Collisions Lesson Plan

Energy & Phase Change

Time: 1 -2 class periods

Lesson Description

In this lesson, students will use Collisions to explore the 6 phase changes and the energy released or absorbed for each phase change.

Key Essential Questions

1. How does energy play a role in phase change?
2. What phase changes are exothermic and what phase changes are endothermic?

Learning Outcomes

Students will be able to explain the 6 phase changes and determine which phase changes are exothermic and which phase changes are endothermic.

Prior Student Knowledge Expected

- A phase change is a physical change.
- The three states of matter are solid, liquid, and gas.

Lesson Materials

- Individual student access to Collisions on tablet, Chromebook, or computer.
- Projector / display of teacher screen
- Accompanying student resources (attached)

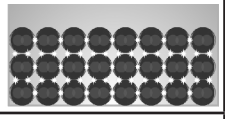
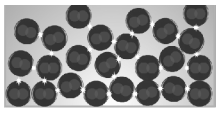
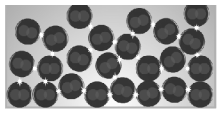
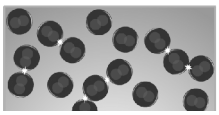
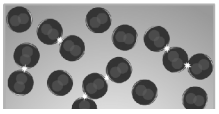
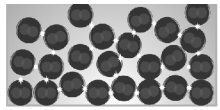
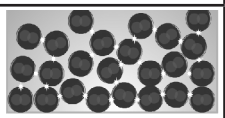
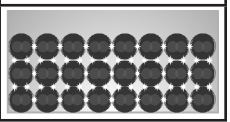
Standards Alignment

NGSS Alignment		
Science & Enginnering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• Developing and using models • Constrcuing explanations and designing solutions	• **HS-PS3-2.** Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.	• Patterns • Structure and Function

PART 1: Explore (20 minutes)

This is an inquiry-driven activity where students will play the first few levels of the Phase Change game and record their observations. **A Student Worksheet for this activity can be found on pages 5 - 6.**

Direct students to log into Collisions with their individual username and password, enter the Phase Change game, and follow the directions on the Student Worksheet on pages 5-6. Answer key below.

	Sketch the starting phase	**Did you *heat* or *cool* the substance?**	**Did you *break IMFs* or *form IMFs*?**	**Did the particles become *more ordered* or *less ordered*?**	**Sketch the ending phase**
Level 1: Melting		Heat	Break IMFs	Less Ordered	
Level 2: Boiling		Heat	Break IMFs	Less Ordered	
Level 3: Condensing		Cool	Form IMFs	More Ordered	
Level 4: Freezing		Cool	Form IMFs	More Ordered	

	Target	**PHASE CHANGE(S)** Hint: Reference table above	**TEMPERATURE** (Heating or Cooling)	**IMFs** (Breaking or Forming?)	**ENGERY** (Released or Absorbed)
Level 5	S -> L	Melting	Heating	Breaking IMFs	Absorbed
	L -> S	Freezing	Cooling	Forming IMFs	Released
Level 6	L -> G	Boiling	Heating	Breaking IMFs	Absorbed
	L -> S	Freezing	Cooling	Forming IMFs	Released
Level 7	S -> L -> G	Melting, Boiling	Heating	Breaking IMFs	Absorbed

