

## The Nature of a Burning Candle

Have you ever really observed what happens to a burning candle, both physically and chemically? The scientific process is made of two very different activities that work hand in hand to help us understand the world around us. The first, observation, is the starting point for all scientific learning and is a skill that must be practised. In this activity, you will have an opportunity to refine your observational skill. The second, critical thinking, is questioning what you observe. In this Investigation, you will need to think critically about what you observe.

### Question

What physical and chemical changes can be observed when a candle burns?

### Predictions

Predict what states of matter exist when a candle burns. Predict the effect of metal on a candle flame. Predict what new substances may be produced when a candle burns.

### Experimental Design

In this Investigation, you will observe and test a burning candle to find out if it undergoes physical and chemical changes.

### Materials

- 1 standard candle
- ruler
- scale
- safety goggles
- apron
- matches
- 2 pieces copper wire
- 1 Petri dish or large watch glass
- pencil
- tongs
- cobalt chloride paper
- water
- 100 mL beaker
- 250 mL flask
- limewater
- rubber stopper

### INQUIRY SKILLS

- |   |   |  |
|---|---|--|
| <input type="radio"/> Questioning           | <input checked="" type="radio"/> Conducting | <input checked="" type="radio"/> Evaluating    |
| <input type="radio"/> Hypothesizing         | <input checked="" type="radio"/> Recording  | <input checked="" type="radio"/> Synthesizing  |
| <input checked="" type="radio"/> Predicting | <input checked="" type="radio"/> Analyzing  | <input checked="" type="radio"/> Communicating |
| <input type="radio"/> Planning              |   |  |



Keep all flammable material, including your hair and your clothing, out of the flames. Hot wax and flames can cause severe burns.

Do not allow limewater to make contact with your eyes. If this happens, flush your eyes with water and have someone contact the teacher immediately.

### Procedure

#### Part 1

1. Work with a partner. First, read through the Investigation. Look for what you need to record. Make a data table for each part to record your observations.
2. Observe the properties of the unlit candle. What states of matter are present? Measure the mass and length of the candle. Measure the mass of the candle and the Petri dish together. Record your observations in your data table.
3. Put on your safety goggles and apron. Light the candle and melt two or three drops of wax in the centre of the dish. Stick the base of the candle in the wax before it cools so that the candle can stand by itself.
4. Time your observation of the burning candle for exactly 5 min. Make careful observations of the flame noting any different regions in it. Make 10 or more observations, and record them in your data table. Start your observations: How many states of matter do you see? Where does the burning take place? What is actually burning?

- After 5 min, extinguish the candle and have your partner put a lit match in the smoke above the candle. Record your observations.
- Determine the length of the candle, and the mass of the candle and Petri dish. Record your measurements.

## Part 2

- Light the candle again. Hold a straight piece of copper wire above, but not in, the flame. What do you observe?
- Make a coil with a new piece of copper wire by wrapping the copper wire around a pencil. With tongs, lower the coil upright over the tip of the flame without touching the candle wax (Figure 1). Be prepared for the flame to go out. If it does, quickly remove the coil. Record your observations.



Figure 1 Step 8

## Part 3

- Test a strip of cobalt chloride test paper with a drop of water to see what happens. Light the candle. Carefully invert a flask over the candle flame and hold it until the flame is extinguished. Be careful not to let the flask get so hot that you get burned. If necessary, use tongs to hold the flask (Figure 2). Test the inside of the flask with a cobalt chloride test strip. Record your observations.



Figure 2 Step 9

- Pour tap water to a depth of 1 cm into the Petri dish that is holding the candle. Light the candle. Carefully lower the 250 mL flask over the candle so that the mouth is completely below the surface of the water (the candle may have to be cut to allow it to fit under the flask). Leave it for 1 min, and record your observations.
- Lift the flask out of the water, turn it upright, add about 25 mL of limewater. Put the rubber stopper in the flask and gently swirl for 1 min. Record your observations.

## Analysis

- What is the role of the wick in the candle? How does it help to keep the candle lit? Does it burn?
- What is the shape of the candle flame?
- Where did the wax from the candle go?
- Which changes that you noted in step 4 were physical? Which were chemical?
- What evidence showed the release of energy? What forms of energy were produced by the burning candle? Where was this energy in the unlit candle?
- Based upon your analysis of your observations in Part 3, what are two substances produced by the combustion of the candle?
- How does the mass of the candle change during combustion? Explain this change in mass.
- Is there any evidence that the candle needs something from the air to help it burn? What do you think this something might be?
- What do you think the copper removes from the flame causing it to be extinguished? (Hint: what did the metal transmit to your fingers?)

## Evaluation

- Did the evidence you gathered in this Investigation support your predictions? Explain.