

How do the wings lift an airplane?

Introduction

Airplane wings look simple in outlook: long flat objects in its sides, like the wings of birds but not as flappy! So how do these flat extensions help the airplanes rise up in the air (create lift)?

It is the shape of the wings that helps in lift.

Activity: Get the students to draw cross-section of wings in a board or paper. Show them the following items if you can collect: fan blades, pictures of bird wings from the slide, and get them to draw them too.

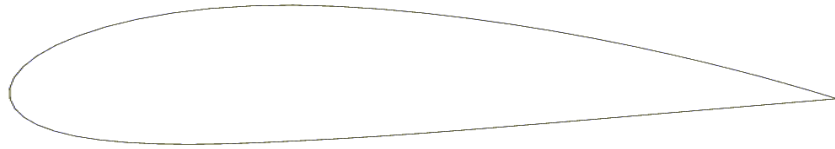


(Image credits: alamy stock photo)



(Image credits: electricplancebygordon.com)

Do the shapes look like this?



Notice how the cross section is curved outside on the upper side and relatively less curved at the bottom. It is this shape that creates the lift. This shape is called an airfoil or aerofoil.

Optional activity:

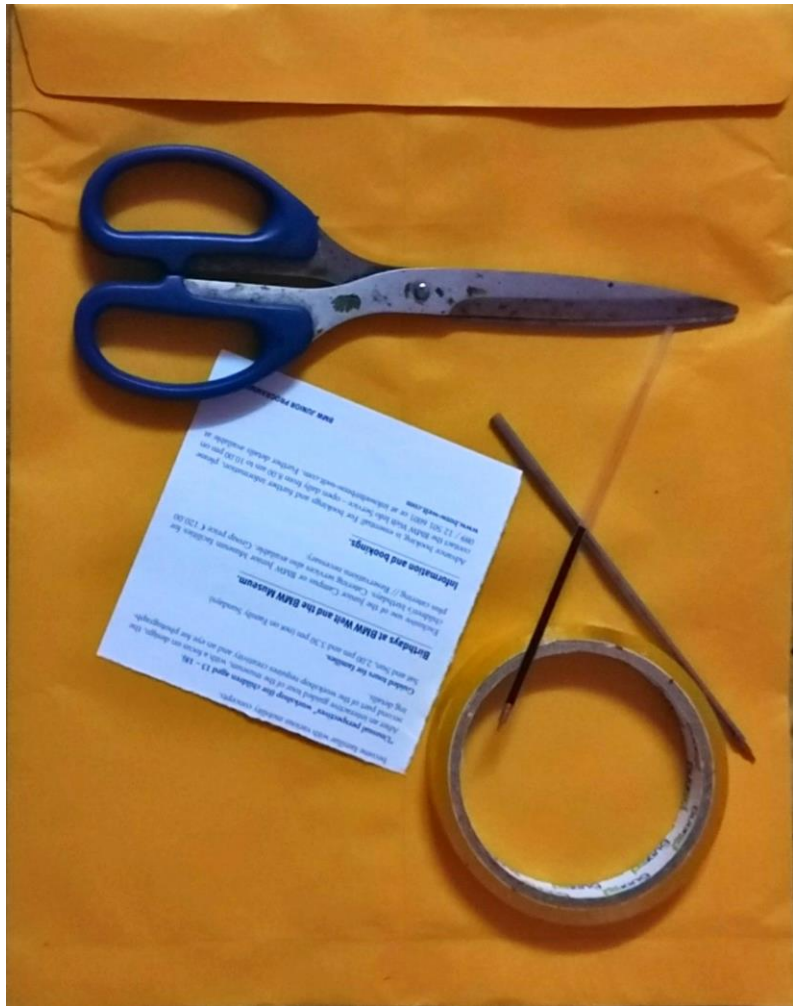
Imagine you have a book on your palms, and your friend pushes it from the top with his hand. If you push the book upwards more than your friend is pushing downwards, the book goes up.

Similar thing happens with the airfoil. This funny shape of airfoil causes air below the foil to push higher with a greater air pressure than the air above the foil. That is why the wing is pushed upwards and the airplane rises up.

