

# Energy Transformation

**Eighth Grade**

**Activity: 8**

**Time: 1 Class Period**

## General Description

Students will be making observations and measurements in order to explain if heat is absorbed or given off by rubber. They will also describe the affects of heat on rubber.

## Objectives

Students will use observation and measurement to determine the affect of heat on rubber.

## Arizona State Standards

SC08 S1C1 PO1 Formulate questions based on observations that lead to the development of a hypothesis

SC08 S1C2 PO1 Demonstrate safe behavior and appropriate procedures (e.g., use and care of technology, materials, organisms) in all science inquiry

SC08 S1C2 PO4 Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers)

SC08 S1C2 PO5 Keep a record of observations, notes, sketches, questions, and ideas using tools such as written and/or computer logs

SC08 S1C3 PO1 Analyze data obtained in a scientific investigation to identify trends

SC08 S1C4 PO1 Communicate the results of an investigation

SC08 S5C1 PO3 Identify the following types of evidence that a chemical reaction has occurred:

- formation of a precipitate
- generation of gas
- color change
- absorption or release of heat

SC08 S5C1 PO7 Investigation how the transfer of energy can affect the physical and chemical properties of matter

W08-S3C2 PO1 Record information (e.g., observations, notes, lists, charts, map labels and legends) related to the topic

W08-S3C2 PO2 Write a summary based on the information gathered that include(s):

- a topic sentences
- supporting details
- relevant information

## Teacher Information

When rubber is heated, it behaves differently than most familiar materials. Most materials expand when they are heated. Consider the liquid in a thermometer. The thermometer works because the liquid expands when its temperature increases. Similarly, a wire made of metal, such as copper, becomes longer as it gets hotter.

Whether a material expands or contracts when it is heated can be ascribed to a property of the material called its "entropy." The entropy of a material is a measure of the orderliness of the molecules that make up the material. When the molecules are arranged in an ordered fashion, the entropy of the material is low. When the molecules are in a disordered arrangement, the entropy is high. (An ordered arrangement can be thought of as coins in a wrapper, while a disordered one as coins in a tray.) When a material is heated, its entropy increases because the orderliness of its molecules decreases. This occurs because as a material is heated, its molecules move about more energetically. In materials made up of small, compact molecules, e.g., the liquid in a thermometer, as the molecules move about more, they push their neighboring molecules away.

Rubber, on the other hand, contains very large, threadlike molecules. When rubber is heated, the sections of the molecules move about more vigorously. In order for one part of the molecule to move more vigorously as it is heated, it must pull its neighboring parts closer. To visualize this, think of a molecule of the stretched rubber band as a piece of string laid out straight on a table. Heating the stretched rubber band causes segments of the molecules to move more vigorously, which can be represented by wiggling the middle of the string back and forth. As the middle of the string moves, the ends of the string get closer together. In a similar fashion, the molecules of rubber become shorter as the rubber is heated, causing the stretched rubber band to contract.

## **Materials**

Paper or Journal to keep records

Rubber band

Weights (fishing weights/sinkers work well)

Hair dryer

## **Procedures/Exploration**

1. Place two fingers through the heavy rubber band, one on each end. Do not stretch the rubber band and touch it to your forehead or cheek. Record how the rubber band feels (cool or warm or about the same as your skin).
2. Repeat the test several times.
3. Move the rubber band slightly away from your skin, so it is not touching you. Quickly stretch the band about as far as you can and while holding it in the stretched position, touch it again to your forehead or cheek. Record how it feels. (Warmer or cooler or about the same as it did).
4. Move the stretched rubber band away from you skin. Quickly let it relax to its original size and again hold it to your skin. Record how it feels.
5. Repeat the stretching and testing, and relaxing and testing several times.

An object feels cool to you when heat flows from your skin to the object. Conversely, an object feels warm or hot when heat flows from the object into your skin. If the stretched rubber band feels cool, then it absorbs heat from your skin. If it feels warm, then it gives off heat to your skin. If the band feels neither warm nor cool, then there is no detectable heat flow.