Mariners Christian School
Kim Wilson 3rd Grade STEM

Objectives: As lunar pioneers, engineers, and explorers, students will be designing and engineering prototypes that will help them meet their basic needs for survival on the moon. They will create solar ovens, solar water heaters, and lunar plant chambers to meet their needs for heat, food, and air. Additionally, they will write information pieces on colonization of the moon, and will present their learning to students, parents, and administration.

Content Standards: CCSS Language Arts W.3.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly. W.3.8: Recall information from experiences or gather information from print or digital sources; take brief notes on sources and sort evidence into provided categories. SL.3.4: Report on a topic or text, tell a story, or recount an experience with appropriate fats and relevant, descriptive details, speaking clearly at an understandable pace. NGSS: 3-5-ETS1-1: Students who demonstrate understanding can define a simple design problem reflecting a need or want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Students who demonstrate understanding can generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3: Students who demonstrate understanding can plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved. 3-LS4-3: Interdependent Relationships in Ecosystems: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. 3-LS3-2: Inheritance and Variation of Traits: Life Cycles and Traits: Students who demonstrate understanding can use evidence to support the explanation that traits can be influenced by the environment. CCSS Math: 3.MD.B.3: Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one-and two-step ‘how many more’ and ‘how many less’ problems using information presented in scaled bar graphs. 3.MD.B.4: Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units—whole numbers, halves, or quarters. ISTE: 4a Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems. 4b Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks. 4c Students develop, test and refine prototypes as part of a cyclical design process.
Project Based Learning Unit: Lunar Colonization Subjects: Science/Engineering/Writing Unit
Length: 6 Weeks

4d Students exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

Materials & Resources: Smartboard, Chromebooks or IPads, thermometers, stopwatches, cardboard pizza boxes, aluminum foil, black construction paper, plastic wrap, plexiglass, S'mores 'fixins', plants, cardboard, black marker, paper cups, plastic tubing (1/4 in. diameter), pitcher of water, scissors, straws, duct tape, Ozobots, Ozobot markers for coding.

Driving Question: How can we, as the first lunar colonists and structural engineers, meet our basic needs for survival on the moon? Lesson One: Solar Ovens (2 60 minute lessons)

Engage: Students will be given five minutes to answer the following in the output side of their engineering notebook: 1. What do you know about the moon? and 2. What do you need to survive on the moon? After five minutes, students will exchange ideas, and will add other students' ideas under the 'line of learning' in their notebooks:

Explore/Identify the Problem: After recording prior knowledge and initial thoughts about the moon/survival on the moon, students will watch the NASA video, Living on the Moon, and will be introduced to the PBL's Driving Question: How can we, as the first lunar colonists and structural engineers, meet our basic needs for survival on the moon? Explain: Students will listen to the book If You Decide to go to the Moon by Faith McNulty read aloud. They will take notes on the Input side of their engineering notebooks on the moon:

Students will read Can we cook while on the Moon? to initiate their understanding of today's design challenge. Students will be introduced to the engineering design challenge of the day: Your mission is to design and build a solar oven to cook your own S'mores with the materials provided.

Brainstorming: Students will answer questions about previously created solar ovens to prepare them to create their own designs in their engineering notebooks.

Design/Build: Students will create individual designs and will explain their designs to one another. They will build the first solar oven prototypes in groups of 3-4.

Evaluate: Students will test and record data from their solar oven initial investigations. Data is to be recorded every 30 seconds for 10 ½ minutes as the temperature increases in solar ovens. Elaborate/Redesign: Students will discuss what they think made their designs successful. They will brainstorm ideas of what might improve the heat in their project, and then will create a modified solar oven.

Share the Solution/Reflection: Students will share the difference in the temperature increase during their first experiment vs. their second. They will incorporate the solution and reflection into the output portion of their science notebooks.

Lesson 2: Solar Water Heaters (1 week)

Engage: Students will brainstorm the following in the output side of their engineering notebooks: Why would we need hot water or heat on the moon? And What did we learn from solar ovens about conducting heat? Watch the TED Talk:
https://www.youtube.com/watch?v=t9c7aheZxls

Interview with International Space Station Engineer Amy Guder: Have students ask about how life is sustained on the ISS, and have them record new understandings in Engineering Notebooks.

Explore: Introduce students to the NASA design challenge: design and build a solar water heater to see how much of a temperature change you can get. (NASA On the Moon Educator Guide pg. 32) Tell them how NASA might use solar-powered heating on the moon, and show them a sample water heater. Have students design their own solar water heaters in their Engineering Design Notebooks, and have them share designs with their teams.

Explain: Discuss the meanings of infrared radiation, and talk to students about heat transfer before they begin their test. Tell them about the measurement requirements for this project: students will measure the volume of the water, the temperature change, and the rate of the water flow (On the Moon Educator Guide, pg. 34)

Evaluate/Test: Students will test their solar water heater models, and will measure the temperature change in the water that runs through their heaters. They will record data and share results with other groups.

Elaborate/Extend: After comparing results with one another, students will modify their initial designs to increase the heat in their solar heaters. As students begin the modification process, let them know they can connect hot water heaters in a series to increase the temperature.

Assessment/Evaluation: Student notebooks with data on temperature change and speed of water movement, along with successfully completed solar water heaters will be the measure of success for this lesson.

Engage: Watch the TED Talk on Mars Rovers. Brainstorm how me might use robots to help us meet our needs for food and water on the surface of the moon.

Explore: (45 minutes) Students will play with different Ozobot templates to get used to coding Ozobot directions (on paper with markers). After several minutes of interacting with the Ozobots, they will be given the following instructions:

On your Lunar Colony, your oxygen tank usage is limited. Unable to use space suits to get every supply drop, you must program a robot to pick up the supplies for you. Your mission,

should you choose to accept it, is to attach a device to your Ozobot and to have it collect supplies from the moon's surface for the people on your colony. The path taken must include the following measured lengths:

One 4 ¼ inch line
One 3 ½ inch line
One 2 ¼ inch line
One 1.25 inch line

Other lines may be used, if necessary, but you must program at least 3 commands to get your Ozobot to the supplies and back to your base quickly and efficiently.

Explain: In engineering notebooks, students will individually map the pathways for their Ozobots to travel. Each team member will discuss the benefits of their pathway, and will listen to feedback from other team members on potential failure points of their pathways.

Evaluate: (30 minutes) Students will test and time each group member's Ozobot pathway to see which is fastest. Students will then modify pathways based on the results of their initial tests. Each team member will test their second pathways, and the group will submit the fastest Ozobot map to a class competition. The team with the fastest pathway, whose Ozobot is capable of picking up supplies, wins the challenge.

Elaborate: If time permits, hold a second team competition with a new construction of a game mat. Allow team members to share their process and results with their kindergarten reading buddies.

The following lessons will also be part of this PBL:

Lesson 4: Lunar Plant Chambers (2 weeks)

Lesson 5: Information writing/presentation on living on the moon (2 weeks)

Lesson 6: Presentations to students, parents, and administration