



# 7 SCIENCE

## Quarter 1



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# Science

## Grade 7

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**SCIENCE Grade 7**  
**PIVOT IV-A Learner's Material**  
**Quarter 1**  
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*PIVOT 4A CALABARZON*

# Guide in Using PIVOT Learner's Material

## For the Parents/Guardian

This module aims to assist you, dear parents, guardians, or siblings of the learners, to understand how materials and activities are used in the new normal. It is designed to provide the information, activities, and new learning that learners need to work on.

Activities presented in this module are based on the Most Essential Learning Competencies (MELCs) in Science as prescribed by the Department of Education.

You are expected to assist the child in the tasks and ensure the learner's mastery of the subject matter. Be reminded that **learners have to answer all the activities in their own notebook**

## For the Learners

The module is designed to suit your needs and interests using the IDEA instructional process. This will help you attain the prescribed grade-level knowledge, skills, attitude, and values at your own pace outside the normal classroom setting.

The module is composed of different types of activities that are arranged according to graduated levels of difficulty—from simple to complex. You are expected to **answer all activities on separate sheets of paper** and submit the outputs to your respective teachers on the time and date agreed upon.

## PARTS OF PIVOT LEARNER'S MATERIAL

	Parts of the LM	Description
Introduction	What I need to know	The teacher utilizes appropriate strategies in presenting the MELC and desired learning outcomes for the day or week, purpose of the lesson, core content and relevant samples. This allows teachers to maximize learners awareness of their own knowledge as regards content and skills required for the lesson.
	What is new	
Development	What I know	The teacher presents activities, tasks , contents of value and interest to the learners. This shall expose the learners on what he/she knew, what he /she does not know and what she/he wanted to know and learn. Most of the activities and tasks must simply and directly revolved around the concepts to develop and master the skills or the MELC.
	What is in	
	What is it	
Engagement	What is more	The teacher allows the learners to be engaged in various tasks and opportunities in building their KSA's to meaningfully connect their learnings after doing the tasks in the D. This part exposes the learner to real life situations /tasks that shall ignite his/ her interests to meet the expectation, make their performance satisfactory or produce a product or performance which lead him/ her to understand fully the skills and concepts .
	What I can do	
	What else I can do	
Assimilation	What I have learned	The teacher brings the learners to a process where they shall demonstrate ideas, interpretation, mindset or values and create pieces of information that will form part of their knowledge in reflecting, relating or using it effectively in any situation or context. This part encourages learners in creating conceptual structures giving them the avenue to integrate new and old learnings.
	What I can achieve	

**Components of Scientific Investigation****I****Lesson**

Welcome Scientist! Yes, you will be a Scientist again as you will journey in understanding the concepts in conducting scientific investigation. But first you have to determine the different components that you will be using in conducting scientific investigations. At the end of this lesson, you will be able to describe the components of a scientific investigation.

This time that you are staying at home, you are probably aware that pandemic caused by unseen Corona virus causing Covid-19 has devastated economic stability and changed the normal life into new normal system.

Examine the picture shown below. Are you familiar with this?



Fig. 1. Bayanihan

What do you observe in the picture? Can you tell that there is a problem in the above situation? If you say yes, you are absolutely correct! It means that you are truly aware of what is happening now in the world, particularly in our country. Natural disasters and pandemic are experienced by most of the people. Now, what do you think are the solutions to this problem?

This pandemic has brought many cases of deaths, loss of jobs, shut down of business and a lot more. But basically as of today, you will experience its effect because under this state of calamity in our country, you are staying at home while learning. Isn't it hard? Or you already appreciate staying with your family while you are studying? Whatever you are feeling right now, that's okay. You will now be analyzing the situation by determining the components of scientific investigation. A systematic method of solving problems around us.

What do you think are the possible researchable problems in the given illustrations?



**Learning Task No. 1:** Refer to the given data inside column A. Write possible problems based on the given data. Choose the at least 3 available data that will support your answer from the choices in column B. Write your answer in a separate sheet of paper.

#### **Available Data**

- 1: There are 200 families that evacuated in the area.
- 2: There are ten children being assisted by medical experts.
- 3: There are 500 boxes of relief goods donated in a barangay.
- 4: Children below 21 years old and senior citizens are not allowed to go out.
- 5: Malls and other businesses are limited in their business operations.
- 6: Schools are closed and studying is done at home.
- 7: Everybody is advised to wear face mask, personal protective equipment, practice social distancing, wash hands, sanitize using alcohol and bring quarantine pass when going out, if necessary.
- 8: The roads are blocked by floods and some fallen trees such that transportation of goods are limited.
- 9: A pandemic was declared by the World Health Organization due to Covid 19.
- 10: The government gave donations and funds to deserving families.

#### **Possible Problems**

- (1) Positive Cases for Covid-19 Infection Increases
- (2) There are no donations or relief goods received by two families in one of the isolated barangays in CALABARZON
- (3) People are arrested by policemen and authorities

I think that the possible problem is:

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I identified the said problem based on the following data :

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There are six components that you need to understand in scientific investigation. The 6 Steps are easy to remember with acronym of PDHECA.

1. **P** for Problem – stating a problem/ identifying a problem. A problem can be identified after a thorough observation or relying on existing data . In observing we have to use our 5 senses to gain information. After observation comes a question, which is now your statement of the problem. A good scientist will ask lots of questions.
2. **D** for Data – gathering of data in a form of research, interview or existing data.
3. **H** for Hypothesis – formulating hypothesis (scientific guess/ educated guess)
4. **E** for Experiment –testing the hypothesis

