

Physical Properties - Melting and Boiling Point

Essential Standard Understand: Phase Change, Physical Properties of Matter and Physical and Chemical Properties.

Clarifying Objective: Compare the physical properties of pure substances that are independent of the amount of matter present including density, melting point, boiling point and solubility to properties that are dependent on the amount of matter present to include volume, mass and weight.

Learning Goal: Understand that different substances have unique physical properties.

Mini-Lesson #1:

State whether each of the following changes is a "chemical change" or "physical change".

1. Breaking a pencil lead
2. Crumpling a piece of paper
3. Burning a match
4. A nail rusting
5. Digesting your food

Active Learning (whole class and independent):

Complete Melting and Boiling Point Investigation by color-coding the thermometer graphs as directed.

Reflection (independent):

Answer the questions on the back of the melting and boiling point sheet.

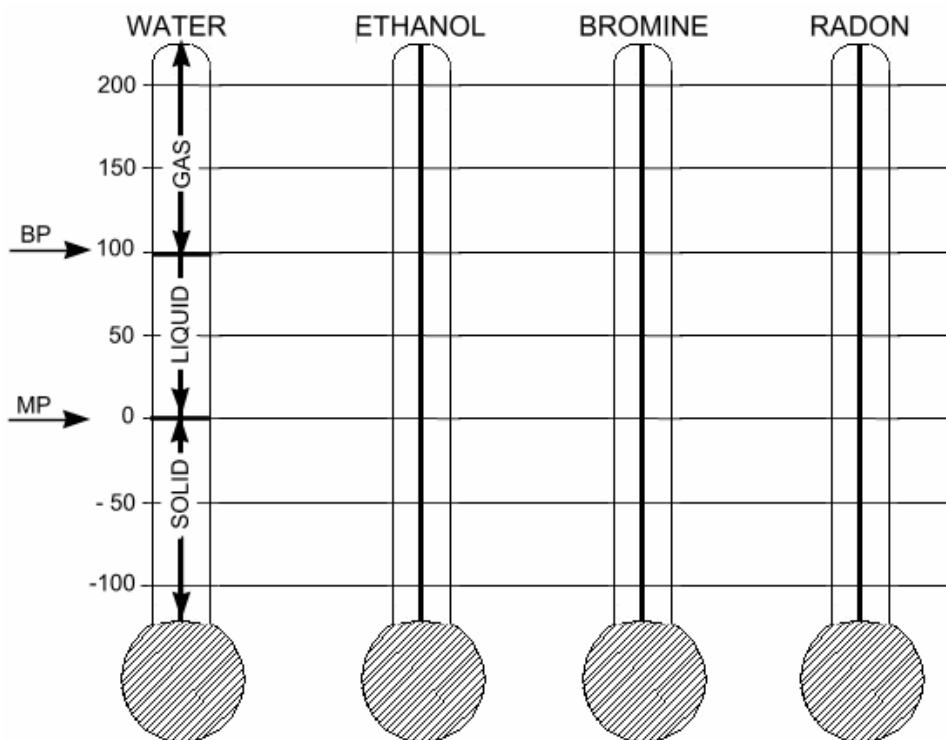
Fill in the "Own Words" definitions of melting point and boiling point on your vocabulary list.

Name _____ CP _____ Date _____

Melting and Boiling Point Investigation

Color the thermometer graphs according to the instructions at the bottom of this page. Some of the information has already been put onto the "Water" graph for you. Then, answer the questions on the back of this page.

Substance	Melting Point °C	Boiling Point °C
Water	0	100
Ethanol	-115	78
Bromine	-7	59
Radon	-71	-61



For each substance:

1. Use a pencil to darken the melting point and boiling point lines.
2. With a yellow pencil, color in the area of the thermometer directly above the boiling point line.
3. With a red pencil, color in the area of the thermometer between the boiling point and melting point lines.
4. With a blue pencil, color in the area of the thermometer below the melting point line.
5. Use a pencil to add arrows to indicate the melting and boiling points. Place the arrows to the left of each thermometer and label them "BP" and "MP."
6. In each of the yellow regions, write the word *gas*.
7. In each of the red regions, write the word *liquid*.
8. In each of the blue regions, write the word *solid*.

