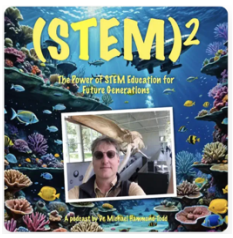

The Power of (STEM)² Podcast Lessons

Dear STEM Teachers – This free lesson plan comes from the educational podcast (STEM)² on NASA's Artemis 2 program and is designed for 3rd-8th Grade learners with a sample NGSS standard. Click here for more Artemis lessons & resources.

(STEAM)² Sample Lesson #5 - 3-Day Lesson Plan for 4th-7th Grades: Designing an Egg Lander Science Experiment

Overview:

In this unit, students will design and test an egg lander model, inspired by NASA's Artemis program, which aims to return astronauts to the Moon. The lesson plan covers three days, with each day focusing on a specific aspect of the design and testing process. By the end of these three lessons (teachers please feel free to add or subtract as needed), students will have developed skills in scientific inquiry, engineering design, and testing methods.

Grade Level: 4th-7th Grades

Duration: 40 minutes per lesson
Unit Focus: Engineering Design, Forces, Motion, Space Exploration

Next Generation Science Standards (NGSS):

- **4-PS3-4**: Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
- **3-ETS1-3**: Plan and carry out fair tests in which variables are controlled and the results are evaluated to determine which design best solves the problem.
- **5-PS1-3**: Make observations and measurements to identify materials based on their properties.
- **MS-ETS1-1**: Define the criteria and constraints of a design problem and evaluate competing solutions.
- **MS-PS2-2**: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Lesson Breakdown:

Day 1: Introduction to the Artemis Mission & Creating the Egg-o-naut

Objective:

Students will learn about the Artemis mission and the importance of safely landing astronauts (or "egg-o-nauts") on the Moon. They will brainstorm ideas for designing an egg to represent an astronaut that can survive a "landing."

Materials:

- A raw egg (1 per student or group)
- Paper and pencils for brainstorming
- Markers, stickers, or other materials for decorating the egg
- Reference materials or videos on the Artemis mission (e.g., images or short video clips of the lunar lander, Artemis rockets – links available in other lessons of this series)

NGSS Standards:

- **3-ETS1-3**: Plan and carry out fair tests in which variables are controlled and the results are evaluated to determine which design best solves the problem.
- **MS-PS2-2**: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Lesson Activities:

1. **Introduction to the Artemis Mission (10 minutes)**:
    - Show a short video or slideshow introducing NASA's Artemis mission (NASA Artemis Introduction Video).
    - Discuss how astronauts are going to land on the Moon, focusing on the challenges of protecting astronauts during landing, such as force, speed, and impact.
    - Explain that the students will simulate this process by designing an egg-o-naut (representing an astronaut) that must survive a safe "landing" from a height (similar to a lunar lander). Allow students to be creative and create their Egg-o-naut's story which can be connected to real NASA astronauts. Teams that care for their Egg-o-nauts tend to design better landers as well.
2. **Brainstorming Design Ideas (15 minutes)**:
    - Ask students: *How can we protect an astronaut during landing? What materials could absorb the impact or cushion the fall?*
    - Allow students time to sketch their egg designs, keeping in mind the goal of protecting the egg during a fall (e.g., parachutes, foam, padding, cradles).
    - Discuss engineering principles like "force" and "impact absorption."
3. **Decorating the Egg-o-naut (15 minutes)**:

- Each student or group will decorate their egg-o-naut to make it unique (a fun aspect of the activity, allowing creativity).
- Encourage them to consider how their egg will be protected based on their design ideas.
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4. **Wrap-up**:
    - Recap the importance of a safe "landing" and reinforce the idea that astronauts must be protected during re-entry and landing on the Moon.
    - Homework (optional): Have students research the engineering concepts behind the Artemis lunar lander or other spacecraft.