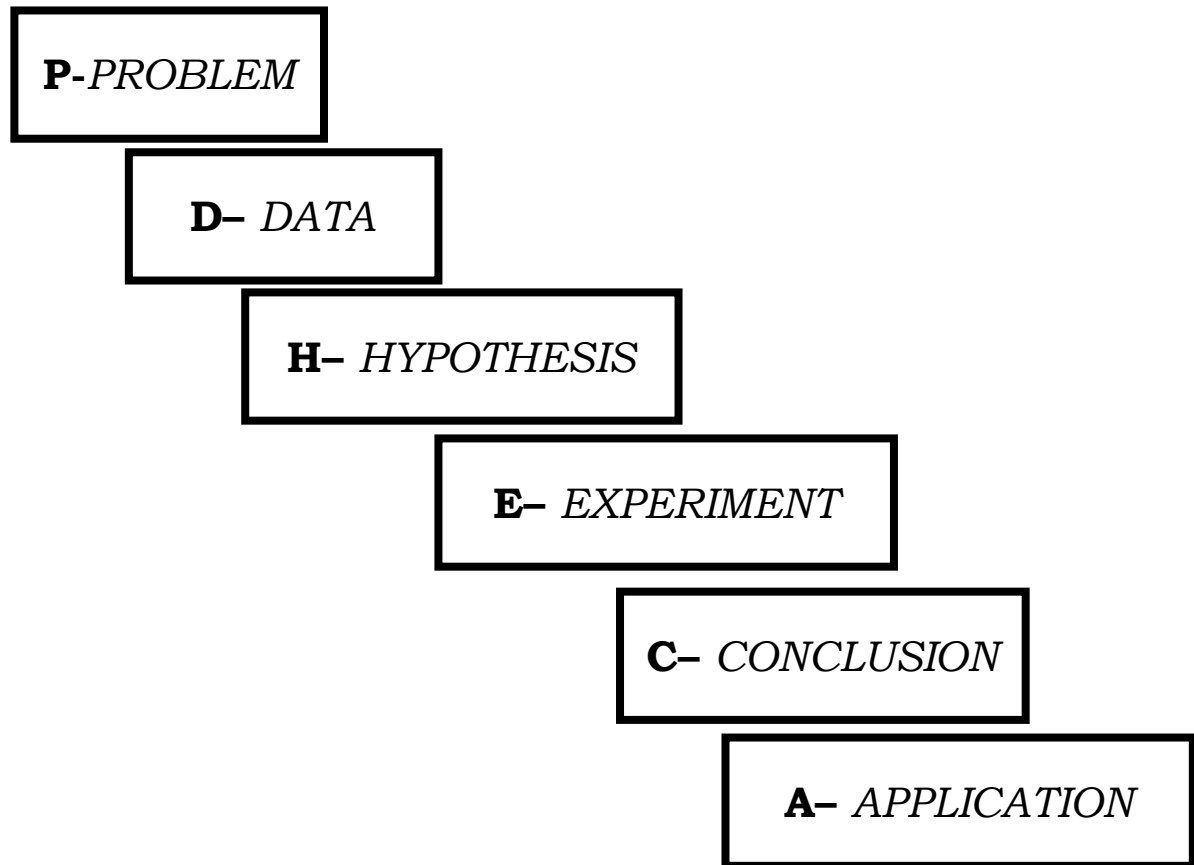
An experiment is a test that will prove or disprove the hypothesis. A good scientist will conduct an experiment more than once to double-check their work.

In testing, variables are of great importance. A **variable** is any item, factor, or condition that can be controlled or changed.

5. **C** for Conclusion – Make a statement that accept or reject the hypothesis. The scientist will report his or her findings so that others may know what they find out.
6. **A** for application – Putting something into use/operation based from the outcome of the experiment.



In understanding the different components , you can develop as many words as you can which are related with the components of scientific investigation using the acronym PDHECA to remember each step .



In solving a problem based on the given data or context of the situation, there are factors that should be considered. These factors are called variables. Variable are any factor or things, condition or trait that are changing in an experiment.

**In** a scientific experiment there are **three kinds of variables**:

1. **Manipulated variables or** independent variable is a factor or condition that is intentionally changed by an investigator in an experiment.

An **independent variable** is the cause. Its value is independent of other variables in your study.

2. **A responding or dependent variable** is a factor or condition that might be affected as a result of that change.

A **dependent variable** is the effect. Its value depends on changes in the independent variable.

3. A variable that is not changed is called a **controlled variable**. These factors are kept constant to determine any changes in the results (dependent variable) is caused by the manipulated variable.

Scientists study the world by asking questions about it and seeking science-based answers. This method is common to other sciences as well and is often referred to as the scientific method. The scientific method was used in ancient times, but it was first documented by Sir Francis Bacon (1561–1626) of England, who set up inductive methods for scientific investigation. The scientific method can be applied to all fields of study as a reasonable, rational, problem-solving technique. The scientific procedure typically starts with an observation that leads to an inquiry. An example of how these components are used is given in the chart below.



Researchable Problems	Independent Variable	Dependent Variable
Are more people infected with Covid-19 under General Community Quarantine (GCQ) or Modified Enhanced Community Quarantine (MECQ)?	The type of quarantine measures issued by the government in a specific area (GCQ, MECQ)	The number of cases of people that are infected by Covid-19? (more or less number of cases)
Do children and senior citizens in a city live more and weigh less than similar individuals in a rural?	The place where children and senior citizen live (city or in rural areas )	The age profile/ life span of children an/or senior citizen The weight (less or more)

## D

**Learning Task No. 2:** Based on your identified problem in Learning Task No. 1, determine the dependent, independent and controlled variable in your proposed testable or researchable problem

Researchable Problem: \_\_\_\_\_

Dependent Variable( s): \_\_\_\_\_

Independent Variable (s): \_\_\_\_\_

Controlled Variable (s): \_\_\_\_\_

**Learning Task No. 3:** Based on your identified variables in Learning Task #1, formulate your hypothesis. Identify the variables and data gathered based in Learning Task #2. Copy the chart below.

Researchable Problem	Hypothesis	Variables	Data gathered
<b>Sample Problem:</b> Are more people infected with Covid 19 under General Community Quarantine (GCQ) or Modified Enhanced Community Quarantine (MECQ)?	Hypothesis No.1. More people are infected with Covid 19 under GCQ than MECQ?  Hypothesis No.2. Less people are infected with Covid 19 under GCQ than MECQ?	Dependent Variable: More or less people are infected  Independent Variable: GCQ and MECQ  Controlled Variable: Specific area under MECQ and GCQ under study.	200 cases of infected people are under GCQ in Area A.  150 cases of infected people are under MECQ in Area A.  No reported cases for three days under GCQ but with several cases under MECQ.
<b>My answer:</b> Identified Problem in LT No. 1.	(based on the available data)	(based on identified problem)	(based on available data)

**Learning Task No. 4:** Based on your gathered data in LT #3, analyze your results. Write a paragraph to show the results of your simple investigative study.

