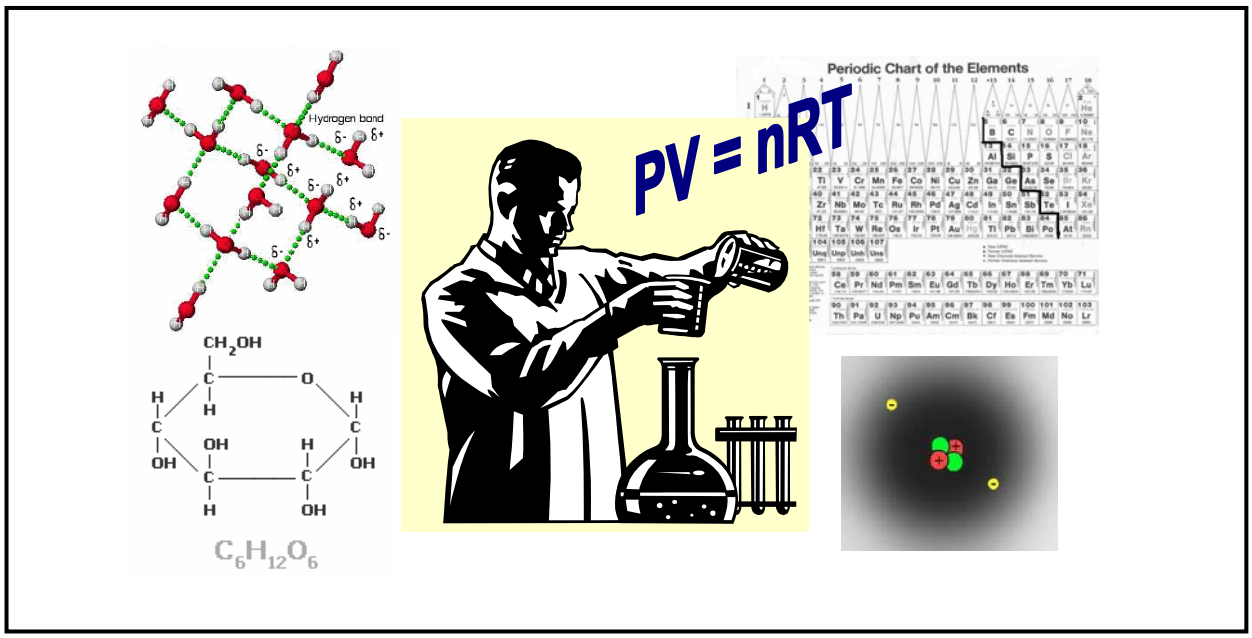
Project EASE

(Effective Alternative Secondary Education)

CHEMISTRY



Changes That Matter Undergoes

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Department of Education
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Changes That Matter Undergoes

What this module is about

The mango turns yellow as it ripens, rust appears on the hinges of the door, and leftover food produces a foul smell. These are just some of the changes we find everyday. As a young curious scientist, you wanted to know why and how these natural events occur. Is it possible for you to control them?

In this module, we will present several phase and chemical changes that occur in our homes, in the environment, outside our homes, and in some industries. We will cover the following lessons:

- **Lesson 1 – Changing Phases**
- **Lesson 2 – When Does A Chemical Change Occur?**
- **Lesson 3 – Types of Chemical Changes**
- **Lesson 4 – Chemical Changes Around Us**

This module is probably the most exciting one that you will read. Ready?

What you are expected to learn

After reading this module, you must be able to accomplish the following:

1. differentiate phase changes from chemical changes;
2. explain how phase changes occur;
3. cite some uses of phase changes;
4. determine the evidences of chemical changes;
5. differentiate the types of chemical changes;
6. describe some changes in the human body;
7. describe some changes in the environment;
8. explain the application of phase changes and chemical changes at home, in the community and in industries; and
9. state how these changes help improve the quality of life.

How to learn from this module

Here are some tips for you to remember to get the most out of this module.

1. Assign a quiet place in the house for your place of study. It should have good reading light and make sure that your learning modules, ball pens, and papers are within easy reach.
2. Assign a daily study time. You probably have a lot of things to do throughout the day, but set aside a fixed study time. For example, you are most mentally alert every afternoon and you choose to start studying the module at 3:00 pm up to 5:00 pm. Do this everyday.
3. Conduct the activities described in each lesson. These activities will help you understand the concepts presented.
4. Ask yourself questions about each topic. You may also write down your questions. Then after reading, check if these questions were answered.
5. Read actively. After reading one or two paragraphs, think of the main idea being presented. Think also of how this idea relate to your environment.
6. Answer the self-tests found at the end of each lesson. They will tell you whether you have learned enough from the lesson or not.
7. Go beyond what is written in this module. Do research.

The tips here are given to improve your concentration and to help you successfully finish this module. You may also have your own ways of improving your reading and comprehension.

