Windsor BOE Curriculum Committee

Tuesday, November 6, 2012 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. **University of Buffalo, Case Studies PD**
3. **Curriculum Development Update**
4. **Proposed Program of Studies**
5. **Adjournment**

What is a Case?

Bringing to Science Education the Established Teaching Tool of Law and Medicine

Clyde Freeman Herreid

The following article by Clyde Freeman Herreid, Distinguished Teaching Professor of Biological Sciences at SUNY-Buffalo, is the first in a series of articles to be published in this new JCST department, "The Case Study." The column will examine the case study method, now an established and successful method of teaching science.

The first sign that a baby is going to be a human being and not a noisy pet comes when he begins naming the world and demanding the stories that connect its parts. Once he knows the first of these he will instruct his teddy bear, enforce his world view on victims in the sandlot, tell himself stories of what he is doing as he plays and forecast stories of what he will do when he grows up. He will keep track of the actions of others and relate deviations to the person in charge. He will want a story at bedtime.

Kathryn Morton

Cases are stories with a message. They are not simply narratives for entertainment. They are stories to educate.

Humans are story-telling animals. Consequently, the use of cases gives a teacher an immediate advantage; he has the attention of the audience.

The best way to start this column is with a glance at the history of case study teaching in academia. I do not propose to start with *Homo erectus* in my search for the origin of cases, but you can be sure that those of us interested in historical antecedents and animal behavior might pick up the elements of story telling even in bee hives, where workers return from their flower hunts and dance out messages to their apian colleagues. Avoiding such temptations, I leap ahead to Harvard Law School at the turn of the twentieth century, where the formal use of cases entered the academic scene. I am helped in my historical musings by a 1991 article by Katherine Merseth, "The Case for Cases in Teacher Education," an AAHE publication.

Law as a discipline is essentially composed of criminal and civil cases. New decisions, new cases, and new laws are built upon old decisions. Students learning the profession must study the cases of the past and use them as examples of judicial reasoning.

Students come to appreciate that there is a correct answer to many of the cases they see in the classroom. Socratic interrogation, as seen in the popular movie and television series, "The Paper Chase," is a common method of instruction. We witness Professor Kingsfield leading, nay browbeating, his law students through cases leading to predetermined correct answers. The cases are closed ended.

The use of the case method in medicine is not much different. The life of a physician is nothing if not a succession of cases—particular examples of general physiological systems gone awry. His job is to reason deductively from general principles to reach the solution of a particular problem. Correct diagnoses exist and "woe be unto you" (and lawsuits) if you make mistakes.

Modern medical education in the United States prepares students for their awesome responsibilities by having them spend two years taking basic courses in anatomy, physiology, embryology, and biochemistry before unleashing them into the clinical setting where they are allowed contact with patients. Recently, a couple dozen medical schools have revolutionized their curricula and set up physician education completely around the study of cases. Small groups of students and faculty tutors work through one case after another as they learn about medicine. This is the Problem-Based Learning Curriculum pioneered by McMaster University in Canada.

Thus, in both medicine and law, cases are real stories dealing with people in trouble. Students attempt to figure out what went wrong and how to fix it. The cases are chosen because they serve to illustrate general principles and good practices; correct answers and facts have a high priority.

In the 1940s, after the ravages of World War II, chemist James Conant returned from the Manhattan Project to life as a professor at Harvard convinced that our educational system in the sciences was flawed. He realized

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that laymen and politicians did not understand how scientific discoveries were made. Determined to correct this academic oversight, Conant began what he called "case study teaching" using the lecture method.

Conant would take an important historical event such as the discovery of oxygen and the overthrow of the phlogiston theory and painstakingly describe the steps and misadventures of the protagonists in the setting of the time. His book, *On Understanding Science,* describes his case method as he reveals scientists in action, following false leads, stumbling upon correct ideas, having brilliant insights one minute and making stupid errors the next, and serendipity always popping up unexpectedly.

Once again, cases are real stories—examples for us to study and appreciate, if not emulate. Facts and principles have importance but the value of the case is to show great scientists in action. Since these are historical lessons, the student is not an active puzzle solver but an observer of human nature. The instructor is a story teller. The student is the audience.

At the other end of the spectrum, we have the cases used in business schools. Harvard professors introduced cases for the first time to give students practical experience for use in the real world. For instance, businessmen were invited into the classroom to tell students about actual problems. The students held discussions and offered solutions, thus the start of "The Case Method." It has become a model that is emulated across the world with thousands of cases now offered for sale. A typical business case may devote fifteen pages plus appendices documenting a business dilemma (*e.g.*, a marketing decision by Coca Cola to change its classic formula). The student would be expected to prepare for the class discussion by closely analyzing the background data leading to the decision. The class would then discuss the case in an organized way with the instructor moving through various critical topics as he outlined the problem on the board with help from the students.

Business cases employed in today's classrooms are real and told in narrative form. Instructors give the cases to the students in an incomplete state, and have the class analyze and discuss them to determine what action should be taken. Like cases in medicine they are puzzles to be solved, but unlike the latter there is no predetermined correct answer. The purpose of the method is to produce managers who both know and act. Harvard business school professor C. Roland Christensen states: "When successful, the case method of instruction produces a manager grounded in theory and abstract knowledge, and more important, able to apply those elements." Cases allow the student to deal with situation-specific dilemmas. Consequently, a business school instructor never expects a discussion to go the same way twice; there are always novelties and unexpected turns in the conversation.

Two characteristics distinguish the use of cases in law (and medicine) from business, according to Merseth. The first is that law and medical practice depend upon a well-defined knowledge base as a starting point whereas in business much of the knowledge is in flux. Conditions are always changing in the business environment. Second, business education stresses the human condition and the subjective view.

According to Christensen, "any problem may well be understood differently by individuals and groups and that perception changes." In law and medicine, deductive logic and lines of precedent make the individual or specific context of a case less compelling. Merseth concludes "to a remarkable extent, the purposes and uses of the case method turn on the nature of the body of knowledge that exists in the professional field."

Given this historical preamble, what can we say in summary? First, it is evident that in all instances cases are stories, usually real stories. Second, it is evident that teachers using cases are not all delivering these stories the same way. There is no "case method" (except perhaps in business). Conant used cases with the lecture method. Law school teachers use Socratic questioning. Business school instructors use discussion leading. Medical school tutors use small group cooperative learning called problem-based learning. Third, the subject matter definitely determines the nature of the cases and their expected conclusions. Some cases (and perhaps the method of teaching) are fact driven and deductive, *i.e.*, there is a correct answer. Other cases are context driven, *i.e.*, multiple solutions are reasonable. The best answer depends upon the situation at the moment.

