroom to assist students.

Windsor Public Schools

Curriculum Map

Pre-Calculus

Purpose of the Course: This is a rigorous course where circular and trigonometric functions are defined and their properties analyzed. Emphasis is also placed on modeling problems using graphing calculators as a tool for their analysis. Conics sections are investigated in an analytical sense. Elementary functions will be analyzed and the concept of limit will be introduced. The use of graphing calculators is integrated throughout the curriculum to prepare students for calculus and other advanced mathematics courses.	
Unit 8 Limits	Length of the unit: 8 blocks
Purpose of the Unit: Using graphical, numerical and algebraic approaches students will develop an intuitive understanding of the concept of the limit in preparation for a more rigorous treatment in calculus.	
Common Core State Standards Addressed in the unit: • F-IF.2 Understand the concept of a function and use function notation. F-IF.7 Analyze functions using different representations.	
Big Ideas: 1. The study of limits involves looking at values close to the desired value over an infinitely decreasing interval; limits	Essential Questions: 1. What is a limit, how is it related to continuity, and how is it reasonably

are used to determine continuity.	estimated and precisely calculated?
Students will know: 1. function characteristics, including limits and continuity 2. strategies to identify asymptotic behavior 3. definition of continuity	Students will be able to: 1. explain the behavior of a function when it fails (i.e. at undefined values) 2. estimate limits using graphs and tables 3. calculate precise limits algebraically 4. interpret the limit definition of continuity 5. state continuous intervals for a function and identify discontinuities 6. distinguish infinite limits from limits at infinity using vertical and horizontal asymptotes

Significant task 1: Finding Limits using Tables and Graphs and Algebraically

Through a self-directed investigation, students will work in pairs encountering limits through the "Bad Luck Ladder" application problem. In this activity students will learn techniques for evaluating limits and develop a strong intuitive understanding of what a limit is. Students will analyze limits using algebra, graphs and tables. This activity will be followed by guided practice. Students will then think about limits, discuss with classmates, and will reflect through writing what they learned about limits.

This task directly targets the following standards: F-IF.2, F-IF.7

Timeline: 2 – 4 blocks

Key vocabulary: one-sided limit, limit, limit notation, left hand limit, right hand limit, limit of the identity function, limit of a sum, limit of a difference, limit of a product, properties of limits, limit of a monomial, limit of a polynomial, limit of a power, limit of a root, limit of a quotient, limit of a piece-wise function

Resources: "Bad Luck Ladder" activity sheets

Materials: graphing calculator

Significant task 2: Limits and Continuity

In this task, the continuity of four functions is explored. The concept of continuity is linked to graphical behavior by performing horizontal zooming. A polynomial function is investigated first followed by a

rational function, oscillating function and piece-wise functions. Students will follow up with guided practice on one-sided limits and continuity with the four functions previously explored.

The tasks will emphasize the relationship, in the formal definition of continuity, between limits and continuity.

This task directly targets the following standards: F-IF.7

Timeline: 3 – 4 blocks

Key vocabulary: continuous, defined, exists, discontinuous, piece-wise functions, polynomial functions, rational functions, oscillating functions

Resources: "Graphical Consequences of Continuity" activity sheet, "One-sided Limits and Continuity with Piece-Wise Defined Functions" activity sheet

Materials: graphing calculator

Common learning experiences:

- Each significant task has exit slips & journal entries which are found in the resource folder.
- Warm-ups should focus on graphing piece-wise functions, polynomial functions, rational functions and oscillating funcitons.

Common assessments including the end of unit summative assessment:

- End of Unit Test

Teacher notes:

- Process standards to highlight through instruction: reason abstractly and quantitatively, look for and express regularity in repeated reasoning, and look for and make use of structure.
- When finding limits, the method being used should be emphasized, either by table, graph or equation. Students must know all three methods
- Definition of continuity needs to be approached with concise and exact practice involving the limit from both sides as well as finding *f(a)*.
- Piecewise function graphing is a trouble spot for students when relating one-sided limits and

continuity, and determining how to fix discontinuities.

- The idea of horizontal zooming – in which just the x-scale is changed – is likely to be new to students.

Calculus Curriculum Unit Sequencing

Honors AB BC

Unit 1 – Limits and Continuity

Unit 2 – Derivatives

Unit 3 – Applications of Derivatives

Unit 4 – Integrals

Unit 5 – Applications of Integrals

Unit 6 – Differential Equations and Slope Fields

Unit 7 – Series and Sequences

Unit 8 – Polar, Parametric and Vector Functions

Windsor Public Schools
Curriculum Map
Calculus
Approved by BOE _____

Purpose of the Course: This is an introductory course in differential and integral calculus with strong emphasis on applications in the field of business, social science and life sciences. Topics covered include functions, limits, rates of change, differentiation, maxima and minima problems, integration techniques and applications. There is extensive use of the graphing calculator and other hands-on activities. AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 1 Limits and Continuity	Length of the unit: Honors: 14 blocks AB: 11 blocks BC: 7 blocks
Purpose of the Unit: This unit extends previous knowledge of function characteristics to include limits and continuity. Then, the concepts of limits, continuity and rate of change are used to define a derivative.	
Common Core State Standards Addressed in the unit: 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. N-VM.3 Represent and model with vector quantities. Solve problems involving velocity and other quantities that can be represented by vectors. A-SSE.1 Interpret the structure of expressions. *(interpreting and applying formal definitions in context and rewriting general equations to model specific quantities)* A-SSE.2 Use the structure of an expression to identify ways to rewrite it. A-SSE.3 Write expressions in equivalent forms to solve problems. F-IF.2 Understand the concept of a function and use function notation. F-IF.7 Analyze functions using different representations. Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at: http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf	
Big Ideas:	Essential Questions:

