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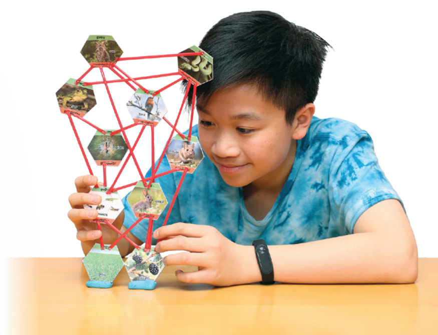

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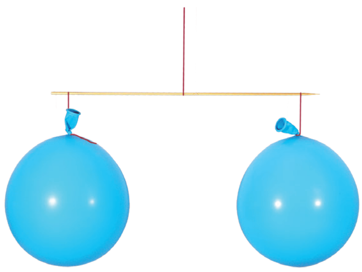

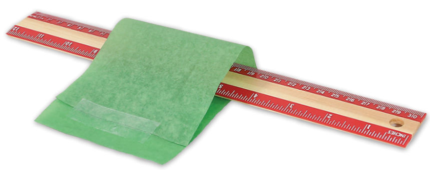

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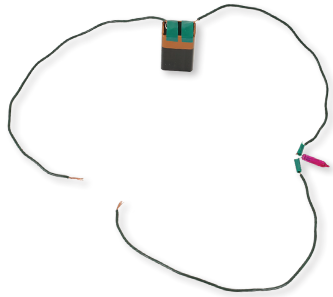

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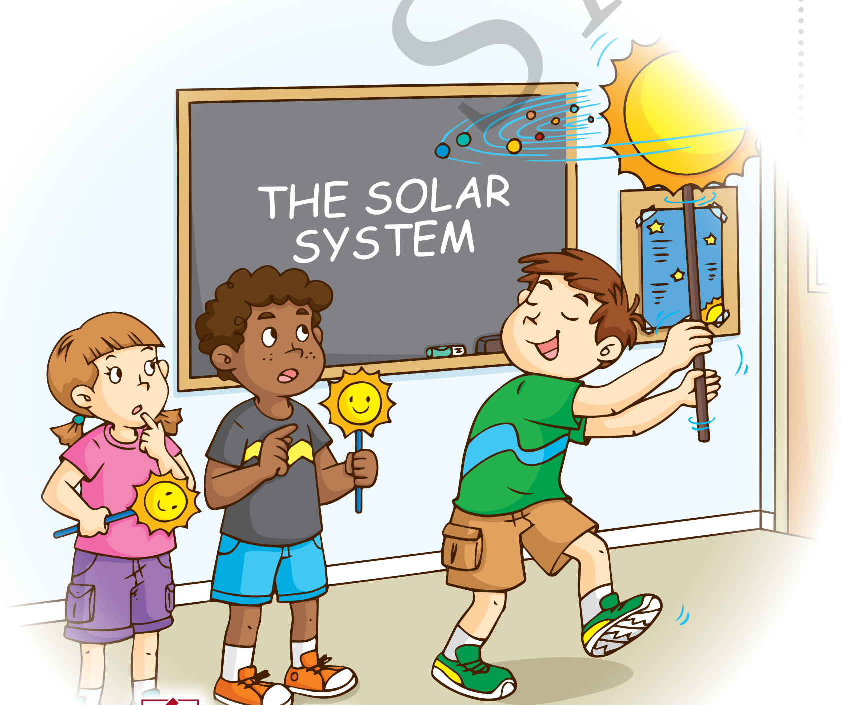
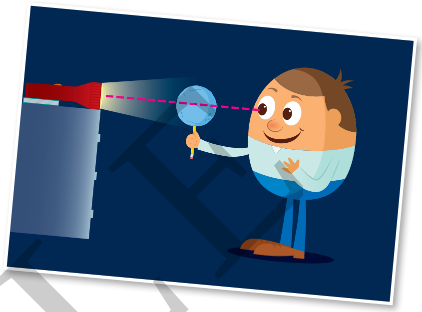
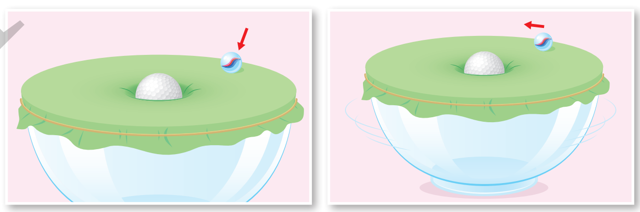


STEM Experiments





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4 Bernoulli's Principle

To understand flight, you must understand Bernoulli's principle. In this unit, you will examine this principle and see how it affects airplane and animal wings. You will also see how Bernoulli's principle acts on an airfoil to make flight possible.

