

Lesson 3-2: Changes in Enthalpy	
Curriculum Expectations	<ul style="list-style-type: none"> • D2.1 • D2.2 • D2.3 • D2.4 • D2.8 • D3.3
Learning Goals	<p>By the end of this lesson you will:</p> <ul style="list-style-type: none"> • Understand and predict the energy changes associated with changes of state. • Understand and predict the energy changes associated with chemical reactions in which bonds are broken and bonds are formed. • Understand the energy changes associated with nuclear reactions: fission & fusion.
Success Criteria	<p>I know I have achieved the learning goals when I can predict and explain the energy changes that occur when matter changes state, when chemical bonds are broken or formed and during nuclear reactions.</p>
Teacher Prep	<ul style="list-style-type: none"> • Prepare slides from Introduction to Exo & Endothermic Reactions Group activity • Print out questionnaires for Where Does the Energy... group activity. • If available, bring in the components of a coffee cup calorimeter and construct one as a class.

Minds On

Goal: The goal of this activity is to have students think about energy transfer and release and what factors may influence how this energy is transmitted.

1. Introduction to Enthalpy Think-Pair-Share

Instructions:

1. Have students open the activity on their computers or place the image on a screen for all to see.
2. Display the first prompt question: **Prompt #1: "What properties would this suit need to have to keep the firefighter safe?"**
3. **THINK:** Instruct students to think about the prompt for 2 minutes and record:
 - a. thoughts on how they would answer the question
 - b. what connections can they make to what they know.
4. **PAIR** Have students pair up with another student in the class for 3 minutes.
5. Pairs of students will share ideas with each other and discuss the first prompt.
6. Encourage students to ask each other questions to clarify their thinking.
7. **SHARE:** one member of the pair will share their ideas with the class.
8. After all groups have shared, pairs will meet up again to discuss and consider how their thoughts may have changed after listening to the class.
9. Repeat steps 3-8 for the following prompt questions:
 - a. **Prompt #2: "If this suit was made of metal would the firefighter be safe?"**
 - b. **Prompt #3: "What type of materials could this suit be made of?"**

Action

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

1. Review Activities:

- i. Units of Matter – The Mole
- ii. Using the GRASS method to solve problems
- iii. Molar Mass
- iv. Calculations Involving Molar Mass

- For this set of activities you should review the content as a class first then allow students to review each individually.
- Students should take notes as they progress through each review activity and ensure they are comfortable with calculations and formulas.
- Each of these review activities covers information from grade 11 chemistry and is required knowledge for this course.
- Emphasize the formulas required to calculate the number of moles from a given mass of sample and how to use the periodic table to deduce the molar mass of compounds.
- Take up all embedded questions as a class, emphasizing proper significant digit determination, proper formatting when answering questions (GRASS) method.
- NOTE: this material will be relevant when calculating molar enthalpy.

2. 3-2A: Calculating Changes in Enthalpy

- Students should take notes as they navigate through the activity, recording relevant information.
- This activity can be done individually by students or as a class with the presentation displayed.
- Encourage students to ask questions as they progress through the activity or to record questions as they take notes.
- Stop the presentation or student navigation at the following points along the presentation, to review concepts and identify any misconceptions.
 - After Specific Heat Capacity section
 - Calculating Heat transfer – make sure students are familiar with the equation $Q = mc\Delta T$ and its components.
 - Emphasize that Q measures the heat transfer that occurs.
 - Stop after the Measuring ΔH section and emphasize the difference between measuring heat transfer and measuring the change in enthalpy of the system.

- Emphasize that with a calorimeter, when you calculate Q you are measuring the heat transferred to the surroundings, therefore when calculating ΔH , they must reverse the sign.
- Once students are comfortable with measuring ΔH , move on to calculating molar enthalpy.
- Take up answers to embedded questions as a class.

3. 3-2B: Changes in Enthalpy

- This activity offers a review of the material in the previous section.
- Students should use this activity to refine their notes from activity 3-2A.

Consolidation

1. Calculating Changes in Enthalpy Practice

- To be completed individually, in class or at home. Take up the answers together the following day.
- Address any misconceptions or questions by reviewing material from the lesson.
- Emphasize the relationship between molar enthalpy and the variables that affect changes in enthalpy.

2. Calculating Changes in Enthalpy Quiz

- To be completed individually by students.
- Answers should be taken up together as a class, identify any issues or areas of weakness and review this material.
- Also recommended to assign additional worksheets from the differentiation resources if there are misunderstandings or the need to reinforce material.

3. The Mole – Practice Worksheet

- To be completed individually, in class or at home.
- You may choose to assign this worksheet after the pre-lesson review, before getting in to calculations involving changes in enthalpy. This will allow students to become comfortable with mole calculations as well as the proper format for solving problems.

4. 3-2F: Calorimetry Lab:

- To be completed individually. Before assigning this to students review the assignment page, making sure students understand where the marks are allocated.

- Emphasize proper format when answering questions:
 - All work must be shown on calculations, following GRASS method.
 - Work should be neat.
 - Written answers must be in full sentences with a clear demonstration of understanding to receive full marks.
 - No copying or cheating.

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