1. Average rates of change are calculated differently than instantaneous rates of change. 2. The study of limits involves looking at values close to the desired value over an infinitely decreasing interval; limits are used to determine continuity. 3. A derivative is an instantaneous rate of change.	1. How are average and instantaneous rates of change calculated? 2. What is a limit, how is it related to continuity, and how is it reasonably estimated and precisely calculated? 3. What is the meaning of a derivative and how is it calculated using the limit definition?
Students will know: 1. function characteristics, including limits and continuity 2. strategies to identify asymptotic behavior 3. definition of continuity 4. relative magnitudes of functions and their rates of change 5. geometric application of the Intermediate Value Theorem on continuous functions 6. a derivative, interpreted as an instantaneous rate of change, is the limit of average rates of change over intervals that decrease without bound 7. the derivative defined as the limit of the difference quotient as $\Delta x \to 0$ 8. the relationship between differentiability and continuity	Students will be able to: 1. explain the behavior of a function when it fails (i.e. at undefined values) 2. estimate limits using graphs and tables 3. calculate precise limits algebraically 4. interpret the limit definition of continuity 5. state continuous intervals for a function and identify discontinuities 6. distinguish infinite limits from limits at infinity using vertical and horizontal asymptotes 7. calculate average and instantaneous rates of change based on secant and tangent lines 8. calculate the derivative of a function using the limit definition

Significant task 1: Finding Limits

Significant task 1 is organized in three distinct lessons. In lesson 1, students work collaboratively to develop an understanding of the purpose of differential calculus. Using the context of a car trip from Denver to Pueblo, students investigate average velocity vs instantaneous velocity. In the whole class discussion that follows, students will summarize their understanding of instantaneous velocity and the problem that ensues in its calculation (Zeno's paradoxes). Included in their summary should be a comparison to average velocity, possibly using the Denver $\rightarrow$ Pueblo trip.

Next, in pairs, students apply new knowledge to estimate the velocity of a *Falling Rock,* at 1.5 seconds after the rock breaks away from the cliff. Using a table, students calculate several average velocities over decreasing time intervals. The teacher circulates to verify that each pair of students has accurately concluded that the limit of the average velocities (slope of the secant

line) over smaller time intervals is the instantaneous velocity (slope of the tangent line) at 1.5 seconds.

Finally, students learn the formal definition of a limit and appropriate notation through direct instruction. This is done using the context of piecewise functions. Topics covered include left- and right-handed limits, infinite limits and asymptotes, and limits that do not exist.

This task directly addresses the following standards: N-VM.3, A-SSE.1, F-IF.2

Timeline: 3-5 blocks
Key vocabulary: tangent, secant, average rate of change, instantaneous rate of change, limit, continuity, asymptote, removable discontinuity, one-sided limit, right-handed limit, left-handed limit, differentiable
Resources: Teacher created resources – see Calculus Resource Folder, Falling rock, Limits from Graphs and Tables, Limit Practice, activities from http://designatedderiver.wikispaces.com/Derivatives

Significant task 2: Continuity

As a whole class, students formally consider the concept of continuity by considering functions that are continuous everywhere, polynomial functions, and those that have discontinuities, rational functions. Then, students determine the continuity of piecewise functions using graphical and algebraic representations. The tasks will emphasize the relationship, in the formal definition of continuity, between limits and continuity. Students will summarize their learning by working collaboratively on the activity We Belong Together.

The concept of continuity will then be extended to the Intermediate Value Theorem. In a think, pair, share activity, students discover the IVT in the context of boiling water. Students must prove that the water reaches an exact temperature of 150°F at some instant during the heating process. Then, student pairs will use the IVT to justify the existence of specific values on an interval in context (e.g. a person's height and speeding on a highway). To summarize, student pairs must solve *The Twin Problem* using IVT. In this problem, quarrelsome twins travel to separate vacation spots, one to a cold climate and the other to a warm climate, and then switch locations. Students must decide whether the twins ever experience the same temperature at the same time, in order to settle an argument between the competitive siblings.

This task directly addresses the following standards: A-SSE.1, F-IF.2, F-IF.7

Timeline: 3-4 blocks
Key vocabulary: piecewise function
Resources: Teacher created resources, see Calculus Resource Folder, Twin Problem, activities from http://designatedderiver.wikispaces.com/Derivatives

Significant task 3: Definition of derivative

Individually, students will begin to discover the formal definition of a derivative by finding the slope of a secant. In a teacher-led discussion, using an application of Geometer's Sketchpad called Calculus in Motion, we will develop $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ and $\lim_{x\to a}\frac{f(x)-f(a)}{x-a}$ as the formal

definitions of a derivative. Students' algebraic skills will be sharpened as we use both limit definitions to analytically determine the derivative of polynomial, radical and rational functions.

In groups, students will investigate the differentiability of piecewise functions. This activity will be summarized with a whole class discussion that will reinforce that differentiability implies continuity but not the converse. We will also address cusps, which are not differentiable, and strategies that ensure the differentiability of piecewise functions.

This task directly addresses the following standards: F-IF.6

Timeline: 3-5 blocks
Key vocabulary: difference quotient, slope of a secant, slope of a tangent
Resources: Teacher created resources – see Calculus Resource Folder, Definition of Derivative Lab, activities from http://designatedderiver.wikispaces.com/Derivatives

Common learning experiences:

- additional practice to analyze distance and velocity graphs, and to represent piecewise functions graphically and analytically
- Geometer sketchpad - definition of derivative & IVT
- YouTube video: *The Two Big Questions of Calculus* http://www.youtube.com/watch?v=0v6kB21KmMc&feature=PlayList&p=404D60E2265E53E3&index=21
- Video: *Engineering a Waterslide* (course intro, to generate interest) http://www.juicetheblog.com/2009/08/04/unbelievable-waterslide/

Common assessments including the end of unit summative assessment:

- Unit 1 Test
- Performance Assessment (Honors only): Prime Time Students are placed in the role of a staff statistician working for the U.S. Bureau of Labor and Statistics. They have been asked to perform an experiment, collect data, and record the data in a table and a graph. Then, they will analyze this data and report findings, in order to prove their abilities. Their report must include the average rate of change in their data, calculated over various time intervals, and an equation that models the data. After estimating the instantaneous rate at a given point, students calculate the actual instantaneous rate of change using graphing calculators. Finally, students analyze all of the data and calculations, draw conclusions, and summarize their findings in a report that includes evidence in the form of graphs created in Excel, and explanations to justify their findings. If they successfully complete this project, they will be promoted to senior statistician. For this task the mathematics will be graded using a task specific rubric. During the completion of the task (1 day) students will also be graded using the critical-thinking rubric

(school wide).

