

Sticky Balloons

Can you make plastic cups stick to a balloon? Find out how in the following activity.

Materials

Part A

- 1 round balloon, 9-inch or larger
- 1 flexible, transparent plastic cup, 9-ounce or larger

Part B

- 1 round balloon, 9-inch or larger
- 1 rigid, transparent plastic cup 6-ounce or larger

Exploration

Part A

Step 1 Inflate the balloon. Squeeze the flexible plastic cup until the sides are somewhat depressed. Position the opening of the squeezed cup firmly against the balloon and slowly release the squeeze on the cup so that it returns to its normal shape. If the cup does not stick to the balloon, repeat the process until it does stick.

Step 2 Describe how far the balloon protrudes into the flexible cup when the two are held together and when they are stuck together. (Repeat Step 1 and draw pictures as appropriate.) How does the air pressure inside the flexible cup compare with the air pressure inside the balloon and with the atmospheric pressure outside the cup when the cup is stuck to the balloon? Explain why the flexible cup sticks to the balloon.

Part B

Step 1 Now find a way to stick the rigid cup to a balloon. Assume that the rigid cup will break if squeezed; that is, do not use the technique which worked in Part A. Think about why the balloon stuck in Part A and what is flexible in this case. You do not have to start with the balloon (fully) inflated.

Step 2 Describe how you got the rigid cup to stick to the balloon. Compare how far the balloon protrudes into the rigid cup before and after you get it to stick. How does the volume and pressure of the air in the cup compare before and after you got it to stick? How does the pressure of the air in the cup compare with atmospheric pressure before and after you got it to stick? Explain why the cup sticks to the balloon.

Challenge

“Stick” cups to balloons using two different methods and determine what factors are responsible for this phenomena.

Sticky Balloons

This activity can be used to introduce the behavior of gases and the gas laws.

Concepts

Boyle's Law, atmospheric pressure

Expected Student Responses to Exploration

Part A

Step 1 The cup should stick to the balloon when its sides are released.

Step 2 The balloon protrudes further into the cup when the two are stuck together. When the cup is released while held against the balloon, it returns (at least partially) to its normal shape. Air can not get into the cup and the volume of the air already inside the cup increases, producing a decrease in pressure inside the cup. The pressure inside the balloon is now greater than the pressure inside the cup; this greater pressure inside the balloon pushes the balloon farther into the cup. Even with this adjustment of pressures, the atmospheric pressure pushing on the outside of the cup is greater than the pressure inside the cup plus gravity so the cup sticks to the balloon.

Part B

Step 2 The rigid cup can be stuck to the balloon as follows: Blow up the balloon about a third of the way. Press the open end of the rigid cup firmly into the side of the balloon. (Note the distance the balloon extends into the cup.) With the cup still in position, fully inflate the balloon and release the cup. It should stick to the balloon.

When the cup is placed on the partially inflated balloon, there is more curvature of the balloon inside the cup. As the balloon is inflated, the curvature lessens and there is less balloon inside the cup. The volume of the air inside the cup is thus greater when the balloon is inflated even though the amount of air remains constant. This causes the pressure inside the cup to be less and thus atmospheric pressure holds the cup to the balloon.

Expected Student Answer to Challenge

The cups stick to the balloons because the pressure inside the cups is less than atmospheric pressure.

Reference

Liem, Tik L., *Invitations to Science Inquiry*, 2nd edition, Ginn Press, Lexington, MA, 1987, 26.

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