What to do before (Pretest)

Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which is a chemical reaction?
   a. melting of ice
   b. frying of egg
   c. boiling of water
   d. drying of clothes

2. Which condition will allow condensation (gas to liquid change)?
   a. high temperature and high pressure
   b. high temperature and low pressure
   c. low temperature and high pressure
   d. low temperature and low pressure

3. The change from solid to gas, which does not pass through the liquid phase, is known as
   a. freezing
   b. melting
   c. sublimation
   d. vaporization

4. Which is an evidence of chemical change?
   a. formation of new shape
   b. drastic change of size
   c. increase of temperature
   d. appearance of new substance

5. What do carbohydrates provide for our body?
   a. oil
   b. water
   c. oxygen
   d. energy

6. In a recipe, which of these words implies a chemical change?
   a. bake
   b. chill
   c. cube
   d. mash

7. Which of these represents a synthesis chemical reaction?
   a. $X + Y \longrightarrow XY$
   b. $XY \longrightarrow X + Y$
   c. $XY + Z \longrightarrow X + ZY$
   d. $XY + ZW \longrightarrow XW + ZY$

8. What type of chemical change is oxidation?
   a. composition
   b. decomposition
   c. single replacement
   d. double displacement

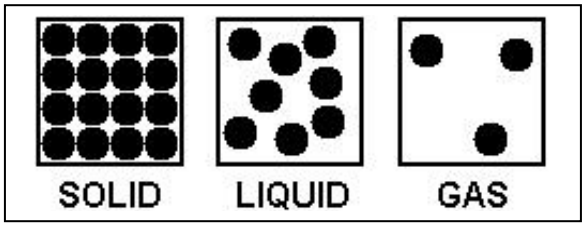
9. What type of chemical change is the extraction of Aluminum metal?
   a. composition
   b. decomposition
   c. single replacement
   d. double displacement

10. Which of these changes is **NOT** considered dangerous?
   a. curing of meat
   b. burning of garbage
   c. blackening of lungs
   d. leaching of fertilizer

Key to answers on page 22.

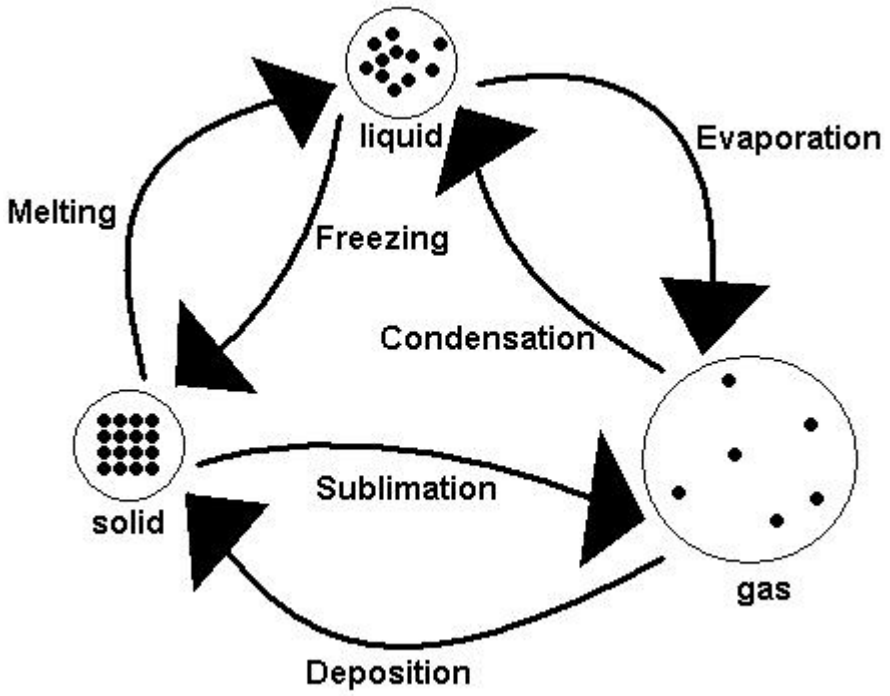
Lesson 1. Changing Phases

There are three phases of matter, namely: **solid**, **liquid**, and **gas**. These three phases of matter can be represented this way:



One phase can change into another phase, that is, solid can become liquid, and liquid can become gas. These changes are called **phase changes**.

Study this diagram:



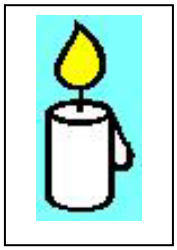
Melting and freezing are reverse processes. Melting is the change of solid to liquid, while freezing is the change of liquid to solid. These changes are influenced by temperature and pressure conditions.

Process	Temperature	Pressure
Melting	Needs higher temperatures	Needs lower pressure
Freezing	Needs lower temperatures	Needs higher pressure

This table shows that in order to melt a solid, the temperature must go higher or the pressure must go lower. To see how this occurs, do this activity:

What you will do

Activity 1.1 The Candle Wax



1. Light a candle and closely observe what happens to the candle wax.
2. Answer these questions:
   a. Why did the wax melt?
   b. When did the melted wax turn solid again?

