Lesson 4-3: Acids & Bases	
Curriculum Expectations	• E2.3 • E2.4 • E2.5 • E3.4 • E3.5 • E3.6 • E3.7 • E3.8
Learning Goals	**Learning Goals:** • Explore the properties of acids & bases. • Discover the relationship between acid-base reactions and equilibrium constants. • Investigate titration experiments and their use in determine the concentration of acids and bases.
Success Criteria	I know I have achieved the goals for this lesson when I can: • Solve problems relating to acid-base equilibrium. • Use acid-base titration data to solve problems. • Use the ionization constant of water to calculate pH, pOH, [H+] and [OH-]
Teacher Prep	• Select music for Weak Acids & Bases Musical Chairs

Minds On

Goal: To review the concept of dynamic equilibrium and how systems at equilibrium react when they are stressed (pushed out of equilibrium)

1. Acids & Bases Brainstorm

Instructions:

- You can break this up into 2 separate brainstorms, one for acids, the other for bases.
- This activity can be done as a whole class or in groups of 2-4 students.
- Write the topic (Acids & Bases) in the center of a piece of paper or on a display board
- Have students express what they know already about acids and bases and connect these ideas/topics to the central word.
- Have a brief discussion after the first round, clearing up any errors or misconceptions.
- For round two, have students add connections to the first round of connections.
- Have students examine the brainstorm and think about questions they would like to learn the answers to related to acids & bases.
- Students can present their questions to the class and have students attempt to answer them based on previous knowledge.

Action

****Refer to the Differentiation Resources link for additional practice worksheets, and to enrich your classroom teaching using different tools throughout the lesson. ****

1. 4-3A: Acids & Bases Introduction

- For each section of this activity have students read through the section and take notes on their own.
- When all students have read through a section, use the text and images within to present the material to the class as a whole.
- Allow time for questions and encourage students to speak up if they don't understand.

- For section E, have the students attempt to answer the question on their own, then take up the solution as a class.

2. Strong vs. Weak Acids & Bases Musical Chairs Group Activity

- **Teacher instructions:** this activity is meant to review some of the concepts of acids and bases and demonstrate the differences in behaviour between strong and weak acids/bases. This activity is fun and serves as a good visual aid for students to see differences in how quickly strong acids dissociate compared to weak acids. The key to this activity working is that when doing the musical chairs for strong acids/bases, the interactions are very short (3-5 seconds, "hello, how are you") whereas for weak acids/bases the interactions are much longer (10-15 seconds). The results should be that when the music stops, very few pairs are sitting for the strong acids/bases vs. the weak acids bases.
- Before the demonstration, you should do a brief review of the differences between strong and weak by using a T-chart to compare and contrast with the headings: Strong acid | Weak Acid and a second T-chart with the headings Strong Base | Weak Base. (items to compare and contrast include: examples of each, behaviour in water, generic formulas, commercial uses/examples, etc.)
- You will then demonstrate how strong and weak acids behave by playing musical chairs using the instructions included in the activity. You should play 4 rounds (strong acid, weak acid, strong base, weak base) and record the results of the number of sitting vs. standing students after each round.

3. 4-3B: Properties of Acids & Bases

- Review the content as a class, displaying the presentation for all.
- Students should take notes as they progress.
- For the naming section, have students read the names out, practicing proper pronunciation and naming conventions.
- Have students pick an acidic or basic compound and explain the naming convention for it to the whole class.

4. 4-3C: pH, pOH & Buffers

- Review the material section by section, having students make notes as they progress.
- Students must be able to calculate pH, pOH and kw using the different methods presented.
- Have students answer the embedded questions and take them up as a class.
- Students must be able to describe how buffers act, what their purpose is and explain the characteristics necessary for something to qualify as a buffer.

5. 4-3D: pH Scale

- Students should make notes as they progress through the activity.
- Review as a class the pH scale and how it relates to acids/bases
- Make sure to focus on the indicators and litmus paper, how they are used and how to interpret colour changes in the context of acidity/alkalinity.
- Use the video at the end of the activity as a review of the basics.

6. Gridlock Activity – pH, pOH & Kw

- In this activity students will work in pairs to complete the grids on the gridlocks worksheet or you can put the gridlock up on a screen and work through the grids as a cla. Read the instructions for each grid and use these to explain to students how each grid needs to be completed.

Teacher Information:

Gridlock Puzzles are designed to do 3 major things:

1. They give the students a problem solving context for the activity – students like solving problems and there is a sense of satisfaction in completing the gridlock. There can be an aspect of competition as well: who solved the most, who was quickest or who made the least mistakes. In the online versions the students are trying to beat the clock.

2. The students need to engage with the factual information the gridlock is based on. In order to solve the puzzle they need to recall the relationships between the data established in the first part of the activity. For example they need to recall that 3 electron pairs gives trigonal planar geometry or that sulfuric acid forms sulfate salts. Whilst they are solving the gridlocks they should find themselves referring to the initial data repeatedly so much so that they recall a fair bit of it by the end.