Teacher notes:

- Process standards to highlight through instruction: reason abstractly and quantitatively, look for and express regularity in repeated reasoning, and look for and make use of structure.
- When finding limits, the method being used should be emphasized, either by table, graph or equation. Students must know all three methods
- Definition of continuity needs to be approached with concise and exact practice involving the limit from both sides as well as finding *f(a)*.
- Piecewise function graphing is a trouble spot for students when relating one-sided limits and continuity, and determining how to fix discontinuities.
- The Intermediate Value Theorem is a key idea that will recur throughout the course, especially during the completion of AP open-response problems.
- Honors level should review function characteristics and algebraic manipulation; AP students will complete a similar review as a summer assignment.

Windsor Public Schools
Curriculum Map
Calculus
Approved by BOE _____

Purpose of the Course: This is an introductory course in differential and integral calculus with strong emphasis on applications in the field of business, social science and life sciences. Topics covered include functions, limits, rates of change, differentiation, maxima and minima problems, integration techniques and applications. There is extensive use of the graphing calculator and other hands-on activities.

AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 2 Derivatives	Length of the unit: 12 blocks AB: 10 blocks BC: 7 blocks
Purpose of the Unit: In Unit 2 we develop "shortcut" methods to determine a derivative more efficiently than the cumbersome limit definition. These shortcut methods will help us to quickly find the equation of the tangent line, which is one of the big ideas of Calculus. Once the differentiation rules are solidified, we will begin to look at how the first, second and third derivatives can be applied to position, velocity and acceleration problems.	
Common Core State Standards Addressed in the unit: A-SSE.1 Interpret the structure of expressions. F-IF.4 Interpret functions that arise in applications in terms of the context.	

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.

F-IF.7 Analyze functions using different representations.

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

F-BF.3 Build new functions from existing functions.

F.BF.4 Find inverse functions.

N-Q.1 Reason quantitatively and use units to solve problems.

N-VM.3 Represent and model with vector quantities.

Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at:
http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf

Big Ideas:	Essential Questions:
1. Patterns can be used to develop differentiation rules. 2. A derivative is the slope of the tangent line to a curve and represents the instantaneous rate of change at the point of tangency. 3. Derivatives can be used to solve position, velocity and acceleration problems.	1. How are derivatives calculated most efficiently? 2. How is the equation of a tangent line determined, and what does it represent? 3. How do derivatives apply to position, velocity and acceleration?
Students will know:	Students will be able to:
1. derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions 2. derivative rules for sums, products, and quotients of functions 3. the chain rule and its relationship to composite functions 4. implicit differentiation and relevance to relations 5. derivative interpreted as an instantaneous rate of change 6. interpretation of the derivative as a rate of change in various applications, including velocity, speed, and	1. differentiate a variety of functions using derivative formulas 2. evaluate the derivative at a point and use it to find the equation of the tangent line 3. determine slope of a curve at a point 4. apply the chain rule to differentiate a variety of composite functions 5. calculate derivatives of relations using implicit differentiation 6. use the first, second, and third derivatives to solve position, velocity and acceleration problems 7. explain how vertical tangents, cusps, and discontinuities arise from

acceleration 7. points at which derivatives do not exist	derivatives that do not exist AP Extension (AB and BC): 8. use a tangent line to calculate an approximation of the derivative at a point 9. calculate the derivative of a function's inverse at a point

Significant task 1: Rules of Differentiation

In this task, students will learn various differentiation rules: Power, Product and Quotient, Trigonometric, and the derivative of *e*. The lesson for each will follow a similar format and will begin with students working in groups to discover the rule by identifying patterns. The whole class will formally establish the new rule and will practice its implementation using a variety of techniques including individual whiteboards, snake, jigsaw, and 'My Favorite No'. Throughout the task, students will also determine equations of tangent lines using the various rules. They are expected to interpret the meaning of the tangent line in multiple contexts and will communicate their understanding in a Microlab activity.

This task directly addresses the following standards: A-SSE.1, F-IF.4, F-BF.3

Timeline: 5-9 blocks
Key vocabulary: constant function, power function, normal line
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Derivatives

Significant task 2: Rules of Differentiation for Complex Functions

The instructor will prove the chain rule using the limit definition of a derivative. Next, as a whole class, students will work through example problems, and then practice skills individually. Emphasis is placed on identifying a variety of composite functions that require application of the chain rule. Whole class instruction is once again employed as students explore relations, such as circles, which are defined implicitly. Attempts to find derivatives of relations motivate the need for implicit differentiation. Students practice this skill in groups by finding equations of tangent lines using historically significant curves (e.g. the Witch of Agnesi). Students extend their understanding of implicit differentiation when working in pairs to find derivatives of inverse trigonometric functions (using Pythagorean identities) and logarithmic functions (using log rules).

This task directly addresses the following standards: A-SSE.1, F-IF.4, F-BF.3, F.BF.4

Timeline: 3 blocks
Key vocabulary: implicitly-defined function
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Calculus+units

Significant task 3: More Derivatives: First, Second and Third, oh my!

Students are introduced to solving Position, Velocity and Acceleration problems using Calculus. In the first activity, *Throwing a Book off a Cliff*, students analyze the motion of a Calculus textbook that is hurled up in the air, using the equation that models its height as a function of time. Next, we engage in a class discussion of terms such as velocity, acceleration, direction of travel, changing direction, displacement vs. total distance, speed vs. velocity, and maximum height. In pairs, students summarize their learning in an activity called '*Follow that Particle!*' by analyzing specific behavior of a moving particle.

A teacher-led discussion emphasizes the connections between the graphs of *f* and *f'*. In groups of three, students create graphs of *f'* based on a given graph of *f*. Then, students consider and peer-evaluate classmates' work on a gallery walk. A whole-class matching activity promotes conceptual understanding during wrap-up of the lesson.

This task directly addresses the following standards: F-IF.4, F-IF.6, F-IF.7, F.BF.1, N-Q.1, N-VM.3

Timeline: 2-5 days
Key vocabulary: position, velocity, acceleration, speed, direction, displacement
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Derivatives

Common learning experiences:

- chain rule video: http://www.brightstorm.com/math/calculus/techniques-of-differentiation/the-chain-rule/
- chain rule visuals:
  - http://webspace.ship.edu/msrenault/GeoGebraCalculus/derivative_intuitive_chain_rule.html
  - Alphahttp://demonstrations.wolfram.com/education.html?edutag=High+School+Calculus+and+Analytic+Geometry&limit=20
  - http://mathinsight.org/applet/chain_rule_multiply_slopes
- extra practice identifying *f, f'* and *f'':*
  - on-line practice matching: http://www.univie.ac.at/future.media/moe/tests/diff1/ablerkennen.html
  - handouts in Stewart's Calculus Instructor's Manual, chapter 3

Common assessments including the end of unit summative assessment:

- Unit 2 Test

Teacher notes:

- Process standards to highlight through instruction: reason abstractly and quantitatively,

construct viable arguments and critique the reasoning of others, use appropriate tools strategically, and attend to precision.

