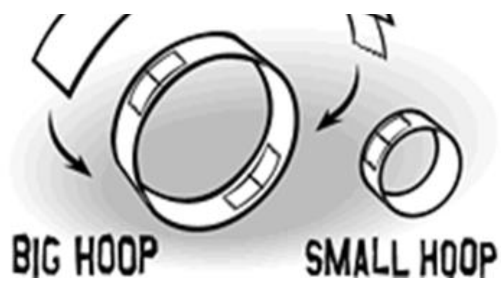
RING GLIDERS MINI LESSON

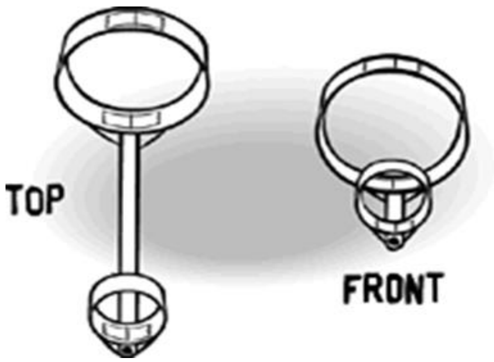
Powered only by gravity and air currents, these gliders like kites move silently through the sky staying aloft by balancing the forces of gravity, lift, drag, and thrust.

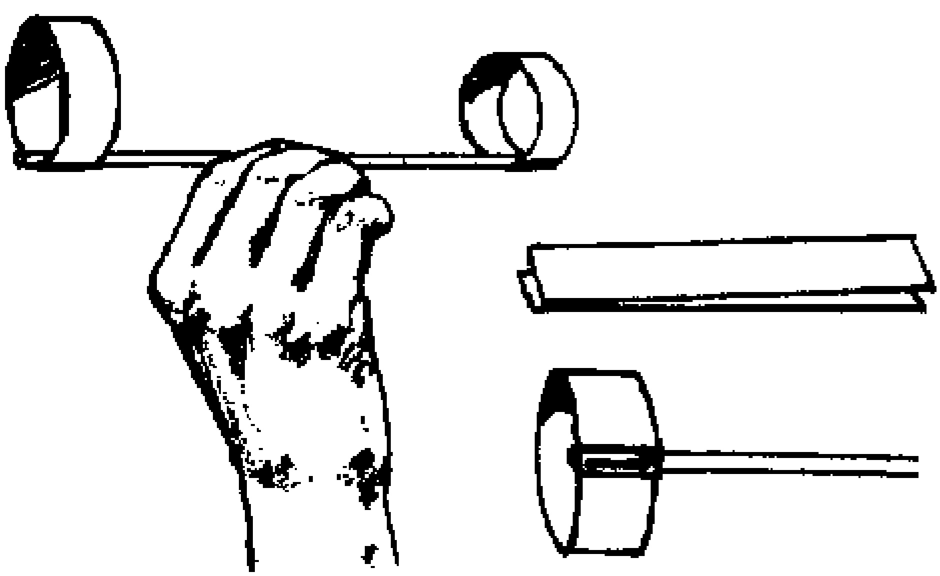
Before the Wright brothers built and flew their airplane, Otto Lilienthal was working on trying to find a way for a man to fly. Flying a glider is probably the closest thing any human will come to feeling like a bird. The students will learn about the four forces and build and fly a ring glider.

Procedure:

- Cut one strip of paper that measures 7'' long by 1'' wide.
- Cut another strip that measures 5'' long by 1/2'' wide.
- Make two rings out of the strips of paper by taping both ends as shown. Make sure the ends overlap by about 1''.
- Carefully slip one end of the straw in between the taped ends of the big ring. Do the same with the smaller ring.
- Check to make sure that the rings stand straight up from the straw. If they are crooked, the glider will not fly right. Tape the inside of each ring to the straw.
- Here's how to make your glider fly: Hold the straw in the middle with the smaller ring in front, and then give the glider a firm push; it does not require a throw. You have liftoff!




TOP
FRONT



How Does it Fly?

The two sizes of rings help to keep the straw balanced as it flies. The larger ring creates "drag" (air resistance) which helps to keep the straw level while the smaller ring keeps the glider on course. Even though the rings are heavier than the straw, the glider does not turn over. The rings will remain upright since objects of different weight generally fall at the same speed.

Experiment 1: Effect of wing size on Ring Glider performance

- Determine if ring glider fly better with different size wings, or wings that are the same size.

Experiment 2: Effect of fuselage (straw) length on Ring Glider performance

- Determine how the length of the straw affects the performance of the Ring Glider by cutting straws to shorter lengths, or join several straws together to make longer lengths.