True or False

	True	False
1. Bromine is a gas at $-60\text{ }^{\circ}\text{C}$.		
2. Radon is a solid at $-100\text{ }^{\circ}\text{C}$.		
3. Ethanol is a gas at $140\text{ }^{\circ}\text{C}$.		
4. Water is a liquid at $-5\text{ }^{\circ}\text{C}$.		
5. Bromine is a solid at $0\text{ }^{\circ}\text{C}$.		
6. Radon melts at a lower temperature than water.		
7. Bromine melts at a lower temperature than ethanol.		

Short Answer

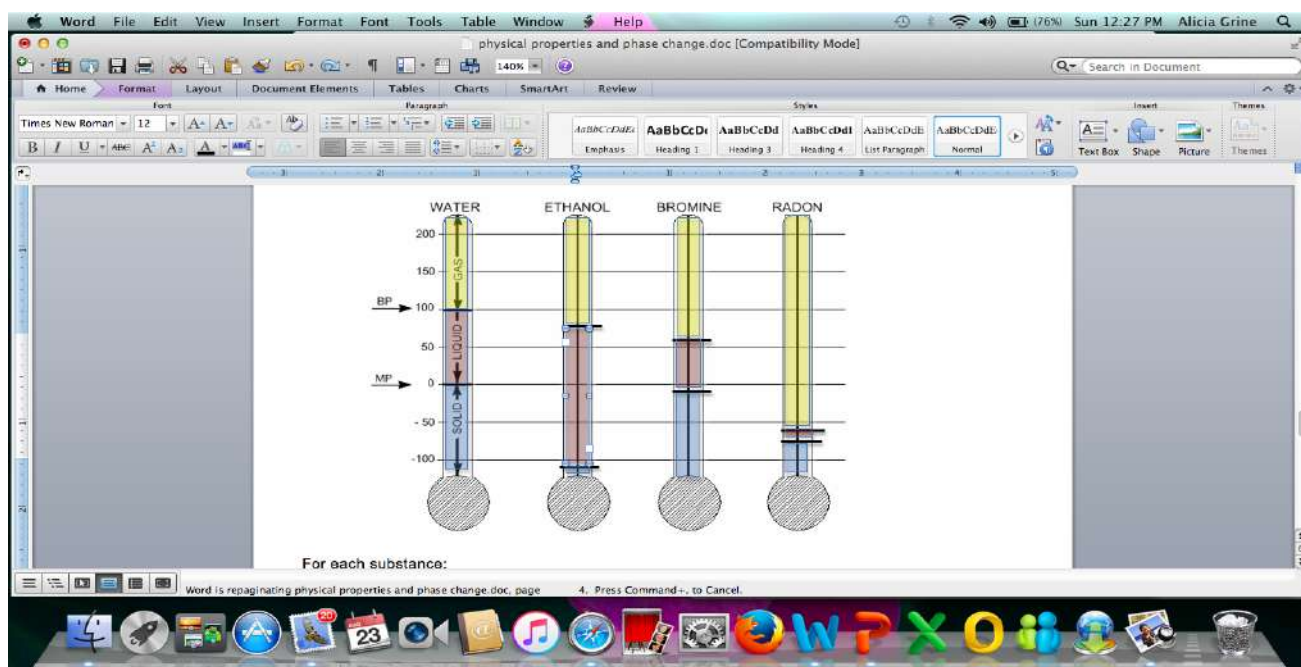
- Which substance has the lowest boiling point?
- Which substance has the highest melting point?
- If temperature were increased at the same rate for all four substances, which substance would turn into a gas first?
- If ethanol melts at $-115\text{ }^{\circ}\text{C}$, at what temperature does it freeze?
- Which substance has to be the coolest before it starts condensing?
- There are 100 degrees between water's melting and boiling points. How many degrees are there between ethanol's melting and boiling points?
- If the temperature were heat up from -10 to 65 , which substance would be most reactive?
- One goal of this activity was for you to see that every pure substance has its own unique properties. How does your completed diagram help you to see this?
- Is changing a substances state of matter (phase change) a physical change or a chemical change? Explain.
- Suppose your teacher gives you a container of salt water and a container of water. Neither of the containers is labeled. Your teacher tells you, your job is to determine which container is salt water and which container is water. You're not allowed to taste the substances, and both containers of liquid look exactly the same. Use your knowledge of physical properties and the phase changes to explain what you could do to determine which container is water.

