Parachutes are a Drag

CR SMITH MUSEUM

SOARING THROUGH SCIENCE EDUCATION

Grade Level(s): 4th – 6th

Length of Time: Two 45-60min classes

Technology Lesson: Yes, Powerpoint/Video

Note: Teacher has option to opt out of introducing the lesson plan by merely playing the provided video. This video will touch base for Gravity, Mass, and Weight. If you do not think you have time to watch the introduction video then proceed with the lesson plan as follows. If you decide to use the video, ask the probing questions in Engagement and skip the Teacher and Student Activity until Exploration when it begins to explain the activity.

Sources and Additional Resources:

http://www.daviddarling.info/childrens_encyclopedia/flight_Chapter5.html

https://www.teachengineering.org/view_activity.php?url=collection/wpi_/activities/wpi_design_a_parachute/design_a_parachute.xml

http://tryengineering.org/lessons/playingwithparachutes.pdf

CONCEPT STATEMENT:

This lesson focuses on parachute design. Teams of students construct parachutes from everyday materials. They then test their parachutes to determine whether they can transport a metal washer or clothespin to a target on the ground. It explores how parachutes are used to slow moving objects. They test their parachutes, evaluate their results, and present to the class.

LESSON OBJECTIVES: Upon successful completion of this lesson, students will be able to...

Identify that drag is the force that slows down a plane as it flies through the air. During this lesson, students will: Design and construct a parachute, Test and refine their designs, Communicate their design process and results.

TEKS ADDRESSED:

Kindergarten Math: 1:(B)(C)(D)(E), 6:(A)(F), 7:(A), 8:(A)(B)(C) Science: 2:(B)(C)(D)(E), 4:(A), 5:(A)

1ST Grade Math: 1:(A)(B)(C)(D)(E), 8:(A)(B)(C) Science: 2:(B)(C)(D)(E), 3:(B), 4:(A), 5:(A), 6:(B)

2ND Grade Math: 1:(A)(B)(C)(D)(E)(F)(G), 10:(B)(C)(D) Science: 2:(C)(D)(E)(F), 3:(B), 4:(A)

3RD Grade Math: 1:(B)(C)(D)(E)(F)(G), 8:(A)(B) Science: 2:(B)(C)(D)(E)(F), 3:(A), 4:(A), 6:(C)

4TH Grade Math: 1:(B)(C)(D)(E)(F)(G), 9:(A)(B) Science: 2:(A)(B)(C)(D)(E)(F), 3:(A), 4:(A), 6:(D)

5TH Grade Math: 1:(B)(C)(D)(E)(F)(G), 9:(A)(B)(C) Science: 2:(A)(B)(C)(D)(E)(F)(G), 3:(A), 4:(A), 6:(D)

RESOURCES, SUPPLIES, HANDOUTS:

Several sheets of tissue paper, Coffee Filters, Tissue paper, Napkins, Construction paper, Newspaper, Paper towels, String, Tape, Weights (such as washers), Tape, Cotton thread, Scissors, A Meter stick, A small object such as a clothespin, Washer, A stopwatch, Cellophane, A large cotton handkerchief, A ladder for teacher's use only

SAFETY CONSIDERATIONS:

Small objects, cutting with scissors, and plastic. Teachers should be the only person to climb the ladder and drop the parachutes.

ENGAGEMENT	
Teacher and Student Activity	**Probing Questions, Answers, Misconceptions**
Teacher asks probing questions. Gravity is the force which pulls you towards the center of the Earth. Teacher drops two different balls. Gravity acts like a magnet – pulling objects together. It's how we keep our feet on the ground rather than floating around the room or floating off into space. Not only does the Earth have gravity, but everything has gravity including our own bodies. However, the Earth's gravity is much stronger than our own gravity. Teacher takes a piece of paper and shows it to the students. Ask them to predict what would happen if you were to throw it up in the air. Then, take a crumpled piece of paper and do the same thing. Throw both papers into the air to test student predictions. Next, ask the students if they could predict where each piece of paper will land if thrown again. The crumpled piece of paper will be easy to predict, but the uncrumpled one will be harder.	What is Gravity? What would happen if I put a parachute on the flat paper and crumpled paper? Would they land in the same place? Would they land at the same time?

TRANSITION…
What is weight? What is mass? Are they the same thing?

EXPLORATION	
Teacher and Student Activity	**Probing Questions, Answers, Misconceptions**
Mass is the "stuff" that matter is made of. Weight and mass are often confused with each other. But weight is actually the result of gravity pulling on the mass. We measure weight in many different ways like ounces and pounds. Your mass is the same even if you travelled to different planets but your weight changes due to how strong the gravity is pulling you. So how does mass, weight, and gravity affect an object that is falling? What is	

EXPLORATION	
Teacher and Student Activity	**Probing Questions, Answers, Misconceptions**
drag? Drag is the force that slows down things such as a plane or helicopter as they fly through the air. Drag puts up a fight as it travels through a liquid like water or even a gas like the air around us. The source of drag depends on the shape of the aircraft. Teacher then divides class into groups of 2-3 people and hands out Parachute Worksheet. The activity we will conduct today will involve you to design and build a parachute that will create drag. You will be working in teams to do this. If your class works better with specific jobs in their groups, you can assign them or let them discuss as a team which each member will be assigned to work on.	

TRANSITION…
So having experimented a little with parachutes what can you think of that flies?

