

Lesson A1–4

Using Scientific Measurement

Unit A. Research

Problem Area I. Scientific Investigation in Agriculture

Lesson 4. Using Scientific Measurement

New Mexico Content Standard:

Pathway Strand: Problem Solving and Critical Thinking

Standard: IV: Solve problems using critical thinking skills (e.g., analyze, synthesize and evaluate) independently and in teams.

Benchmark: IV-B. Analyze information critically to ascertain its value to whatever discipline it is applied.

Performance Standard: 1. Explain how to analyze, synthesize, and evaluate information and apply its implications to a variety of avenues.

Student Learning Objectives. Instruction in this lesson should result in students achieving the following objectives:

1. Explain the metric system.
2. Explain how temperature is measured.
3. Explain how linear distance is measured.
4. Explain how area is measured.
5. Explain how volume is measured.
6. Explain how weight is measured.

List of Resources. The following resources may be useful in teaching this lesson:

Recommended Resources. One of the following resources should be selected to accompany the lesson:

Lee, Jasper S. and Diana L. Turner. *Introduction to World AgriScience and Technology*. Danville, Illinois: Interstate Publishers, Inc. 1997 (Textbook and Activity Manual, Chapter 4)

Other Resources. The following resources will be useful to students and teachers:

Cooper, Elmer L. and L. DeVere Burton. *Agriscience: Fundamentals & Applications*. Albany, New York: Delmar. 2002 (Chapter 2)

Osborne, Edward W. *Biological Science Applications in Agriculture*. Danville, Illinois: Interstate Publishers, Inc. 1994 (Chapter 1)

List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters

Terms. The following terms are presented in this lesson (shown in bold italics):

Area
Calipers
Celsius scale
Fahrenheit scale
Gram
Gravity
Inside calipers
Linear measurement
Measuring sticks
Meterstick
Outside calipers
Scale
Tape measures
Temperature
Volume
Weight

Interest Approach. Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

Place several objects in front of the class. Ask the students to tell you the size of each of the various objects. What are the different ways to describe the size of objects? How could you explain the size of the object to someone who was not in the room? Why are standard measurement systems developed? Lead a discussion into the lesson.

Summary of Content and Teaching Strategies

Objective 1: Explain the metric system.

Anticipated Problem: How is the metric system set up?

- I. The metric system is used by all scientists around the world. Its official name is the International System of Units; often know as SI because of its French origin. The metric system is increasingly used in the United States. In 1975, Congress passed a law calling for the United States to change to the metric system. The change has been slow in agriculture.
 - A. The metric system is easy to use. It is based on a decimal system that increases or decreases numbers by 10s. In one sense, it is similar to the money system used in the United States and Canada. The metric system uses prefixes to decrease or increase numbers. The prefix is added before the unit or measure being used. Common measurements in the metric system are grams, meters, liters, and seconds.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding the metric system. Chapter 4 in Introduction to World AgriScience and Technology is recommended. Use TM: A1–4A to aid in discussion on this topic.

Objective 2: Explain how temperature is measured.

Anticipated Problem: How is temperature measured?

- II. **Temperature** is the degree to which something is hot or cold. It is measured with a thermometer.
 - A. Two temperature scales are commonly used: Fahrenheit scale (F) and Celsius scale (C). In the **Fahrenheit scale**, water boils at 212°F and freezes at 32°F. Celsius is the metric system of temperature measurement. On the **Celsius scale**, water boils at 100°C and freezes at 0°C.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how temperature is measured. Chapter 4 in *Introduction to World AgriScience and Technology* is recommended. Use TM: A1–4B to aid in discussion on this topic.

Objective 3: Explain how linear distance is measured.

Anticipated Problem: How is linear distance measured?

- III. **Linear measurement** is the distance between two points. It is also known as length. Length measurements are often needed to determine other measures of an object, such as area and volume. The most common unit of linear measurement in the metric system is meter. Several different instruments can be used in determining linear measurement. Some of the most common are:
- A. Measuring sticks—Graduated **measuring sticks** are typically made of wood, plastic, or metal. They are often the length of one unit and marked in smaller units. An example would be a meterstick. A **meterstick** is one meter long.
 - B. Tapes—**Tape measures** are flexible linear measuring devices made of metal or fabric. They may be enclosed in cases that the tape rolls into when not in use.
 - C. Calipers—**Calipers** are used for determining the thickness, diameter, or distance between things. They have jaws or legs that are moved to determine that measurement. Calipers are classified as inside or outside. **Inside calipers** measure the inside distance of tools or equipment. **Outside calipers** measure the outside diameter of objects. Calipers can be adjusted to make very fine and accurate measurements.

