Out of This World! - Week 7

Grades K-2

Day 3: Lunar Touchdown: Ask, Imagine & Plan

Teacher/Parent Background:

NASA has announced its plans to return astronauts to the Moon by 2024 through a collaboration with commercial and international partners. In going to the Moon, NASA is laying the foundation that will eventually enable human exploration of Mars. The Moon will provide a proving ground to test technologies and resources that will take humans to Mars and beyond, including building sustainable, reusable architecture.

Overview:

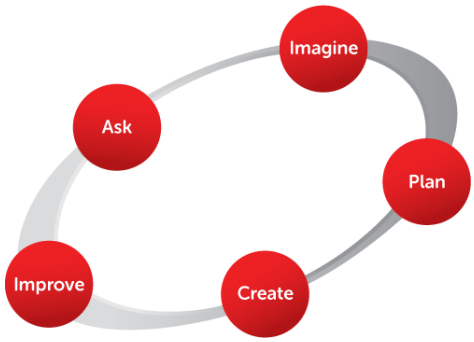
In this activity, learners will apply their knowledge of the features of the Moon (particularly craters) to imagine and develop a plan to design and build a spacecraft that can land in one of the Moon's craters without injuring astronauts or damaging the spacecraft.

Related Standards:

- **Plan and carry out investigations** which demonstrate how equal forces can balance objects and how unequal forces can push, pull or twist objects, making them change their speed, direction or shape.

Key Terms:

- moon - a natural satellite of a planet
- satellite - an object that stays in an orbit around a planet
- crater - dish-shaped pits formed when objects from space struck the moon's surface
- engineering design process - a set of steps engineers use to propose solutions to problems



Engineering Design Process

- blueprint - a design plan

Materials List:

- *Exploring the Moon* handout
- NASA missions overviews
    - Kid on the Moon (interactive app)
    - Apollo 11 - The First Moon Walk
    - The Moon Landing
- 1 piece of cardboard (4"x5")
- 1 small cup (8 oz, paper or plastic)
- 3 index cards
- 2 regular marshmallows
- 10 miniature marshmallows
- 3 rubber bands
- 8 plastic straws
- scissors
- tape
- pencil

Activity Description:

1. Read, discuss and/or view images/videos of NASA's prior explorations of the Moon.
    - Apollo missions explored various Moon features and returned with rock samples for future study.
    - Ranger and Surveyor spacecraft shared pictures of the Moon.
    - Artemis program will send the first woman and the next man to the Moon and develop a sustainable human presence on the Moon that will set the stage for further human exploration of Mars.
2. Then introduce the engineering design challenge that the student will be problem-solving:
    - NASA is looking to further explore the Moon, in particular, several craters observed while orbiting the Moon during previous trips. Testing and studying these craters may help NASA identify areas on

the Moon that are rich in water and other resources to determine how to best use those materials while on the lunar surface.
    - Before they can even consider sending a spacecraft and astronauts, NASA must locate safe landing sites within a crater
    - Once they find one, they need to design and build a spacecraft that can land there without injuring astronauts or damaging the spacecraft.
3. Prompt the student to begin the challenge by responding to the question prompts under the "Ask" phase of the *Exploring the Moon* handout.
    - What is the problem?
        - Design and build a spacecraft that can safely land in a crater on the Moon in order to look for water and other usable resources.
    - What has NASA already done related to the problem?
        - Apollo missions explored various Moon features and returned with rock samples for future study.
        - Ranger and Surveyor spacecraft shared pictures of the Moon.
        - Artemis program will send the first woman and the next man to the Moon and develop a sustainable human presence on the Moon that will set the stage for further human exploration of Mars.
    - What are your constraints?
        - Spacecraft must land in the designated crater on the Moon's surface.
4. Next, introduce the additional challenge constraints which should be recorded on the *Exploring the Moon* handout.
    - Spacecraft must hold two astronauts (regular marshmallows).
    - Spacecraft cannot tip over during the landing maneuver.
    - Spacecraft must be built using only the provided materials: 1 piece of cardboard (4"x5"), 1 small cup (8 oz, paper or plastic), 3 index cards, 2 regular marshmallows (astronauts), 10 miniature marshmallows, 3 rubber bands, 8 plastic straws, scissors and tape.
5. Once the student understands the goal and constraints, provide the opportunity for him/her to ask any questions and record (need to knows) about the challenge such as:
    - Where am I building the spacecraft?
    - How big does the spacecraft need to be?
    - Do I have to use all the materials?
    - How much time do I have to build?
    - How are we testing the spacecraft?
6. Now it is time for the student to imagine what the spacecraft will look like given the constraints. To do this, prompt him/her to draw his/her ideas in the "Imagine" section of the *Exploring the Moon* handout.
    - Engineers record their design ideas on paper so they can look at them while they are building and so they can share their ideas with

others. These design plans have a special name called a blueprint. You are going to create blueprints for your spacecraft.
    - Draw more than one idea. Engineers need to consider multiple ways to solve the same problem. What are two ways you could design a spacecraft that meets the constraints?
7. Provide the student with time to draw his/her spacecraft designs. Check in with the student as needed to encourage him/her to include as much detail as possible.
    - Describe your blueprints. What material(s) will you use to build _____ (i.e., the spacecraft, the cockpit)? Why do you think that material is best?
    - How will the different parts of the spacecraft work together?
    - What feature(s) of your spacecraft will keep the astronauts safe during the flight and landing?
    - What feature(s) of the spacecraft will keep it from tipping over during landing?
    - How is Blueprint 1 different from Blueprint 2? Why did you design it that way?

Closure:

Encourage the student to make necessary revisions based on thinking that might have changed during his/her conversation with you. The goal is to have detailed plans that the student can follow when building. Making changes during the actual building process will be discouraged. The student will have time to consider and make changes to his/her design during the Improve stage of the engineering design process.

Extension:

Using information gathered about the Moon's surface and features, such as craters, and the goal of the design, prompt the student to select one blueprint to create. Prompt the student to record this blueprint in the "Plan" section of the *Exploring the Moon* handout.

- You have two different blueprints for your spacecraft. You can only build one. Which one do you want to build? Why?
- What materials will you use and in what quantities?
    - The student may only have access to the materials listed, however, he/she may elect not to use some types or quantities.
    - The student must include the use of the two regular marshmallows as those will represent the astronauts traveling in the spacecraft.

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Never stop wondering.
Never stop imagining.

Exploring the Moon

Goal: Design and build a spacecraft that can safely land in a crater on the Moon in order to look for water and other usable resources.		
ASK		
What is the problem?	What has NASA already done related to the problem?	What are your constraints?
Need to Knows		

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IMAGINE

Blueprint #1

Blueprint #2

PLAN

Diagram with labels

Materials (type & quantity)