Humans are story-telling animals. Thus, the teacher using the case method has an immediate advantage. It is the advantage of gaining the attention of the audience.

Depending upon the case, instructors might employ different types of teaching methods. So where does this leave us on the matter of using cases in science? My answer is that we are in the catbird seat.

Science is a body of facts, concepts, principles, and paradigms that forms the core of scientific knowledge. This is textbook science. We want our students to know a substantial amount of information, such as how the heart works, the definition of the Second Law of Thermodynamics, what pH is, the concept of Plate Tectonics, and so on. Instructors traditionally teach these subjects through lecture and need substantial work and creativity to come up with cases dealing with these scientific topics.

On the surface, the situation appears to demand closed-ended cases with correct answers. This is not necessarily the case. Instead, many fact-driven cases are open-ended and have multiple solutions because the data are inadequate or emotions are involved, and ethical or political decisions are at stake. Consider, for example, a case involving a mother trying to decide whether to enroll her child in an experimental program to cure a genetic disorder such as muscular dystrophy. Or think about cases involving government decisions on global warming, pollution control, human cloning, or NASA space probe funding to find life on Mars. All such cases can be loaded with facts but many of the decisions to be made are necessarily open ended. Moreover, all cutting edge science, "frontier science," is necessarily contentious. Science philosopher Stephen Cole put it this way: "In frontier knowledge different scientists looking at the same empirical evidence can reach different conclusions. Frontier knowledge is accepted by scientists not as true but as claims to truth of particular scientists." So all kinds of case structures should be available to us depending upon the goals at the moment.

Personally, I feel liberated knowing that I do not have to conform to a particular method or someone else's vision about what a case is. Nor do I feel obligated in any way to always use cases in my teaching. Surely there are moments when the standard lecture approach is appropriate, inspirational, and superior to other methods. Surely it makes sense to mix and match our teaching techniques to reach the best arrangement possible. Using cases is simply another arrow in our pedagogical quiver. But when we do choose to use cases, we are responding to the child in all of us, who once demanded there be heroes and heroines and mysteries galore in our stories at bedtime. ■

Lady Tasting Coffee: A Case Study in Experimental Design

by

Jacinth Maynard, Department of Mathematics, Lock Haven University of Pennsylvania
Mary Puterbaugh Mulcahy, Division of Biological and Health Sciences, University of Pittsburgh at Bradford
Daniel Kermick, Division of Biological and Health Sciences, University at Pittsburgh at Bradford

Part I – Coffee Shop Wager

Characters

Model—an attractive young woman with impeccable taste, working as a successful model for an advertising firm.

Escort—a tall, dark and handsome young man, working as a marketing and survey researcher for the same advertising firm.

Older Gentleman—an adjunct professor of biostatistics at a local college and a coffee house regular; dressed in slightly-aged tweed jacket.

Setting

The red sports car makes a quick stop in front of the Philadelphia coffeehouse after an evening on the town. A sleek model and her tall, dark, and handsome escort gracefully exit the car and approach the counter where the escort purchases two cups of house coffee. At the condiments table, the escort proceeds to pour milk into the two coffees, and the following dialogue results.

Dialogue

Model:	Oh, no. I'll need a fresh cup.
Escort:	You like milk in your coffee, right?
Model:	Yes, I like milk in my coffee, but only, and I say only, if it is added to the cup first.
Escort (laughing):	Oh, come on, that's ridiculous; you can't possibly tell the difference. Coffee is coffee whether you add the milk first or second.
Model:	Of course I can tell the difference; you've no right to laugh at me.
Older Gentleman:	Pardon me for overhearing your conversation. Actually, the lady may be able to tell the difference.
Escort:	You're kidding me, right?
Older Gentleman:	Such claims have been made before. A woman made that claim at an afternoon tea party in Cambridge in the 1920s. She stated that

she could always tell whether milk was added before or after the tea was poured in the cup. The famous statistician Sir Ronald Fisher was at high tea* that afternoon and immediately designed an experiment to test the woman's palate. Rumor has it that she shocked the guests because she correctly told Sir Fisher whether milk had been added first or second after tasting multiple cups of tea. The event became famous because Sir Fisher used it to explain the basics of experimental design in one of the first textbooks ever published on the topic.

Escort: Well that's a good story, but it also sounds suspiciously like a story with no basis in reality, invented by an imaginative professor writing a textbook. You certainly haven't convinced me to buy the lady another cup of coffee.

Older Gentleman: From what I've read, it was a real event, and furthermore, humans have very sensitive taste buds. I think she deserves a new cup.

Model: Now that the coffee is cold, I certainly deserve a fresh cup.

Older Gentleman: Ma'am I fully agree. In fact, I think you deserve several cups of fresh coffee! Let's set up our own experiment to determine whether this lady can or can not discern whether milk was added to the cup before or after the coffee.

Model: How fun! Yes, let's see who is right with our own tea test, I mean coffee test.

Older Gentleman: Clever pun, ma'am. You know the real student's t-test was developed in the early 1900s by a taste tester of sorts at the Guinness Brewery in Dublin, Ireland. Only he wasn't tasting tea either. Sir, are you a gambling man? How about a wager? If our experiment shows that she can tell the difference, you will pay for the coffee. If the experiment does not demonstrate her discerning palate, I will pay for the fresh cups.

Escort: You're on! But I want the rules hashed out before she starts sipping. I mean, how many cups are we talking about? And what if she's wrong for just a few cups? I don't want to pay for the coffee just because she is a good guesser.

Older Gentleman: Fisher would agree completely. Even the smallest experiment requires forethought and planning. You must tell me, sir, just how sure do you want to be that she isn't guessing?

*Going all the way back to the 1600s, many English people have enjoyed an afternoon tea. The phrase "high tea" refers to that traditional practice of people gathering in the late afternoon to drink tea, usually served with some sort of meat, bread, crackers, or other food.

Questions

Imagine that you are going to design and perform the experiment described in the dialogue.