Researchable Problem	Hypothesis	Variables	Data gathered	Results and Discussion	Conclusion
<p>Sample:</p> <p>Are more people infected with Covid 19 under General Community Quarantine (GCQ) or Modified Enhanced Community Quarantine (MECQ)?</p>	<p>Hypothesis No.1.</p> <p>More people are infected with Covid 19 under GCQ than MECQ?</p> <p>Hypothesis No.2.</p> <p>Less people are infected with Covid 19 under GCQ than MECQ?</p>	<p>Dependent Variable:</p> <p>More or less people are infected</p> <p>Independent Variable:</p> <p>GCQ and MECQ</p> <p>Constant Variable:</p> <p>Specific area under MECQ and GCQ under study.</p>	<p>200 cases of infected people are under GCQ in Area A.</p> <p>150 cases of infected people are under MECQ in Area A.</p> <p>No reported cases for three days under GCQ but with several cases under MECQ.</p>	<p>It was found out that there are more cases of infected people with Covid 19 in Area A with 200 cases under GCQ. There were about 50 cases less for people infected with Covid 19 in Area A under MECQ.</p>	<p>I therefore conclude that under GCQ, more people are infected with Covid 19.</p>
<p><b>My answer:</b></p> <p>Identified Problem in LT No. 1:</p>					

**Learning Task No. 5:** Choose the letter of the best correct answer. Write your answer in your notebook.

1. What skill does a scientist show when she listens to the sounds that whales makes?
  - A. Making a hypothesis
  - B. Making observations
  - C. Interpreting data
  - D. Drawing conclusion
2. Which question would be the best high level scientific question?
  - A. How many giraffes live in Africa?
  - B. Who made the first microscope?
  - C. How long ago did dinosaurs live on Earth?
  - D. Does the amount of salt in water affect the temperature at which it boils?
3. What do you call the series of steps designed to help you solve problems and answer questions?
  - A. Observation
  - B. Scientific Method
  - C. Hypothesis
  - D. Experiment
4. In science, an educated guess is called a/an
  - A. Conclusion
  - B. Observation
  - C. Hypothesis
  - D. Question
5. When you decide whether or not the data supports the original hypothesis, you are
  - A. Asking questions
  - B. Drawing conclusions
  - C. Making observations
  - D. Forming a hypothesis
6. When a scientist shares her findings with other scientists, she is
  - A. Experimenting
  - B. Making a hypothesis
  - C. Analyzing data
  - D. Communicating results
7. The final part or a summary of reasonable inferences is/a
  - A. Controlled experiment
  - B. Question
  - C. Hypothesis
  - D. Conclusion
8. Anything that can change in an experiment is called\_\_\_\_\_.
  - A. Variable
  - B. Hypothesis
  - C. Experiment
  - D. Conclusion
9. All good experiment should be
  - A. Questionable
  - B. Testable
  - C. Explainable
  - D. Thoughtful
10. Which of the following does not belong to the group?
  - A. Hypothesis
  - B. Conclusion
  - C. Experiment
  - D. Plagiary

In this lesson, you will learn concepts about elements and compounds. Remember that substances in matter are broken down into two categories. They can either be pure substances or mixtures. Pure substances are further broken down into elements and compounds. Any substance is composed of one type of atom or molecule. Whereas, mixtures are composed of different types of atoms or molecules that are not chemically bonded.

At the end of the lesson and each learning activity, you will be able to recognize that substances are classified into elements and compounds.

The 100 plus elements in the Periodic Table are the "alphabet" of matter because every tangible material is a combinations of these elements.

The elements are categorized as: Metals, Non-metals, Metalloid and Noble Gases. This main categorization is based on the electrical attributes of the elements. Some elements tend to "lose" an electron, and become positively charged. (These are the metals), other elements tend to "acquire" an electron, and become negatively charged, (the non-metals). The third group, (metalloids), fall in between these two extremes. And the Noble Gas category -- displays no interest in either acquiring or losing an electron, but unlike the metalloids which can be "persuaded" one way or the other -- the noble ones simply don't engage.

Since chemical reaction and chemical bonding are electrical in nature, it so happens that members of a certain category can substitute for another member and thereby create a combination which is slightly different, but generally similar. Say then that by carefully choosing a replacement element in a chemical compound, it is possible to "engineer" a desired slight change in the nature of the compound. This used to be an art, and now is the science of chemistry.

The pictures below show sample of matter commonly found at home. Can you identify the components of these sample of matter? What kind of substance are they? Are they pure substances or mixtures?



## Elements

A chemical element is a pure substance that consists of one type of atom. Each atom has an atomic number, which represents the number of protons that are in the nucleus of a single atom of the element. The periodic table of elements is ordered by ascending atomic number.

The chemical elements are divided into metals, metalloids and non – metals. Metals are typically found on the left side of the periodic table they are: **often conductive to electricity, malleable, shiny, and sometimes magnetic**. Aluminum, Iron, Copper, Gold, Mercury and Lead are examples of metals.

Non-metals are found on the right side of the periodic table (to the right of the staircase), they are: **typically not conductive, not malleable, dull (not shiny) and not magnetic**. Examples of non-metals are carbon and oxygen. Metalloids have some characteristics of metals and some characteristics of non-metals. Silicon and arsenic are examples of metalloids.

1 H																	2 He			
3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne			
11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar			
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr			
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe			
55 Cs	56 Ba			72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn		
87 Fr	88 Ra			104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn								
				57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu		
				89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr		

Study the different elements found in the Periodic Table of Elements. This tool is used by scientists to determine quickly the properties of elements. For example, the first element found in the table is hydrogen. It has a symbol represented by capital letter H. Letter or letter, like in He, which is a symbol of Helium make up the list of the different elements in the table.



**Learning Task No. 1:** Study the Periodic Table of Elements as shown in the diagram above. Write twenty elements and their symbols in your notebook.

Elements	Symbol
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Elements	Symbol
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	



**Learning Task No. 2:** Using the Periodic Table of Elements, determine the elements asked in each guide question. Write your answer in your notebook.

**Guide Questions:**

1. Which elements are likely to lose electrons?

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2. Which elements are likely to gain electrons?

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3. Which type of elements are likely to have no electrical charge at all?

