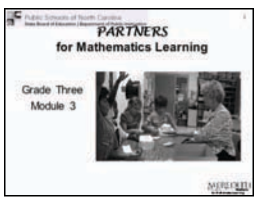
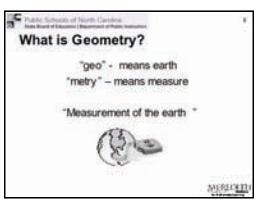
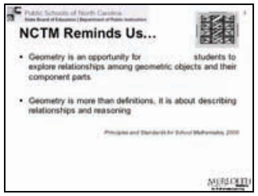
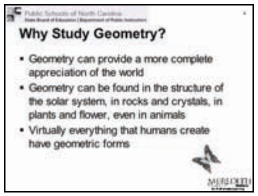
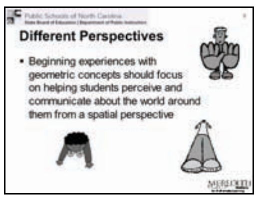
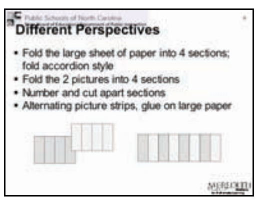
General Materials and Supplies:
scissors, markers, index cards, masking tape, large white paper, glue sticks, index cards (4 x 6); large index cards (5 x 7)
Prop to show for Greedy Triangle story; 2 sheets of large chart paper; markers

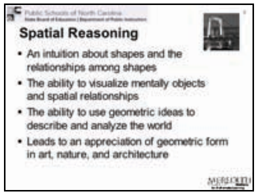
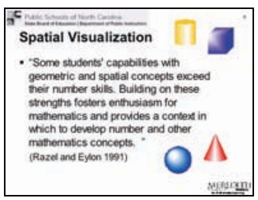
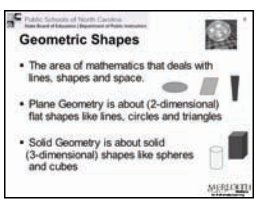
Straws (flexible) pipe cleaners, pattern blocks, geoboard, geobands, geodot paper; dice of two different colors, coordinate grids, van de Walle cards for polygons; twenty 4 inch by 4 inch squares of 2 different colors (10 yellow, 10 blue);
Labels for representation of 4-Triangle problem;
Model to illustrate perspective in blue and 1 picture in yellow;
model for slide 64 (index cards with drawing and description of polygon shape)

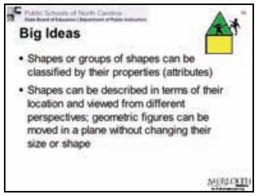
Handouts

Books: *The Greedy Triangle* by Marilyn Burns; *The Fly on the Ceiling* by Julie Glass (story of Descartes with a tale about how he figured out locating points on a coordinate grid from a spider's web on the ceiling.); *Flat Stanley* by Jeff Brown

Slide	Tasks/Activity	Personal Notes
	**(Slide 1) Title of Module 3** In the handouts there is a vocabulary list that teachers can use at any point in time. It is not a list to be given to students to memorize.	
	**(Slide 2)What is Geometry?** Give each group large paper and markers. Ask each group to record 5 ideas that answer the question, WHAT IS GEOMETRY? Share. In the geometry strand children learn to describe, compare, classify, represent and relate to objects in their own environment. Their own experiences with two-dimensional and three-dimensional objects provide children with opportunities to discover attributes and relationships among the geometric shapes. Collaboration with the art teacher offers a way to strengthen and integrate geometry into the students "real world.	

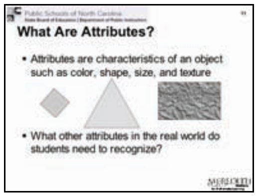
	**(Slide 3)NCTM Reminds Us…** *Ask* participants to read points on the slide. **Before the Next Slide**: Pose the question: What are other reasons to study geometry? Talk with a partner. Elicit ideas from the group.	
	**(Slide 4)Why Study Geometry?** When given appropriate experiences in mathematics, children can use the experiences to make sense of the world. Some children come to school with many experiences in their "backpack" and others have practically nothing there. What are examples of geometric experiences at home?	
	**(Slide 5)Different Perspectives** Imagery plays a significant role in mathematical reasoning. Students need many opportunities to use their spatial sense. A student might form an image of a triangle as having a horizontal base. Without other experiences, the student has a limited concept of a triangle.	
	**(Slide 6) Different Perspectives Handout 1 and 2 - Pictures for Perspective** Participants will need handout of 2 pictures; one sheet of large white paper, scissors, glue stick *Leader will need a model of final product.* Take one sheet of large white paper and fold it accordion style into 8 sections. Fold the two pictures into 4 sections, accordion style. Label each section of both pictures 1, 2, 3, and 4. Cut each of the 2 pictures into 4 parts, along the fold lines. Moving left to right on the large paper, glue section #1 of picture 1 on the first fold; glue section 1 of picture 2 on the 2nd fold of the white paper; Continue. Tape or glue sections of each picture on the large sheet, alternating pictures in order (See slide) Classroom Tip: This activity can be used as a part of projects in other subject areas. For	

	example, students can draw one picture of an ecosystem in its natural state and another picture of the ecosystem after it has been polluted. This activity could be incorporated into any topic where you show change.	
	**(Slide 7) Spatial Reasoning** Read points on the slide. We think about geometry in two different but related frameworks. 1. Spatial reasoning or spatial sense which has to do with the way students reason about shape and space. People with spatial sense have a sense of the shapes formed by objects in the environment and have an ability to mentally turn things around and view them from different perspectives. They are able to navigate in their surroundings. 2. Specific content which includes symmetry, parallel lines, shapes and properties, transformations, etc. *Ask:* What are occupations or hobbies that require spatial reasoning? Ask: Does anyone think they have good spatial reasoning? Explain. Anyone who doesn't? Explain. Spatial reasoning can be learned with experiences.	
	**(Slide 8) Spatial Visualization** Ask participants to read points on the slide. Have you taught any students that mirror the description on the slide?	
	**(Slide 9) Geometric Shapes** Ask participants to read points on the slide. Our focus in third grade will be on 2-D geometry.	