1. What is the hypothesis that will be tested in this experiment?
2. Why is it important to offer the model more than just two cups (one with the milk added first and one with the milk added second)? Explain your answer.
3. How many cups of coffee should the model taste? Explain your answer.
4. Describe exactly how the cups should be prepared. Does every cup need to be exactly the same in every way except the order of the addition of milk and coffee? Can you actually make every cup identical? Explain your answer fully.
5. In what order should the cups be presented? What method or decision rules might you use to decide which cup is to be offered first, second, etc.?
6. How do you recommend that the characters decide if the model is able to tell whether the milk was added to the cup before or after the coffee? (In other words, how many cups does she have to correctly evaluate for you to conclude that she really can tell the difference?) Explain your choice.
7. Without looking it up in a textbook or online, provide your own definition of "experimental design."

Part II – Tasting Tea

Read Fisher's essay entitled "Mathematics of a Lady Tasting Tea," available online at **http://legacy.library.ucsf.edu/tid/fqi22e00/pdf**; then answer the questions below.

Questions

The questions below ask you to compare your answers from Part I to the explanations found in Fisher's essay.

1. Referring to your answers to the questions in Part I, was the hypothesis you chose different than the null hypothesis given by Fisher in his essay? Explain your answer.
2. What reason did you give for why it is important to offer the model more than just two cups (one with the milk added first and one with the milk added second)? Was your answer the same as Fisher's answer? Based on the essay, please describe Fisher's answer to this question.
3. How many cups did you say the model would taste? How many cups did Fisher say that the "tea lady" in the story should taste? Please describe fully Fisher's answer to this question, including any mathematical considerations. Was your answer the same as Fisher's answer? If not, how is it different?
4. Before reading Fisher's essay, did you think that every cup needed to be exactly the same in every way except the order of the addition of milk and coffee? Does Fisher believe that every cup should be prepared identically? Describe Fisher's explanation for how to deal with uncontrollable variation among cups.
5. Before reading Fisher's essay, what method did you recommend for choosing the order that the cups should be presented? Was your answer different than what Fisher recommends in his essay? Please describe Fisher's explanation for how to choose the cup order.
6. In Part I, you answered the question of how one should decide if the model is able to tell whether the milk was added to the cup before or after the coffee. (In other words, how many cups does she have to correctly evaluate for you to conclude that she really can tell the difference?) Compare your answer to Fisher's answer and then describe Fisher's answer fully.
7. Your instructor will provide you with a textbook definition of experimental design. Was your definition complete? Your answers to all of the questions in Part I probably differed in small or large ways from Fisher's proposed design of a tea tasting experiment. Are there any differences that changed your perception of statistics and experimental design? If yes, describe how Fisher's essay enlightened you. Even if you did not find that Fisher's essay changed your views, make a short summary list of the important design concepts that you think are emphasized in Fisher's essay.
8. Following the guidance of your instructor, use Part III of the story or, alternatively, if your instructor has provided materials, set up a mock event similar to the tea tasting experiment. Instead of tea, you might consider seeing if your classmates can tell the difference between 1% and 2% milk, between two brands of bottled water, between two brands of flavored diet or regular soda, or some other simple taste comparison. Adhere to the principles of Fisher's paper, and draw conclusions based on your results, using Fisher's rules.
9. Rumor has it that the real lady who had tea with Fisher on an afternoon in the 1920s was able to accurately tell whether the milk was added first or second every single time she was offered a new cup. Can you conclude from her success that most people can tell the difference between milk-first and tea-first cups? Briefly describe the design of an experiment that would test this broader question.

Part III – Tasting Coffee

Setting

The escort and the older gentleman prepared four cups of coffee to which they added the milk first and four cups of coffee in which they added the milk second. The two men attempted to make sure that the cups were identically prepared as much as possible in terms of the amount of coffee, milk, etc. By writing the numbers 1–8 on slips of paper and pulling the numbers out of the hat, the escort and older gentleman randomly decided that cups #2, 3, 6, and 7 would be prepared with the milk added first and cups #1, 4, 5, and 8 would be prepared with the coffee added first. The model has just finished sipping all cups (presented in order 1–8), and she has written down her decision.

Dialogue

Older Gentleman: Are we all in agreement that we will use Fisher's rules for deciding the conclusion for the experiment?

Escort: Yes, we are. Please tell us which cups you think had the milk added first.

Model (smiling broadly): It is so obvious that cups #2, 3, 4, and 7 had the milk first.

Older Gentleman: Are you sure? Is this your final answer?

Model: Yes, those are the cups that had the milk added first.

Escort: Ha! Based on Fisher's rules, you can't really tell the difference! The milk was added first to cups #2, 3, 6, and 7. Hot dog, mister! YOU will have to pay for the cups!

Model: But I got 6 of the 8 correct! That's pretty good! Who is this Fisher guy to say I can't do it?

Older Gentleman: I have to agree ma'am that you may be able to tell the difference, but we did decide beforehand that we would use Fisher's rules, and his rules are quite strict. We can only conclude that you can tell the difference if there was less than a 5% chance that your success could be explained by good guessing.

Model: But I didn't guess! I really can tell; it seems unfair that you accuse me of guessing just because I made one mistake!

Escort: We aren't really accusing you of guessing; the 5% rule is the common cutoff that is used in many statistical analyses.

Model: Fisher's rules are too strict. Give me another two cups and, if I get it right this time, my success rate will be better than the 5% guess rate. I'll show you that I really am able to tell the difference!

Escort: Hold on! It would be cheating to change the plan now. No more cups. Please, let's quit while I'm ahead!

Questions

1. Did the characters correctly follow Fisher's rules when they concluded that the results do not allow us to conclude that the woman can tell the difference between the two types of cups?
2. Do you think the lady really can tell the difference between the milk-first versus the milk-second cups?
3. Which of the following sentences do you think most accurately and clearly states the conclusion of the experiment? Propose your own statement if you find flaws in all of the statements below.
   a. The model cannot tell the difference between the milk-first and the milk-second cups.
   b. There is a 5% or greater chance that the woman guessed her answers.
   c. At the 5% level, the model cannot significantly tell the difference between the milk-first and the milk-second cups.
4. Would it be acceptable to add two more cups now? Why or why not? What is the value of deciding the experimental design before you begin an experiment and not changing it in the middle of the experiment?
5. Do you think Fisher's rules are too strict? Why or why not?
   a. Would you feel the same way about his rules if we were testing whether a monitor at a nuclear power plant can really recognize elevated levels of radiation?
   b. Would you feel the same way if we were testing whether a new children's vitamin caused increased risk of kidney dysfunction?
   c. In order to answer these questions better, read the more detailed descriptions of these two hypothetical experiments given below. For each design, state the null hypothesis. There are two types of mistakes that statisticians can make at the conclusion of a significance test: they can incorrectly reject a true null hypothesis (Type I error) or they can incorrectly fail to reject a false null hypothesis (Type II error). The 5% rule ensures that a Type I error is never made at a greater rate than 5%, and the likelihood of making a Type I error is often inversely related to the likelihood of making a Type II error. Type II error rates are usually not controlled in scientific experiments, and can be considerably higher than 5%. For the following two experiments, what would be the human ethical consequence of making Type I and Type II mistakes in your conclusion at the end of the experiment? Would you recommend the 5% rule for these experiments? Why or why not?
      i. Nuclear Monitor Experimental Design: The monitor is exposed to eight environments (four high and four low radiation levels) and the experimenter records whether the monitor warning light comes on or not.
      ii. Vitamin Experimental Design: Eight children are given a placebo and eight children are given the new vitamin. Urine from the children is collected and the pH in the urine is monitored and compared between the two groups. Both high and low pH are indications of kidney dysfunction.
6. Return again to the coffee-tasting experiment. Does the outcome described prove that the model cannot tell the difference between the two types of cups of coffee?

