MMS - Module Overview

Module Title: Spiraling the Engineering Design Process in Middle School (Grades 6 - 8)

LS Team: Kimberly Dedini, Anna Som, Mary Ann Sheridan, Lisa Klar

Grade level(s): 6th, 7th, 8th

Big Idea – Student Learning

Our team is working to show how we can spiral the Engineering Design Process from 6th grade through 8th grade. Each grade level will focus on units that spiral the math, science, and engineering standards.

Students will work in collaborative teams to experience and become adept with utilizing the Engineering Design Process at each grade level. 6th grade will explore the process, 7th grade will use data to drive decision making, and 8th grade will go through the entire process with an emphasis on iterations.

Learning Targets – "I Can" Statements

6th Grade

I can

1. make a conjecture about solar cookers and whether or not the proportional size matters.
2. collect accurate data.
3. graph my data.
4. compare data and determine whether my conjecture was accurate or not.
5. suggest iterations to my project based on the data collected.
3. create at least two different types of graphs to describe the data.
4. decide which measure of center best describes our school's electrical use.
5. compare bivariate data.
6. use the Engineer Design Process to identify a possible solution to decrease electric consumption at MMS.
7. communicate clearly my findings to others.

8th Grade

I can...

1. collaboratively engineer a solution to a problem.
2. make iterations on a design.

MMS - Module Overview

7th Grade **I can..** 1. analyze data. 2. analyze data using measures of central tendency.	3. create an alternate energy source. 4. clearly communicate recommendations and findings. 5. analyze bivariate data and use choose appropriate graphs for the given data.

Prior Knowledge

6th Grade

- use knowledge/understanding of ratio and proportion
- how to graph a point on a graph
- the basics of constructing a graph

7th Grade

- calculate the measures of central tendency
- which measure of central tendency best represents the data

8th Grade

- the structure of matter (atoms, molecules, subatomic particles)
- energy is stored in chemical bonds
- multiplication and division

MMS - Module Overview

Community/Place-based connections:

Students will use the school grounds and the energy audit to gather baseline information regarding our energy usage. We will include guest speakers from our community to offer their expertise in the areas of energy consumptions and alternative energy sources/technologies.

How are STEM integrated?

6th Grade - Students will use their knowledge of ratio and proportions to scale down a solar cooker that 8th grade is making. As part of the process, they will make a conjecture as to whether their solar cooker will produce the same, less, or more heat than their 8th grade counterparts' solar cookers. Students will collect data as to how quickly their solar cooker heats up, graph it (online graph tool), and finally compare their data to the 8th grade's data. In addition, students will learn about solar heat and the benefits of this form of energy as it relates to their energy footprint left on their ecosystem.

7th Grade - Students will analyze electrical bills; use a watt reader to gather data between 2-3 bulb types from RCEA "Bust a Watt Activity"; create graphs via Google Sheets to organize and analyze data from their "watts" reading; research the financial and environmental impacts of each bulb type; and create and present to MUSD School Board their recommendations of the best bulb to use in our district.

8th Grade -The MMS team created a unit on energy consumption issues through an investigation of school buildings and grounds. Students will use mathematical concepts to quantify the scientific data. Students will utilize the Engineering Design Process to be able to organize information and have a common strategy/language. Students will watch a video, use online resources, and iPads to integrate technology.

MMS - Module Overview

What will be some community benefits?

1. There could be a potential for money savings based on student recommendations. 7th grade's research into different forms of lighting.
2. Community members will come on campus to share their knowledge with students and interact with them.
3. MMS will use less energy = happier world.
4. Students can take lessons learned from school regarding energy usage and apply them to their own lives.
5. Students will have an opportunity to speak to local government (principal, superintendent, school board, county, etc.) to share their findings, recommendations, projects.

STEM College/Career Connections:

- Students will participate in in a presentation/dialog with PG&E, HSU students & professors, local businesses who have a knowledge in alternative energy sources.
- Students will learn about Engineering careers.
- All 7th grade students take an online interest survey at Kuder Navigator (kudernavigator.com).
- 7th grade students attend college readiness presentations at College of the Redwoods, and 8th grade goes to Humboldt State.