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how linear distance is measured. Chapter 4 in *Introduction to World AgriScience and Technology* is recommended. Use TM: A1–4C and TM: A1–4D to aid in discussion on this topic.

Objective 4: Explain how area is measured.

Anticipated Problem: How is area measured?

- IV. **Area** is the measurement of surfaces. Linear measurements must be made in order to determine area. It is reported in square units, such as square meters. Area is based on the length of the sides of an object. Area is the amount of space within linear measurements. The units used to measure a surface must be the same in order to determine the area.
- A. The shape of the surface being measured determines how the area is calculated. The following is a list of some common shapes and the formula used to calculate their area.
 - 1. Square: Area = length \times width
 - 2. Rectangle: Area = length \times width
 - 3. Triangle: Area = (base \times altitude)/2

4. Trapezoid: Area = $[(\text{base} + \text{base})/2] \times \text{altitude}$
5. Circle: Area = $(\text{radius}^2 \times 3.14)/2$

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how area is measured. Chapter 4 in Introduction to World AgriScience and Technology is recommended. Use TM: A1–4E to aid in discussion on this topic.

Objective 5: Explain how volume is measured.

Anticipated Problem: How is volume measured?

- V. **Volume** is the total size of an object. Volume is the amount of space something takes or holds. It is reported in cubic units, such as cubic meters or cubic centimeters. Volume is measured as area times depth.
- A. As with area, the shape of the object being measured determines the formula used to determine its volume. Some of the most common shapes used in agriculture are:
1. Square or rectangular containers: Volume = length \times width \times height
 2. Cone: Volume = $(\text{radius}^2 \times 3.14 \times \text{height})/3$
 3. Cylinder: Volume = $\text{radius}^2 \times 3.14 \times \text{height}$

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how volume is measured. Chapter 4 in Introduction to World AgriScience and Technology is recommended. Use TM: A1–4F to aid in discussion on this topic.

Objective 6: Explain how weight is measured.

Anticipated Problem: How is weight measured?

- VI. **Weight** is the heaviness of something. It is related to **gravity** which is the pull of the earth. Weight is often measured using a **scale**, which is a machine for weighing.
- A. The most common measurement for weight in the metric system is grams or kilograms. A **gram** is the mass or weight of 1 cubic centimeter of water, which is also the same as 1 milliliter of water. This makes it easy to convert from volume to weight and vice versa. This is often expressed as: $1 \text{ g} = 1 \text{ cm}^3 = 1 \text{ mL}$

There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in understanding how weight is measured. Chapter 4 in Introduction to World AgriScience and Technology is recommended.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the end of the textbook chapters may also be used in the review/summary.

Application. Use the exercises on page 36–38 of the Activity Manual of *Introduction to World AgriScience and Technology*.

Evaluation. Focus the evaluation of student achievement on mastery of the objectives stated in the lesson. Measure student performance on classroom participation, laboratory assignments, and written tests or quizzes.

Answers to Sample Test:

Part One: Matching

1 = c, 2 = e, 3 = a, 4 = b, 5 = d, 6 = f

Part Two: Completion

1. altitude
2. 1975
3. 100, 0

Part Three: Short Answer

1. 55 m²
2. 1504.5 m³

Test

Lesson A1–4: Using Scientific Measurement

Part One: Matching

Instructions. Match the term with the correct response. Write the letter of the term by the definition.

- | | | |
|-----------|-----------------------|---------------------|
| a. Volume | b. Linear measurement | c. Gram |
| d. Area | e. Weight | f. Outside calipers |

- _____ 1. The mass or weight of 1 cubic centimeter of water.
- _____ 2. The heaviness of something.
- _____ 3. The amount of space something takes or holds.
- _____ 4. The distance between two points.
- _____ 5. The measurement of surfaces.
- _____ 6. Measures the outside diameter of objects.

