

Student Learning Map

Unit Topic: Ch. 12

Key Learning(s):
Fire

Unit Essential Question:
What is fire and how does it burn?

Instructional Tools
Fire Lab 1-6
Percent Calculations
Review sheets

Concept:	Concept:	Concept:	Concept:
Temperature of Flames	The Rate of Burning	Uses of Flames	Heat
Lesson EQ: 1. What are the parts of a burner flame?	**Lesson EQ:** 1. How does the rate of burning affected by surface area?	**Lesson EQ:** 1. How can flames by used to identify materials? 2. How can flames be made portable? 3. How are flame extinguished?	**Lesson EQ:** 1. How can the heat from a flame be calculated? 2. What units are used to measure heat?
Vocabulary:	**Vocabulary:** 1. surface area	**Vocabulary:** 1. emission spectrum	**Vocabulary:** 1. Joules

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab "Fire-1": Temperature of Flames

Objective: To determine the relative temperature of 3 types of flames, and to determine the hottest part of each flame.

Procedure **Observations**

Make complete and accurate observations during the lab.
Observations include: 1) what is happening,
2) the color, appearance, and phase (solid, liquid, gas) of all chemicals,
3) any other observations requested (odor, temperature, etc.).
Check off the Procedure steps as you do them

Part A - Change in Mass of a Burning Candle

_____1. Secure a candle to a glass plate.

_____2. Mass the candle and glass plate (include units): _____

_____3. Light the candle.

_____4. Let the candle burn until the end of the lab.

_____5. At the end of the lab, mass the candle and glass plate (include units): _____

Part B-1: Temperature of a Burner Flame

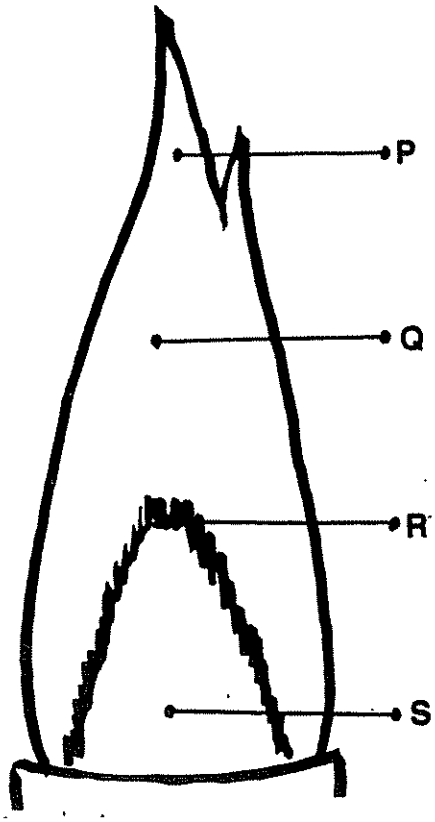
_____6. Obtain 6 pieces of heavy copper wire (16 gauge) which are 15 cm or greater .

_____7. Sandpaper one end of each wire until each is bright and shiny.

_____7.a. Bend one end of each wire into a small hook shape.

_____8. One partner will do step 8.a. while the other partner is timing.

_____8.a. Using a burner and tongs, hold **only** the tip of one wire at each of the 4 positions shown in the diagram (P, Q, R, S) until it becomes bright orange. Do this one position at a time. Indicate the number of seconds for each position on the diagram. If it takes longer than 60 seconds, indicate "over 60". Also indicate **all** of the colors each wire changed during the heatings.

