Engineer: Parachutes are a Drag

Time: 50 Minutes **Skill Level:** Elementary (age 9-11), Middle School (age 12-14)

Background

What is Science Inquiry?

Children are natural scientists. From a very early age they explore the world, ask questions and seek answers. This journey of exploration and discovery is Science Inquiry. Science Inquiry helps young people understand their environment, solve problems and gain knowledge about scientific ideas and processes.

Next Generation Science Standards (NGSS)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
1. Defining problems	**PS2:** Motion and stability: Forces and interactions	**2.** Cause and effect: Mechanism and explanation
2. Developing and using models	**ETS1:** Engineering design	**6.** Structure and function
3. Planning and carrying out investigations	**ETS2:** Links among engineering, technology, science, and society	
4. Analyzing and interpreting data		
6. Designing solutions		
7. Engaging in argument from evidence		

Objective

In this activity students will use the engineering cycle to design a parachute to carry cargo safely to the ground.

Intro to Engineers

Engineering begins with a problem, need or desire that suggests an engineering problem needs to be solved. Engineering makes use of models to test possible solutions to problems. A simple engineering design cycle consists of six steps:

1. State the Problem
2. Generate Ideas
3. Select a Solution
4. Build the Item
5. Evaluate
6. Present Results

The Science of Parachutes

Originally parachutes were shaped like an umbrella or half of a balloon. Today there are rectangular and triangular styles as well, for different uses. Parachutes are lightweight and large. The large area traps air during the fall. The trapped air creates an upwards push that works against

The Science of Parachutes *(continued)*

gravity. The bigger the area of the parachute the more air friction, also called drag, there is. A paratrooper's parachutes is 10 meters (about 33 feet) in diameter. If the paratrooper wants to also drop a vehicle to the ground, a parachute of over 30 meters in diameter would be needed. Alternatively, more than one parachute may be used for heavy objects.

Watch the Video: http://oregon.4h.oregonstate.edu/science-engineering-and-technology

Materials List:

- Large paper coffee filters
- Metal washers for weights
- Tape measure
- String (lightweight string or thread works best)
- Clear tape
- Scissors
- Paperclips

Discuss …What do students know about how parachutes work? Discuss the engineering cycle. Discuss what can be varied in the design: length of string, number of strings, number of parachutes for a single load, weight of load. Select a design challenge that the groups agree upon for the parachutes. How should a parachute be designed to meet the challenge?

Predict …Generate Ideas. Select a Solution.

Experience "What to Do"- What is the plan for the investigation?

Show students how to do the following:

1. Cut 4 lengths of string 18" long.
2. Tape the 4 strings to the outside edge of the coffee filter. The string must be the same length.
3. Gather the strings together at the lower end and tie into a knot. Verify they are still the same length.
4. Unfold one end of the paper clip and twist it around the knot.
5. Hang washers from the other end of the paper clip.
6. Find a location to safely drop the parachutes, preferably a stairway or balcony.

How can the parachute be modified for different results? Help the students use the engineering design cycle to address the engineering challenge. While students are waiting to test their parachutes, have them use markers or colored pencils to decorate their parachutes.

Share …Each parachute displays different drop (air friction, drag) characteristics; encourage the students to share their results and discuss what they would like to change for their next drop test. Encourage the students to record their results.

Reflect …**Analyze and interpret the data and results. Discuss among the group.** Help the students develop questions of their own. Some example questions may be:

- How fast would it fall with three strings vs. four? How would you measure a change?
- Would adding more weight make a difference?
- Would more than one parachute make a difference?
- Would a larger parachute have different results?
- Does the color of the parachute make a difference?

Generalize …**to real world examples. Construct explanations.** If a student made more than one change in a parachute to test its drop characteristics, how would they know what change made the difference?

Apply …**outside the classroom or club meeting.** Where else do you see parachutes being used? How would you apply this learning experience or questioning process to other areas of your life?

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