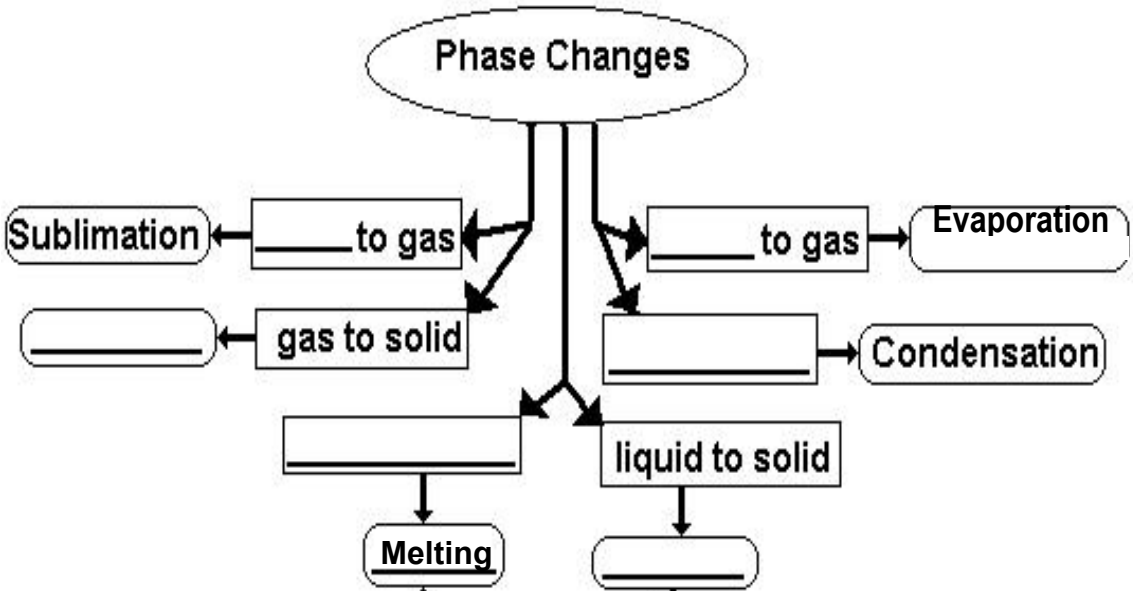
Evaporation is the change from the liquid phase to the gas phase. This can be done if the temperature is increased or the pressure is lowered. Condensation is the opposite process of evaporation. It is the change from gas to liquid phase. The opposite conditions are also needed. That is, the temperature must be lowered or the pressure must be increased.

Sublimation is the direct phase change from solid to gas, without passing through the liquid phase. This happens to substances like mothballs. Deposition is the opposite process of sublimation. This is the direct change from gas to the solid phase, without undergoing condensation or freezing.

What you will do

Self-Test 1.1

Directions: Fill in the blanks of this concept map.



Key to answers on page 22.

Lesson 2. When Does A Chemical Change Occur?

Aside from phase changes, another group of changes is happening around us. These changes are called **chemical changes**.

What you will do

Activity 2.1 Identifying Changes

Do the following steps:

Step 1: Cut a piece of paper into smaller pieces
Step 2: Light a match
Step 3: Mix vinegar and baking powder
Step 4: Boil water
Step 5: Boil water with egg white

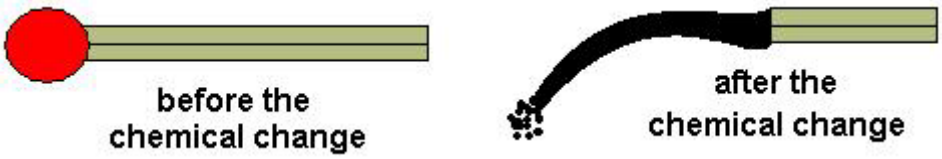
Each step shows a ***change***. But which of them could be classified as a **chemical change**?

A chemical change always results to the **formation of a new substance**. The surest way to know if a chemical change has occurred is to check if you observed one or more of these ***indicators of chemical change***.

1. Change of color
2. Evolution of gas
3. Formation of precipitate

Change of color. A change in color means that a new substance was formed after the chemical change. This new substance has different properties, including its color, from the original materials.

The burning of the lighted match results in the change of color of the match. Before lighting the match, the body is made of a pale colored wood and a red or black tip. After burning, the tip becomes black and charred. The pale color of the wood also becomes black. It is no longer the original wood.



Evolution of gas. Sometimes, you don't see a color change after a chemical change. But you will find that gas is produced. This gas is the new substance. When you mix vinegar and baking powder, you will hear a fizzing sound and see gases bubble up. This gas is carbon dioxide. It is produced when the acetic acid of vinegar reacted with the sodium bicarbonate of the baking powder.

Acetic acid + Sodium bicarbonate $\longrightarrow$ carbon dioxide + other new substances

Formation of precipitate. The precipitate is the solid material that appears in a solution, and this solid sinks or precipitates to the bottom of the container. This precipitate is the new substance formed from the chemical change. Which of the steps in the activity resulted in the formation of a precipitate?

The role of temperature change. In the previous lesson, we learned that changing the temperature would result to a phase change. This is what happened in step 4 of the activity. But sometimes, changing the temperature results to a chemical change. This is shown in step 5.

When none of these indicators can be observed, only a ***physical change*** has occurred. Phase changes are physical changes. Physical changes may show a change in shape, size, or volume.

What you will do

Self-Test 2.1

Directions: Study each picture closely. Identify the chemical changes that you find.

Picture 1

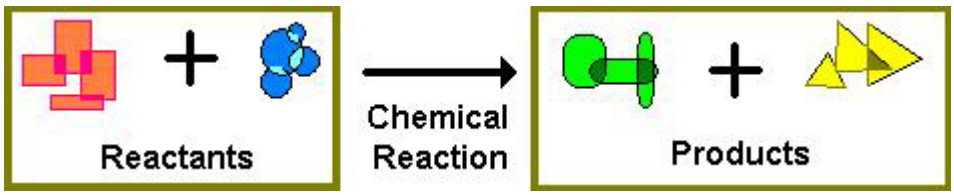
Picture 3

Picture 2

Key to answers on page 22.

