LIFEPAC®

SCIENCE

STUDENT BOOK

11th Grade | Unit 1

Alpha Omega
PUBLICATIONS

SCIENCE 1101

ESTIMATE AND MEASUREMENT

LIFEPAC Test is located in the center of the booklet. Please remove before starting the unit.

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Alpha Omega
PUBLICATIONS

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Estimate and Measurement

Introduction

Chemistry is a very old science. Every substance we see, smell, or touch is a chemical. The application of chemistry to change man's environment was known very soon after he was created. Genesis 4:22 indicates that brass and iron were already used for sculpting and building materials. Copper and zinc, of which brass is a mixture, do not occur in nature as pure substances, nor does iron. It follows, then, that man must have been able to refine natural ores, smelt them, and purify the resulting mixtures, as early as 6,000 years ago. Chemistry is a science. It is neither good nor evil. Man's use or misuse of the knowledge of chemistry is what is good or bad. We are surrounded by chemistry every day. Our bodies, all plant and animal life, changes in our physical world, the fuels we burn, the energy from the sun, and the plastics and containers we use involve chemistry. If we are to be good stewards of the world that God created and put in our charge, we must have a good working knowledge of chemistry. Our wise use of the resources of this planet will not just happen. When man is left to his own, he will self-destruct through pollution, excessive use of resources, greed, and interference with the natural laws and balances the Creator established. Our Creator clearly wants man to subdue and use the resources that were created for man's benefit. However, man's sinful nature causes him to misuse this beautiful creation rather than manage it wisely.

Our study of chemistry will be designed to help us understand the material world around us, develop an appreciation of the beauty and marvel of his Creation, and wisely use and develop the resources of this planet and universe. This course should be a "fun" adventure and challenge. Be prepared to work and enjoy our study together.

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC®. When you have finished this LIFEPAC, you should be able to:

1. Describe and use the metric units of measurement.
2. Demonstrate how and when to use common laboratory instruments.
3. Define *accuracy* and apply it to measurements of instruments.
4. Make observations and present data graphically.
5. Use and express numbers using scientific notation.
6. Describe at least three careers related to the study of chemistry.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. METRIC UNITS

Science and scientists have used the metric system of measurement for almost two hundred years. This system is much like the American monetary system which is based on multiples of ten. The metric system is used in nearly all countries in the world for the standard units of measurement. The modern metric system is known as the *International System Of Units.* The international abbreviation *SI* was given to the system by the General Conference of Weights and Measures in 1960. America has been using this system in the scientific world for many years. As early as 1790, colonial leaders proposed that the metric system be adopted as the official American system of measurement. The metric system was legalized in America in 1866 by act of Congress.

In chemistry the units used most frequently are mass, volume, and length. Section 1 of the LIFEPAC will be a study of these three units.

Section Objectives

Review these objectives. When you have completed this section, you should be able to:

1. Describe and use the prefixes of the metric system.
   - 1.1 Describe and use the metric units of measurement.
   - 1.2 Define and use the metric units of length.
   - 1.3 Define and use the metric units of volume.
   - 1.4 Define and use the metric units of mass.

The metric system is of French origin. About 1790 it came into prominent use and was soon adopted as the official French system of measurement. From that time on, it was adopted by nearly all countries throughout the world. The metric system has had a very interesting history in America.

In chemistry we will use *defined* units of metric measurement for length, volume, and mass: the *meter*, the *liter*, and the *kilogram*.

Prepare a report.

1.1 Prepare a detailed report on the history of the metric system in America. Be sure to include details on past government actions, its controversial nature, and its current status. Some groups oppose its adoption and use in everyday life. What is the basis of this position? Attach your report to this LIFEPAC for evaluation.

LENGTH

Length is the measure of the distance from one point to another. It can be measured in large units such as light years or small units like angstroms.

The standard unit of length in the metric system is the *meter*. All of our measurements of length *and* volume derive from this standard.

| Instruments of length (left to right): caliper, micrometer, ruler

Meter. The meter is a standard length about the length of your arm. The definition of a meter has changed somewhat with time. The first definition was one ten-millionth of the distance from the North Pole to the equator as measured along a meridian. Obviously, this distance was difficult to measure accurately. Thus, for many years the meter was defined as the distance between two etched lines on a platinum-iridium bar kept in Sevres, France. Although this definition was more useful, it was difficult to produce replicas for use in other parts of the world. From 1960 to 1983, scientists agreed that one meter equaled 1,650,763.73 times the wavelength of the orange-red spectral line in an isotope of Krypton 86. In 1983, the meter was defined as the distance light travels in a vacuum in 1/299,792,458 seconds. In our studies we will be satisfied with less precision and use the metric rulers available as reproductions of the etched bar.

The meter (m) is the primary unit of length. Conventional multiples and subdivisions of the meter are the kilometer, centimeter, and millimeter. The kilometer equals 1000 meters; the centimeter equals one-hundredth meter; and the millimeter equals one-thousandth meter.

Units			Prefix			Symbol
kilometer	=	1000 meters	kilo	=	1000	km
meter	=	1 meter		=		m
centimeter	=	1/100 meter	centi	=	1/100	cm
millimeter	=	1/1000 meter	milli	=	1/1000	mm

Conversions. Sometimes we encounter dimensions which are inconvenient to use because of the units in which they are expressed. For example, 0.0003 km is not as convenient as its equivalents, 0.3 m or 30 cm. Similarly, 402,000 mm is more conveniently written 402 m or 0.42 km. Therefore, we must learn to convert back and forth among equivalent units.