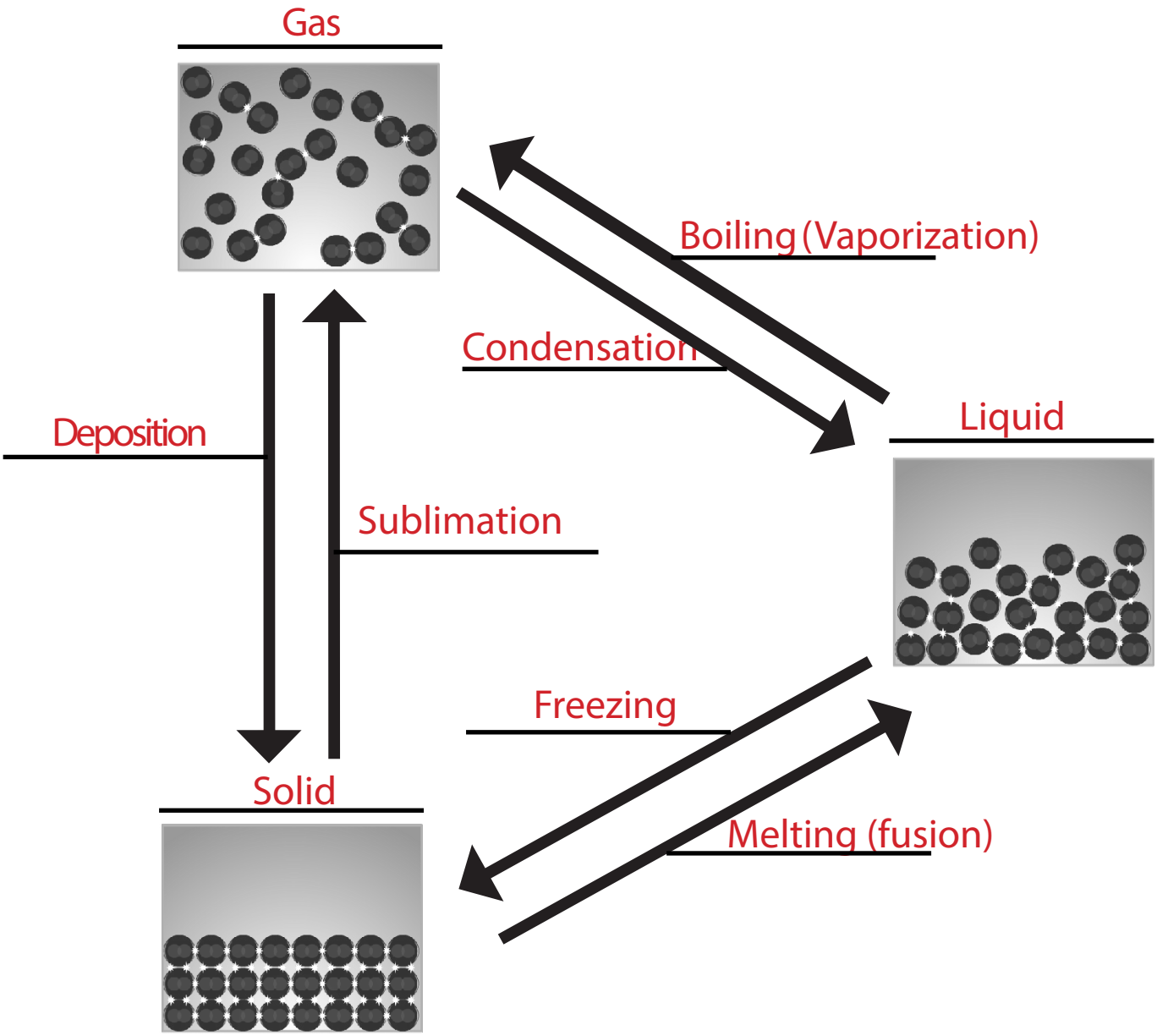
Analysis Questions:

1. Which phase change(s) involved the release of energy? Freezing
2. Which phase change(s) that you conducted involved the absorption of energy? Melting, Boiling
3. Describe the relationship between heating/cooling and energy. As you heat a substance, energy is absorbed. As you cool a substance, energy is released.
4. Describe the relationship between breaking/forming IMFs and energy? Breaking IMFs absorbs energy. Forming IMFs releases energy.
5. CHALLENGE QUESTION: A phase change occurs ONLY during the step of breaking/forming of IMFs. During this time, what happens to the temperature? Temperature remains constant during a phase change.

PART 2: Explain (10 minutes)

Review the Explore Activity and introduce the following concepts with your students by completing the chart below together as a class. **(Student version on page 7).**

*Note: Students were not yet introduced to deposition or sublimation during Collisions gameplay. This is covered in Phase Change Level 9.