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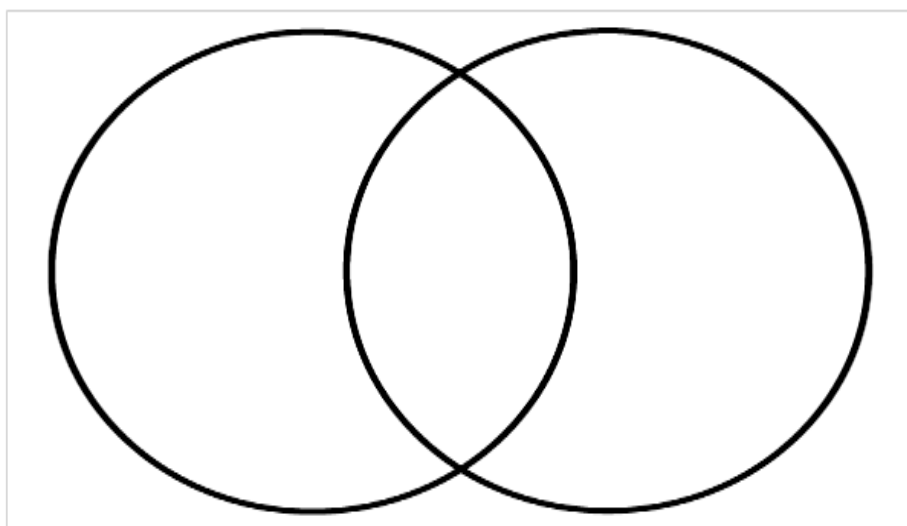
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**Learning Task No. 3:** Fill in the blanks by describing the words listed in the box. Write your answer in your notebook.

atomic number	elements	letters
compound	carbon	mixtures
symbols	pure	carbon dioxide
properties	Periodic Table	

- \_\_\_\_\_ cannot be separated by physical or chemical means.
- Elements are abbreviated with \_\_\_\_\_, which consist of one or two \_\_\_\_\_.
- Elements are organized on the \_\_\_\_\_ according to their \_\_\_\_\_.
- Two or more elements chemically combined make up a \_\_\_\_\_.
- \_\_\_\_\_ is an example of an element and \_\_\_\_\_ is an example of a compound.
- Elements and compounds are called \_\_\_\_\_ substances because they have a unique set of chemical and physical \_\_\_\_\_.

**Learning Task No. 4:** Copy the Venn diagram below in your notebook. Write the similarities of elements and compounds at the intersection of the two circles. Write the differences on the opposite sides of each circles.



**Learning Task No. 5:** Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following is a compound?  
A. Wood    B. Iron    C. Water    D. Air
2. A substance containing two or more elements chemically bonded together is considered a(n):  
A. mixture    B. atom    C. alloy    D. compound
3. How many different atoms are there in a compound?  
A. one    C. two or more  
B. always two    D. none of these
4. Which of these is the smallest particle?  
A. An atom    B. A molecule    C. An element    D. A speck of dust
5. Which of these is the correct symbol for magnesium  
A. MG    B. mg    C. Mg    D. Mag
6. A pure substance which atoms are of the same type is called  
A. Mixture    B. Compound    C. Element    D. All of the Above
7. Examples of noble gases are:  
A. Hydrogen and Helium    C. Helium and Neon  
B. Nobelium and Einsteinium    D. Magnesium and Chlorine
8. The lightest gas is:  
A. Helium    B. Oxygen    C. Neon    D. Carbon Dioxide
9. The tool used by scientists to determine easily the properties of elements.  
A. Mendeleev's Table    C. Chemistry Element Table  
B. Periodic Table of Elements    D. Octet Table
10. The chemical symbols of chlorine, potassium, copper, sodium, nitrogen and iron in order are:  
A. Cl, K, Co, So, Ni, I    C. Cl, K, Co, So, N, Fe  
B. C, K, Co, Na, N, Fe    D. Cl, K, Cu, Na, N, Fe

## Substances and Mixtures

### Lesson

When different substances are physically mixed together mixtures are formed. But how does a mixture differ from a pure substance? Have you ever prepared a chocolate drink? Have you ever noticed what happened if you let your chocolate drink sit for a while? Well, sometimes the chocolate powder will settle on the bottom of the glass. We call it mixtures. Sometimes, two or more ingredients look all the same when mixed together and sometimes they do not.

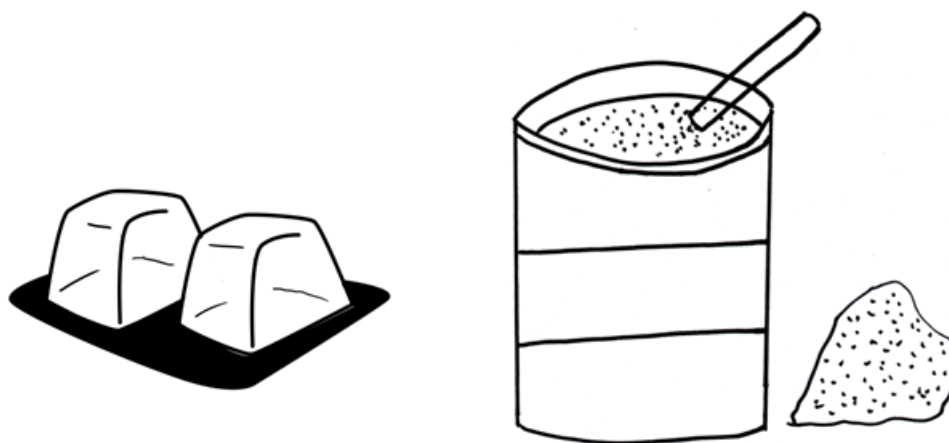
In this lesson, you will find out the difference between mixtures and pure substances based on a set of properties.

Matter can be classified into pure substances and mixtures. When two or more kinds of matter are put together it is called a mixture. Mixtures can be made with solids, liquids or gases. Any combination will result in a mixture. A pure substance consists of one phase with definite composition which appears uniform in appearance and composition, regardless of its size.

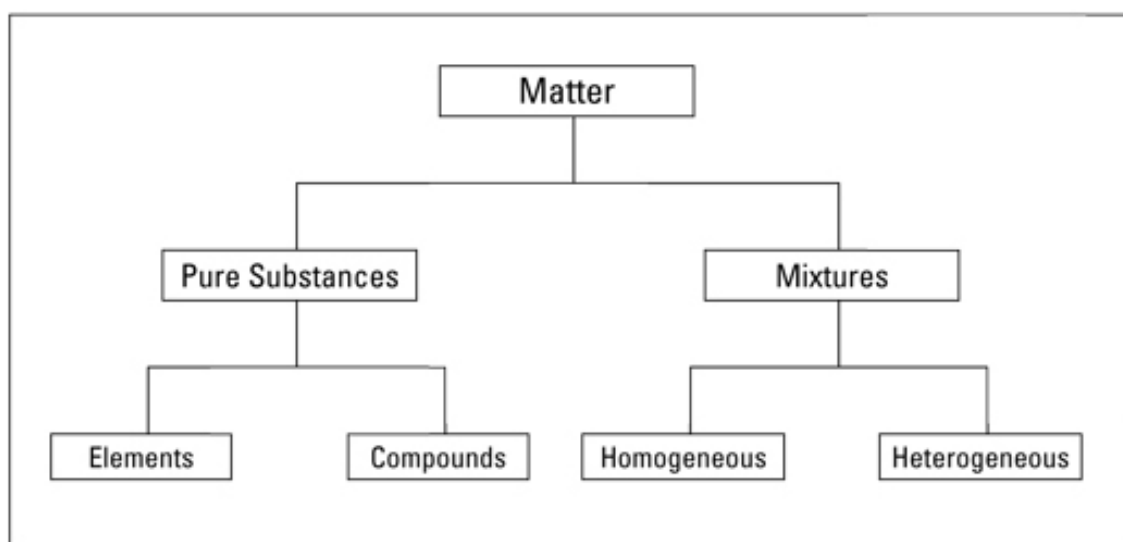
You learned about solutions like milk, juice and coffee are examples of a mixture. A solution may exist in any phase and it consists of a solute and a solvent. The dissolving agent is the solvent and the substance that is dissolved is the solute.