CONVERSION CHART

Prefix	Symbol	Exponent	Decimal	Fraction of Base Unit
mega-	M	10^6	1,000,000	1,000,000 × base
kilo-	k	10^3	1,000	1,000 × base
hecto-	h	10^2	100	100 × base
deka-	dk	10	10	10 × base
base **unit**		meter, liter, gram, second		
deci-	d	10^{-1}	0.1	1/10 of base
centi-	c	10^{-2}	0.01	1/100 of base
milli-	m	10^{-3}	0.001	1/1000 of base
micro-	µ	10^{-6}	0.000001	1/1,000,000 of base
nano-	n	10^{-9}	0.000000001	1/1,000,000,000 of base

Complete the following chart based on the prefix definitions.

1.2

	kilometer km	meter m	centimeter cm	millimeter mm
	0.001	**1**	**100**	**1000**
a.		100		
b.			120	
c.			0.1	
d.		63		
e.				126.3
f.		31.5		
g.	0.536			
h.			1.92	
i.		6.84		
j.				9.30
k.	61.39			
l.		0.1516		
m.			0.0031	
n.				123,400
o.	0.00000036			
p.				3660

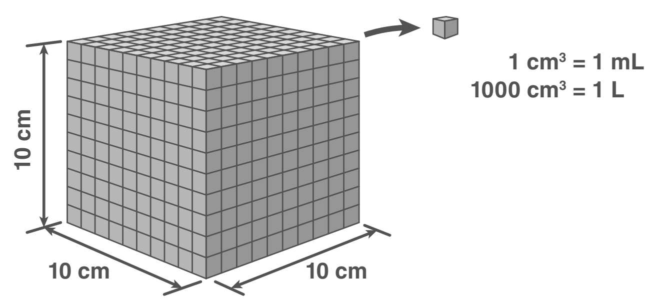
| Instruments of volume (left to right): burette, graduated cylinders, beaker, Erlenmeyer flask

VOLUME

Volume might be defined as length in three dimensions: i.e., height × width × thickness. When you multiply these three dimensions, a cubic dimension results. All liquids, solids, and gases occupy a volume because they all take up space.

Liter. The primary unit of metric volume is the liter (L). It is defined as one-thousandth cubic meter. This volume is the same as a cube 10 cm on a side or 1000 cm^3 (10 cm × 10 cm × 10 cm).

Conversion. A more common volume unit used in our chemistry laboratory is the milliliter (ml). This unit is one-thousandth liter and is the same as one cubic centimeter (1 cm^3). This unit is the one we will use most of this year.



Complete the following chart based on volume conversions.

1.3

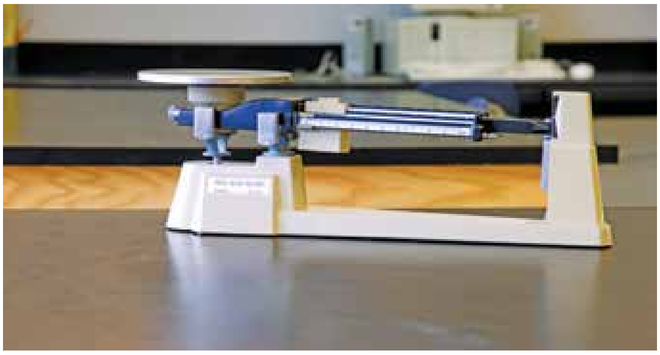
	cm^3	ml	L		cm^3	ml	L
a.	13.5	13.5	0.0135	g.		0.025	
b.		2100.0	2.10	h.			22.4
c.			0.00105	i.		12.86	
d.		941.		j.			0.321
e.			0.1005	k.		22.4	
f.		10,300.		l.			0.025

MASS

Mass is a measure of the "stuff" in an object. The amount of matter of which you are made is your mass. The amount of matter in an unopened box of salt is the same *regardless of where it is in the universe*. All matter has mass.

Kilogram. The primary mass unit for the metric system is the kilogram (kg). This standard is a platinum-iridium cylinder that is kept in the Bureau International des Poids et Mesures (International Office of Weights and Measures) in Sevres, France. All kilogram mass pieces are made as duplicates of that standard.

Conversion. A more common mass unit used in our chemistry laboratory is the gram (g). The gram is one-thousandth kilogram. For our purposes, one gram is the mass of 1 cm^3 (1 ml) of water at 4° Celsius. Sometimes in advanced work in chemistry the smaller mass unit, the milligram (mg), is used. One gram is equal to 1000 mg. Common to some high school chemistry labs are centigram (cg) balances. They can measure to the nearest cg or 1/100 g.



| Instruments measuring mass: triple-beam balance (top), electronic scale (bottom)

Complete the following chart of mass conversions.

1.4

	kg	g	cg	mg
	0.001	**1.0**	**100**	**1000**
a.		100		
b.				1.34
c.		0.01011		
d.	0.00684			
e.			8540	
f.		0.0379		
g.				10,840
h.			905	
i.	0.00000165			

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