

Paper Airplanes

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Subject: Physics

Grade Level: 3-8

Standards: (Next Generation Science Standards: www.nextgenscience.org)

3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Schedule: 1 Hour

Objectives:

Students will choose different paper airplane designs to make. They will then test and collect data on each type to observe and explain how they fly.

Vocabulary:

Aerodynamics	Thrust
Force	Lift
Drag/Resistance	Pressure
Weight	

Students Will:

- Understand how an airplane works and the forces acting on it.
- Follow directions to construct different paper airplane designs.
- Design an experiment to test a hypothesis.

Materials:

- Paper (different types if you want to have it as a variable)

Optional Materials:

- Ruler, Meter stick, Measuring Tape
- Stopwatch

Safety

There are no safety concerns



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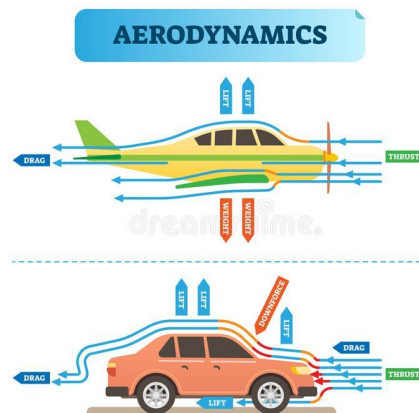
Science Content for the Teacher:

Have students read the following before doing the experiment:

What Makes Paper Airplanes Fly?

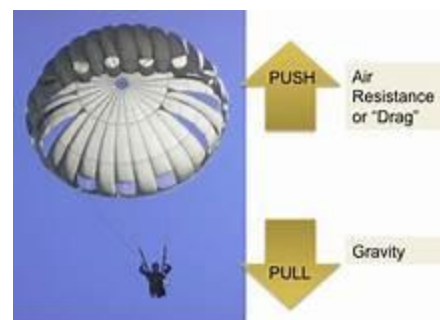
Aerodynamics

What makes a paper airplane fly? Air — the stuff that's all around you. Hold your hand in front of your body with your palm facing sideways so that your thumb is on top and your pinkie is facing the floor. Swing your hand back and forth. Do you feel the air? Now turn your palm so it is parallel to the ground and swing it back and forth again, like you're slicing it through the air. You can still feel the air, but your hand is able to move through it more smoothly than when your hand was turned up at a right angle. How easily an airplane moves through the air, or its aerodynamics, is the first consideration in making an airplane fly for a long distance.



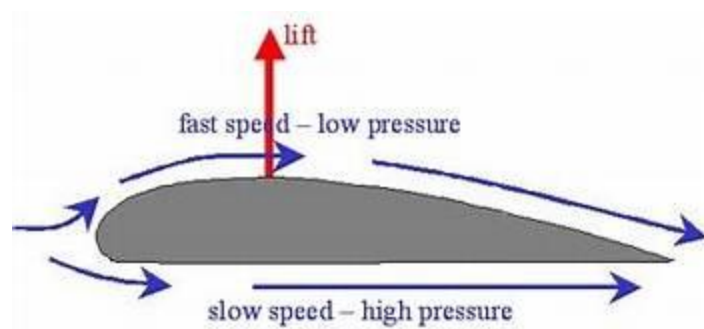
Drag and Gravity

Planes that push a lot of air, like your hand did when it was facing the side, are said to have a lot of "drag," or resistance, to moving through the air. If you want your plane to fly as far as possible, you want a plane with as little drag as possible. A second force that planes need to overcome is "gravity." You need to keep your plane's weight to a minimum to help fight against gravity's pull to the ground.

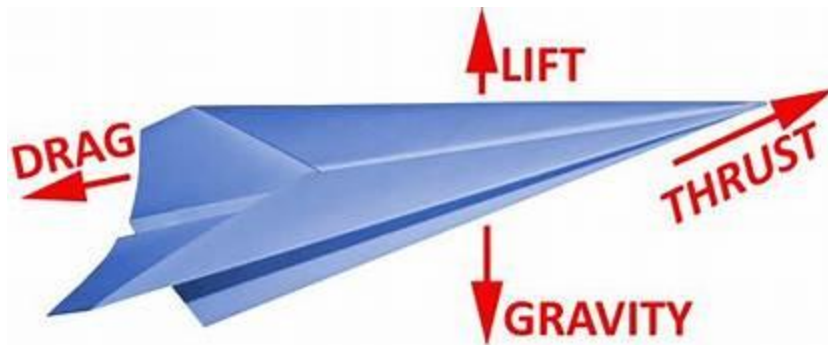


Thrust and Lift

"Thrust" and "lift" are two other forces that help your plane make a long flight. Thrust is the forward movement of the plane. The initial thrust comes from the muscles of the "pilot" as the paper airplane is launched. After this, paper airplanes are really gliders, converting altitude to forward motion. Lift comes when the air below the airplane wing is pushing up harder than the air above it is pushing down. It is this difference in pressure that enables the plane to fly. Pressure can be reduced on a wing's surface by making the air move over it more quickly. The wings of a plane are curved so that the air moves more quickly over the top of the wing, resulting in an upward push, or lift, on the wing.



The Four Forces in Balance



A long flight occurs when these four forces — drag, gravity, thrust, and lift — are balanced. Some planes (like darts) are meant to be thrown with a lot of force. Because darts don't have a lot of drag and lift, they depend on extra thrust to overcome gravity. Long distance fliers are often built with this same design. Planes that are built to spend a long time in the air usually have a lot of lift but little thrust. These planes fly a slow and gentle flight.

"What Makes Paper Airplanes Fly?" *Scholastic*,
www.scholastic.com/teachers/articles/teaching-content/what-makes-paper-airplanes-fly/.



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