3. It develops some important thinking skills. The students have to survey the data given in the gridlock to find which squares can initially be filled in. They cannot simply choose a square at random and fill it in because there may not be enough information yet in the grid to narrow down the options to one possible answer. This thinking skill is sadly missing in the students who, given a titration calculation want to straight multiply a concentration by a volume to give the moles of the reactant asks for despite not having all the relevant information yet. Gridlocks also encourage logical reasoning e.g. 'it has to be x because it can't be w, y or z'.

How they might be used:

Gridlocks are suitable for an episode in a lesson or homework. They are designed to be follow up activities rather than an introduction to a topic. The students should have met at least some of the data the gridlocks are based on. The online gridlocks

could be tackled by students working individually or a class using a projector. The paper based gridlocks are easy to set and readily peer or self assessed. Some gridlocks go beyond specifications and could be used as extension activities.

The first time you use a gridlock:

It is best to put up the gridlock on a screen and show the class how they work by talking through how to fill in the first few boxes on the first gridlock. Otherwise too many will say 'I don't get it'. Weaker groups may need this careful introduction several times.

7. **4-3E: Acid-Base Neutralization**
    - Students should make notes as they progress.
    - By the end of this activity students must be able to describe neutralization reactions and predict the products of a neutralization reaction.
    - Have students review content on their own, making notes. Follow up by guiding the whole class through the embedded presentation, stopping to allow students to ask questions along the way.
    - Embedded questions should be answered by students individually and then taken up as a class.

8. **4-F: Titration**
    - Describe titration as a class, if possible find the equipment required to set up a titration and describe the set-up and components to the students.
    - Have students review the content of sections A & B on their own, followed by a summary from the teacher.
    - Emphasize the equivalence point, and what is happening to the different species as the system approaches the equivalence point.
    - Work through the sample problem as a class, stopping to make sure all students understand.
    - Give additional problems from the check-up time or differentitation resources to help identify areas of weakness.
    - Emphasize the proper protocol for setting up ICE tables.

9. **4-F: Titration Experiment**

    - In this activity students will navigate through a set of 4 different simulations to further your understanding of titration techniques and how the results can be used to determine concentrations of unknown acids & bases.

- You can choose to have students complete this task individually, in small groups or as a whole class.

Instructions

1. Click on the "Quickstart" button.
2. Begin with Titration Level 1
3. Click "Ok" when the box that says "If you want to save your progress within the level ensure you register or log in using the buttons in the header." appears.
4. Navigate your way through the interactive module until you reach the end.
5. Students only need to know the content from level 1, but levels 2-4 can be completed for additional learning opportunities.
6. Once all students have completed the activity, lead a class discussion, reviewing proper titration techniques and addressing any areas of weakness or misconceptions.

10. Pass the Page Acids & Bases Review Activity

- This activity is meant to be used as a review exercise after the acids and bases lesson is complete. Alternatively, you can choose to handout the worksheet before the lesson and have students fill in whatever answers they can based on their previous knowledge. This is often a good way to begin the class as it activates prior learning and can offer clues into areas of strength and weaknesses for the students.
- For this activity you will divide the class into groups of 2-4.
- Each group will have one copy of the handout placed down in front of them and one pen. No talking is allowed between group members. Designate a specific amount of time for the first part of the activity. (10-15 minutes).
- On the teachers cue one student in the group flips over the page and answers any question they like on the sheet. They then pass the paper and pen over to the next group member.
- Group members cannot correct eachothers' answers once they have been written until the next part of the activity. That person then answers any question they like and passes it on etc.
- At the end of 15 minutes groups will have 10-15 minutes to discuss any unanswered questions or change any answers they may have answered incorrectly.
- The final part of the activity you will discuss the answers to the worksheet as a class. Use the discussion to help clarify any remaining misconceptions.

Consolidation

1. Acids & Bases Practice Worksheets

- To be completed individually, in small groups in class or at home.
- Take up the answers together the following day.
- Address any misconceptions or questions by reviewing material from the lesson.

2. 4-3H: Acids & Bases Quiz

- To be completed individually either at home or in class.
- Answers should be taken up together as a class, identify any issues or areas of weakness and review this material.
- Call on individual students to share their answers and explanations to each question.
- Address any misconceptions or questions by reviewing material from the lesson

3. 4-3E: Titration Lab

- To be completed individually by the students.
- Before they begin, review the assignment as a class.
- Review proper file formats and naming protocol
- Emphasize where marks are allocated, proper completion and submission protocol (file size, name, etc.)
- For all calculations students must show all their work, including ICE tables.

****Refer to Differentiation Resources for additional practice worksheets, and to enrich your classroom teaching using different tools. ****