

Field Measurements

Teacher's Guide

Subject: Integrated Science (Life; Earth-Space; Physical)

Topic: This field lab introduces students to the methods, skills, and tools associated with making common environmental field measurements including the following: Length, Mass, Liquid Volume, Temperature, Light, Humidity, Wind Speed

Summary: Students will learn how to take field measurements in a systematic and consistent manner in order to maximize precision and accuracy. Students will be introduced to the concepts of qualitative observations, quantitative measurements the International System of Units (SI). They will be introduced to the importance of measurements as the basis for drawing inferences.

Objective(s): After completing the field lab, students will be able to:

1. Measure length, mass, volume, and other conditions
2. Calculate measurements and converts answers within/between metric & customary units.
3. Uses appropriate units and significant digits when taking measurements.

Ecosystem(s): Any, Indoor/Outdoor

Equipment:

- 100 meter Tape Measure
- Ruler with (cm)
- Stopwatch
- Graduated Cylinder
- Spring scale
- Beam Balance
- Frisbees
- Multimeter
- Calculator

Background:

- **Vocabulary:** observation, measurement, precision, accuracy, estimation, physical properties, matter
- **Reference Material:** Glencoe 7th Grade Florida Science Skill Handbook pages 576-584; Accuracy and precision: <http://www.fordhamprep.org/gcurran/sho/sho/lessons/lesson22.htm>
- Post activity: Have students chart or graph the heights of the students in the classroom.

Procedure (Engage; Explore; Explain)

1. *Engage* the students by asking a specific question that gets to the heart of the activity: What measurements to you make in your life? Why is it important to make accurate measurements? Use the students' answers to ascertain what they already know, clarify any misconceptions, and then ask them to formulate their own hypothesis relating to their own expectations of the outcome of the lab.
2. In groups of 4-6 students, rotate through the three pre-established measurement stations:
3. 1) a. Height of student: Use a level to get an accurate measurement. Have student record their own height and the average of their group's height, then the average height of the class. b. Weight and mass of pennies. Weight is measured with a spring scale; Mass is measured with a balance. *use the same number of pennies as in station 2, so that density can be determined later.
4. 2) Volume in cubic cm of an object (LWH=V); Volume of pennies in mL, by displacement
5. 3) Distance and Time. (outdoors) Use multimeter to determine wind speed. Have each student in the group throw a Frisbee from a marked line. Measure the distance from the line to the furthest Frisbee thrown. Use this measurement for the group. Record the amount of time (with stopwatch) it takes to walk to the Frisbee. Average speed will be determined later.
6. After completing the lab, allow the students to answer the discussion questions as a group and explain their answers relating them to the concepts, processes and skills associated with the activity. Students should record their answers individually. At this time, facilitators can introduce/explain the specific concepts and explanations in a formal manner.

Sunshine State Standards

Science: SC.A.1.3.1; SC.H.1.3.1; SC.H.1.3.4; **Language Arts:** LA.C.1.3.1; **Social Studies:** SS. B.2.3.9

Mathematics: MA.A.1.3.1; MA.A.3.3.3; MA.B.1.3.2, 3; MA.B.2.3.1-2; MA.B.3.3.1; MA.B.4.3.1; MA.E.1.3.1

Field Measurements

Student Data Sheet

General Information

Full Name:		Date:	
School (teacher):		Time:	

Student Hypothesis and Rationale

If accuracy is determined by the number of times a measurement is taken, then accuracy will (increase or decrease) when more measurements are taken. I think this because _____.

Field Observations/Measurements/Data

	Parameter (unit of measure)	Group 1	Group 2	Group 3	Average	Actual Measurement	Difference
Station 1	Weight (kilograms)						
	Mass (grams)						
	Height (inches) Your Height: _____	group average	group average	group average	class average	N/A	N/A
	Volume (cubic meters) • Length • Width • Height						
	Volume (ml)						
Station 2	Distance (m)					N/A	N/A
	Time (s)					N/A	N/A
	Wind Speed (m/s)					N/A	N/A
Station 3	Temperature of Air						
	Temperature of Soil						
	Temperature of Water						

Field Measurements

Student Assessment Questions

1. Which parameter or condition had the greatest variation between the groups' measurements? Why do you think this is?

2. What was the volume of the pennies according to your group's measurement? What was the average volume of the pennies? Calculate the density of pennies.

Your group:

Average:

Density ($m/V = D$):

3. How would wind speed effect the distance you were able to throw the Frisbee? Are there other factors that might affect this distance?

4. Was your hypothesis supported by your data? Whether your hypothesis is supported or not, what can you infer from your observations, measurements, and results? Can we determine the accuracy of all the measurements we took? Why or why not?

5. We measured the volume of water in milliliters and one milliliter of water represents 1 cubic centimeter. If we put a small stone into 50 milliliters of water, and the water level rose to 57 milliliters, what would the volume (in cubic centimeters) of the stone be?

6. Think about the observations you have just made. Did the activity raise new questions? Write a short question (start with "What, Why, Where, When, or How") about something you want to learn more about.

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Conversion Reference Sheet

Common System International (SI) Prefixes

Prefix	Symbol	Meaning	Meaning
kilo-	k	1,000	thousand
hecto-	h	100	hundred
deka-	da	10	ten
deci-	d	0.1	tenth
centi-	c	0.01	hundredth
milli-	m	0.001	thousandth

Unit System Equivalents

Type of Measurement	Equivalent
Length	1 in = 2.54 cm
Mass and weight*	1 lb = 0.45 kg
Volume	1 gal = 3.78 L
Area	1 yd ² = 0.83 m ²
Temperature	°C = (°F – 32)/1.8

*Weight is measured in standard Earth gravity.

1 milliliter = 1 gram = 1 cubic centimeter

1 mL = 1 g = 1 cm³