Part Two: Completion

Instructions. Provide the word or words to complete the following statements.

1. Triangle: Area = (base \times _____)/2
2. In _____, Congress passed a law calling for the United States to change to the metric system.
3. On the Celsius scale, water boils at _____ $^{\circ}$ C and freezes at _____ $^{\circ}$ C.

Part Three: Short Answer

Instructions. Provide information to answer the following questions.

1. Determine the area of a rectangle with length 10 meters and width 5.5 meters.

2. Determine the volume of a cylinder with radius 3.7 meters and height 35 meters.

PREFIXES USED IN THE METRIC SYSTEM

Prefix	Symbol	Factor by which multiplied
Giga	G	1,000,000,000.0 (one billion)
Mega	M	1,000,000.0 (one million)
Kilo	k	1,000.0 (one thousand)
Hecto	h	100.0 (one hundred)
Deka	da	10.0 (ten)
Deci	d	0.1 (one tenth)
Centi	c	0.01 (one-hundredth)
Milli	m	0.001 (one-thousandth)
Micro	μ	0.000001 (one-millionth)
Nana	u	0.000000001 (one-billionth)

Converting Fahrenheit (F) to Celsius (C)

Formula: $C = \frac{5}{9}(F - 32)$

- Steps:
1. Determine the F temperature.
 2. Subtract 32 from the F temperature.
 3. Multiply the difference found in step 2 by 5.
 4. Divide the amount found in step 3 by 9.
- (The result is the equivalent temperature in degrees C.)

Example: If the temperature is 100°F, what is the C temperature?

$$100 - 32 = 68$$

$$68 \times 5 = 340$$

$$340 \div 9 = 37.7^{\circ}\text{C}$$

Converting Celsius (C) to Fahrenheit (F)

Formula: $F = \frac{9}{5}C + 32$

- Steps:
1. Determine the C temperature.
 2. Multiply the C temperature by 9.
 3. Divide the amount found in step 2 by 5.
 4. Add 32 to the amount found in step 3.
- (The result is the equivalent temperature in degrees F.)

Example: If the temperature is 40°C, what is the F temperature?

$$40 \times 9 = 360$$

$$360 \div 5 = 72$$

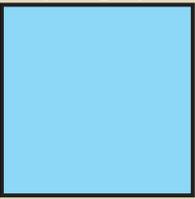
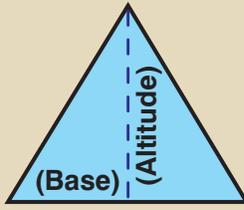
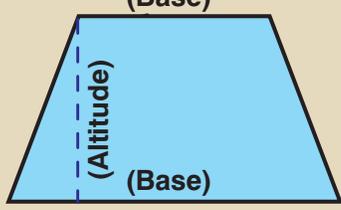
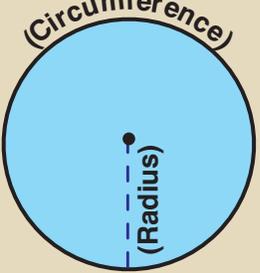
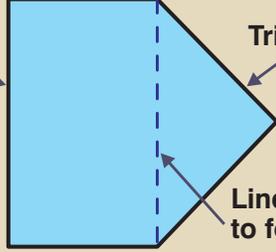
COMMON LINEAR MEASUREMENTS

Customary System:	
1 foot (ft.) =	12 inches (in.)
1 yard (yd.) =	3 feet or 36 inches
1 mile (mi.) =	8 furlongs or 1,760 yards or 5,280 feet
Metric System:	
(Note: The meter is the basic unit of length. Measuring 39.37 inches long, the meter is slightly longer than a yard.)	
1 millimeter (mm) =	0.001 meter
1 centimeter (cm) =	0.01 meter
1 kilometer (km) =	1,000 meters