THE STANDARDS FOR SCIENTIFIC INQUIRY, LITERACY AND NUMERACY ARE INTEGRAL PARTS OF THE CONTENT STANDARDS FOR EACH GRADE LEVEL IN THIS CLUSTER.

Grades 6-8 Core Scientific Inquiry, Literacy and Numeracy

How is scientific knowledge created and communicated?

Content Standards	Expected Performances
SCIENTIFIC INQUIRY ♦ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. ♦ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. ♦ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists. **SCIENTIFIC LITERACY** ♦ Scientific literacy includes speaking, listening, presenting, interpreting, reading and writing about science. ♦ Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media. **SCIENTIFIC NUMERACY** ♦ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.	**C INQ.1** Identify questions that can be answered through scientific investigation. **C INQ.2** Read, interpret and examine the credibility of scientific claims in different sources of information. **C INQ.3** Design and conduct appropriate types of scientific investigations to answer different questions. **C INQ.4** Identify independent and dependent variables, and those variables that are kept constant, when designing an experiment. **C INQ.5** Use appropriate tools and techniques to make observations and gather data. **C INQ.6** Use mathematical operations to analyze and interpret data. **C INQ.7** Identify and present relationships between variables in appropriate graphs. **C INQ.8** Draw conclusions and identify sources of error. **C INQ.9** Provide explanations to investigated problems or questions. **C INQ.10** Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

THE STANDARDS FOR SCIENTIFIC INQUIRY, LITERACY AND NUMERACY ARE INTEGRAL PARTS OF THE CONTENT STANDARDS FOR EACH GRADE LEVEL IN THIS CLUSTER.

Grades 9-10 Core Scientific Inquiry, Literacy and Numeracy

How is scientific knowledge created and communicated?

Content Standards	Expected Performances
SCIENTIFIC INQUIRY ♦ Scientific inquiry is a thoughtful and coordinated attempt to search out, describe, explain and predict natural phenomena. ♦ Scientific inquiry progresses through a continuous process of questioning, data collection, analysis and interpretation. ♦ Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists. **SCIENTIFIC LITERACY** ♦ Scientific literacy includes the ability to read, write, discuss and present coherent ideas about science. ♦ Scientific literacy also includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media. **SCIENTIFIC NUMERACY** ♦ Scientific numeracy includes the ability to use mathematical operations and procedures to calculate, analyze and present scientific data and ideas.	**D INQ.1** Identify questions that can be answered through scientific investigation. **D INQ.2** Read, interpret and examine the credibility and validity of scientific claims in different sources of information. **D INQ.3** Formulate a testable hypothesis and demonstrate logical connections between the scientific concepts guiding the hypothesis and the design of the experiment. **D INQ.4** Design and conduct appropriate types of scientific investigations to answer different questions. **D INQ.5** Identify independent and dependent variables, including those that are kept constant and those used as controls. **D INQ.6** Use appropriate tools and techniques to make observations and gather data. **D INQ.7** Assess the reliability of the data that was generated in the investigation. **D INQ.8** Use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate forms. **D INQ.9** Articulate conclusions and explanations based on research data, and assess results based on the design of the investigation. **D INQ.10** Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic.

Using Case Studies as a Method to Teach Science

Lee Currey
Mona Fitzgerald
Christine Tedisky

Big Idea

- Case studies provide opportunities to engage all learners in the application of 21st century skills and are designed to measure skills in critical thinking, reasoning, problem solving, and written communication.

Essential Questions

- How can case studies in science improve student engagement and cause students to develop and apply science and engineering skills?
- How do case studies foster communication and collaboration among students who might not have the chance to make connections easily?

Objectives

- By the end of this presentation, you will:
  - Understand what case studies are;
  - Engage in a meaningful and relevant case study experience;
  - Understand how case studies can apply to Windsor Public Schools curriculum across the disciplines.

University of Buffalo Conference

- September 21-22, 2012
- Plenary Sessions – *Reinventing Science Teaching* and *Unclear Nuclear*
- 15 different sessions to choose from
- Poster session demonstrating how case studies have been implemented in secondary schools and colleges and universities

What are Case Studies?

"Case studies are stories with a message. They are not simply narratives for entertainment. They are stories to educate."

- Methods:
  - Story-Telling
  - Discussion (Directed, Debate, Trial)
  - Small Groups (Problem-based, Team-based, Interrupted, Clicker)
  - Individual
- Types of Case Studies
  - Analysis (Issues) Cases – Contemporary and Historical
  - Dilemma (Decision) Cases – What happened and what do we do about it?
- Trigger vs. Capstone Cases:
  - Stimulate interest at the beginning; more information needed
  - Summative, all information presented, new perspectives

Lady Tasting Coffee: A Case Study in Experimental Design

- Model a case study experience on experimental design
- See connections between CINQs and DINQs

Plans for Implementation

- Sage Park Middle School
- Windsor High School
- Windsor University

Resources

- http://sciencecases.lib.buffalo.edu/cs/
- http://www.cse.emory.edu/cases/
- http://www.udel.edu/inst/

Questions?

Thank you!