Lesson 3. Types of Chemical Changes

In a chemical change or chemical reaction, the materials that are present before the reaction takes place are called the **reactants**. The materials that appear after the reaction takes place are called the **products**. This means that a chemical change or chemical reaction can be represented like this:

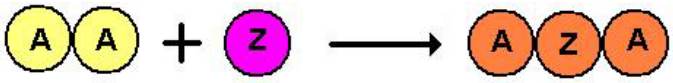


There are four types of chemical reactions. These are:

1. Combination Reaction
2. Decomposition Reaction
3. Single Replacement
4. Double Displacement

Combination Reaction. A combination reaction happens when two or more reactants form only one product. This is also known as the ***composition reaction*** or the ***synthesis reaction***. We can represent a combination reaction this way:

$$A + Z \longrightarrow AZ$$

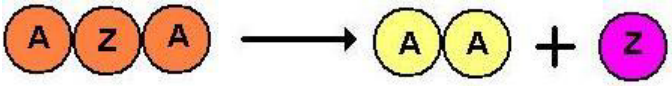


For example, ethylene glycol is a substance used in making polyester fiber. Producing ethylene glycol is a combination reaction.

$$\text{Ethylene oxide} + \text{Water} \longrightarrow \text{Ethylene glycol}$$

Decomposition Reaction. A decomposition reaction happens when one reactant forms two or more products. This is also called a ***decay reaction***. We can represent a decomposition reaction this way:

$$AZ \longrightarrow A + Z$$



For example, the anesthetic used by dentists is dinitrogen oxide. This is also called *laughing gas*. It is produced by the decomposition of ammonium nitrate.

Ammonium nitrate $\longrightarrow$ dinitrogen oxide + water

Single Replacement Reaction. A single replacement reaction happens when a reactant made of one element reacts with a compound, and replacing one of the elements of the compound. We can represent a single replacement reaction this way:

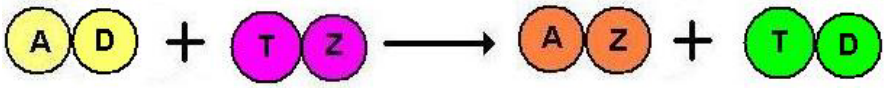
$$A + TZ \longrightarrow AZ + T$$

For example, one side of a circuit board is made of copper. An electronics engineer would like to remove some of the copper by submerging the circuit board in ferric chloride. What happens next is a single displacement reaction. The copper (Cu) atoms displaced the iron (Fe) atoms.

3 Cu	+	2 $FeCl_3$	$\longrightarrow$	3 $CuCl_2$	+	2 Fe
copper		ferric chloride		copper chloride		iron

Double Displacement Reaction. A double displacement reaction happens when the elements in one of the reactants "exchange partners" with the other reactant. We can represent a double displacement reaction this way:

$$AD + TZ \longrightarrow AZ + TD$$



A special type of double displacement reaction is called ***neutralization***. In neutralization, an ***acid*** and a ***base*** react with and neutralize each other. The product is a ***salt*** and water. For example, hydrochloric acid reacts with sodium hydroxide to form sodium chloride (salt) and water.

HCl	+	NaOH	$\longrightarrow$	NaCl	+	H_2O
Acid		Base		Salt		Water
Hydrochloric acid		Sodium hydroxide		Sodium chloride		

What you will do

Self-Test 3.1

Direction: Identify the type of reaction.

_____ 1. The match head is made of tetraphosphorus trisulfide. Heating phosphorus and sulfur above 100^{O}C makes this compound:
$P_4 + 3S \rightarrow P_4S_3$

_____ 2. The components of water can be separated using electricity.
$2H_2O \rightarrow 2H_2 + O_2$

_____ 3. Carbon tetrachloride (CCl_4), a compound used as a dry cleaning agent and a component in fire extinguishers, is made by this reaction: $2\,S_2Cl_2 + C \rightarrow CCl_4 + 4S$

_____ 4. Freon-12, CCl_2F_2, a substance used as refrigerant, is made by this reaction: $CCl_4 + 2HF \rightarrow CCl_2F_2 + 2HCl$

_____ 5. Ammonia, NH_3, which is used in fertilizers, is formed by this reaction: $N_2 + 3H_2 \rightarrow 2NH_3$

_____ 6. $Mn_4Ga_2S_6 \rightarrow 3MnS + Ga_2S + S_2$

_____ 7. $Al_4C_3 + 12H_2O \rightarrow 4Al(OH)_3 + 3CH_4$

_____ 8. $3\,Zn + 2H_3PO_4 \rightarrow Zn_3(PO_4)_2 + 3\,H_2$

_____ 9. $Al_2(SO_4)_3 + 3Ca(NO_3)_2 \rightarrow 3CaSO_4 + 2Al(NO_3)_3$

_____ 10. $2KClO_3 \rightarrow 2KCl + 3O_2$

Key to answers on page 23.

Lesson 4. Chemical Changes Around Us

Are you aware of the chemical changes that are happening around us? Let us study some of them by reading the following:

Chemical Changes in Our Body

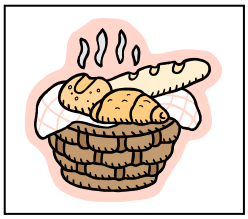
Chemical changes in our body are important. These changes keep us alive. Here are some chemical changes in our body.

Digestion

We eat everyday, but what happens to the food that we eat? The carbohydrates, like sugars and starches, are broken down into ***blood sugar***, called **glucose**, and this provides energy for our body.

