

## Numbers in Science

### Exploring Measurements, Significant Digits, and Dimensional Analysis

#### About this Lesson

This lesson is an introductory activity for proper measuring techniques, the correct use of significant digits, and dimensional analysis. Students are asked to gather data on a cube and a sphere using proper metric measuring techniques and significant digits. The students use the data to calculate volume, circumference, diameter, and density.

This lesson is included in the LTF Middle Grades Module 2.

#### Objectives

Students will:

- Be introduced to proper measurement techniques, the correct use of significant digits, and dimensional analysis
- Take dimensions of and identify significant digits for a cube and a sphere
- Calculate the volume and density of a cube and a sphere
- Calculate the circumference and diameter of a sphere
- Use dimensional analysis to make conversions

#### Level

All

#### Common Core State Standards for Science Content

LTF Science lessons will be aligned with the next generation of multi-state science standards that are currently in development. These standards are said to be developed around the anchor document, *A Framework for K–12 Science Education*, which was produced by the National Research Council. Where applicable, the LTF Science lessons are also aligned to the Common Core Standards for Mathematical Content as well as the Common Core Literacy Standards for Science and Technical Subjects.

Code	Standard	Level of Thinking	Depth of Knowledge
(LITERACY) RST.9-10.3	Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	Apply	II
(MATH) A-CED.4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance $R$ .	Apply	II

Code	Standard	Level of Thinking	Depth of Knowledge
(MATH) N-Q.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	Apply	II

### Connections to AP\*

Students are expected to report measurements and perform calculations with the correct number of significant digits.

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### Materials and Resources

*Each lab group will need the following:*

aprons	paper towels
balance	die
beaker, 250 mL	marble
goggles	ruler, clear metric
graduated cylinder, 100 mL, plastic	string

### Assessments

The following types of formative assessments are embedded in this lesson:

- Visual assessment of measuring techniques used within the lesson

The following assessments are located on the LTF website:

- Short Lesson Assessment: Numbers in Science
- Introduction to the Science Classroom Assessment
- 2008 6th Grade Posttest, Free Response Question 1

## Teaching Suggestions

This lesson is designed to introduce or reinforce accurate measurement techniques, the correct use of significant digits, and dimensional analysis. Dimensional analysis is also called the “Factor-Label” method or “Unit-Label” method, and is a technique for setting up problems based on unit cancellations. Lecture as well as guided and independent practice of these topics should precede this activity. Students should be provided with reference tables containing metric and standard conversion factors.

The purpose of significant digits is to communicate the accuracy of a measurement as well as the measuring capacity of the instrument used. Remind students repeatedly to take measurements including an estimated digit and to perform their calculations with the correct number of significant digits. Emphasize that points will be deducted for answers containing too many or too few significant digits. The correct number of significant digits to be reported by your students will depend entirely upon your equipment.

Small wooden alphabet blocks or dice should be inexpensive and easy to obtain. Be sure to find a cube/graduated cylinder combination that ensures total submersion of the cube because its volume will be determined by water displacement. If the chosen cube or sphere floats, forceps can be used to gently submerge the object just under the surface of the water.

Spherical objects could be a marble or small rubber ball. Again, be sure to check the sphere/cylinder size to ensure that total submersion of the sphere is possible.

Provide students with a length of string and metric ruler or a flexible tape measure. The string can be wrapped around the sphere, marked, and then removed and measured.