

# FLIGHT TEST LAB

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## SAFETY

### **WARNING.**

Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled. Strangulation hazard — long rubber bands may become wrapped around the neck.

Keep the packaging and instructions, as they contain important information.

### **WARNING.**

**CHOKING HAZARD** — Children under 8 yrs. can choke or suffocate on uninflated or broken balloons. Adult supervision required. Keep uninflated balloons from children. Discard broken balloons at once. Use an air pump to inflate the balloons. Made of natural rubber latex, which can cause allergies.

## EXPERIMENT 1: FLOATING ON AIR

This simple experiment demonstrates the fundamental principle that keeps airplanes up in the air.

1. Bend the bendable straw and hold it with the short part facing up.
2. Cut four small incisions in the opening and bend the plastic strips outward into a funnel as shown.
3. Rest the small ball on the funnel and blow evenly into the other end of the straw. The ball takes off and hovers in the air stream above the funnel.



Air behaves like a fluid. The faster fluids move, the lower their pressure. This is called **Bernoulli's principle**. Airplane wings use Bernoulli's principle to lift the plane upward. In this experiment, the air flowing around the sides of the ball is moving faster than the air directly under it. This high pressure pushes the ball inward from all sides, keeping the ball in place.

## EXPERIMENT 2: PROPELLER

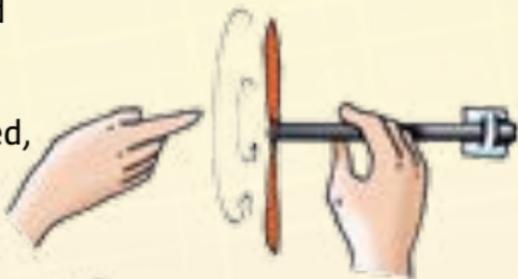
A car moves because its wheels push the ground away. An airplane doesn't have wheels, but its propeller moves it forward.

Test the propeller by blowing on it. It turns when it is pushed by the wind. So, if it were to be turned by an engine, it should push back on the air! Let's assemble the propeller shaft.

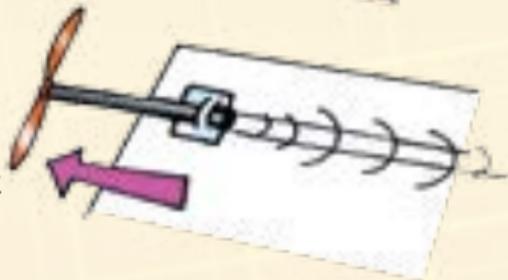
1. Guide the rubber band through the black straw. This works best when you cut a slit in the end of the other straw, hook the rubber band to it, and slide it through the black straw.
2. Fix the rubber band at the end with the cardboard piece from the die-cut sheet as shown. Insert the propeller into the straw at the other end.



3. Now hold the straw and turn the propeller 30 times. The rubber band winds up. When released, it turns the propeller rapidly. Do you feel the flow of air?



4. Wind up the propeller and place it on the edge of a table so that it can still rotate freely, and let it go. It shoots forward.



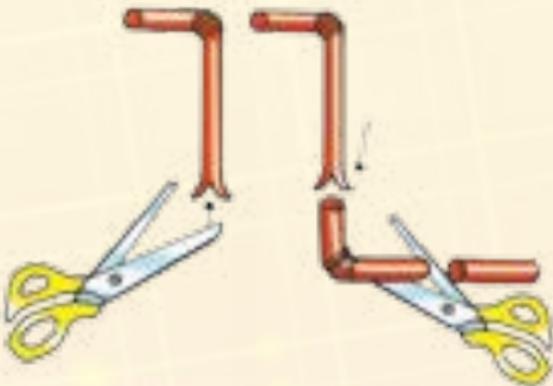
The same forces that generate lift on airplane wings are at work in the **propeller**. The special shape of the propeller pushes the air forward or backward depending on which way it rotates. In most propeller-driven aircraft, the propeller is located at the front of the aircraft and pulls it forward. Small ultralight planes often have a propeller at the back that sends a stream of air backward and pushes the aircraft forward.

## EXPERIMENTS 3 AND 4: REPULSION

1. Blow up the balloon and let it go. It zooms around the room quickly. Apparently, it is the air flowing out of the balloon that propels it forward.



2. Now, cut two slits in the end of one bendable straw. Shorten the other bendable straw, and insert it into the first straw as shown.



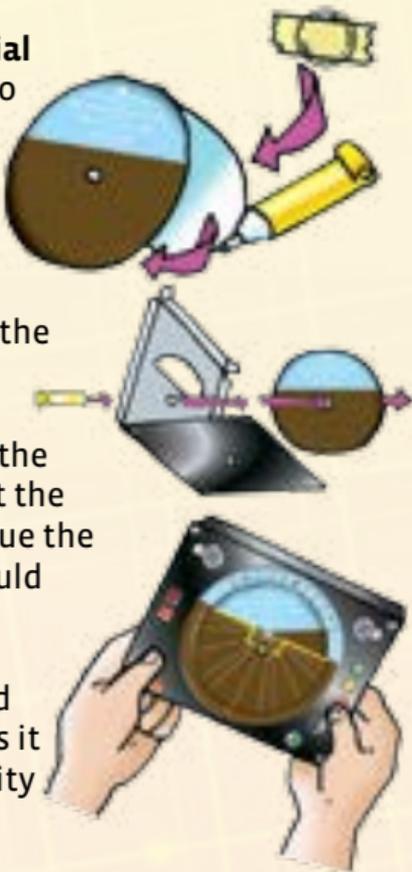
3. Place the upper short end loosely between your lips and hold it lightly with the long part down and the lower straw pointing to the side. Blow into it and the straws rotate. These two experiments show you how **jet engines** work!



## EXPERIMENT 5: ARTIFICIAL HORIZON

Build a simple model of an **artificial horizon**, a device that pilots use to see if their planes are horizontal in the air when they are flying in darkness or through fog.

1. Fold the disc and glue the two sides together. Tape a penny in the spot indicated.
2. Put the brass fastener through the hole in the outer casing and put the disc on it. It must spin easily. Glue the marked faces. The fastener should pass through to the other side.
3. Tilt the finished model right and left. The horizon line changes as it would in a real airplane as gravity pulls the penny downward.



## EXPERIMENT 6: RING PLANE

Now put ring-shaped wings on the propeller shaft from Experiment 2.

1. Cut out the two strips of paper.
2. Bend the two strips into rings and secure them with tape.
3. Tape the rings to a straw. Tape this to the propeller shaft so that the tail part (the smaller ring) is near the propeller and the wing part (the larger ring) faces forward.

4. Altering the position of the rings changes the center of gravity and hence the flight behavior. Try out different positions to see how it affects the flight. The two rings act as wings and generate **lift**. At the same time, they enable straighter flight. The propeller pushes the plane forward through the air.