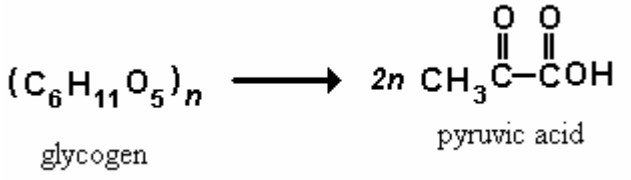
$$\underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{oxygen}}{O_2} \longrightarrow \underset{\text{Carbon dioxide}}{6CO_2} + \underset{\text{water}}{6H_2O} + \textbf{Energy}$$

If we eat too much carbohydrate some of the extra carbohydrates are stored in the liver as **glycogen** (animal starch) and the rest are converted to **fat**. Too much fat can't be safe. Do you watch the amount of carbohydrates you eat everyday?

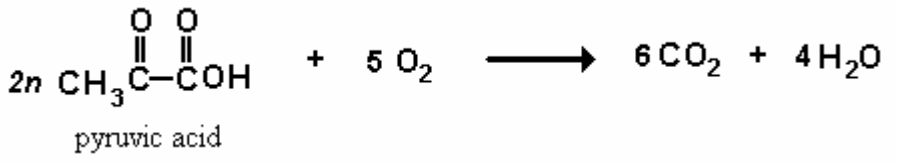


Exercise

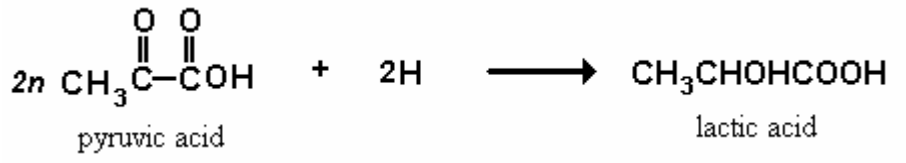
During exercise or any body activity, we contract our muscles. As this happens, the glycogen in our body is changed into ***pyruvic acid***.



If there is enough oxygen, this substance is changed into carbon dioxide and water.



But if there is a lack of oxygen (maybe you did not breathe deeply?), the pyruvic acid changes into ***lactic acid***.



When lactic acid builds up in your muscles, you will feel tired and weak. Some people also feel pain in their muscles.

What you will do

Activity 4.1 Which needs more oxygen?

You will perform two activities to determine which of them require more oxygen in your body. You will need a timer or a watch.

Activity 1: Jog in place. Have a lively music in the background and keep pace with the rhythm of this music. How long can you jog before you feel that you're already out of breath?

Take at least 30 minutes rest before doing activity 2.

Activity 2: Do jumping jacks. How long can you do this exercise before you feel out of breath?

Which activity needs more oxygen?

Chemical Changes At Home

Chemical changes happen in our homes everyday because of the various activities that we do at home. Let us identify some of them.

Cleaning

We must always clean our house or else it will look like a haven for pirates. And we use different chemicals to clean the house. Before knowing more about these chemicals, let's do this simple activity.

What you will do

Activity 4.2 Effect of Soap

You may have done this everyday, but let's take a much closer look at how soap works. In a dirty plate, add a little water. And then pour two drops of dishwashing liquid or soap into it. Write your observations here:

_____

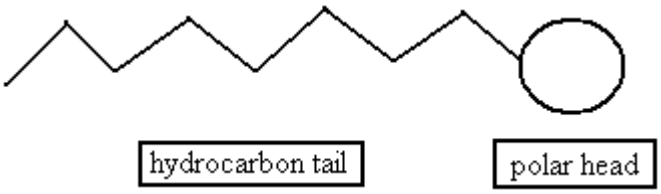
_____

_____

Basic **soap** is made of fat and lye. It is produced from the reaction of animal fat or vegetable oil with sodium hydroxide.

Animal fat or Vegetable oil + NaOH ⟶ Soap

Soap is a complex substance that has two main parts: the "polar head" and the "hydrocarbon tail"



These two parts give soap the ability to clean. The hydrocarbon tail sticks into the oily stain or grease while the polar head dissolves in water. The oily stain is broken down and becomes easier to remove from your cloth, plate, or body.

Can you think of another way of cleaning these dishes?

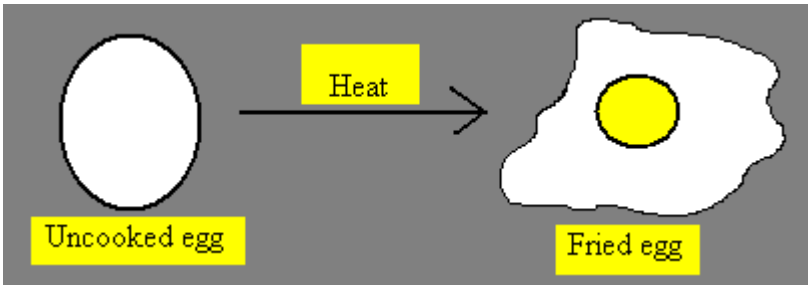
Dishwashing detergents like soap have the same parts, too. But these have other ingredients such as perfumes, color, and ***surfactants***. Surfactants like LAS (linear alkylsulfonates) simply loosen food residue so that you can easily remove them.

Cooking

Cooking is also an activity that we do everyday. The chemical change that usually happens is this:

Uncooked food ⟶ Cooked food

The change usually involves heat. Study this diagram:



An egg undergoes a chemical change when cooked. The liquid egg ***coagulates*** or solidifies when heat is applied.

