



Sandy Garrett, State Superintendent of Public Instruction

Oklahoma State Department of Education

# Building Spaces: A Study in Area and Assistance

AREA OF SERVICE	Environment, Health & Public Safety, Human Need
COMMUNITY NEED	Safe, accessible, useable structures
TYPE OF SERVICE	Indirect, Direct
SUBJECT AREA/LEVEL	Math/6-12
CONCEPT	Structure



## SERVICE-LEARNING PROJECT SUMMARY

This secondary school project uses student learning from a study of geometry, measurement, and area to address a community problem or need for safe, accessible, and useable structures. Following a study in geometric properties students will design and build or refurbish community structures.

### ***LEARNING STANDARDS***

*Oklahoma Priority Academic Student Skills*

#### ***Math***

Standard 4: Geometry and Measurement – The student will use geometric properties and relationships to recognize and describe shapes and use customary and metric measurements to solve problems.

Process Standard 1: Problem Solving

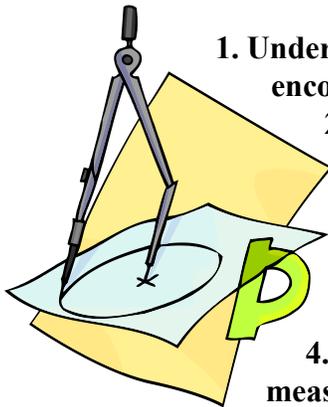
Process Standard 5: Representation

#### ***Art***

Standard 1: Language of Visual Art – The student will identify visual art terms.

Standard 3: Visual Art Expression – The student will observe, select, and utilize a variety of ideas and subject matter in creating original works of art.

## Building Spaces Implementation Outline



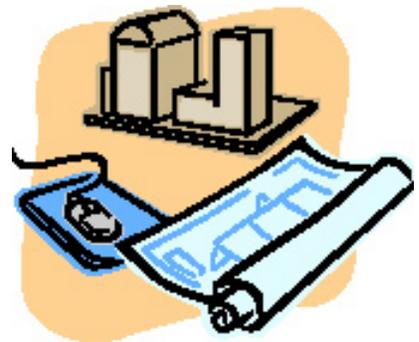
1. Under teacher direction, students will examine a variety of shapes and structures encountered in daily life.
2. Under teacher direction, students will analyze the use and prevalence of shapes and structures in their lives.
3. Under teacher direction, students will imagine the meaning of structure and create a “structure.”
4. Teacher will teach a unit on area, and the use of geometric properties and measurements to recognize and describe structures, shapes, and the use of customary and metric measurements to solve problems in a variety of contexts.

5. Under teacher direction, students will practice and demonstrate their new learning and understanding of the geometric principles outlined in #4.

6. Students will identify a need in their community and design service project(s) that utilize the knowledge and skills developed in #4 and #5.

7. Students will refine their service project(s); identify any local, state, or national laws, agencies, or policies related to the identified community need and their proposed service; and articulate the civic and public meaning of their service.

8. Students will implement their service project and share their accomplishments with the community.



## TEACHER'S GUIDE Building Spaces

### *Teacher's Note*

Using the concept of “structure” the teacher will engage students in an active unit of study around the mathematical topic of “area” to solve a student-identified community problem. Teachers may collaborate with others to broaden student understanding of the concept including formal government structure, sentence structure, literary structure, chemical structure, and art structures.

**1. Under teacher direction, students will examine a variety of shapes and structures encountered in daily life. (Depending on the age of the students, the teacher may select from the following activities that will capture students' attention regarding the concepts of shape and structure.)**

Activity 1: Accompany students on a walk around the school perimeter to locate, identify, and draw as many geometric shapes as they can on a piece of paper.

Activity 2: Tell students to draw a picture of their bedroom then label the geometric shapes used in their pictures. Tell students to draw their house around their bedroom and again identify any geometric shapes used in their drawings.

Activity 3: Divide students into groups of four and provide them with a variety of building materials (blocks, Legos, Tinkertoys, Lincoln Logs, model airplanes or cars, dollhouse kits, etc.). Tell students they have 10 minutes to play with the materials.

Activity 4: Tell students they have been asked to design a “perfect school campus.” Ask them to brainstorm all the facilities, rooms, and furnishings that might be included in their “perfect school campus.”

## **2. Under teacher direction, students will discuss and analyze the use and prevalence of shapes and structures used in the previous activity.**

Activity 1: Lead a discussion with the students about the different shapes and structures they encountered in the previous activity. Ask students to talk about the most commonly used shapes. Ask students to discuss their own comfort with using geometric shapes as part of larger structures.

