

P R O J E C T D E S I G N : O V E R V I E W

Name of Project: A Knightly Problem for the Metro Cafeteria	Duration: 2 months	
Subject/Course: Chemistry	Teacher(s): Gerardo Lopez	Grade Level: 10-12
Other subject areas to be included, if any: Statistics and Math		

Significant Content (CCSS and/or others)	<p>Standard 1.1: Overview scientific method steps (question, hypothesis, research question, design of experiment, collection of data, results, conclusion) to use in solving various problem scenarios.</p> <p>Standard 1.2: Write and speak effectively to present and explain scientific results, using appropriate terminology and graphics</p> <p>Standard 2.1: Distinguish between precision and accuracy with respect to experimental data.</p> <p>Standard 2.5: Express numbers in scientific notation when appropriate.</p> <p>Standard 2.7: Use graphical, mathematical and/or statistical models to express patterns and relationships inferred from sets of scientific data.</p> <p>Standard 2.8: Interpret data sets to determine meaning, including possible patterns and relationships.</p>			
21st Century Competencies (to be taught and assessed) augment list with details (p21.org)	Collaboration: Demonstrate ability to work effectively and respectfully with diverse teams; exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal; assume shared responsibility for collaborative work, and value the individual contributions made by each team member.	X	Creativity and Innovation: Use a wide range of idea creation techniques (such as brainstorming); elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts; work creatively with others; develop, implement and communicate new ideas to others effectively.	X
	Communication: Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts; Listen effectively to decipher meaning, including knowledge, values attitudes and intentions; Use communication for a range of purposes (e.g. to inform, instruct, motivate, persuade); Use multiple media and technologies, and know to judge their effectiveness as well as assess their impact; communicate effectively in diverse environments.	X	Other: Be open & responsive to new & diverse perspectives; incorporate group input and feedback into the work; demonstrate originality & inventiveness in work & understand the real world limits to adopting new ideas; view failure as an opportunity to learn; understand that creativity and innovation is a long-term, cyclical process of small successes & frequent mistakes; implement innovations; act on creative ideas to make a tangible & useful contribution to the field in which the innovation will occur.	X
	Critical Thinking: Reason effectively – use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation. Use systems thinking – analyze how parts of a whole interact with each other to produce overall outcomes in complex systems. Make judgments and decisions – effectively analyze and evaluate evidence, arguments, claims and beliefs. Analyze and evaluate major alternative points of view. Synthesize & make connections between information & arguments. Interpret information and draw conclusions based on best analysis.	X		

Project Summary / SCENARIO / TASK
(include student role, issue, problem or challenge, action taken, and purpose/beneficiary)

Topic: Standard work using DMAIC and Scientific Method.

How do you identify and prevent cross-contamination during production of food and at the same time create standard work that will prevent any cross-contamination, while improving the efficiency of the food line?

Introductory Paragraph – Introduce problem and make it urgent. (2 sentences)

Metro Tech is a high school in the Phoenix Union High School District that feeds over 1,500 students daily from Monday through Friday. However, there was a recent contamination incident that has caused the many parents and students to be concerned in addition to the complaints about the long wait time at the lunch line. Twelve students had to be sent to the school nurse. The school nurse was baffled. Thus, a system must be created through the production line to produce the devices the most efficiently while eliminating waste, but meeting customer demands immediately. This requires several teams to work on this project by working on the different subsystems. A subsystem is simply a quality aspect of the production line – material replenishment, standard work (walk path), visual management, etc. All of these subsystems together are called a Value Stream. In the process of creating the Value Stream, care must be taken not to contaminate the food.

The work area of production is also called a COS (Cell Operating System). Part of the process in developing a Value Stream is to create a mockup of the COS with all the kitchen utensils and a sketch. A Time Study has to be created for the whole process. In addition, a Time Study allows for the cafeteria students to develop a service line that balances the work between the all team members the most efficiently and as previously stated, permits the cafeteria to immediately adjust to student demand. Cafeteria staff must also foresee any possible cross-contamination scenarios in the packaging and labeling end of the COS (Cell Operating System). To prevent/identify any possible contaminants, the school cafeteria has a chemistry lab that identifies many unknown substances using various instruments, such as the FTIR (Fourier Transfer Infrared) and UV-Vis, which can determine a concentration of a solution. The chemistry lab also follows a standard operating procedure on how unknown substances are identified. Based on the evidence given, could you identify the unknown chemical so that the affected individuals can get treatment and design a protocol to prevent any future problems with contamination?

Paragraph 2 – Describe importance of the issue and relationships. (3 sentences)

Students depend on their food to be free from any contamination. Food contamination can get the school cafeteria into many problems with the county health inspector. It can also lead to lawsuits from parents of students affected as a result of the contamination.

Statement – Reemphasize the importance of the issue. (1 sentence)

The well-being of the students are at stake, thus the food served must be free of any contamination.