(Slide 10) Big Ideas
Read but don't elaborate as these ideas are addressed in this module.

What do we know about the shape of a stop sign? The top of different tables? Shape of the Pentagon building in Washington? Shape of a football field? Why are some places called squares?



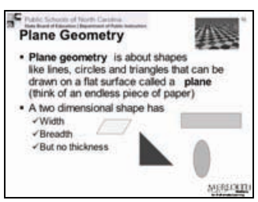
(Slide 11) What are Attributes?
The use of the word "attributes" by the teacher is important to the learner.

Say: In your group, list other attributes that might be used to describe the shapes on the slide. (Number of sides, number of vertices or angles, length of sides, size of angles.)

Suggest taking students on a "shape walk" both inside and outside of the school building. After several shape walks, listen for students' increased understanding and knowledge of geometry. Provide opportunities for students to choose one or more objects to illustrate and write about.

For those students who need to hear and apply language, play the game of "I Spy". This gives children a chance to understand the meaning of the word attributes.

Find an object in the room that is easily visible to all students. (i.e. "I spy something in our room that is circular, has black around the outside edge, has numbers on its face, What do I spy?) Ask students to describe objects for others to find.



(Slide 12) Plane Geometry
Our world has three dimensions, but a plane has only two dimensions. A plane is a surface determined by three points on that surface that are not on the same straight line.

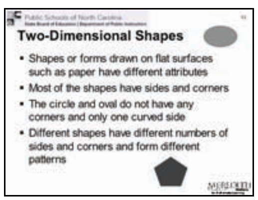
When we draw a picture or write on the top of a piece of paper, or walk on the top of a floor, we can think of the very top of the paper and the floor as a plane. This is difficult to understand as the paper and the floor both have thickness. The paper and the floor do not extend on forever in space but they help us imagine a plane as flat with no depth.
A table top is often thought of as a plane surface, as the plane on which it lies, goes on infinitely

Note: We use three dimensional materials such as pattern blocks, attribute blocks and pictures, etc to make sense of plane figures. It is important that teachers know and understand that we use 3-D shapes to support students in comparing shapes and discussing attributes and properties of 2-D shapes.

- Leaders: Please stress the fact that many third grade students figure out that pattern blocks, etc. are three dimensional shapes and get confused when using them to discuss 2-D shapes. It is important that students understand why we use 3-D shapes to learn about 2 –D shapes.

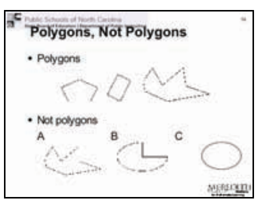
Ask students to imagine what it would be like to live in a 2 dimensional world where nothing would have height?

(Suggest that students read the book, Flat Stanley by Jeff Brown.)
There is a series of books as well as projects for third graders. Check out this web site.
http://en.wikipedia.org/wiki/Flat_Stanley



(Slide 13) Two-Dimensional Shapes
Side: The outside of 2-D shapes are referred to as sides. The sides can be straight or curved.

The manipulatives are three-dimensional but we use them to represent two-dimensional shapes. (Stress this idea as many students see pattern blocks and attribute blocks, etc. to 3-dimensional and then get confused when they are using them to discuss 2 D shapes.)



(Slide 14) Polygons, Not Polygons
Ask participants to talk with a partner to determine:

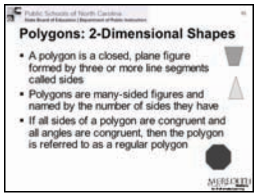
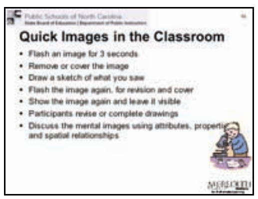
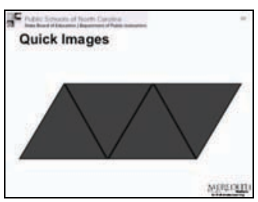
How are the top three shapes alike?

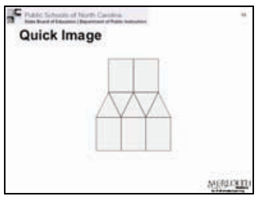
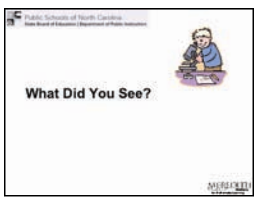
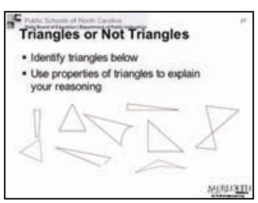
Compare Shape **A**, B, and C to a polygon.

Ask: How does looking at non-examples strengthen understanding of polygons?.
Participants should be clear and concise with reasoning.

Ask: What conjectures can you make about polygons?

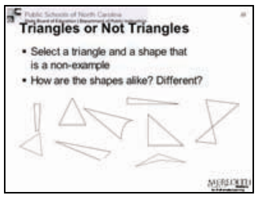
Leader Notes:

	Shape A, is not a closed figure; Shape B has a curved side Shape C. sides are closed but are also curved. "What might be a definition of polygons?" (Polygons are closed two-dimensional figures with straight sides.)	
	**(Slide 15) Polygons: 2-Dimensional Shapes** • Which pattern blocks are regular polygons? (square, equilateral triangle, hexagon) What are some other regular polygons? (any polygon with equal sides and angles) • Ask: Does a rectangle belong in a group with regular polygons? (no as sides do not have to be the same length) • What conjectures can you make about regular polygons? (Regular polygons are polygons that have both equal angles and equal sides.)	
	**(Slide 16) Quick Images in the Classroom** Review process for Quick Images. Explain that the purposes of Quick Images are to: • become more aware of thinking processes and the use of vocabulary to describe drawings • support the process of holding mental images and being able to describe them to others • support a group of students to develop shared meanings for geometric vocabulary	
	**(Slide 17) Show Image** Show for 3 seconds. Click forward.	
	**(Slide 18) Quick Images** Select questions below to generate discussions around the image. Suggested questions: • How were you thinking about the image? • What did you notice first about the shape? • Were you noticing the parts of the shape?	

