

<b>LessonTitle: Classifying Polygons</b>		<b>Geo 2.0b</b>
<b>Utah State Core</b> Geometry Content Standard 3.1 Process Standards 1-4		
<b>Summary</b>		
<p>This lesson is a set of activities that involve students in discovering the definitions and characteristics of triangles and quadrilaterals. The first activity is a logic game that helps students understand classification systems. The second activity uses Geometer’s Sketchpad to learn the triangle classifications and then provides a practice sheet for students. The quadrilaterals section starts with a Sketchpad activity, and has a discovery activity where students identify the properties of quadrilaterals. A graphic organizer is provided for students to record their findings. The final activity involves students in folding and identifying the shapes that result. See also another excellent graphic organizer (see associated link).</p>		
<p style="text-align: center;"><b>Enduring Understanding</b></p> <p>Communicating effectively about shape and space involves a logical system of classification. This classification involves analyzing characteristics and properties and developing arguments about geometric relationships.</p>	<p style="text-align: center;"><b>Essential Questions</b></p> <p>What are the similarities and differences among different triangles and quadrilaterals? How do you precisely describe and classify them?</p>	
<p style="text-align: center;"><b>Skill Focus</b></p> <ul style="list-style-type: none"> <li>• Observing geometric shape characteristics</li> <li>• Classifying shapes by sides and angles</li> </ul>	<p style="text-align: center;"><b>Vocabulary Focus</b></p>	
<b>Materials:</b> Computers with Geometer’s Sketchpad, Tangrams, Polygon Cutouts (see below)		
<b>Launch</b>		
<b>Explore</b>		
<b>Summarize</b>		
<b>Apply</b>		
<p><b>Assess</b></p> <ul style="list-style-type: none"> <li>• Have students keep a record of learning associated with defining and classifying quadrilaterals (see below).</li> <li>• Circle folding assessment below.</li> </ul>		

**Directions**

Sorting shapes by characteristics and using informal deduction skills are basic to Geometry. Pick and choose from the selection of these kinds of activities below. **As students investigate the following activities, they should record their learning as they go. (See record sheet below) Save the worksheet for use in Module 5 in classification of geometric solids.**

**Part I General sorting using logic about shapes** (depending on your students’ experience you may choose to leave this section out. However the Classify and Capture game also involves a lot of logic and gets the kids to differentiate properties. It could be used at any time during the year.)

- Have students analyze 2 and 3 dimensional shapes by exploring their characteristics and properties in the following activity from Navigating Through Geometry: Geodee's sorting Scheme, pages 13-15 and student worksheet page 86
- Play the Classify and Capture game. See directions and card set 1 below. (Taken from an article in Mathematics in the Middle School, NCTM, February 2003)

### Part II Triangles

- Access the worksheet on page 63-64 of Exploring Geometry with Geometer's Sketchpad. You will also need the Classify Triangles.gsp from the premade sketches found on the disc which accompanies the book.
- Access the activity, "Exploring Triangles" from Navigating Through Geometry, pages 16-18 and student worksheet pages 87-88. This also requires the use of Geometer's Sketchpad or some other dynamic software.
- Have students **classify triangles** using Venn Diagrams. See Navigating Through Geometry, Using Venn Diagrams to Reason about Shapes, pages 23-24 and student worksheet page 93.
- Have students sort the triangles on the handout below. They might sort them by
  1. size
  2. angles: obtuse, right and acute.
  3. sides: scalene, isosceles, equilateral.
  4. sides and angles: scalene obtuse, scalene right, isosceles right, scalene acute, isosceles scalene, equilateral.

### Part III Quadrilaterals

- To help students **define quadrilaterals**, access the worksheets on page 89-98 of Exploring Geometry with Geometer's Sketchpad. You will also need the Special Quads.gsp from the premade sketches found on the disc which accompanies the book.
- Have students do the **Properties of Quadrilaterals** activities found in Patty Paper Geometry pages 87-97, 76-78, 81-82
- Have students **classify quadrilaterals** using Venn Diagrams. See Navigating Through Geometry, Using Venn Diagrams to Reason about Shapes, pages 23-24 and student worksheet page 93.
- Have students create property lists (use the rules below) for quadrilaterals: squares, rectangles, rhombi, parallelograms, trapezoids, kites. Have the student groups create the property lists. Then create a master list. From that master list have student groups eliminate redundancies and create a minimal list.

