**The Shape and Space Strand: Outcome SS7.2**

[Learning Space](#ls) [What Students Should…](#wss) [Key Questions](#kq) [Assessment](#assessment) [Instruction](#instruction)

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| **Outcome** | **Indicators** |
| SS7.2 Develop and apply formulas for determining the area of:* triangles
* parallelograms
* circles.

[CN, PS, R, V]*In support of the K-12 Mathematics goals of Spatial Sense, Number Sense, Logical Thinking, and Mathematical Attitude.* | 1. Illustrate and explain how the area of a rectangle can be used to determine the area of a triangle.
2. Generalize a rule to create a formula for determining the area of triangles.
3. Illustrate and explain how the area of a rectangle can be used to determine the area of a parallelogram.
4. Generalize a rule to create a formula for determining the area of parallelograms.
5. Illustrate and explain how to estimate the area of a circle without the use of a formula.
6. Illustrate and explain how the area of a circle can be approximated by the circumference of the circle times its radius.
7. Generate a formula for finding the area of a circle.
8. Solve problems involving the area of triangles, parallelograms, or circles.
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| **Learning Space** [**Top**](#top) |
| In grade 6, the students developed a formula for determining the area of a rectangle as well as formulas for determine the perimeter of polygons and the volumes of right rectangular prisms. Along with the developing and applying formulas for the circumference of circles, the students in grade seven also are developing formulas for determining the areas of triangles, parallelograms and circles. It is very important that the students discover and generalize formulas based on their prior knowledge and new experiences rather than being given the formulas directly. Development of the formulas by the students help the students to make connections and see relationships that otherwise would likely be missed. As well, if the students have to develop the formulas themselves, they are more likely to remember them later, and even if they don’t, they will have the understanding necessary to determine the area of 2-D shapes using alternate strategies to the formulas.Geometrical figures occur everywhere, so the students should be able to explore these relationships in a variety of contexts, environments, and subject areas. Students should be encouraged to look around them and to identify possible problems and situations that they could use to explore area, develop formulas, and practice applying the formulas. |

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| **What Students Should…** [**Top**](#top) |
| **Know** | **Understand*** A rectangle can be divided into two equal triangles.
* A parallelogram can be cut and the pieces rearranged to form a rectangle.
 | **Be Able to Do*** Determine, by measuring, comparing, or reading labelling on a diagram, the height and base length of a triangle or parallelogram.
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|  | * The area of a triangle and the area of a parallelogram are directly related to the area of a rectangle with the same height and base length as the triangle or parallelogram.
* The height of a 2-D shape is the shortest distance from a vertex of the triangle to the side opposite, and the side opposite is the height.
* A triangle has 3 pairs of heights and base lengths that need not be the same.
* The height of a parallelogram is the shortest distance between a pair of parallel sides in the parallelogram and the length of one of the parallel sides is the base length.
* The area of a parallelogram is directly related to the area of a rectangle with the same height and same base length.
* A parallelogram has two different pairs of heights and base lengths that may or may not be the same.
* A circle that is cut into wedges defined by central angles can have the pieces rearranged to form a 2-D shape very similar to a parallelogram.
 | * Determine the area of a triangle using a formula and explain.
* Determine the area of a parallelogram using a formula and explain.
* Determine the area of a circle using a formula and explain.
* Estimate the area of a triangle, parallelogram, or circle.
* Solve problems involving the areas or estimates of the areas of triangles, parallelograms, and circles.
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|  | * As a circle is cut into more and more wedges the 2-D shape formed by rearranging the pieces becomes closer and closer to a perfect parallelogram with a height that is the same as the radius of the circle and a base length that is ½ of the circumference of the circle.
* Area is a measure of the amount of surface on a 2-D shape.
* Area is a 2-dimensional measurement and will have squared units.
* Relate the squared units of area to squares of length and width 1 unit long.
* That  can be used to determine the approximate area of a circle and explain why.
* The reasoning behind formulas for finding the areas of triangles, rectangles, and circles.
* Area is conserved through physical movement.
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| **Key Questions** [**Top**](#top) |
| * What is area?
* How are the formulas for the areas of different 2-D shapes similar? How are they different?
* How is the area of a triangle related to the area of a parallelogram or a rectangle?
* How is the area of a circle related to the area of a parallelogram?
* Why are the units for area squared?
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| **S****uggestions for Assessment:** [**Top**](#top) |
| **Big Idea:**Area of triangles.**Suggestions for assessment tasks:**1. Provide the students with a drawing of two triangles shown in different orientations and ask the students to predict which they believe would have the greater area and to justify their choice. Next, ask them to verify their prediction. (Note: the students should be allowed to look up the formula that they derived for the area of a triangle, or it should be provided to them.)
2. Using the small triangles from a Tangram set, ask the students to explain how the formula for the area of a triangle is related to the area of a rectangle.
3. As a homework assignment, ask the students to find something that is triangular in shape, write a problem about the area of the triangle and solve the problem.

