Lesson 5-3: Galvanic Cells	
Curriculum Expectations	• F2.4 • F2.5 • F2.6 • F3.2 • F3.3 • F3.4
Learning Goals	**Learning Goals:** • Discover the practical uses of redox reactions with respect to generating electrical energy. • Explore the conditions necessary to produce a Galvanic cell. • Learn to predict the spontanaeity of redox reactions and the impact of these spontaneous reactions on functional Galvanic cells.
Success Criteria	I know I have achieved the goals for this lesson when I can: • Describe the principles that allow a galvanic cell to produce electrical energy. • Build a Galvanic cell using common lab equipment and chemicals. • Predict whether redox reactions will occur based on half-cell reactions.
Teacher Prep	• Print out one or more of the practice worksheets for students to complete in class.

Minds On

1. **Practical Uses of Electrochemistry Discussion**

    - This activity is meant as an introduction to the topic, and in intended to activate prior learning and knowledge related to electricity.
    - Lead a class discussion using the following prompts:
    - Prompt #1:

    "What is electricity?"

    - Prompt #2:

    "What is electricity used for?"

    - Prompt #3:

    "How are electricity and electrochemistry related to each other?

Action

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

1. 5-3A: Galvanic Cells

- Have students take notes from this section.
- They should produce a step-by-step guide, in their own notes for how to properly balance a redox reaction using the oxidation numbers method.
- After students are given time to review the techniques, review as a class.
- Encourage questions and clear up any misconceptions.
- Have students answer the check your understanding question on their own, followed by taking up the solution together as a class.
- You may choose to assign questions from the practice worksheets at this time to allow students to practice while the technique is fresh.
- Make sure to emphasize that students need to pay attention on assignments and tests for which method the question is asking them to use to balance.
- Assess understanding with questions using the two or three before me method.
    - This strategy is effective when students have learned the material and are trying to consolidate the information learned. Especially with more difficult topics, this strategy gives students a chance to hear other students' understanding of the material.
    - **Ask a question.** The question you ask should be specific to the material covered.
        - "How have galvanic cells improved and influenced technology today?"
        - "How is the galvanic cell set up to make use of redox reactions?"
        - "Does the galvanic cell have a limited lifetime?"
    - **Students' responses.** With this questioning strategy, you could either have students volunteer to answer and or select non-volunteering students at random. But once a student does participate, they have to wait until at least two or three other students take part before speaking again. Inform them to take this as an opportunity to rethink and review their ideas before sharing their answers with the class.

2. 5-3B: Spontaneity of Redox Reactions

- Have students take notes from this section.
- Students should have clear definitions recorded and understood for the following terms:
    - Reduction potential
    - Cell potential
    - Hydrogen half-cell
- Go through the example, together as a class, encouraging questions.
- Have students read through sections A and B, followed by a class discussion summarizing key points.
- For section C, go through the example together, explaining how the table of standard reductions is organized.
- Have students answer the check your understanding question on their own, followed by taking up the solution as a class.
- Watch the video at the bottom of the activity, together as a class. Pause along the way to clarify the main points and to offer opportunities for questions.

3. Electrochemical Cells Think-Pair-Share Activity

- This activity has a series of 4 prompts for students to use the get them thinking about the relationship between chemical and electrical energy and how our needs for electrical energy can have consequences on the environment.

  Big idea: Electrochemical reactions can be used to generate electricity in a portable format.

  For each prompt have students follow the instructions below:

1. Carefully think about the prompt for 2 minutes. Thinking about how you would answer it, what connections can be maed to what you already know.
2. Pair with another student for 3-5 minutes. Share ideas with each other and discuss the prompt. Ask questions to each other to clarify thinking.
3. Choose one member to share ideas with the class.
4. Have a class discussion about each prompt.

   <u>Prompts:</u>

   a) **What sources of portable energy do you use in your daily life? List some of the positive and negative characteristics of each source.**
   b) **What characteristics should an ideal source portable of energy have?**
   c) **Discuss any potential environmental consequences of portable sources of energy that you listed in prompt #1.**
   d) **What are any potential alternative sources of energy for portable devices?**

4. 5-3C: Cells & Batteries

- Watch the video together as a class. Have students take notes on how a battery works and its relation to electrochemistry.
- Select students to come to the front of the class to summarize different parts of the video.
- After, have students individually work through the interactive describing what is in an electrochemical cell. Once students have had that opportunity, navigate through the interactive as a class.

5. 5-3D: Cold Fusion – A solution to Our Energy Needs?

- Watch the video together as a class.
- After the video review the content, ensuring that students understand the basics of cold fusion and why it is relevant.

- After watching the video have students read the response requirements and either individual or in groups of 2-3 perform the research necessary to respond to each prompt.
- Students must post their responses to the forum and comment on the responses of their peers.
- Facilitate online discussion encouraging students to ask provocative questions and engage their peers in debate.

Consolidation

1. **Galvanic Cells Reactions 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

2. **Galvanic Cell Interactive Practice**
    - To be completed individually either at home or in class.
    - This is a good review opportunity for students and for the teacher to identify areas of weakness.
    - Answers to the exercise questions should be taken up together as a class
    - 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. **5-3H: Galvanic Cell Lab**
    - To be completed individually.
    - Review the assignment beforehand, emphasizing where marks are allocated and proper submission formats.
    - Emphasize that students must show and submit all their work and answer using full sentences.

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