

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

Name of Project: Living Working in a Mining Town: This place is about to blow!	Duration: 2 weeks	
Subject/Course: Geometry	Teacher(s): Jessica Killgore	Grade Level: 9-10
Other subject areas to be included, if any: Geology, Economics, Surveying		

Significant Content (CCSS and/or others)	<p>ISTE: 1acd, 2bd, 3bd, 4ac, 5ab, 6abd</p> <p>Content Standards:</p> <p>CCSS.Math.Content.HSG.GPE.B.4: Use coordinates to prove simple geometric theorems algebraically.</p> <p>CCSS.Math.Content.HSG.GPE.B.7: Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.</p> <p>CCSS.Math.Content.HSG.MG.A.1: Use geometric shapes, their measures, and their properties to describe objects.</p> <p>CCSS.Math.Content.HSG.MG.A.3: Apply geometric methods to solve design problems.</p> <p>ISTE Student Standards:</p> <p>1. c: Use models and simulations to explore complex systems and issues.</p> <p>1. d: Identify trends and forecast possibilities.</p> <p>4. a: Identify and define authentic problems and significant questions for investigation.</p> <p>4. c: Collect and analyze data to identify solutions and/or make informed decisions.</p> <p>5. b: Exhibit a positive attitude toward using technology that supports collaboration, learning, and productivity.</p>
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21st Century Competencies (to be taught and assessed) augment list with details	Students will work and plan with their assigned groups, but will share and rotate to get a well-rounded approach to the project. <ul style="list-style-type: none"> - Document/monitor progress on checklist - Communicates with other members - Open discussions & documentation of ideas 	Creativity and Innovation <ul style="list-style-type: none"> - Plot creation/surveying - Simulations - Presentation 	
	Students will keep a journal of their group discussions and assignments. <ul style="list-style-type: none"> - The project will end with a shared PowerPoint which will be presented (hopefully) to classmates, some faculty, administrators, and guests brought in from FMI. - Students will keep work and create posters & additional visual aids to explain their findings 	Other:	
	Critical Thinking <ul style="list-style-type: none"> - Identify conflicts of production vs price - Create question board – questions lead to more questions. Keep a running question log where students can add questions they have in groups 	(Critical thinking cont'd) or individually. Students will also be asked to answer the questions from their class as they discover solutions and new information. <ul style="list-style-type: none"> - Document assumptions prior to performance then compare results and discover reasoning 	

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

ROLE:

- You have an assigned job title: short range planner, long range planner, drill & blast crew, geologist, or economist. You will have to communicate and develop a good work relationship with your fellow co-workers within your department, but you must ALSO be aware of how a relationship with employees from another department may benefit you. You will participate in both design and manufacturing/production.
 - o Surveyor: Take measurements for what is to be worked on. Look at the span of things and determine what you hope to accomplish. (*WHAT is the possible scope?*)
 - o Engineer: Create/format spreadsheets to further calculate and translate data to work towards achievement of desired results. (*HOW?*)
 - o Planner (ST): Establish limits and controls for *today* so that we can function tomorrow.
 - o Planner (LT): Determine/create a plan for where we hope to be in one month, two months, three months, six months, etc.
 - o Geologist: Know what we are working with (*RESEARCH!*) Where did it come from & why is it coming up now?
 - o Economist: Know the economic value of what we are working with. (*WHY?*)
 - o Laborer/Driver: Workers do the work. (Everything needs to be created in a laborer's words. If the simplest man can understand, then an open bridge of communication is created).

SITUATION:

- The context you find yourself in is this. Engineers use math on a daily basis, and so do other employees of Freeport. The difference is that engineers use theoretical/pure mathematics while laborers use practical/applied mathematics. Miscommunications arise because theoretical mathematics and equations do not look like the types of inputs a machinist will put into a machine. There needs to be a way to bridge the communication gap between the two.
- The challenge involves an abstract math concept and developing a “Rosetta Stone” for the other employees (laborers), a set of equations that a laborer can view as a template for the data they use on a daily basis.
- You are an employee for Freeport McMoRan. You have been asked by the head engineer of mine planning to develop a mine layout over a given surface that will take availability, production, resources, and costs into consideration.
- Once you have established limits for your mine, you will create a haul route that complies with the given specifications. You will then calculate the cost of recovery based on productivity and efficiency to determine the best plan of action. You will be responsible for representing this to your head engineer and co-workers.
- Your job is to work with your department as well as the other departments within the company to recognize the relationships that exist between the theoretical and practical aspects of mathematics.

