

**Mathematics CSO's**  
**Grades 9-12**  
**Module \_\_\_\_**  
**Discovering Areas of Squares**

Work phone: Larry Lamb  
304-558-7805  
E-mail: llamb@access.k12.wv.us

---

**CONTENT STANDARDS AND OBJECTIVES**

**Standard 3: Geometry (MA.S.3)**

Students will:

- Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships;
- Specify locations and describe spatial relationships using coordinate geometry and other representational systems;
- Apply transformations and use symmetry to analyze mathematical situations; and
- Solve problems using visualization, spatial reasoning, and geometric modeling through communication, representation, reasoning and proof, problem solving, and making connections within and beyond the field of mathematics.

**Objectives:**

**G.3.5** apply definitions, theorems, and postulates related to such topics as complementary, supplementary, and vertical angles and angles formed by perpendicular lines.

**G.3.8** explore and identify properties of quadrilaterals and verify the properties for parallelograms, rectangles, rhombuses, squares, and trapezoids.

**G.3.11** apply the Pythagorean Theorem and its converse in solving practical problems and in deriving the special right triangle relationships.

**G.3.13** given a polygon, find angle measures of interior and exterior angles; find length of sides from given data; and use properties of regular polygons to find missing data.

**G.3.15** develop and apply formulas for area, perimeter, surface area, and volume and apply them in the modeling of practical problems.

**G.3.16** develop and apply concepts of analytical geometry such as formulas for distance, slope, and midpoint and apply these to finding dimensions of polygons on the coordinate plane.

**G.3.20** find or approximate the area of irregularly shaped regions.

**G.3.21** using the Cartesian coordinate system, find the dimensions of a polygon, given the coordinates of the polygon.

## **BEST PRACTICES FOR INSTRUCTION AND INSTRUCTIONAL STRATEGIES**

Students will be given a review of the Pythagorean Theorem, perfect squares, slopes of lines, the relationship of slopes of perpendicular lines, and area formulas for squares and related quadrilaterals.

Divide the class into groups of four or five students per group. Each student will be given a geo-board and rubber bands. They are instructed to make squares of different dimensions. After each square is constructed on the geo-board, it is then drawn onto an activity sheet and the area of each square is found. Students are given plenty of time to construct all squares up to the square area of 25, for example, (1x1, 2x2, 3x3, 4x4, 5x5).

Then ask what determines a square? How can you get other squares with an area of less than 25? Have several students come up and make these “non-perfect” squares on the geo-board on the overhead. Some methods of finding these “non-perfect” squares are:

- Connect the mid-points of the sides of squares found. This only works for perfect squares that are even numbers i.e. 4, 16, ... because  $\frac{1}{2}$  of 4 = 2.
- Apply the negative reciprocal notion of perpendicular lines. Example: construct a side by going 3 to the right and up 1, the next side is perpendicular so from the endpoint apply a negative reciprocal slope by going up 3 and 1 to the left.

Ask students to construct one of these “non-perfect” squares on their geo-boards and to estimate the area by counting. Then ask for exact areas by using the formula  $A = S^2$ , students will be reminded that a square is a special rhombus and the formula  $A = \frac{1}{2} (d_1 \cdot d_2)$  will be available for the class.

### Performance Descriptors to Measure Student Achievement

- **Distinguished**  
The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in geometry. The student produces geometric figures and polygons and verifies properties of each. The student applies definitions, theorems and postulates to determine measures of angles found in figures containing polygons and justifies solutions in a clear, concise manner. Students apply appropriate formulas to solve complex practical application problems involving area of polygons expressing solutions in both exact and approximate forms in a clear, concise manner.

- **Above Mastery**  
The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in geometry. The student verifies properties of geometric figures and polygons. The student applies definition, theorems, and postulates to determine measures of angles found in figures containing polygons. Students apply appropriate formulas to solve practical problems involving area of polygons.
- **Mastery**  
The student demonstrates fundamental course or grade level knowledge and skills by showing accurate academic performance that meets the standard in geometry. The student identifies and represents basic geometric figures of polygons and uses basic properties of them to solve problems. The student finds measures of angles found in figures containing polygons, as well as those formed by parallel and perpendicular lines, using definitions, theorems, and postulates. The student solves problems involving area by using the appropriate formulas. The student uses the Pythagorean Theorem and coordinate geometry to determine distance, slope, and midpoint.
- **Partial Mastery**  
The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in geometry. Performance needs further development. The student identifies basic geometric figures such as points, lines, and quadrilaterals and inconsistently uses basic properties of each to solve problems. Given definitions, theorems, and postulates, the student inconsistently finds measures of angles found in figures containing polygons, as well as those formed by lines. Given appropriate formulas and detailed drawings or representations, the student inconsistently solves problems involving area.
- **Novice**  
The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in geometry. Performance needs considerable development. The student recognizes some of the basic geometric figures such as points, lines, and quadrilaterals and basic angle pairs. Given appropriate formulas and tools, a student attempts to determine the area of quadrilaterals.

