## Candle Lab (Teacher Guide)

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### Purpose

The purpose of this investigation is to have students observe and interpret a chemical reaction using qualitative observations.

### When To Do This Investigation?

This is designed to point out the important role that qualitative observations can play in chemistry. There is no prerequisite knowledge that the students need to have in order to perform this experiment, so it can be given at any time of the year. It may be worthwhile to do this as one of the first labs of the year in order to have students understand the importance of collecting qualitative observations. It couples well with a lab that focuses on developing quantitative collection skills. For example a lab on accuracy vs. precision.

Since this experiment does involve combustion, it can be linked to this topic as an introduction, or supporting activity to this topic.

### Materials

This investigation does require some readily available materials in order to conduct. It may be worth giving the students a heads-up a few days prior to conducting it, just in case they do not have any of these items at home.

Glass slide (can be replaced with a small, flat plate)

Candle/ Tea candle

Matches (or barbeque lighter)

Scoopula (can be replaced with a knife)

Metric ruler

Aluminum foil

Tongs

String (ideally similar diameter as the wick of your candle)

Toothpick

### Results & Sources of Error

This is an investigation where the students are making qualitative observations, so their responses may vary significantly. There are also some situations that they may need further clarification with and it may be helpful to run through this lab on your own first, so you can anticipate their questions.

The goal of this lab is to have the students collect data that will support their theory about how a candle functions. The procedure is scaffolded to help them make connections. Insist that their answers to the questions are supported with evidence from steps in the procedure. Consider having them complete an initial run followed by a class discussion about things to watch out for.

Although the observations of this lab are relatively simple, putting it all together in order to recognize the processes involved in this surprisingly complex piece of technology are not. The following videos may help put things together:

# The Science of How a Candle Burns:

# <https://youtu.be/B9asozzeAwY>

# Where Does the Candle Wax Go?:

# https://youtu.be/onS4vjfHmoM

### Safety Considerations

In this experiment the students will be working with an open flame. It may be worth discussing appropriate home spaces in which to conduct this lab with them a day or two ahead of time. Items to consider with them are: tie back long hair, do not wear loose fitting clothing, and wear eye protection; to conduct the experiment on a clear, flat, hard surface (ideally ceramic or metal); to ensure that all matches and burned materials are completely extinguished (consider recommending that they have a small container with water ready) and disposed of properly; to be mindful of the hot liquid wax.

### Evaluation

There is a provided rubric for this investigation that teachers can use or modify as needed. Note that there are two tabs in the spreadsheet, including one with instructions for the teacher on how it works.

## Candle Lab (Possible ANSWER KEY for Student Guide)

**Procedure**

1. Note appearance, odour and feel of the unlit candle.

 Answers will vary.

2. Light the candle and allow it to burn for several minutes. Note any changes. Briefly describe the burning candle.

Answers will vary. These observations will act as their comparison for noting changes with respect to. Characteristics of the flame are important.

3. Blow out the flame and immediately place a lit match in the “smoke” about 2 cm above the wick.

Answers will vary. The key observation here is that the flame should reignite the wick (without touching it).

4. Using a scoopula to transfer a small amount of liquid from the bowl of the candle onto a slide. Try to light it and note the result.

 Answers will vary. The key observation here is that the liquid wax will not combust.

5. Place a toothpick into the soft candle next to the unlit wick to form a wooden wick. Light the toothpick and note the result.

 Answers will vary. The key observation here is that although the toothpick will initially burn, it will not stay alight like the wick did. Different flame features should be noted.

6. Place a length of string about 4 cm long on the glass square. Light it and observe its behavior.

 Answers will vary. The key observation here is that the string will not stay alight.

7. Make a slit in a small piece of aluminum foil. Light the candle. Carefully, place the foil between the base of the flame and the liquid in the candle bowl. Note the behaviour of the flame.

Answers will vary. The key observation here is that the wick will not stay alight.

**Conclusions and Questions**

1. What phases (solid, liquid, gas) are present in the unlit candle? What phases (solid, liquid, gas) are present in the burning candle? Which phase appears to take part in the chemical reaction? Defend your response with evidence from your observations.

Answers will vary. The states of solid and liquid will easily be noted (did they make note of these states in their observations?), but they may overlook the gaseous state. The goal is to have them conclude the gaseous state (based on the “smoke” that is able to be ignited after it is blown out).

2. What part does the wick play in the burning of the candle? What properties should the wick have? Explain the result when aluminum is placed between the liquid and the wick. Is the wick part of the chemical reaction? Defend your response with evidence from your observations.

Answers will vary. The goal is for them to identify the absorbance properties of the wick (it doesn’t burn on its own when it was placed on the slide and the toothpick is not a suitable replacement), and the heat from the flame is melting the solid wax (the aluminum foil should eventually prevent this from happening and the flame will extinguish).

3. A source of energy is needed to start the burning of the candle. What energy source is used? Is the overall reaction exothermic or endothermic?

 Answers will vary. The key is for them to recognize that the ignition source (ie. match) is exothermic (since it produces electromagnetic and heat energy). You may consider removing this question if you think that they do not know enough about combustion reactions yet.

4. Give an example in this lab that illustrates the difference between observation and interpretation.

Answers will vary. A good example of this would be the gaseous state of the wax, which can be concluded based on the fact that the vapour trail can be reignited. They may also refer to the interpretation that the wick is absorbing liquid wax, which is based on the fact that the sting did not burn and the toothpick did not serve as a replacement for it.