The meat of pork, chicken, and fish, also undergo chemical changes when heat is applied. Vegetables also change when heat is applied.

Sometimes, food undergoes a chemical change even if no heat is applied. This happens when food is being preserved. For example, salting raw fish makes ***bagoong***.

Meat is ***cured*** or preserved by adding ***salitre*** or sodium nitrite. Tocino, chorizo, and hotdogs are preserved this way.

What you will do

Self-Test 4.1

Directions: Identify whether the following is a physical or chemical change.

_____ 1. Scrubbing the floor
_____ 2. Sweeping the backyard
_____ 3. Wiping the table
_____ 4. Making salad
_____ 5. Frying dried fish
_____ 6. Baking a cake
_____ 7. Bleaching cloth
_____ 8. Making syrup
_____ 9. Scraping food from the pan
_____ 10. Removing cobwebs

Key to answers on page 23.

Chemical Changes in the Environment

The environment is one big chemical system where many complex and vital chemical reactions happen. Here are some of them.

Changes in Plants

Plants undergo complex chemical changes. The stem grows higher, the roots go deeper, the flowers bloom, and the fruits ripen. The most studied change in plants is the process of photosynthesis. Plants make their own food by photosynthesis.


Complex changes happen in plants

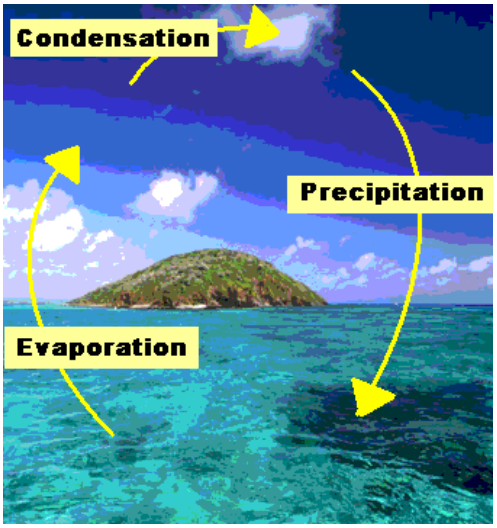
The general chemical reaction for photosynthesis is:

$$CO_2 + H_2O \longrightarrow C_6H_{12}O_6$$

The carbon dioxide comes into the plant through the leaves and the roots absorb water. With the presence of sunlight, these materials are changed into sugar.

The Water Cycle

The processes in water cycle are physical changes. **Evaporation** is a phase change in which liquid water from lakes, rivers, and oceans is changed into water vapor. **Condensation** of water vapor results in the formation of clouds. And **precipitation** happens when the clouds released water into the ground as rain. In other countries, precipitation can be in the form of snow.



Changes in the Soil

The Philippines is an agricultural country. This means that many people depend on the soil for food and livelihood. Many people are farmers. But as we cultivate the land, changes happen to the soil.

The plants absorb minerals from the soil. As time goes by, less and less minerals are left in the soil. To solve this problem, we use fertilizers. Fertilizers contain the three **primary plant nutrients**. These are **nitrogen**, **phosphate**, and **potassium**.

Nitrogen can be added to the soil as ammonia. Ammonia can be produced using the Haber process.

$$3H_2 + N_2 \longrightarrow 2NH_3$$

Phosphate fertilizers are produced by making a phosphate rock react with phosphoric acid. The product (calcium dihydrogen phosphate) is soluble in water and can be readily absorbed by plants.

$$Ca_3(PO_4)_2 + 4H_3PO_4 \longrightarrow 3Ca(H_2PO_4)_2$$

Potassium in fertilizers is in a compound called potassium chloride, KCl. This compound is mined. Most soils have potassium. Unfortunately, when plants take in potassium, they leave the soil acidic.

Corrosion

Corrosion is another chemical change that happens all around us. One of the most common forms of corrosion is the rusting of iron metals when it is exposed to air and moisture.

$$4Fe + 3O_2 + \longrightarrow 2Fe_2O_3$$

This final product is called iron (III) oxide or **rust**. To actually see how this happens, let's do this activity.

What you will do

Activity 4.3 Rusting of Iron Nail

You will need two tin covers of bottles and two nails. The nails should have no rust and must look exactly the same with each other. In one tin cover, place one nail. This is our set-up A. In another tin cover, place the other nail. But this time submerge half of the nail's body in water. This is set-up B. Write your observations here.

Day	Set-up A	Set-up B
1		
2		
3		
4		
5		

What you will do

Self-Test 4.2

Direction: Read each change and write the possible results or products

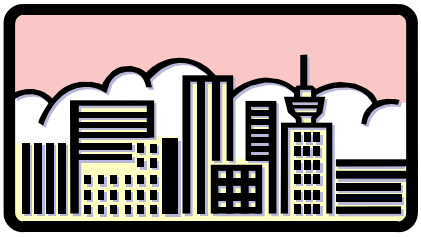
1. Water vapor encounters cold temperatures in the air: _____
2. Potassium is taken in by the roots of plants: _____
3. Plants perform photosynthesis: _____
4. Iron metal is exposed to air and water: _____
5. Phosphate rock is treated with phosphoric acid: _____

Key to answers on page 23.

Chemical Reactions Used In Industries

Many chemical changes have technological applications. These applications improve our quality of life. At the same time, these chemical reactions are used profitably in several industries. We will present some of them here.

