



Universität  
Basel

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## Expanding air

When air is heated, it expands. This is an important phenomenon, which we're going to demonstrate in two experiments.

### Experiment 1

#### What you'll need

- 1 bottle
- 1 balloon
- 2 bowls large enough to fill with water and place the bottles inside
- hot and cold water

#### Instructions

- Stretch the balloon over the bottle neck.
- Pour some hot water into one bowl, and cold water into the other.
- Place the bottle in the bowl of hot water and wait.
- After a while, move the bottle to the bowl of cold water.

#### What happens?

- When you place the bottle in the bowl of hot water, the air inside the bottle heats up.
- When air is heated, it expands.
- There is no longer enough room for it inside the bottle, so the air is pushed into the balloon, causing it to inflate a little and stand upright.
- When you move the bottle to the bowl with cold water, the air inside it cools down too. The cool air takes up less space, so it flows out of the balloon back into the bottle, and the balloon deflates.



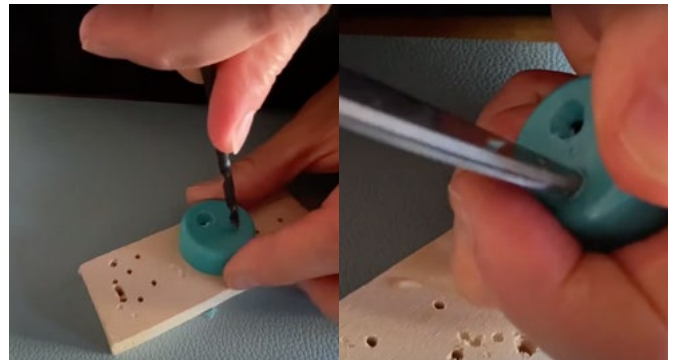
## Experiment 2

### What you'll need

- 3 plastic bottles (ideally, one of them should be bigger than the others)
- a drill and a piece of wood to work on
- scissors
- 4 flexible drinking straws
- strong adhesive tape
- a glue gun or some strong glue
- a container big enough to hold the large bottle surrounded with water
- hot and cold water
- food dye (not strictly necessary, but dyeing the water makes it easier to observe what's happening)

### Instructions

- Make a hole in one of the bottle caps, and use the scissors to widen it until it is big enough for a drinking straw to fit through. In the second cap, make two holes next to each other. These holes should also be big enough for a drinking straw to fit through. It's best to get a grown-up to help with this step, and make sure you work on a piece of wood to protect the table.
- Take one of the drinking straws, and cut a piece off the longer end. Join the short ends together with the adhesive tape, making an airtight seal. Repeat the process so that you end up with two long drinking straws, each with two joints.
- Fill a bottle with cold water and add a little food dye (this bottle will go in the middle). Screw the cap with two holes tightly onto this bottle.
- Screw the cap with one hole onto the largest bottle. Leave the third bottle open.
- Place the three bottles in a row, with the bottle full of water in the middle.
- Connect the bottles with the drinking straws so that the longer end of each one is below the surface of the water.
- Use the glue gun to make an airtight seal around the drinking straws where they go through the bottle caps, and leave the glue to set. This step is very important! You need to make sure that air can only escape through the drinking straws, and not through any gaps between the straw and the cap. Once again, ask a grown-up for help as the glue gets very hot, and you could easily burn your fingers.
- Pour some hot water into the container, place the large bottle in it, and watch what happens.



### What happens?

- When you place the bottle in the hot water, the air inside it heats up, causing it to expand.
- The warm air flows through the drinking straw into the second bottle. You can see the air bubbling up through the water (as shown by the arrow in the second photo).
- The increased pressure in the second bottle pushes water through the drinking straw into the third bottle.
- If you shorten the drinking straw connecting the first bottle to the second one so that it is above the surface of the water, the experiment still works: the increased pressure still pushes water into the third bottle.
- If the experiment doesn't work, it probably means that one of your seals is not airtight. You can check by turning the first two bottles upside down to see if any water leaks out. If it does, you'll have to redo the seals.