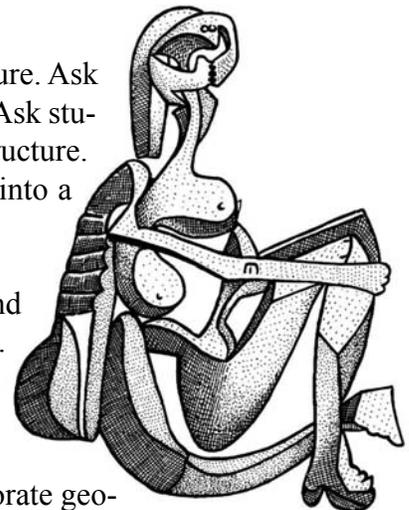
## **3. Under teacher direction, students will imagine the meaning of structure and create a “structure.”**

Activity 1: Lead a discussion about the concept of shape and structure. Ask students if all living and non-living things have shape and structure. Ask students to imagine what the world would be like without shape and structure. Lead students to consider structure as a means of organizing parts into a whole.

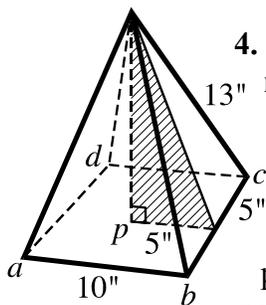
Activity 2: Play the theme song from “2001: A Space Odyssey” and ask students to imagine the musical structures used to describe space. Ask students to imagine other musical structures and what they might describe.

Activity 3: Show students some samples of modern art that incorporate geometric shapes. Ask students to imagine what the artist was thinking about when the art was painted or produced. Ask students to draw a geometric representation of their thoughts.

Activity 4: Divide students into groups of four. Distribute a sleeve of graham crackers and one cup of icing to each group. Tell each group that they have exactly the same amount of materials. Instruct each group to build a freestanding graham cracker house. Have students compare the structures in terms of size and shape. Ask them to guess which of the structures has the largest interior area or space. Ask students how they would measure the area. Ask students how scientists measure area. Ask students how mathematicians measure area. Ask students how historians deal with space. Ask students how writers deal with space. Ask again, how do you measure space? List all responses on the board or overhead. Explain to students that the size of any space or structure can be determined by its area and volume. Show pictures of a small house, a middle-sized house, a large house, and a very large house. Tell students that houses are measured in square feet and that their value is partly determined by the number of square feet. Ask students to guess which house is worth more money. Ask them to estimate the size of each of the houses and to discuss how they would determine the sizes and values. Show them real estate ads that describe the square footage of houses.



Activity 5: Ask students to imagine what the world would be like without structure and organization. Without government and laws. Ask them to draw a picture of the world without government or laws. Post their pictures on the wall then discuss the pictures.



**4. Teacher will teach a concept unit on area, the use of geometric properties and measurements to recognize and describe shapes, and the use of customary and metric measurements to solve problems in a variety of contexts.**

Activity 1: Explain to the students that just as a graham cracker is divided into sections representing length and width, all structures may be divided into smaller parts of a whole to determine the total area. Define geometric terms such as area, perimeter, square, rectangle, triangle, circle, and trapezoid. Allow students to discover the formulas for square, rectangle, triangle, and circle using a hands-on approach. For example, fold a rectangle in half and have students analyze the relationship between the formula for finding the area of a rectangle and the formula for finding the area of a triangle. Explain the area formulas for calculating the area of a square, rectangle, triangle, circle, and trapezoid. Explain how to find the surface area of a three-dimensional object. Demonstrate how the formulas are used in problem solving.

Activity 2: Invite an architect to speak to the class about the use of geometry and measurement in designing building structures. Invite a city planner to speak to the class about the use of design, space, and structures. Invite someone from the parks and recreation department to talk to the class about tasks related to that department that require knowledge and understanding of area, space, and structures. Invite a builder to demonstrate the tools used in the construction industry to measure area, space and structures. Invite a graphic designer to talk about the use of area and space in graphic work.

Activity 3: Use the videos, activities, and interactive labs from David Macauley's "Building Big" unit on structure found at <http://www.pbs.org/wgbh/buildingbig/index.html>.

**5. Under teacher direction, students will practice and demonstrate their new learning and understanding of the geometric principles outlined in #4.**

Activity 1: Students will complete all assignments and activities developed in Step 4.

Activity 2: Students will demonstrate knowledge and understanding of the concepts and skills through relevant standard materials including worksheets, text problems, workbooks, exercises, quizzes, and tests.