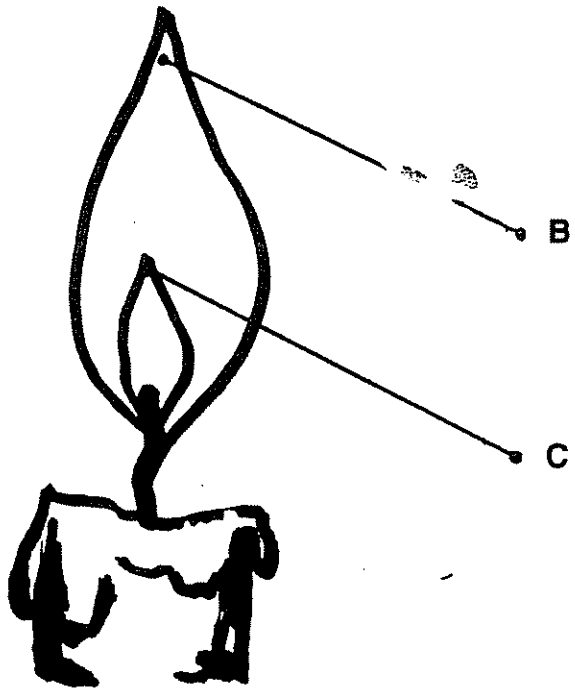


Number of Seconds	Colors during Heating

Part B-2: Temperature of a Candle Flame

_____9. Hold the tip of one wire at each of the 2 positions shown in the diagram (B, C) for 2 minutes. Do both of these at the same time.

_____10. Indicate the color that the wire turns in each section of the flame after the 2 minute time.



Color of Wire after 2 Minutes

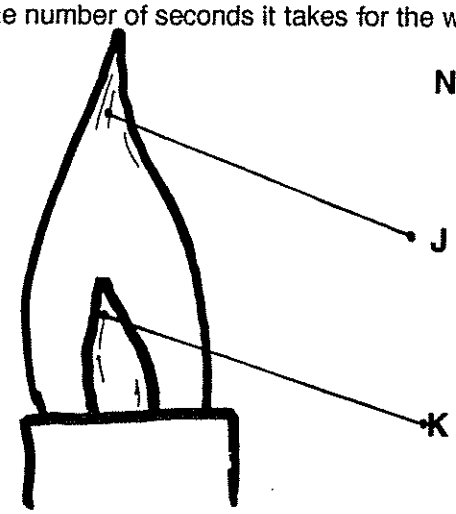
B _____

C _____

Part B-3: Temperature of an Oxyacetylene Welding flame

_____11. Your teacher will hold the same type of wire in an oxyacetylene flame which is used in a type of welding.

_____12. Indicate the number of seconds it takes for the wire to become orange:



Number of Seconds

J _____

K _____

(_____13. (Remember to blow out your candle from Part A and mass it.)

A Little Background and a few Questions...

Part A - Change in Mass of a Burning Candle

1. Calculate the change in mass of the candle (include units):

Mass of the candle and glass plate at the beginning---------->	
- Mass of candle and glass plate at the end---------->	
Change in mass of the candle---------->	

2. Hopefully, the candle lost mass. Since **mass is never gained or lost under normal chemically circumstances**,

what happened to the mass ? _____

_____

3. Is a burning candle a chemical reaction ? _____

a. What observation indicated your answer ? _____

4. What type of reaction (decomposition, combustion) is a burning candle ? _____

Part B - Temperatures of Burner, Candle, and Welding Flames

Not all flames are the same. Different materials burn at different temperatures. Different parts of a flame are also at different temperatures.

5. Rank the temperatures of the 3 types of flames:

Hottest flame:_____

Middle flame: _____

Coolest flame: _____

6. Which part of each flame was the hottest ?

a) Burner flame (P, Q, R, S)_____

b) Candle flame (B, C)_____

c) Welding flame (J, K)_____

7. Remember that **combustion is the chemical reaction of burning (combining with oxygen gas).** The gas in the burner was probably methane (CH_4). The candle was paraffin ($C_{25}H_{52}$). The gas in the welding torch was acetylene (C_2H_2). **The products of complete combustion are carbon dioxide and water vapor.**

For the lab burner flame, methane (CH_4):

a) Write the **word equation** for the complete combustion of methane (CH_4):

methane + _____ ----------> _____ + _____

b) Write the **formula equation** for the complete combustion of methane (CH_4):

_____ + _____ ----------> _____ + _____

For the candle flame, paraffin wax ($C_{25}H_{52}$):

c) Write the **word equation** for the complete combustion of paraffin ($C_{25}H_{52}$):

paraffin + _____ ----------> _____ + _____

d) Write the **formula equation** for the complete combustion of paraffin ($C_{25}H_{52}$):