As you go along with this lesson, you will learn other examples of mixtures other than solutions. You will also learn about pure substances and its example.

The picture below shows some examples of materials. From this diagram, what can you say about substances and mixtures?








**Learning Task No. 1: Study the diagram below.** Write a statement about each of the classification of matter..



1. Pure Substances
2. Mixtures
3. Elements
4. Compounds
5. Homogenous Mixtures
6. Heterogenous mixtures

**Learning Task No. 2:** Identify the materials if it a mixture or pure substance. Write your answer in your notebook. Give the reason for your answer.

Material	Mixture or Pure Substance/ Why
<p>1. orange juice</p> 	
<p>2. halo-halo</p>  <p><b>HALO HALO</b></p>	
<p>3. Carbon atom</p> 	
<p>4. steel</p> 	
<p>5. sugar</p> 	

- **Mixture** refers to the physical combination of two or more substances in which the identities of the individual substances are retained.
- **Heterogeneous mixture** is a mixture of two or more chemical substances (elements or compounds), where the different components can be visually distinguished and easily separated by physical means.
- **Homogeneous mixture** is a mixture of two or more chemical substances (elements or compounds), where the different components cannot be visually distinguished.
- **Pure substance** is a form of matter that has constant chemical composition and characteristic properties.
- **Element** is a chemical substance that is made up of a particular kind of atom and hence cannot be broken down or transformed by a chemical reaction into different element.
- **Compound** is a chemical substance that is composed of a particular set of molecules or ions that are chemically bonded. Two or more elements combined into one substance through a chemical reaction, such as water, and form a chemical compound. All compounds are substances, but not all substances are compounds. *Source (Learners Manual p.30, 32-33, p 51-52)*

## D

**Learning Task No. 3:** Match the statements in Column B with the terminologies in Column A. Write your answers on your answer sheet.






### Column A

1. mixture
2. homogenous
3. compound
4. heterogenous
5. elements

### Column B

- A. substance that cannot be separated or broken down into simpler substance
- B. Made by mixing other substances together
- C. Composed of two or more elements
- D. Exhibits only one phase
- E. It contains more than one phase

**Learning Task No. 4:** Identify the given materials if they are homogenous or heterogeneous mixtures. Give reasons for your answer.

Material	Homogeneous or Heterogeneous Element or compound Why
1.milk 	
2. Hydrogen 	
3. Sand mixed with water 	
4. carbon dioxide 	
5. milk and oat- 	



**Learning Task No. 5:** Based on the pictures that you have identified in the previous activity, answer the guide question below.

**Guide Questions:**

1. Which of the following materials have uniform appearance?

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2. Which of the following materials have non-uniform appearance?

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3. How will you differentiate homogeneous mixtures from heterogeneous mixtures?

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4. Which of the given examples are element? compound?

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5. Identify the elements that make up this compound.

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**Learning Task No. 6:** Choose the letter of the best answer. Write your answers on your answer sheet.

1. Mixture is \_\_\_\_\_.

- A. a chemically combined substance.
- B. a combination of elements to make a new substance.
- C. a combination of substances where new substances are formed through a reaction.
- D. a combination of substances in which the atoms of the substance do not chemically combine

2. Mixtures can be classified into 2 types, homogeneous and heterogeneous. They are different because

- A. Heterogeneous has 2 substances while homogeneous has 3 or more substances.
- B. Homogeneous looks the same throughout, with heterogeneous you can see the different parts.
- C. Heterogeneous looks the same throughout, with homogeneous you can see the different parts
- D. They are the same, just different names

3. Which of these is a pure substance?
- A. bread                      B. table salt                      C. garden soil                      D. sea water
4. What is the simplest form that cannot be broken down to anything simpler?
- A. element                      B. solution                      C. compound                      D. colloids
5. Which of the following is a homogeneous mixture?
- A. oil and water                      C. halo-halo  
B. sand and water                      D. air
6. This type of mixture contains two or more substances that are visibly distinguishable.
- A. homogeneous                      C. solution  
B. heterogeneous                      D. suspension
7. A substance which consists of two or more elements which have been combined chemically is called \_\_\_\_\_.
- A. element                      B. compound                      C. mixture                      D. atom
8. Select the term that describes the smallest particle of a compound that can exist and still retain the characteristic chemical properties of a substance.
- A. molecule                      B. atom                      C. electron                      D. nucleus
9. Which of the following is a way in which elements and compounds are similar?
- A. Elements and compounds are both pure substances.  
B. Elements and compounds are both listed on the periodic table.  
C. Elements and compounds are both made up of different kinds of atoms.  
D. Elements and compounds can both be broken down by physical changes.
10. If Jo wants to get the iron filings out of some sand, what could she use to separate these two solids?
- A. magnet                      B. evaporation                      C. decanting                      D. filter paper

