Collisions Lesson Plan

Acid Strength

Time: 1 -2 class periods

Lesson Description

In this lesson, students will use Collisions to explore the behavior of strong vs. weak acids.

Key Essential Questions

1. How does a strong acid compare to a weak acid?
2. How doea acid strength correlate to dissociation rate?

Learning Outcomes

Students will be able to explain the behavior of acids and differentiate between strong acids and weak acids.

Prior Student Knowledge Expected

Students should understand general molecular compound structure and ionic compound structure.

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 • Constrcucing explanations and designing solutions		• Structure and Function

PART 1: Explore (20 minutes)

This is an inquiry-driven activity where students will play the first few levels of the Acids & Bases game to introduce themselves to acids & bases and explore acid strength.

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. Answer key below.

	Questions (ANSWER KEY)
Level 1	1. HF is an acid. What is the behavior of an acid? An acid donates a proton. 2. What happens to hydrogen's only electron? It stays with the Flourine. 3. What does the hydrogen become? A proton (H^+) 4. Is HF a strong or weak acid? Weak Acid 5. What is the dissociation rate of 0.1 M HF? 8.13%
Level 2	6. What is the behavior of a base? A base accepts a proton 7. What is created when a base (OH^-) accepts a proton (H^+)? H_2O
Level 3	8. Is HI a strong or weak acid? Strong Acid 9. What is the dissociation rate of 0.1 M HI? 100% 10. What is a neutralization reaction? When an acid donates a proton, a base accepts the proton, and water is created.
Level 4	11. Is HBr a strong or weak acid? Strong acid 12. Click the ⓘ. What is the dissocation rate? 100%
Level 5	13. What does it mean to be amphoteric? When a molecule can act as an acid & a base 14. Is water a strong or weak acid? Weak acid. 15. Click the ⓘ. What is the dissocation rate? 0.01%
Level 6	16. Is HCl a strong or weak acid? Strong acid 17. Click the ⓘ. What is the dissocation rate? 99.99%

PART 1: Explore Cont... (20 minutes)

Acid	Strong or Weak Acid?	Dissociation Rate
HF	Weak Acid	8.13%
HI	Strong Acid	100%
HBr	Strong Acid	100%
H_2O	Weak Acid	0.01%
HCl	Strong Acid	100%

SUMMARY:

Strong acids have a very high dissociation rate and weak acids have a very low dissocation rate.

PART 2: Explain (10 minutes)

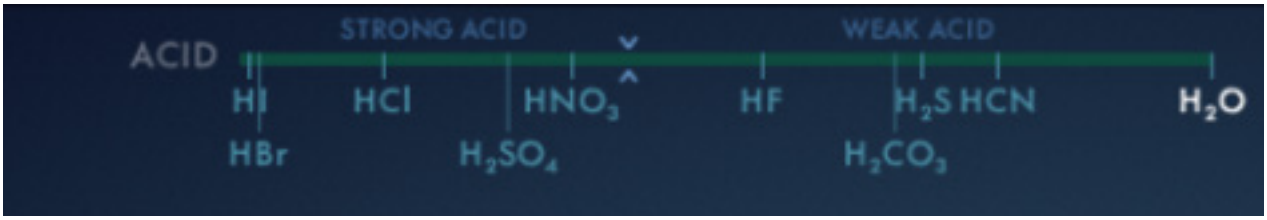
Introduce the following concepts with your students.

- An **acid** is a '**proton donor.**'
- A **base** is a '**proton acceptor.**'

- Acids can be **strong** or **weak**.

Strong Acid Characteristics	Weak Acid Characteristics
Easy to remove a proton.	*More difficult to remove a proton.*
High dissociation rate.	*Low dissociation rate.*

To show the scale of 'Acid Strength' you can use the visual below from the Acids & Bases game.



PART 3: Exend (30 minutes)

To continue allowing your students to practice and review Acid Strength, assign the Extend Activity on Page 7.

