Lesson 2.7.1: Physical Science – Chemical Reactions Part 2

Weekly Focus: Comprehension
Weekly Skill: Science Experiment

Lesson Summary: This week students will continue with chemical reactions with a reading and conducting a science experiment.

Materials Needed:

- Reading with comprehension questions **Unit 2.7.1 Handout 1**
- **Unit 2.7.1 Handout 2** (see experiment materials below)
- Extra Work/Homework **Unit 2.7.1 Handout 3**
- 3 clear cups per group
- Water (2 gallons)
- White vinegar (gallon)
- Hydrogen peroxide (gallon)
- Steel Wool (1 bag/box)
- Epsom Salts (1 pound)
- Salt alternative (1 box)
- Baking soda (1 large box)
- 12 student thermometers
- 1 bag of Ice cubes/chips

Objectives: Students will be able to…

- Activate prior knowledge in physical science related to chemical reactions
- Complete a science experiment to assist with a better understanding of chemical reactions

College and Career Readiness Standards: RI, RST, WHST, SL

ACES Skills Addressed: EC, LS, ALS, CT, SM, N

Notes: Please review and be familiar with classroom routine notes for: reading for fluency strategies (**Routine 2**), summarizing techniques (**Routine 4**), and self-management skills (**Routine 1**). The notes will help with making a smooth transition to each activity.

GED 2014 Science Test Overview – For Teachers and Students

The GED Science Test will be 90 minutes long and include approximately 34 questions with a total score value of 40. The questions will have focus on three content areas: life science (~40%), physical science (~40%), and Earth and space science (~20%). Students may be asked to read, analyze, understand, and extract information from a scientific reading, a news brief, a diagram, graph, table, or other material with scientific data and concepts or ideas.

The online test may consist of multiple choice, drop down menu, and fill-in-the-blank questions. There will also be two short answer questions (suggested 10 minutes each) where students may have to design an experiment or identify errors in a conducted experiment, summarize, find evidence (supporting details), and reason or make a conclusion from the information (data) presented.

MINNESOTA Literacy COUNCIL
Sharing the Power of Learning

Lesson 2.7.1: Physical Science – Chemical Reactions Part 2

The work students are doing in class will help them with the GED Science Test. They are also learning skills that will help in many other areas of their lives.

Activities:

Warm-Up: Journal Writing	**Time: 5 - 10 minutes**
As students enter the class, Write on the board *"What do the words **chemical reactions** bring to your mind?"* Ask students to write about this in their notebooks or journals. This is an opportunity for students to think about what they may already know regarding chemical reactions.	

Activity 1: Chemical Reactions (Unit 2.7.1 Handout 1)	**Time: 35- 40 minutes**
1) Hand out **Unit 2.7.1 Handout 1** to students. **2)** Discuss with students that when reading, they should pay close attention to what all of the passage is about. This passage has a connection to ideas and information about chemical reactions. **3)** Ask students to read the passage and answer the questions that follow. Circulate the class while students are working independently to help as needed. Remind students to review the guide words in bold on the left to help with new vocabulary. **4)** When students are finished, review answers as a whole class. **5)** Ask for students to share their answers if they would like. If there is time, you may have students practice reading for fluency and read the passage to each other in pairs.	

Break: 10 minutes

Activity 2: Science Experiment (Unit 2.7.1 Handout 2)	**Time: 40 – 50 minutes**
1) Hand out **Unit 2.7.1 Handout 2** to students. Explain to them that since they have been reading more about chemical reactions, it is time to conduct an experiment with chemical reactions. **2)** Discuss with students although this is not a science lab, there are some details that everyone will have to follow in order to make this safe. Follow the directions carefully, always have something absorbent under the containers to help with spills/splashes, be careful when moving the materials, and if there are any questions, please speak with the teacher. **3)** Ask students if there are any other guidelines they would like to follow with the experiment and its materials. **4)** Students will work in groups of 2-3 to conduct the experiment. Explain that they will work together on the experiment and share their results with the entire class. **5)** While students are getting materials and working on the experiment, circulate to make sure they are performing it correctly. Be prepared to assist as needed and to offer a lending hand when it is necessary. **6)** Review the experiment results as a whole class. **7)** Ask for students to share their predictions and results.	

MINNESOTA Literacy COUNCIL Sharing the Power of Learning

Lesson 2.7.1: Physical Science – Chemical Reactions Part 2

Wrap-Up: Summarize	Time: 5 minutes
Have students turn to a partner (or write in their journals) about what they have learned today from the reading on chemical reactions or the science experiment with chemical reactions. They may want to discuss some of the areas that they would like to do further study on in the future. Ask them to tell a partner what matter is in one or two sentences. *Note: Use Routine 4 Handout*	

Extra Work/Homework: Unit 2.7.1 Handout 3	Time: 30 minutes outside of class
Students can read and answer questions from the reading passage. This is an excellent opportunity for students to review previous material in an independent manner.	

Differentiated Instruction/ELL Accommodation Suggestions	Activity
If some student groups finish early, they can turn their paper over and summarize the reading passage.	**Handout 1**

Online Resources:

Endothermic and Exothermic Chemical Reactions Online Quiz @ Softschools.com -
http://www.softschools.com/quizzes/science/chemical_reactions/quiz380.html

Suggested Teacher Readings:

- **GED Testing Service** – online free Science practice test (to get an idea of test questions – there is no grading on this practice test and there are no answers given)

http://www.gedtestingservice.com/freepractice/download/GED_Science/GEDSciencePracticeTest.html

- **GED Testing Service** – GED Science Item Sample (to get an idea of what the test *may* be like)

http://www.gedtestingservice.com/itemsamplerscience/

- **4tests.com** – free online practice tests – Practice Test B is for GED 2014 (Practice Test A is for older version of test) students can get a feel for what the online test is like.

http://www.4tests.com/exams/examdetail.asp?eid=139

- **Assessment Guide for Educators**: A guide to the 2014 content from GED Testing Service:

http://www.riaepdc.org/Documents/ALALBAASSESSMENT%20GUIDE%20CHAPTER%203.pdf

- **Minnesota is getting ready for the 2014 GED test!** – website with updated information on the professional development in Minnesota regarding the 2014 GED.

http://abe.mpls.k12.mn.us/ged_2014_2

- **Essential Education's 2014 GED Test Curriculum Blueprint** (PDF)

http://www.passged.com/media/pdf/educators/curriculum-blueprint.pdf

Unit 2.7.1 Handout 1 (4 pages total)

Chemical Reactions

Does the term *chemical reaction* bring to mind an image like this one? In the picture, a chemist is mixing chemicals in a lab. Many chemical reactions take place in labs. However, most chemical reactions do not. Where do they occur? They happen in the world all around you. They even happen inside your own body. In fact, you are alive only because of the many chemical reactions that constantly take place inside your cells.

What Is a Chemical Reaction?

A **chemical reaction** is a process in which some substances change into different substances. Substances that start a chemical reaction are called **reactants**. Substances that are produced in the reaction are called **products**. Reactants and products can be elements or compounds. Chemical reactions are represented by chemical equations, like the one below, in which **reactants** (on the left) are connected by an arrow to **products** (on the right).

Reactants → Products

Chemical reactions may occur quickly or slowly. Look at the two pictures in the **Figure** below.

Both represent chemical reactions. In the picture on the left, a reaction inside a fire extinguisher causes foam to shoot out of the extinguisher. This reaction occurs almost instantly. In the picture on the right, a reaction causes the iron tool to turn to rust. This reaction occurs very slowly. In fact, it might take many years for all of the iron in the tool to turn to rust.

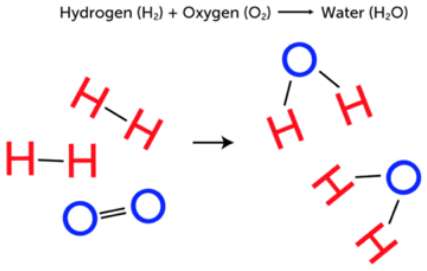
Q: What happens during a chemical reaction? Where do the reactants go, and where do the products come from?

A: During a chemical reaction, chemical changes take place. Some chemical bonds break and new chemical bonds form.

Same Atoms, New Bonds

The reactants and products in a chemical reaction contain the same atoms, but they are rearranged during the reaction. As a result, the atoms are in different combinations in the products than they were in the reactants. This happens because chemical bonds break in the reactants and new chemical bonds form in the products.

Consider the chemical reaction in which water forms from oxygen and hydrogen gases. The Figure below represents this reaction. Bonds break in molecules of hydrogen and oxygen, and then new bonds form in molecules of water. In both reactants and products there are four hydrogen atoms and two oxygen atoms, but the atoms are combined differently in water.



Types of Chemical Reactions

The chemical reaction in the **Figure** above, in which water forms from hydrogen and oxygen, is an example of a synthesis reaction. In this type of reaction, two or more reactants combine to synthesize a single product. There are several other types of chemical reactions, including decomposition, replacement, and combustion reactions. The **Table** below compares these four types of chemical reactions.

Type of Reaction	General Equation	Example
Synthesis	A+B → C	$2Na + Cl_2 \rightarrow 2NaCl$
Decomposition	AB → A + B	$2H_2O \rightarrow 2H_2 + O_2$
Single Replacement	A+BC → B+ AC	$2K + 2H_2O \rightarrow 2KOH + H_2$
Double Replacement	AB+ CD → AD + CB	NaCl+ AgF → NaF + AgCl
Combustion	fuel + oxygen → carbon dioxide + water	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Q: The burning of wood is a chemical reaction. Which type of reaction is it?

A: The burning of wood—or of anything else—is a combustion reaction. In the combustion example in the table, the fuel is methane gas (CH_4).

Energy In and Energy Out

All chemical reactions involve energy. Energy is used to break bonds in reactants, and energy is released when new bonds form in products. In terms of energy, there are two types of chemical reactions: endothermic reactions and exothermic reactions.

- In **exothermic** reactions, more energy is released when bonds form in products than is used to break bonds in reactants. These reactions release energy to the environment, often in the form of heat or light.
- In **endothermic** reactions, more energy is used to break bonds in reactants than is released when bonds form in products. These reactions absorb energy from the environment.

Q: When it comes to energy, which type of reaction is the burning of wood? Is it an endothermic reaction or an exothermic reaction? How can you tell?

A: The burning of wood is an exothermic reaction. You can tell by the heat and light energy given off by a wood fire.

Summary

- A chemical reaction is a process in which some substances, called reactants, change into different substances, called products. During the reaction, chemical bonds break in the reactants and new chemical bonds form in the products.
- Types of chemical reactions include synthesis, decomposition, replacement, and combustion reactions.
- All chemical reactions involve energy. Exothermic reactions release more energy than they use. Endothermic reactions use more energy than they release.

Lesson 2.7.1: Physical Science – Chemical Reactions Part 2

Review: *Use the information from the reading passage to answer the questions below.*

1. What is a chemical reaction?

2. Write a general chemical equation that shows the relationship of products to reactants in a chemical reaction.

3. Contrast exothermic and endothermic chemical reactions.

Unit 2.7.1 Handout 1

TEACHER ANSWER KEY

Review

1. What is a chemical reaction?

Answers may vary: Students should paraphrase definition from the reading:

*A **chemical reaction** is a process in which some substances change into different substances.*

2. Write a general chemical equation that shows the relationship of products to reactants in a chemical reaction.

Answers may vary: Students could use one of the equations from the reading passage.

$A+B \rightarrow C$ $\qquad$ $2Na + Cl_2 \rightarrow 2NaCl$

3. Contrast exothermic and endothermic chemical reactions.

Answers may vary: Students should paraphrase definition from the reading:

Exothermic reactions release energy in the form of heat or light and endothermic reactions break bonds by absorbing them.

Unit 2.7.1 Handout 2 (3 pages total)

Experiments with Endothermic and Exothermic Chemical Reactions

As you have read earlier, every chemical reaction that exists is one of two things: **endothermic** or **exothermic**. The Greek root *therm* means temperature or heat, which gives us a clue about all reactions: there is energy exchange! *Endo* means "within" while *exo* means "outside," so these types of reactions are opposite.

Endothermic reactions are those that absorb heat during the reaction. They take in more energy than they give off, which leaves the surrounding cooler that the starting point. Evaporation of water by sunlight is a great example. The sun and the liquid water combine and the water absorbs energy and eventually becomes a gas.

Exothermic reactions are exactly the opposite. While they take some energy to get going, called the activation energy of reaction, these reactions give off heat during the reactions. Good examples of exothermic reactions are explosions like fireworks or combustion in engines.

Chemical Reaction Experiment

You will work in groups of 2-3 to conduct experiments. You will predict outcomes, observe endothermic and exothermic reactions, and determine which reactions absorb or produce the most energy. Finally, you state why the reactions took place.

Materials for your group experiment:

- 2 or 3 clear cups
- Water
- White vinegar
- Hydrogen peroxide
- Steel Wool
- Epsom Salts
- Salt alternative
- Baking soda
- 1 student thermometer
- Ice cubes/chips

Procedures: Follow the directions carefully.

1. Use the table below (a list of liquids and additives) to combine with solids.
2. Pick two or three combinations (write your combination in the chart marked "experiment") and fill up the glass or cup about half way with the liquid you have chosen.
3. Insert the thermometer in the liquid and record the temperature in the chart.
4. Add a tablespoon of the dry material. Record your observations (what happens) in the chart.
5. Wait 2 minutes and record the final temperature of the solution in the chart. *(Critical Thinking: Why do you think it is important to wait the same amount of time for each combination you use in your experiments?)*

6. Discard the solution and try another combination.
7. For each trial, calculate the change in temperature of the reaction by subtracting the final value (temperature) from the initial value (temperature).

Choose the liquid and additive combination from the chart below:

Liquid	Additive
Water	Epsom salt
Water	NoSalt salt alternative
Vinegar	Baking soda
Vinegar	Steel wool pad
Hydrogen peroxide	Dry yeast
Water	Ice

Predictions:

1. Which combinations of liquids and additives will have endothermic reactions (make the temperature decrease)? **Why** do you think this will happen?

2. Which combinations of liquids and additives will have will have exothermic reactions (make the temperature increase)? **Why** do you think this will happen?

Record experiment information in the chart below:

Combination of liquid & additive	Start temp	Observations	End temp	Type of chemical reaction

Extension: Graph your results! Make a bar for each reaction and draw a line from 0 to the temperature change. Be sure to label each line!

Unit 2.7.1 Handout 2

TEACHER ANSWER KEY

Results

Endothermic (temps decreasing) reactions:

- water and Epsom salt
- water and NoSalt
- water and ice

Exothermic (temps increasing) reactions:

- vinegar and baking soda
- vinegar and steel wool
- hydrogen peroxide and dry yeast

Why? Answers will vary. Here is an example from which to check students' answers.

Energy can be a reactant or byproduct of any reaction. While all reactions require some amount of energy to get going, called the activation energy, whether the reaction is endothermic or exothermic depends on where energy fits into the equation. For example:

Endothermic reactions:

reactants + energy = products

And for Exothermic reactions:

reactants = products + energy

It is important to measure the time for each experiment because some may go on even longer than 2 minutes, or be done far before 2 minutes have passed. Taking the temperature measurements at the same time for each trial allows you to compare the combinations. Time is the ***control variable****.*

Unit 2.7.1 Handout 3 (2 pages)

Read these passages from the text and answer the questions that follow.

Biochemical Reactions and Enzymes

Biochemical reactions are chemical reactions that take place inside the cells of living things. Biochemistry is a relatively new field that emerged at the interface of biology and chemistry. Its emergence shows that knowledge of chemistry as well as biology is needed to understand fully the life processes of organisms at the level of the cell. The sum of all the biochemical reactions in an organism is called **metabolism**. It includes both exothermic and endothermic reactions.

Types of Biochemical Reactions

Exothermic reactions in organisms are called **catabolic reactions**. These reactions break down molecules into smaller units and release energy. An example of a catabolic reaction is the breakdown of glucose, which releases energy that cells need to carry out life processes. Endothermic reactions in organisms are called **anabolic reactions**. These reactions build up bigger molecules from smaller ones. An example of an anabolic reaction is the joining of amino acids to form a protein. Which type of reactions catabolic or anabolic do you think occur when your body digests food?

Enzymes

Most biochemical reactions in organisms need help in order to take place. Why is this the case? For one thing, temperatures are usually too low inside living things for biochemical reactions to occur quickly enough to maintain life. The concentrations of reactants may also be too low for them to come together and react. Where do the biochemical reactions get the help they need to proceed? The help comes from enzymes.

An **enzyme** is a protein that speeds up a biochemical reaction. An enzyme works by reducing the amount of activation energy needed to start the reaction. Less activation energy is needed when the correct enzyme is present than when it is not present.

Enzymes are involved in most biochemical reactions, and they do their job extremely well. A typical biochemical reaction could take several days to occur without an enzyme. With the proper enzyme, the same reaction can occur in just a split second! Without enzymes to speed up biochemical reactions, most organisms could not survive. The activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings. Some enzymes work best at an acidic pH, while others work best in neutral environments.

Lesson 2.7.1: Physical Science – Chemical Reactions Part 2

Review Questions

1. What is an enzyme?

_____

_____

2. How are biochemistry and metabolism related?

_____

_____

3. Which type of reaction—catabolic or anabolic—do you think occurs when your body digests food?

_____

_____

4. How do enzymes work?

_____

_____

5. What is activation energy?

_____

_____

ADAPTED FROM CK12.ORG – BIOCHEMICAL REACTIONS (RYAN TERRY)

Unit 2.7.1 Handout 3

TEACHER ANSWER KEY

1. What is an enzyme?

   Answers may vary: Students should paraphrase definition from the reading:

   *An **enzyme** is a protein that speeds up a biochemical reaction.*

2. How are biochemistry and metabolism related?

   Answers may vary: Students should paraphrase definition from the reading:

   *The sum of all the biochemical reactions in an organism is called **metabolism**.*

3. Which type of reaction—catabolic or anabolic—do you think occurs when your body digests food?

   Answers may vary: Students should paraphrase definition from the reading:

   Catabolic reactions break down molecules into smaller units and release energy. This is what happens when your body digests food.

4. How do enzymes work?

   Answers may vary: Students should paraphrase definition from the reading:

   An enzyme works by reducing the amount of activation energy needed to start the reaction.

5. What is activation energy?

   Answers may vary: Students should paraphrase definition from the reading:

   Activation energy is the energy needed to start a biochemical reaction.

ADAPTED FROM CK12.ORG – BIOCHEMICAL REACTIONS (RYAN TERRY)