Red Planet: Read, Write, Explore!

Extension Activity
Atmospheric Pressure on Mars

Teaching time: 20-40 minutes

Materials:
- 0.65 Liter vacuum-sealable container (for saving tea or nuts)
- Wine-saver vacuum pump (or similar)
- Two marshmallows

Notes on materials: 0.65 Liter vacuum-sealable container (for saving tea or nuts) can be purchased from online retailers for about $25. The container alone costs around $12, and the pump (with wine stoppers) costs about $10 at most liquor stores and other retailers.

Motivation:
The atmospheric (air) pressure on Mars is 1/100 of Earth's. On Earth, every inch of your body experiences a pressure of about 15 pounds (6.8 kilograms)! We don't notice the pressure because we've never left the comfort of Earth's atmosphere. How does your body feel at the bottom of a swimming pool? That's an example of a larger amount of pressure on your body. Have you ever been in a car traveling up or down a mountain and noticed that when the pressure changes your ears pop? That's because the atmospheric pressure is lower at higher altitudes, and the pressure in your head tries to equalize (become the same) with the outside pressure. If the pressure in your head is higher than the outside pressure (moving up a mountain), the air in your head tries to move out. If the pressure in your head is lower than the outside pressure (moving down a mountain), the air from outside tries to move in!

Now, what do you think would happen to your head on Mars?

Procedure:
- Have a control marshmallow and a second marshmallow ready.
- At the beginning of the experiment, the marshmallows have air inside that equals the outside air pressure. The air pressure pushing in on the marshmallow is exactly equal to the air inside the marshmallow pushing out.
- Place one of the marshmallows into the clear Vacu Vin container or jar sealed with the vacuum stopper.
- Using the vacuum pump, begin pumping out the air. You should see the marshmallow increase in size slightly as the air inside the marshmallow equalizes to match the reduced air pressure in the container. Another way to think about this is that you have reduced the amount of air

pressure pushing on the marshmallow, but the air pressure inside the marshmallow is the same as it was before, so the marshmallow expands. Some of the air will escape the marshmallow.

- The pump will become difficult to pull. There will be a small "clicking" noise, and you have created your vacuum. Stop pumping.
- Have students observe the differences in the two marshmallows—the control and the marshmallow exposed to a vacuum.
- Using the nub on the top of the stopper, re-pressurize the bottle by letting the air back in.
- The air in the marshmallow has already decreased since some of the air escaped. As it re-pressurizes the marshmallow deflates because there is less air inside than at the beginning of the experiment, and because the air pressure pushes in on the marshmallow.

Example Discussion Questions:

- What happened to the marshmallow? A: *It expanded in a vacuum and then it deflated when it was at normal pressure.*
- How is your head similar to a marshmallow? A: *There is air inside of your head (sinus cavity).*
- How is your head different from a marshmallow? Hint: If you try to squish a marshmallow, what happens? Could you do that to your head? A: *Your head has bones and cartilage holding it together. Your head would not expand like a marshmallow.*
- There is air pressure on Mars, but it is much lower than on Earth. Also, Mars has very little oxygen. What would you bring with you to ensure your safety? A: *Pressurized helmet, oxygen tank, pressurized space suit, etc.*

Troubleshooting Tips

- Try this out a few times before demonstrating with students. If the pump is not properly placed on the stopper, a vacuum will not be created.
- The container is small, so the marshmallow cannot be seen from every angle. You may have to have students gather around closely.
- The marshmallow will expand, but the difference in size will not necessarily be noticeable until you re-pressurize the container.