Metal Industries



Many things around us are made of metals, such as buildings, bridges, houses, airplanes, ships, cars, and jeeps. Where did all these metals come from? Most metals are mined. But they are not mined in pure form. For example, copper can be taken from the copper sulfide (Cu_2S) ore. And then this reaction is done:

$$Cu_2S + O_2 \longrightarrow 2Cu + SO_2$$

This is a reaction with oxygen (O_2). A chemical reaction with oxygen is called **oxidation**. The production of copper metal from its ore is an oxidation process.

Iron is produced from its ore by using carbon monoxide in this chemical reaction:

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

This reaction is done in a blast furnace. The temperatures are very high and the iron produced is called ***pig iron***. Pig iron is also known as cast iron because it can be cast into molds. But cast iron is brittle. To make it more useful, it is oxidized to produce **steel**.

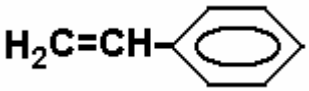
Aluminum is another important metal. The ore of aluminum is called bauxite, or aluminum oxide. Pure aluminum metal is extracted from this ore by passing electricity through it.

$$2Al_2O_3 \xrightarrow{\text{electricity}} 4Al + 3O_2$$

Plastics

Plastics are also almost everywhere on our planet. They are used in innumerable ways. Plastics are created through the process called **polymerization**. It is basically a combination reaction. For example, putting together many molecules of ethylene makes the plastic polyethylene. Ethylene is a gas while polyethylene is a solid which is used in plastic bags, bottles, toys, and electrical insulations

Here are the other plastics, their monomers, and their uses.

Polymer	Monomer	Some Uses
Polyvinyl chloride (PVC)	$H_2C=CCl$	Plastic wrap, simulated leather, plumbing, garden hoses, floor tile
Polypropylene (PP)	$H_2C=CH-CH_3$	Indoor-outdoor carpeting, bottles, luggage
Polystyrene (PS)		Simulated wood furniture, cups, toys, styrofoam insulation, packing materials

Aside from plastics, there are also other products made by the process of polymerization. Some of these products are:

1. Teflon – the nonstick coating of cooking pans
2. Nylon – used in carpeting
3. Polyvinyl acetate – used in adhesives and paints
4. Plexiglass or Polymethyl methacrylate – used as glass substitute
5. Synthetic rubber – used in tires
6. Polyurethane – used in cushions, mattresses, and padded furniture
7. Silicones – used to treat umbrellas and raincoats to make them waterproof

Plastics are recycled so that there will be less environmental pollution. To know which plastic to recycle, an object made of plastic, like a cup, has a corresponding number.

What you will do

Activity 4.4 Plastic Code Numbers

You will collect samples of plastics with these code numbers. Then write down the characteristics that make them unique from each other.

Plastic	Abbreviation	Code Number
Polyethylene terephthalate	PET	1
High density polyethylene	HDPE	2
Polyvinyl chloride	PVC	3
Low-density polyethylene	LDPE	4
Polypropylene	PP	5
Polystyrene	PS	6
All others		7

What you will do

Self-Test 4.3

Direction: Identify the substance described in each number.

_____ 1. The ore of aluminum
_____ 2. The ore of copper
_____ 3. A chemical reaction with oxygen
_____ 4. The process of making plastics
_____ 5. The process of making steel
_____ 6. It is also known as cast iron
_____ 7. The non-stick coating of cooking pans
_____ 8. This material makes umbrellas waterproof
_____ 9. A plastic used for indoor and outdoor carpeting
_____ 10. It is needed to decompose bauxite and produce aluminum
_____ 11. It is used for plumbing and floor tiles
_____ 12. Used as substitute for glass
_____ 13. The monomer of polystyrene
_____ 14. The monomer of PVC
_____ 15. The monomer of polyurethane

Key to answers on page 23.

Let's Summarize

1. One phase can change into another phase, that is, solid can become liquid, and liquid can become gas. These changes are called **phase changes**.

2. A chemical change always results to the **formation of a new substance**. The surest way to know if a chemical change has occurred is to check if you observed one or more of the following ***indicators of chemical change***: change of color, evolution of gas and formation of precipitate.

3. In a chemical change or chemical reaction, the materials that are present before the reaction takes place are called the **reactants**. The materials that appear after the reaction takes place are called the **products**.

4. There are four types of chemical reactions namely: (1) Combination Reaction, (b) Decomposition Reaction, (c) Single Replacement and (d) Double Displacement.

5. A combination reaction happens when two or more reactants form only one product. This is also known as the ***composition reaction*** or the ***synthesis reaction***.

$$A + Z \longrightarrow AZ$$

6. A decomposition reaction happens when one reactant forms two or more products. This is also called a ***decay reaction***. The decomposition reaction can be presented this way:

$$AZ \longrightarrow A + Z$$

7. A single replacement reaction happens when an element reacts with a compound, and replacing one of the elements of the compound. We can represent a single replacement reaction this way:

$$A + TZ \longrightarrow AZ + T$$

8. A double displacement reaction happens when the elements in one of the reactants "exchange partners" with the other reactant. We can represent a double displacement reaction this way:

$$AD + TZ \longrightarrow AZ + TD$$

9. A special type of double displacement reaction is called ***neutralization***. In neutralization, an ***acid*** and a ***base*** react with and neutralize each other. The product is a salt and water.

10. The environment is one big chemical system where many complex and vital chemical reactions happen

11. Many chemical changes have technological applications. These applications improve our quality of life. At the same time, these chemical reactions are used profitably in several industries.