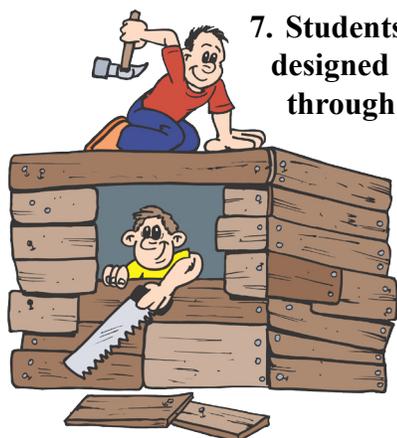
**6. Students will identify a need in their community and design service project(s) that utilize the knowledge and skills developed in #4 and #5.**

Activity 1: Students may identify a need in their community related to structures to design a service project that utilizes their new knowledge and skills of measurement, area, and structures. For assistance in designing a service or action project refer to the resources listed at the end of this unit.



Activity 2: Teacher will present the students with a community need related to shelter, local structures or public spaces and ask the students to design a project that would address the need and engage them in using their new knowledge and skills of measurement, area, and structures to implement the project. Projects might include calculating the area of a house that needs painting, calculating the cost of the materials necessary to paint the home. Others might include working on a city park or recreational space, designing and constructing a skate park, working with a local Habitat for Humanity chapter, or building and installing birdhouses for a local park or retirement center.

Activity 3: The teacher will present the students with a community need related to shelter and clothing and ask students to design a project that would address the need and engage them in using their new knowledge and skills of measurement, area, and structures to implement the project. A quilting project will allow students to work at the second, third and fourth levels of geometry; analysis, information deduction, and formal education. They will see the elements of design in geometry as they create patterns for their quilts. Projects might include designing quilts for the elderly, the homeless, infants, or to give to ABC Quilts, a volunteer organization that distributes quilts to babies who are born drug, alcohol, or HIV affected.



**7. Students will refine their service project(s), and examine any public policies designed to address the community problem that they have selected to address through their service project(s).**

Activity 1: Students will analyze and refine their project design and develop a rubric for assessing the personal and community impact of their service. In small groups, students will take turns leading a session that critiques an assignment or a solution to the community problem they identify.

Activity 2: Students will explore the deeper civic and public meanings of their service and synthesize any formal or informal government structures or laws related to the causes or effects of the community need addressed in their project. Students will explore the role of community members from four domains – government, business, media, and non-profits related to the issue. Students will examine possible policy options and evaluate the costs and benefits of each. (To succeed at this phase students must understand the different areas of government and how each area addresses specific issues. For assistance, refer to the Civic and Public Meaning section of this curriculum document.)

Activity 3: Students will write a paragraph, essay, or journal entry that reflects their understanding of the concept of structure as it relates to math, government, and personal responsibility.

Activity 4: Students will develop a cause and effect chart related to the community need then discuss any questions raised by the chart relative to their own lives and the general welfare of their community.

Activity 5: Create a scaled drawing of the project that includes dimensions in customary and metric units and includes area calculations of all structures.

## **8. Students will implement the service project and share their accomplishments with the community.**

Activity 1: Students will implement their project(s).

Activity 2: Guide students to discuss what they learned through the service-learning project and to identify any personal or communal impact or change that occurred through the project. Teachers may use any number of reflection exercises, oral or written, formal or informal, to assist students in determining, discussing, and documenting the value of their experience.

Activity 3: Students will document their learning and their service in a reflective report or other manner suitable for the public.

## **INTERNET and OTHER RESOURCES**

### ***For information about designing a service or action project:***

<http://www.crf-usa.org/act/act.html>

<http://www.crf-usa.org/cityyouth/cityyouth.html>

[http://www.projectwild.org/materials/taking\\_action.htm](http://www.projectwild.org/materials/taking_action.htm)

[http://www.civiced.org/project\\_citizen.php?link=curriculum](http://www.civiced.org/project_citizen.php?link=curriculum)

<http://www.cns.org>

### ***For more information and ideas about quilts and geometric structures:***

<http://teachers.eusd.k12.ca.us/bbuchel/Photos/2000-2001/quilts.htm>

<http://www.thecraftstudio.com/qwc/rachelle.htm>

<http://www.psd267.wednet.edu/~kfranz/Math/quiltmath2000/quiltmath2000.htm>

### ***For more information about building structures:***

<http://www.pbs.org/wgbh/buildingbig/index.html>

### ***For information on building skate parks:***

<http://www.tonyhawkfoundation.org/>