	• Were you noticing how the parts of the shape fit together? • Were you noticing the whole shape at once? • Did anyone see the image or shape differently? • Did you notice the way the parts fit together or were you looking at the whole shape? • Were you able to only get part of an image? • Did you notice any relationships between the shapes? With students, teachers should introduce correct geometry terms for shapes. As teachers use these terms in class discussions, students will begin to connect knowledge and recognition to the image.	
	**(Slide 19) Quick Image** Show image for 3 seconds.	
	**(Slide 20) Quick Image** *Ask* questions from previous slide to generate discussions about the image. *Ask:* What is the mathematical emphasis for Quick Images? Ideas: Analyzing visual images; develops concepts and language to communicate about spatial relationships and properties of shapes; to support making any patterns explicit; to use number relationships to describe patterns	
	**(Slide 21) Triangles or Not Triangles** *Ask:* • Which shapes are not triangles and why? • Identify the attributes of each triangle. • Are there some shapes on the "Triangles or Not Triangles" page that are tricky? • Why do students need examples of lots of triangles as well as a variety of orientations?	

Teachers might introduce the prefix "tri" to students. "The word triangle has the prefix "tri".
What other words do you know that begin with "tri"? (tricycle, tripod)
What does the name triangle tell you about a triangle? A triangle has 3 angles.

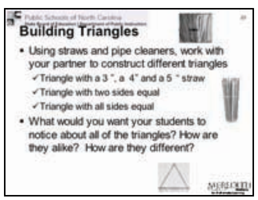
When working with students, it is important to note if students can identify the angles in the triangles? Do students recognize that triangles may have angles that are the same size or angles that are very different sizes?
In addition, triangles must have exactly 3 sides, 3 angles and 3 vertices (to be discussed later).



(Slide 22) Triangles or Not Triangles

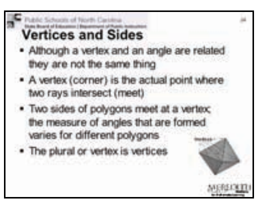
Sketch the two shapes. Record ways they are alike and ways they are different. Ask one or two participants to share whole group.

How might this task support student understanding of triangles? Explain.



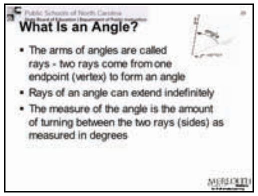
(Slide 23) Building Triangles
Use scissors, straws, pipe cleaners and rulers to construct triangles described on the slide.
With partners, compare triangles using attributes and properties to discuss likes and differences.
Share.

Note: Polygons can be built using toothpicks for the sides and small marshmallows, clay, (soaked) chick peas or jelly beans for the vertices.



(Slide 24) Vertices and Sides
Read points on slide to clarify correct vocabulary when describing 2-dimensional shapes, in this case polygons.

- *Ask* participants to extend their left arm. Touch the elbow of your left arm with fingertips on your right hand and move you left arm up and down.
- Think of the elbow as a vertex.
- Thinking of motion or rotation is one way of thinking about angles.



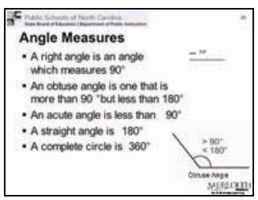
(Slide 25) What is an Angle?

Ask participants to read the points on the slide.

- The measure of the angle is the amount of turning of one ray from the other.
- When an angle makes a square corner, it is called a right angle. A right angle measures 90 degrees.
- Participants can use their left or right elbow as a vertex. Using fingertips from the opposite hand, demonstrate angles of different measures.
- It is important to build with your students an agreement on "classroom" vocabulary. For ex. students might use words like 'pointy" and "square corner" and other language as they develop understandings of angles. Teacher should use correct language.

The entire class must have meaning used by students' descriptions using informal vocabulary. How might you develop these common understandings in a classroom?

The word degree is a unit that is used to measure temperature but the degree measure in geometry is used to measure the amount or turn of an angle.



(Slide 26) Angle Measures

Third graders are expected to identify the types of angle as exactly 90 degrees, less than 90 degrees, and greater than 90 degrees.

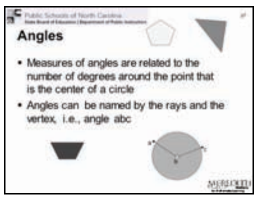
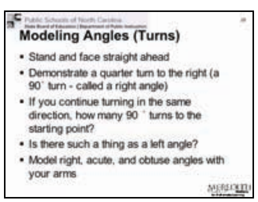
Point out the square in the right angle on the slide.

What does this show about the measure of this angle? (square corners will fit into a right angle)

We measure angles in degrees. There are 360 degrees in one full rotation or complete circle. In mathematics we use a symbol, which is a little circle ° following the number, to mean degrees. For example **90°** means **90 degrees.**

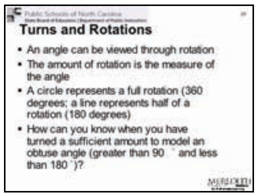
Tell participants:

- Students are expected to know the name of each type of angle (acute, right, obtuse)
- An acute angle is less than 90 degrees.
- An obtuse angle is greater than 90 degrees but less than a straight angle.

	• A straight angle is a straight line and measures 180 degrees. A full circle is 360 degrees. This is not information students must know but this information supports learning about angle measure. A connection can be made to skateboarding or other sports in which athletes "do a 180 or 360". You can also talk about the use of 180 in everyday usage. Why would it make sense for a person to say that someone "did a 180" when he changed his mind? • Many students who have experiences with skateboarding, can share connections to angle measure or degree of turn. *(Note: Teachers should tell students that "Degrees" can also mean <u>Temperature</u>, but in geometry we are referring to Angles in shapes.)*	
	**(Slide 27) Angles** *Ask* participants: "How do you think about an angle?" There are several ways to we might think about an angle. • Angle in a drawn figure is static. View angle as the measure of the distance in degrees between of two lines (rays) meeting or intersecting when drawing a triangle or a quadrilateral. • Consider an angle as a rotation or a sweeping motion as in a clock • Consider an angle in relation to a circle where the two line segments (radii) drawn from the center of a circle designate a portion of the circle. (Students would see angles in a circle graph • In polygons, the number of angles helps identify the name of the polygon. • Angles can be identified as right, acute, or obtuse.	
	**(Slide 28) Modeling Angles (Turns)** • Model angle turns. Face forward.. Tell participants to focus on something they see straight in front of them (or use directions of north, south, east, west) • Make a right angle turn using your body. Where or what are you facing now? • Make an additional right angle turn, using your right body. • Students can visualize this as halfway around a circle. Students can see that two 90 degree turns equal a 180 degree turn. Tell students this is called a straight angle. • Continue turning by making another right angle. Finally turn again, making another right	

angle. You should arrive back to your starting place. (Some students might model this by pretending to jump with a skateboard.)

