

Name: _____

Observing a Candle

Background

You will observe a burning candle in this experiment. When you light a candle, you initiate a chemical reaction called combustion. This reaction is expressed as follows:



or



You can tell that a chemical reaction occurs because heat and light are released. Combustion reactions require three things to take place: fuel (hydrocarbons), oxygen, and ignition. Hydrocarbons are molecules made up of hydrogen and carbon and substances such as gasoline, fuel oil, and propane are examples of hydrocarbons.

In this experiment you will use a candle, which is also a hydrocarbon. You will use oxygen in the atmosphere, and you will supply ignition with a match.

It may seem odd to think that burning the candle produces water. It is hard to see the water that results from burning the candle because it is a gas. Carbon dioxide is also a gas and it is more dense than air, so it "sinks" and can be separated from air easily.

When CO_2 is added to a calcium hydroxide, $Ca(OH)_2$, solution (limewater), it reacts to form insoluble calcium carbonate, $CaCO_3$. This substance is white and when the reaction occurs, it makes the solution turn cloudy because of the insoluble $CaCO_3$.

Prelab Questions

Answer the following questions on a separate sheet of paper and turn in before lab day:

1. What happens to a candle when you light it?
2. How can you prove that a candle needs oxygen to burn?
3. How can you prove that a candle produces carbon dioxide when it burns?
4. How can you prove that a candle produces water when it burns?
5. What happens when you hold a piece of glass in different parts of the flame? What do these results say about the process of burning wax in a candle?
6. Is it possible to light a candle without directly touching the flame and the wick? Why or why not?

Purpose

You will make a series of observations to hone your observation skills for future experiments. You will learn something new about an object you assume is familiar.

Materials

- Candle
- Matches
- Safety goggles
- Ruler
- Balance
- Watch glass
- 400-mL beaker
- CO_2 indicator solution in a beaker

Safety

- Always wear safety goggles when working in a chemistry lab.
- Tie back loose hair and clothing.

Procedure

Before proceeding with any procedure steps your group has designed, get approval from your teacher. Once you have made observations, if you feel you don't quite understand what you've observed, check in with your teacher to discuss before moving on to the next part.

PART I: Observations of the Candle

1. Record some quantitative observations about the candle before you light it. Record things such as length, mass, diameter, length of wick, or anything else that occurs to you. Try getting the mass of the candle at specific time intervals while burning: does its mass change over time?
2. Record some qualitative observations about the candle before you light it. Record such things as wax color, color of wick, smell, new/old/damaged, or anything else that occurs to you.
3. Record the sequence of events that occurs as you light the candle. Try to be as detailed as possible. These observations will be qualitative and should be as organized as possible.

PART II: Candles Use Oxygen as They Burn

1. When the chemical change called combustion happens, oxygen must be present. Oxygen is a gas that makes up about 20% of Earth's atmosphere (by volume). Can you prove that oxygen from the air is required for the candle to burn? As a group, suggest a procedure. Have your teacher approve the procedure before carrying it out.
2. Write down what you observe in your experiment, whether it seems relevant or not.

PART III: Candles Produce Carbon Dioxide as They Burn

1. Combustion produces carbon dioxide (CO_2). Recall from the background a way to detect CO_2 using a solution. Devise and carry out an experiment to test whether a candle releases CO_2 .
2. Write down what you observe in your experiment, whether it seems relevant or not.

PART IV: Candles Produce Water as They Burn

1. Combustion reactions also produce water (H_2O). Because the candle also releases heat, if water is present you will have to provide a way to cool it down to see it. Can you prove that candles do release H_2O ? Devise and carry out an experiment.
2. Write down what you observe in your experiment, whether it seems relevant or not.

PART V: Flames Have Parts

1. There are at least three distinct regions in a candle flame. One: the blue-rimmed clear region very close to the wick. Two: the dim-orange-fading-to-bright-yellow region that produces light. Three: the clear region just above the visible flame. Observe these flame regions. Devise and carry out an experiment to observe what is in these regions. Write down the steps of your experiment below and show them to your teacher before proceeding.
2. Write down what you observe in your experiment, whether it seems relevant or not.

PART VI: Flames Can Be Surprising

Your teacher will show you the “jumping flame trick”.

Analysis

Part II-V:

1. Write a short story about what happens to the solid wax as it melts, enters the flame, burns, and leaves the flame.

Part VI:

1. Describe how to perform the jumping flame trick in your own words.
2. What makes the trick possible?
3. What burns in a candle: the wick, the solid wax, the melted wax, or vaporized wax? Justify your answer.