

## SNC1D/1P Atoms, Elements, and Compounds/Exploring Matter

### Teacher Demo/Student Activity: The Candle Family

Topics	Timing
chemical changes gas tests	preparation: 10 min demonstration: 10 min activity: 20 min

### Specific Expectations

#### SNC1D

**A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

**A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams

**A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions

**C2.4** conduct appropriate chemical tests to identify some common gases (e.g., oxygen, hydrogen, carbon dioxide) on the basis of their chemical properties, and record their observations [PR, C]

#### SNC1P

**A1.1** formulate scientific questions about observed relationships, ideas, problems, and/or issues, make predictions, and/or formulate hypotheses to focus inquiries or research

**A1.6** gather data from laboratory and other sources, and organize and record the data using appropriate formats, including tables, flow charts, graphs, and/or diagrams

**A1.10** draw conclusions based on inquiry results and research findings, and justify their conclusions

**C2.1** use appropriate terminology related to the exploration of matter, including, but not limited to: combustion, conductor, decomposition, lustrous, precipitate, reaction, and soluble [C]

**C2.7** conduct chemical tests to identify common gases (e.g., oxygen, hydrogen, carbon dioxide) on the basis of their chemical properties, and record their observations [PR, AI, C]

### Introduction

This activity is a good opportunity for students to

- exercise their hypothesis-generating skills and
- practice making quantitative observations
- apply what they have learned about the fire triangle and the gas tests.

Revisit the fire triangle with students, explaining the need for fuel, heat, and oxygen for a fire to ignite and continue to burn. Also emphasize that the absence of any one of these factors will prevent combustion from occurring.

Carbon dioxide, which is produced when a fuel like wax is burned, has a density about 1.5 times that of air. However, warm air is less dense than cold air and is consequently forced to the top of a sealed container.

## Materials

safety goggles	barbecue lighter
lab coat or apron	3 birthday candles of different heights
Bell jar or pickling jar or Mason jar	beaker of water
modelling clay (1 per group)	timer or stop watch
3 long-handled matches	

## Safety Considerations

- Provide MSDS sheets for all chemicals used.
- Hair must be tied back to keep it out of the flames.
- A fire blanket and sand bucket should be available in case of unlikely emergencies.
- The glass jar may become quite warm if the demonstration is repeated several times, so use oven mitts to handle the jar.
- Remind students of emergency procedures for fires (extinguisher use, fire exit, etc.).

## Hazardous Materials Identification System Rating

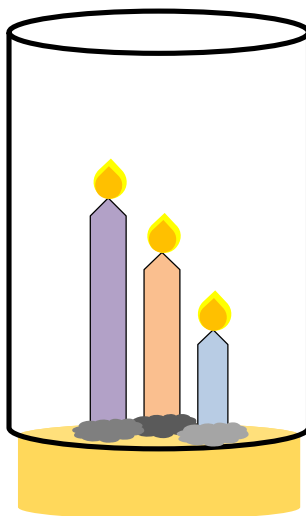
(0-minimal 1-slight 2-moderate 3-serious 4-severe)

paraffin wax		matches	
Health	1	Health	1
Fire Hazard	1	Fire Hazard	3
Reactivity	0	Reactivity	2

## Procedure

Wear appropriate PPE: safety goggles, lab coats or aprons.

1. Use modelling clay to attach the candles to the inside of the jar lids, or base of the bell jar.
2. Light one candle using the barbecue lighter.
3. Ask the students whether a physical or chemical change is occurring, and have them justify their reasoning.
4. Light the other two candles.
5. **Predict/Explain**  
Tell the students that you are going to cover the candles with the jar. Ask them what they think is going to happen. Further prompt the students to predict whether all of the candles will behave in the same manner. Have the students justify the predicted behaviour of the candles.
6. **Observe**  
Place the glass jar over the candles (Fig.1), until all three have been extinguished. Be careful when removing the jar; the glass may become hot. Use oven mitts.
7. **Explain**  
Have the students suggest explanations for why the candles behaved the way they did.
8. In order to help them with the explanation, ask the students to recall which gases are produced and which are consumed when a fuel such as wax is burned.



**Fig.1** Which candle will be extinguished first?

## Disposal

The matches should be dunked into the beaker of water to ensure that they are completely cooled and extinguished. They can then be thrown in the regular garbage. Everything else can be kept and reused in the future.

## What happens?

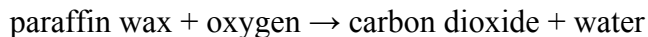
The candles are extinguished one at a time from tallest to shortest.

## How does it work?

The hot air around the candle flames includes a high concentration of carbon dioxide and a low concentration of oxygen. Since it is warmer than the rest of the air in the container, it is less dense and is pushed to the top of the container. As the flames come in contact with this carbon dioxide-rich and oxygen-poor air, they are unable to continue burning and are extinguished.

## Teaching Suggestions/Hints

1. Students rarely have the opportunity to repeat experiments to see if the data is reproducible. If this is run as a student activity it is easy to get the students engaged in timing the candles. The class as a whole can even make a graph relating candle height to burning time.
2. This demonstration could also be used in Grade 10 science, where the word equation for the reaction could be written:



## Next Steps

The products of combustion are the molecular compounds carbon dioxide and water. Have students design an experiment to test for the production of carbon dioxide during this reaction. (Hint: this could be done by adding lime water to the jar. Lime water becomes cloudy in the presence of carbon dioxide.)

Students could also test for water using cobalt chloride paper and for oxygen using a glowing splint (with all the appropriate safety precautions).

### **Additional Resources**

1. A primer demo using only one candle could be shown early in the demonstration to help get students on the right track with their predictions:  
<http://www.youtube.com/watch?v=qUwxq7QmSmQ>
2. This short demo shows how the burning candles go out from the tallest to the shortest as the oxygen in the jar is replaced by carbon dioxide from the highest part of the jar downward: <http://www.youtube.com/watch?v=Pjklza6Imk>