Use body movements to measure acute angles as well as obtuse angles. Use language of students to build correct vocabulary as they identify, describe and classify shapes and rotations.



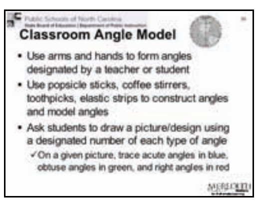
(Slide 29) Turns and Rotations

Ask: What understandings do we want third graders to have about angle measures?

<u>Note:</u> Students do not measure angles with protractors until Grade 5.

- Students can describe rotations as whole turns, half turns, and quarter turns around a center point.
- Students know and can demonstrate with their arms or by rotation of their bodies that a quarter turn creates a right angle and measures 90 degrees. An obtuse angle measures greater than 90˚ and less than 180˚.
- Students should see that an obtuse angle lies between a right angle and a straight angle, and that an acute angle is less than 90˚, smaller than a right angle.
- Students should discuss that an acute angles lies between no turn and a quarter turn or right angle, an obtuse angle lies between a right angle and a half turn or straight angle.

Many students can describe a rotation as a whole turn or "a 360" and a half turn as "a 180" based on experiences with skateboards or other sports.



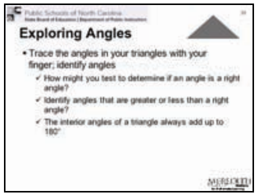
(Slide 30) Classroom Angle Model

Handout 3 " Creating 2-D Shapes-Elastic Strips"

Give directions to students.

"Please show me a right angle" etc. Students can use their arms, using the elbow as a vertex. Students can use elastic strips, string, yarn etc. to model different size angles with a partner. These angles can be within polygon shapes. Examples: Ask students to make a triangle with all sides equal. Describe the angles. Identify and describe the angles in the shape.

Take students on an angle hunt. Students might sketch drawings and label each type of angle found in their drawings.



(Slide 31) Exploring Angles

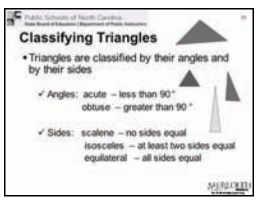
Students may come to Third Grade with no experiences with angles.
Some will come with informal language of thinking of a right angle as a square corner.

Ask: Is it possible to draw a triangle with 2 right angles**?** Explain.
(No, The sum of all angles in a triangle is always 180 degrees. Two right angles would sum to 180 degrees but would not make a triangle.) This is not information students must know but teachers need to know that the sum of the angles for all triangle is 180 degrees.

(Slide 32) Angle Search

Refer participants to handout 4 "Angle Search Recording Sheet"

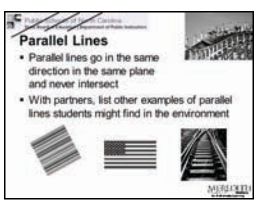
Ask Participants: "Where do we encounter angles every day?" (street intersections, letters of the alphabet, movement of clock hands, etc...)
Give participants a few minutes to find one or more of each angle on the recording sheet.



(Slide 33) Classifying Triangles

- In table groups, classify the triangles you created. What discoveries did you make?
- Third graders are not accountable for the names of scalene or isosceles but they do need many experiences that support understanding that a single geometric shape can belong in more than one category or grouping.
- Third graders should consider an isosceles triangle as at least two sides equal and then describe each angle as right, acute or obtuse.

(Teachers should use correct vocabulary terms when discussing geometry. Charts with illustrations can be developed as terms are introduced. A class chart can be created by students.)



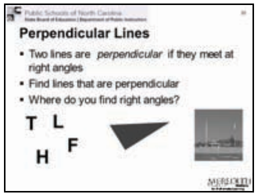
(Slide 34) Parallel Lines

- Read points on the slide.
- Lines are parallel if they are always the same distance apart (called "equidistant"), and will never meet.

Elicit ideas of places students might find parallel lines (*parallel bars in gymnastics, lines on notebook paper, railroad tracks, roller coaster tracks, picture frames, etc.*

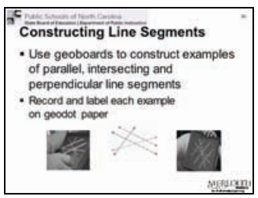
- What are other ways to describe parallel lines? *(They lie in the same plane and are the same distance apart. Parallel lines will never meet.)*

- What are ways you might develop; this concept? (Look for parallel lines in the environment; in designs in clothes, etc.)
- Instructionally, what might be the problem with using a picture like the railroad tracks to demonstrate parallel lines? *(In real life they are parallel, but from the perspective of a picture they look like they are converging.)*



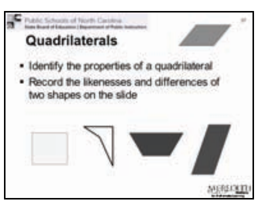
(Slide 35) Perpendicular Lines
Elicit answers to points on the slide.
Ask: Can you draw a shape has a right angle with out 2 lines that are perpendicular?

The letter Y does not have two lines that are perpendicular as the line segments do not intersect to create a right angle.
The vertical poles on the goal post attach on the horizontal pole at right angles.
Two segments of the triangle intersect forming the right angle. Does the goal post have any parallel lines? (Yes the two vertical posts going up on each end appear to be parallel.)
Look for places in the environment where two lines intersect to form a right angle?



