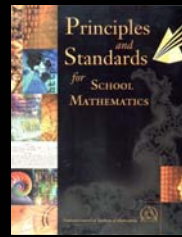


Navigating through Geometry Grades 3-5

Presented by
Dr. Karol L. Yeatts
Navigations Writer
Navigating through Algebra Grades 3-5
Navigating through Number and Operations
Grades 3-5
Navigation Grade Level Specific
Investigation Series
NCTM Academy Presenter



Principles and Standards for School Mathematics



Content Standards
Process Standards
Principles



Content Standards

- ◆ Number and Operations
- ◆ Algebra
- ◆ Geometry
- ◆ Measurement
- ◆ Data Analysis and Probability



Process Standards

- ◆ Problem Solving
- ◆ Communication
- ◆ Connections
- ◆ Representation
- ◆ Reasoning & Proof

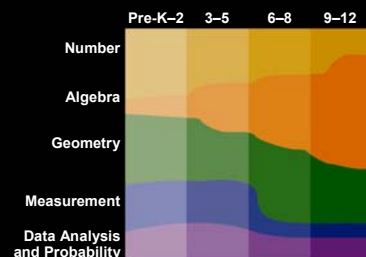


Principles

- ◆ Equity
- ◆ Assessment
- ◆ Teaching
- ◆ Learning
- ◆ Curriculum
- ◆ Technology



Emphasis across the Grades



The Navigation Series

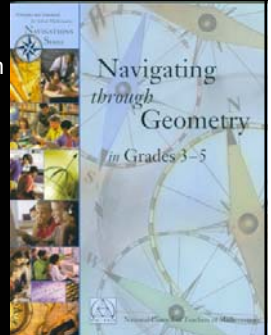
- ◆ An instructional resource for the implementation of the Principles and Standards
- ◆ Illustrative guide to the development of ideas in each of the content strands
- ◆ Tools to incorporate the instructional principles identified in the Standards
- ◆ A source of professional development content.



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Navigating *through* Geometry in Grades 3-5

- ◆ Written by
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 - Ann Marie Spinelli
 - Judy St. Marie
- ◆ Editor
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Geometry Standard

Instructional programs from prekindergarten through grade 12 should enable all students to—

- ◆ 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
- ◆ Use visualization, spatial reasoning, and geometric modeling to solve problems



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- ◆ Chapter 1
Shapes
 - Build What I've Created
 - Thinking about Triangles
 - Roping in Quadrilaterals
 - Building Solids
 - Searching for the Perfect Solids



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Location
 - Find the Hidden Figure
 - Xs and Os
 - Can They Be the Same?



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- ◆ Chapter 3
Transformations
 - Patchwork Symmetry
 - Symmetry Detectives – Learn the Secret Code
 - Going Logo for Symmetry!
 - Tetrominoes Cover ψ
 - Motion Commotion
 - Zany Tessellations



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- ◆ Chapter 4
- Spatial Visualization
 - Puzzles with Pizzazz
 - Exploring Packages
 - It's All in the Packaging
 - It's the View That Counts!
 - Fraction Fantasy
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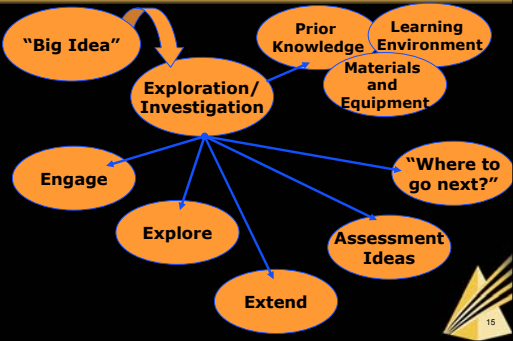


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- ◆ Appendix
 - Black line Masters and Solutions
- ◆ CD ROM with Applets and Resources
 - Exploring Geometric Solids and their Properties
 - Geoboard
 - Isometric Drawing Tool
 - Pattern Patch
 - Shape Sorter
 - Tangram Challenge



Organization of Lessons



Searching for the Perfect Solids

- ◆ How many Perfect Solids are there?
- ◆ What are the names of the Perfect Solids?
- ◆ Tell something that you know about Perfect Solids.



Searching for the Perfect Solids

- ◆ There are 5 Perfect Solids
- ◆ The names of the Perfect Solids are:
 1. Tetrahedron
 2. Octahedron
 3. Icosahedron
 4. Hexahedron (cube)
 5. Dodecahedron



Searching for the Perfect Solids

Grades 4–5

Goals
Discover the five perfect solids (see below) in Platonic solids.
Develop mathematical arguments to justify conclusions.