- Students struggle to identify the inside and outside functions when applying the chain rule to composite functions.
- Students will need to review trigonometric functions, inverse functions, and identities in order to develop conceptual understanding of related derivatives.

Windsor Public Schools
Curriculum Map
Calculus
Approved by BOE _____

Purpose of the Course: This is an introductory course in differential and integral calculus with strong emphasis on applications in the field of business, social science and life sciences. Topics covered include functions, limits, rates of change, differentiation, maxima and minima problems, integration techniques and applications. There is extensive use of the graphing calculator and other hands-on activities.

AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 3 Applications of Derivatives	Length of the unit: 14 blocks AB: 11 blocks BC: 7 blocks

Purpose of the Unit: Derivatives provide abundant data about functional relationships. This unit develops knowledge and skills from Units 1 and 2 to demonstrate the relevance and importance of derivatives. Activities emphasize problem-solving in the natural and social sciences involving quantities that are changing. Both fields require relevant and accurate data in order to progress. Derivatives allow individuals to analyze existing data using multiple representations, calculate optimal values, and predict future outcomes with accuracy and precision.

Common Core State Standards Addressed in the unit:

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.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.

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.

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.

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

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

F.TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

G.SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Note: The above standards are applied to functions and their first and second derivative functions. Thus, one or more of the quantities represented may describe a rate, or a value that is changing with respect to time (e.g. the angle of elevation in a right triangle or the radius of a sphere).

Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at: http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf

Big Ideas:	Essential Questions:
1. Problems involving rates of change where more than one quantity varies can be solved by using derivatives 2. Characteristics of graphs can be determined using several techniques of Calculus 3. Calculus can be used to find the optimal value in a practical problem	1. How can derivative functions be used to solve problems that involve multiple changing quantities? 2. How do the first and second derivatives of a function correspond to key characteristics of the graph? 3. How can the optimal value of a function be calculated and why is it important?
Students will know:	Students will be able to:
1. relationship between the increasing and decreasing behavior of f and the sign of f' 2. relationship between the concavity of f and the sign of f" 3. points of inflection occur where concavity changes	1. differentiate common formulas to solve problems involving multiple changing quantities with respect to time 2. calculate absolute maximum and absolute minimum values of a function using the first derivative

4. the first and second derivatives of a function correspond to specific characteristics of the graph of the function. 5. the geometric interpretation of the Mean Value Theorem 6. L'Hôpital's (L'Hospital's) Rule for determining limits	3. determine critical values of a function and use them to determine local maximums and local minimums of a function 4. determine characteristics of *f* indicated by *f'* and *f"* and use them to create the graph of *f* 5. solve problems using the Mean Value Theorem 6. calculate the optimal value of a quantitative relationship to solve problems in context

Significant task 1: Related Rates

Students begin this unit by working in pairs to consider a ladder sliding down a wall. Given how fast the bottom of the ladder is sliding away from the wall, students must determine how fast the top of the ladder is sliding down the wall, at the instant that the bottom is six feet from the wall. The conceptual knowledge that they build is then carried forward to related rates problem-solving. Students analyze problems to determine quantities that are changing and those that are not. They create a labeled diagram, identify the equation that relates quantities, substitute constant value(s), differentiate the equation, substitute remaining known quantities, and solve for the unknown quantity. Since this is a complex process, students practice requisite skills using various techniques, such as error analysis, matching, and experimentation. They conclude the task with a project that requires each student to create an interesting related rates problem that a fellow classmate will solve.

This task directly targets the following standards: A.CED.4, F.IF.6, F.BF.1, F.TF.5, G.SRT.8

Timeline: 3 – 5 blocks
Key vocabulary: marginal cost, marginal revenue, cost function, profit function, demand or price function
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Derivatives, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 3

Significant task 2: Curve Sketching including MVT and L'Hôpital's Rule

Significant task 2 involves comprehensive analysis of functions using various representations. In Algebra 2, students identified characteristics that described the behavior of functions and key points, such as intercepts. Students now extend this knowledge to find these items algebraically and verify them with graphs. They reveal what *f'* and *f"* indicate about *f.* This section is mostly skills-based and gives students another opportunity to refine their algebraic skills. They practice these skills using a

variety of methods such as matching activities, analysis of various representations, and graphic organizers (e.g. sign chart and web). The MVT is used to determine whether or not a car was speeding, and L'Hôpital's Rule is used to determine limits of indeterminate ratios, products, differences and powers involving 0 and ∞.

This task directly targets the following standards: F.IF.4, F.IF.7, F.IF.8,

Timeline: 3 – 5 blocks
Key vocabulary: increasing, decreasing, local/relative extrema, absolute/global extrema, maximum, minimum, critical number, concave up, concave down, inflection point, optimization, indeterminate form
Resources: Teacher created resources – see Calculus Resource Folder, The Manga Guide to Calculus, activities from http://designatedderiver.wikispaces.com/Derivatives, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 4

Significant task 3: Optimization

Significant task 3 requires similar reasoning as in significant task 1, which is demonstrated by an introductory whole class example. Then, in groups, students must solve problems using various techniques. Overall, they must be sure to determine variables and equations to relate quantities and then apply strategies learned in significant task 2 to identify optimal values. Various problem solving strategies include, sketching a diagram, identifying appropriate formula(s), and solving systems by substitution.