PART 1 answers will vary based on student selection. PART 2 Answers can be found below:

1. HNO_3 - STRONG ACID
2. H_2O - WEAK ACID
3. H_2SO_4- STRONG ACID
4. H_2S- WEAK ACID
5. HF- WEAK ACID
6. HCN- WEAK ACID

PART 4: Evaluate (5 minutes)

Share the following questions with your students as an 'exit ticket.' You can project the following questions on your screen and have your students answer these questions during the last 5 minutes of class.

1. Order the following acids from **strongest to weakest**:

HF HI HCl HCN H_2SO_4

2. Which acid(s) above **holds most tightly to it's H^+**?

3. Whic acid(s) above **holds least tightly to it's H^+**?

4. Which acid(s) above have a **high dissociation rate**?

4. Which acid(s) above have a **low dissociation rate**?

Acids & Bases Explore

ACID STRENGTH

Name: _____

DIRECTIONS: Complete the following activity as an introduction to today's topic: Acid Strength

1. Log into Collisions and enter the Acids & Bases game.
2. Play through Level 1 - 6. During play, complete the questions.

	Questions
Level 1	1. HF is an acid. What is the behavior of an acid? 2. What happens to hydrogen's only electron? 3. What does the hydrogen become? 4. Is HF a strong or weak acid? 5. What is the dissociation rate of 0.1 M HF?
Level 2	6. What is the behavior of a base? 7. What is created when a base accepts a proton (H+)?
Level 3	8. Is HI a strong or weak acid? 9. What is the dissociation rate of 0.1 M HI? 10. What is a neutralization reaction?

Acid Strength Explore

ACID STRENGTH

	Questions
Level 4	11. Is HBr a strong or weak acid? 12. Click the ⓘ What is the dissocation rate?
Level 5	13. What does it mean to be amphoteric? 14. Is water a strong or weak acid? 15. Click the ⓘ. What is the dissocation rate?
Level 6	16. Is HCl a strong or weak acid? 17. Click the ⓘ. What is the dissocation rate?

ANALYSIS:

1. Complete the table below using your findings from above.

Acid	Strong or Weak Acid?	Dissociation Rate
HF		
HI		
HBr		
H_2O		
HCl		

2. Using the information from the table, describe the relationship between acid strength and dissociation rate?

Acid Strength Extend

ACID STRENGTH

Name: _____

PART 1 DIRECTIONS:

1. Enter Acids & Bases Sandbox. (You must have up to Level 6 completed).
2. Remove a proton from 6 different acids and complete the information below.

Acid #1:	**% Dissociation:**
Click the ⓘ and draw and label the solution after dissociation below:	

Acid #2:	**% Dissociation:**
Click the ⓘ and draw and label the solution after dissociation below:	

Acid #3:	**% Dissociation:**
Click the ⓘ and draw and label the solution after dissociation below:	

Acid #4:	**% Dissociation:**
Click the ⓘ and draw and label the solution after dissociation below:	

Acid #5:	**% Dissociation:**
Click the ⓘ and draw and label the solution after dissociation below:	

Acid #6:	**% Dissociation:**
Click the ⓘ and draw and label the solution after dissociation below:	

Acid Strength Extend

ACID STRENGTH

PART 2 DIRECTIONS: Using the Collisions Acids & Bases Sandbox, determine the acid and acid strength in each of the reactions below.

1. $HNO_3 + H_2O \rightarrow H_3O^+ + NO^{3-}$

Acid: _____

Strong or weak?: _____

2. $NH_3 + H_2O \rightarrow NH_4^+ + OH^-$

Acid: _____

Strong or weak?: _____

3. $H_2SO_4 + H_2O \rightarrow HSO_4^- + H_3O^+$

Acid: _____

Strong or weak?: _____

4. $H_2O + H_2S \rightarrow HS^- + H_3O^+$

Acid: _____

Strong or weak?: _____

5. $HF + NaOH \rightarrow H_2O + F^- + Na^+$

Acid: _____

Strong or weak?: _____

6. $HCN + NH_3 \rightarrow NH_4^+ + CN^-$

Acid: _____

Strong or weak?: _____