# Properties of Saturated and Unsaturated Solutions

## I

## Lesson

WEEK

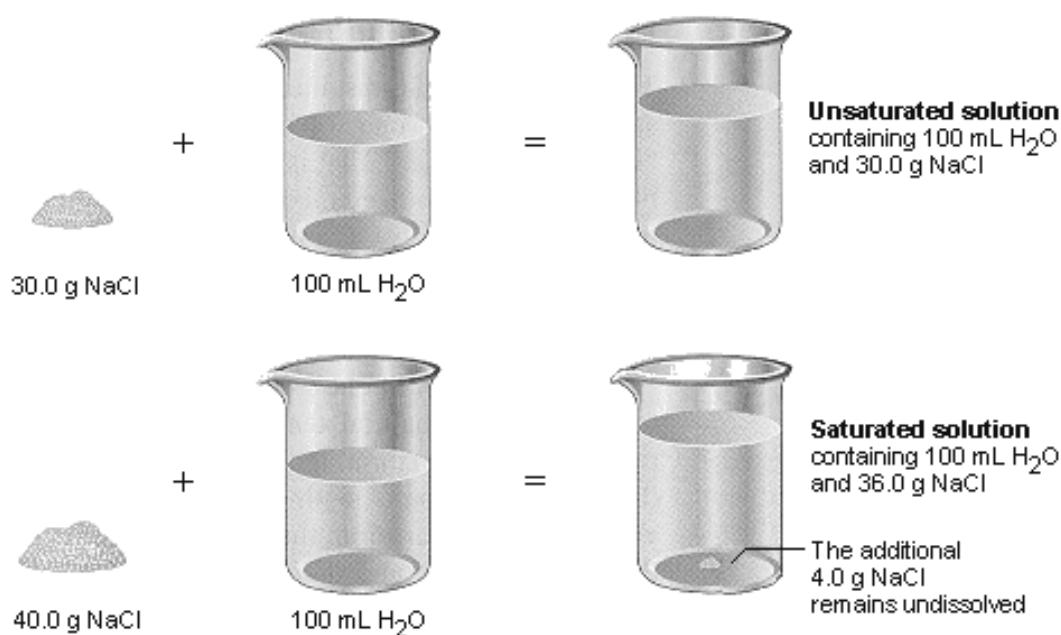
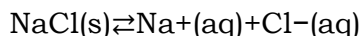
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In this lesson, you will determine that solutions can either be saturated or unsaturated. Are you familiar with these science terms describing the properties of solutions? What are these properties that make solution saturated and unsaturated? Specifically, at the end of the lesson, you will learn to investigate properties of unsaturated and saturated solutions.

There are cases where contaminants are present in some substances. The process of recrystallization can be used to remove these impurities. The crystals are dissolved in a hot solvent, forming a solution. When the solvent is cooled, the compound is no longer as soluble and will precipitate out of solution, leaving other materials still dissolved.

### Saturated and Unsaturated Solutions

The chemical formula for salt is  $\text{NaCl(s)} \rightleftharpoons \text{NaCl(aq)}$ . Supposed you dissolve salt in water, the solution will be unsaturated as this can still accommodate more salt. But there will come a time that these salt are completely dissolved. When you add more salt, the additional salt remained undissolved. This is what actually happens in a saturated solution. See the diagram below showing the preparation's of unsaturated and saturated solutions of salt and water. How does saturated differs from unsaturated solution?

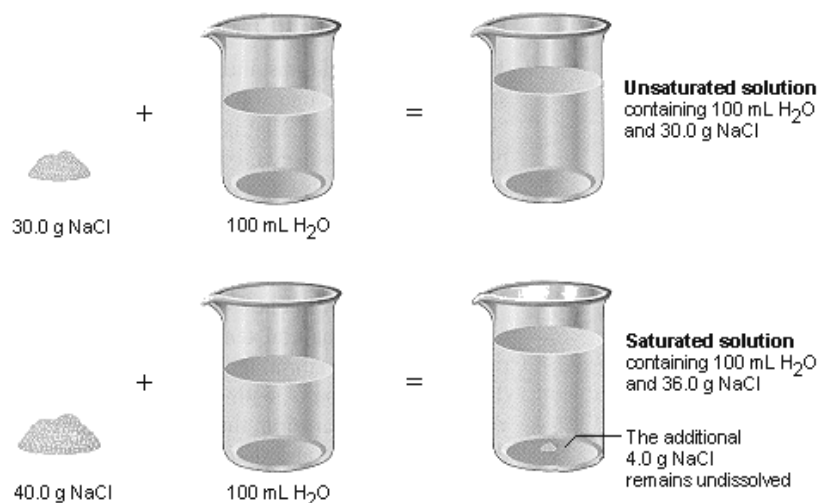


Why is it that additional salt cannot be dissolved anymore? On the molecular level, we know that action of the water causes the individual ions to break apart from the salt crystal and enter the solution, where they remain hydrated by water molecules. What also happens is that some of the dissolved ions collide back again with the crystal and remain there.

**Recrystallization** is the process of dissolved solute returning to the solid state. At some point the rate at which the solid salt is dissolving becomes equal to the rate at which the dissolved solute is recrystallizing. When that point is reached, the total amount of dissolved salt remains unchanged.

**Solution equilibrium** is the physical state described by the opposing processes of dissolution and recrystallization occurring at the same rate. The solution equilibrium for the dissolving of sodium chloride can be represented by one of two equations.

While this shows the change of state back and forth between solid and aqueous solution, the preferred equation also shows the dissociation that occurs as an ionic solid dissolves.



When the solution equilibrium point is reached and no more solute will dissolve, the solution is said to be saturated. A **saturated solution** is a solution that contains the maximum amount of solute that is capable of being dissolved. At 20°C, the maximum amount of NaCl that will dissolve in 100. g of water is 36.0 g. If any more NaCl is added past that point, it will not dissolve because the solution is saturated.

What if more water is added to the solution instead? Now more NaCl would be capable of dissolving in the additional solvent. An **unsaturated solution** is a solution that contains less than the maximum amount of solute that is capable of being dissolved. The figure above illustrates the above process and shows the distinction between unsaturated and saturated solutions.

Solution equilibrium exists when the rate of dissolving equals the rate of recrystallization.

**Learning Task No. 1:** Prepare the materials. Do the simple activity.

Identify the solutions if they are saturated or unsaturated. Give reason(s) for your answers.

**Materials:**

2 teaspoon of sugar for solution A                      1 teaspoon of sugar for Solution B

1 cup water                                                              1 cup water

Teaspoon for stirring

Note: the cup and amount of water must be the same for Solution A and B

**Steps:**

1. Label the two cups with Solution A and Solution B, appropriately.
2. Dissolve 1 teaspoon of sugar in 1 cup of water for Solution A.
3. Stir until all sugar are dissolved.
4. Dissolve 1 teaspoon of sugar in 1 cup of water for Solution B
5. Stir until all sugar are dissolved.
6. Add another 1 teaspoon of sugar in the same cup of water for solution B.
7. Stir until al sugar are dissolved.
8. Copy and complete the chart below.

Type of Solution	Saturated /Unsaturated	Observations that will support your answer
Solution A		
Solution B		

## D

**Learning Task No. 2:** Based on your observations, determine if the given solutions are either saturated or unsaturated.