This task directly targets the following standards: A.CED.4

Timeline: 3 – 5 blocks
Key vocabulary: maximum profit
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Derivatives, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 4

Common learning experiences:

- Graphic organizers for curve sketching.
- Animation for sliding ladder: http://www2.seminolestate.edu/lvosbury/calculusI_folder/RelatedRateProblems.htm
- Additional curve sketch and derivative matching activities may be selected as needed from: http://designatedderiver.wikispaces.com/Derivatives
- The Manga Guide to Calculus merges technical content with the Japanese comic genre, and explains concepts from the perspective of Noriko, who "is just getting

started as a junior reporter for the *Asagake Times."* Excerpts from the *Mean Value Theorem* chapter give students a different way of viewing calculus and stress the relevance of concepts that might otherwise be elusive.

Common assessments including the end of unit summative assessment:

- Unit 3 Test
  - Performance Assessment: Financial Advisor Students become financial advisors as they determine when it is best to sell the baseball card, based on several parameters their client has given them. These include the current value of the card and the predicted retirement age. Findings will be presented in a report that includes options and recommendations. Visual representations of relevant data are necessary to communicate mathematical data to non-mathematical clients. For this task, the mathematics will be graded using a task specific rubric. During the completion of the task (1 day) students will also be graded using the critical-thinking rubric (school wide).

Teacher notes:

- Process standards to highlight through instruction: Make sense of problems and persevere in solving them, reason abstractly and quantitatively, model with mathematics, and attend to precision.
- When solving related rates problems, students often struggle with notation for variables that are constant and those that change, and with notation for derivatives. Also, they tend to substitute values in equation(s) prior to differentiation. For example, for the sliding ladder problem, the length of the ladder does not change and should be entered into the original equation, but the distances of the ladder from the wall and from the ground do change and should be substituted only after differentiation.
- Students struggle to identify increasing and decreasing intervals vs positive and negative intervals.

Windsor Public Schools
Curriculum Map
Calculus
Approved by BOE _____

Purpose of the Course: This is an introductory course in differential and integral calculus with strong emphasis on applications in the field of business, social science and life sciences. Topics covered include functions, limits, rates of change, differentiation, maxima and minima problems, integration techniques and applications. There is extensive use of the graphing calculator and other hands-on activities.

AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 4 Integrals	Length of the unit: 12 blocks AB: 9 blocks BC: 7 blocks
Purpose of the Unit: This unit is exciting because students learn the other branch of calculus, integral, and they connect both branches with the Fundamental Theorem of Calculus. They use their knowledge of inverses to reveal differentiation and integration as inverse processes. Just as they developed an understanding of slope and derivative as the rate of change of a quantity (e.g. velocity is the gradient of distance as a function of time), students determine quantities that are accumulated, as the independent variable changes, by calculating the area under the curve over an interval. Integration, as differentiation, employs limits to determine exact integral values.	
Common Core State Standards Addressed in the unit: A-SSE.1 Interpret the structure of expressions. F-IF.4 Interpret functions that arise in applications in terms of the context. F-BF.3 Build new functions from existing functions. F.BF.4 Find inverse functions. N-Q.1 Reason quantitatively and use units to solve problems. N-VM.3 Represent and model with vector quantities. G.MG.1 Use geometric shapes, their measures, and their properties to describe objects. G.MG.2 Apply concepts of density based on area and volume in modeling situations. G.MG.3 Apply geometric methods to solve design problems. Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at: http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf	
Big Ideas: 1. Integrals represent the area under a curve and can be estimated using Riemann Sums. 2. Differentiation and integration are inverse processes. 3. Integration can be used to find net	Essential Questions: 1. What is an integral and why is it important? 2. What is a Riemann Sum? 3. What is net change and how is it calculated? 4. How are derivatives and integrals

change of a quantity over a specific interval. 4. The derivative, or rate of change for a quantity, can be used to determine how much is accumulated over an interval. For example, as water flows, volume is accumulated; the net change in linear density of a rod over an interval represents the mass of the rod.	related?
Students will know: 1. the anti-derivatives that follow directly from derivatives of basic functions 2. properties of definite integrals 3. the area under a curve can be estimated using areas of geometric figures 4. a definite integral is a number and an indefinite integral is a function (or family of functions) 5. displacement vs total distance and the use of absolute value of integrals	Students will be able to: 1. integrate functions using techniques of anti-differentiation, including substitution for composite functions 2. approximate the value of a definite integral using Riemann and trapezoidal sums when functions are represented algebraically, graphically, or numerically 3. use the Fundamental Theorem to find both general and particular solutions of definite integrals 4. calculate net change using Fundamental Theorem AB and BC: 5. anti-derivatives by substitution of variables (including change of limits for definite integrals) 6. use the Fundamental Theorem of Calculus to determine the derivative of an integral BC only: 7. integrate by parts, and simple partial fractions (non-repeating linear factors only 8. improper integrals as limits of definite integrals

Significant task 1: Area under the Curve

Significant task 1 begins with an exploration activity in which students work in pairs to "undo" a derivative, and discover an anti-derivative. After generalizing the patterns in their calculations, students uncover the power rule of integration. Students practice finding anti-derivatives by going backwards from the derivative rules, and find that determining the constant for an anti-derivative is impossible. Representing the constant as " $+ C$ ", students can easily identify the anti-derivative as a family of functions differing only by a vertical shift. Also, students recognize anti-derivatives as inverses of derivatives. Students practice calculating indefinite integrals in a whole class activity.

Next, students approximate the area under a curve using the method of their choice. This concept is formalized through direct instruction on Riemann Sums, including discussion around the limiting process that allows for the exact calculation of area. These two concepts (anti-derivative and area under the curve) are connected as students practice making left-, right-, and midpoint-rectangles to estimate area under the curve. Using Calculus in Motion, students soon realize that the more rectangles, the more accurate their estimation. The number of rectangles is increased infinitely using the limiting process. The integral is defined and definite integrals calculated.

This task directly targets the following standards: A-SSE.1, F-IF.7, G.MG.1,

Timeline: 4 – 6 blocks
Key vocabulary: inverse, accumulation, integral, net change, indefinite integral, definite integral
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Derivatives, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 5

Significant task 2: The Fundamental Theorem of Calculus

In significant task 2, students connect the concept of an anti-derivative and the area under a curve with the Fundamental Theorem of Calculus (FTC) - net change yields the accumulated value resulting from a changing quantity. An indefinite integral is a function defined to calculate the definite integral, or accumulation of values, for a specific interval. U-substitution is used to integrate composite functions ("inverse" of chain rule). Working in groups, students solve a variety of problems selected to promote conceptual understanding through practice of key skills.

