NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE™

Parachutes and Drag

Students will obtain an understanding of the force of drag, and how various designs of parachutes can alter the magnitude of this force. This activity allows the student to design multiple parachutes with the objective of maximizing drag

LESSON PLAN

Learning Objectives

The students will:

- Demonstrate an understanding of drag and how drag can be applied to everyday situations.
- Build a variety of models to compare drag.
- Measure time, average results, and plot data results on a line graph

Goal

In this lesson, students will discover how the force of drag affects a parachute. Students will make two different parachutes and measure their time of descent, which allows for them to observe which yields the most drag. Students will graph the time of descent for each parachute, compute the average descent time, and compare their results with classmates on a class graph.

Background

Aerodynamics is the study of forces acting upon objects as they move through the air. There are four fundamental forces acting upon airborne objects: lift, thrust, weight, and drag. This lesson focuses on drag. Drag generally is the force that opposes the motion in which an object is moving.

Drag is commonly understood as air resistance, which is realized in many common situations. This force is helpful for parachutist, ski jumpers, and flying squirrels. But car designers may want to seek to minimize drag to increase the fuel economy of the car.

Grade Level: 5 – 6

Ohio Learning Standards/Technology (2017)
Design and Technology
3-5.DT.2.b.: Plan and implement a design process
3-5.DT.2.c.: Generate, develop and communicate design ideas and decisions

Ohio Learning Standards/Science (2018)
Expectations for Learning
Nature of Science

Physical Science
5.PS.1: Force and Motion
6.PS.4: Matter and Motion

Ohio Learning Standards/Mathematics (2017)
Statistics and Probability
6.SP.4: Display numerical data
6.SP.5: Summarize numerical data sets

Materials Required:

For the warm-up activity:

- Large sheet of poster board
- Stopwatch
- Umbrella

For the main activity:

- Plastic garbage bag
- String
- 4 metal waters or nuts
- Tape
- Scissors
- Stopwatch

Let's Get Started: A Warm-Up

First and foremost, make sure there is appropriate space for the activity and discuss appropriate behavior while testing parachutes

To introduce students to the concept of drag, complete some or all of these warm-up activities. Ponder what the word *drag* means, and what it means in relationship to an airborne object. How do you think we could demonstrate drag? When is it important to have a lot of drag, or very little drag?

A Few Warm-Up Exercises

1. Have a student run between two points. Run again, but this time, the runners will hold a large iee of poster board in front of them. Repeat this with the edge against the wind. Observe and discuss the differences in the amount of resistance. Time each of these runs with a stop watch and discuss the differences.
2. Give a student a closed umbrella. Have them hold the umbrella behind themselves and run between two points. Now, have them open the umbrella and repeat the run. Discuss the effects of air resistance on the umbrella. Why has the air resistance changed?
3. Take two identical sheets of paper in your hands, leave one intact and crumple the other in a ball. Form a hypothesis of which piece of paper is going to hit the floor first. Hold your hands at the same height and drop the two pieces of paper at the same time. Observe which one reached the floor first. Why? (Crumpled paper because it has less air resistance, or drag.)

The Main Activity

First and foremost, make sure there is appropriate space for the activity and discuss appropriate behavior while testing parachutes

1. From a large plastic trash bag, cut out four squares measuring 25 cm on each edge
2. Cut four pieces of string that have the same length (20 cm is suggested)
3. Attach one end of string to a corner of one of the plastic squares, and repeat for all four corners, using tape
4. Gather the four ends of string, and tie them to a metal washer/nut
5. Next, cut one of the plastic squares into a circle. You may use a compass, but it need not be precise
6. Cut six pieces more pieces of string that are the same length as those used in step (2)
7. Using tape, attach six pieces of string around the perimeter of the plastic circle. The more equidistant, the better
8. Tie all of the strings to a separate washer/nut from step (4)
9. Using a timer or stopwatch, drop the parachutes from the same height (on eat a time) and record how long that it takes for it to hit the ground. Record the time it takes for each parachute three times, for a total of 6 trials for this experiment.
10. Develop a record sheet, record these results and find the average. Graph the results on a line graph.
11. *optional* Using the two remaining squares, design two more parachutes. Keep the weight (the washer/nut) and the string length constant so the only thing changing is the shape of the parachute. Record the time it takes for each of these to fall and record this data in the same table from before. Plot these data points on the individual line plot
12. **optional** Once finished collecting data, cut a small hole in the center of the parachute. What will happen?

Optional Challenges or Exercises

1. Try making parachutes of different sizes, but the same shape.
2. Use different materials – how do you think a material like cardboard or thick paper would perform?
3. Tie two parachutes together and test, is the result what you expected?

Resources

On the Forces of Flight

https://www.scienceworld.ca/resource/four-forces-flight/

https://mste.illinois.edu/TCD_new/Aerodynamic_Forces/four_aerodynamic_forces.html

On Parachutes, and how they work

https://www.nasa.gov/sites/default/files/atoms/files/orion_parachutes.pdf

https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/195681/excelsior-gondola/

https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196438/berlin-airlift-little-vittles-parachute/

https://www.nationalmuseum.af.mil/Visit/Museum-Exhibits/Fact-Sheets/Display/Article/196415/an-6510-parachute-seat/