## **ADAPTATIONS FOR DIVERSE LEARNERS**

First, consult with the primary special education teacher of eligible students regarding modifications listed on their Individualized Education Plans. This collaboration will assist in the development of specific adaptations to match this module.

This activity is just one way of getting students involved in mathematical modeling. A few adaptations for this lesson could include having the students actually build squares

using algebra blocks or regular building blocks, this will allow the tactile and concrete learners to feel and see the actual squares. Another adaptation is to have the students cut out the “non-perfect” squares so that they can manipulate the square by rotating to a position that can be easier for them to see that the area of the square is not easily determined because it does not fit exactly between the dots on the activity sheet. The Pythagorean Theorem can be used to find the length of a side of a square. You can find many other opportunities that involve students in dealing directly with whatever kind of mathematical relationships you are studying.

*Look For Opportunities:* Search for mathematical relationships that appear in activities that interest your students. Look around your community for people, places, and things that can be used to take the world of mathematics beyond the textbook.

*Develop Group Learning Skills:* This activity flows very smoothly in a classroom where sound cooperative learning strategies are consistently used and lab experiences occur regularly. The amount of time and structure that you should expect to lead the laboratory activity is contingent on past inquiry-based experiences of the students. By placing students in cooperative learning groups that accentuate each student’s learning strength, you provide a learning opportunity that is power in numbers. If for example, you have a student who cannot manipulate the rubber bands on the geo-board, then that student can observe the other group members and then model the squares using other manipulatives.

*Be Flexible:* Alterations and modifications in this lesson will depend on each Individualized Education Plan.

### **Additional Resources for Adaptations**

**Geometry World – Mathrealm software by Cognitive Technologies Corporation**

#### **Student Assistance Team Manual**

West Virginia Department of Education  
Division of Instructional and Student Services  
Office of Student Services and Assessment

#### **The Teacher’s Resource Guide**

Hawthorne Educational Services, Inc.  
800 Gray Oak Drive  
Columbia, MO 65201  
Telephone: (573) 874-1710  
Fax: 1-800-442-9509

## **Adapting Curriculum and Instruction in Inclusive Classrooms: A Teacher's Desk Reference**

The Center for School and Community Integration  
Institute for the Study of Developmental Disabilities  
283 East Tenth Street  
Bloomington, Indiana 47408-2601  
(812) 855-6508

### **Websites:**

Mathrealm.com  
LDOnline.org

## **Integration of Technology**

### **Standard 3: Technology Productivity Tools (TEC.S.3)**

Students will:

- Use technology tools to enhance learning, increase productivity, and promote creativity; and
- Use productivity tools to collaborate in constructing technology-enhanced models, preparing publications, and producing other creative works.

### **Technology Productivity Tools Objectives:**

Student will:

TEC.9-12.3.2 select and use appropriate technology tools to efficiently collect, and analyze and display data that is relevant to class assignments.

### **Standard 6: Technology Problem-solving and Decision-making Tools (TEC.S.6)**

Student will:

- use technology resources for solving problems and making informed decisions; and
- employ technology in the development of strategies for solving problems in the real world.

### **Technology Productivity Tools Objectives:**

Student will:

TEC.9-12.6.1 investigate and apply expert systems, intelligent agents, and simulations in real world situations.

## **Instructional Materials**

### **Useful Books:**

*Geometry*- Glenco McGraw-Hill, New York, New York, Columbus, Ohio  
Woodland Hills, California, Peoria, Illinois

*Geometry*- American Guidance Service, Inc. Circle Pines, Minnesota 55014-1796

**Useful Activities:**

Professor Boyd Holton- Shoebox Activities West Virginia University, Allen Hall  
Morgantown, WV 26505

**Needed Materials:**

Geo-boards/ rubber bands

Alge-blocks

Blocks

Scissors

Dot paper

Overhead projector

Dotted transparency

**Web-based Resources**

[Reinvent.k12.wv.us](http://Reinvent.k12.wv.us)

[Matti.usu.edu](http://Matti.usu.edu)

[NCTM.org](http://NCTM.org)

[Wvde.state.wv.us](http://Wvde.state.wv.us)