The Changing Life of Air Pressure

Summary

These activities will demonstrate that heating air will cause air to rise and become a low-pressure area.

Materials

The Soda Bottle Crush

- Two-liter bottle with lid
- Hot water
- Funnel
- Graduated pouring container (ml)

Activity One - Pop Goes the Balloon

- 20 oz bottle (glass) that juice comes in with the opening about the size of an egg (you can usually find it in the nutrition section of a grocery store)
- Piece of paper towel
- Matches or fireplace lighter
- Medium sized balloon filled with water about the size of an egg

Additional Resources

Books

- *Weather*
  , Gail Gibbons 082340952X
- *Weather Words*
  , Seymour Simon, 0060884398
- *Handy Weather Answer Book*
  , by Walter A. Lyons 0760757674

Videos

- Heat, Wind and Pressure, VH, 2001 United Learning

Background for Teachers

Depending on how many air molecules there are in a given space depends on how much air pressure there will be in that space. As stated previously, the air pressure on Earth's surface (at sea level) is about 15 pounds per square inch. However, the air pressure above Earth's surface gradually gets less and less the higher the air is because there are fewer air molecules packed together in the same amount of space. The weight of the molecules stacked on each other are not as great in the upper atmosphere as they are on Earth's surface.

But, can air pressure in a given area be reduced at or near Earth's surface? If it can, what is the outcome? Whenever something gets hot (such as by the sun, a burner or, a flame) it--in turn--heats the air and the air rises. The reason it rises is the air molecules spread out causing fewer air particles existing in that given area. When there are fewer air particles in a given area a low pressure is created. The air rises like a bubble in water because the air is now lighter. The air farther out that is not being affected by the heat has a higher pressure than the air around the candle. Therefore, this outside air having more pressure moves into the lower pressure. Whenever a high-pressure area meets a low-pressure area, the high pressure will always move into the low area. These differences in air pressure are what cause air masses to move and create weather.

Intended Learning Outcomes

1- Use Science Process and Thinking Skills

3- Understand Science Concepts and Principles

Instructional Procedures

Invitation to Learn

The Soda Bottle Crush

Explain to the students that air pressure at any location changes over time. Sometimes air can be a high pressure area and sometimes it can be in a low pressure area depending on how much air is in a given area. As stated in the background information, heating air will cause the air to rise and become a low-pressure area.

Show the following experiment to the students. Tell the students to observe what is happening. The only words that will be spoken are by the teacher telling what he/she is doing. The students are to write in their journals what the teacher is doing and write down what they are observing.

- Fill up a graduated pouring container with 500 ml of very hot water. (Don't use boiling water because it might melt the two-liter bottle.)
- With a funnel in a two-liter bottle, pour the hot water into the bottle.
- Keep the hot water in the bottle for about a minute, then pour it out.
- After pouring it out, quickly put the lid on so no cold air can get into the bottle.
- Set it down on the table and tell the students to observe and write down what happens during the next couple of minutes. (The bottle will begin to crush.)
- Have the students write down a conclusion why the bottled was crushed, but don't discuss it at this time. (The hot water caused the air to heat up and created a low pressure. After the hot water was pushed out and the lid put on the air began to cool and sink, but the low pressure was still in the bottle. The high pressure outside the bottle pushed in on the bottle, crushing it.)

Instructional Procedures

Activity One--Pop Goes the Balloon

With the following experiment, we want to show that when a low pressure area is created, a high pressure area surrounding the low pressure will rush into that area. We are actually going to see the air pressure actively pushing into a low pressure area.

- Have the students take notes and answer the teacher questions in their journals.
- Get a glass juice bottle that has an opening about the size of a medium or large egg.
- Ask the students what is in the bottle. (Air)
- Put the egg-sized balloon on the opening of the bottle and try to push it in with your index finger.
- Ask, "What is happening?" (It won't go in.) Ask, "Why won't the balloon go in?" (Because the air in the bottle is full of air and it won't let the balloon in. It has the same amount of air pressure in the bottle that is outside the bottle.
- Tell the students that today they are going to see air pressure push the balloon into the bottle.
- Ask the students, "What is going to have to happen to get the balloon inside the bottle." (The air pressure inside the bottle needs to be less than the air pressure on the outside of the bottle.)
- Ask, "What do we need to do to the air to lessen the air pressure in the bottle?" (Heat the air somehow.)
- Tell the students how you are going to do to lower the pressure inside the bottle with heat. Tell them that you want them to observe your every move and observe carefully what is happening in the experiment. Before you start make sure they are all attentive because they are going to observe things with their eyes, ears, and nose.
- Tell the students of the following steps you are going to take to get the egg into the bottle.
    - Tear off a small piece of paper towel (2"x 2") and roll it up.
    - Light the piece of paper at one of the ends and drop it into the bottle.
    - Quickly put the egg-sized balloon on the bottle. Tell the students to watch carefully. They might see the balloon dance around on top of the bottle for a few seconds.