Observations

1 Does the placement of the hoops on the straw affect its flight distance?
2 Does the length of straw affect the flight? (You can cut the straws or attach straws together to test this)
3 Do more hoops help the hoop glider to fly better?
4 Do the hoops have to be lined up in order for the plane to fly well?

Hints:

- If the glider nose dives, move the large wing forward slightly and try again. If you move it too far forward, the glider will wobble through the air.
- If the glider wobbles when you first fly it move the small wing back slightly and try again. Properly adjusted, the glider should have a long, flat glide.

Education Standards (NGSS)

Motion and Stability: Forces and Interactions 5-PS2-1
Engineering Design MS-ETS1-4

ROTOCOPTER MINI LESSON

Background:

Engineers take into account all forces acting on the object when designing recreation and transportation vehicles. The drag force generally increases for objects with a large surface area. Drag exists because of the motion between a fluid (even air!) and an object. It doesn't matter if the object is stationary and the fluid is moving, or if the fluid is still and the object is moving through it. What really matters is the difference in speeds between the object and the fluid. Students learn about weight and drag forces by making paper helicopters and measuring how adding more weight affects the time it takes for the helicopters to fall to the ground.

Objectives:

- Understand drag and that this force depends upon factors such as the shape of a helicopter blade.
- Understand that weight is a force that increases by adding mass
- Think about how engineers could re-design a helicopter for different purposes

Procedure:

- Have students drop an unfolded piece of paper.
- Have the students predict what will happen if they wad up the paper and drop it.
- Decide a height from which to drop the helicopter and determine where to hold the helicopter to drop it from the agreed-upon height.

2 Have the students predict the time it will take for helicopters to fall.

3 Have students drop the helicopter from the agreed-upon height.

4 Now, have students drop an unfolded piece of paper and the helicopter. Ask: Which one fell faster? Students will observe that the paper falls faster because it did not generate lift, whereas the spinning helicopter reduced the rate of its fall by producing lift and resisting the pull of gravity.

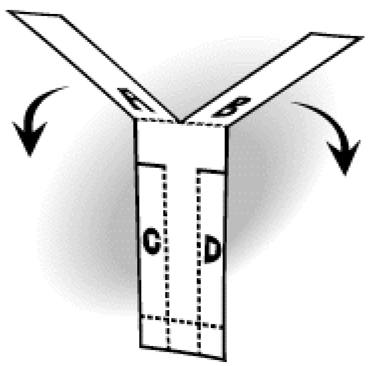
5 Have students add 1, 5 and 10 paperclips to the bottom of the helicopter and drop the helicopter. How do the paper clips affect the landing of the helicopter?

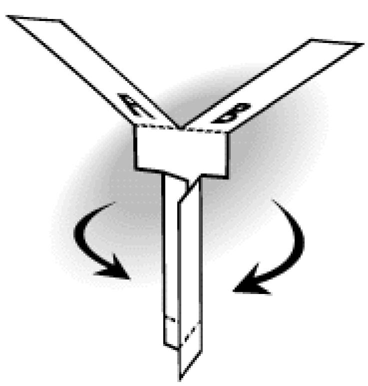
- How could they design their helicopter to make it more effective? What do you think your design would accomplish that this helicopter design did not accomplish?
- Now ask what design change would make their helicopter move SLOWER.

- Tell them that this is what engineers do when coming up with the perfect design of something – they test an original design and modify it in some way.
- Ask the students what can we do to influence forces? Do parachutes/helicopters with larger surface areas go faster or slower? (Answer: Slower) Which force is this influencing? (Answer: Drag) What if we add weight? (Answer: It will fall faster.) Could we make a parachute with a large area and a large weight that falls at the same rate as a small area and a small weight? (Answer: Yes)

Why does the Roto-Copter spin?
When the Roto-Copter falls, air pushes up against the blades, bending them up just a little. When air pushes upward on the slanted blade, some of that thrust becomes a sideways, or horizontal, push. Why doesn't the copter simply move sideways through the air? That's because there are two blades, each getting the same push, but in opposite directions. The two opposing thrusts work together to cause the toy to spin.

- Gravity causes the model Roto-copter to descend.
- Air resistance on the blades pushes upward.
- Compressed air under the blades pushes the right blade one way and the left blade the opposite way.
- Because of resistance and drag the Roto-copter rotates as it descends.





STEP 1: Fold A toward you.

STEP 2: Fold C and D over each other so they overlap.

STEP 3: Fold the bottom up and put a paper clip on it.

Step 4: Fold B away from you.