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Melting and Boiling Point Investigation

Color the thermometer graphs according to the instructions at the bottom of this page. Some of the information has already been put onto the "Water" graph for you. Then, answer the questions on the back of this page.

Substance	Melting Point °C	Boiling Point °C
Water	0	100
Ethanol	-115	78
Bromine	-7	59
Radon	-71	-61



For each substance:

1. Use a pencil to darken the melting point and boiling point lines.
2. With a yellow pencil, color in the area of the thermometer directly above the boiling point line.
3. With a red pencil, color in the area of the thermometer between the boiling point and melting point lines.
4. With a blue pencil, color in the area of the thermometer below the melting point line.
5. Use a pencil to add arrows to indicate the melting and boiling points. Place the arrows to the left of each thermometer and label them "BP" and "MP."
6. In each of the yellow regions, write the word *gas*.
7. In each of the red regions, write the word *liquid*.
8. In each of the blue regions, write the word *solid*.

True or False

	True	False
1. Bromine is a gas at $-60\text{ }^{\circ}\text{C}$.		✓
2. Radon is a solid at $-100\text{ }^{\circ}\text{C}$.	✓	
3. Ethanol is a gas at $140\text{ }^{\circ}\text{C}$.	✓	
4. Water is a liquid at $-5\text{ }^{\circ}\text{C}$.		✓
5. Bromine is a solid at $0\text{ }^{\circ}\text{C}$.		✓
6. Radon melts at a lower temperature than water.	✓	
7. Bromine melts at a lower temperature than ethanol.		✓

Short Answer

8. Which substance has the lowest boiling point? **Radon**
9. Which substance has the highest melting point? **Water**
10. If temperature were increased at the same rate for all four substances, which substance would turn into a gas first? **Radon**
11. If ethanol melts at $-115\text{ }^{\circ}\text{C}$, at what temperature does it freeze? **-115, because melting point and freezing point are the same.**
12. Which substance has to be the coolest before it starts condensing? **Radon**
13. There are 100 degrees between water's melting and boiling points. How many degrees are there between ethanol's melting and boiling points? **193**
14. If the temperature were heat up from -10 to 65 , which substance would be most reactive? **Bromine**
15. One goal of this activity was for you to see that every pure substance has its own unique physical properties. How does your completed diagram help you to see this? **Melting point and**

boiling point are physical properties. This activity shows that each of the 4 elements have different melting and boiling points.

16. New substances form as a result of a chemical change. Based on this knowledge is changing a substance's state of matter (phase change) a physical change or a chemical change? Explain. Phase change is a physical change because nothing new is formed. The substance just changes its state of matter.
17. Suppose your teacher gives you a container of salt water and a container of water. Neither of the containers is labeled. Your teacher tells you, your job is to determine which container is salt water and which container is water. You're not allowed to taste the substances, and both containers of liquid look exactly the same. Use your knowledge of physical properties and the phase changes to explain what you could do to determine which container is water. You could boil both substances. Only the water will boil at 100 degrees Celsius because boiling at 100 degrees Celsius is a physical property of water. Salt Water is a different substance so it will have a different boiling point.