(Slide 36) Constructing Line Segments
Just mention that geoboards provide another opportunity for students to explore parallel and perpendicular line segments. The geoboard allows students to be risk-takers because errors are easily corrected.
Using geoboards allows students to be active participants and to develop visual memory of geometric concepts. The geoboard provides opportunities to build vocabulary.

Tell participants to make the initials for their name on the geoboard.
Ask: Do you have any lines of symmetry? Perpendicular lines? Parallel lines?

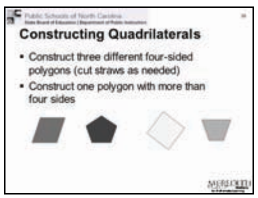


(Slide 37) Quadrilaterals
Ask: What are attributes of a quadrilateral?
Give Directions: Pair with a partner. Choose two quadrilaterals on the slide.
Sketch them on paper.
Focusing on attributes, compare ways the quadrilaterals are alike and different.

All 4 sided polygons are quadrilaterals. Which quadrilaterals have parallel lines?
Which are parallelograms?

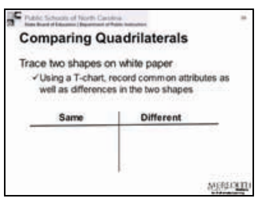
What other names do your quadrilaterals have?

A shape with two sets of parallel sides is called parallelogram. There may be no right angles.
What shapes on the slide are parallelograms?
Explain attributes that determine a parallelogram.
Teachers might extend this activity by using some of the Van de Walle cards or quadrilaterals from Power Polygons or other polygon sets.



(Slide 38) Constructing Quadrilaterals
Ask participants to work in table groups.
As a table group, follow directions on the slide while making different examples.
Table groups should have no polygons that are congruent.

Ask: How are quadrilaterals named?
How many different terms can be used to describe squares?
A square can be identified as polygon, quadrilateral, parallelogram, rectangle, rhombus, square. Other terms that may come up are congruent, similar, trapezoid (DPI use "exactly one pair of parallel sides" to define a trapezoid so a square would not fit).

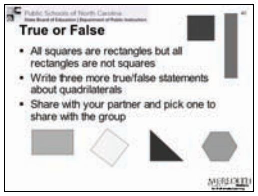


(Slide 39) Comparing Quadrilaterals

- *Ask* table groups to select two of their quadrilaterals and follow directions on the slide. Ask one or two pairs to share comparisons.
- *Ask*: What attributes would you want third graders to notice as they compared shapes?
- Hold up a rectangle made of straws (from previous work). If I slant the sides, what happens to the angles? Is the shape still a parallelogram?

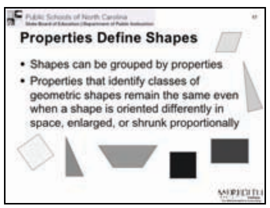
Ask: How might students prove the sides are parallel or not parallel?
Participants may consider whether diagonals are equal or number of diagonals.

If students have access to Turtle Logo games they can test their using technology. Illuminations is a website developed through NCTM which has a lot of interactive experiences for geometry.



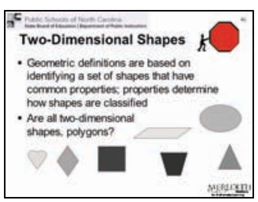
(Slide 40) True or False
Ask: Is a square a rectangle?
True or False: All squares are rectangles but all rectangles are not squares.
True: A rectangle is defined as a quadrilateral with only right angles and a square also has this property. Opposite sides are congruent (equal).

Participants write three more true/false statements about quadrilaterals with a partner.
Have a few participants read their statements for the group to discuss and decide. This would be a good opportunity to model an "every student response" technique. For example, participants could do thumbs up for true and thumbs down for false. Point out that this strategy gives teachers a chance to quickly assess their students' understanding and to decide on their next steps such as who they will call on to explain. Be sure to point out that it is sometimes productive to call on a student who has the wrong answer to explain as well as the student who has a correct answer.

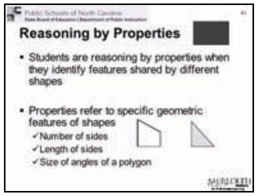


(Slide 41) Properties Define Shapes
Ask: Why is it important that students focus on attributes of shapes?
Does turning the paper change the shape?

Remind participants we want students to focus on properties. Does the shape have all of the properties of a triangle (closed shape, 3 straight sides, 3 angles)?
A rhombus, a parallelogram with four equal sides, only becomes a square when the angles are right angle, and it remains a rhombus if it is turned on the page or reoriented and if it is larger, smaller, or a different color.



(Slide 42) Two-Dimensional Shapes
Before students are introduced to definitions, students need to experience activities that develop their critical observation skills and focus on properties of figures rather than on simple identification or just the ability to name shapes.

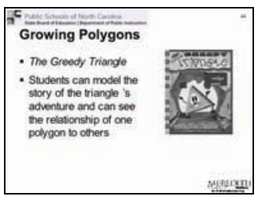


(Slide 43) Reasoning by Properties
Ask: What attribute is shared by the shapes on the slide?

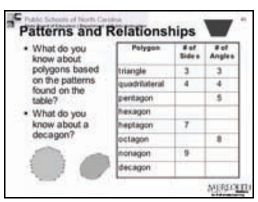
As children begin to develop ideas about geometric shapes, they begin to determine which aspects of the object to ignore and which to aspects to consider.

Example: When a student examines a group of figures and says, "All of these are triangles", the student is reasoning by properties. The student is able to see common features that designate the shapes as triangles.

Students may notice a striped book and a lid to a shoe box are both rectangles, even though the shapes have many different attributes (such as color), both objects have a rectangular shape. Attributes include many different ways to describe an object (color, smell, etc.). Properties refer specifically to geometric features.



(Slide 44) Growing Polygons
Refer participants to handout 5 "Greedy Triangle"
Introduce the book "The Greedy Triangle" by Marilyn Burns and briefly give an overview of the story. Demonstrate how the prop for the book is constructed. (Show a model of the prop; see handout.)
Demonstrate how the prop is used as the story is read to students.
Leaders may add more strips to build polygons with more sides if they wish to do so.
Point out the information for naming polygons in the back of the book.