Do the three directions that are listed in the bullets above in number seven. Have the students observe.

When the experiment is over, ask, "What is the final thing that happened in the experiment?" (The balloon went into the bottle.)

Ask, "What are some of the things you saw happening during the experiment before the egg went into the bottle? (The flame burned inside the bottle. When the egg was on the bottle, it jumped around for a few seconds. The flame went out in just a few seconds. When the flame went out the egg dropped in.)

Ask a few questions:

What was the flame doing to the air inside the bottle? (It was heating the air.)

Why was the egg dancing on top of the bottle? (The hot air was rising and escaping from the bottle through the bottle opening making the egg go up and down.)

Once air left the bottle what was created in the bottle? (A low pressure area because now there was less air in the bottle in the same sized space.)

Why did the flame go out? (There was no more oxygen to burn.)

Why did the egg pop into the bottle? (When the flame went out, the air gathered together. Since there was less air in the bottle there was now a low pressure area in the bottle. The high pressure wanted to go into bottle, but it had to push the egg in first to get into the bottle.)

Remember, when a high pressure area meets a low pressure area, the high pressure will always go into the low pressure area.

Now, pull the balloon out of the bottle by the tied end. What do you observe? (There was a popping sound.) What caused the sound? (With to balloon in the bottle, it took up space in the bottle. Once the balloon is pulled out, more air must go in the bottle to fill up the empty space the balloon once occupied. The popping sound in the sound of rushing air--high pressure to low pressure.)

Extensions

Curriculum Extensions/Adaptations/Integration

For advanced learners, have them investigate other ways of showing that high pressure wants to go into a low pressure area.

For learners of special needs, have them explain verbally to a classmate what happened in each experiment. Possibly the teacher could replicate the experiment(s) for the special needs learner letting him/her explain what is happening.

Have the students draw pictures of the two bottles used to create a low pressure. Have them show on these bottles what the air molecules look like in the high pressure area and in the low pressure areas. (Visual Arts: Standard III, Objective 2)

Family Connections

Send home a list of materials needed for the students to show their families the two experiments they were shown or did in class. Have them explain the reasons behind the results of the two experiments.

Have the student go to the library and check out books about more experiments that can be done with air pressure. Have them do them as families to learn more about air pressure.

Assessment Plan

Divide the class into groups of three or four students and ask them to discuss and answer these questions in their journals or on paper.

In the juice jar/balloon experiment, what caused the air pressure to change in the bottle?

When heat is causing a pressure change, where does the hot air go? Explain.

Describe the experiment with juice jar/balloon. Explain how a low pressure was created and what showed that the high pressure wanted to go into the low-pressure area.
When the balloon went into the bottle, what did you hear? Explain.
When the balloon was pulled out of the bottle, what sound did you hear? Explain.
Explain other times you hear high pressure rushing in to low pressure areas.

Have the students draw pictures of one or both experiments. Have them label the parts and show where the high pressures and the low pressures are. Have them write a caption of what is happening in the experiment(s).

Bibliography

Townsend, J., Bunton, K., (2006). Indicators for inquiry. *Science and Children*, Volume 43 (Number 5), Page 37

The National Science Education Standards specifically state that students should be able to observe simple objects and patterns and report their observations. When inquiry is involved with a hands-on approach, the topics cater to the natural curiosity of children and allow them to use a wide range of investigation and science-process skills. As children explore, the teacher can provide some guiding questions that may lead the way.

Heuser, D., (2005). Inquiry, science workshop style, *Science and Children*, Volume 43 (Number 2), Page 32

A good science workshop inquiry mode should be in three parts:

Exploration--hands-on experiences to produce interest and knowledge of desired science ideas to generate student questions.
Investigation--experiments based on student questions
Reflection--Reflective activities including discussion and writing to be unified in the results of the experiments. What did we learn?

Ketch, A., (2005). Conversation: the comprehension connection. *The Reading Teacher*, Vol. 59 (Number 1), Page 8

Students who engage in conversation in the classroom become reflective thinkers. Conversation brings meaning to life as they contemplate to understand our complex world. Conversation is the comprehension connection. There are literature circles, book clubs, whole-class discussions, pair/share, small-group discussion, and individual conferences.

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