Prior Knowledge
Students should be familiar with building and using three-dimensional shapes. They should have learned how to name the edges, faces, and vertices and understand how the vertices are used to define the characteristics of three-dimensional figures. They should also be familiar with the relationship of two-dimensional figures to three-dimensional shapes (e.g., a circle is made up of six faces that are squares, “flat” solids,” the surface activity, can refer to progressions for the activity).

Materials and Equipment
A stack of five perfect solids plus a triangular prism and a square prism.
These solids are necessarily available to use for several days in the program on the flexible systems “Patterns for the Perfect Solids” and “Patterns for Other Solids.”
“Solid” modeling clay, wire, or such commercially available products as 1/8 inch and “Hexamers” (hexahedrons, pentahedrons, and other three-dimensional solids).
A large modeling space on which to keep stacks of prisms and pyramids (also paper or cardboard prisms or a classroom board, and string, etc.).

Learning Environment
This activity is a combination of work to gain and solidify their theories. The “Tangram” section describes a whole-class activity and the “Digital” section involves work in pairs and whole-class discussion.

Important Geometric Terms
Edges, rays, vertices, quadrilaterals, pentagons, circles, cube, pyramid, square, face, rectangular, quadrilateral.

Notes and These three-dimensional figures consist of regular polygons joined at their vertices and edges (edges are not necessarily the same length, but they are all the same length).

The ancient Greeks, especially Plato, believed that these regular solids represented the basic elements of the universe. The tetrahedron was thought to be fire, the octahedron was air, the cube was earth, and the dodecahedron was water and the combination of the universe.

Activity
Before the lesson, show the class models of two perfect solids: a tetrahedron and a cube. Ask the students to count the faces, edges, and vertices of each and to compare their results. Then ask them to build a tetrahedron and a cube from paper and to compare their results. Then ask them to build a tetrahedron and a cube from paper and to compare their results. Then ask them to build a tetrahedron and a cube from paper and to compare their results.

Fig. 1.16
To the comparison of regular prisms and pyramids, see Fig. 1.16.

Notes
Have the students work in pairs to make models of a cube with “solid” and “Hexamers.” When a pair finishes, have them describe their final model with the class and explain why they believe it is perfect. Then allow the pairs to compare and put the solid on an other. The comparison of the two models is a comparison of the two models. The comparison of the two models is a comparison of the two models. The comparison of the two models is a comparison of the two models.



Searching for the Perfect Solids

- ◆ **Goals**
 - Discover the five perfect solids (Platonic Solids)
 - Develop mathematical arguments to justify conclusions.
- ◆ **Prior Knowledge**
 - Be familiar with three-dimensional objects and terms, faces, edges, and vertices
- ◆ **Materials and Equipment**
 - Models of the five perfect solids
 - Sticks and fasteners
 - [BLM – Patterns for the Perfect Solids](#)
 - [CD-ROM - Exploring Geometric Solids and Properties](#)

Searching for the Perfect Solids

- ◆ **Learning Environment**
 - Combination of working in pairs and whole-class activities and discussions
- ◆ **Important Geometric Terms**
 - faces, edges, vertices, polygons, dodecahedron, polyhedron, cube, tetrahedron, icosahedron, octahedron, platonic solids
- ◆ **Engage**
 - Show the class the models of two perfect solids and two solids that are not perfect.

Searching for the Perfect Solids

- ◆ **Explore**
 - Have students work in pairs to make the other perfect solids.
 - Have students justify why they believe their solid is perfect.
- ◆ **Assess**
 - Have students write a letter to a friend explaining what they have learned about perfect solids.

Searching for the Perfect Solids

- ◆ **Engage**
 - Make a list of the properties of each solid.

- All perfect solids are regular polyhedra; that is, each is made up of a single type of regular polygon, either an equilateral triangle, a square, or a regular pentagon.
- At each vertex, the same number of polygons intersect.
- In a cube, for example, three square intersect at each vertex.

Exploring Geometric Solids and Properties CD ROM Applet

Did you know that—

- Each solid has flat sides called *faces*?
- Each solid has *edges* to connect

Directions

- Choose a shape: Click on the New Shape button.
- Rotate the shape: Place the mouse pointer on the shape. Move the mouse while holding down the mouse button.
- Color the shape: Click on a color. Hold the shift key while clicking the mouse where you want to paint. You can paint a face in a color, an edge in white, or a corner in black. Remove the color: Click on the Reset Shape button.
- See through the shape: Click the box by Transparent.
- Change the size of the shape: Use the mouse to move

Xs and Os

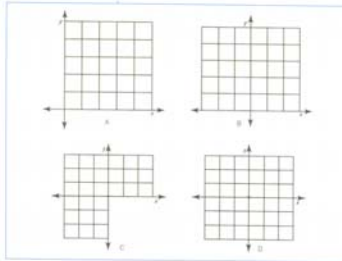
- ◆ **Goals**
 - Locate points on a rectangular coordinate plane using ordered pairs.
 - Use the point of origin as a point of reference
 - Understand and use positive and negative integers to identify points in four quadrants.
- ◆ **Materials**
 - BLM – Coordinate Grids
 - Overhead projector and markers

Xs and Os

- ◆ **Engage**
 - Play a game similar to tick-tack-toe.
 - Half the class will be X and the others O.
 - Display the coordinate grid on the overhead projector
 - One person from each group will tell you where to place an X or an O by naming the ordered pairs.

