

How do birds fly?

Overview: Students will demonstrate several key principles involved with flight.

Objectives Students will

- model how birds flap their wings
- model how air moves over the wing
- model a streamlined shape
- model stopping and turning

Concept Words: aerodynamic, Bernoulli Principle, drag, lift, streamlined

Materials: White computer paper *
Tape measure, stop watch (optional)
*provided by the teacher

Preparation: Have sheets of 8.5 x 11 paper available for students to use. Paper should not have holes in it. Allow for at least 3 sheets per student. Additionally cut enough sheets of paper in half lengthwise so that each student gets a half- sheet.

The information in the leveled reader “What Makes a Bird a Bird” is excellent background material for this activity. This leveled reader discusses the many ways that a bird is adapted for flying.

Check websites for animation and/or videos of birds flying. Also check out websites for instructions and templates for making paper airplanes. (See links at the EPS website www.espsciencetime.org)

Background Information: While feathers are the characteristic that defines an animal as being a bird, flight is the characteristic that most of us associate with birds. Feathers along with a number of other physical adaptations enable a bird to fly.

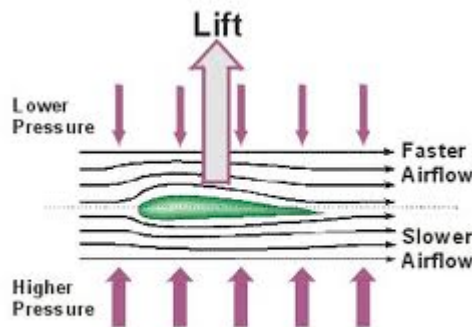
In this lesson students will look at several factors involved with flying. These factors include how the wings move, the shape of the wings, the bird's streamlined shape, the use of feathers to stop and to turn. Each factor is demonstrated with an activity. These are described in the **Procedure**.

Procedure: Flapping wings
Have students stand and hold their arms out. Ask them to imagine that their arms are wings. Have them look at their hands. If they were birds, primary feathers would be attached their fingers and wrist bones. Secondary feathers would be attached to their forearms. On the front of the forearm would be additional layers of feathers called coverts. (The importance of coverts will be discussed in the next activity.)

Have students model how birds move their wings. Ask students to lift their arms up high, then move their arms forward and down in a circular motion. As they move their arms back and up, have them open their fingers (their primary feathers). Then as they lift their arms up again, have them close their fingers. If this is too complicated, just have students get the sense of how birds move their wings by having students stretch out their arms and rotate them. See if students can do this for 5 minutes. (Most students tire by the end of 2 minutes.) Although this is an imperfect model of how birds flap their wings, it will certainly give students an appreciation of how much energy flying requires. Birds do have the advantage of having large chest muscles to make moving their wings easier. Even still, because flying requires so much energy, birds have to eat a lot of high calorie foods like seeds. To make sure that the flight muscles get enough oxygen, there are air sacs connected with their respiratory system and birds' hearts beat much faster than humans'. (This information is covered in the leveled reader "What Makes a Bird a Bird".)

The Shape of the Wings

As mentioned before, the front of the bird's forearm or wing is covered with covert feathers. Coverts make the wings thicker and rounder at the front. The result is a wing shape that is convex above and is called an airfoil. The importance of this shape is that it requires air to move faster over the top of the wing than it does below the wing. The result of this air movement is lower air pressure over top of the wing, higher air pressure below the wing. This is the **Bernoulli Principle**. The higher pressure below the wing results in lift and helps to hold the bird up in the air.



Students can model this by holding the half-sheet of paper below the bottom lip. Ask students to blow across the paper. This should cause the paper to rise or lift up. The paper lifts for the same reason a bird's wing causes the bird to lift up. Faster moving air across the top of the paper creates lower pressure on top of the paper. The air pressure below the paper is relatively higher and this pushes up on the paper and causes it to lift.



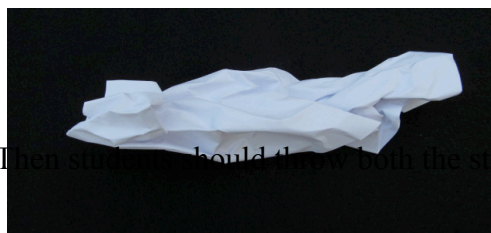
Streamlined Shape

As a bird tries to go forward, it's held back by the air pushing against it. This force is called **drag**. But the shape of the bird is **streamlined** so the bird experiences less friction from the air it moves through. Another word that can be used to describe the shape of a bird's body is **aerodynamic**. The shape of a bird's body allows air to easily flow around it.

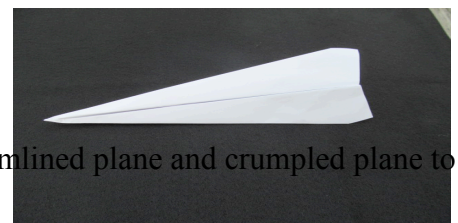
Students can model the bird's streamlined and aerodynamic shape by making a paper airplane. The front of the paper airplane is pointed and allows the plane to "cut through the air". A bird's beak is pointed and achieves the same effect. The surface of the paper airplane is smooth and if the creases are tight then the shape is streamlined and air can flow easily around it. The overlapping layers of contour feathers on a bird's body provide a similar smooth surface that air can easily flow around.

Instructions for making a basic model of a paper air plane follow this lesson, but students may already know how to make a paper airplane. The instructions provided here are for just one of many different types of paper airplanes.