Day 2: Design and Build the Egg Lander

Objective:

Students will use the knowledge from Day 1 to begin designing and building their egg landers. They will learn about engineering constraints and the process of iterative design.

Materials:

- Raw egg (1 per student or group)
- Building materials (straws, cotton balls, rubber bands, tape, cardboard, plastic containers, etc.) As an extension and home-school connections, students can also be encouraged to bring materials from home.
- Scissors, glue, tape
- Rulers and measuring tapes
- Construction paper, markers (for decoration and additional design ideas)
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NGSS Standards:

- **MS-ETS1-1**: Define the criteria and constraints of a design problem and evaluate competing solutions.
- **3-ETS1-3**: Plan and carry out fair tests in which variables are controlled and the results are evaluated to determine which design best solves the problem.
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Lesson Activities:

1. **Introduction to Design Constraints (10 minutes)**:
    - Discuss the design constraints: The egg must be protected during a drop from a height of 2-3 meters (convert to feet as an option).
    - Talk about the concept of *criteria* (e.g., the egg must survive the drop) and *constraints* (e.g., using limited materials).

- Provide students with the building materials and encourage them to start brainstorming ways to protect the egg during a fall.
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2. **Design & Build (25 minutes)**:
    - Allow students to design and build their egg landers, working in groups or individually.
    - Encourage creativity in terms of cushioning, structure, and how the egg will be cradled.
    - Teachers should circulate and help groups refine ideas, discuss engineering principles (e.g., how to disperse force, how to slow the fall, etc.), and encourage students to test their landers as they work.
3. **Wrap-up**:
    - Discuss how the engineering design process involves trial, error, and refinement.
    - Homework (optional): Have students think about potential improvements to their designs after seeing others' ideas.

Day 3: Testing the Egg Lander

Objective:

Students will test their egg landers by performing a drop test, collect data, and evaluate the success of their designs. They will also refine their designs based on test results.

Materials:

- Egg-o-naut (decorated egg)
- Egg lander prototypes from Day 2
- Measuring tape or ruler to measure the drop height (3 feet)
- A soft surface to catch the egg (e.g., cushioned mat, large sponge, or sandbox)
- Clipboards and observation sheets (to record data)
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NGSS Standards:

- **MS-ETS1-1**: Define the criteria and constraints of a design problem and evaluate competing solutions.
- **5-PS1-3**: Make observations and measurements to identify materials based on their properties.
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Lesson Activities:

1. **Review of Test Procedure (5 minutes)**:

- Briefly review the test procedure for dropping the lander from a height of 3 feet and making sure the egg survives.
- Remind students to observe how their landers behave when dropped, and whether the egg survives.

2. **Testing (25 minutes)**:

   - Allow each group to test their egg lander. After each test, check if the egg survived and record the results.
   - If the egg breaks, ask the group to assess their design and suggest changes.
   - Allow groups to make improvements and re-test their landers.
   - For each test, record:
     - Did the egg survive? (Yes/No)
     - What could have improved the design?
     - What worked well?

3. **Evaluation & Conclusion (10 minutes)**:

   - Have each group present their design and the results of their tests.
   - Discuss the different strategies that worked well and why.
   - Ask: *What did you learn about engineering, design, and testing?*
   - Discuss real-world engineering processes, such as redesigning based on test results, and how space missions, like Artemis, go through similar processes.
   - End by having students reflect on how scientific inquiry and engineering are essential to space exploration.

Assessment:

- **Formative**: Observation during brainstorming, design, and building phases.
- **Summative**: Evaluation of the egg-o-naut's survival after the drop tests and the student's ability to articulate design choices.

This unit ties together scientific principles, hands-on learning, and the excitement of space exploration while following the engineering design process. Students gain a deeper understanding of physics concepts such as force, impact, and materials properties, all while participating in a creative, problem-solving challenge inspired by NASA's Artemis mission.


(STEM)2
The Power of STEM Education for Future Generations
A podcast by Dr. Michael Fasnacht, Ed.D.