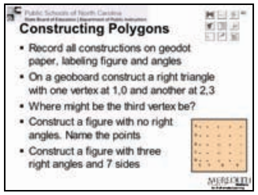


(Slide 45) Patterns and Relationships
Ask: Describe the relationship shown on the function table. For each side added, one angle is added. If I take out an angle, I will take out one side on the polygon.
If I added two sides to a polygon, how many angles would be added? (2)

In the book, *The Greedy Triangle,* each shape is changed by adding another side. Students can see that another angle is added, each time a side is added. Ask students to explain why happens.

Ask: Is this true for irregular polygons?
Yes. The relationship between the number of sides and the number of angles exists in all

polygons. To have a closed shape, the side added to a polygon must connect to another side, creating a vertex with an interior angle.



(Slide 46) Constructing Polygons

Refer to handout 6, "Polygons on a Geoboard"; handout 7, "Make Geometry Visual"; and handout 8 "How Many Different Polygons"

- Give participants geoboard, geoband, and dot paper. Using a 5 x 5 geoboard, ask participants to follow direction on the slide. Describe your shape to a partner.
- What mathematics did you use in this activity? How does this activity support a focus on attributes of shapes?
- What other shapes might you ask student to make?
- How does this activity promote student discussion and use of vocabulary?

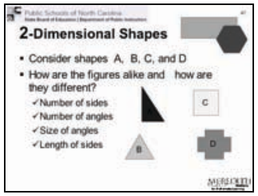
Tell participants that students will need to use coordinates to identify location of a vertex or vertices of 2-D shapes.

Refer participants to handout for more suggestions for geoboard activities.

This activity provides students with an opportunity to focus on precise language as well as properties of geometric shapes. Students should be able to use geoboards to investigate properties of polygons, including number of sides, number of angles, size of angles and to determine which sides are equilateral etc.

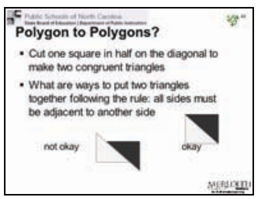
Students will need Geodot paper and a 5 x 5 geoboard with both axes labeled. If you don't have this type of geoboard, attach masking tape along both axes and have students label the pegs using a thin marker.

Students transcribe geoboard designs onto geodot paper and make and test conjectures about properties of triangles and quadrilaterals.



(Slide 47) 2-Dimensional Shapes
Say: With a partner, discuss different attributes of Shapes A, B, C, and D.
Are there relationships within a shape? Among shapes?

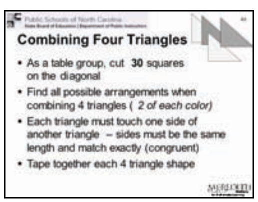
As you classify shapes, consider the attributes shapes have in common. Students need opportunities to see interrelationships of properties within shapes. For instance, if the sides of a triangle are equal, the angles are equal. Seeing relationships among shapes is reflected when classifying a square as a rectangle because the square has all the properties of a rectangle. Remember a rectangle has 4 right angles. The opposite sides of a rectangle are congruent. Does a square have each of these properties?
(Shape D is a dodecagon – "do" meaning 2 and "deca" meaning 10 so 2 + 10 or 12 sides)



(Slide 48) Polygon to Polygons?
Ask participants to create all possible polygons using 2 right triangles.
Ask? What is a key mathematical idea of this activity?
(Shapes can be decomposed and recomposed to make different shapes.)

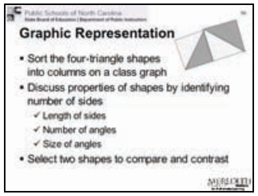
There are only three shapes possible with one square. (a square, a triangle and a parallelogram)

What would the possible shapes be if you started with a rectangle instead of a square? (For this activity students could start with an index card).



(Slide 49) Combining Four Triangles
Participants work in groups of 3 or 4. When participants think they have found all shapes, ask participants to check to make sure that no shapes are congruent to another shape.

Remind participants that it is common for students to think shapes are different because they are positioned differently. Students should test for congruency by flipping or rotating shapes. There are 14 possibilities.



(Slide 50) Graphic Representation
Refer participants to handout 9, "Squares"; handout 10, "Four-Triangle Graph"; and handout 11, "Labels for Graph"
Prepare paper ahead of time for a graphic display. You can make a display on a counter, table, floor, etc.

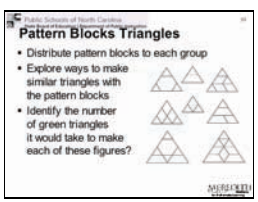
- *Ask*: What shape did you make that has the least number of sides?
- Ask a participant to bring the shape.
- Discuss name and properties of each shape added to the graph by identifying number of sides, length of sides, and size of angles.
- Is there a different shape with 3 sides? Are there any shapes with 4 sides? Are there different 4 sided shapes? 5 sided and 6 sided shapes.

Have cards available to label graph. Participants should decide where to place the cards and why. Discuss: Ways to modify this activity with your students?

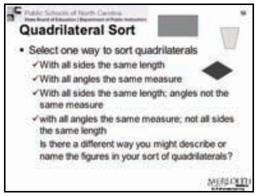
This activity provides another opportunity for students to establish interrelationships of properties within shapes (for instance, if the sides of a triangle are equal, the angles are equal) and among shapes (a square is a rectangle because it has all the properties of a rectangle). 5 sides? 6 sides? If duplicate shapes are added, allow students to figure out which shape is congruent to another shape. What might you do when students call the parallelogram a diamond? (Ask them to look at a pattern blocks might be one suggestion) Accept students' language but continue to use the correct language in discussions and when adding labels.

Remind participants that students need access to a dictionary or a computer to look up vocabulary as needed. There are many web sites for geometry definitions with examples.

Chart showing correct shapes and cards are in the handouts.



(Slide 51) Pattern Blocks Triangles
*Tell participants: "*You might have students work in pairs to give or write or describe directions for building one of the triangles, then see if another pair of students can build it by following the directions." Elicit other ideas if time allows. Point out that giving students opportunity to *use* vocabulary is much more productive than simply memorizing them.