Vocabulary

air pressure: amount of pressure exerted by air

airfoil: a curved shape that helps generate lift

exert: to apply (force)

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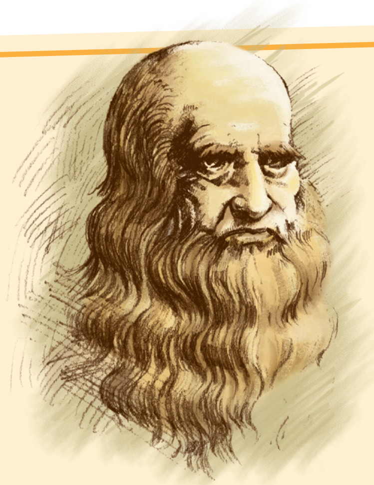
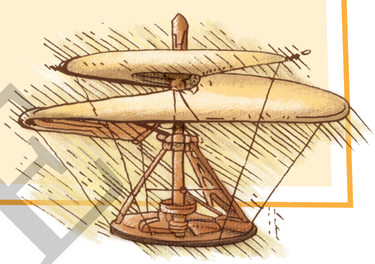
Extension

Leonardo da Vinci was a painter, sculptor, mathematician, engineer, and scientist born in Italy on April 15, 1452. Though he was born long before human flight was a reality, he was fascinated with flight and he studied birds extensively. He also drew many plans for flying machines that resemble today's helicopters and hang gliders. While these plans were visionary, few were practical, and almost none would have been able to fly had he constructed them.





A. Read each experiment and check your prediction. Then try the experiments and record the results.

1. Blow under the paper.

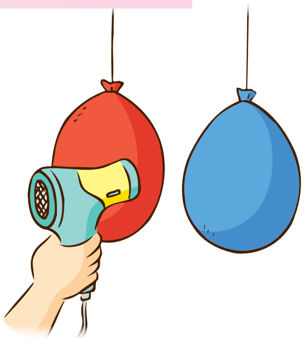
Prediction:

(A) The paper sinks down between the books.

(B) The paper rises.

Result: ____________________

2. Blow air between two balloons.



Prediction:

(A) The balloons move away from each other.

(B) The balloons move closer to each other.

Result: ____________________

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B. Fill in the blanks to reveal Bernoulli's principle and complete the paragraph. Then complete the diagram with the words in bold.

wings faster speed above lower lift slower

Bernoulli's Principle

Daniel Bernoulli, a scientist, proposed that changes in air 1.__________ are related to changes in air pressure. 2.__________ moving air exerts **lower** pressure than **slower** moving air.

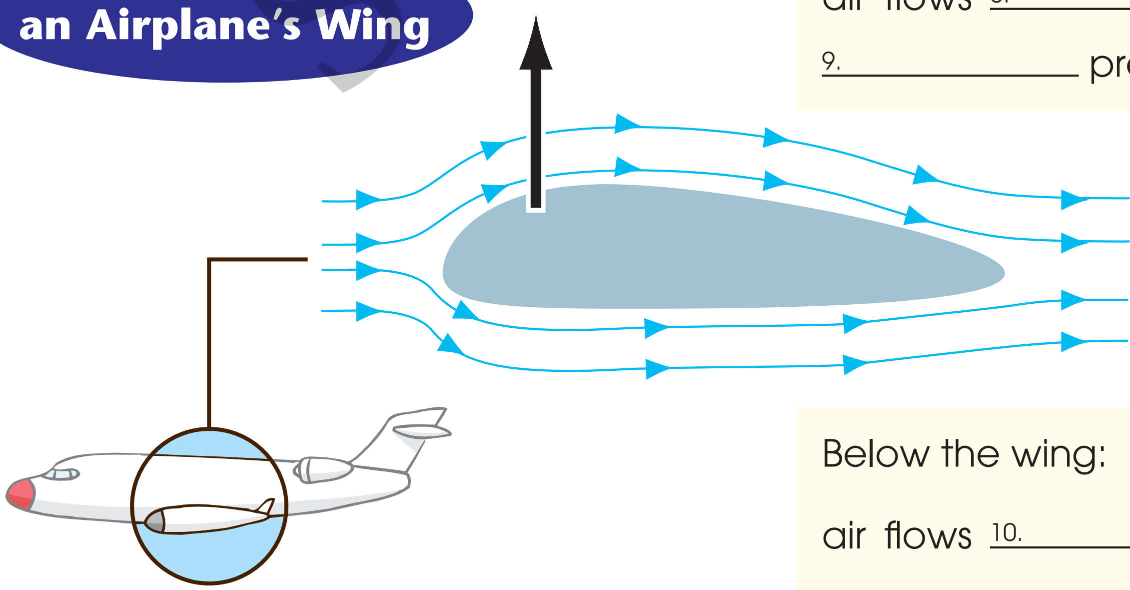
An airplane's 3.__________ take advantage of this principle. The top surface of its wing is curved and the end of the wing is 4.__________ than its front edge. The air 5.__________ the wing travels **faster** over the curved surface than the air below the wing. The 6.__________ air has **higher** pressure than the faster air, and it is this pressure difference that generates 7.__________ .