Xs and Os

- ◆ **Extend**
 - Have students work in pairs to play the game.



Motion Commotion

- ◆ **Goals**
 - Manipulative a figure using the following basic transformations:
 - Translations (slides)
 - Reflections (flips)
 - Rotations (turns)
- ◆ **Materials**
 - [BLM- Motion Commotion](#)
 - Overhead projector
 - Scissors, markers and pencils
 - Coffee stirrers

Motion Commotion

Grades 3-4

Goals

- Manipulate a figure using the following basic transformations: translations, reflections, rotations, and dilations.
- Predict the new orientation of a figure after a specific transformation.

Prior Knowledge

The students should have had some experience with naming, sliding, and flipping figures and drawing the results of these actions on the coordinate grid.

Materials and Equipment

- A copy of the "Motion Commotion" Student resource for each student.
- An overhead projector and suitable overhead transparency materials.
- Overhead transparency copies of the figures from the "Motion Commotion" Student resource.
- Scissors, markers or crayons, and pencils.
- Coffee stirrers.

Learning Environment

The students work in whole groups during the "Engage" portion of the lesson and in pairs for the remainder of the lesson.

Important Geometric Terms

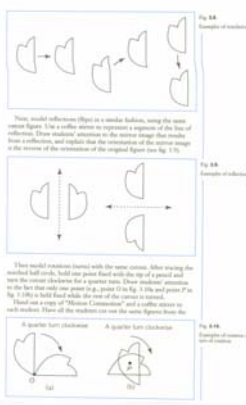
Translation: sliding, reflection: flip, rotation: turn.

Use the previous activity for definitions and illustrations of the terms above, but also the "Engage" and "Explore" sections of this activity.

Activity

Engage

Cut out the overhead half-circle from "Motion Commotion," and place it on top of an overhead transparency on the overhead projector. Trace the figure onto the overhead transparency. Discuss with students the need for this transparency—convenient place to use when demonstrating, rather than cluttering up the table. Have students compare to figure 1 in the Student resource on the overhead projector and discuss how they change the orientation of a figure, the original figure and figure 2 are named as new figures.



The paper transparency only one quarter inch from the students get confidence with instructions, and discussion about the center figure, "Figure 1," of a variety of transformations. Be sure to mention that the students may use coffee stirrers to represent a system of lines of reflection. When drawing a rotation, have the students indicate the center of rotation as well as the direction and size of the angle. For example, "rotate 90°." Name the figure after each transformation.

Engage

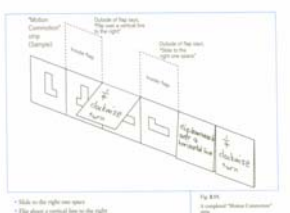
Have the students work collaboratively with the basic transformations, and have each pair make a "Motion Commotion" copy using white, blue, and red. Have each pair create each step. First discuss with the students how to use the grid. The "Motion Commotion" copy. Explain to the students how to use the grid. The students may use coffee stirrers to represent a system of lines of reflection. When drawing a rotation, have the students indicate the center of rotation as well as the direction and size of the angle. For example, "rotate 90°." Name the figure after each transformation.

Explore

Have the students work with the basic transformations, and have each pair make a "Motion Commotion" copy. This has to be the only one that has not been done by the students. Have the students place the figure in the same orientation as that figure and have the students perform a translation, a reflection, or a rotation of the figure and record the resulting image on the grid to the right of the first one. Discuss the students in half down the page. The second one has to be done in the same orientation as the first one. The students may use coffee stirrers to represent a system of lines of reflection. When drawing a rotation, have the students indicate the center of rotation as well as the direction and size of the angle. For example, "rotate 90°." Name the figure after each transformation.

Activity

Have the students work with non-mathematical materials, such as small blocks, toothpicks, and one ball of yarn. Encourage them to discuss how half-turns and reflections are related. Challenge the students to find multiple applications of these materials. Picking a ball of yarn as a disk is an example of a translation. The movement of the ball of yarn in a straight line is an example of a translation. A pair of sticks holding up a cardboard length different configurations. The movement of a ball of yarn in a straight line is an example of a translation. A pair of sticks holding up a cardboard length different configurations. The movement of a ball of yarn in a straight line is an example of a translation.



