Egg Drop Exploration

April 2019

Learning Objective: Students will be able to:

- Define engineering and recognize the engineering process within the activity
- Identify the forces of gravity, drag, and the term air resistance

Materials:

- Eggs (about 3 per student)
- Student handout (1 per student)
- Pencils/markers
- Ipad or phone for drop filming
- Toothpicks
- Rubber bands
- Straws
- Newspaper
- String
- Paperclips
- Cotton balls
- Paper
- Cups
- Balloons
- Paper plates
- Scissors
- Tape

Motivation (5 min)

Who thinks they would want to go live on Mars? (take answers)

Who knows how we're currently exploring Mars? (take answers)

- We're exploring Mars with various rovers (things on the surface) and orbiters (things that just get stuck around Mars, kind of like moons). We just landed the InSight rover on Mars in November of 2018.

We are dropping a very expensive, very fragile piece of fancy science onto the surface of a planet over 33.9 million miles away. *How does it land?*

Think, Pair, Share (5 min)

In pairs, discuss how "things" land. Some questions to pose might be:

- What bounces? What stays in one spot?
- When does something break when it falls?
- What do you do when you jump off something? How do you land?
    - Students might notice when they land they bend their knees to absorb their impact

Encourage some basic testing. (Let them jump off things or drop things.)

1st Exploration (20 min) - see *Student Handout*
Pretend the egg is the Mars Rover and you want to land it safely on Mars. How will you do that? In pairs or separately have students follow the Student Handout.

1. Show students the possible materials. Have students sketch what they would want their lander to look like.
2. Students have $100 in imaginary money. Have students "buy" materials based on the table on the Student Handout.
3. Students build their design.
4. Students test their design by dropping it off the roof. Have someone film the drop for review and reflection.

1st Exploration Reflection (10 min)
Have students discuss what was successful in their design and what failed.

- If the egg broke, did the lander break or did it not protect the egg enough?
- If the egg didn't break, how could the design be improved - could it be done cheaper? More reliably?
- If multiple designs were tested, how could they be integrated into one design?

Watch the following clip of a Mars rover landing.

- Why does the lander speed up as it drops?
    - Gravity is pulling it back to the ground.
- Why did NASA use a parachute?
    - Mars has an atmosphere just like Earth does. The air is made up of various gases that we can't see but that have some weight. These molecules push back on the lander creating air resistance. The more air resistance, the slower the object moves.
        - This means we want to create a lot of air resistance to counteract gravity

2nd Exploration (20 min)
Repeat the previous exploration with the modifications from the reflection stage. Encourage the designs to be mixed together if multiple were tested.

Either all together, in pairs, or separately have students follow the Student Handout.

1. Sketch
2. Buy materials
3. Build
4. Test & film

2nd Exploration Reflection (10 min)
Have students discuss what was successful in their design and what failed. What have been the good aspects of each design?

3rd Exploration (20 min)

For the final trial, only one design can be tested. Have students collaborate to use their previous knowledge to create just one lander. Test & film. **The most successful lander will be what they present at the science fair.**

Science Fair:

- Students will outline their scenario: they were trying to build models that would simulate landing a rover on Mars
- Students will explain why they chose the design they are presenting. They should mention things like “we made a big parachute to increase air resistance to counteract gravity.”

Things to discuss during the activity:

- What is engineering?
    - *Engineering is the branch of science and technology concerned with the design, building, and use of engines, machines, and structures.*
- How is the engineering process different from the scientific process?
- Does anyone know an engineer?
- What types of jobs can an engineer do?

Women in Engineering

- CEO of Girl Scouts - *Sylvia Acevedo*
    - Worked for NASA, IBM, Dell
    - Under her tenure, the Girl Scouts introduced a series of badges in robotics, coding, engineering, and cybersecurity.
- *Mars women*: https://mars.nasa.gov/msl/mission/missionteam/womenworkingonmsl/
- *Emily Roebling* - stepped in as Chief Engineer of the Brooklyn Bridge when her husband became paralyzed. Saw to the completion of the project.
- President and COO of SpaceX - *Gwynne Shotwell*
    - Could be company to send first people to Mars
    - Directed re-landing the rocket on a drone ship, launching the Falcon Heavy - most powerful rocket in use