This task directly targets the following standards: F-IF.4, F.BF.1, F-BF.3, F.BF.4

Timeline: 4 – 6 blocks
Key vocabulary: anti derivative, limits of integration, definite integral
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Derivatives, AP Calculus release items, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 5

Extension Task: Integration by partial fractions (BC only), parts(BC only), and substitution with change of limits (AB & BC)

In groups, students will combine the two previous skills of partial fraction decomposition (non-repeated linear term only) and integration of natural logs to find the integrals of rational functions that are otherwise impossible to integrate. Integration by parts will be derived as the inverse of the product rule and then applied to several examples that the students complete in pairs. Lastly, students will explore integration by substitution further in a self-guided activity by determining how to evaluate a definite integral when the limits are in terms of u and not x.

This task directly targets the following standards: F-IF.4, F.BF.1, F-BF.3, F.BF.4

Timeline: 4 – 6 blocks
Key vocabulary: partial fraction decomposition, repeated linear terms, parts
Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com/Derivatives, AP Calculus release items, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 5

Common learning experiences:

- Calculus in Motion – geometer's sketchpad provides students with visual representations of FTC and Riemann Sums
- Practice evaluating integrals in an activity known as SNAKE, or the card-shuffle.
- Area and accumulation activities from: http://www.nms.org/ (National Math and Science Initiative)

Common assessments including the end of unit summative assessment:

- Unit 4 test

Teacher notes:

- Process standards to highlight through instruction: attend to precision, look for and make use of structure, and look for and express regularity in repeated reasoning.
- Honors students need additional instruction and practice to conclude that left-rectangles and right-rectangles correspond directly to the beginning and end of an interval, respectively.
- Honors students practice u-substitution, but are not assessed on changing limits for definite integrals

Windsor Public Schools
Curriculum Map
Calculus
Approved by BOE _____

Purpose of the Course: This is an introductory course in differential and integral calculus with strong emphasis on applications in the field of business, social science and life sciences. Topics covered include functions, limits, rates of change, differentiation, maxima and minima problems, integration techniques and applications. There is extensive use of the graphing calculator and other hands-on activities. AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 5 Applications of Integration	Length of the unit: 12 blocks AB: 8 blocks BC: 6 blocks
Purpose of the Unit: Integrals can be used to find the area of irregular shapes, the volume of irregular solids, and the work done by varying forces. Area, volume, and work can be divided into smaller parts and estimated using Riemann Sums. The limit process gives us the exact value, or the integral, which is evaluated using the Fundamental Theorem of Calculus.	
Common Core State Standards Addressed in the unit: 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. 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. F.BF.1 Write a function that describes a relationship between two quantities. 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).	

Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at: http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf

Big Ideas:	Essential Questions:
6. Irregular shapes can be analyzed by graphing functions that represent the figure. 7. Irregular solids can be represented by two-dimensional figures that are rotated around an axis. 8. Integrals can be used to solve problems involving area, velocity, acceleration, and volume of a solid.	1. How can the area of irregular shapes be calculated? 2. How can the volume of irregular solids be calculated? 3. How are integrals used to model problems in the natural and social sciences?
Students will know: 1. interpretations and properties of definite integrals	Students will be able to: 1. use appropriate integrals to model and solve a variety of problems in the natural and social sciences 2. calculate the following: a. area of a region b. volume of a solid with circular cross sections c. volume of a solid with known cross sections that are not circular d. average value of a function e. distance traveled by a particle along a line, and f. accumulated change from a rate of change 3. determine the average value of a function using integrals

Significant task 1: Area

In significant task 1, students visualize irregular shapes as a figure formed by the graphs of two different functions. Working in pairs, students will begin by graphing two curves and calculating the net area and the total area between the curves.

This task directly targets the following standards: G.GMD.4, F.IF.7, F.BF.1, G.MG.1

Timeline: 1-2 days
Key vocabulary: total area, area
Resources: Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 6

Significant task 2: Finding volume

In this task students are introduced to solids formed by revolving an area around a given axis of rotation. To visualize this, a model example of a radical function revolved around the x axis is represented by cookies of varying diameters. From this representation and a Calculus in Motion diagram, the class as a whole develops a formula to find the volume of a 3D object using the disc method. Students will then work in groups of three to complete more examples that have slight differences including rotating around the y-axis, the line y=a and the line x=a. Using a similar method, the class will find the volume of a bundt cake to understand the concept of finding volumes by cylindrical shells. Students will again master this skill by working through examples that have varying parameters. Finally, students will find the volume of objects that do not have rotational symmetry but have cross-sections that are defined by one or more functions.

This task directly targets the following standards: G.MG.1, G.MG.2, G.MG.3, F.IF.7, F.BF.1

Timeline: 7 days

Key vocabulary: disk method, washer method, cylindrical shells, cross-sectional area

Resources: Resources: Teacher created resources – see Calculus Resource Folder, activities from http://designatedderiver.wikispaces.com, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 6

Common learning experiences:

- Alphabet rotations provide great prompts for visualizing solids of revolution: http://universrevolved.com/1.The%203-D%20Alphabet/1.alphabetframeset.htm
- solids formed by revolution via videos found on:
- http://designatedderiver.wikispaces.com.
- Calculus in Motion – Geometer's Sketchpad

Common assessments including the end of unit summative assessment:

- Unit 5 test
- Performance Assessment: Volume and Rotational Symmetry In this assessment students work individually to find the volume of an object that has rotational symmetry. To complete this task they will take a picture of the

object, overlay cm graph paper, and find a function to fit the curve using regression. Then they will use the skills from Significant Task #2 to calculate the volume of the object and apply a scale factor to arrive at a calculated volume. Students will finally find the exact volume of their object by submersion and compare it to their calculated volume. A science fair set up of these projects will afford students the opportunity to view the work of their peers. Students will be graded on a rubric specifically tailored to the task that evaluates the precision of measurements and calculations, as well as the business quality of their graphs.

Teacher notes:

- Process standards to highlight through instruction: attend to precision, model with mathematics and use appropriate tools strategically.
- If students have trouble visualizing the 3-dimesional objects, videos and Calculus in Motion can be used
- Students often mistake volume by washers as $\int_a^b \pi(R-r)^2\,dx$

Windsor Public Schools
Curriculum Map
Calculus
Approved by BOE _____

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AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 6 Differential Equations and Slope Fields	Length of the unit: AB: 6 blocks BC: 4 blocks
Purpose of the Unit: This unit will use integration to solve an equation that is in differential form. There are many rich applications of this technique including Newton's Law of Cooling and exponential population growth.	
Common Core State Standards Addressed in the unit:	

A-SSE.3 Write expressions in equivalent forms to solve problems.