Above the wing:

air flows 8.__________ ;

9.__________ pressure

Cross Section of an Airplane's Wing



Below the wing:

air flows 10.__________ ;

11.__________ pressure

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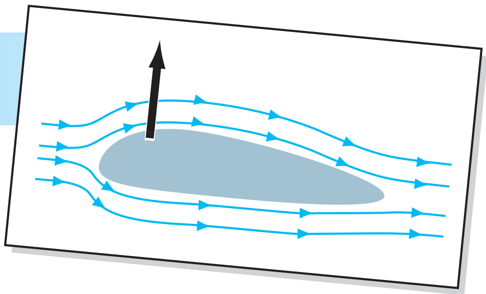
C. Fill in the blanks to find out about airfoils. Then check the pictures that are examples of airfoils.

natural lift Bernoulli's air airfoil



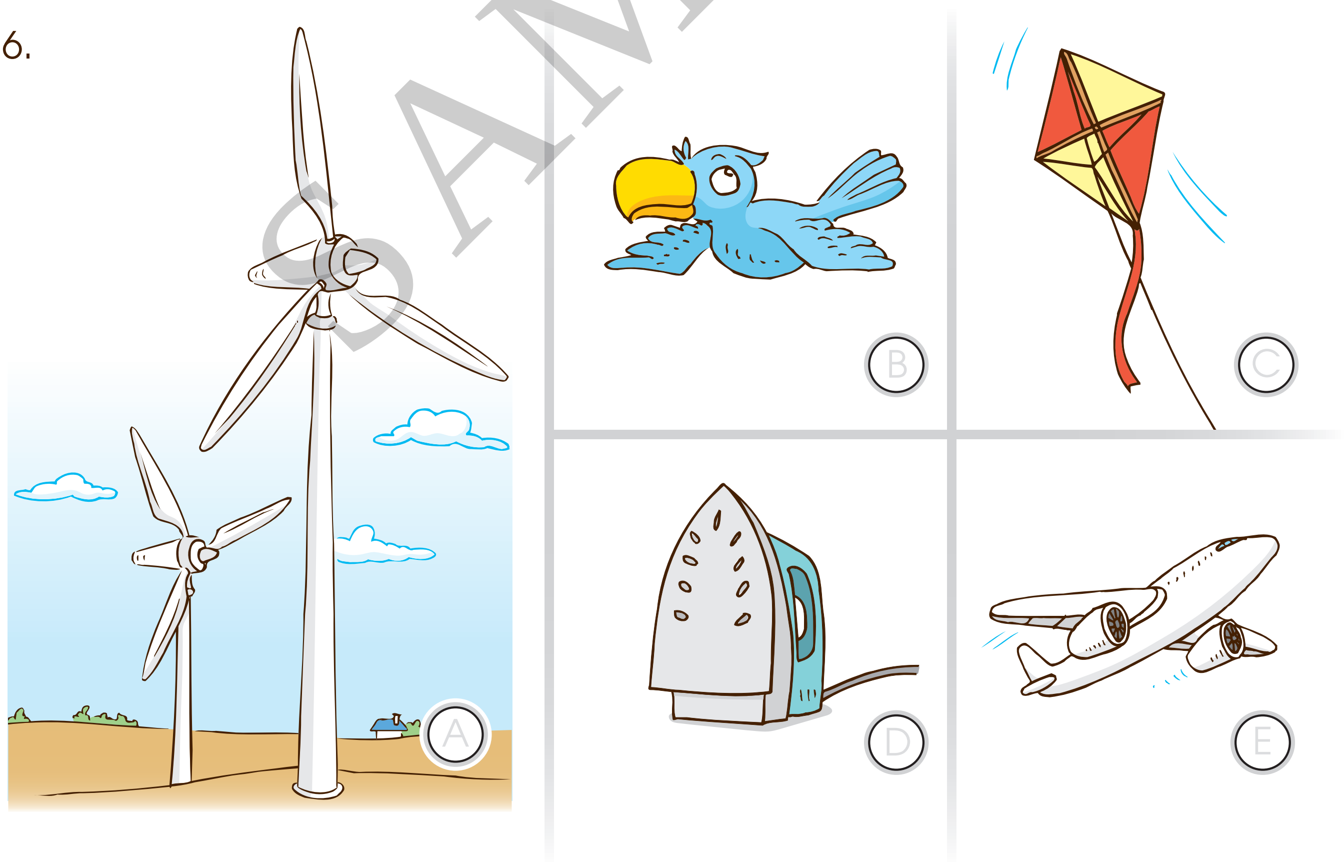
Airfoil

An airplane's wing is not the only object that takes advantage of 1. ______________ principle.