Session Descriptions

Friday, September 21, 2012

8–9am REGISTRATION & CONTINENTAL BREAKFAST

9–9:15am *Welcoming Remarks*
Nancy A. Schiller, Co-Director, and *Clyde (Kipp) Herreid*, Director, National Center for Case Study Teaching in Science, University at Buffalo

9:15–10:15am PLENARY SESSION

Reinventing Science Teaching: Using PBL and Case Studies in Middle through Grad School
Pat Marsteller, Director, Center for Science Education, and Professor of Practice, Department of Biology, Emory University

No one learns anything unless they are engaged. This presentation addresses the use of PBL and case studies to create a compelling "need to know" in students from middle school through graduate school. Since 2003, Emory's Problems and Research to Integrate Science and Mathematics (PRISM) program has offered graduate and undergraduate students fellowship opportunities to partner with local teachers to engage middle and high school students in science and math through problem-based learning. The teams develop and implement engaging lessons that connect science disciplines and highlight science in the real world. The primary goal of PRISM is to transform K-16 science education by enhancing the teaching, communication, and research-dissemination skills of future faculty; building sustainable university-community partnerships in which Emory students can be engaged; enhancing teacher content knowledge and pedagogy skills; and providing teachers and graduate students with opportunities and skills to take leadership roles in producing knowledge about pedagogical practice so that they can act as change agents within the K-16 educational system. This plenary will highlight the joys, benefits, and challenges of reinventing science teaching.

10:15–10:30am COFFEE BREAK

10:30am–12pm MORNING BREAK-OUT SESSIONS

Track A: *What Is a Case? / Different Types of Cases*
Kipp Herreid, Director, National Center for Case Study Teaching in Science, University at Buffalo

Business and law schools have a long tradition of using real or simulated stories, or cases, to teach students about their fields. Other disciplines such as medicine, psychology, and teacher education also have found the method effective in capturing the imagination and attention of their students. The formal use of case studies in the science classroom, however, is still relatively novel. Yet cases have great pedagogical potential, not only for teaching scientific methodology, ethics, and the relationship of scientists to society to non-majors, but also for delivering content-rich courses for science majors. In this session, we will cover the elements of a case study, the different forms that cases can take, and the many different ways of teaching them.

- OR -

Track B: ***Adopt and Adapt: Integrating Quantitative Skills into Cases***
Pat Marsteller, Director, Center for Science Education, and Professor of Practice, Department of Biology, Emory University

In this workshop, participants will be introduced to principles of adapting cases to address quantitative skills development. Initially, we will work with examples of existing cases, adapting the learning outcomes to include analysis of datasets and other statistical and quantitative enhancements. We will employ tools such as Gapminder as well as simulations, games, and datasets. Each participant will bring or find a favorite case to work on. Sample cases will include biology, chemistry, physics, and anthropology topics from middle school to college levels.

12–1pm LUNCH

1–2:30pm EARLY AFTERNOON BREAK-OUT SESSIONS

Track A: ***The Discussion Case Method***
Kipp Herreid, Director, National Center for Case Study Teaching in Science, University at Buffalo

Discussion cases are typically written as dilemmas that give the history of an individual, institution, business, or community faced with a problem that must be solved. The teacher's goal is to help students sift through the facts, analyze the problem, and consider possible solutions and their consequences. On the surface of it, the method is simple: the instructor asks probing questions and the students analyze the problem presented in the story with probity and brilliance. Most science teachers, however, have little experience running this type of a class. In this session, you will have the opportunity to participate in a discussion case and then analyze the process.

- OR -

Track B: ***CaseIt!***
Mark Bergland, Professor of Biology, University of Wisconsin-River Falls, and *Karen Klyczek*, Professor of Biology, University of Wisconsin-River Falls

CaseIt! is an NSF-sponsored project to provide molecular biology computer simulations and associated cases at no cost to educators. *CaseIt v6.06* will perform a variety of laboratory procedures on any DNA or protein sequence including electrophoresis, PCR, blotting, ELISA, and SNP and expression microarrays. The simulation can also be integrated with MEGA software for bioinformatics analyses. It is used by students to analyze cases based primarily on infectious and genetic diseases, but can also be used as a tool to study original research questions. In this session, participants will be shown *CaseIt v6.06* and how it can be used to analyze existing cases as well as learn how to create their own case scenarios using information from the literature and sequences from online repositories such as GENBANK. They also will learn ways in which *CaseIt* materials have been effectively used in the classroom to enhance students' understanding of molecular biology. The simulation software and cases, video tutorials, and forums are available at http://www.caseitproject.org.

2:30–2:45pm COFFEE BREAK

2:45–4:15pm LATE AFTERNOON BREAK-OUT SESSIONS

Track A: *The Interrupted Case Method*
Kipp Herreid, Director, National Center for Case Study Teaching in Science, University at Buffalo

In the interrupted case method, a problem (case) is presented to students to work on in small groups, with the information given to them in stages. After the groups are given a short time to discuss the initial information they receive, the instructor gives them additional information to analyze, apply, and discuss. This sequence is repeated several times as the problem gets closer to resolution. One of the great virtues of the method is the way in which it mimics how real scientists go about their work. Scientists do not have all of the facts all at once; they get them piecemeal. This method of "progressive disclosure" is characteristic of problem-based learning (PBL), but in the interrupted case method, the case is accomplished in a single class period rather than over several days. In this session, you will participate in an interrupted case and analyze the experience.

- OR -

Track B: *Let's Be Friends: Using Social Networking to Enhance Science Teaching*
Aditi Pai, Associate Professor and Vice Chair, Biology Department, Spelman College

One of the persistent challenges of a large science classroom is ensuring an effective discussion. In a large classroom, it is often impossible to hear from all students because of time restrictions as well as the fact that many students hesitate to participate in the large classroom setting. Teachers have tried using Learning Management Systems (LMS) to promote online discussions; however, the use of traditional LMS has limitations. In this workshop, we will discuss how popular social media platforms like Facebook can be used to facilitate the discussion of scientific case studies. Participants will learn how to use Facebook for science discussions, see assessment data from our Facebook classes, and discuss the pros and cons of using social media for science education

5:30–7pm POSTER SESSION / COCKTAIL HOUR

7–8pm BANQUET

Saturday, September 22, 2012

8am–9am REGISTRATION & CONTINENTAL BREAKFAST

9–10:15am PLENARY SESSION

Unclear Nuclear

Cathy Middlecamp, Associate Professor, Nelson Institute for Environmental Studies, and Howe Bascom Professor, Integrated Liberal Studies Program, University of Wisconsin-Madison

We would have a different history - and different stories to tell - had we been born with the ability to detect nuclear radiation. The fact that we weren't is one of the many reasons why it is challenging to teach concepts relating to the nuclear sciences. When engaging students with a case study that involves nuclear something-or-other (e.g., medical radioisotopes, power plants, forensics, uranium enrichment, dirty bombs), instructors can do a better job if they know the difficulties that students experience when learning the underlying concepts and facts. If we slip into teaching these concepts and facts by simply "covering" them, we run the risk of landing right back into practices that made us seek alternatives in the first place. As my examples with radioactivity will show, leading students to develop an understanding of nuclear-related content requires a blend of detective work, creativity, good stories, and a knowledge of how people learn.

