



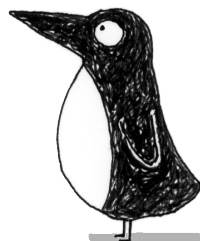
Black and White Bottle Experiment

Written by GEF Staff

Grades: 3-5

Subject: Science

Time: 50-60 minutes



***Standards:** Students will...

Science Standard 9: Understand the sources and properties of energy.

Benchmark # 1: Know that heat is often produced as a byproduct when one form of energy is converted to another form.

Benchmark # 3: Know that light can be reflected, refracted or absorbed.

Science Standard 12: Understand the nature of scientific inquiry.

Benchmark # 3: Plan and conduct simple investigations.

Benchmark # 5: Know that scientists' explanations about what happens in the world come partly from what they observe and partly from how they interpret their observations.

Technology Standard 6: Understand the nature and uses of different forms of technology.

Benchmark # 3: Know that different types of energy (solar, fossil fuels) have different advantages and disadvantages (e.g., solar energy is a cleaner source of energy than fossil fuels, but currently is more expensive.)

Objective: Students will be able to...

- Explain the relationship between color and solar energy absorption and identify ways to use color to harness or repel the sun's energy.
- Organize and record data using a variety of graphic representations.

[Please click here to view both the creative artwork for this great lesson and the downloadable PDF.](#)

Materials:

- One plastic bottle painted white
- One plastic bottle painted black
- Several small balloons
- "Black and White Experiment: Prediction, Directions, and Conclusions" worksheet provided below

Overview: Our sun is a non polluting, renewable energy source that has been burning for 4.5 billion years. If people used solar energy to its full potential, nearly every house on Earth could be energy independent. As a result, the amount of pollution would greatly decrease. In addition, the amount of non-renewable fossil fuel used for energy would be reduced. Although turning solar energy directly into electricity is not very efficient, solar energy can be collected as heat.

The color of an object depends on the wavelengths of colors reflected by that object. When a black object is illuminated by white light all wavelengths are absorbed. Dark objects appear dark because they absorb light instead of reflecting it. The light absorbed by dark objects does not disappear. The absorbed light energy is transformed into heat energy. Since darker colors absorb light better they also emit heat better. Wearing a white T-shirt rather than wearing a black T-shirt on a hot day keeps you cooler. A white t-shirt reflects more sunlight, so it absorbs less heat. When an object's temperature rises, its molecules spread apart and become lighter. This causes the object to expand.

**Kid's Speak:**

When light is shined on an object, the object can reflect the light or absorb it. The color white reflects light, and the color black absorbs light. The absorbed light is energy, which heats the object and causes the object to expand.

Human beings have used solar energy for thousands of years. Solar energy is radiant light or heat from the sun. The sun's energy provides a renewable resource that people will continue to use in the future.

Eco-Facts: The energy output of 1 kilowatt of solar energy unit is roughly equivalent to the burning of 170 pounds of coal, which releases 300 pounds of carbon dioxide into the atmosphere.

Instructions:**Before Conducting Experiment:**

- Explain to the class that the sun's rays are attracted to dark colors. Then tell students that they are going to test the effect colors have on energy absorption. Explain or read experiment directions.
- Have students predict which balloon will expand more quickly, and have students write a brief explanation of their predictions.

Experiment Directions:

1. Teachers may wish to divide the class into groups of 3 or 4 students that will each have their own set of materials.
2. Place the open end of one small balloon on the mouth of the white bottle. Do the same for the black bottle. Be sure the balloon forms a tight air seal.
3. Place both bottles in bright sunlight either inside or outside.
4. Observe both bottles. (The balloon on the black bottle will expand, while the balloon on the white bottle will remain limp.) Students can use a watch to see how long it takes the balloon on the black bottle to expand.
5. In addition, touch both bottles. The balloon on the black bottle will produce heat, while the balloon on the white bottle will not.
6. Have students record the visual appearance of each balloon and how each balloon and bottle feels when touched.

After Conducting Experiment:

- Students will write observations and/or draw diagrams showing experiment results.
- Students can create a diagram showing what happened to their bottles: the sun hitting the two bottles, the sun's energy blowing up the black bottle's balloon, and nothing happening to the white bottle.
- Discuss results of experiment and offer scientific reason for the results. In addition, discuss the implications of the results as they relate to solar energy and its uses in the future.

Adaptations:

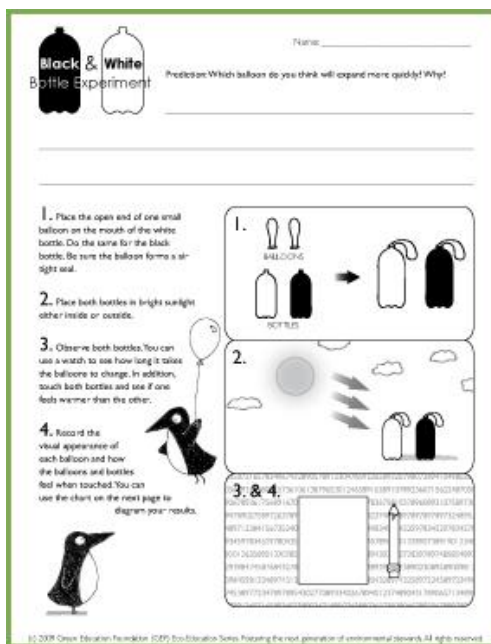
- Students can use different colored bottles and different colored balloons to see if the balloons will expand.
- Students can compare how long it takes the balloon on the black bottle to expand at different times during the day.

Extensions:

- For homework students can write a conclusion to the experiment using their observations. Have students include two examples of objects that you would want to attract the sun's energy and two object you would want to repel the sun's energy. Have students write a brief explanation for each example.
- Compare temperatures of light and dark colored cars.
- Students can take a field trip to a solar power plant to learn more about solar energy.



GEF Community: Students can share what they have learned about solar energy with the GEF Community. Join the Green Energy Challenge where students can share their diagrams, conclusions for this experiment and their thoughts and ideas about how solar energy can be used today and in the future.



To view full-size lesson plan and print, follow these directions:

1. Click on the image above
2. Click on the small "print" icon at the top left of the lesson
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* All lessons listed on the GEF website have been aligned with the McREL Compendium of Standards and Benchmarks for K-12 Education. GEF curriculum has been developed in accordance with the McREL standards in order to reflect nationwide guidelines for learning, teaching, and assessment, and to provide continuity in the integrity of GEF curricular content from state to state. The decision to utilize McREL's standards was based upon their rigorous and extensive research, as well as their review of standards documents from a variety of professional subject matter organizations in fourteen content areas. Their result is a comprehensive database that represents what many educational institutions and departments believe to be the best standards research accomplished to date. To access the McREL standards database, or for additional information regarding the supporting documentation used in its development, please visit <http://www.mcrel.org>.