EXPLANATION	
Teacher and Student Activity	**Probing Questions, Answers, Misconceptions**
Teacher asks probing questions. We designed planes to be like birds. Birds have hollow bones which make them light, and they have feathers that help them fly. The wings on planes are also hollow and shaped so that air glides over the top and pushes up on the bottom of the wing. This allows planes to fly. So having tested out your first parachute what have you learned so far about how a parachute works and what drag does?	How do you think birds and planes fly? Do you think that we based our planes off of how birds fly, what is your reasoning behind your answer?

TRANSITION…
Now think about any modifications you would like to make to your parachute. Whether it involves starting from scratch and using different materials or modifying a few things on your original design.

ELABORATION	
Teacher and Student Activity	**Probing Questions, Answers, Misconceptions**
Students will make any modifications to their parachutes and test out this new model that they created. They will record in their results and if they have extra time they can continue to modify their parachutes. Once they have completed this new modification the students will discuss as a class what materials they discovered worked best. They will also give their definitions to terms that they	What type of paper is the best material to make a parachute? Why? What materials did not work well? Why? What changes could you make to improve your design?

ELABORATION	
Teacher and Student Activity	**Probing Questions, Answers, Misconceptions**
used to describe how drag works and explain their findings.	

TRANSITION…
Now knowing what we do about how parachutes work as well as drag could we set a goal for the entire class and try to accomplish this goal using what we have already learned?

EVALUATION	
Teacher and Student Activity	**Probing Questions, Answers, Misconceptions**
Students for the remainder of their class will work as a whole to create a goal they would like to set for a parachute. This can be to have the parachute land in a specific spot, to fall as slowly as possible, to travel a longer distance, etc. Then have the class separate into groups of 3-4 students and let them take the information they learned by testing out their parachutes to create a parachute that could possibly achieve this goal, making any modifications they need to along the way to achieve this goal. Keep a record on the board of each teams' progress until one team or all the teams achieve their goal.	As students are experimenting the teacher walks around the classroom asking questions like: What type of material should you use to achieve our goal? Do you think it would be best to use a light weight material or heavier material? Can you use any of your prior knowledge from your first parachutes to create this new parachute?

Parachutes Are a Drag...

You will need:

- Several sheets of lightweight paper
- Coffee Filters
- Tissue paper
- Napkins
- Construction paper
- Newspaper
- Paper towels
- String
- Tape
- Weights (such as washers)
- Tape
- Cotton thread
- Scissors
- A Meter stick
- A small object such as a clothespin
- Washers
- A stopwatch
- Cellophane
- A large cotton handkerchief
- Walmart Sacks

Introduction

What is the purpose of a parachute? What is the role of a parachute in skydiving?

Imagine you are jumping out of a plane 10,000 feet in the air. What type of material would you want your parachute to be made of and what size would you want it to be?

The design of a parachute is very important, especially in an extreme sport such as skydiving because someone's life is dependent on the parachute functioning correctly. Engineers thoroughly test the materials and designs of parachutes to ensure that they open as intended and reliably, and are strong enough to withstand the air resistance needed to slow skydivers to safe landing speeds.

Background

A parachute is an umbrella-shaped device of light fabric used especially for making a safe jump from aircraft. Due to the resistance of air, a drag force acts on a falling body (parachute) to slow down its motion. Without air resistance, or drag, objects would continue to increase speed until they hit the

ground. The larger the object, the greater its air resistance. Parachutes use a large canopy to increase air resistance. This gives a slow fall and a soft landing.

Planning Stage

Meet as a team and discuss the problem you need to solve. Then develop and agree on a design for your parachute. You'll need to determine what materials you want to use. Draw your design in the box below, and be sure to indicate the description and number of parts you plan to use. Present your design to the class. You may choose to revise your teams' plan after you receive feedback from class.

Design:

Materials

Parachute Construction

1. Cut a circle (or other shape) from the chosen paper. Make a hole in the center of the shape.
2. Cut six pieces of equal length string and tape them at equal distances around the edge of the shape.
3. Tape the other ends of the string to a weight.

Test the parachute. Go outside and drop it from a specific height to see if it flies slowly and lands gently. Or bring your parachute to your teacher to drop from a certain place on a ladder. Record your observations.

Parachute Data			
	Drop Height	**Drop Time**	**Distance Landed From Target**
Test 1			
Test 2			
Test 3			
Test 4			
Average			

As time permits, repeat the process, modifying the variables of canopy material and shape. Record your observations.

Use this worksheet to evaluate your team's results in the Playing with Parachutes Lesson:

1. Did you succeed in creating a parachute that could hit the target? If so, what was your slowest time of descent? If not, why did it fail?

2. Did you decide to revise your original design or request additional materials while in the construction phase? Why?

3. Did you negotiate any material trades with other teams? How did that process work for you?

4. If you could have had access to materials that were different than those provided, what would your team have requested? Why?

5. Do you think that engineers have to adapt their original plans during the construction of systems or products? Why might they?

6. If you had to do it all over again, how would your planned design change? Why?

7. What designs or methods did you see other teams try that you thought worked well?

8. Do you think you would have been able to complete this project easier if you were working alone? Explain…

9. What kind of changes do you think you would need to make to your design if you needed to transport a heavier payload? Try it!

Bonus

Repeat the whole experiment using objects of different weight, threads of different length, and parachutes of different shape. Does a circular parachute, for instance, work better than a square one of the same area? What happens if you cut a small hole in the middle of the parachute?

Try using different materials such as cellophane or cotton. Which works best? Try to explain your findings.

https://www.teachengineering.org/view_activity.php?url=collection/wpi_/activities/wpi_design_a_parachute/design_a_parachute.xml

http://www.daviddarling.info/childrens_encyclopedia/flight_Chapter5.html