PRODUCT, PERFORMANCE, PURPOSE:

- Students will identify the P80 rule of blasting and how different constraints on plots could yield a better production.
- You will format an excel spreadsheet that determines specific haul truck characteristics based on given conditions (horizontal distance, lifts, drops, etc.) – Identify EFH (effective flat haul) and other components – must stay within mandatory restrictions (available # of haul trucks)

Deconstructed Scenario:

Freeport McMoRan is an international corporation that mines primarily for copper here in Morenci at the nation’s largest open pit mine. The current lifespan of the mine is only for about 20 more years and is in need of new land for possible expansion.

In 2016, the Garfield pit will reach the end of its lifespan which leaves two active pits (Western Copper and Sun ridge) along with a third potential pit (Shannon). Mining takes great risks, so it is very important to have alternative potential pits in mind. According to Freeport McMoRan, there are 3,700 people employed by the company between Safford and Morenci, AZ. Freeport’s mines in this location generated an estimated \$430 in economic benefits for Greenlee and Graham counties and approximately \$1.2 billion for Arizona in 2014. Due to the importance of production to both the company and city which the mine is located in, it is extremely important to know your next steps. 3,000+ people could be affected within their career field. While we are currently safe in terms of production, there is still a possibility of the market tanking or false trajectories.

Rock samples can be indicators of potential copper based on the oxide/sulfide bases found in the area. However, determining the lifespan of a mine is not a surface endeavor. This requires drilling, blasting, and exploration. There are several things that must be taken into consideration such as expenses, water, fault lines, and other geological features. In Morenci, there is porphyry, pyrite, cuprite, chrysocolla, chalcocite, chalcopyrite, and many other types of porphyrous rocks.

Copper is also especially important to all individuals as it is used in several different ways in many areas of life. It is used in electrical wiring and electrical devices due to its great use as an electrical conductor. It is highly resistant to the damage of water and other elements, so it is found useful in construction. Bacteria will not grow on it, so it is even useful in the medical field.

It has been said that a great percent of the copper in the United States comes from the plant in Morenci. If the lifespan can’t be extended past the projected 20 years, what does this mean for Morenci and for the copper industry?