A-SSE.2 Use the structure of an expression to identify ways to rewrite it.

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).

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

Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at: http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf

Big Ideas:	Essential Questions:
1. Some differential equations can be solved using integration. 2. Slope Fields are a visual representation of many solutions to a differential equation.	1. What manipulation of a differential equation is used to create a more useful form? 2. What is a slope field and why is it useful?
Students will know: 1. geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential BC Extension 2. numerical solution of differential equations using Euler's method equations	Students will be able to: 1. find both general and particular solutions to separable differential equations 2. use particular solutions of differential equations to solve application problems (including the study of the equation y = ky and exponential growth)

Significant task 1: Solving Differential Equations

A whole class discussion will motivate the work we will do to solve differential equations. This discussion will include examples of differential equations that model population growth and temperature change as items cool. Contextual examples will include writing the differential equations from a word problem. Together, we will solve a differential equation that models population growth to yield an equation the gives population as a function of time. In groups, students will review techniques of integration while they work together to solve separated differential equations. Next, as a class, we will discover how to use algebraic manipulation to create a separated differential equation. Finally, by direct instruction, the teacher will show how to find a particular solution of a differential equation. Individually, students will practice how to concisely find a particular solution to a given differential equation.

This task directly targets the following Common Core Standards: A-SSE.2, A-SSE.3, F.BF.1

Timeline: 2-4 blocks
Key vocabulary: differential equations, general and particular solutions, separable and non-separable differential equations
Resources: Teacher created resources – see Calculus Resource Folder, Released AP Open Response questions, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 9

Significant task 2: Slope Fields

A whole class discussion based on non-separable differential equations will motivate the use of slope fields as a graphical approach to the solution. In pairs, students will create several slope fields by hand. Next, they will input a slope field program into their graphing calculators that will create slope fields for them. Finally, students will individually complete AP open response question #5 from 2008 and then check answers amongst each other.

BC extension: Using Calculus in Motion, the teacher will determine an approximate solution graphically and algebraically using Euler's method. Students will develop an algorithm that will allow them to quickly calculate many iterations of Euler's method. Students will also complete an extension to 2008 #5 to reinforce understanding.

This task directly targets the following Common Core Standards: A.REI.10

Timeline: 1-2 blocks
Key vocabulary: slope field, solution curve
Resources: Teacher created resources – see Calculus Resource Folder, Released AP Open Response questions, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 9

Common learning experiences:

- Solving Differential Equations Problems in context
- Graphing Calculator Slope-Field Calculator
- Calculus in Motion-Euler's Method

Common assessments including the end of unit summative assessment:

- Unit 6 Test
- Performance Assessment: How Fast Does a Tank Drain?: Students will work in groups of 3 to determine how long it takes to drain a tank. The flow rate is not consistent and so through the application of Torricelli's Law students will calculate various flow rates at different times. Then, they will time the draining

of a 2 liter bottle and compare their actual times with those that Torcelli's Law predicted. Further analysis will introduce students to sprinkler system pressure and tanks that are not shaped as cylinders. Students will produce a business quality report representing their findings. During the completion of this task, (3 days) students will be graded using the collaboration rubric (school wide).

Teacher notes:

- Process standards to highlight through instruction: look for and express regularity in repeated reasoning, and look for make use of structure, and model with mathematics.
- When separating differential equations students often make mistakes when algebraically manipulating the parts. (e.g. disregarding the distributive property)
- Differential Equations whose particular solutions involve *ln* (and therefore a domain restriction) must be practiced for concise yet thorough solutions.
- Emphasize that a curve drawn on slope fields is the solution to the differential equation.

Windsor Public Schools
Curriculum Map
Calculus
Approved by BOE _____

Purpose of the Course: This is an introductory course in differential and integral calculus with strong emphasis on applications in the field of business, social science and life sciences. Topics covered include functions, limits, rates of change, differentiation, maxima and minima problems, integration techniques and applications. There is extensive use of the graphing calculator and other hands-on activities.

AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 7 Series and Sequences (BC only)	Length of the unit: 12 blocks
Purpose of the Unit: Functions can be represented by the sum of an infinite series. This is very helpful when working with functions such as e^{-x^2} that cannot otherwise be integrated. There are many functions in the study of Chemistry and Physics that are defined as the sum of a series and so familiarity with the ideas of convergence is important.	
Common Core State Standards Addressed in the unit: 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.	

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

Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at:
http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf

Big Ideas:	Essential Questions:
1. A sequence, and therefore a series can diverge or converge. 2. Functions can be represented as a power series. 3. Power series can be manipulated just as functions can be.	1. When is a series convergent or divergent? 2. Why are power series useful? 3. How are functions manipulated to represent infinite series?
Students will know: 1. series is defined as a sequence of partial sums, and convergence is defined in terms of the limit of the sequence of partial sums 2. properties of geometric series 3. properties of the harmonic series 4. properties of alternating series with error bound 5. the integral test, its derivation, and its use in testing the convergence of p-series 6. the ratio test for convergence and divergence 7. the comparison tests for convergence or divergence 8. Taylor polynomial approximation with Maclaurin series and the general Taylor series centered at x = a 9. Maclaurin series for the functions e^x, $\sin(x)$, $\cos(x)$, and $\frac{1}{1-x}$ 10. radius and interval of convergence of power series 11. Lagrange error bound for Taylor polynomials	Students will be able to: 1. demonstrate understanding of L'Hôpital's (L'Hospital's) Rule, including its use in determining limits and convergence of improper integrals and series 2. approximate polynomials using infinite series 3. use technology to show a graphical demonstration of convergence or divergence (for example, viewing graphs of various Taylor polynomials of the sine function approximating the sine curve) 4. create a Taylor series to represent a specific function 5. manipulate Taylor series and use shortcuts to compute another Taylor series, including substitution, differentiation, anti-differentiation, and the formation of new series from known series

Significant task 1: Testing for convergence and divergence

This significant task involves students discovering various tests for the convergence or divergence of an infinite series. These include the integral test, comparison tests, alternating series tests, ratio, and root tests. In groups, students will practice the implementation of the various tests. Ultimately, students will apply this knowledge to find the interval of convergence of a series algebraically as well as interpret it graphically. A whole-class matching activity promotes conceptual understanding during wrap-up of the lesson.