_____ + _____ ----------> _____ + _____

For the Welding Flame , acetylene (C_2H_2):

e) Write the **word equation** for the complete combustion of acetylene (C_2H_2):

acetylene + _____ ----------> _____ + _____

f) Write the **formula equation** for the complete combustion of acetylene (C_2H_2):

_____ + _____ ----------> _____ + _____

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab "Fire-2": The Rate of Burning and Surface Area

Objective: To determine the relationship between surface area and the rate of burning

Procedure	Observations

Make complete and accurate observations during the lab.
Observations include: 1) what is happening,
2) the color, appearance, and phase (solid, liquid, gas) of all chemicals,
3) any other observations requested (odor, temperature, etc.).
Check off the Procedure steps as you do them

Part A - One wooden block

_____1. Obtain a wooden block from your teacher.

_____2. Mass the wooden block (include units): _____

_____3. Place the wooden block on a ring stand.

_____4. Ignite the wooden block from the **bottom** using your lab burner. You will need to continue to re-light it (it goes out often).

_____5. Observe your burning block for 5 minutes. Indicate what it looks like and how much burned away:

_____

_____

_____6. Extinguish the wooden block, and let it cool until you are done Parts B, C, and D.

_____7. At the end of the lab, mass the cool, burnt wooden block (include units): _____

Part B - Several wooden blocks

_____8. Obtain several wooden blocks which are much smaller than the single wooden block.

_____9. Place the wooden blocks on a ring stand on a wire gauze which **does not have a center.**

_____10. Mass the wooden blocks and wire gauze (include units): _____

_____11. Ignite the several wooden blocks from the **top** using your lab burner.

_____12. Observe your burning blocks for 5 minutes. Indicate what it looks like and how much burned away:

_____

_____13. Extinguish the wooden blocks, and let them cool until you are done Parts C and D.

_____14. At the end of the lab, mass the cool, burnt wooden blocks and wire gauze (include units): _____

Part C - Wood Shavings

_____15. Obtain a small amount of wood shavings on a wire gauze which **has a center** from your teacher.

_____16. Mass the wood shavings and the wire gauze (include units): _____

_____17. Place the wood shavings and wire gauze on a ring stand.

_____18. Ignite the wood shavings from the top using your lab burner.

_____19. Observe your burning wood shavings for 5 minutes. Indicate what it looks like and how much burned away:

_____

_____20. Extinguish the wood shavings, and let it cool until you are done Part D.

_____21. Mass the cool, burnt wood shavings and wire gauze (include units): _____

Part D - Saw Dust

_____23. Obtain a small amount of saw dust from your teacher.

_____24. Place the saw dust on a small piece of paper given to you by your teacher.

_____25. **Gently** flick the saw dust off the paper and over the burner flame: _____

_____

_____26. Remember to mass the wooden block, wooden blocks, and wood shavings from Parts A, B, and C.

_____27. Clean all equipment and glassware; wipe down your lab area; wash your hands; then take off your safety goggles and have a seat.

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A Little Background and some Questions...

1. What did you observe which indicated that a chemical reaction was most likely occurring ? _____

_____

2. What type of reaction did you perform in Parts A through D ? _____

In general, for any reaction to occur, the reactants must come in contact with each other. Consequently, the amount of material which comes in contact with the other material will greatly influence the rate of the reaction.