10:15–10:30am COFFEE BREAK

10:30am–12pm MORNING BREAK-OUT SESSIONS

Track A: *Using Cases to Teach the Nature of Science: Alfred Russel Wallace & the Origin of Species*

Douglas Allchin, Fellow, Minnesota Center for the Philosophy of Science / Instructor, History of Science and Technology, University of Minnesota

Most people are familiar with Darwin's theory of evolution of natural selection. We frequently hear of Darwin's travels on the *H.M.S. Beagle* and his book *On the Origin of Species*. Some may even know about the influence of Lyell and Malthus on his thinking. Not everyone knows however that Alfred Russel Wallace, a naturalist and contemporary of Darwin's, developed a theory on the origin of species independently. In this session, participants (in the role of students) will engage in a guided historical case study that focuses on Wallace's story, highlighting his middle class background, his career as a collector, and the observations and experiences that led to his own insights. After we run the case, we will discuss the experience from the perspectives of both students and teachers, and consider how nature-of-science lessons are designed and facilitated. Finally, we will survey a handful of other historical cases.

- OR -

Track B - High School Teacher Session 1: *Making a Case for Scientific Argumentation*

Douglas Llewellyn, Adjunct Faculty, Graduate Mathematics, Science, and Technology Education, Ralph C. Wilson, Jr. School of Education, St. John Fisher College, Rochester, NY

The draft of the new *Framework for K-12 Science Education* released in 2011 provides a glimpse into what's ahead for curriculum and professional development in K-12 science education. The words "argument" or "argumentation" appear in the document 97 times, a fact that illustrates its importance. Yet if you ask pre-service and practicing science teachers if they can describe the essential features of scientific argumentation or if they have students write arguments from investigations, most answer "no." To prepare science educators for the use of argumentation in their classrooms, this session will focus on several questions: What does the new *Framework* say about scientific argumentation? What is the role of argumentation in K-12 science instruction? How do students make and defend arguments in the secondary level science classroom? How can case studies and inquiry-based investigations be modified to accommodate students forming and justifying arguments? Participants should bring to the session a favorite case study or inquiry-based lab where students collect and draw conclusions related to an investigable question. We will modify these to reflect an argument-based format and then discuss the modifications. By the end of the session, participants should have a fundamental understanding of scientific argumentation as well as a better understanding of their role as instructional change agents in being "ahead of the curve" in adopting the new science standards. This session is applicable to science teachers in grades 7-12 and pre-service college professors.

12–1pm LUNCH

1–2:30pm EARLY AFTERNOON BREAK-OUT SESSIONS

Track A: ***Involving Students in Case Study Writing: Naive or Brilliant?***
Annie Prud'homme Genereux, Founding Faculty & Coordinator, Life Sciences, Quest University Canada

The design of novel case studies requires the author to research information, synthesize it, and think about the best approach to teach a concept. These are some of the very skills we want our students to develop. Armed with my own case writing experience, I devised an assignment where freshmen non-major students were guided through the design of cases on topics of individual interest. The goal was to have some cases be of sufficient quality to submit for consideration for publication on the NCCSTS peer-reviewed website. Was it an unmitigated success or a total failure? This session presents some of the findings from the experience. Whole classes can be enlisted in the development of a case, harnessing the creativity and potential of the whole group. In this hands-on workshop, we will collaborate to draft a case study. Is that possible within the timeframe of this workshop? Only one way to find out! Come to this session and explore, experience, and reflect upon the possibility of developing cases with your students.

- OR -

Track B - High School Teacher Session 2: ***Learn by Doing: Using Case-Based Instruction to Integrate NGSS and Common Core Standards While Motivating and Engaging All Learners***
Kathy Hoppe, Science Support, K-12 Monroe 2-Orleans BOCES, NY

Case-based lessons for high school students involve connecting to the learner and engaging them in real-world scenarios that directly correlate to content and pedagogy emphasized in both state and national science standards. Participants will learn about the process of integrating a case that combines modeling, inquiry, literacy, and application of information by students. You will take on the student role and at the same time learn how to coach and facilitate the lesson, giving students control of their own learning. The case that we will do will be integrated with lab, literacy, and modeling and at the same time be correlated to the draft of the Next Generation Science Standards as well as the Common Core in English Language Arts (ELA) for Science Content.

- OR -

Track C: ***Watts Up?***
Cathy Middlecamp, Associate Professor, Associate Professor, Nelson Institute for Environmental Studies, and Howe Bascom Professor, Integrated Liberal Studies Program, University of Wisconsin-Madison

Last semester, I took another look at our undergraduate chemistry biodiesel synthesis lab. With a certain amount of chagrin, I realized that I was taking perfectly good vegetable oil, making perfectly good biodiesel, and then discarding it as waste via our campus organic solvent disposal system. Worse yet, I was using the lab experiment to teach principles relating to sustainability. What to do? This semester, I gathered a group of students in a senior capstone course in environmental studies. Together we revised the experiment - in essence, engaging in learning with a real-world scenario involving laboratory design. In the process, we got pretty good with an inexpensive meter that you can plug things into in order to determine the number of kilowatt hours it uses and did a bunch of back-of-the-envelope energy calculations. This workshop welcomes all who would like to involve students in case studies involving energy and might be struggling with the logistics. It also welcomes those who were trained to think of energy in terms of calories and joules who might now be struggling with the unit of kilowatt hours. And, perhaps most importantly, it welcomes those who likewise have fallen into potholes after abandoning their status as an "expert" to join their students in the learning process.

2:30–2:45pm COFFEE BREAK

2:45–4:15pm LATE AFTERNOON BREAK-OUT SESSIONS

Track A: ***How to Write a Case***
Kipp Herreid, Director, National Center for Case Study Teaching in Science, University at Buffalo

Finding a topic isn't difficult. Cases can be used to teach almost any topic, from mitosis to nuclear fission. The challenge is how to craft a case study so that it achieves your teaching objectives while providing students with a compelling story that is relevant and thought provoking. In this session, we will provide you with a recipe for writing successful cases. Join us and leave the workshop with a rough draft of a case for one of your own courses.

