

What Causes the Balloon to Get Pushed/Pulled Into the Flask?²

(Reinforcement Activity)

Materials

- Hot plate
- Erlenmeyer flask, 250 ml with 20 ml of water in it
- Balloon
- Tongs
- *What Causes the Balloon to Get Pushed/Pulled into the Flask?* activity sheet

Background Information

In this activity, a balloon and flask are heated as in Lesson 8. However, this time a small amount of water is placed in the flask and brought to a boil first. As it is heated the molecules in the air and the water speed up and spread out, taking up more space. Then the balloon is put on the flask, making it a closed system. When the balloon and flask cool, additional molecules cannot enter the flask to take up the additional space as the molecules in the container slow down and the water vapor condenses. Therefore, the pressure inside the flask is lower than the pressure outside of the flask. This pressure differential results in the balloon getting pushed into the flask. *It is not the case that the outside air pressure alone pushes the balloon into the flask; it's an imbalance in the relational model that results in the air pressure pushing the balloon into the flask.*

Steps

1. Place about 20 ml of water in the flask and boil it before you put a balloon on the top, as in Lesson 8. Then remove the flask/balloon set-up and let it cool. As it cools, have students observe what happens. (*The balloon should get 'pushed' into the flask.*)
2. Working in groups of three, have students discuss what is going on and try to come up with a model to explain their observations. Pass out the activity sheet, *What Causes the Balloon to Get Pushed/Pulled into the Flask?* to guide them. While they are thinking, invite them to come up and observe the balloon in the flask.
3. Bring the class back together for a discussion. Gather ideas. Have two or three students put their models on the board. (Try to get a variety of models). See if others agree or disagree and why. Note similarities in all of the models and list these on the board. How does a relational causal model give the best explanation for what happens? (*As the air inside the flask cooled, the heated molecules slowed down and the water vapor condensed on the inside of the flask. This created a lower air pressure than what there was initially. This air pressure differential—lower inside, higher outside—resulted in the balloon*

not only deflating, but being pushed into the flask until equilibrium was reached.) Emphasize how the term “pushed” rather than “pulled” more accurately describes what happened to the balloon. Be sure that students know that movement is from higher to lower pressure, so that it appears that lower pressure pulls matter from areas of higher pressure towards it, and higher pressure pushes matter towards areas of lower pressure.

What Causes the Balloon to Get Pushed/Pulled Into the Flask?

(Reinforcement Activity)

Name _____ Date _____

We have been learning about Charles' Law. According to Charles' Law, as the air inside the balloon and flask cools, its volume should decrease until the air pressure inside the flask is equal to the air pressure outside the flask. But the balloon did not return to its original position. Instead it got pushed/pulled into the flask! Why did this happen?

Use what you've learned about obvious and non-obvious causes and relational causality to come up with a model to explain this demonstration. Think about all of the possible variables involved, and how they relate to each other.

Ask yourself, "Was the balloon pulled into the flask or pushed into the flask?" Reasoning with relational causality can help you figure this out.

Draw your model:

Explain your model:

Review: Read your explanation and analyze your model carefully. List any 'gaps' in your model and explanation that you cannot account for: