CHAPTER RESOURCES

Chapter 8
Chemical Reactions

Includes:

LEVELED ASSESSMENT

Chapter Review

Chapter Tests

- Test A (Below Level) BL
- Test B (On Level) OL
- Test C (Advanced Learner) AL

LABS

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Lab worksheets from Student Edition Labs

- MiniLab
- Lab: Version A (Below Level) BL
- Lab: Version B (On Level) OL
  (Advanced Learner) AL

UNIVERSAL ACCESS/LEVELED RESOURCES

Target Your Reading

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Chapter Content Mastery Spanish (Below Level) BL

Reinforcement (On Level) OL

Enrichment (Advanced Learner) AL

READING SUPPORT

Content Vocabulary

Chapter Outline

TEACHER SUPPORT AND PLANNING

Chapter Outline for Teaching

Teacher Guide and Answers

Mc Graw Hill Glencoe

New York, New York Columbus, Ohio Chicago, Illinois Peoria, Illinois Woodland Hills, California

Glencoe Science

Photo Credits

Cover: Roger Ressmeyer/CORBIS

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The McGraw-Hill Companies

Send all inquiries to:
Glencoe/McGraw-Hill
8787 Orion Place
Columbus, OH 43240-4027

ISBN-13: 978-0-07-875464-7
ISBN-10: 0-07-875464-X

Printed in the United States of America.

2 3 4 5 6 7 8 9 10 009 11 10 09 08 07 06

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Teacher Approval Initials
Date of Approval

Student Lab/Activity Safety Form

Student Name: _____

Date: _____

Lab/Activity Title: _____

In order to show your teacher that you understand the safety concerns of this lab/activity, the following questions must be answered after the teacher explains the information to you. You must have your teacher initial this form before you can proceed with the activity/lab.

1. How would you describe what you will be doing during this lab/activity?

2. What are the safety concerns associated with this lab/activity (as explained by your teacher)?

- _____
- _____
- _____
- _____
- _____

3. What additional safety concerns or questions do you have?

Adapted from Gerlovich, et al. (2004). The Total Science Safety System CD, JaKel, Inc. Used with Permission.

Name _____ Date _____ Class _____

MiniLab

How can you tell a chemical change from a physical change?

CHAPTER 8

What is the difference between a chemical and a physical change? In this activity you will observe a variety of changes and record your observations and thoughts about the changes.

Procedure

1. Study the table below or copy it into your Science Journal.
2. Complete the table as your teacher performs the changes.

Data and Observations

Change or Reaction	Chemical or physical change? How do you know?
Burning wood or paper	
Breaking a match	
Striking a match	
Burning magnesium	
Shaving magnesium	
Making foil into a ball	
Placing zinc metal in copper nitrate solution	
Melting ice	
Burning a candle	
Hammering copper metal	

Analysis

1. List any pieces of evidence that a chemical reaction occurred.

_____

_____

_____

2. Identify some key words that let you know a change is chemical. Are there key words that let you know a change is physical?

_____

_____

Name _____ Date _____ Class _____

MiniLab

Can you model the burning of methane?

CHAPTER 8

When materials burn, they are reactants in a chemical reaction. In order for materials to burn, oxygen is needed. What are the products? How are they related to the reactants?

Procedure

1. Read and complete a lab safety form.
2. Observe the flame as your teacher lights the Bunsen burner.
3. Write your observations in your Science Journal.
4. The equation below is for the burning of methane. Copy it into your Science Journal.
   $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
5. Write the names for the reactants and products under the formulas.
6. Use a **molecular model kit** to build models of the reactants and products in the equation. Draw the models in your Science Journal.

Analysis

1. **Copy and complete** the table. **Decide** whether the equation is balanced.

Number of Atoms	
Reactants	**Products**
C:	C:
H:	H:
O:	O:

2. **Identify** the physical properties of each product and reactant.

3. **Plan a way** to test whether water vapor is produced by the reaction.

Name _____ Date _____ Class _____

Lab

Forensics: Dirty Jewelry

CHAPTER 8
VERSION A

Problem Rafir was cleaning the copper jewelry in his shop when suddenly a passerby had a heart attack on the sidewalk. Rafir rushed out to help the victim. When he returned to his shop, the jewelry had turned green.

Rafir thought he must have done something incorrectly in the cleaning procedure. But in the excitement of the emergency, he couldn't remember which step he might have left out. Rafir wrote down what he thought he did.

1. I washed the jewelry with soap and water.
2. I mixed an acid (I'm not sure whether it was lemon juice or vinegar) and some salt in water.
3. I put the jewelry into the mixture to soak.
4. I took the jewelry out of the mixture and rinsed it in clean water.

Form a Hypothesis After reviewing Rafir's procedure, where do you think Rafir might have made a mistake?

Materials

salt
lemon juice, lime juice, vinegar
water
dirty pennies
beaker
graduated cylinder
scoop

WARNING: *Copper in solution can be poisonous. Dispose of your solutions as your teacher tells you.*

Procedure

Directions: *Check the boxes below as you complete each step of the procedure.*

- ☐ **1.** Read and complete a lab safety form.
- ☐ **2.** Use copper pennies as a jewelry substitute.
- ☐ **3.** Make a plan for tests that you will do to find out what Rafir's mistake was.
- ☐ **4.** Write your procedure. Have your teacher approve your procedure.
- ☐ **5.** Use the data table on the next page to record your observations.
- ☐ **6.** Make sure your teacher approves your experiment before you begin.

Lab: Version A CONTINUED

Data and Observations

Rafir's Steps	Observations
1.	
2.	
3.	
4.	

Analyze and Conclude

1. **Describe** how well soap and water cleans the dirty pennies.

2. **Explain** how well lemon juice in water cleans pennies.

3. **Describe** how well salt water cleans pennies.

4. **Identify** what you think the dirt on the pennies was.

Name _____ Date _____ Class _____

Lab: Version A CONTINUED

5. Identify the combination of chemicals that cleaned the pennies best.

6. Explain Rafir's mistake.

7. Evaluate any parts of your procedure that you feel did not go well. What could you do to improve the lab?

8. Critique What problem might arise with jewelry or money that was cleaned frequently by this method?

Communicate

Write a Pamphlet How do you think the knowledge you have gained in this lab applies to jewelry cleaning? Could you use your knowledge of household chemicals to clean old pieces of jewelry bought at flea markets? Write a short pamphlet to give to flea-market sellers describing how to clean jewelry.

Name _____ Date _____ Class _____

Lab

Forensics: Dirty Jewelry

CHAPTER 8
VERSION B

Problem Rafir was cleaning the copper jewelry in his shop when suddenly a passerby had a heart attack on the sidewalk. Rafir rushed out to help the victim. When he returned to his shop, the jewelry had turned green.

Rafir thought he must have done something incorrectly in the cleaning procedure. But in the excitement of the emergency, he couldn't remember which step he might have left out. Rafir wrote down what he thought he did.

1. I washed the jewelry with soap and water.
2. I mixed an acid (I'm not sure whether it was lemon juice or vinegar) and some salt in water.
3. I put the jewelry into the mixture to soak.
4. I took the jewelry out of the mixture and rinsed it in clean water.

Form a Hypothesis After reviewing Rafir's procedure, where do you think Rafir might have made a mistake?

Materials

salt
lemon juice, lime juice, vinegar
water
dirty pennies
beaker
graduated cylinder
scoop

WARNING: *Copper in solution can be poisonous. Dispose of your solutions as your teacher tells you.*

Procedure

Directions: *Check the boxes below as you complete each step of the procedure.*

☐ **1.** Read and complete a lab safety form.
☐ **2.** Use copper pennies as a jewelry substitute.
☐ **3.** Make a plan for tests that you will do to find out what Rafir's mistake was.
☐ **4.** Write your procedure. Have your teacher approve your procedure.
☐ **5.** Prepare a data table on the next page to record your observations.
☐ **6.** Make sure your teacher approves your experiment before you begin.

Name _____ Date _____ Class _____

Lab: Version B CONTINUED

Data and Observations

Analyze and Conclude

1. **Describe** how well soap and water cleans the dirty pennies.

2. **Explain** how well lemon juice in water cleans pennies.

3. **Describe** how well salt water cleans pennies.

4. **Identify** what you think the dirt on the pennies was.

5. **Identify** the combination of chemicals that cleaned the pennies best.

Lab: Version B CONTINUED

6. **Explain** Rafir's mistake.

7. **Evaluate** any parts of your procedure that you feel did not go well. What could you do to improve the lab? Use a separate sheet of paper for your answer.
8. **Critique** What problem might arise with jewelry or money that was cleaned frequently by this method? Use a separate sheet of paper for your answer.

Going Further

Challenge

9. **Hypothesize** Why do you think the soap and water were not effective?

10. **Evaluate** Bernice argues that the experiment isn't actually cleaning the pennies, since the soap and water were not effective at removing the brown layer. Do you agree or disagree with Bernice's assertion?

11. **Speculate** John spilled ketchup on some pennies. He was surprised that when he rubbed the pennies dry, they were shiny. Explain what happened.

Extension

The Statue of Liberty is covered with a copper skin. It becomes tarnished just as the pennies in the lab. This tarnish is called surface oxidation. Research the causes of this surface oxidation.

Communicate

Write a Pamphlet How do you think the knowledge you have gained in this lab applies to jewelry cleaning? Could you use your knowledge of household chemicals to clean old pieces of jewelry bought at flea markets? Write a short pamphlet to give to flea-market sellers describing how to clean jewelry.

Name _____ Date _____ Class _____

Target Your Reading

Chemical Reactions

CHAPTER 8

Use this to focus on the main ideas as you read the chapter.

1. **Before you read** the chapter, respond to the statements below on your worksheet or on a numbered sheet of paper.
   - Write an **A** if you **agree** with the statement.
   - Write a **D** if you **disagree** with the statement.
2. **After you read** the chapter, look back to this page to see if you've changed your mind about any of the statements.
   - If any of your answers changed, explain why.
   - Change any false statements into true statements.
   - Use your revised statements as a study guide.

Before You Read A or D	Statement	After You Read A or D
	1. In physical and chemical changes, the identity of a substance changes.	
	2. The boiling of water is a physical change.	
	3. Physical and chemical changes are not reversible.	
	4. A molecule contains two or more atoms bonded together.	
	5. In chemical reactions, atoms rearrange to form one or more new substances.	
	6. To balance a chemical equation, it may be necessary to add coefficients and subscripts.	
	7. A chemical equation must have the same number and kinds of atoms in the reactions and products.	
	8. Energy is always released in a chemical reaction.	
	9. In an exothermic reaction, the products have less energy than the reactants.	
	10. The energy released in a chemical reaction is always in the form of heat.	

Name _____ Date _____ Class _____

Chapter Content **Mastery**

Chemical Properties and Changes

CHAPTER 8
LESSON 1

Directions: *Use the following terms to complete each sentence below.*

chemical change	**chemical property**	**conductivity**	**dissolving**
malleability	**melting point**	**physical property**	

1. A _____ is any characteristic of a material that can be observed without changing the material itself.
2. A substance's _____ is the temperature at which the substance changes from its solid state to its liquid state. It is a physical property.
3. _____ is another physical property, which is the ability of a substance to transfer heat or electricity.
4. _____, a physical property, is the ability of a substance to be hammered or rolled into shapes.
5. _____ is a process by which substances mix evenly with one another.
6. A _____ is the change of one or more substances into other substances.
7. A _____ is any characteristic of a substance that can be observed only by changing the identity of the substance.

Directions: *Respond to each question or statement below in the space provided.*

8. What kind of a change occurs when ice melts? How do you know?

9. List three examples of chemical changes.

10. When salt dissolves into water, the salt seems to disappear. Why is dissolving called a physical change?

Name _____ Date _____ Class _____

Chapter Content **Mastery**

Chemical Equations

CHAPTER 8
LESSON 2

Directions: *Unscramble each of the words from the chapter below. Then use them to complete the numbered definitions.*

_____ **1.** mdatioci coulmeel

_____ **2.** emeucllo

_____ **3.** slup gsni

_____ **4.** odsuptrc

_____ **5.** uolafmr nuti

_____ **6.** ecnatsart

_____ **7.** iccmehla aqtunoei

_____ **8.** sibpcustr

_____ **9.** fcoieietfnc

Directions: *Using the words you unscrambled in questions 1–9, fill in the blanks in the sentences below. Each correct answer from questions 1–9 will be used once.*

10. A(n) _____ is a neutral particle in which atoms share electrons.

11. A(n) _____ tells how many atoms of an element are contained in one molecule of a substance.

12. A(n) _____ is a molecule that contains two atoms.

13. The law of conservation of mass tells us that in a chemical reaction, the total mass of the _____ will equal the total mass of the _____.

14. A(n) _____ tells how many molecules of a particular substance take part in a chemical reaction.

15. When used in chemical equations, the _____ means "reacts with."

16. A(n) _____ is the smallest whole-number ratio of the elements in an ionic or covalent compound.

17. A(n) _____ is an efficient way to represent what happens in a chemical reaction.

Name _____ Date _____ Class _____

Chapter Content **Mastery**

Energy and Chemical Change

CHAPTER 8
LESSON 3

Directions: *Circle the word or phrase that correctly completes each sentence below.*

1. An (endothermic/exothermic) process is a process that releases energy.
2. Cold light is a term used for light that is produced at (room temperature/absolute zero).
3. The law of (conservation/permanence) of energy states that energy is neither created nor destroyed in chemical reactions.
4. An endothermic process is a process that absorbs (energy/matter).
5. A chemical (bond/reaction) is a force that holds atoms together in a compound.
6. Because the burning of paper releases heat, it is an (exothermic/endothermic) reaction.

Directions: *For each process described below, decide whether it is endothermic or exothermic. Write the correct term on the line provided.*

_____ **7.** the chemical reaction that takes place in an ice pack used to treat sports injuries

_____ **8.** the burning of charcoal

_____ **9.** the digestion of food in your body

_____ **10.** the decomposition of water into hydrogen and oxygen

_____ **11.** the combustion of liquid oxygen; the fuel used by the space shuttle

Directions: *Answer the question in the space provided.*

12. The explosion of a firecracker is an exothermic reaction. Where does the energy released come from, and into what forms is it changed?

_____

_____

_____

_____

_____

Nombre _____ Fecha _____ Clase _____

Dominio del contenido

Las propiedades químicas y los cambios

CAPÍTULO 8
LECCIÓN 1

Instrucciones: *Usa los siguientes términos para completar las oraciones.*

cambio químico	**conductividad**	**disolver**	**maleabilidad**
propiedad física	**propiedad química**	**punto de difusión**	

1. Un(a) _____ es una característica de un material que se puede observar sin cambiar el material.

2. El (La) _____ de una sustancia es la temperatura en la cual la sustancia cambia de un estado sólido a un estado líquido. Es una propiedad física.

3. El (La) _____ es otra propiedad física, que es la habilidad de una sustancia de transferir calor o electricidad.

4. El (La) _____, una propiedad física, es la habilidad de una sustancia de ser martillada o laminada en formas.

5. _____ es el proceso por el cual una sustancia se mezcla uniformemente con otra.

6. Un(a) _____ es el cambio de una o más sustancias a otras sustancias.

7. Un(a) _____ es una característica de una sustancia que se puede observar solamente cambiando la identidad de la sustancia.

Instrucciones: *Contesta las siguientes preguntas en el espacio.*

8. ¿Qué clase de cambio ocurre cuando el hielo se derrite? ¿Cómo lo sabes?

_____

_____

_____

9. Haz una lista de tres ejemplos de cambios químicos.

_____

_____

_____

10. Cuando la sal se disuelve en el agua, parece que la sal desaparece. ¿Por qué es que el disolver se llama un cambio físico?

_____

_____

Nombre _____ Fecha _____ Clase _____

Dominio del contenido

Las ecuaciones químicas

CAPÍTULO 8
LECCIÓN 2

Instrucciones: *Descifra cada una de las siguientes palabras del capítulo. Entonces, úsalas para completar las definiciones.*

_____ **1.** aulcmloé ciatómida

_____ **2.** aéolmucl

_____ **3.** gonsi ed sám

_____ **4.** oodsuptrc

_____ **5.** addniu afmrólu

_____ **6.** ttnescraae

_____ **7.** óniceuac cmiaqíu

_____ **8.** ebcdusíni

_____ **9.** tenfeecicio

Instrucciones: *Usando las palabras que descifraste en las preguntas 1–9, completa las siguientes oraciones. Cada respuesta de 1–9 se usará solamente una vez.*

10. Un(a) _____ es una partícula neutra en la cual algunos átomos comparten electrones.

11. Un(a) _____ indica cuantos átomos de un elemento se contienen en una molécula de una sustancia.

12. Un(a) _____ es una molécula que contiene dos átomos.

13. La ley de la conservación de la masa indica que en una reacción química, la masa total del (de la) _____ igualará la masa total del (de la) _____.

14. Un(a) _____ indica cuantas moléculas de una sustancia especifica toman parte en una reacción química.

15. Cuando se usa en ecuaciones químicas, el (la) _____ significa "reacciona con."

16. Un(a) _____ es la proporción del numero entero más pequeño de los elementos en una compuesta iónica o covalente.

17. Un(a) _____ es una manera eficiente para representar lo que ocurre en una reacción química.

Nombre _____ Fecha _____ Clase _____

Dominio del contenido

La energía y los cambios químicos

CAPÍTULO 8
LECCIÓN 3

Instrucciones: *Circula la palabra o frase que correctamente completa cada oración.*

1. Un proceso (endotérmico/exotérmico) es un proceso que suelta energía.

2. La luz fría es un término para la luz que se produce a (la temperatura ambiente/cero absoluto).

3. La ley de la (conservación/permanencia) de la energía indica que la energía no es creada ni es destruida en las reacciones químicas.

4. Un proceso endotérmico es un proceso que absorbe la (energía/materia).

5. Una (afinidad/reacción) química es una fuerza que mantiene los átomos juntos en un compuesto.

6. Porque el papel que se está quemando suelta calor, es una reacción (exotérmica/endotérmica).

Instrucciones: *Para cada proceso descrito abajo, decide si es endotérmico o exotérmico. Escribe el término correcto en la línea.*

_____ **7.** la reacción química que se lleva a cabo en una bolsa de hielo que se usa para tratar heridas de deportes

_____ **8.** la quemada de carbón

_____ **9.** la digestión de la comida en tu cuerpo

_____ **10.** la descomposición del agua a hidrógeno y oxígeno

_____ **11.** la combustión del oxígeno líquido, el carburante que usa el trasbordador espacial

Instrucciones: *Escribe tu respuesta en el espacio.*

12. La explosión de un petardo es una reacción exotérmica. ¿De donde viene la energía que se suelta y a qué formas se cambia?

_____

_____

_____

_____

_____

Name _____ Date _____ Class _____

Reinforcement Chemical Properties and Changes

CHAPTER 8
LESSON 1

Directions: *In the space at the left, write* T *if the statement is true and* F *if the statement is false. For each false statement, write a new version that is true on the line provided.*

_____ **1.** A physical property is any characteristic of a chemical reaction that can be observed without changing the material itself.

_____

_____ **2.** Dissolving is a process in which substances mix evenly with one another.

_____

_____ **3.** Malleability is the ability of a substance to transfer heat or electricity.

_____

_____ **4.** A chemical change is the change of one or more substances into other different states.

_____

_____ **5.** A substance's boiling point is the temperature at which the substance changes from its solid state to its liquid state.

_____

_____ **6.** Malleability is the ability of a substance to be hammered or rolled into shapes.

_____

_____ **7.** A chemical property is any characteristic of a substance that can be observed only by changing the identity of the substance.

_____

Directions: *Respond to each statement below in the space provided.*

8. Describe two physical changes you have observed in the last day. Explain why each is a physical change.

_____

_____

_____

9. Describe one chemical change you have observed in the last day. Explain why it is a chemical change.

_____

_____

Name _____ Date _____ Class _____

Reinforcement Chemical Equations

CHAPTER 8
LESSON 2

Directions: *For each phrase, write the term it defines in the space provided.*

_____ **1.** an efficient way to represent what happens in a chemical reaction

_____ **2.** tells how many atoms of an element are contained in one molecule of a substance

_____ **3.** a molecule that contains two atoms

_____ **4.** the number that tells how many molecules of a particular substance take part in a chemical reaction

_____ **5.** neutral particles in which atoms share electrons

_____ **6.** the starting materials in a chemical reaction

_____ **7.** the scientific law that says the total mass before a chemical reaction is the same as the total mass after the reaction

_____ **8.** the new substances that are formed during a chemical reaction

_____ **9.** the smallest whole-number ratio of the elements in an ionic or covalent compound

Directions: *For each question below, choose the letter of the best answer and write it on the blank provided.*

_____ **10.** Which of the following is a chemical equation?

A. $4H_2O$
B. $3C_2H_6$
C. $CO_2 + 2NaCl$
D. $2H_2O \rightarrow 2H_2 + O_2$

_____ **11.** How many atoms are present at the beginning of the chemical reaction represented by the equation $2KClO_3 \rightarrow 2KCl + 3O_2$?

A. 0
B. 5
C. 10
D. 14

Name _____ Date _____ Class _____

Reinforcement Energy and Chemical Change

CHAPTER 8
LESSON 3

Directions: *For each description below, choose the words from the list that are related to the description and write them on the blank provided. Words may be used more than once.*

chemical bond	**cold light**	**endothermic process**
exothermic process	**law of conservation of energy**	

1. When combined, the chemicals inside a glow necklace produce a soft glow. It is still safe to wear the glow necklace while it is producing this glow.

_____

2. Using two electric wires, you run an experiment to separate hydrogen and oxygen atoms that make up water. You notice that there is twice as much hydrogen gas as there is oxygen gas when you are done.

_____

3. A firecracker explodes, transferring energy from the bonds of the gunpowder inside to heat, light, and sound.

_____

4. As you walk down the beach at night, you notice that your footprints are glowing behind you. Even though you touch the sand that seems to glow, you do not feel anything unusual. You realize that microscopic plankton are emitting a faint light when you step on them.

_____

Directions: *Answer each question below in the space provided.*

5. If the law of conservation of energy is always true, how can the products of a chemical reaction store less energy than the reactants?

_____

_____

_____

6. If the chemical bonds of the molecules in two beverages store the same amount of energy, how can one be called an "energy drink" and the other just a normal drink?

_____

_____

_____

Name _____ Date _____ Class _____

CHAPTER 8
LESSON 1

Enrichment Ionic and Covalent Bonds

Many of the foods we eat include some kind of additive. Sometimes additives are used to improve the appearance of the food, as is often the case with fruits. For example, antioxidants are added to cut fruits so that they won't turn brown as quickly as they otherwise would. In addition, desserts and soft drinks often have artificial sweeteners added to keep the overall caloric count low without adversely affecting the taste.

A Common Cure

People have been using food additives for centuries. Before refrigeration, people used to pickle or cure their food to keep the food from spoiling. While pickling and curing still take place, the refrigerator and freezer have made these methods less of a necessity than they once were.

A common ionic substance, curing salt, is used to help preserve ham, bacon, sausage, and most other cured meats. At first, this was thought to be a wonderful way to reduce the risk of botulism, which is a dangerous disease. As time went on, however, scientists discovered that the ionic properties that prevent the growth of bacteria also cause cancer.

Trouble with Nitrites

The ion nitrate used in curing is converted to nitrite by enzymes or bacteria. The nitrite then prevents the bacteria from growing. Both nitrate and nitrite help in producing the pinkish coloring in some meat. Unfortunately, nitrite also interacts with a type of substance called an amine. Amines are organic molecules that exist in every living thing. All meat contains amines. When nitrite and amine react at high temperatures, they produce a group of chemicals called nitrosamines. Nitrosamines have been found to cause cancer in every species of animal on which they have been tested. In order for the chemical reaction that produces nitrosamines to take place, the meat must be cooked at high temperatures. Any meat that has been fried is more likely to contain nitrosamines.

Directions: *Use resources from your library to gather information to respond to each statement below.*

1. **Determine** if any of the foods you eat or beverages you drink contain antioxidants.

_____

_____

2. **Discuss** whether or not antioxidants are safe to consume.

_____

_____

3. **Judge** whether it is accurate to say that curing salts are both beneficial and harmful. Explain your judgment.

_____

_____

_____

Name _____ Date _____ Class _____

Enrichment Catalysts of Change

CHAPTER 8
LESSON 2

Sometimes a chemical reaction can be started by adding a chemical called a catalyst. Catalysts have a wide range of formulas, shapes, sizes, and even chemical properties.

Changing to Become the Same

Every catalyst speeds up a chemical reaction. In fact, catalysts are necessary to start reactions in some circumstances, but catalysts are not reactants. The identity of a substance that acts as a catalyst is not permanently changed during a chemical reaction. How can this happen?

The catalyst in a reaction *does* actively take part in an intermediate chemical reaction. The catalyst *does* combine with one or more reactants to form other substances. The products of that intermediate reaction *do not include* the catalyst.

But the overall reaction doesn't stop there. The products of the intermediate reaction undergo at least one more intermediate reaction. Several more intermediate reactions might take place. For a substance to be a catalyst, however, it must always be one of the products of the last intermediate reaction that takes place.

Reaching the Goal

To help understand how a catalyst works, think of a soccer game. Imagine that the soccer ball and the soccer goal are reactants. The reaction you want to take place will combine the soccer ball and the goal to score a point. The combination of the goal and the ball into something called a point is the product. However, the ball and the goal start meters away from each other. By themselves, they will not combine to score a point.

Now imagine that you are on the field with the ball and the goal. In this situation, you act as the catalyst. If you were not on the field, the ball and the goal would just sit there, and the point would not be scored. However, when you are on the field, you do temporarily combine with the ball as you kick it down the field. For a time, you and the ball both move toward the goal as one unit.

To score the point, though, you and the ball separate. You kick the ball into the net. Now, the ball and the net combine to score a point. The reactant was created; the reaction took place. And you, the catalyst, are separate and unchanged, just as you were before the reaction.

Directions: *Respond to each statement or question in the space provided.*

1. Infer What is a catalytic converter, and why is one required on every car in California?

_____

_____

_____

2. Deduce why some people, like Dr. Martin Luther King, Jr., have been called catalysts for social change. _____

_____

_____

_____

Name _____ Date _____ Class _____

Enrichment

Using Chemical Reactions on Food Labels

CHAPTER 8
LESSON 3

One chemical property is the sensitivity of a substance to heat. Some chemicals might change form when their temperature changes; others might undergo chemical reactions with other substances. When these changes result in a change in color, the chemicals involved are called thermochromic. (*Thermo* means "related to heat," and *chrom* means "having to do with color.")

Thermochromic Labels

Some thermochromic chemicals undergo irreversible changes when they are heated. Thermochromic chemicals are being used on labels for fresh foods.

All fresh meats contain some bacteria. However, bacteria grow slowly at cool temperatures. Meat is safe to eat as long as it is kept refrigerated or frozen. But if meat is exposed to high temperatures anywhere on its journey from the packing plant to your kitchen, the bacteria in the meat can grow more quickly. Bacteria might even build up to levels that would make the meat unsafe to eat.

Color Change

A thermochromic label is designed to help people tell if meat has been exposed to high temperatures. When the meat is packaged, a thermochromic label is placed on the package. The label is then activated, which allows two or more chemicals that are part of the label to mix. If the temperature increases enough, a reaction will occur between these chemicals and cause the label to change color. The color change tells customers that the meat is not safe to eat.

Time-Temperature Indicators

The chemicals in thermochromic labels for meat are sensitive not only to temperature, but also to time. For this reason, these labels are sometimes called TTI (Time-Temperature Indicator) labels. Regular labels on meat usually have an expiration or "sell-by" date. After the expiration date, the meat is no longer safe to be sold. A TTI label is not marked with a date. Instead, the label changes color after a certain amount of time has passed (whether or not the meat has been exposed to high temperatures).

Because different combinations of chemicals have different sensitivities to temperature and time, scientists can design TTI labels that change color at almost any temperature or after almost any period of time. This allows TTI labels to be used on a variety of different foods. If you haven't already, you will probably see these labels at a store near you soon.

Directions: *Respond to each statement below in the space provided.*

1. **Conclude** why it is important that the color changes on thermochromic labels for meat are irreversible.

_____

_____

2. **Hypothesize** as to why meat might be dangerous to eat even if the bacteria in it have been killed by cooking it.

_____

_____

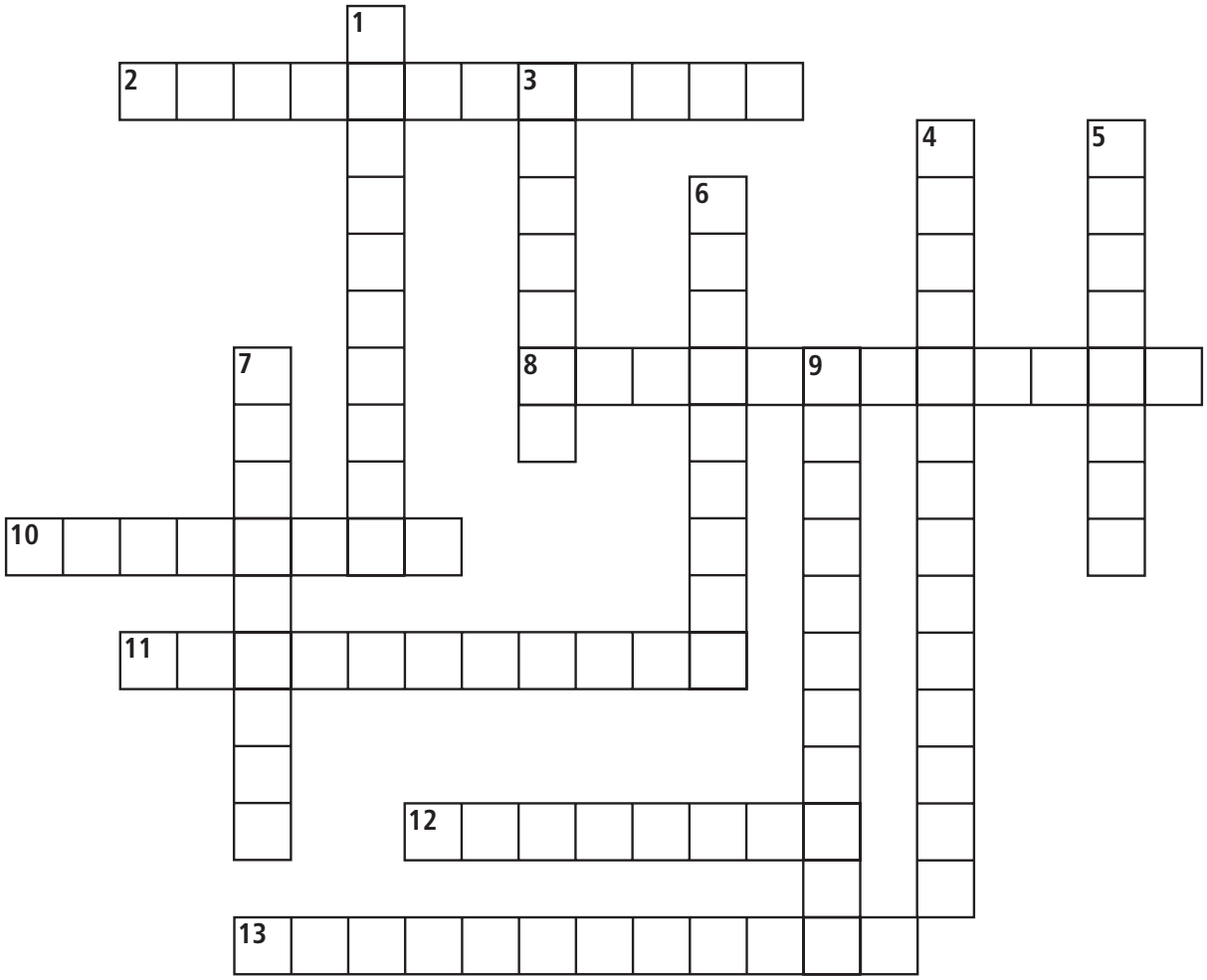
Name _____ Date _____ Class _____

Content Vocabulary

Chemical Reactions

CHAPTER 8

Directions: *Complete the crossword puzzle using the clues below.*



Across

2. the temperature at which a substance changes from its solid state to its liquid state

8. the ability of a substance to transfer heat or electricity

10. a symbol used in chemical equations that means "reacts with"

11. the smallest whole-number ratio of the elements in an ionic or covalent compound

12. a neutral particle in which atoms share electrons

13. the ability of a substance to be hammered or rolled into shapes

Down

1. a process in which substances mix evenly with one another

3. a new substance that is formed during a chemical reaction

4. the change of one or more substances into other substances

5. starting material in a chemical reaction

6. light that is produced at room temperature

7. tells how many atoms of an element are contained in one molecule of a substance

9. the number that tells how many molecules of a particular substance take part in a chemical reaction

Name _____ Date _____ Class _____

Content **Vocabulary** CONTINUED

Directions: *Circle the word that correctly completes each sentence.*

14. An (exothermic/endothermic) process is a process that releases energy.

15. The law of conservation of (mass/energy) states that the total mass before a chemical reaction is the same as the total mass after the reaction.

16. A (chemical/physical) property is any characteristic of a material that can be observed without changing the material itself.

17. If you need to add energy to a substance to cause a chemical reaction, that chemical reaction is called an (exothermic/endothermic) reaction.

18. A (diatomic/bipolar) molecule is a molecule that contains two atoms.

19. The light produced by fireflies is an example of (incandescent/cold) light.

20. A (quadratic/chemical) equation is an efficient way to represent what happens in a chemical reaction.

21. When burned, charcoal combines with oxygen from the air to form carbon (hydroxide/dioxide).

22. The (theory/law) of conservation of energy states that energy is neither created nor destroyed in chemical reactions.

23. A chemical (bond/pairing) is a force that holds atoms together in a compound.

24. An endothermic process is a process that (releases/absorbs) energy.

25. A chemical property is any characteristic of a substance that can be observed (without/only by) changing the identity of the substance.

Name _____ Date _____ Class _____

Chapter Review — Chemical Reactions

CHAPTER 8

Part A. Vocabulary Review

Directions: *Identify the item in Column II that matches the description in Column I by writing the correct letter in the space provided.*

Column I	Column II
_____ **1.** any characteristic of a material that can be observed without changing the material itself	**A.** chemical bond
_____ **2.** a force that holds atoms together in a compound	**B.** chemical change
_____ **3.** the temperature at which a substance changes from its solid state to its liquid state	**C.** chemical property
_____ **4.** the change of one or more substances into other substances	**D.** coefficient
_____ **5.** a process in which substances mix evenly with one another	**E.** cold light
_____ **6.** the number that tells how many molecules of a particular substance take part in a chemical reaction	**F.** conductivity
_____ **7.** a process that absorbs energy	**G.** dissolving
_____ **8.** the ability of a substance to transfer heat or electricity	**H.** endothermic
_____ **9.** a neutral particle in which atoms share electrons	**I.** exothermic
_____ **10.** a symbol used in chemical equations that means “reacts with”	**J.** law of conservation of energy
_____ **11.** any characteristic of a substance that can be observed only by changing the identity of the substance	**K.** melting point
_____ **12.** light that is produced at room temperature	**L.** molecule
_____ **13.** the new substances that are formed during a chemical reaction	**M.** physical property
_____ **14.** the scientific law that says energy is neither created nor destroyed in chemical reactions	**N.** plus sign
_____ **15.** a process that releases energy	**O.** products

Name _____ Date _____ Class _____

Chapter **Review** CONTINUED

Part B. Concept Review

Directions: *For each question below, choose the correct answer and write its letter on the blank provided.*

_____ **1. Analyze** each of the chemical equations below. Which equation is not balanced?

A. $H_2 + Cl_2 \rightarrow 2HCl$

B. $KClO_3 \rightarrow KCl + O_2$

C. $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$

D. $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

_____ **2. Pick** the equation that contains a coefficient.

A. $C + O \rightarrow CO$

B. $Na + Cl \rightarrow NaCl$

C. $H_2 + Cl_2 \rightarrow 2HCl$

D. $Ca(H_2PO_4)_2 + CaSO_4 + HF \rightarrow Ca_{10}F_2(PO_4)_6 + H_2SO_4$

_____ **3. Determine** which substance from the following equation is a diatomic element:
$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$

A. water

B. oxygen

C. ethane (C_2H_6)

D. carbon dioxide

_____ **4. Choose** the equation that represents a decomposition reaction.

A. $Na + Cl \rightarrow NaCl$

B. $H_2 + Cl_2 \rightarrow 2HCl$

C. $2H_2 + O_2 \rightarrow 2H_2O$

D. $KClO_3 \rightarrow KCl + O_2$

_____ **5. Compute** For each substance, write the coefficient that will balance the chemical equation in the blank provided. Then follow the directions in steps A–D.

_____ $LiCl$ + _____ $O_2 \rightarrow$ _____ $LiClO_3$

A. Draw a circle around each reactant.

B. Draw a square around each product.

C. Draw a small vertical arrow directly under each subscript, pointing up to the subscript.

D. Draw a single line through the symbol(s) that represent the element chlorine.

Name _____ Date _____ Class _____

Chapter Outline

Chemical Reactions

CHAPTER 8

Lesson 1: Chemical Properties and Changes

A. Ability to Change

1. A(n) _____ is any characteristic of a substance that allows a substance to undergo a change that results in a new substance.

a. To observe some chemical properties, the original _____ being observed must change into one or more _____ substances. An example is iron's _____ property of rusting, which is only observed when iron turns to rust.

b. A chemical property can also describe how a substance _____ change. An example of this kind of chemical property is that helium does not burn.

2. Physical properties can be _____ without changing the identity of the material being observed. Physical properties include malleability, conductivity, melting point, and color.

B. Chemical and Physical Changes

1. A(n) _____ is the change of one or more substances into other substances.

a. Burning is a(n) _____ change, and cannot be reversed.

b. One type of chemical change takes place when a(n) _____ is decomposed into its elements.

c. A chemical change takes place when two or more _____ join to form a compound.

2. Physical changes do change the _____ of a substance, but not the identity of the substance. Physical changes can almost always be _____.

Chapter **Outline** CONTINUED

3. _____ is a process in which substances mix evenly with one another, and is a physical change that can be reversed.

Lesson 2: Chemical Equations

A. Is matter conserved in chemical reactions?

1. In all _____, the amount of matter is the same before and after the change takes place.

   a. In a chemical reaction, _____ between atoms break and new chemical bonds form, but there are the _____ number and types of atoms before and after a chemical reaction.

   b. The chemist Antoine Lavoisier conducted experiments that supported the _____, which states that the total mass before a chemical reaction is the same as the total mass after the reaction.

B. How do you write a chemical equation?

1. _____ are the starting materials in a chemical reaction.

   a. In chemical equations, the reactants are written on the _____ side of an arrow pointing to the right.

   b. If there are multiple reactants in a reaction, they are written with _____ separating them.

2. _____ are the new substances that are formed during a chemical reaction.

   a. Products in a _____ are separated from each other by plus signs.

   b. The products in a chemical reaction are written on the right side of the _____.

3. Elements contain one type of _____.

Chapter **Outline** CONTINUED

4. A molecule is a(n) _____ particle in which atoms share _____. It can be a compound or an element.

a. If the atoms in a(n) _____ all have the same atomic number, the molecule is a(n) _____.

b. A(n) _____ is a molecule that contains two atoms.

c. Molecules composed of two or more different atoms are _____.

d. A(n) _____ is the smallest whole-number ratio of the elements in an ionic or covalent compound. Two examples of formula units are NaCl and H_2O.

5. A(n) _____ is an efficient way to represent what happens in a chemical reaction.

a. The chemical symbols for the _____ are separated by plus signs and written on the left-hand side of a horizontal arrow pointing to the right.

b. The plus sign in a chemical equation can be read as "_____," while the _____ can be read as "produces."

c. The chemical symbols for the products are separated by plus signs and written on the _____ side of a horizontal arrow pointing right.

d. The chemical equation for the burning of charcoal, which is the reaction of _____ and oxygen to produce carbon dioxide, is written as C + _____ $\rightarrow CO_2$.

C. How do you balance a chemical equation?

1. _____ a chemical equation means writing the equation so that the same _____ of each type of atom exists on both sides of the arrow in the equation.

2. A(n) _____ is the small number written to the right of a chemical symbol that tells how many atoms of an element are contained in one molecule of a substance.

3. _____ are the full-sized numbers written in front of symbols and formulas. A coefficient tells how many atoms, molecules, or formula units take part in a chemical reaction.

4. To balance a chemical equation, choose _____ for each reactant or product so that the same number of atoms is shown on each side of the equation.

Chapter **Outline** CONTINUED

a. You must balance each type of _____ separately, working through them one by one.

b. For the decomposition of _____, the balanced equation is written as

$2H_2O \rightarrow$ _____ + O_2.

D. Equations for Common Chemical Reactions

1. Natural gas is made up mostly of the compound _____, whose chemical formula is CH_4.

a. Methane reacts with _____ in the air to

produce _____ and water. The balanced chemical equation for this

reaction is _____ + $2O_2 \rightarrow$ _____ + $2H_2O$.

b. When a(n) _____ occurs in more than one product or reactant, balance the number of atoms of that element last. For example, in the methane reaction,

you should count the number of _____ atoms last.

2. The balanced equation for the _____ of baking soda with vinegar is $NaHCO_3 + HC_2H_3O_2 \rightarrow CO_2 + H_2O + NaC_2H_3O_2$.

3. The atoms within the _____ of an equation act as one unit. A

subscript or coefficient _____ the number of each type of atom in the parentheses.

Lesson 3: Energy and Chemical Change

A. Energy and Chemical Reactions

1. The rearrangement of _____ involves energy. The

_____ involved in many chemical reactions is heat.

2. Some chemical reactions can produce _____ as light, with almost no

thermal energy (or _____).

a. _____ is a term used for light that is produced at room temperature,

or at a(n) _____ lower than an incandescent bulb needs to produce light.

b. Light sticks and fireflies use _____ that produce cold light.

Chapter **Outline** CONTINUED

3. The _____ states that energy is neither created nor destroyed in chemical reactions.

a. The total amount of _____ before and after a chemical reaction stays the same.

b. Energy changes from one _____ to another during a chemical reaction.

c. Molecules can store energy in chemical _____. In your body, digesting molecules of fat, protein, or carbohydrates transfers energy from _____ in the molecules to your cells.

B. Net Release of Energy

1. A(n) _____ releases energy. The products of an exothermic process have _____ energy stored in their chemical bonds than the reactants.

2. Burning is one example of a(n) _____ process. Products react with each other to produce reactants and heat.

C. Net Absorption of Energy

1. A(n) _____ absorbs energy; the reactants have less energy than the products and are more stable than the products.

2. In an endothermic process, _____ has to be supplied to make the process happen.

3. The decomposition of water is an example of an endothermic reaction. Often, _____ is used to provide the energy needed to decompose water.