Exothermic Phase Changes	Endothermic Phase Change
Examples: freezing,condensation,deposition	Examples: melting,boiling,sublimation
IMFs break or form? IMFs form	IMFs break or form? IMFs break
Energy released or required? Energy released	Energy released or required? Energy required

PART 3: Exend (15 minutes)

To continue allowing your students to practice exothermic and endothermic phase changes, direct students to the Phase Change Sandbox and have them earn the Achievements, EXOTHERMIC & ENDO-THERMIC, 6 times each and document each phase change.

A student worksheet (Phase Change Extend) can be found on Page 8.

Note: If students have not yet earned Achievements, remind them that they need to select the Achievement first, in order to receive credit for completion.

PART 4: Evaluate (5 minutes)

Project the below image and have students answer the following question on a separate sheet of paper (or create your own molecules in the IMF Sandbox).

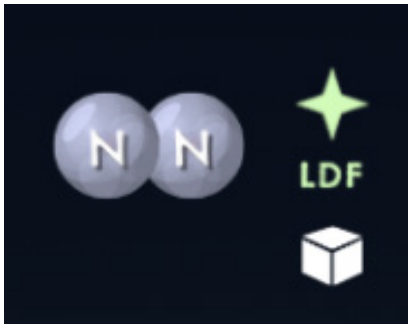
Exit Ticket

A student is playing Collisions and would like to melt a substance.

1) Does melting require energy?

2) Are IMFs broken or formed during melting?

3) Which molecule would melt using LESS energy. WHY?



Phase Change Explore

ENERGY & PHASE CHANGE

Name: _____

DIRECTIONS: Complete the following activity.

1. Log into Collisions and enter the Phase Change game.
2. Play Levels 1 - 7. During play, complete the tables below.

	Sketch the starting phase in the box below	**Did you *heat* or *cool* the substance?**	**Did you *break IMFs* or *form IMFs*?**	**Did the particles become *more ordered* or *less ordered*?**	**Sketch the ending phase in the box below**
Level 1: Melting 					
Level 2: Boiling 					
Level 3: Condensing 					
Level 4: Freezing 					

	Target	**PHASE CHANGE(S)** Hint: Reference table above	**TEMPERATURE** (Heating or Cooling?)	**IMFs** (Breaking or Forming?)	**ENGERY** (Released or Absorbed?)
Level 5					
					