- OR -

Track B - ***High School Teacher Session 3: Thinking Critically About Using Cases to Teach Critical Thinking Skills***

Maureen Griffin, Science School Improvement Leader, Des Moines Public Schools, and *Eric Hall,* Science Teacher, Des Moines Public Schools

Next Generation Science Standards, ACT's College Readiness Standards, as well as state and local standards have the expectation that teachers will prepare all students to think critically. In both school settings and the world outside the classroom, it is crucial for people to have skills in questioning, analyzing, comparing, contrasting, and evaluating. Research supports that these skills are teachable and learnable. Although there are plenty of strategies for teaching these skills, there is a huge void when it comes to how teachers teach students to apply them appropriately. In this session, participants will learn how case studies can provide a relevant context for teaching critical thinking skills. Participants will be provided with time to work through a process for introducing critical thinking skills and analyzing documents using a case study.

Requested Changes in Program of Study

Department: Art

Add Sculpture **Honors**
.5 credit Prerequisite: 3D Foundations

Ready to get your hands dirty? This advanced course picks up where 3D foundations leaves off. Using the concepts you learned to manipulate forms in space, you will now explore more advanced materials such as wire, plaster, foam, wood and metal. You will learn what inspires current artists as you develop technical skills in contemporary materials. This class is highly recommended for students who hope to develop a sculpture portfolio or pursue careers in Fine Arts, Engineering, Design or Architecture.

Add Advanced Jewelry Design **Honors**
.5 credit Prerequisite: Jewelry Design

Bling-Bling! This advanced course picks up where Intro to Jewelry Design leaves off. Students will learn more advanced techniques including, gem/stone setting, enameling and kiln-firing jewelry. Students will have the chance to work with precious metals as they bring their own jewelry forms to life. This course will focus on advancing technical skill and developing the individual student's artistic voice as they create a professional collection of their own jewelry pieces. This course is highly recommended for students interested in developing a jewelry portfolio or pursuing a career in Metals, Design, Fashion or Marketing.

Remove Commercial Art and Remove Printmaking (More contemporary versions of Printmaking and Commercial Art are taught in the Tech Ed Dept under Intro to Graphics and Applied Graphics)

Remove Humanities: Literature and the Arts (no interest, has not run since 2008)

Department: Elective

Add Yearbook **College**
1.0 credit Prerequisite: None

This course will provide students with experience publishing an authentic school publication. Students develop the book's organization, layout, and content using web based professional graphic design software. Units of study would include teamwork, responsibility, brainstorming, content, coverage, concept, reporting, writing, headlines, captions, editing, photography, typography, design, finances, yearbook campaigns, advertising, and distribution.

Department: English

Add African American Literature **College**

.5 credit Prerequisite: None

This course incorporates writers from the 18th century through the Harlem Renaissance and beyond, each of whom contributed greatly to the diverse body of American literature. Students will analyze major concepts within the literature that are associated with brotherhood, bias, identity, community, rebellion, and spiritual resistance. The course will emphasize how experiences with these issues impact all people. The students will evaluate the authors' works for their literary merit and will connect the literature with American history, society, and culture. Students will be encouraged to share personal perspectives, as related to the literature. This course is best suited for juniors, but is open to all students. It is a companion to English 11 and AP Language and Composition, both of which require critical reading of American literature. It also serves as a literary backing for the African American history course offered by the social studies department.

Add Science Fiction/ Fantasy **College**

.5 credit Prerequisite: None

Students will read various pieces of literature that explore the realm of science fiction and fantasy; these will include "classics" and modern works. Students will consider how these texts help define human experience and human potential. Students will question the characteristics of the genre and address concerns, themes, and motifs that arise from reading the texts. The class will ultimately answer the question, "How is science fiction and fantasy writing distinctive?" Students will also begin to understand how this type of writing encourages the reader to see familiar things in a new way. The literature will allow students to understand the appeal of this genre and to become better problem solvers by stretching the mind to new possibilities. By the end of the course, students will be encouraged to create a publishable work of science fiction or fantasy.

Add Young Adult Literature **College**

.5 credit Prerequisite: None

This multi-cultural, multi-genre course incorporates award-winning young adult literature into the framework of an appealing, but challenging English course. Course work will explore issues of adolescence, gender, ethnicity, and social justice with precise attention to literary technique. Students are expected to read independently and use the texts to identify themes that are relevant in "their world." Students will use the literature to answer, "What issues are important to me?" and "How does this book qualify as a literary text?" Young adult literature is becoming increasingly popular in pop culture and the adult world. Through evaluation of its features and quality, students will begin to understand its profound impact on the entire literary canon

Change English 9 **1031 College**

2.0 credits (1 English and 1 elective)

This is a standard first course in English 9 that meets everyday for a full block. This course introduces various genres of literature, including the short story, the novel, poetry and drama. It also covers nonfiction works. Students use the literature to develop expository compositions and to practice speaking and performing skills. Attentions is given to spelling, vocabulary development, conventional English usage, mechanics and grammar.

Remove SAT Prep (No student interest. Skills to improve SAT performance are being woven into other curriculum)

Remove Communications (Content is covered in other core courses.)

Department: Math

Change Algebra 1 **1213 College**

2.0 credits (1 math and 1 elective)

This is a standard first course in Algebra that meets everyday for a full block. Essential topics include: patterns, equations, linear functions, systems, exponential functions and quadratics functions. Integrated topics include: data analysis, geometry, and discrete mathematics. The use of real-life applications, graphing calculators, long-term investigations, problem solving strategies and mathematical modeling empowers students to think mathematically and prepares students for continued study in mathematics. The extended time is intended to increase students' understanding and comfort level with key algebraic concepts as well as review and enrich prerequisite skills. Students will earn one credit towards the mathematics graduation requirement and one additional elective credit.

Algebra 1 **1215 Honors**

1.0 credit, Prerequisite: Recommendation of 8th grade teacher

This rigorous first course in Algebra meets every other day with no extended time. Essential topics include: patterns, equations, linear functions, systems, exponential functions and quadratics functions. Integrated topics include: data analysis, geometry, and discrete mathematics. The use of real-life applications, graphing calculators, long-term investigations, problem solving strategies and mathematical modeling empowers students to think mathematically and prepares students for continued study in mathematics. Students are expected to make a major commitment in time and effort. Students who are successful in this course will be recommended for honors geometry.