After students have made a paper airplane, have them take another piece of paper, fold it in half lengthwise and crumple it. This represents the non-streamlined shape.



non-streamlined



streamlined

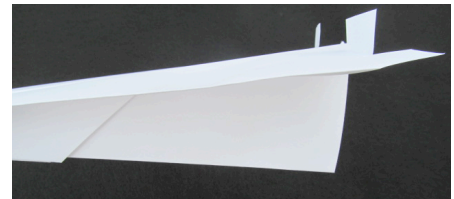
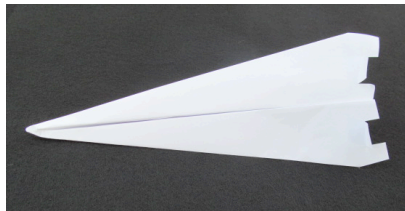
Then students should throw both the streamlined plane and crumpled plane to compare

Have students throw their streamlined paper airplane and their non-streamlined plane (the crumpled paper). Streamlined plane should go further and faster. Putting a paper clip on the front-mid part of the plane can improve performance. The paper clip can even represent where the center of gravity is on a bird. Birds carry most of their weight in their center of gravity

Stopping and Turning

Birds use their wings and tails as brakes. By opening up wing and tail feathers, they catch the air and slow down. Some birds even stretch out their legs to slow themselves down. All of these actions increase drag.

Students can model this by taking their paper airplanes and cutting two flaps on the back end of their plane. Have students push both flaps down and then throw the plane. The plane should dive downward.



Similarly birds use their wings and tails to steer. By raising and lowering their wings and by twisting their tails a bird can turn itself right or left. Students can model this by turning one flap up and the other flap down on their plane and then throwing the plane. Ideally students should notice that the plane banks either to the right or to the left.

Processing

Review with students the key idea behind each of the factors that they modeled.

Extension

As students know, from modeling wing movement, flying requires a lot of energy. To save energy, birds will glide or soar when possible so they can travel without having to flap their wings. Birds of prey commonly glide and soar. These birds need to be in the air for long periods of time as they search for food. Birds that soar over oceans tend to have long, narrow wings that let them ride on the winds that blow over the ocean. Birds that glide over land tend to have large, wide wings. These large wings provide greater lift allowing these birds to ride on land breezes.

Certain birds use air thermals to rise up into the air. An air thermal is created where air is warmer in spot than in another. For example the air over a blacktopped driveway will be much warmer than the air over a nearby pond. Warm air rises and as the warm air rises up, certain types of birds will ride upward on these air thermals.

Birds will also take advantage of updrafts. An updraft can form when wind hits a mountain or a building and is pushed upwards. Certain birds will take advantage of these updrafts to move upward.

There are websites such as www.funpaperairplanes.com/ that provide instructions and templates for make paper models of raptors and condors. Raptors include hawks, falcons, owls which along with condors are birds of prey. Once these paper models are made, students can throw them and time how long they “glide” (stay in the air).

Point out to students that the shape and size of a bird’s wings and tail vary from one type of bird to another. This variation, like the variation in beaks and feet, represents variations in life styles. For example, fast flying birds will have a different shaped wing and tail than those that glide.

Instructions for making a paper airplane



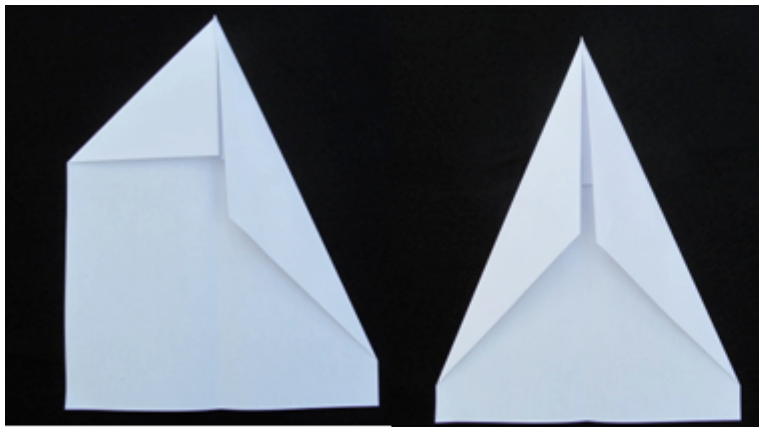
1. Take a sheet of paper



2. Fold in half lengthwise



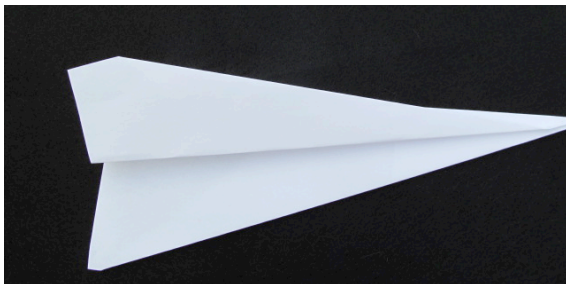
3. Unfold the sheet of paper.
Fold the top corners to the center.



4. Then fold the 2 edges toward the center.



5. Fold in half so the folded edges
are on the outside.



6. Fold each side in half lengthwise going from
the bottom towards the crease. Fold sharply
so the pointed end stays pointed.



7. Pick the plane up from the bottom
at the center crease.
Shown here is the top view.