Driving Question /s (essential questions)	<ul style="list-style-type: none"> - What characteristics of a trapezoid qualify it as the best shape for drilling and blasting the football field? - How is a point related to a plane? (truck related to the bench it is hauling to/from) - Given bench height and width constraints, how can we determine the angle for our slopes that will provide the greatest amount of stability? <ul style="list-style-type: none"> o What factors could cause changes from one bench to another? - (ISTE based): Which department is the least important? Which is the most important? <ul style="list-style-type: none"> o Could the company function if the least important department no longer existed? - How are we affected by living in a mining town? <ul style="list-style-type: none"> o How would we be affected if the cost of copper drops below \$3.00? \$2.50? etc. 	
Entry Event	<p>The tortoise and the hare took different routes at different speeds. Create a route that proves the old tale was telling the truth!</p> <ul style="list-style-type: none"> - This could be a start, but then transition to haul trucks and creating a mine of their own making where they could calculate routes for haul trucks based on efficiency and productivity. <p>Rumor has it.. There is a great chance that there are some old copper deposits deep under the football field. I like Friday night football, but I would rather get rich (or die mining)! So let's start by blowing up the field.. One plot at a time.</p>	
Products	Individual: <ul style="list-style-type: none"> - Outline of assumptions (prior to research/performance) - Panel discussion – based on articles and/or project - Participation in group product - Completion of journal 	Specific content and competencies to be assessed: <ul style="list-style-type: none"> - Understanding of how math is related to mining - Realistic problems involving coordinates, measurements, perimeters, and volumes
	Team: <ul style="list-style-type: none"> - Surveying data – create blueprint - Excel spreadsheet - PowerPoint presentation 	Specific content and competencies to be assessed: <ul style="list-style-type: none"> - Finding unknowns - Problem Solving - Production and the effects of the economy
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Public Audience (Experts, audiences, or product users students will engage with during/at end of project)	AUDIENCE: <ul style="list-style-type: none"> - Your client is also your company, Freeport McMoRan, FMI. - The target audience is your general manager who is look for the most efficient and clearest data presentation that will make sense to other employees who would enact the plan. - You will need to convince the management team (classmates) that your set of equations are true given any circumstance, and that the set of equations will make sense to all fellow employees and departments. 			
Resources Needed	On-site people, facilities: <ul style="list-style-type: none"> - People: teacher (self), surveyor (day of or day before surveying the field), speakers throughout the quarter if possible (from the departments represented by work groups) - Facilities: classroom, football field Equipment: Surveying Equipment (school-owned), student computers Materials: posters, markers, laptops (with PowerPoint & excel abilities), surveying equipment Community Resources: Guests from Freeport representing different fields represented by student work groups (surveyor, mine engineer (short range and long range, geologist, economist, etc.))			
Reflection Methods (Individual, Team, and/or Whole Class)	Journal/Learning Log <ul style="list-style-type: none"> - Record collaboration & personal participation - Questions - Problems - Ending with a self-report discussing their individual use of 21st century skills 		Focus Group <ul style="list-style-type: none"> - Within focus groups, students will submit a proposal giving their plans for blasting. - Once approved, students will also submit a proposal (including spreadsheets) giving a cost analysis of the project. 	
	Whole-Class Discussion <ul style="list-style-type: none"> - Panel discussions about articles as well as approaches to the project 		Fishbowl Discussion <ul style="list-style-type: none"> - Discuss dilemmas and alternative approaches that are stumbled upon in the project (establishing a mine) and how it relates to FMI in Morenci (articles will be involved for homework) 	
	Survey <ul style="list-style-type: none"> - Upon completion of the PBL, students will take a survey that discusses personal and group participation, standard understanding, and personal opinion of the project. 		Other:	

Notes:

PROJECT DESIGN: STUDENT LEARNING GUIDE

Project: ~~Living~~ Working in a Mining Town: This place is about to blow!

Driving Question: What's the worth? (What does it really mean to live in Morenci?)

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
(individual and team) Your job is to create a mining site that takes up as much as the football field as possible. You will have to survey the land, create a diagram that shows availability of land, create plots for potential blasting, and then create a spreadsheet that calculates the potential value of the field. Students will also have to consider other costs to determine whether or not it would be worth it to blow up the field (haul trucks, laborers, etc.)	CCSS.Math.Content.HSG.GPE.B.7: Use coordinates to compute perimeters of polygons and areas of triangles and rectangles.	Homework: students work with phet simulators to establish a personal perspective of how area is related to volume. Exploration of area versus volume – phet resources used individually before discussion	Verifying student understanding of area/volume relationships, or specific learning related to the PhET sim (area vs volume)
	ISTE: 1.d: Identify trends and forecast possibilities. ISTE: 4.a: Identify and define authentic problems and significant questions for investigation.	Identify trends in sample data and make forecasts.	Discussion of how economics drives what we do and how we do it (in relation to mining) – I will have to discuss copper value, haul trucks/routes, drilling, blasting, and shovel costs.
	CCSS.Math.Content.HSG.MG.A.1: Use geometric shapes, their measures, and their properties to describe objects.	Exit ticket/Journal: quick write about a geometric shape of your choice. Be sure to include the type, important measurement values, and properties.	Students will explore/research geometric figures, their properties, and functionalities. There will be an inner/outer circle discussion (fishbowl) where we compile the facts and discoveries.
	CCSS.Math.Content.HSG.MG.A.3: Apply geometric methods to solve design problems. ISTE: 1.c: Use models and simulations to explore complex systems and issues.	Rough draft for project submittal (group) Students will create a budget that reflects the costs	Model what it looks like to create a budget in excel