Puzzles with Pizzazz

◆ Goals

- Practice mentally manipulating shapes
- Develop strategies to solve visual logic puzzles
- Combine shapes to create different shapes

◆ Materials

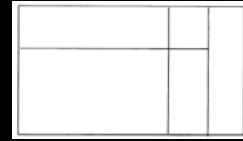
- A variety of spatial-visualization and logic puzzles
- [BLM masters – Puzzles and Tangrams](#)
- CD-ROM – Tangrams



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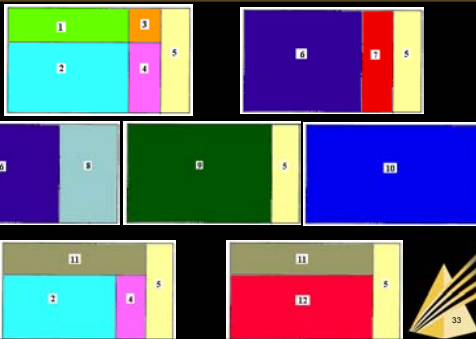
Puzzles with Pizzazz

How many rectangles are in the rectangle puzzle?



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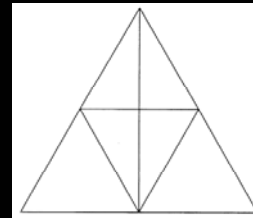
Solution



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Puzzles with Pizzazz

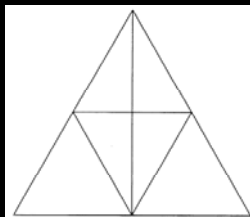
How many triangles are in the triangle puzzle?



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Puzzles with Pizzazz

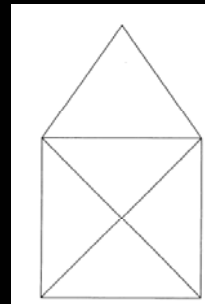
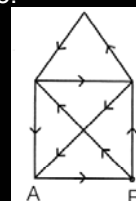
How many other shapes are in the triangle puzzle?



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Puzzles with Pizzazz

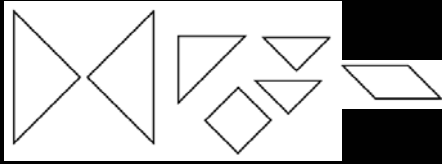
Without lifting your pencil or retracing the lines, trace this figure.



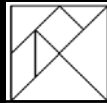
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Tangram Puzzles with Pizzazz

Try to create a square using 1, 2, 3, 4, 5, 6, or 7 tangram pieces.

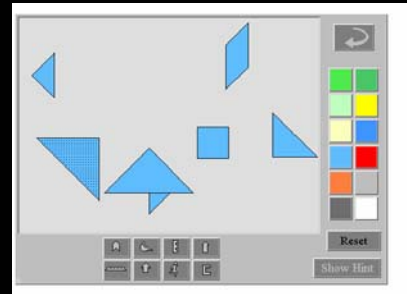


SOLUTION



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Tangram Challenges CD-ROM Applet



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Pattern Patch CD-ROM Applet




- ◆ To begin, click on a shape to place them in the work space.
- ◆ The Slide, Turn, Flip, and Delete buttons can be used on any shape.
- ◆ Have the students examine the designs to see if they can rearrange the pattern blocks to find new shapes with five, six, or seven sides.
- ◆ They should record which blocks make up the new figure, trace around the new shapes, and verify the number of edges by counting the sides in the diagram.
- ◆ They can also discuss the number of angles in their diagrams and compare that number with the number of sides.

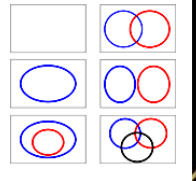
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Shape Sorter CD-ROM Applet

Students use the Shape Sorter applet to become familiar with the characteristics of quadrilaterals, including parallelograms, trapezoids, rectangles, rhombuses, and squares.

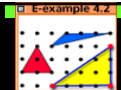
Click on  and move the cursor into the work space. Place the figure in the in the diagram. A total of sixteen quadrilateral pieces are generated.

Use  to select one of the following Venn diagrams.



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Geoboard CD ROM Applet



Directions:

Click on the rubber-band box and drag a rubber band to the geoboard. Click on a node to attach one end of the rubber band to that node.

Discussion Questions:

- Is it possible for a triangle to have two right angles?
- How many different right triangles can be made on the geoboard?
- If you could make a triangle that was as large as you wanted, would you be able to make one that had two right angles?
- Write everything you know that is true about all right triangles.
- Write in your own words the definitions for the new geometric terms we have found (isosceles, scalene, acute, and obtuse).

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Additional CD-ROM Resources

- ◆ [Templates](#)
- ◆ [Puzzle Sets](#)
- ◆ [Students' Tessellation Art](#)
- ◆ [Articles](#)

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