Collisions Lesson Plan

IMF Types

Time: 1 -2 class periods

Lesson Description

In this lesson, students will use Collisions to explore the three types of intermolecular forces (IMFs): (1) London Dispersion Forces, (2) dipole-dipole, and (3) hydrogen bonding.

Key Essential Questions

1. What is an intermolecular force and what are the three types of IMFs?
2. What influences the strength of an IMF?

Learning Outcomes

Students will be able to identify the 3 types of intermolecular forces and compare IMF strength.

Prior Student Knowledge Expected

Atoms can covalently bond together to form molecular compounds. In a bond, electrons are not always evenly shared.

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 • Construcing explanations and designing solutions	• **HS-PS-2.** Construct and revise an explanation for the outcome of a simple chemical rection based on the outermost electron states of atoms, trends int he periodic table, and knowledge of the partterns of chemical properties.	• Patterns • Structure and Function

PART 1: Explore (15 minutes)

This is an inquiry-driven activity where students will play the first few levels of the Intermolecular Forces game to introduce themselves to the 3 types of Intermolecular Forces.

A student worksheet for this activity can be found on PAGE 5.

Direct students to log into Collisions with their individual username and password, enter the Intermolecular Forces game, and follow the directions below. Student answer key below.

	Questions (ANSWER KEY)
Level 1	1. What is a **temporary dipole**? Temporary partially positive and negative ends in an atom or a molecule based on the location of electons 2. Draw the molecule that you created. Draw HCl 3. Are the bonded electrons 'evenly shared' in this molecule? No 3. The molecule that you built has a **permanent dipole**. What does this mean? A permanent dipole occurs when positive and negative charges are permanently induced in a molecule due to the uneven distribution of electrons 4. What type of **intermolecular force (IMF)** did you make? Dipole-Dipole
Level 2	5. In this level, you must create two polar molecules. Did these molecules have temporary or permanent dipoles? Permanent Dipoles 6. What type of IMF did these molecules form? Dipole-Dipole
Level 3	7. What new **type of IMF** did you create in this level? Hydrogen Bond 8. Does this type of IMF require stronger or weaker dipoles than a dipole-dipole (D-D) IMF? Stronger
Level 4	9. What molecule did you build to create a dipole-dipole (D-D) IMF? HBr 10. What molecule did you build to create a hydrogen bond IMF? HF
Level 5	10. What new **type of IMF** did you create in this level? London Dispersion Force 11. Did the atom/molecules created have a temporary or permanent dipole? Temporary 12. Is this IMF stronger or weaker than a dipole-dipole (D-D) IMF? Weaker
Level 6	13. What type of IMFs are you creating in this level? London Dispersion Forces 14. What is the relationship between electron number and charge imbalance? There is a greater charger imbalance as the number of electrons increase. 15. Which IMF is stronger? An IMF between He or an IMF between Xe? Why? Xe becuase there are more electrons

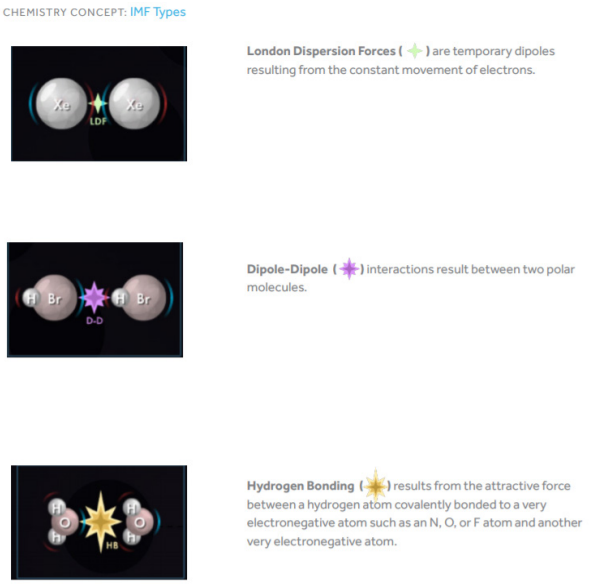
PART 2: Explain (15 minutes)

Introduce the following concepts with your students.

