Is Air Pressure Involved?

(Reinforcement Activity)

1. An inventor who likes to snorkel decides to invent a snorkel that unrolls like a garden hose so that he can swim in deeper water and see more fish. Before he tests it out, a friend convinces him that the new snorkel is not safe. What argument did she make to convince him?
2. Why do your ears pop when taking off in a plane?
3. Why do some people put their tennis balls in the freezer?
4. A hurricane is approaching. Meteorologists advise people to open their windows. After the storm passes, people who did not open their windows notice that their windows are broken and have fallen outside their houses as though they have blown out. What is going on?
5. A Social Studies teacher is telling a story in the teacher's lounge. "It was a hot day and I bought a set of helium balloons for a party. I put them in the far corner of the car so that they were away from the open window. The balloons stayed there while I was in the parking lot, but as soon as I got on the highway, they made a beeline for the open window and floated out. How did the balloons know how to find the only open window?" What did the science teacher say to him?
6. Ian is pumping air into the tires on his bike. The tires are pretty flat and at first it is easy to push the pump up and down to fill the tires. The more full the tires become, however, the harder it is to move the pump. Eventually, it gets so hard that Ian gives up. "Good enough" he decides. Why did it get increasingly difficult to push the pump up and down?
7. Some of the earliest tires were made of metal in order to support the weight of the vehicle. Today tires are made of rubber. How can rubber support the weight of a vehicle? An average car weighs about 3000 lbs.
8. Tamika brought her water bottle, which was half full of water, on the plane with her when going to visit relatives. About an hour into the flight, she tipped the bottle upside down to drink from it and pulled the top open with her lips. As soon as she did, the water spurted out down her throat and left her coughing. What happened?

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Teacher Resource

Note to Teacher: The following explanations are meant to guide you in your own understanding. Don't share the explanations with your students yet.

1. **An inventor who likes to snorkel decides to invent a snorkel that unrolls like a garden hose so that he can swim in deeper water and see more fish. Before testing it out, a friend convinced him that the new snorkel is not safe. What argument did she make to convince him?**[5]

   She told him to think about the effects of the air pressure inside his lungs and the air pressure of the outside air. If he is under the water, there will be a lot of pressure on his body, and thus the air in his lungs will be higher pressure than the outside air. When he puts the long snorkel in his mouth, the pressure of the air in his lungs will even out with the air outside and his lungs might collapse.

2. **Why do your ears pop when taking off in a plane?**

   As an airplane takes off and lands, there are great changes in altitude. Our bodies sense this pressure change through our ears. As you take off in an airplane, the pressure in your ears (as in the rest of your body) must adjust to the change in altitude. You can sense this change when your ears pop.

3. **Why do some people put their tennis balls in the freezer?**[6]

   Tennis balls have a higher internal pressure than the outside air pressure. To maintain that higher internal pressure, people sometimes put their tennis balls into the freezer, since the lower temperature cools the ball, decreasing the internal pressure in the ball so less air leaks out.

4. **A hurricane is approaching. Meteorologists advise people to open their windows. After the storm passes, people who did not open their windows notice that their windows are broken and have fallen outside their houses as though they have blown out. What is going on?**

   During a hurricane, the atmospheric pressure drops. If the house is closed up, the inside pressure will remain at the level that it was at before the storm. Therefore, the relative air pressure outside the house ends up being less than the air pressure inside the house. Unless the windows are opened so that inside and outside air pressures can equalize, if the differential is big enough, the greater pressure inside the house will push the windows out, because there is not enough pressure from the outside to push back in the opposite direction.

5. **A Social Studies teacher is telling a story in the teacher's lounge. "It was a hot day and I bought a set of helium balloons for a party. I put them in the far corner of the car so that they were away from the open window. The balloons stayed there while I was in the parking lot, but as soon as I got on the highway,**

they made a beeline for the open window and floated out. How did the balloons know how to find the only open window?" What did the science teacher say to him?

The science teacher told him that the balloons didn't actively know or do anything. They were pushed out of the window by the air pressure in his car. When he got on the highway, the air outside his car was moving faster than the air inside of his car. According to Bernoulli's principle, the pressure in a fluid (such as air) decreases as the speed of the fluid increases. Therefore, the air pressure outside the car was lower than the air pressure inside the car. The balloons were pushed from an area of higher pressure to an area of lower pressure.

6. **Ian is pumping air into the tires on his bike. The tires are pretty flat and at first it is easy to push the pump up and down to fill the tires. The more full the tires become, however, the harder it is to move the pump. Eventually, it gets so hard that Ian gives up. "Good enough" he decides. Why did it get increasingly difficult to push the pump up and down?**

   When the tires were deflated, there was relatively low air pressure inside. As Ian added air to the contained space, the air pressure increased. As the air pressure increased, it pushed back on the pump with increasing pressure as Ian forced more air into the fixed space in the tire.

7. **Some of the earliest tires were made of metal in order to support the weight of the vehicle. Today tires are made of rubber. How can rubber support the weight of a vehicle? An average car weighs about 3000 lbs.**

   The weight of the car is supported by the air pressure in the tires, rather than by the rubber that the tires are made of. The molecules that make up the air in the tire are bouncing all around inside the tire, and the collective result of the force that they create results in the air pressure that supports the car.

8. **Tamika brought her water bottle, which was half full of water, on the plane with her when going to visit relatives. About an hour into the flight, she tipped the bottle upside down to drink from it and pulled the top open with her lips. As soon as she did, the water spurted out down her throat and left her coughing. What happened?**

   When Tamika closed her bottle before the flight, the air pressure in her bottle was the same as the air pressure at ground level. When the plane took off, the air pressure inside the plane decreased, because there is less air pressure at higher altitudes than at lower altitudes. Even though the passenger cabin is pressurized to minimize discomfort, its pressure is still lower than the pressure at ground level. The water in the bottle was pushed from an area of higher pressure to an area of lower pressure (Tamika's mouth).