ARIZONA SCIENCE CENTER
Never stop wondering.
Never stop imagining.

# Out of This World! - Week 7

# Grades 3-5

## Day 3: Lunar Touchdown: 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:

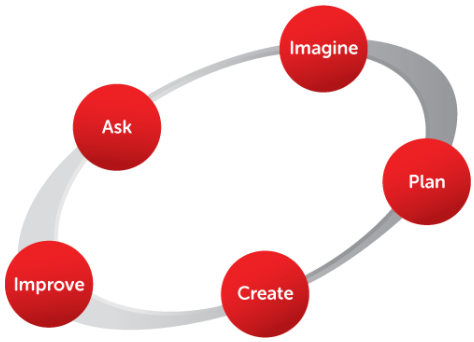
In this activity, learners will apply their knowledge of the features of the Moon (particularly craters) to imagine and develop a plan to design and build a spacecraft that can land in one of the Moon's craters without injuring astronauts or damaging the spacecraft.

### Related Standards:

- **Define problems** and **design solutions** pertaining to force and motion.

### 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
- 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. Revisit the engineering design challenge that the student is exploring this week by prompting the student to review his/her responses to the question prompts under the "Ask" phase of the *Exploring the Moon* handout from Day 1.
    - 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.
2. Next, introduce the additional challenge constraints which should be recorded on the *Exploring the Moon* handout.
    - Spacecraft must absorb the shock of the landing.
    - Spacecraft must hold two astronauts.
    - 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.
3. Now it is time for the student to imagine what the spacecraft will look like given the constraints. To do this, provide the student with a copy of the next page of the *Exploring the Moon* handout. Prompt him/her to draw his/her ideas in the "Imagine" section of the 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?
4. 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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# 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.**

## IMAGINE

| Blueprint #1 | Blueprint #2 |
| --- | --- |
| | |

## PLAN

Diagram with labels

Materials (type & quantity)