Pose a problem – One sentence, and pose one question.

If you had to identify an unknown contaminant using the FTIR (Fourier Transform Infrared) or the UV-Vis (Beer's Law) how would you go about and use these apparatuses to deal with unknown contamination molecules that could be found on the food and how would you design a walk path and handling procedure that would prevent any possible contamination?

	<p>Task: Your job is to investigate and present to your audience the root cause of the contamination. As a result, you will present standard work for the cafeteria food preparation.</p> <p>Role 1: You are a chemistry student. Given the instruments and spectra graphs in the lab – FTIR and the UV-Vis, how would you use them proactively that could be of value to the school, which would allow you to use the scientific method to sample, determine and archive any possible contaminants that might lead to the chemical root cause. (1-2 students)</p> <p>Role 2: You are also an industrial engineering student and problem-solver. As a result, you must design a method to eliminate any possible cross-contamination in the kitchen by creating standard work. Standard work includes creating a walk path with balanced work times amongst all of the team members and proper handling procedures. (1-2 students)</p> <p>Role 3: You will be responsible for developing the A3 DMAIC and present your findings to your audience (classmates, administrators, cafeteria staff, and county health inspector). To implement quality control standard operating procedures, the engineering team has to develop standard work that would allow the cafeteria staff to continuously improve the Value Stream for the COS (cafeteria kitchen). (1-2 students)</p> <p>Role 4: You will present your findings to your audience (classmates, administrators, cafeteria staff, and county health inspector) in a power point and you have to make sure all of your teammates meet deadlines. You must follow the power point rubric and format as per Canvas. You will also be responsible to make sure that all team members meet deadlines and hand over pertinent information for the power point presentation. (1 student)</p> <p>Your job is to investigate and present to your audience the root cause of the contamination. As a result, you will present standard work for the cafeteria food preparation.</p>
<p>Driving Question /s (essential questions)</p>	<p>Driving Question: What are the possible consequences of not creating standard work in any work setting?</p> <p>Open-ended Question: How can the fundamentals of spectrophotometry be beneficial in other facets (concepts) of the real-world?</p> <p>Direct/Closed Question: Given the evidence, how could you determine and prove to the administrators what the root cause was and create standard work (standard operating procedures) that would eliminate any possible cross-contamination in the future?</p>

Entry Event

A GROUP OF STUDENTS BECAME SICK FROM EATING CAFETERIA FOOD AND THE SCHOOL IS TRYING TO FIND ANSWERS AS TO WHAT COULD HAVE GONE WRONG.

1 THE SITUATION

The first fourteen students were sent to the nurse during Advisory class that had eaten the meal served at the Metro Tech Cafeteria. All were suffering from headaches, dizziness and nausea. The main entrée on the menu consisted of chicken enchiladas *rojas*, beans (*frijoles fritos*), Mexican rice, and chopped carrots on the side. The first 14 plates were pre-served and left ready to be picked up by the first 14 students. None of the staff members has admitted to serving the first 14 plates.

2 THE SCENARIO

To protect the identities of the possible suspects, aliases were used.

1. Prior to serving the food, the staff had a party to celebrate a year without any accidents. There were 3 types of drinks served at different concentrations of sweetness – light, medium, high. There was a drink left next to the first 14 plates served that was left by one of the staff members. None of the staff members have claimed the ownership of the drink. Whoever left the drink, it was out of view from the security camera.
2. **Giovanni** came in that morning and prepared the beans. He cleaned them out, boiled the water, added salt and added the rinsed beans. He also prepared the chicken by boiling it earlier that morning. Giovanni's uncle owns a pesticide store and Giovanni stayed up the previous night helping his uncle restock the shelves filled with dangerous chemicals. Giovanni did not wash his hands and used the same shirt the following day. Giovanni drank the **lightly** sweetened drink.
3. **Alessandra** chopped up the carrots after she washed them, but didn't bother washing the cutting board in between the different veggies. She said that she was helping her dad paint a couple of metallic home decorations the night before. Alessandra was seen by the security camera that she did not wash her hands either nor used any gloves when she was chopping the carrots. A sweetened drink was also left by Alessandra's work station. Alessandra drank the **lightly** sweetened drink.
4. **Bob**, the landscaper, fumigated the premises around the cafeteria building early that morning. At that point, the food delivery truck was unloading several sacks of beans that were left by the outside wall momentarily where the fumigation happened. Bob joined the staff for a drink and had the **highly** sweetened drink.
5. **Juan Carlos**, the part-time assistant cook, is also a chemist and works for a company in the evenings to make α -trifluoromethyl alanines and diamines. Juan Carlos arrived a little late that day and was drinking a cola soft drink that he had left by the *mole de pipian*. Juan Carlos said that he had the **medium** sweetened drink.

