

# Is Air Really There?

Without air, balloons and birds and airplanes couldn't fly. But since you can't taste, see, or often even feel air, how can you prove it's really there? Maybe you're convinced air is stuff, but does it have weight? If so, how much?

## Air Is Stuff

### Try This:

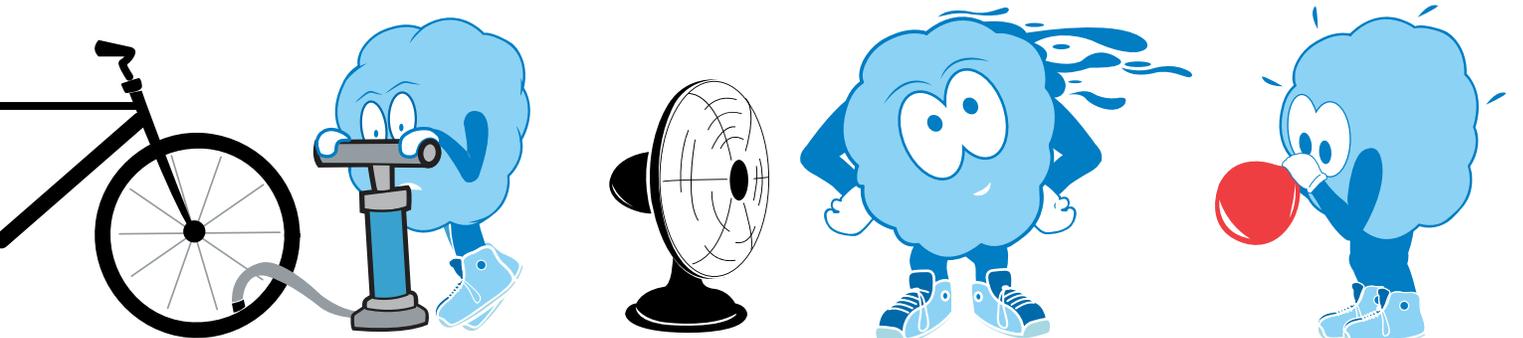
Blow up a flat bike tire or basketball with a bike pump. Blow up a balloon. Sit in front of a fan. How do these activities prove air is stuff? Which one convinces you the most? Why?

### Materials

- Bike tire or basketball
- Bike pump
- Balloon
- Fan

## WHAT'S GOING ON?

Since air is invisible we easily forget that it is all around us. When we blow air in a balloon, we can feel the air pushing on the balloon. It's the same with a tire or basketball. When we sit in front of a fan, we can actually feel the air molecules moving in the same direction. That's what wind is.



## Paper Wad

### Try This:

Wad a small piece of paper into a pea-sized ball. Hold an empty plastic bottle on its side and place the wad just inside the rim. Without touching the wad of paper or tilting the bottle, try to blow the wad into the bottle. Try different-sized bottles. Challenge your friends with this trick.

### Now Try This:

Poke a hole at the back of the bottle and try again to blow the wad of paper into the bottle. Does this make it easier? How could a straw help you get the paper into the bottle?

### Materials

- **Small piece of paper**
- **Empty plastic bottles of different sizes**
- **Straw**



## WHAT'S GOING ON?

The bottle may look empty, but it's not. There is no room in the bottle for the air from your lungs, because the bottle is already filled with air. Your breath just bounces off the air already in the bottle. The paper wad simply traces the air stream you are blowing.

Poking a hole in the back of the bottle allows the air to leave the bottle and make room for the air you're blowing. If you tried blowing air into the bottle with the straw it won't work. Try sticking the straw into the bottle without disturbing the paper wad and suck the air out. The paper wad should jump into the bottle, because you've removed air from the bottle and created room for outside air to push the paper wad inside.

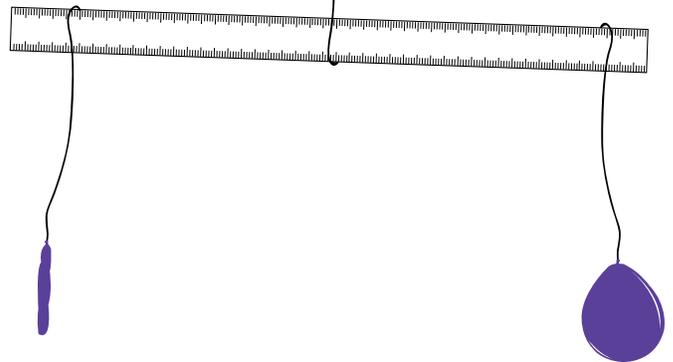
# Does Air Have Weight?



## Try This:

Make a scale to measure the weight of air. Find the center of a meter stick (probably the 50-centimeter mark). Tie a string to the center and tape it in place so it doesn't move, and hang the meter stick. Attach two equal lengths of string to each end of the meter stick at the same exact place. This is your scale. Tape an empty balloon to the end of each string. (Make sure you use equal lengths of tape.) Is your scale in balance? It should be!

Now remove one of the balloons and blow it up. Tie the end in a knot and tape it back to the string. What happens?