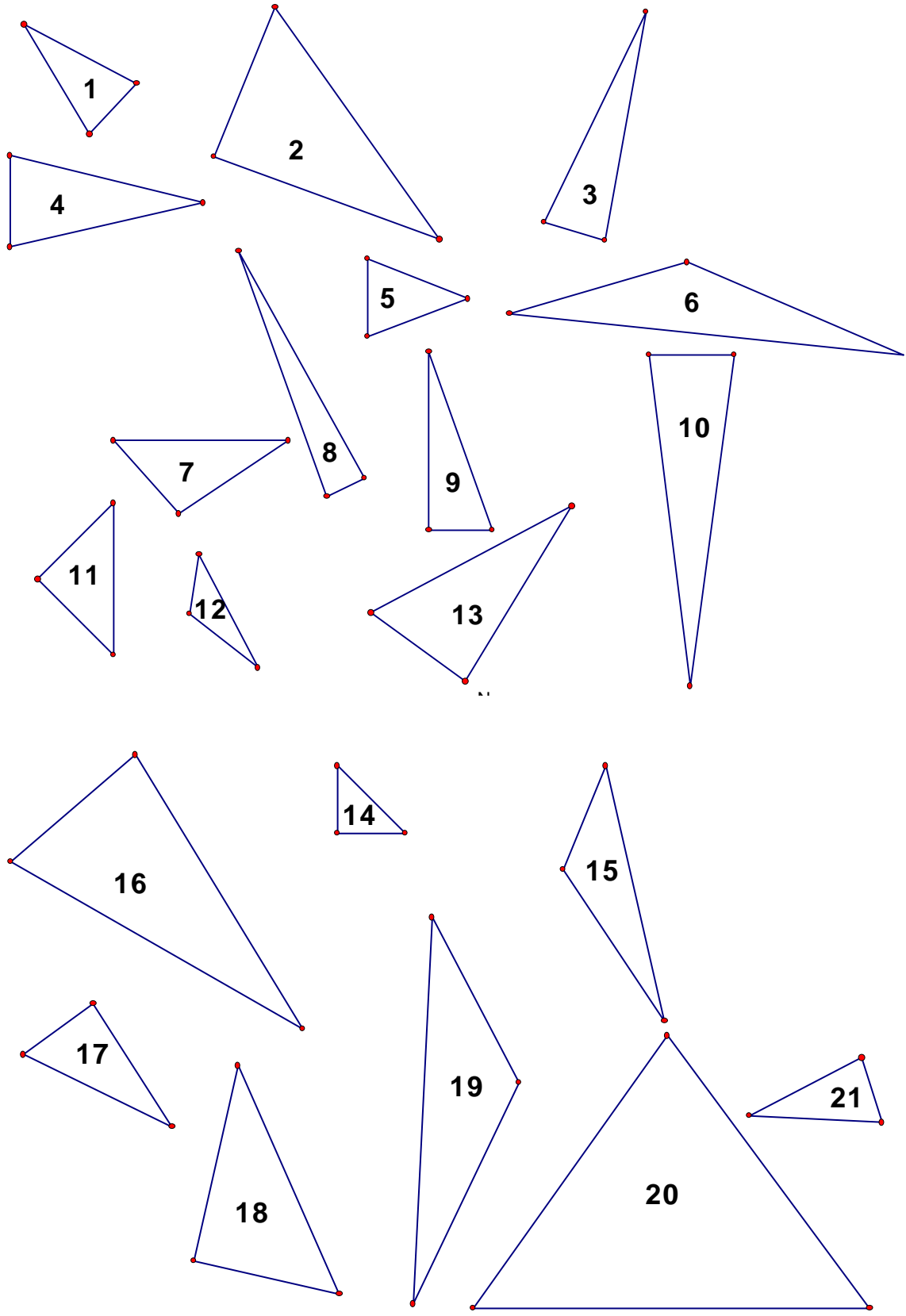
### Wrap-up

Don't forget the circle assessment found below.

Students could now play the classify and capture game using attribute cards for card set 2. (See pattern below.)

## Record of Geometry Terms, Figures and Shapes

Shape	Description	Examples
Concave		
Convex		
Symmetrical		
Nonsymmetrical		
Regular Polygons		
Triangles (classified by properties of sides)		
Equilateral		
Isosceles		
Scalene		
Triangles (classified by properties of angles)		
Right		
Acute		
Obtuse		
Quadrilaterals (convex)		
Parallelogram		
Rectangle		
Square		
Rhombus		
Kite		
Trapezoid		
Isosceles Trapezoid		
Regular Polyhedra		
Semiregular Polyhedra		
Prisms		
Right Prisms		
Pyramids		
Right Pyramids		
Cylinders		
Right Cylinders		
Cones		
Right Cones		



## Geo 2.0b Rules and Suggestions for Creating Property Lists

1) In order to be a property, the characteristic must be true for every shape. That is, you must be able to say “all squares...” not “some squares...”

2) Organize the properties in categories:

- **Properties of sides:**
- **Properties of angles:**
- **Properties of diagonals:** (Note: Diagonals can be perpendicular or not perpendicular, congruent or not congruent, bisected by the other diagonal or not bisected.)
- **Properties of symmetry (line and point):**
- **Can be inscribed or circumscribed with circles:** (assumes this has been taught—not required).

3) Where appropriate, use terms such as “At least n things...” or “At most n things...”

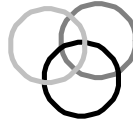
4) Avoid talking about smaller shapes created by drawing diagonals or other lines. For example, that “the diagonal of a rectangle forms two right triangles” is not really different than saying it has four right angles.