1. A 500 g of flour completely dissolved in 1 liter of water. \_\_\_\_\_
2. When another 200 g of flour was added in the solution , the additional flour was not dissolved completely and settled . \_\_\_\_\_.
3. The solutions cannot hold any more solute when added in the solution. \_\_\_\_\_
4. One pack of gelatin powder completely dissolved in 400 g water. \_\_\_\_\_
5. The milk powder cannot be dissolved anymore in a cup of water. \_\_\_\_\_

## E

**Learning Task No. 3:** Write a short paragraph regarding the differences between saturated and unsaturated solutions.

Type of Solution	Explanations about the differences of the two solutions
Saturated solution	
Unsaturated solution	



**Learning Task No. 4:** Make a simple steps that will determine your skills in distinguishing saturated and unsaturated solutions. Follow the simple guide below.

Use the materials that are available at home and that ensure your safety in preparing the solutions.

**Materials:**

---

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---

**Steps:**

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_
4. \_\_\_\_\_
5. \_\_\_\_\_

Note: You can add more steps if necessary.

**Observations:** Draw the set up of your two prepared solutions.

**Conclusion:**

**Saturated solutions are** \_\_\_\_\_  
\_\_\_\_\_.

**Unsaturated solutions are** \_\_\_\_\_  
\_\_\_\_\_.

## Concentrations of Solutions

### Lesson

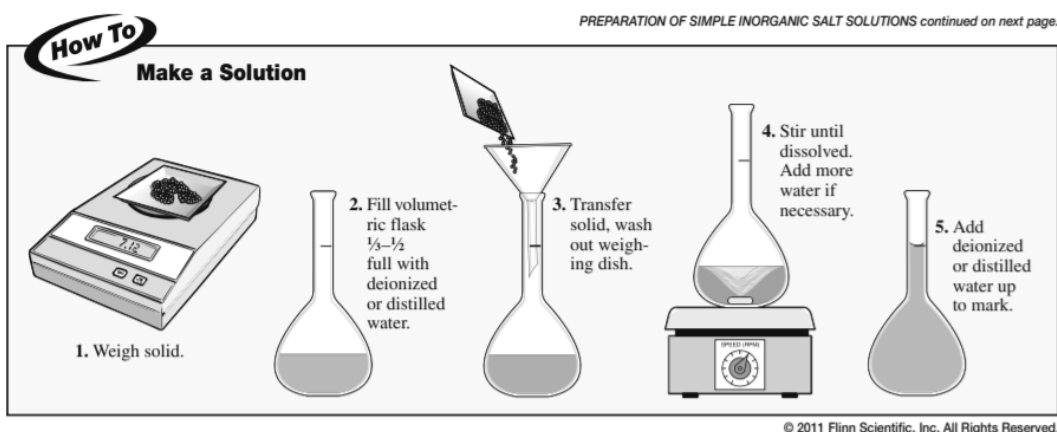
In this lesson, you will be applying your skills in preparing different concentrations of solutions. In preparing these solutions, you will express concentrations of solutions quantitatively by preparing different concentrations of mixtures according to uses and availability.

Many of the materials used in science are in the form of solutions which can be available at home. For many purposes, the exact value of concentration is not critical; in other cases, the concentration of the solution and its method of preparation must be as accurate as possible. Quality and fresh chemicals and solvents are used, and meticulous procedures are followed.

Thus it is very important that when solutions are prepared, an extra care should be done and that the resources or materials should not be wasted. The available resources or poor method in the preparations of solutions can greatly affect the result of the mixtures being prepared. For example, in pharmaceutical laboratories, the exact amount and concentrations of each solution must be carefully done so as not to harm the health of the people or consumers.

Accurate solutions can be prepared in laboratories because of the availability of materials. Since there is no access in the laboratory today, you will be preparing solute which are available at home.

Examine the figure below on how solutions are made in the laboratories.



The instruments used in a Chemistry laboratory are accurate in terms of measuring the materials needed in making solutions. Such laboratory apparatus include digital weighing scale, volumetric flask, funnel, filter paper and hot plate.

The accuracy in the measurement of each ingredients or solutes and solvent are of prime importance specially when making medicines of standard concentrations. There must be an extra care in handling the chemical and the equipment as well as the apparatus.

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**Learning Task No. 1:** Read the handout about preparations of solutions below. Answer the guide questions.

## **SOLUTION PREPARATION**

A solution is a homogeneous mixture created by dissolving one or more solutes in a solvent. The chemical present in a smaller amount, the solute, is soluble in the solvent (the chemical present in a larger amount). Solutions with accurately known concentrations can be referred to as standard (stock) solutions.

These solutions are bought directly from the manufacturer or formed by dissolving the desired amount of solute into a volumetric flask of a specific volume. Stock solutions are frequently diluted to solutions of lesser concentration for experimental use in the laboratory. Preparing a Standard Solution from a Solid A solution of known concentration can be prepared from solids by two similar methods. Although inherent errors exist with each of the methods, with careful technique either will suffice for making solutions in General Chemistry Laboratory.

In the first method, the solid solute is weighed out on weighing paper or in a small container and then transferred directly to a volumetric flask (commonly called a "vol flask").

A funnel might be helpful when transferring the solid into the slim neck of the vol flask. A small quantity of solvent is then added to the vol flask and the contents are swirled gently until the substance is completely dissolved. More solvent is added until the meniscus of the liquid reaches the calibration mark on the neck of the vol flask (a process called "diluting to volume").

The vol flask is then capped and inverted several times until the contents are mixed and completely dissolved. The disadvantage of this method is that some of the weighed solid may adhere to the original container, weighing paper, or funnel. Also, solid may be spilled when it is transferred into the slim neck of the vol flask.

### **Guide Questions:**

1. What is a solution?
2. What are the materials mentioned in the handout in preparing a solution using the first method?
3. Are these materials available at home?
4. Why is it that manufacturing companies have this special kind of instruments in preparing solutions?
5. Can you still prepare solutions using available materials at home? Why?

## D

**Learning Task No. 2:** Knowing the limitations of standard instruments in preparing solutions, think of the available materials found at home that can be used in measuring solute and solvent when making solutions listed below.

Solutions to make:	suggested material of known volume
1. 450 gram of flour added with 1 L of water.	_____
2. 500 ml alcohol dissolved with 1 gallon of water.	_____
3. 300 g rice grains mixed with 540 ml water	_____
4. 450 g sugar and 360 ml coconut milk	_____
5. 50 ml liquid detergent mixed with 250 ml water	_____

## E

**Learning Task No. 3:** Choose materials found at home with known volume or measurement in making solutions. Use the guide below.