This task directly addresses the following standards: This task goes beyond the CCSS standards and is aligned to AP defined knowledge and skills.

Timeline: 5 days

Key vocabulary: convergence, divergence, sequence, series, power series

Resources: Teacher created resources – see Calculus Resource Folder, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 11

Significant task 2: Taylor and Maclaurin series

This significant task involves a teacher demonstration of the development of the general Taylor Polynomial. Once the formula has been determined, the class, working in pairs will develop the Taylor polynomials for $\sin x$, $\cos x$, e^x, and $\frac{1}{1-x}$. These will be presented to the rest of the class for eventual memorization. Further exploration will include manipulating the polynomials using substitution to represent other functions and also integration and differentiation of various Taylor Series. For these skills, students will take part in a class discussion of one example and then master the ideas by working in smaller groups on past AP questions.

This task directly addresses the following standards: F.BF.1, F.IF.7, F.IF.8

Timeline: 5 days

Key vocabulary: Taylor Series, Maclaurin Series, Interval of convergence

Resources: Teacher created resources – see Calculus Resource Folder, Released AP Open Response questions, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 11

Common learning experiences:

- Students will use TI graphing calculators to plot Taylor polynomials vs. the original function to help visualize intervals of convergence.

- A flowchart of the various convergence tests will be created for reference with homework exercises but not for use on quizzes or tests.

Common assessments including the end of unit summative assessment:

- Unit 7 Test
- Performance Assessment: Radiation from the Stars: Students will work as a whole class or two large groups to determine a Taylor Polynomial approximation for Plank's Law which tells how much radiation is given off from a blackbody based on the wavelength of the radiation being emitted. The Taylor polynomial will then be graphed and used to determine the value of the wavelength that creates a maximum under Plank's Law. Individually, students will research a blackbody of their choice and determine the total radiation that is emitted from that star using the maximum wavelength that was earlier determined. A small presentation to the class will outline their individual discoveries and then the class as a whole will determine how the total radiation emitted varies as the temperature of the star changes. For this task the mathematics will be graded using a task specific rubric. Their individual work will be graded using the Effective Communication rubric (school wide).

Teacher notes:

- Process standards to highlight through instruction: make sense of problems and persevere in solving them, reason abstractly and quantitatively, use appropriate tools strategically, and look for and make use of structure.
- This unit is the most conceptual in the curriculum. Time should be taken in the beginning to ensure students have internalized the differences between a series and a sequence as well as divergence and convergence.
- Notation can be confusing in this unit. Some students will create incorrect Taylor polynomials based on misunderstandings of the notations of the formula.

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AP Extension: Additional topics to be covered include: volumes of revolution; differential equations and slope fields; series and sequences (BC only); and polar, parametric and vector functions (BC only).

Name of the Unit: Unit 8 Polar, Parametric and Vector Functions	Length of the unit: 5 blocks
Purpose of the Unit: Some curves are best described using parametric or polar equations rather than forcing them to be functions or relations involving x as the independent variable. Parametric and polar equations can also be differentiated and then interpreted into meaningful applications such as velocity, acceleration and speed.	
Common Core State Standards Addressed in the unit: 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. 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. F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. F.TF.3 Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosines, and tangent for x, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number. Knowledge and skills, found below, are adapted from the AP Central curriculum guide for AP Calculus, which can be found at: http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf	
Big Ideas: 1. Polar and parametric curves can be differentiated.	Essential Questions: 1. How can polar and parametric functions be differentiated?
Students will know: 1. ways to convert from polar to Cartesian coordinates 2. derivatives of parametric, and polar functions	Students will be able to: 1. graph planar curves given in polar form 2. interpret derivatives of parametric and polar functions in various applications

	3. calculate the area of a polar curve

Significant task 1: Polar Curves
In groups, students will review the unit circle and how to graph polar curves on a polar coordinate plane by hand. In a class discussion, the formula for the area of a polar curve will be developed using proportions. In pairs, students will find the area between two polar curves, calculating the integrals using a calculator. Polar arc length will demonstrated as an extension of the Pythagorean Theorem and the class will practice together on an example that ties together polar differentiation by including Cartesian conversions, velocity and arc length. Individual students will then complete several released AP practice items on this topic.

This task directly targets the following standards: F.IF.4, F.IF.7, F.TF.1, F.TF.3

Timeline: 2 days

Key vocabulary: radius, Cartesian, arc length

Resources: Teacher created resources – see Calculus Resource Folder, Released AP questions, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 10

Significant task 2: Parametrics and their derivatives

Significant task 2 involves a whole class analysis of position, velocity, acceleration, speed and total distance in terms of parametric equations. After the class discussion, students will complete activities in pairs that contain various parametric equations as a position function or the velocity function. As a summary, the class will compare and contrast the processes used in one activity versus another activity to deepen their understanding of the nuances that can occur.

This task directly targets the following standards: This task goes beyond the CCSS standards and is aligned to AP defined knowledge and skills.

Timeline: 3 days

Key vocabulary: speed, total distance, velocity, position

Resources: Teacher created resources – see Calculus Resource Folder, Released AP questions, James Stewart, *Calculus: Single Variable; Early Transcendentals* (Brooks/Cole, 2010), Chapter 10

Common learning experiences:

- Graphing Calculator Activities in polar and parametric mode
- Investigate the structure of cartioids and roses

Common assessments including the end of unit summative assessment:

- Unit 8 Quiz

Teacher notes:

- Process standards to highlight through instruction: model with mathematics and look for and make use of structure.
- Students' experience with polar and parametric equations can vary greatly depending on prior courses in Physics and Pre-Calculus. It can be helpful for knowledgeable students to be presenters of review information such as how to graph in polar coordinates.
- Students often struggle with determining the limits of an integral that is used to find the area of a polar curve or area between 2 polar curves.
- Attention should be paid to variables to give hints as to if the function is Cartesian (in terms of x), polar (in terms of θ) or parametric (in terms of t).