



Lessons from Scout Elf School:
**Aerodynamics of
Santa's Sleigh**





Note to Teacher

In the stories of Scout Elf School, the elves learn about the magic and mechanics of Santa's sleigh so they can help plan and prepare for his journey around the world each year. In this activity, your students will learn the basic concepts of aerodynamics and will experiment using a variety of paper airplane designs.

Core Curriculum Concepts

- Engineering
- General Science
- Physics
- Measurement

Next Generation Science Standards:

- Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Introductory Activity

- Review the terms:
 - Lift: a force that pushes objects up
 - Drag: a force that pushes objects back
 - Velocity: how fast an object moves over a distance
- Demonstrate lift:
 - Place an empty gallon size zipper plastic bag on a table.
 - Insert a flexible straw in the bag and close the zipper. Use two small strips of duct tape to seal the bag around the straw to keep air from escaping.
 - Place a textbook on top of the plastic bag on the table.
 - Blow into the straw to fill the bag with air, showing how compressed air will lift the book off the table.
 - Try again with more than one book!



- To demonstrate drag and velocity, have students fold paper airplanes as shown in the printable activities. Remind students that it takes more velocity to lift heavier objects. Have them experiment using different weights of paper (construction paper, copy paper, card stock) to make their paper airplanes, then have them test the same design in different weights.
- Have students experiment with different levels of force (toss strength).
Have students experiment by using a fan to see if they can increase or decrease flight distance.
- Have students measure flight distance of each design.
- Have students measure flight time of each design.

Resources

Buddies, Science. "Soaring Science: Test Paper Planes with Different Drag." Scientific American, Scientific American, 28 Feb. 2013, <https://www.scientificamerican.com/article/bring-science-home-paper-planes-drag/>.

Activity Instructions

Beginning learners:

Using airplane design #1, students will fold an 8.5" x 11" piece of paper into the airplane shape and record flight distance for 5 trials. Students may experiment further by adding pieces of tape, folding additional flaps or snipping away parts of their plane to see if flight distance will increase or decrease.

Progressing learners:

Using airplane design #1 and #2, students will fold an 8.5" x 11" piece of paper into the airplane shape and record flight distance for 5 trials. Students may experiment further by adding pieces of tape, folding additional flaps or snipping away parts of their plane to see if flight distance will increase or decrease. For further experimentation, try folding the same design with different types/weights of paper to see which paper performs the best.

Advanced learners:

Using airplane design #1, #2 and #3, students will fold an 8.5" x 11" piece of paper into the airplane shape and record flight distance for 5 trials. Students may experiment further by adding pieces of tape, folding additional flaps or snipping away parts of their plane to see if flight distance will increase or decrease. For further experimentation, try folding the same design with different types/weights of paper to see which paper performs the best. Students will measure distance and/or flight time of each design.