## Materials

- Meter stick
- String
- Two large, identical balloons
- Tape

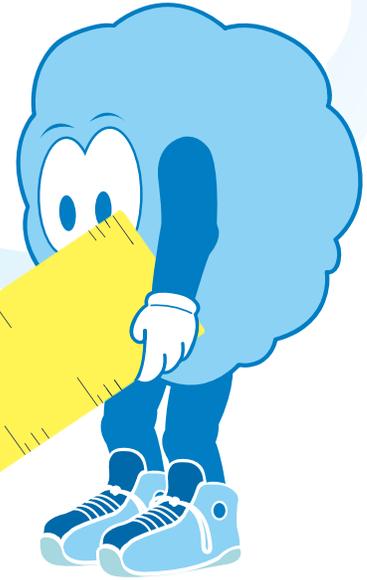
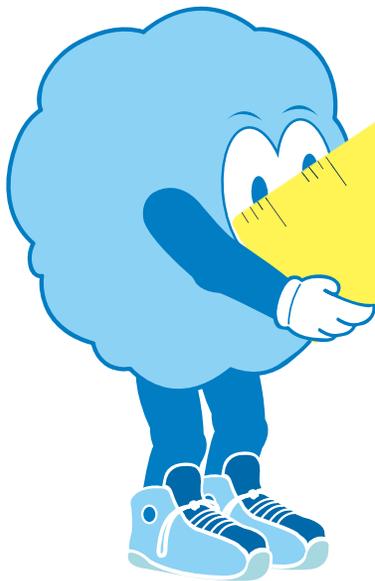
## WHAT'S GOING ON?

When you attached the empty balloons to the meter stick, it showed the balloons weighed the same and the meter stick stayed balanced. When you put air in one balloon, it tipped the scale to one side. Why? The only thing you added was air, so the air must have increased the weight of the balloon.

## Weigh the Air

### How much does the air in your room weigh?

Choose an answer from the list below, before you read on.



#### Now Try This:

Measure the length, width, and height of your room in meters or feet, then multiply these amounts together. This total equals the volume of your room. Now multiply the volume by 1.2 if you measured in meters to get the number of kilograms or by 0.07 if you measured in feet to get the number of pounds. Surprised?

- a) Nothing.
- b) Hardly anything, like a bunch of fluff.
- c) As much as something I could lift.
- d) Way more than I could lift.

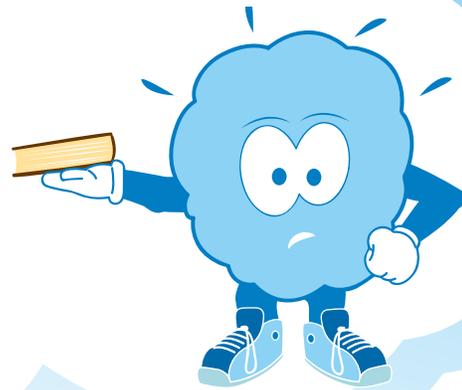
#### Materials

- Measuring stick or tape

### WHAT'S GOING ON?

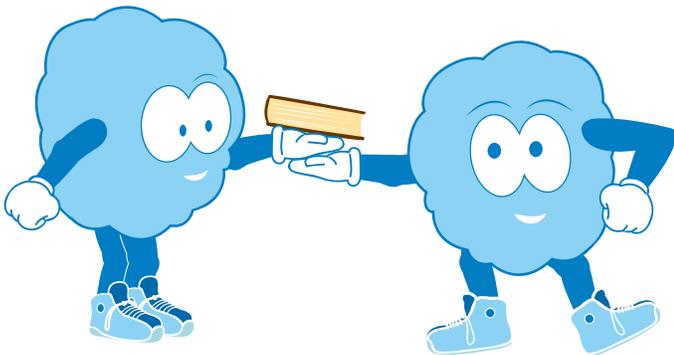
Even though air is invisible it has substance, or mass, so it must also have weight. A cubic meter of air weighs 1.2 kilograms; a cubic foot weighs 0.07 pounds. All the air in your room probably weighs more than you thought it did. Even a fairly small room can hold close to 45 kilograms (100 pounds) of air.

## Why Can't I Feel That Weight?



### Try This:

Hold a bag of sugar or a large book in your hand. Notice how heavy it feels. Now have a partner support that weight by placing a hand under yours and pushing up. How does it feel now?



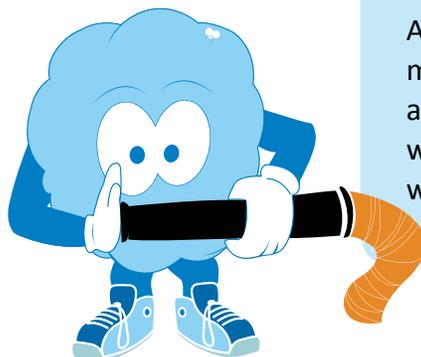
**Hint:** If a friend isn't handy, rest your hand on a table and notice the difference.

### Now Try This:

Hold your hand up to the end of a vacuum cleaner hose, then turn on the vacuum. The vacuum's pump removes some of the air under your hand while the air on top continues to push with its normal strength. How does your hand feel now? What is happening?

### Materials

- Bag of sugar or heavy book
- Vacuum cleaner with attached hose



## WHAT'S GOING ON?

The weight of book was less noticeable when another hand or a table pushed against your hand. Air is constantly pushing against us, but it feels more like pressure than weight since it pushes from all sides. This all-around push is called air pressure.

## WHAT DOES THIS HAVE TO DO WITH FLIGHT?

Earth's gravity holds air to its surface, so we are all submerged in a "sea" of air. The weight of the air is constantly pushing against us, but it feels more like pressure than weight since it pushes from all sides. This all-around push is a force called air pressure.

Air pressure also helps airplanes fly. When air moves past an airplane, air pressure decreases above the wings. The air pressure below the wings remains almost normal and pushes the wings up. This push is called lift.