

Money to Burn

Recommended Grade Level(s):

Appropriate for: Middle school and High school

Time Requirements:

Activity Time: 30 minutes

Teaching Topics & Concepts:

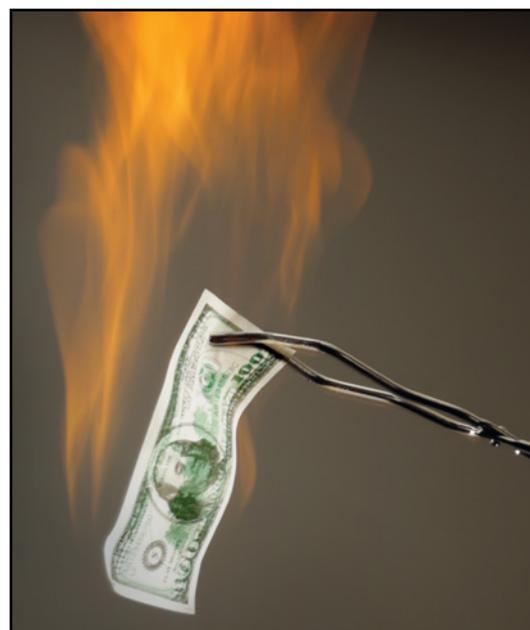
- Combustion, Chemical Reactions, Enthalpy of reaction, and Flammability
- Indicators, Observing, Inferring, and Investigating

Background:

Does money burn a hole in your pocket? Well, it doesn't burn in this demonstration. With this dramatic demonstration of a combustion reaction involving a solution with a low combustion temperature, your students will be amazed as they watch money (play or real) or paper catch fire, yet not burn at all. Asking students to explain this phenomenon leads to a discussion of enthalpy of reaction, flammability, and flashpoint.

Materials:

- Paper (\$20.00 bill or piece of white paper towel)
- Isopropyl alcohol, 99%
- (1) 400—mL beaker
- Crucible tongs
- Container of water (to extinguish the burning paper)



Safety

- Read the SDS sheets for all chemicals before using them.
- Wear safety glasses, gloves, and lab coat.
- Alcohol is highly volatile and flammable. Ensure no open flames are present (candle, Bunsen burner).
- Avoid inhalation of alcohol vapors.
- Burning drops of alcohol may fall from the bill/paper so ensure the audience is at least 1 meter away and activity is conducted on a table that is flame resistant.
- This activity uses flammable materials, so it requires adult supervision when students use it. Or an adult can light and handle the materials for the students.



Money to Burn (continued)

Procedure:

1. Pour 100 mL of water into a 400 mL beaker.
2. Add 100 mL of isopropyl alcohol to the beaker. Stir.
3. Soak the bill or paper towel in the solution and then remove with crucible tongs.
4. Light the bill.
5. Extinguish the paper by waving it in the air or submerging it into a container of water.

Expected Results:

The soaked paper ignites into a blue flame, but the paper does not burn due to its combustion temperature, 232°C. This occurs as heat energy is transferred from a chemical reaction to water molecules. The high specific heat of water allows it to absorb the heat energy from the alcohol's combustion reaction protecting the money/paper from the flames. So, even though flames are coming off, the money itself is not burning.

Follow up:

- Add some salt to the solution to color the flame and make it more visible. (Ex.: Sodium chloride colors the flame yellow instead of blue).
- Use a paper cup or snow cone cup and fill it with water. Place it over a small flame. Students observe that the cup will not burn, but the water will eventually boil.
- Use a candle to investigate the products of combustion. The combustion reaction of a candle is like the burning of wood or gas.

Teaching notes:

- The products of combustion — carbon, water, and carbon dioxide — were all seen in this experiment.
- Ethanol and water in a 2-to-1 ratio by volume works as well.
- Other learning outcomes: Investigate and classify chemical reactions as synthesis, decomposition, single displacement, double displacement, or combustion. It shows how a combustion reaction requires hydrocarbon and oxygen.

Questions and observations for students:

1. Why did the flame/fire stop?
2. What happens to the water?
3. What are examples of common combustion reactions in everyday life?
4. How do the products of combustion contribute to pollution?
5. What happens to the paper if you get the alcohol-to-water ratio wrong? Why? (Just don't use real money to test your theories, you'll really burn money then!)

Disposal/Clean-Up:

The unused solution can be stored in a sealed and properly labeled container for reuse.
Alcohol soaked paper should be rinsed thoroughly with water after using it.

Find materials for this activity at wardsci.com.
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