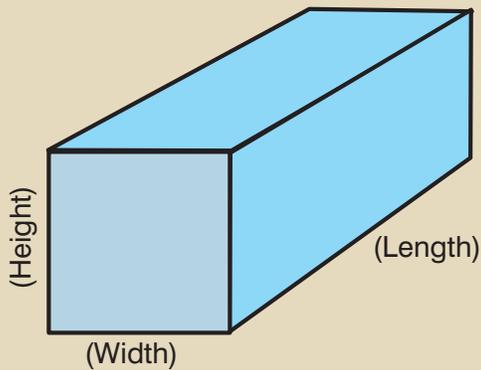
LINEAR MEASUREMENT EQUIVALENTS AND CONVERSIONS

Equivalents		
Customary:	Metric:	
1 inch =	2.54 centimeters	
1 foot =	30.48 centimeters	
1 yard =	0.9144 meter	
1 mile =	1.609 kilometers or 1,609 meters	
Converting Customary to Metric		
If you know the length in:	Multiply by:	To find:
Inches	2.54	centimeters
Feet	30	centimeters
Yards	0.9	meters
Miles	1.6	kilometers
Converting Metric to Customary		
If you know the length in:	Multiply by:	To find:
Centimeters	0.4	inches
Meters	1.1	yards
Kilometers	0.6	miles

CALCULATING AREA

	
<p>Square</p> <p>Definition: all sides equal and meet at right angles</p> <p>Formula: Area = length × width</p>	<p>Rectangle</p> <p>Definition: adjacent sides of equal length; sides meet at right angles</p> <p>Formula: Area = length × width</p>
	
<p>Triangle</p> <p>Definition: surface with three sides</p> <p>Formula: Area = $\frac{\text{base} \times \text{altitude}}{2}$</p>	<p>Trapezoid</p> <p>Definition: four sided surface with two sides parallel</p> <p>Formula: Area = $\frac{\text{base} + \text{base}}{2} \times \text{altitude}$</p>
	
<p>Circle</p> <p>Definition: surface that is round</p> <p>Formula: Area = $\frac{\text{radius}^2 \times 3.14}{2}$</p>	<p>Irregular</p> <p>Definition: surface that is not a regular shape but can be divided into two or more</p> <p>Formula: use those for the shapes that are formed when the surface is divided</p>

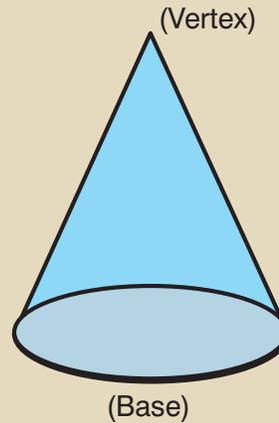
CALCULATING VOLUME



Square or rectangular containers

Definition: a square or rectangle with height (altitude)

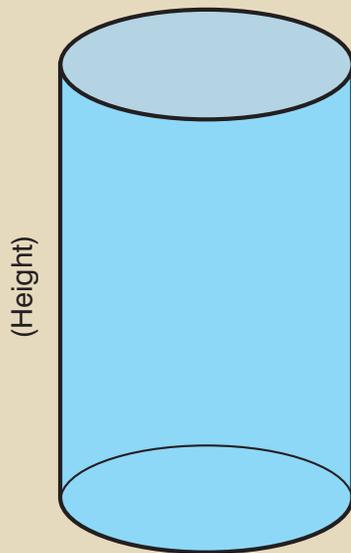
Formula: Volume = length \times width \times height



Cone

Definition: a cylinder that tapers to a point

Formula: Volume = $\frac{r^2 \times 3.14 \times \text{height}}{3}$

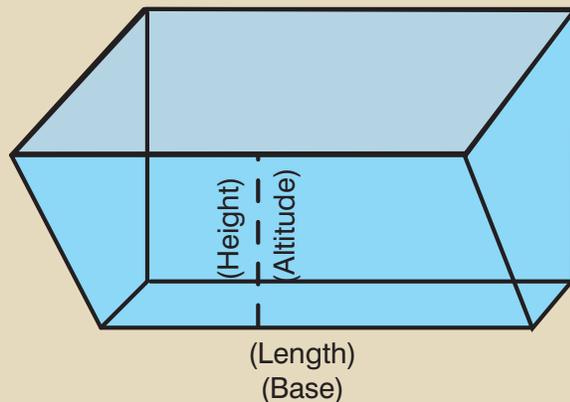


(Base)

Cylinder

Definition: a circle with height (altitude)

Formula: Volume = $r^2 \times 3.14 \times \text{height}$



Irregular Shape

The volume of this shape is determined by getting an average area for the base and using the formula for a square or rectangle container