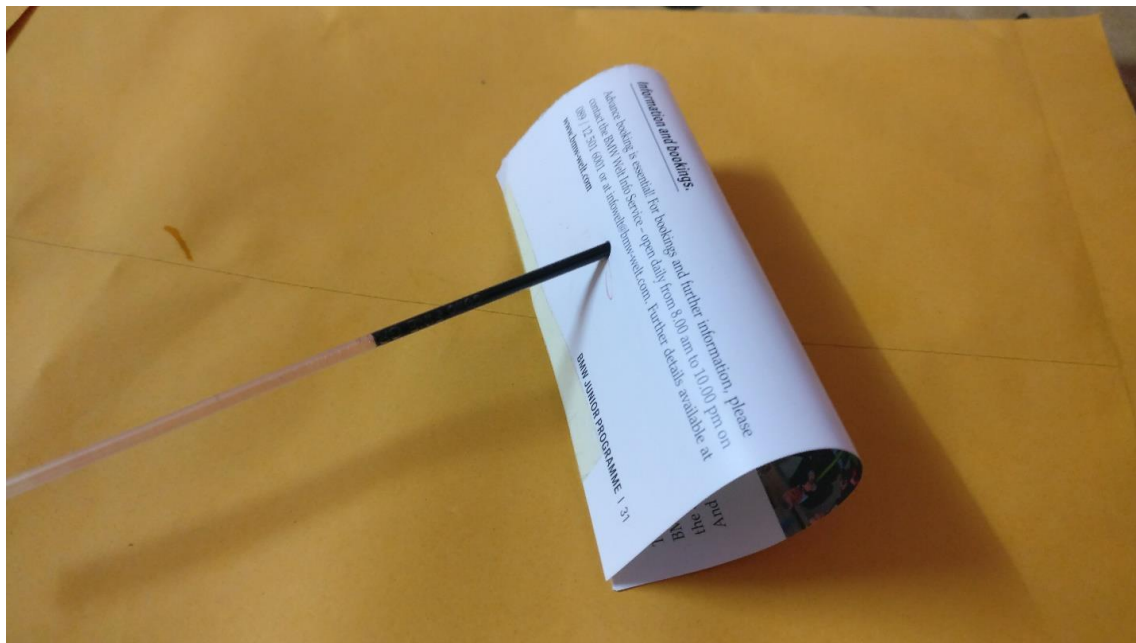
Don't believe me just because I tell you so. Let's make our own wing to find out if we can create a lift.

Activity: Make a paper wing and lift it by blowing air

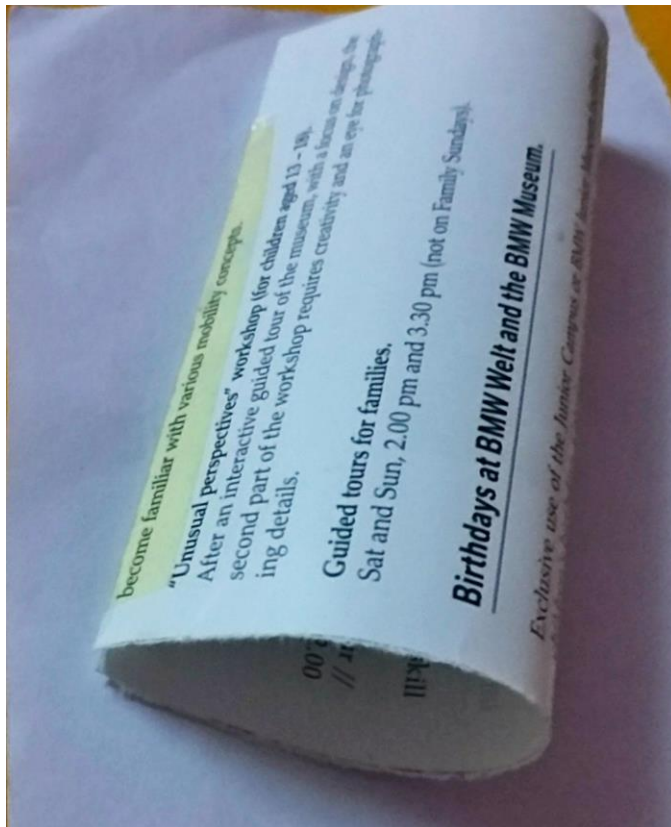
Here's what we need to get started: a sheet of paper, two ball pen refills of slightly different thickness and a cello tape roll.



Images of the things required.



Take a sheet of paper (I am taking a quarter of an A4 paper from a brochure) and tape the opposite ends.