Assessment: What evidence of learning will you gather across the module's implementation?

- Pre-Post Online Student Survey of the Engineering Design Process
- Student work samples of data analysis
- Student written conclusions of their analysis
- Student project that demonstrates energy use
- Student presentation of findings

MMS - Module Overview

General Outline of the Module

- Day 1: Pre Assessment - EDP
- Day 2: School-wide: A Day Without Power
  - What is Energy?
- Day 3: Introduce the Engineering Design Process
- Multiple Days: Implement grade-level units
- Final Day: Post Assessment - EDP

6th Grade	7th Grade	8th Grade
(Learn/Practice using Design Engineering Process - very teacher	(Review/Practice using Design Engineering Process - some teacher	(Review/Use Design Engineering

DRAFT 8.12..2015

MMS - Module Overview

directed)	direction)	Process - minimal teacher diirection)
CCSS.MATH.CONTENT.6.RP.A.3.C CCSS.MATH.CONTENT.6.NS.C.6.C Math SPM's: 1-8 NGSS: MS-ESS3-3 MS-PS3-4 Energy	NGSS: MS-ETS 1-1, 1-2, 1-3 Math CCSS:7. SPA1.2 and SPB.3, 4 Math SMPS's: 1-6	Math CCSS: 8.SP.A.1, 8.SP.A.4 Math SMP's: 1-6 NGSS: MS-ETS1-1, 1-2, 1-3, 1-4
• Pre-Assessment - Engineering Design Process • **Pre Activity 1:** "A Day Without Power"	• Pre-Assessment- Engineering Design Process • **Pre Activity 1: "A Day without Power"** What is Energy? • **Pre Activity 2: Review Engineering Design Process (from 6th grade)**	• Pre-Assessment- Engineering Design Process • **Pre Activity**: 1 "A Day Without Power"
• **Lesson 1:** (Lesson Study) ○ EDP & Vocabulary (1 - 2 periods) ○ Students will be introduced to vocabulary that's relevant to the Engineering Design Process (EDP). • **Lesson 2:** (3-9 periods) Vocabulary: temperature, heat, energy,	• **Lesson 1: Engineering Design Process-** brainstorm solutions to reducing electrical energy consumption in classroom and then school and teach Engineering Design Process • **Lesson 2 & 3: Bust a Bulb Activity** ○ analyzing electrical energy	• **Lesson 1:** Exploring Energy Consumption: Fermi Question: How much hot water, in liters, do we use on our campus every calendar year? (2 periods) • **Lesson 2**: Building a Reservoir Box

MMS - Module Overview

solar energy ○ Students will make conjectures . ○ Students will work in teams to complete the lab - create a 12 panel double angle solar panel. ○ Students will collect, analyze, and compare data. ○ Students will also compare their data to the data collected by 8th grade students. • **Lesson 3:** (1 - 2 periods) ○ Using the Gallery Walk strategy, students will present their findings to invited guests and peers. • **Lesson 4: LAST DAY** (1 - 2 periods) ○ Class Debrief ○ Post Assessment - Engineering Design Process	conservation using a watt meter ○ gather and analyze data ○ monetary savings ○ determine how data drives decision making in EDP • **Lesson 4: Presenting our Ideas**. • **Lesson 5:** Post Assessment- Engineering Design Process	(accuracy, measurement, volume) (1-2 periods) • **Lesson 3**: Testing Materials for Reservoir Insulation (2 periods) • **Lesson 4**: Engineering Water Heaters (6-8 periods) ○ Review Engineering Design Process ○ Teacher led discussion: design process concerning heating water ○ Build Water Heater ○ Compile student data from all trials and analyze graphically. ○ Iterate Design ○ Have students make a recommendation based off of data showcasing cost savings. • Post Assessment- Engineering Design Process