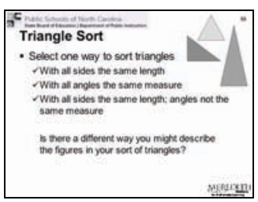
(Slide 52) Quadrilateral Sort
(Van de Walle Cards)
You will not have time to do this activity. Discuss possible sorts.

In the classroom: Students need experiences sorting polygons and labeling groups.
Venn diagrams allow students to play "Guess My Rule" games.

- Give directions for this sort.
- Remind participants that they received these cards last summer.
- Use polygon shapes from Van de Walle card set.
- Assign a different sort for each group of 3 or four. For larger groups, there may be two groups for each number.

Sort 1: All shapes are quadrilaterals
Sort 2: All shapes are rectangles (The quadrilaterals should include all rectangles which will also include squares. This will help students begin to see why a square is classified as a rectangle.)
Sort 3: All shapes should be rhombi (plural of rhombus). Why are squares included?
Sort 4: All shapes should be parallelograms.
Sort 5: All non-polygon 2 dimensional shapes
Sort 6: Polygons by number of sides

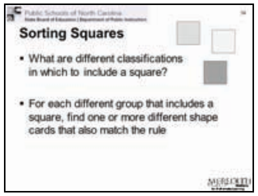
Ask for other suggestions of ways to sort Polygons.



(Slide 53) Triangles Sort
Discuss, but you will not have time to sort cards.
Each group should think about these three sorts using the shape cards with triangles.

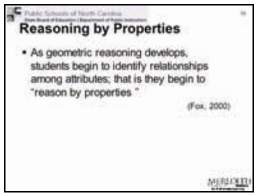
Ask: What is the relationship between sides and angle measure for triangles? (For triangle, if sides are the same length, then angles have the same measure).

Ask: Does this hold true for quadrilaterals? (no) Justify your thinking.



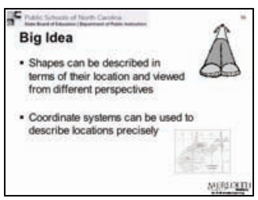
(Slide 54) Sorting Squares
Make a list of different classifications in which to put a square.

For each classification, find a different shape in the same group that follows the same rule. (polygon, quadrilateral, parallelogram, rectangle, rhombus, square)



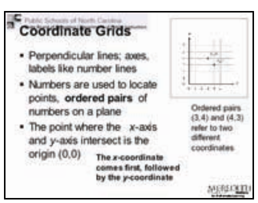
(Slide 55) Reasoning by Properties
Refer participants to handout 12, "Constructing Polygons".
Participants might notice: All sides are equal or congruent and opposite sides are parallel, or adjacent sides are perpendicular. These are examples of reasoning by properties.

Students at an analysis level (based on the Van Hiele Levels) are able to consider all shapes within a class rather than a single shape. At this level, students are able to talk about all rectangles and are able to reason about the properties of rectangles.



(Slide 56) Big Idea
Ask participants, "When do we use coordinate grids?" Identifying points on a coordinate grid is important in understanding how the coordinate system works and in constructing simple line graphs to display data to plot points.

These skills can be used to examine algebraic function and relationships. Work with coordinate grids can be applied to interpreting latitude and longitude in map reading in social studies and to plot points to represent data collected and recorded during science experiments. Many cities have streets that have been designed based on a coordinate system.



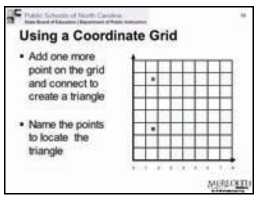
(Slide 57) A Coordinate Grid is …
In third grade, students are introduced to the system Descartes invented for locating points on a plane. Students plot points on a coordinate plane. They are introduced to new vocabulary: axis, origin, coordinate grid, horizontal axis, y-axis, x-axis.

A coordinate grid has two perpendicular lines, or **axes**, labeled like number lines. The **horizontal axis** is called the ***x*-axis**. The **vertical axis** is called the ***y*-axis**. The point where the *x*-axis and *y*-axis intersect is called the **origin**.

The numbers on a coordinate grid are used to locate points. Ordered pairs are written in parentheses (*x*-coordinate, *y*-coordinate). The origin is located at (0,0). Note that there is no space after the comma.

When introducing coordinate grids to students, ask students to identify perpendicular lines and parallel lines that create the coordinate grids.

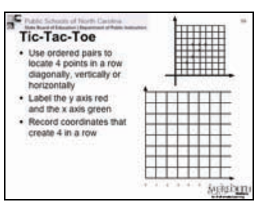
To reinforce and deepen students' understanding of coordinate grids, ask students to use rulers and draw a coordinate grid. Label origin, both axes, and add numbers.



(Slide 58) Using a Coordinate Grid
Refer participants to handout 13, "Using Coordinates to Locate Polygons", and handout 14 "Coordinate grid paper"
Answer questions on slide. Find grid paper in handout.

- Work with a partner to model a different polygon.
- Designate two or more points and ask a partner to complete the shape.
- Record coordinates and describe the properties of the shape.
- Reverse roles.
- What are advantages for using grid paper to construct and locate polygons versus geoboards.
- What other activities might you provide third grade students to develop ideas around coordinate grids? (maps of their town or city, maps of their state; games using coordinate grids such as Battleship and online games.

Another classroom activity: Teachers can give coordinate points for mystery shapes and ask students to predict what figure they think will be formed by connecting the points of the grid.



(Slide 59) Tic-Tac-Toe
Refer participants to handout 15, "Tic-Tac-Toe Four in a Row Game", and handout 16, "Grids for Game"
Game Directions (See handout for more detail):

Materials: Coordinate grids; 2 colored pencils of different colors: dice of 2 different colors per team (one die represents the horizontal line and a different color of die represents the vertical line.)

Participants share a game board which is a coordinate grid.
(Partners may play on different game boards as they are learning the rules)

In turn players roll 2 regular dice of two different colors and plot the point on the grid indicated by the roll. Players determine which player places O on the grid and which player places X the grid.
The winner must get 4 Os or 4Xs in a row horizontally, vertically, or diagonally.

