Subject: Science Grade Level: 6th

Standards:

- **Next Generation Science Standard MS-ESS1-1:** Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.
- **Next Generation Science Standard MS-ETS1-4:** A solution needs to be tested, and then modified on the basis of the test results, in order to improve it.

Objectives:

- Students will be able to collaborate in a small group to create a prototype model of the sun, moon, and earth using the LittleBits kit and various materials found at school and/or at home.
- Students will be able to complete a written explanation on the cause of the phases of the moon, the seasons, and lunar and solar eclipses.

Critical questions:

- What causes the phases of the moon?
- What causes lunar and solar eclipses?
- What causes the seasons?

Big Ideas:

- The phases of the moon occur because as the moon orbits Earth we sometimes only see the parts of the moon that are in shadow and other times the sunlit part of the moon can be seen on Earth. This causes phases each of which have their own name (full moon, new moon, waxing gibbous, waxing crescent, waning gibbous, waning crescent, first quarter, third quarter).
- Lunar eclipses occur when the Earth passes between the moon and the sun and blocks the sunlight reflected by the moon. Solar eclipses occur when the moon passes between the Earth and the sun casting a shadow on the Earth.
- The seasons are caused due to Earth's tilt on its axis meaning at different points in the year the Northern and Southern hemisphere have different exposure to solar energy due to the angle of the sun on Earth's surface.

Materials:

- LittleBits Gizmos and Gadgets Kits (2nd Edition)
- Teacher provided materials for models: pipe cleaners, rulers, Scotch tape, masking tape, plastic cups, cardboard tubes, rubber bands, popsicle sticks, string, paper, plastic

bottles, markers/crayons/colored pencils, scissors, pencils, shoe boxes, wire clothes hanger, ping pong balls, cotton balls, paperclips, thumb tacks, and paper
- Other materials will be utilized based on the “found objects” that students bring in for their groups
- Rubric for prototype models
- Rubric for written explanation
- Self-assessment for students

Instructions to students:

Prior to this lesson
Students would have multiple opportunities to play and practice working with the LittleBits kit and pieces. Students would have already gone through the process of learning about the causes of phases of the moon, eclipses, and seasons.

Day 1

(5 minutes) Scenario for the project is presented to students and explained by the teacher.

Scenario: The Michigan Science Center wants to create a new exhibit about space. They are looking for someone to create an interactive model demonstrating the positioning of the earth, moon, and sun along with an explanation of why the phases of the moon, solar and lunar eclipses, and seasons occur. You will be working in small groups to develop a model demonstrating these processes using the LittleBits kit as well as any objects you can find around the classroom or at home to repurpose for this project.

Small groups will first develop a “blueprint” for their model prototype with a plan on what the model will be built with and how they will put it together. Students will be reminded of expectations for collaboration and to keep in mind they may need to have a backup plan if their first plan does not work out.

(20 minutes) Students are split into small groups (3-4) and are given time to begin designing their prototype.

(15 minutes) After the groups have developed and designed a prototype they will get feedback from students in other groups. Each group will have sticky notes to use and give feedback to other groups. Group designs will be placed on the counter around the room and the groups will rotate so that they will get to see all of the groups designs. Sticky notes may be used to include the following types of feedback: a positive comment about the design and one area for improvement. Students will put the sticky note on the counter next to the group’s design paper and wait until the teacher tells them to rotate to the next spot. Students will be reminded that the group will be reading the notes so make sure comments are positive and encouraging.

(Teacher will ask students to remind everyone what productive feedback means and give some examples of appropriate comments vs. inappropriate comments before beginning the activity.)

(5 minutes) Once all of the groups have rotated through and groups are back at their design, they will take time with the group to read feedback from peers and reflect. They will then go back and revise their design based on any feedback they think would be helpful for their prototype design.

(5 minutes) At the end of class, the teacher will quickly poll the class to get an idea of how prepared they are to begin building tomorrow and how much time groups may need to complete plan revisions at the beginning of the next class period. Students will be given time to clean up before leaving class.

