Handout: Introduction to Surveying — Measurement Lab

Background: Surveying is the science of measuring and mapping the land, a skill essential for engineers, geoscientists, and city planners. By collecting precise measurements, land surveyors can determine the shape, slope, and volume of landscapes or features such as rain gardens.

Key Question: How do scientists measure the shape of the land?

MATERIALS

- meter sticks
- bubble levels
- corner brackets
- ruler (optional)

LAB ROLES

1. **Equipment Handler:** This person is in charge of handling the meter stick, corner bracket, and bubble level. When taking a measurement, they should decide on which way to hold and where to place the meter stick. When setting up for a measurement, hold the corner bracket with the bubble level resting flat on the bracket against the meter stick. Ensure the meter stick is perfectly vertical by getting the bubble centered when the Data Reader is taking a measurement.

2. **Data Reader:** This person is in charge of reading the measurement on the meter stick. They will get down to eye level with what they are measuring and read the measurement with correct significant figures and units. If it is helpful, use a ruler to line up the top of the object with the meter stick.

3. **Data Recorder:** This person is responsible for collecting the data. They should fill out the data table below with the object identifier, its height and depth (as shared from the Data Reader), and any notes about the measurement and/or object that are worth capturing.

4. **Quality Control Officer:** This person oversees the work of the other group members and ensures proper procedures are being followed. They should especially ensure the meter stick is being held in the correct orientation, the meter stick is level, that centimeters are being measured, significant figures that are being reported are correct, and units are included.

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PROCEDURE

1. Each member of the group selects or is assigned a role. Rotate roles every two objects measured.

2. Record all data in Data Table 1. Make a copy of this table to add more rows, if needed.

3. Measure the height of the object (from the ground up) and the depth of the object from the reference elevation in centimeters (cm).
   a. For all measurements, ensure the meter stick is level by holding the bracket with the bubble level against the meter stick.
   b. For height, place the 0 cm side of the meter stick down, and measure up to the top of the object.
   c. For depth, measure the difference from the top of the object to the reference elevation.

4. Record any observations, comments about the measurement, or difficulties in the *Notes* section.

5. After all objects have been measured or time is called, share your measurements with your class.

Data Table 1

Object	Height	Depth	Notes

ANALYSIS

1. Compare your group's measurements with the class dataset. Where are they similar? Where are they different?

2. What possible sources of error might explain differences in measurements between groups?

3. Are there any measurements that seem unusual or unexpected? How would you verify whether they are correct?

4. For each object, calculate the mean and range of the class depth measurements. Identify and exclude any clear outliers before calculating. Record your results in Data Table 2.

5. What does the range tell you about the reliability of the class data?

6. How might you use the mean and range of the class dataset to decide whether your group's measurements were accurate?

Data Table 2

Object	Class Average Depth	Range	(Extension) Percent Error

REFLECTIONS

1. How does the information we get from the two types of measurements differ?

2. What role was easiest for you? Which was most challenging? Why?

3. What strategies did your group use to make sure your measurements were accurate and consistent?

4. Tomorrow you'll use this equipment and technique to measure a real depression outdoors. Based on today's lab, what advice would you give your group to be successful in the field?

EXTENSION

Compare your group's depth measurements to the class average for each object. Calculate the percent error for your group's results using the formula, then record your calculations in Data Table 2:

$$Percent\ Error = \frac{|Group\ Value - Class\ Average|}{Class\ Average} \times 100$$

♦ What does this tell you about the accuracy of your group's measurements compared to the rest of the class?

♦ What do you think contributed to the percent error you observed?