Add Linear Algebra **High Honors**

1.0 credit, Prerequisite: 3 or better on the AP Calculus BC exam

This course presents the main concepts and terminology of linear algebra. It is a full introductory linear algebra course equivalent to a first-year college linear algebra course. Topics include: linear equations, matrix algebra, determinants, vector spaces, eigenvalues, orthogonality, least squares, symmetric matrices, and quadratic forms. As illustrated throughout the course, the topics presented play an essential role in areas such as computer science, engineering, environmental science, economics, statistics, business management, and the social sciences. This course provides an excellent foundation for Multivariable Calculus.

Remove Applied 1, Applied 2, General Algebra, Algebra 1 part 1 for 2013-2014
Remove Algebra 1 part 2 for 2014-2015

Additional Language for Math:

- Students who fail a course will continue to move on in the next course in the grade level sequence but will recover the credit for the failed course during that academic year as well.
- Students who earn a D in a course and do not meet the pre-requisite will also take the next course in the grade level sequence but will be required to participate in a structured math support until they demonstrate mastery of the content for that course as determined by the Math Teacher Leader.

Department: Science

Add Forensics **College**

.5 credit Prerequisite: Chemistry

This course focuses on various aspects of forensic science and modern criminal investigation analysis. Forensics will involve an analytical look at the study of crime scenes, where students will investigate engaging scenarios in which they will utilize sophisticated laboratory techniques to explore criminal evidence. Students will understand the science behind forensics investigations, the tools and techniques, of the field, and the statistical reliability of past and current DNA testing. This course is designed to integrate concepts in biology, chemistry, and physics and will include laboratory work

Change Human Anatomy and Physiology from .5 to 1.0 credit. Maintain Honors and College levels. (reflects demands of the content and supports our students who are pursuing medical careers).

Remove Chemistry Seminar (replaced by AP Chemistry)

Department: Social Studies

Add Military History: The American Military Experience Since 1890 **College**

.5 credit Prerequisite: Students in grades 10-12

The Course would examine the military heritage of the United States from the onset of the America's Imperial expansion to the present time. Through an in-depth analysis of literature, primary & secondary sources, maps, data, biographies and documentaries students will assess key individuals, military policies, organizations, strategies, campaigns, tactics and battles that have defined the military experience. Students will also investigate connections between America's military infrastructure the country's social and cultural framework.

Change Economics from 1.0 to .5 credits. **College**

(condenses curriculum to core issues while increasing student accessibility).

This course is an examination of the five factors of production (land, labor, capital, management and government). Topics include wealth in the American economy, government spending and taxing policies and international economics. This course is highly recommended for students pursuing careers in business.

Change Description for Human Rights **College**

The Human Rights course is an in depth semester elective designed to promote awareness and understanding of global human rights. Based on the original United Nations charter of the Universal Declaration of Human Rights, this course seeks to encourage students to investigate issues around the world where human rights are threatened or violated and to seek pro-active solutions in accordance to their findings. Topics include women's rights, human trafficking, child soldiering, genocide and fair trade. Critical thinking and problem solving skills will be strengthened through the use of outside readings, guest speakers, films, and projects.

Department: Technology Education and Family/Consumer Sciences

Add Fashion Merchandising **Honors**
1.0 credit Prerequisite: Fashion and Clothing I
This year-long course would focus on retailing aspects of the world of fashion. The offering would incorporate building an understanding of the textile field, provide an introduction to product development and manufacturing and give students an opportunity to practice retailing skills.

Add Computer Assisted Drawing/Computer Assisted Machining (CAD/CAM) **Honors**
1.0 credit Prerequisite: Intro to Manufacturing or Intro to Drafting
This innovative year-long course will give students the opportunity to experience the engineering process first hand. After designing parts utilizing industry-standard drafting software, students will fabricate their design using computer-aided machining equipment. The focus of student work will be to design and fabricate parts for the WHS battery-operated car that will be raced at the Electrathon competition.

Remove Electronics/Computer Servicing Course (not offered in 2012-13)

Department: World Languages

Add Spanish Conversation and Culture **College**
1.0 credit Prerequisite: Spanish I
This course is designed for students that want to learn about culture related to Spanish-speaking countries. Culture will be the main focus where students will do reading about different related topics in Spanish-speaking countries. Students will also learn basic conversation related to the culture topic in a specific Spanish-speaking country. Topics will include school, sports, food, entertainment, dances, music money and fashion.

Add French 4 **College**
1.0 credit Prerequisite: French 3
This course continues to refine the four basic skills of listening comprehension, speaking, reading and writing. Students and teachers will use French as much as possible and will emphasize greater use of French by the students. Knowledge of verb tenses in extended to include present, past, future and subjunctive. Students will be encouraged to express themselves in the target language in both oral and written work. The culture of French speaking countries will be studied through the use of the language itself, readings, videos, student reports, audio visuals and internet sites.

Online Courses

Add Virtual High School
The Virtual High School provide students with access to high quality online learning experiences and courses not offered at their school, while supporting educators with the professional development and services they need to provide an effective 21st century education to every student. VHS member schools have access to a range of collaborative core, elective, enrichment and AP® courses that inspire, ignite and deepen learning as well as enable students to develop digital literacies and independent learning skills, explore college majors and careers, try interesting electives, earn credits, participate in global classrooms and get the opportunity to take advanced courses not offered at their school. Courses are taught by active classroom teachers who are specially trained in online teaching best practices, highly qualified, and certified in their subject areas.

Omitted in Original Presentation Special Education

Change Resource Study
.5 credit Prerequisite: None **College**
(This course would be changed from a guided study hall assigned for special education students to a curriculum -based course aligned with IEP goals.)

This course supports student's efforts to master the areas identified in their IEP goals. Participants will receive individual and small group supports to promote their academic and career goals. Transition activities (resume, interviewing, job shadowing, etc.) are also a primary focus of this course.

Omitted in Original Presentation Tech Ed

Change Applied Graphics
1 credit Prerequisite: None **College**
(This change will only occur if the necessary equipment is purchased.)

This course emphasizes the graphic design process. The use of graphic arts in advertising, packaging, and business are explored along with techniques in computer-based design. In this course, students will utilize computer systems and software to work on projects which include the design of logos, trademarks, flyers, posters, brochures, advertisements, and product packaging. Students will engage in projects that start with the design stage and follow through to the finish product. In addition, students will be trained on the most up-to-date digital press, the DocuColor 700i. Students will engage in foundational learning related to how digital production printing technology works, where it fits in the marketplace, what applications can be produced using this technology, and how to set up, operate, maintain, and finish printed pieces from this output device within commercial, in-plant, and data center workflows.