

## Week 5: Chemical Energy

Today we will talk about chemical energy? What is a chemical? Is water a chemical? Yes, it's a molecule made up of two hydrogen atoms and one oxygen atom (H<sub>2</sub>O). There are three states of matter: solid, liquid, and gas. Which one is water? What about ice? How could we turn solid ice into another state? Heat! And heat is energy.

Chemical energy is stored energy in substances that is released when at least two distinct substances are brought together and react with one another and turn into different substances.

Chemical vs physical change: <https://www.youtube.com/watch?v=BgM3e8YZxuc> @15se-50  
Ripping up this sheet of paper is a physical change because the appearance or form may have changed, but the substance is still the same -- it's still paper! In a chemical change the substance form to create a new substance. Like when a car or another piece of metal rusts due to oxygen.  
→ complete page 1 of worksheet together

**The emphasis of today's lesson is that we can convert chemical energy to other forms of energy through a chemical reaction.**

So we could add heat to make the ice melt. This would be endothermic. Endothermic process means that energy--typically heat--must be added from the surroundings.

Exothermic process is the opposite of endothermic...so what's the opposite of the reaction absorbing energy from the surroundings? Putting out energy, often in the form of heat!!

### Instructions

1. Place the thermometer in the jar and close the lid. Allow about 5 minutes for the thermometer to record the temperature, then open the lid and read the thermometer.
2. Remove the thermometer from the jar (if you didn't already in Step 1).
3. Soak a piece of steel wool in vinegar for 1 minute.
4. Squeeze the excess vinegar out of the steel wool.
5. Wrap the wool around the thermometer and place the wool/thermometer in the jar, sealing the lid.  
Could move on to the next Exercise while you wait for the temp to change, but then could miss the mild temperature change (go down)..
6. Allow 5 minutes, then read the temperature and compare it with the first reading.

### Exercise 1

1. Thermometer
2. Jar with lid
3. Steel wool
4. Vinegar

## Results

Not only does the vinegar remove the protective coating on the steel wool, but once the coating is off, its acidity aids in oxidation (rust) of the iron in the steel.

The thermal energy given off during this chemical reaction causes the mercury in the thermometer to expand and rise up the column of the thermometer tube.

In the rusting of iron, four atoms of solid iron react with three molecules of oxygen gas to form two molecules of solid rust (iron oxide).

Let's look at an endothermic reaction caused by a chemical reaction (since ice melting is a physical endothermic reaction).

**Have students record amount of citric acid (with units), starting temp, coolest temp, and time to reach temp. Then try varying the amount of citric acid in solution.**

### Creating the Reaction

1. Pour the citric acid solution into a coffee cup. Use a thermometer or other temperature probe to record the initial temperature.
2. Stir in the baking soda -- sodium bicarbonate. Track the change in temperature as a function of time.
3. Now vary the amount of citric acid! See how long it takes for the temperature to drop to a (possibly) new low.

#### Exercise 2:

1. 25 milliliters of water and begin with  $\frac{1}{8}$  teaspoon of citric acid solution
2. 15 grams of baking soda
3. plastic foam cup
4. thermometer
5. stirring rod

### Tips for Success

1. An endothermic is a reaction that requires energy to proceed. The intake of energy may be observed as a decrease in temperature as the reaction proceeds. Once the reaction is complete, the temperature of the mixture will return to room temperature.

Group Demo ([Elephant Toothpaste](#)) (10 minutes) In the group demo we demonstrate how energy is released in a chemical reaction between  $\text{H}_2\text{O}_2$  and yeast to produce  $\text{H}_2\text{O}$  and  $\text{O}_2$ . The oxygen gas expands quickly, making the dish soap foam up. The reaction also releases heat which we can feel from the bottle. The hot gas is a form of energy release.

### Fun exercise (3) – Elephant Toothpaste (Exothermic!)

1. 10% hydrogen peroxide
2. food coloring
3. dish soap
4. yeast