Lesson 9: Staying Afloat

Grade: 3rd-8th

Duration: 30 minutes

Standards:

- *NGSS Physical Science* – Relationships between forces and energy; Types of interactions between objects with different forces and energy

Objectives:

- Students will be able to identify forces that allow airplanes to fly by participating in demonstrations of Bernoulli's principle.

Key Vocabulary:

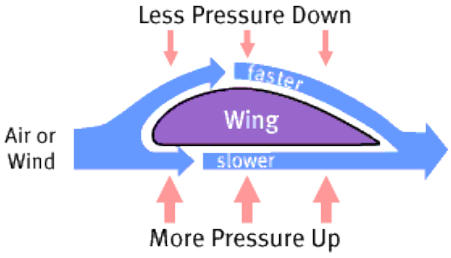
- air pressure, high pressure, low pressure, lift, airfoil

Materials:

- bendy straws, small funnels to fit inside the straw, ping pong balls, hair dryer, strips of paper (approximately 2in. x 8 in.), paper clips, tape

Procedure:

1. Engage students by asking them to ponder: How do things fly? After a few ideas are shared, explain to students that it wasn't until a Swiss mathematician and scientist, Daniel Bernoulli, made an important discovery about the movement of air that humans were able to make great advances in flight. Bernoulli discovered that if fluid (like air or water) in an area is moving faster than the surrounding area it lowers the pressure.
2. Demonstrate this principle by giving students each a thin strip of paper. Hold the paper on the chin under the bottom lip and blow quickly over the top of the paper. The once droopy paper should rise up.
3. As students explore this phenomenon, explain that the fast moving air over the top of the paper creates a low pressure zone. Under the paper is relatively higher pressure and the air forces up to fill in the low pressure zone. Use a diagram to help explain this effect.
    a. Diagram illustrating Bernoulli's Principle:



4. Demonstrate the same effect with ping pong ball levitation. Show students how you can hold up a ping pong ball using a blow dryer. Explain that this is not magic and that the students can achieve the same effect if they create enough pressure with their breath.
5. Have students lie on their backs with a straw in their mouth. Have them hold a ping pong ball over the straw and see if they can get it to float in the air by blowing air through the straw. This won't work! But have students attach a small funnel to the bendy end of the straw and try again. Secure the straw using tape, but be sure not to pinch the straw shut. Put the ball in the funnel and blow through the straw. This time the ball will float! As an added challenge, see if they can get the ball to float in the funnel when it's upside down.
6. Reiterate how this floatation occurs using a diagram. The fast air coming out of the straw makes the pressure underneath the ball lower than the pressure around it. Air tries to move from where there is a lot of pressure to where there is a little pressure and that movement causes force called lift. This is known as Bernoulli's Principle.
7. Explain that Bernoulli's Principle is important for many things, one of those being airplane wings. Airplane wings are airfoils, meaning their shape is curved at the top and flat at the bottom. This makes the air at the top of the wing travel further than the air at the bottom. For the air traveling at the top of the wing to reach the other side at the same time as the air at the bottom, it has to move faster. The airfoil design forces air to move faster over the top of the wing, creating a low pressure zone. Since the air at the bottom of the wing has higher pressure than the top, it creates lift, pushing the wings upwards. Differently shaped airfoils can create different amounts of lift and drag.
8. Let's try to find out just how much force lift can provide. Make sure each student still has their small strip of paper and give them several paper clips. With the strip of paper against their chins, just below their mouth, have student blow outward and watch as the paper rises. Now attach a paperclip to the end of the paper away from their chin and have them repeat the process. How many paper clips can they lift?
9. As a wrap up, reiterate the basics of Bernoulli's Principle and have students identify how lift plays a role in the flight of airplanes.