This game gives students an opportunity to learn how to plot points on a coordinate grid as well as thinking strategically.

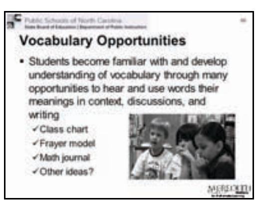
The first player to connect 4 Xs or 4 Os in a row wins the game.
Winner might have 2,2 3,2 4,2 5,2.

Once one player has 4 in a row, the game is over.

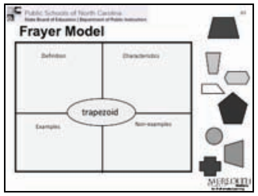
Both players should record the winning coordinates using the recording sheet in the handout.

Classroom:
After several games, have a class discussions around the patterns found in the coordinates for 4 in a row vertically, horizontally, and diagonally. For example, in the example game above, the winner always had 2 as the y-coordinate. Did she win with a vertical, horizontal, or diagonal line? How do you know?
Ask: What is the mathematics in this game?

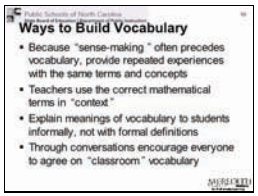
Share book: *The Fly on the Ceiling* by Julie Glass



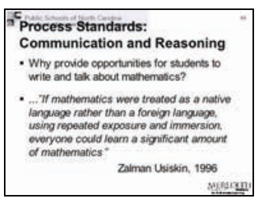
(Slide 60) Vocabulary Opportunities
Language is one way students express their ideas and images about shapes. Children have and use their own informal language which becomes a base for building more mathematical vocabulary as well as geometric ideas. Through students' verbal expressions, we gain insights into their thinking.
Share ideas around ways to support student in learning and understanding vocabulary.



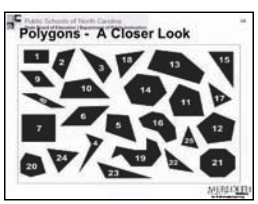
(Slide 61) Frayer Model
This is an example of a graphic organizer as a way to develop vocabulary.
There are other versions for this model as well as other models on line.



(Slide 62) Ways to Build Vocabulary
Refer participants to handout 17, "Geometry Vocabulary"
With a partner: Choose one or two of the bullets to discuss.
Share thoughts whole group.
Students will begin to use their informal language as well as mathematical vocabulary at the same time as they hear words in a context which builds understanding. Teachers should always keep in mind that "sense making" precedes the accurate vocabulary. This process takes time. Do not expect students to use terms as soon as they are "told" to them. Provide repeated experiences which build ideas around concepts and terms.

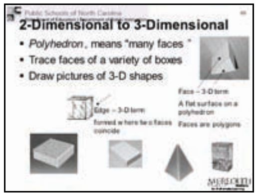
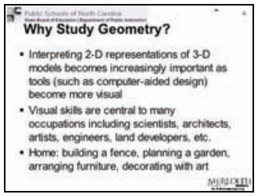
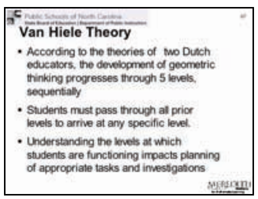
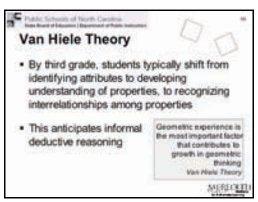
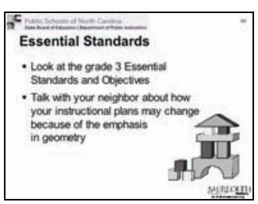


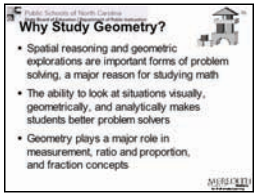
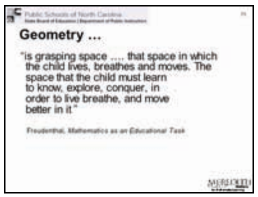
(Slide 63) Process Standards:
Communication and Reasoning
Pose question:
Why have students writing and talking about mathematics? Share ideas.
Writing and talking about their thinking clarifies students' ideas and gives the teacher valuable information from which to make instructional decisions.
This idea shifts the role of the teacher to a role which allows students to assume more responsibility for their own ideas and thinking. Students need ongoing opportunities to communicate and justify their thinking and ideas both orally and in writing.



(Slide 64) Polygons - A Closer Look
Refer participants to handout 18, " Shapes for A Closer Look". If you have time you can do the activity. If not, briefly explain or give participants time to look over it.

When students do this activity they sometimes focus on the number printed on the shape (ex. The number on my shape is odd.). Leaving the door open for this is a nice way to encourage students' number sense.

	**(Slide 65) 2-Dimensional to 3-Dimensional** In building understanding of the structure of objects, children must move between two-dimensions and three dimensions (Van de Walle, 1997). As students draw, build, and take apart solids, children see how flat surfaces come together to form an object that they can pick up, hold, and rotate.	
	**(Slide 66) Why Study Geometry?** Ask participants to read points on slide.	
	**(Slide 67) Revisiting Van Hiele Theory (handout 19 notes on Van Hiele)** The next two slides are a reminder that the right geometric experiences are critical if students are to show growth in geometric thinking. You can find more information in handouts if needed in your district.	
	**(Slide 68) Revisiting Van Hiele Theory** Read the slide.	
	**(Slide 69) Essential Standards** Provide a few minutes for participants to look at essential standards for geometry.	

	**(Slide 70) Why Study Geometry?** Find an acute and an obtuse angle on the clocks. Where might the hands on a clock be to form a right angle? Note: Because of the way the minute hand moves on a clock, the angles may not be exact. Use "teaching" clocks that can be purchased or create clocks using paper plates. Fractions concepts are related to geometric part-to-whole constructs. Ratio and proportion are directly related to concepts of similarity, measurement, and geometry and have many relationships such as area, perimeter, surface area, volume, capacity, etc.	
	**(Slide 71) Geometry (closing slide)** Read quote.	
	(Slide 72-75) Credits	