Level 6					
					
Level 7					

Phase Change Explore

ENERGY & PHASE CHANGE

ANALYSIS QUESTIONS

1. You conducted several phase changes. Which ones involved the release of energy?

2. You conducted several phase changes. Which onces involved the absorption of energy?

3. Describe the relationship between heating/cooling and energy.

4. Describe the relationship between breaking/forming IMFs and energy?

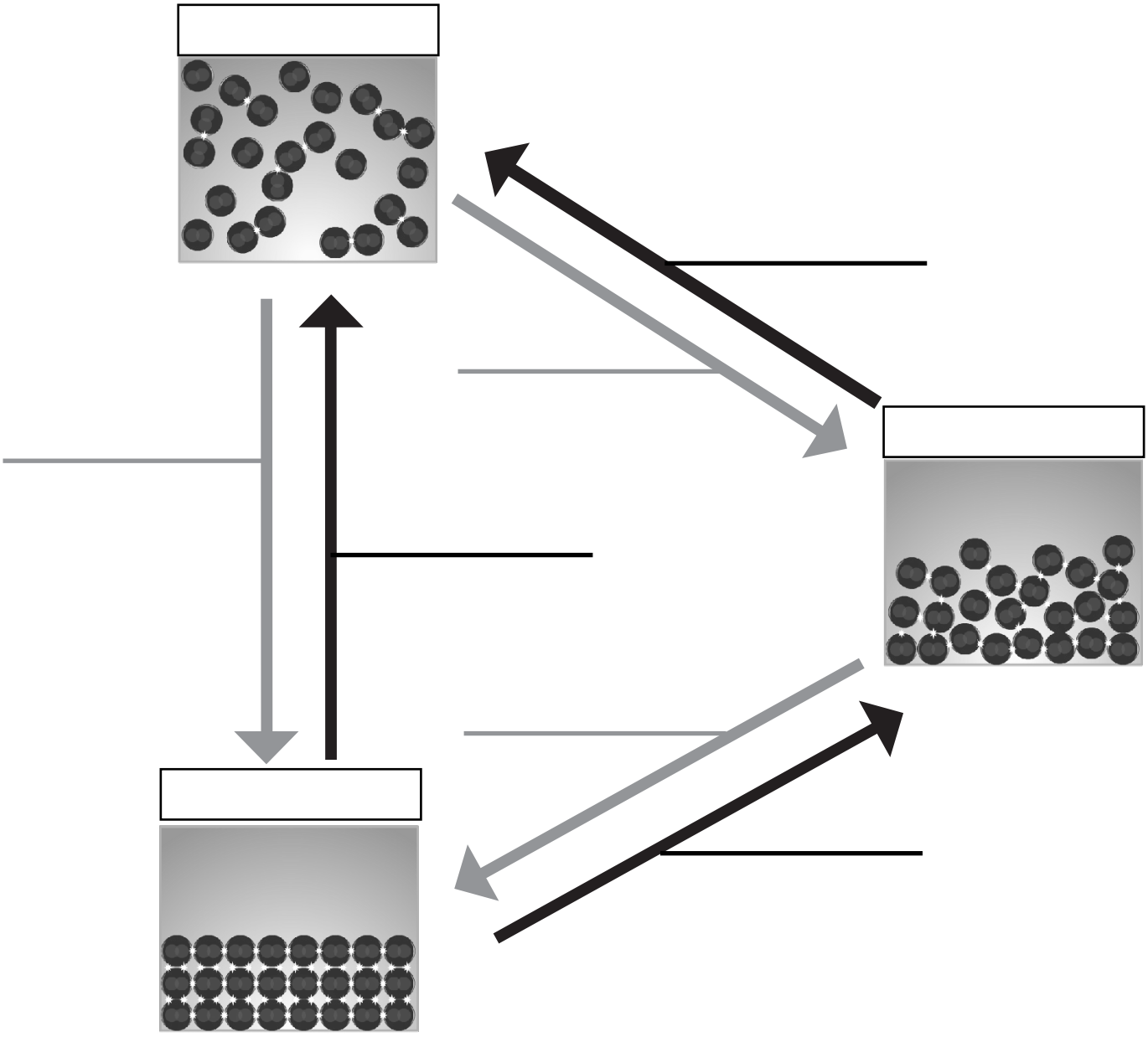
5. CHALLENGE QUESTION: A phase change occurs ONLY during the step of breaking/forming of IMFs. During this time, what happens to the temperature?

Phase Change Notes

ENERGY & PHASE CHANGE

Name: _____

DIRECTIONS: Label each box with the state of matter and label each arrow with the correct phase change.



Exothermic Phase Changes	Endothermic Phase Change
Examples:	Examples:
IMFs break or form? _____	IMFs break or form? _____
Energy released or absorbed? _____	Energy released or absorbed? _____

Phase Change Extend

Energy & Phase Change

Name: _____

DIRECTIONS: Complete the following activity as an extension of today's topic: Energy & Phase Change.

Enter into the Phase Change Sandbox and earn the following 2 Achievements in 6 unique ways.
Track each phase changes that you conducted to earn these achievements below.

ACHIEVEMENT #1: Exothermic		
1 Substance: _____	2 Substance: _____	3 Substance: _____
- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:
4 Substance: _____	5 Substance: _____	6 Substance: _____
- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:

ACHIEVEMENT #2: Endothermic		
1 Substance: _____	2 Substance: _____	3 Substance: _____
- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:
4 Substance: _____	5 Substance: _____	6 Substance: _____
- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:	- Starting state: - Ending state: - Heating or cooling: - IMF type: - IMFs broken or formed:

ANALYSIS QUESTION: There are 3 different IMF types that can form between molecules (LDF, D-D, and HB). During a phase change, do these 3 IMF types require the same amount of energy to form and/or release the same amount of energy when breaking? Explain.