- **Intermolecular forces** are attractive forces that occcurs between molecules.
- There are 3 types of IMFs:

IMF Type	Definition
London Dispersion Force	Attractions between atoms and nonpolar molecules with temporary dipoles
Dipole-Dipole	Attractions between polar molecules with permanent di-poles
Hydrogen Bond	Attractions between very polar molecules with permanent dipoles Occurs when H is bonded to N, O, or F

Reminder: The Collisions IMF Game Guide includes the following image(s) that you can share with your students as well.



PART 3: Exend (30 minutes)

To continue allowing your students to practicing / reviewing IMF Types, assign the IMF Type Extend Activity on page 6. See below for the answer key.

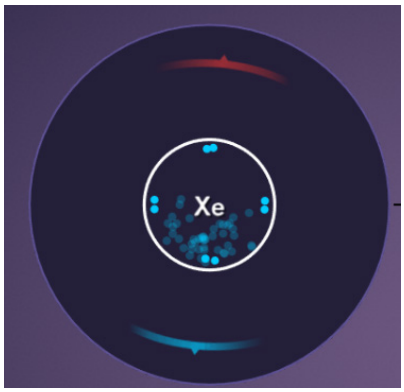
Your Results		
LDF	Dipole-Dipole	Hydrogen bond
He, Xe, CH_4, CO_2, Cl_2	SF_2, CF_2H_2, HCl, HBr	NH_3, HF, HOF

PART 4: Evaluate (5 minutes)

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

#1

#2



#3

Using the images above:

1) What IMF will each atom/molecule above form?

2) Order the images above from weakest to strongest IMF.

3) In Image #3, if the F was changed to an H, would this change the IMF formed?

IMF Explore

IMF TYPES

Name: _____

DIRECTIONS: Complete the following activity as an introduction to today's topic: Intemolecular Forces.

1. Log into Collisions and enter the IMFs game.
2. Play through Level 1 - 6. During play,completed the questions below.

	Questions
Level 1	1. What is a **temporary dipole**? 2. Draw the molecule that you created. 3. Are the bonded electrons 'evenly shared' in this molecule? 3. The molecule that you built has a **permanent dipole**. What does this mean? 4. What type of **intermolecular force (IMF)** did you make?
Level 2	5. In this level, you must create two polar molecules. Did these molecules have temporary or permanent dipoles? 6. What type of IMF did these molecules form?
Level 3	7. What new **type of IMF** did you create in this level? 8. Does this type of IMF require stronger or weaker dipoles than a dipole-dipole (D-D) IMF?

IMF Explore

IMF TYPES

	Questions
Level 4	9. What molecule did you build to create a dipole-dipole (D-D) IMF? 10. What molecule did you build to create a hydrogen bond IMF?
Level 5	10. What new **type of IMF** did you create in this level? 11. Did the atom/molecules created have a temporary or permanent dipole? 12. Is this IMF stronger or weaker than a dipole-dipole (D-D) IMF?
Level 6	13. What type of IMFs are you creating in this level? 14. What is the relationship between electron number and charge imbalance? 15. Which IMF is stronger? An IMF between He or an IMF between Xe? Why?

SUMMARY QUESTION: List the three types of IMFs below and order them from weakest to strongest.

IMF Extend

IMF TYPES

DIRECTIONS: Complete the following activity as an extension of today's topic: Intemolecular Forces.

1. Based on your assumptions, predict which IMF type the following molecules/atoms have by placing them in a columns below under 'Your Predictions'.

Bank of Molecules/Atoms			
He	NH_3	HCl	HOF
CO_2	Xe	Cl_2	HF
SF_2	CF_2H_2	HBr	CH_4

Your Predictions		
LDF	Dipole-Dipole	Hydrogen Bond
Why did you place these atoms/ molecules in this category?	Why did you place these atoms/ molecules in this category?	Why did you place these atoms/ molecules in this category?

2. Test your predictions by building these atoms/molecules in the IMFs Sandbox with the predicted IMF. Document your results below.

Your Results		
LDF	Dipole-Dipole	Hydrogen bond

3. How did your predictions compare to the results observed in the IMF Sandbox?

4. How could you change C**H_4** to make it a dipole-dipole. Explain why this change makes this difference.