### Materials needed:

- Sets of commercial or homemade tangrams in four different colors. (If you are playing the advanced polygon game, then you will need to create the playing pieces in different colors for each of the four group members. Using the pattern below, copy 8–10 groups of four colors. Use cardstock, laminate and cut out.)
- Sorting hoops (can be purchased from Educator’s Outlet) or appropriate Venn diagrams drawn on large sheets of paper.
- A set of teacher-made attribute-label cards for each group. Make color cardstock copies of the sheet below. Laminate

### Getting Started:

- Divide students into groups of four.
- Distribute one set of playing cards and three sorting hoops to each group.
- Each player receives 1 set of tangrams.(four players receive four different colors)
- Place label cards face down on the table.
- Arrange the sorting hoops in overlapping
- circles.



### Playing the Game:

- Player 1 begins the game by turning over 3 label cards and placing one in each of the three circles
- All four players place their tangrams in the appropriate circles, classifying each piece according to the label cards in each of the three hoops. Once pieces are placed, players are not permitted to retrieve them.
- The object of the game is to “capture” misplaced pieces. The person with the most pieces at the end of the game wins. After all players have placed their pieces, students reason and argue about placement. Player 1 tries first. If he/she identifies a misplaced piece (his or someone elses), he must argue why the piece does not fit and then explain where it should be placed. If player 1 argues his point correctly, he takes the piece. If the misplaced piece was his own, he can use it again in the next round. If the misplaced piece belonged to an opponent, player 1 “captures” this piece; it doesn’t go back into play for the remainder of the game.
- After player 1, the other players take their turns identifying misplaced pieces. On each turn, players may identify and remove only one misplaced piece at a time. Play continues until everyone in the group agrees there are no more misplaced pieces.
- To prepare for round 2, remove the three label cards used in the first round and players collect their uncaptured pieces. Player two places three new cards on the Venn diagram. After all players place their pieces back on the diagram, player two begins the process of arguing and capturing misplaced pieces.
- If a player identifies a piece as misplaced when it was placed correctly, the next player continues.
- Play continues until all label cards have been used.
- If a player loses all her pieces, she may still argue and capture in turn.

Classify and Capture card set 1

Yellow	Not Yellow	Large Triangle
Blue	Not Blue	Not Large Triangle
Green	Not Green	Medium Triangle
Red	Not Red	Not Medium Triangle
Triangle	Not Triangle	Triangle
Square	Not Square	Not Small Triangle
Parallelogram	Not Parallelogram	

Classify and Capture advanced polygon card set 2

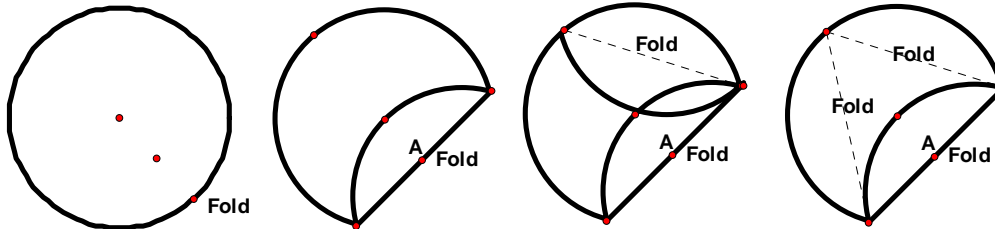
Isosceles	Not Isosceles	Trapezoid
Equilateral	Not Equilateral	Not Trapezoid
Scalene	Not Scalene	Square
Right	Not Right	Not Square
Acute	Not Acute	Triangle
Obtuse	Not Obtuse	Not Triangle
Parallelogram	Not Parallelogram	Quadrilateral
Kite	Not Kite	Not Quadrilateral
Concave	Convex	Tesselating
Regular	Irregular	Non Tesselating
Curved	Noncurved	Rectangle
Not Rectangle	Rhombus	Not Rhombus

## Assessment

## Folding a Circle

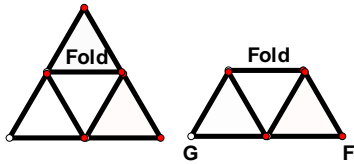
You will submit your folded circle for evaluation along with the following worksheet.

1) Create a circle with about a 20 cm diameter (about the width of a sheet of paper). Mark the center. Pick a point on the circle and fold to the center. Do it again, using one endpoint of A as an endpoint of B.



Fold the remaining third to the center. What shape do you have? \_\_\_\_\_.

2) Find the midpoint of one side by creasing lightly. Fold the opposite vertex to the midpoint and you have now formed \_\_\_\_\_



3) Observe the 3 triangles in the shape above. Fold one triangle over the top of the middle one and you have made a \_\_\_\_\_ or a \_\_\_\_\_

4) Fold the remaining triangle over the top of the other 2 triangles. What shape do you have now? \_\_\_\_\_

4) Let the 3 triangles folded over in steps 2, 3, and 4 open up. Bring points G and F together. What 3D shape is revealed? \_\_\_\_\_

8) Open back up to the original triangle you made in step 1. Fold each of the vertices to the center. You now have a \_\_\_\_\_