**Guide to choose materials found at home with known volume.**

1. 500 ml = 2 glasses
2. 50 ml = 1 empty glass bottle
3. 4 g = 1 teaspoon
4. 14 g = 1 table spoon
5. 180 ml = 1 rice cooker cup
6. 150 g = 1 cup

Question: What materials will you use to measure the different amounts in preparing solutions using the materials in the guide above.

1. 450 g flour and 1 L water
2. 500 ml alcohol and 1 L water
3. 300 g rice grains and 540 ml water
4. 450 g sugar and 360 ml coconut milk
5. 50 ml liquid detergent and 250 ml water



**Learning Task No. 4:** Using the available materials at home, make the following solutions . Be careful in handling materials. Use the sample problem as a guide to help you solve the % concentration of your prepared solution.

Dissolve 10.0g of a substance in 100.0g of water., the concentration by mass will be:

Divide the mass of the solute by the total mass of the solution.

$$c\% = \frac{10.0\text{g}}{10.0\text{g} + 100.0\text{g}} \times 100\% = 9.09\%$$

Solutions to make:

1. 450 g flour and 1 L water
2. 500 ml alcohol and 1 L water
3. 300 g rice grains and 540 ml water
4. 450 g sugar and 360 ml coconut milk
5. 50 ml liquid detergent and 250 ml water



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**Week 2****Learning Task No. 1:**

Use Periodic Table of elements.

E.g. C - carbon; N - nitrogen, O - oxygen

Learning Task No. 2:

1. Metals

2. Non-metals

3. Noble gases

Learning Task No. 3:

1. Elements

2. Symbols, letters

3. Periodic table, atomic number

4. Compound

5. Carbon, carbon dioxide

6. Pure, properties

Learning Task No. 4:

Elements: pure substances, smallest part is

an atom, found in the periodic table

**Week 1****Learning Task No. 1 to 4:**

1. Answers will vary depending on the problem proposed by the student. Concepts include data-based basis of the problem (based on the picture and available data).

**Learning Task No. 5:**

- |      |       |
|------|-------|
| 1. B | 6. D  |
| 2. D | 7. D  |
| 3. B | 8. A  |
| 4. C | 9. B  |
| 5. B | 10. D |

Compounds: made from 2 or more different elements, smallest part is a molecule, made through chemical reaction, commonalities: made of atoms, found in nature, essential part in life

**Week 4****Learning Task No. 1:**

A: unsaturated / the sugar molecules completely dissolved in the water

B: saturated / there are sugar molecules that didn't dissolve in the water

**Learning Task No. 2:**

1. unsaturated

2. Saturated

3. Saturated

4. Unsaturated

5. Saturated

**Learning Task No. 3:**

Saturated: A solution with solute that dissolves until it is unable to dissolve

any more, leaving the undissolved substances at the bottom.

Unsaturated: a solution that completely dissolves leaving no remaining substances

**Learning Task No. 4:**

Activity– answer will vary depending on the available materials found at home by each student

**Saturated solutions** are solution that contains the maximum amount that is capable of being dissolved

**Unsaturated solutions** are solution that contain less than the maximum amount of solute that is capable of being dissolved.

**Week 3****Learning Task No. 1:**

1. Pure substance consist of only one element or compound

2. Mixtures are formed by mixing two or more different substances not chemically joined together.

3. Elements are materials consist of a single type of atom

4. Compounds are formed by the bonds that link elements together to form more complex molecules

5. Homogeneous mixtures– are solid, liquid or gas– eous mixtures that has the same proportion of its components throughout the given sample.

6. Heterogeneous mixtures are formed when two or more phases of materials combines like in oil and water.

**Learning Task No. 2:**

1. mixture / it has water and orange juice as components

2. Mixture / it has ice and different ingredients as components

3. Pure substance / it is an element

4. Mixture / it contains iron and carbon fused together with other metals/non-metals components

5. Compound / it contains C, H, O

**Learning Task No. 3:**

1. D
  2. B
  3. B
  4. A
  5. D
  6. B
  7. B
  8. B
  9. A
  10. A
- Learning Task No. 5:**
1. milk, carbon
  2. Sand mixed with water, oatmeal with milk
  3. Heterogeneous mixture has different phases while homogeneous only has one phase within the mixture
  4. Carbon, carbon dioxide
  5. Carbon and oxygen

**Learning Task No. 6:**

1. D
  2. B
  3. B
  4. A
  5. D
  6. B
  7. B
  8. B
  9. A
  10. A
- Learning Task No. 6:**
1. B
  2. D
  3. C
  4. E
  5. A
- Learning Task No. 4:**
1. homogeneous / it only has one phase
  2. element / it is pure and cannot be broken down into components
  3. heterogeneous / it has solid phase (sand) and liquid phase (water)
  4. compound / it contains

**Week 5****Learning Task No. 4:**

- Learning Task No. 1:
1. A solution is a mixture created by dissolving one or more solutes in a solvent.
  2. Volumetric flask, weighing paper, solute, solution, funnel
  3. Some of them.
  4. In order to achieve accurate concentrations for experiment uses.
  5. Yes. Some materials can have substitutes that can be found at home.
1.  $450 \text{ g} / 1, 450 \text{ ml} * 100 = 31.03\%$
  2.  $500 \text{ ml} / 1, 500 \text{ ml} * 100 = 33.33\%$
  3.  $300 \text{ g} / 840 \text{ ml} * 100 = 35.71\%$
  4.  $450 \text{ ml} / 300 \text{ ml} * 100 = 16/67\%$

**Learning Task No. 2:**

Answer: materials like measuring cup, empty bottle of vinegar & soy sauce, and glass

Examples

1. empty mineral bottle
2. Empty alcohol bottle, ice cream container, etc.
3. Cups and glasses, or mineral bottle
4. Cups and empty mineral bottle
5. Empty bottle of liquid detergent and/or mineral bottle, glass

**Learning Task No. 3:**

1. 3 cups flour and 4 glasses water
2. 2 glasses alcohol and 4 glasses water
3. 2 cups rice grains and 3 rice cooker cup of water
4. 3 cups sugar and 2 rice cooker cup coconut milk
5. 1 empty glass bottle liquid detergent and 1 glass water

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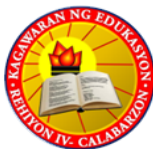
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