A wing's special shape is called an 2. ______________ , and many other objects, both 3. ______________ and human-made, share this shape in order to generate 4. ______________ or move through 5. ______________ .

Examples of Airfoils

6.



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A STATIC DETECTOR

building an electroscope to detect static electricity

Static electricity lurks in the environment and likes surprising people. The buildup of negative charges jump and shock you unexpectedly and unpleasantly when you shake hands with people, pet animals, or remove a sweater, especially on a cold, dry day. Since no one likes being shocked or zapped, are there ways to detect static electricity so that we can "see" its presence?

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What you need:

- a clear jar with a lid
- a straw
- aluminum foil
- a plastic comb
- scissors
- copper wire
- tape
- a nail
- a hammer

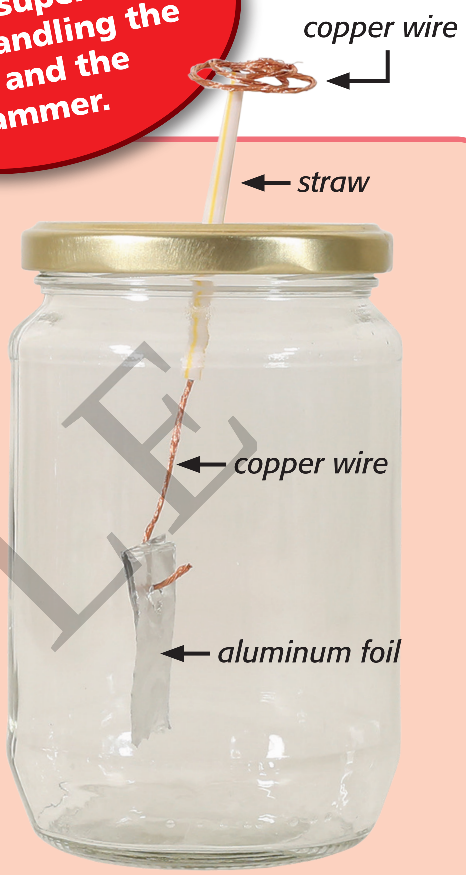
CAUTION!

Make sure you are supervised when handling the nail and the hammer.

Difficulty: ●●●○○

Time needed: 1 hour

In this experiment, you will build an electroscope to detect the presence of static electricity.



electroscope

What to do:

1. Use the nail and the hammer carefully to poke a hole in the middle of the lid.
2. Cut out a piece of straw that is 2 in (about 5 cm) long. Put it through the hole and tape it in place.
3. Cut out a piece of copper wire that is 6 in (about 15 cm) long and put it through the straw. Leave at least 1.5 in (about 4 cm) exposed on both ends.
4. Curl the upper end of the wire into a spiral to create a flat surface. Bend the other end to make a hook.
5. Cut out two pieces of 1.5-in-by-1-in (about 4-cm-by-2.5-cm) aluminum foil. Poke a small hole into each. Hook them to the wire.
6. Secure the lid to complete your electroscope.
7. Brush your hair with the plastic comb. Place it near the copper spiral but do not let it touch the spiral. Observe what happens to the pieces of aluminum foil.

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WHAT *just* happened?

You should have noticed that in the electroscope you made, the pieces of aluminum foil moved apart and formed an inverted "V" shape. This is because of the presence of static electricity! Brushing the comb through your hair caused negative charges to build up on the comb. When the comb was close to the copper spiral, the negative charges on the comb repelled and pushed the negative charges on the spiral down to the pieces of foil. Once they took the negative charges, they repelled each other and formed an inverted "V."

The "V" formation in the electroscope is an indication of the presence of static electricity on the tested object!

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STEM INQUIRY

- What is the function of the spiral? Can it be in other shapes?
- Why do you think it was important to let both foil pieces touch in the first place?
- Why does brushing your hair with the plastic comb create static electricity?
- Once you removed the comb, what did you notice?
- While the foil pieces stayed V-shaped, let the comb touch the spiral. What did you notice? Explain what happened.

- Test more household materials with your electroscope. Which ones could be charged with static electricity? Which ones could not? Which material had the potential to build up the greatest static electricity?
- What properties of aluminum make the electroscope function? What other materials can serve as an indicator of the electroscope?
- What will happen if you put more pieces of aluminum foil together on the hook?

Fun to know

Antistatic Gloves

Other than being an unpleasant surprise, static electricity does not bother us very much. However, protection against static electricity is important when handling sensitive and fragile electronics. Antistatic gloves, wrist straps, shoes, bags, and coatings all help prevent static electricity from damaging electronics when being handled.

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