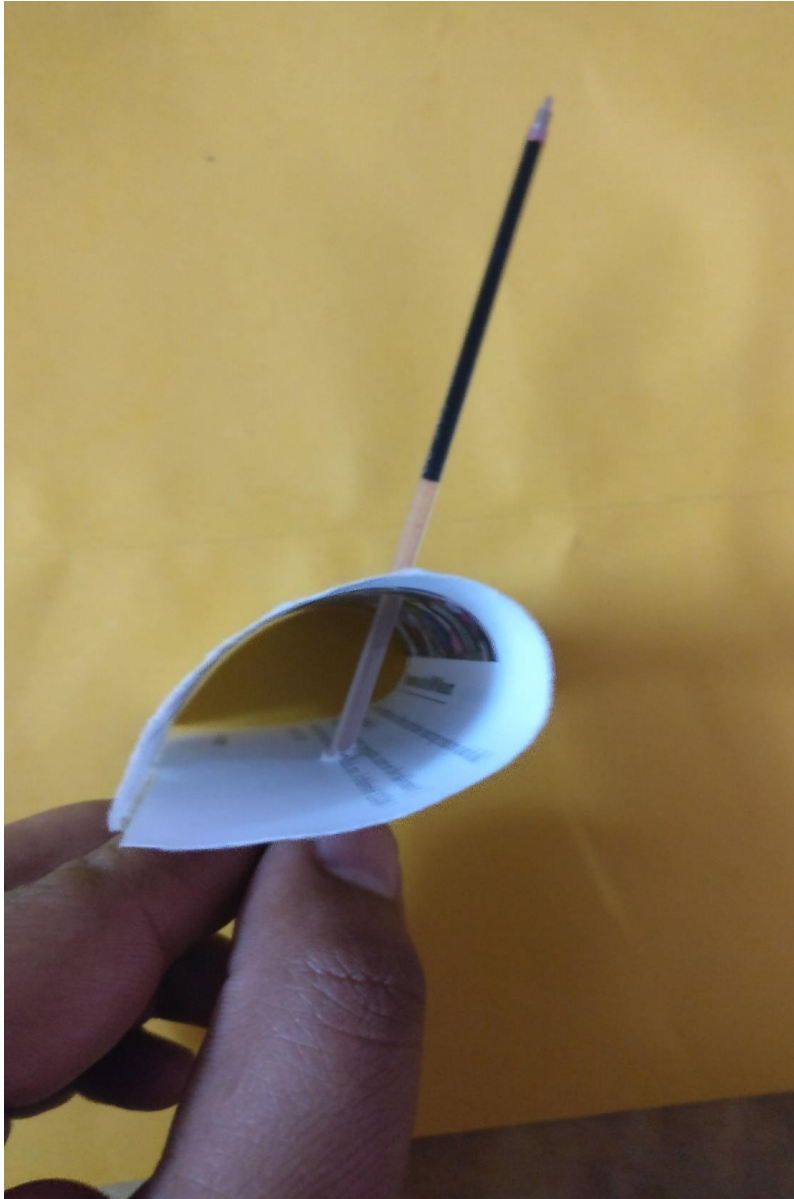
Take the thicker ball pen refill and make a hole in the middle of one side of the paper. This will be the bottom of the wing.



Insert the refill in the hole and while making the wing slanted, and make another hole with the refill vertical in position where its tip touches the upper side of the wing. We are making the wing slanted to simulate an airplane taking lift. Remember how it is at an angle to the ground, so the airplane wings become slanted too?



Now replace the thicker refill with thinner refill.



Blow air from your mouth steadily from the front end of foil. While you are blowing your air from the front, the airplane rises.

<https://youtu.be/N5hl0Jvw4m8>

This is similar to what happens in an airplane.

How does it work?

Have you ever heard about Newton's Third Law of Motion? It states that to every action, there is an equal and opposite reaction.

The shape of the airfoil makes the air go downward, as an equal and opposite reaction to that – the air pushes the wing upwards.

But, for the air to flow downwards, the air should be sticking to the curved outer surface. How do we know this is what happens? We cannot see air.

Let's do an activity to demonstrate that fluids like air stick to surfaces that are curved outwards.

Activity: Demonstration of Coanda effect

Take a cylindrical object – your water bottle will do. Take a glass of water and pour the water over the cylinder's curved outer surface keeping the bottle horizontal to the ground. You can see that water sticks to the curved surface instead of separating as a tangent. In the same way, air sticks to the outer surface of an airfoil.

Activity: Exploring by experimenting

Science is an exploration. Let's see for ourselves if the wing still works if we change things in the setup.

Here are some things we can try:

1. Changing the type of paper. Use thin paper, standard printing paper, and thicker papers.
 - a. Did any change made it easier to lift?
 - b. Did any change made it harder to lift?
 - c. Why do you think changing paper affected the lift?
2. Changing the weight of paper. Add or tape paperclips to different places of the wing.
 - a. How did adding extra weight affect the lift?
 - b. Why do you think that happened?