

Zome System

Builds Genius!

Measures of Space - I: Lengths and Areas

Mathematics Intermediate Concept

Lesson Objective:

Students will learn how to measure in one and two dimensional space. They will calculate how much space any object of a given dimension occupies, based on its measurements.

Prerequisite Skills:

Experience working with 2 and 3 dimensions ("2-D and 3-D Shapes," and "Speed Lines!").

Time Needed:

One or two class periods of 45-60 minutes.

Materials Needed:

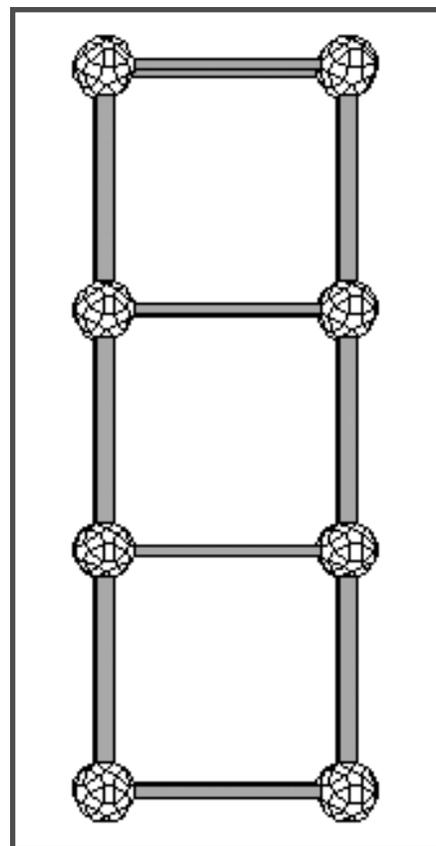
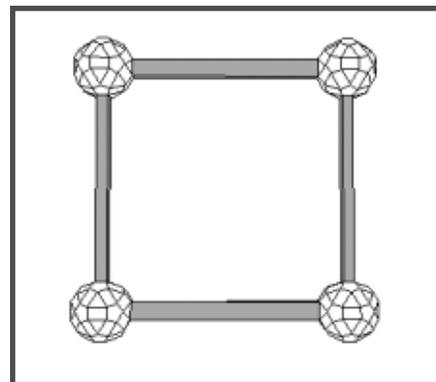
- Two Zome System Creator Kits for 25-30 students

Procedure:

Start the class with a discussion about dimensions. *What are dimensions? What is the difference between objects with 2 dimensions, and those with 3 dimensions? What does a 1-dimensional object look like?* Allow the students to debate until they have agreed that a line is the representation of 1-D space. *How many directions can we move in in 3 dimensions? In 2 dimensions? In 1 dimension? What can we measure in 1 dimension?* The students should try to agree on definitions and enter them in their math journals. A formal definition might state that; A **line** is a space of one dimension. In this space we can move right (by convention known as the positive direction) or left (negative direction). We can not move in (positive) or out (negative), and we can not move up (positive) or down (negative), outside of the line in one dimension.

A **length** on a line is a portion of the line which can be measured in units of our choosing.

Divide the class into teams of 3-4 students, and dis-



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tribute the Zome System pieces. The first project for the teams is to build a 1-D structure using blue lines and determine a useful system to measure it. They are to present the structure to the class and report its measurements. No more information than this should be given.

The students will rapidly figure out that the structure is just a continuous line of blue struts connected by nodes. They are likely to spend a few minutes more agreeing on a unit of measurement. As they are not allowed to use a traditional measuring instruments, they will have to settle on one of the 3 strut lengths as their unit. In order to report a measurement, they can only use struts of their chosen unit. *What is their chosen unit? How long is their line? What happens when we subtract 2 units from this? What is left over? What is the benefit of agreeing on units of measurement in this fashion?* From the discussion, the class will discover that the lengths can added or subtracted just like numbers.

The next step is to add another dimension. *What would be the result if we were also able to move up and down as well as right and left? How will this change the teams' structures? If one strut is a unit piece of one dimension space, then what is a unit piece of two dimension space (square of same size struts)?* Allow the teams 5-10 minutes more to build their resulting square grids and settle on the square they will use as a measuring unit in 2-dimensional space.

After discussing the 2-D structures, the students should agree on a definition of **area**, and write it in their math journals. A formal definition might state that; Area is two dimensional space, or a plane, which can be measured in square units of our choosing. *Is there a way to determine the number of squares in a structure by only counting some of them (Yes, if the overall shape is a rectangle, we can multiply the lengths of the two sides)?*

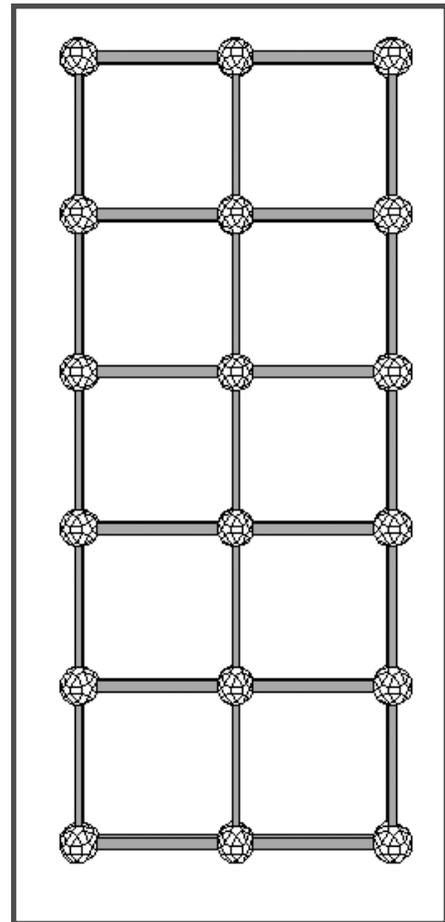
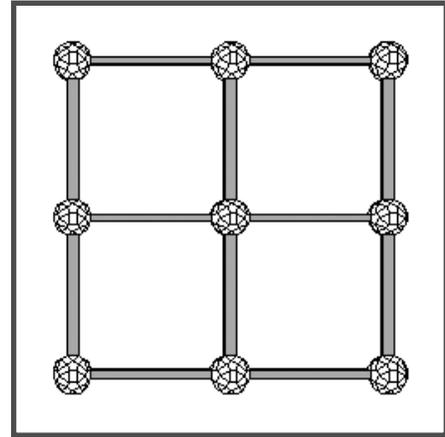
Save the grids for the lesson "Measures of Space - II: Volumes".

Assessment:

Take notes while the students discuss their structures and definitions. Review notes in math journals. To meet the standard students must build the line and the grid and

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show that they understand the measurements in two and three dimensions. To exceed the standard they must verbalize correct definitions for line, and for area.

Standards Addressed:

- * Mathematics standards addressing **mathematics as a means of communications** (NCTM Standard 2).
- * Mathematics standards addressing **the study of the geometry of one, two, and three dimensions** in a variety of situations (NCTM Standard 12).
- * Mathematics standards addressing extensive **concrete experiences using measurement** (NCTM Standard 13).

Transfer Possibilities:

Study of area of various shapes, and measurements of volume ("Measures of Space - II: Volumes"). Discussions of standardization of measuring units.