3. What is "surface area" ? _____

_____

4. Rank your 3 wood samples (single wooden block, several small wooden blocks, saw dust):

Greatest amount of surface area: _____

Middle amount of surface area: _____

Least amount of surface area: _____

Part A - One wooden block

5. Calculate the change in mass of the wooden block in Part A:

Mass of the wooden block (include units)---------->

- Mass of the burnt wooden block (include units)---------->

Mass of the burned up wood (include units)---------->

_____

6. Calculate the percent of wood which burned up (divide your answer from 5 by your mass of the block):

Your answer from 5 (include units)---------->

_____

Mass of the wooden block (include units)---------->

_____ x 100 =

Part B - Several wooden blocks

7. Calculate the change in mass of the wooden blocks in Part B:

Mass of the wooden blocks (include units)---------->

- Mass of the burnt wooden blocks (include units)---------->

Mass of the burned up wood (include units)---------->

_____

8. Calculate the percent of wood which burned up (divide your answer from 7 by your mass of the blocks):

Your answer from 7 (include units)---------->

_____

Mass of the wooden blocks (include units)---------->

_____ x 100 =

Part C - Wood Shavings

9. Calculate the change in mass of the wood shavings in Part C:

Mass of the wood shavings (include units)---------->

\- Mass of the burnt wood shavings (include units)---------->

Mass of the burned up wood shavings (include units)------>

_____

10. Calculate the percent of wood which burned up (divide your answer from 9 by your mass of the wood shavings):

Your answer from 9 (include units)---------->

_____

Mass of the wood shavings (include units)---------->

_____ x 100 =

11. Comparing your answer from question 4 with your answers to questions 6, 8, and 10, what is the relationship between the amount of surface area and the amount that burned ? _____

_____

12. When most things burn, including wood, it appears that mass is lost (a large hunk of wood eventually ends up as a small pile of ashes). The mass is not really lost.

What happens to the mass ?_____

_____

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Review Questions

R-1. Are all flames the same temperature ? _____

R-2. Which is the hottest flame, candle, lab burner, oxyacetylene welding ? _____

R-3. What part of the lab burner flame is the hottest ? _____

R-4. Write the **formula equation** for the combustion of methane (CH_4), the lab gas used.

_____

R-5. Write the **word equation** for the combustion of acetylene (C_2H_2), the welding gas used.

_____

Name:	Partner's Name:
Date of lab:	If absent, data obtained from:

Lab "Fire-3": Flame Tests

Objective: A short but neat lab used to identify a few elements from the colors they emit when burned.

Procedure	Observations

Make complete and accurate observations during the lab.
Observations include: 1) what is happening,
2) the color, appearance, and phase (solid, liquid, gas) of all chemicals,
3) any other observations requested (odor, temperature, etc.).
Check off the Procedure steps as you do them

_____1. When instructed to do so by your teacher, pick up one wooden splint which has been soaking in one of the solutions of chemicals below.

_____2. When instructed to do so by your teacher, ignite the wooden splint in your burner flame. Indicate the color of the flame for each one. Oohhs, and aahhs are appreciated and expected.

Lab burner only: _____

Barium chloride ($BaCl_2$): _____

Calcium chloride ($CaCl_2$): _____

Copper chloride ($CuCl_2$), or copper sulfate ($CuSO_4$): _____

Lithium chloride (LiCl), or lithium nitrate ($LiNO_3$) _____

Potassium chloride (KCl), or potassium nitrate (KNO_3): _____

Sodium chloride (NaCl): _____

Strontium chloride ($SrCl_2$), or strontium nitrate ($Sr(NO_3)_2$): _____

_____2. Obtain a wooden splint which has been soaking in one of the chemical solutions used today. Determine which solution it was soaking in. Indicate the color of the flame. _____

_____3. Clean all equipment and glassware; wipe down your lab area; wash your hands, then take off your safety goggles and have a seat.

A Little Background and some Questions...

1. Was this a great lab, or what ? _____

The first element listed in each chemical's name was the reason for the color emitted when burned. These are characteristic colors and can be used to identify the elements under certain circumstances.

2. What is a probable use for this property ? _____

Review Questions

R-1. When things burn, there appears to be a loss of mass. The mass is not lost. What really happens to it ?

_____

R-2. What part of the lab burner flame is the hottest ? _____

R-3. Write the **word equation** for the burning of methane (CH_4).

_____

R-4. Write the **formula equation** for the burning of paraffin wax ($C_{25}H_{52}$).

_____

R-5. What are the products of complete combustion (names and formulas) ? _____

_____

R-6. What is surface area ? _____

R-7. Generally, what is the relationship between surface area and the rate of a reaction ? _____

_____

R-8. Explain why a smart camper starts a wood fire with small, dry twigs and not big, dry twigs. _____

_____

_____

R-9. Calculate the mass of burned up wood from the following data (include units).

Mass of wooden block: 55.5 g
Mass of burned wooden block: 50.2 g