FLYING HIGH

How does something as big as an airplane stay up in the air?

THE GOAL:
Explore two of the basic forces of flight, then use your new knowledge to design a paper airplane.

WHAT YOU NEED:
- Paper
- Umbrella, blanket, or similar large, lightweight object
- 2 balloons
- 2 pieces of string
- Timer (optional)

EXPLORE LIFT

1. Blow up two balloons. You can add a small amount of water to them to make them more stable. Tie a string to the end of each balloon.
2. Hold the the two balloons next to each other a few inches apart, in front of your face. Blow air through the space between the balloons. What happens?
3. You can also try this experiment with two sheets of paper. Hold them so that they are hanging vertically with their surfaces facing each other, close together in front of your mouth. Now blow in between the papers, and observe the result.

DID YOU KNOW?

Air is a fluid, meaning it flows and has no fixed shape. Both liquids and gases are considered fluids. **Fluid dynamics** is the study of how fluids (like air) move.

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FLYING HIGH CONT.

Explanation: Did you notice that when the air between two objects starts moving faster, the objects move closer together? That's because **faster moving air has lower pressure than slower moving air**. So, the slower air surrounding the objects pushed them inward.

Think about pressure differences like an arm wrestling match. If one arm wrestler is stronger than the other, their arm will create more pressure and push the other person's arm in one direction. In this example, the slow air on the outside of the cans "won the match" by creating more pressure, and it pushed the balloons inward.

What does this have to do with flight?
The shape and tilt of an airplane's wing affect the flow of air that moves above and below it. When the air above the wing moves faster than the air below, it lowers the air pressure and the wing is pushed up. This is what creates lift. A plane needs to have enough air under its wings to hold it up.

EXPLORE DRAG

1. Move to an open space where you can run safely. Run in a straight line between two points. Time yourself, if possible.
2. Now open up an umbrella (if you don't have an umbrella you can hold a jacket or towel in both hands and spread it out behind you). Run the same distance again, this time holding the umbrella behind you. Time yourself again.
3. Was it easier to run with the umbrella or without it?

Explanation: When an object moves, it collides with air. This creates air resistance, or drag, which slows the object down. Which do you think will collide with more air, an object with a compact shape or an object with a shape that is more spread out?

FLYING HIGH CONT.

DESIGN YOUR OWN AIRPLANE!

1. Construct a paper airplane and test it out. How well does it fly?
2. Use what you just learned to improve your airplane. How can you increase lift? How can you reduce drag?
3. Construct an airplane designed to fly fast. What special qualities does it have?
4. Construct an airplane designed to stay in the air for a long time. What special qualities does it have?
5. Experiment with different airplane shapes and materials. How does changing the shape affect the way the plane flies? What happens when the airplane has wide wings? Narrow wings?

MORE TO EXPLORE

- Besides lift and drag, there are two other forces that affect flight. Can you guess what they might be? Look up the other two forces, then think about how they might affect your paper airplane.
- Visit the How Things Fly website. This website from the Smithsonian National Air and Space Museum has games and activities that help students further explore the science behind flight: https://howthingsfly.si.edu/activities.

READ ALL ABOUT IT!

- **DK Eyewitness: Flight** by Andrew Nahum
- **To Fly: The Story of the Wright Brothers** by Wendi C. Old
- **The Hallelujah Flight** by Phil Bildner

This activity aligns with the following Oklahoma Academic Standards:

- 3-PS2-1, 3-PS2-4, & 5-PS1-1 Motion and Stability: Forces and Interaction
- 4-PS3-3 Energy

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STEM in a Bag