Day 2

(5 minutes) The teacher will start class by asking everyone to debrief from yesterday's class, remind students of expectations, and answer any questions students may have.

(~10 minutes) Based on feedback from the previous class, the teacher will give groups a set time to wrap up revisions to their design plans and post a timer so students can appropriately gauge their time. As groups complete their design, they will begin assembling their materials and may begin building their prototype.

(45 minutes) Once the time is up all groups will be encouraged to get their supplies and start building their models. As they build, groups will be encouraged to revise their models as necessary. The goal is for all groups to be done building by the end of the class period. (Students will be reminded that they will get a chance to see all of the other group models in later class periods so they can focusing on building their group prototype.)

After this lesson

- In next class period (or once all groups are complete with building), groups will get the opportunity to share their prototypes with the other students. They will also complete a self-assessment of their participation and contribution to the group as well what they learned from the design process.
- Students will individually write an explanation demonstrating their knowledge to go along with their group's prototype explaining phases of the moon, eclipses, and seasons including visuals/diagrams. (A rubric will be provided by the teacher and this will serve as a cumulative assessment.)

Assessment:

Students will be formatively assessed by the teacher observing and questioning students while they are working in their groups. The prototypes will be assessed by the teacher via rubric once

all the groups are complete with the building and revising process. Students will also complete a self-assessment provided by the teacher evaluating their contribution to the project. The summative assessment will take place after this lesson where students will individually write the explanation of the processes to go along with their group's model for the exhibit.

Rationale:

This lesson is an opportunity for students to demonstrate their understanding while also having the opportunity to create and collaborate with their peers. The scenario presented to students is a way to connect and "situate" their learning to the real world so it is relevant and meaningful. In this lesson, each small group of students will be able to share their ideas, be creative, problem solve through the challenge, and collaborate as a group in order to build a successful model. Students will be working in small groups to create and build their models which will allow them to work on collaboration skills while attempting to develop a solution. As stated in Chang et al. (2017) "Collaborative problem solving (CPS) is considered as one of the core competencies of the 21st century" (p. 222). Students need opportunities to develop their problem solving skills by collaborating with their peers to solve real world scenarios in order to prepare for the future. "The goals of problem-based learning are to engage students in a complex problem-solving process to foster the development of (a) flexible knowledge, (b) problem-solving skills, (c) self-directed learning skills, (d) effective collaboration skills, and (e) intrinsic motivation (Hmelo-Silver, 2004, as stated in O'Donnell, 2012). Through the experience of project design, students are able to come to the realization that problem solving is not always successful the first attempt, but requires continuous tests and improvements (Yu et al., 2015, p. 1398). Asking students to create a model will demonstrate their learning and make the concept more concrete for them since space is such an abstract concept for young adolescents. The challenge of selecting and repurposing objects to use in the model will require students to be innovative and revise their models if original items do not work for their final model.

Libow-Martinez (2013) states "Making is about a stance towards learning. That kids are born to learn and that if you give them right materials, the right guidance, and the right environment and amazing things happen." In this lesson students are utilizing various objects as well as their LittleBits kit in order to create something new. Each group may have completely different models, even though all may meet the requirements given by the teacher, which demonstrates the wide variety of unique ideas from students. Experiences like this in the classroom will prepare students to be effective problem solvers and have the opportunity to develop their skills by creating and collaborating with peers.

References:

Chang, C.J., Chang, M.H., Chiu, B.C., Liu, C.C., Chiang, S.H.F., Wen, C.T., Hwang, F.K., Wu, Y.T., Chao, P.Y., Lai, C.H., Wu, S.W., Chang, C.K., & Chen, W. (2017). An analysis of student collaborative problem solving activities mediated by collaborative simulations. *Computers and Education,* 114, 222-235. Retrieved from

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Libow-Martinez, S. (Connected Learning Alliance). (2013). *Making is a stance toward learning.* [Video file]. Retrieved from https://vimeo.com/82595186.

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How-to steps (including images/videos):

An example of a prototype similar to what students will be creating can be found on my blog post, "Repurposing with LittleBits in the Name of Science" including images, step by step instructions, and a video explaining how the prototype works.