Posttest

Multiple Choice. Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which event does **NOT** show a chemical reaction?
   a. Electroplating
   b. Food spoilage
   c. Rusting of iron
   d. Formation of clouds

2. Which of these conditions favors a change from liquid to gas?
   a. High temperature and high pressure
   b. High temperature and low pressure
   c. Low temperature and high pressure
   d. Low temperature and low pressure

3. The change from gas to solid, without passing the liquid phase, is known as
   a. Deposition
   b. Evaporation
   c. Fusion
   d. Sublimation

4. Which is **NOT** necessarily an evidence of chemical change?
   a. Formation of precipitate
   b. Change in temperature
   c. Evolution of gas
   d. Change in color

5. What happens to the extra carbohydrates that we take in our body?
   a. Stored as fat
   b. Released as energy
   c. Removed as human waste
   d. Converted into vitamins and minerals

6. Which activity will result in a chemical change?
   a. Broiling
   b. Whipping
   c. Sun drying
   d. Brine making

7. Which of these represents a single replacement chemical reaction?
   a. $X + Y \longrightarrow XY$
   b. $XY \longrightarrow X + Y$
   c. $XY + Z \longrightarrow X + ZY$
   d. $XY + ZW \longrightarrow XW + ZY$

8. What type of chemical change is combustion?
   a. Composition
   b. Decomposition
   c. Single replacement
   d. Double displacement

9. What type of chemical change is the making of plastics?
   a. Composition
   b. Decomposition
   c. Single replacement
   d. Double displacement

10. Which of these changes is **NOT** considered dangerous?
    a. Spoilage of food
    b. Corrosion of metal
    c. Explosion of a bomb
    d. Neutralization of acid

Key to answers on page 23.

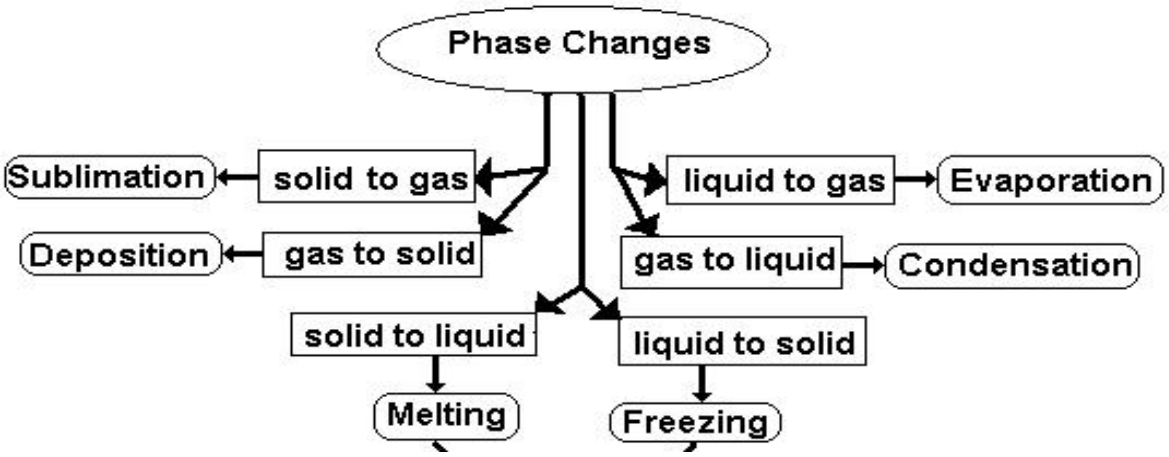
Key to Answers

Pretest

1. b
2. c
3. c
4. d
5. d
6. a
7. a
8. c
9. b
10. a

Lesson 1

Self-Test 1.1



Lesson 2

Self-Test 2.1

Picture	Chemical Changes
Picture 1: A lighthouse near a beach	1. Erosion of rocks by the waves 2. Rusting of some parts of the lighthouse because of water
Picture 2: Fireworks	1. Explosion and/or burning of some chemicals 2. Formation of gases after the explosion
Picture 3: Trees along a road	1. Decay of leaves on the road 2. Changing of the color of leaves 3. Growth of trees and other plants

Lesson 3

Self-Test 3.1

1. Combination
2. Decomposition
3. Single replacement
4. Double displacement
5. Combination
6. Decomposition
7. Double displacement
8. Single replacement
9. Double displacement
10. Decomposition

Lesson 4

Self-Test 4.1

1. physical change
2. physical change
3. physical change
4. physical change
5. chemical change
6. chemical change
7. chemical change
8. physical change
9. physical change
10. physical change

Self-Test 4.2

1. Clouds
2. Acidic soil
3. Sugar/Starch or plant food
4. Rust
5. Calcium dihydrogen phosphate

Self-Test 4.3

1. Bauxite or aluminum oxide
2. Copper sulfide
3. Oxidation
4. Polymerization
5. Oxidation
6. Pig iron
7. Teflon
8. Silicones
9. Polypropylene
10. Electricity
11. Polyvinyl chloride
12. Plexiglass or Polymethyl methacrylate
13. Styrene
14. Vinyl chloride
15. Urethane

Posttest

1. d
2. b
3. a
4. b
5. a
6. a
7. c
8. c
9. a
10. d

Reference

Hill, J. & Kolb D. (1995). *Chemistry for changing times*. (7th ed.) NJ: Simon & Schuster (Asia) Pte.Ltd.