	<p>6. Mary, the supervisor, was seen removing her finger nail polish using finger nail polish remover as she was rolling up the enchiladas and preparing to heat them up with the cheese. Mary said that she’s trying to watch her diet and opted for the lightly sweetened drink with her glazed donuts.</p> <p>7. The cafeteria has a vanilla scented room deodorizer where the onions are stored. Alessandra was seen chopping up the onions after she was done with chopping up the carrots. She admitted that she accidentally spilled about 5 ml of the vanilla scent liquid on the onions as she was removing it from the wall. The vanilla smell was bothering her.</p> <p>8. None of the workers were wearing gloves nor ever washed their hands according to the security cameras, which have a direct view of the sink!!</p> <p>3 YOUR OBJECTIVE AND GOAL</p>	
	<p>You are to use the given scenario and data to determine who was responsible in the contamination and develop a system that would prevent any risk in contamination of the food, while at the same time create a Value Stream that would improve efficiency of the food preparation and food line.</p>	
<p>Products</p>	<p>Individual: Each student will be assigned one of the 3 roles. They will produce an artifact/evidence that substantiates their defined role.</p>	<p>Specific content and competencies to be assessed: Use spectra graphs from FTIR and UV-Vis and mathematical data to solve a dilemma. Statistical models will also be used to express patterns and relationships inferred from sets of time study data and the graphs of infrared and spectroscopy to problem-solve.</p>
	<p>Team: The team will present their part of their findings in an 8-minute power point or through Prezi and within specific parameters set forth in the presentation.</p>	<p>Specific content and competencies to be assessed: Collaboration, communication, creativity, and innovation will be assessed.</p>
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<p>Public Audience (Experts, audiences, or product users students will engage with during/at end of project)</p>	<p>Administrators, students that eat at the school cafeteria and the cafeteria staff who work there will be the primary audience in addition to the county health inspector.</p>	
<p>Resources Needed</p>	<p>On-site people, facilities: Cafeteria staff and management and cafeteria facility.</p>	

	Equipment: The UV-Vis spectrophotometers and samples.
	Materials: FTIR spectra graphs, Canvas, mathematical models, excel spreadsheet, The Cafeteria in Distress document, power points on Canvas (i.e. DMAIC, examples, explanations of Beer's Law, Spectrophotometry, FTIR spectra graphs, standard work) and any other learning materials/resources.
	Community Resources: Internet.

Reflection Methods (Individual, Team, and/or Whole Class)	Journal/Learning Log: Chemistry notebook.		Focus Group: NA	
	Whole-Class Discussion: All of the groups within the class will discuss and debate the possible outcomes of the scenario mystery story presented to them.		Fishbowl Discussion: NA	
	Survey: NA		Other: NA	

Notes: Copies of spectra will be uploaded onto Canvas for the students to use as a resource to solve the scenario problem.

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PROJECT DESIGN: STUDENT LEARNING GUIDE

Project: PBL Summer 2015

Driving Question: How can we prevent cross-contamination in any food-serving establishment without slowing down the efficiency of the service?

Final Product(s) Presentations, Performances, Products and/or Services	Learning Outcomes/Targets content & 21st century competencies needed by students to successfully complete products	Checkpoints/Formative Assessments to check for learning and ensure students are on track	Instructional Strategies for All Learners provided by teacher, other staff, experts; includes scaffolds, materials, lessons aligned to learning outcomes and formative assessments
<p>Your job is to investigate and present to your audience the root cause of the contamination. As a result, you will present standard work for the cafeteria food preparation.</p> <p>Power Point: Scientific Method Format</p> <p>DMAIC: Poster Board</p>	<p>Students who demonstrate understanding can:</p> <p>MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.</p> <p>MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</p> <p>MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.</p> <p>MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.</p>	<p>One of the first checkpoints will be the design phase.</p> <p>Students will be asked to investigate the current walk path and standard operating procedures (daily routine) of each of the cafeteria workers.</p> <p>Students will be asked first to compose a rough draft of their standard walk path and improved standard operating procedures onto paper for their design.</p> <p>This design will be evaluated first by group peers, then other groups, and finally by the instructor.</p> <p>You will perform the Beer's Law lab as part of your investigation and record all of your data. In addition, you will also investigate the results of FTIR spectra provided to you.</p> <p>Through the scientific method, students will be asked to provide their approach, methods of investigation, and results of their investigation and a rough draft of their A3 DMAIC poster board.</p> <p>You will put together a power point or prezi presentation, meeting all of the parameters put forth by the instructor.</p>	<ul style="list-style-type: none"> • Model design phase with a similar scenario as Medtronic example (but nothing that can be copied) • Socratic evaluation of obviously failed constructions (taken from internet) • Scaffold learning from Chemistry class and labs. • Minor formative assessments to judge progress within the criteria and constraints of the challenge