**What to look for:*** See [*Area of Triangles Rubric*](file:///C%3A%5CUsers%5Ckw426%5CAppData%5CLocal%5CTemp%5CArea%20of%20Triangles%20Rubric.doc)*.*

**Big Idea:**Area of parallelograms.**Suggestions for assessment tasks:**1. Provide the students with the square and two small triangles from a tangram set and ask them to construct a parallelogram for you. Next, ask the students to use the same pieces to construct a rectangle. Ask the students what they know about the area of the parallelogram and why.
2. Provide the students with two of the beige triangles in the pattern blocks and ask them to construct a parallelogram. Next ask the students to determine the area of the parallelogram and to explain their reasoning.
3. Have the students solve a problem involving the area of a parallelogram.

**What to look for:*** See [*Area of Parallelograms Rubric*](file:///C%3A%5CUsers%5Ckw426%5CAppData%5CLocal%5CTemp%5CArea%20of%20Parallelograms%20Rubric.doc)*.*

**Big Idea:**Area of circles.**Suggestions for assessment tasks:**1. Provide the students with a radius length and ask them to construct a circle with that radius. Next, ask the students to determine both the circumference and area of the circle and explain the meaning of each measurement.
2. Have the students develop a problem involving the area of circle and solve the problem. Have the students exchange problems and solve.

**What to look for:*** See [*Area of Circles Rubric*](file:///C%3A%5CUsers%5Ckw426%5CAppData%5CLocal%5CTemp%5CArea%20of%20Circles%20Rubric.doc)*.*
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| **S****uggestions for Instruction:** [**Top**](#top) |
| **Big Idea:**Area of Parallelograms.**Suggestions for instructional activities**1. Have the students recall what they know about the area of rectangles. Have the students draw a rectangle and determine its dimensions and area. Next, ask the students how much area there would be if they cut the rectangle into two smaller rectangles. Just as recognizing that 5 objects grouped in any way is still 5 objects, the conservation of area through physical movement is a crucial understanding for students. It should not be assumed that this conclusion is obvious – in fact, it may take some exploration beyond the first example.
2. Have the students use concrete manipulatives, such as pattern blocks and Tangram pieces, as well as diagrams for drawing on and/or cutting, to explore what shapes can be used to make up a parallelogram, and how those shapes can be moved around to make other shapes. Have the students share their results, their ideas, and their struggles.
3. Draw the students’ attention to a parallelogram transformed into a rectangle. Have the students determine the area of the rectangle. Then, ask the students what they think the area of the parallelogram would be and why. When the students come to the conclusion that the area of the parallelogram would be the same as the area of the rectangle, ask them if the formula for the area of the rectangle still works, and if so, where would they measure. If they feel it does not, allow the students to experiment with determining a formula through exploration of the parallelogram.
4. Debrief the students’ strategies. Tell them that typically the area of a parallelogram is defined in terms of base length (b) and height (h). The students will likely be used to using the terms length and width. Ask the students why these terms (length and width) aren’t as good when describing a parallelogram.
5. Have the students explore the classroom and school for examples of parallelograms, and find the areas of those parallelograms. Also ask the students to write, solve, and share problems involving the area of parallelograms.

**Big Idea:**Area of Triangles.**Suggestions for instructional activities**1. Have the students use concrete manipulatives, such as pattern blocks, power polygons, as well as diagrams for drawing on and/or cutting, to explore the relationship between triangles and parallelograms and rectangles. Ask the students to write in their journals about the relationship, and to hypothesize a formula for the area of a triangle. Have the students share their hypotheses and reasoning. As a class, come to consensus regarding what is the area of a triangle.
2. Provide the students with drawings of parallelograms and rectangles with triangles inscribed that have the same base length and height. For each 2-D drawing, provide the students with the shape of either the parallelogram, rectangle or triangle and ask them to determine the area of the other 2-D shape in the drawing. Have the students explain their reasoning with a partner.
3. Provide the students with problems about triangles in the classroom which they can measure the dimensions of and have the students solve the problems.
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| ***Big* Idea:**Area of Circles.**Suggestions for instructional activities**1. Beginning with a set of fraction circles, construct parallelograms made from each fraction of the circles. For example, use the eight 1/8 pieces to make a parallelogram-like 2-D shape with four of the 1/8 pieces pointing downwards and the other four filling in the spaces from below. Have the students discuss what is happening with the shape of the rearrangement of the pieces as the pieces get smaller (and emphasize that this means there are more pieces). Using either a commercial circle or one that you have constructed with at least 36 equal pieces, construct the parallelogram-like 2-D shape to verify the students’ hypothesis about the shape.
2. Next, have the students suppose that the circle pieces have become so small that the new shape is a true parallelogram. Have the students individually reflect on the following questions: “What is the height of this new parallelogram?” and “What is the base length of this new parallelogram?”. You may need to give the hint that the students should be thinking about the circle that the parallelogram came from.
3. In pairs and using the answers from 2, have the students hypothesize what they think the formula for the area of the circle and write a journal entry explaining why.
4. Have the students compare their formulas and come to consensus regarding the formula for the area of a circle. Note: the students may not be familiar with the notation of r2, so some time may need to be spent on developing that notation. The formula A = r2 can also be recorded as A = rr
5. Have the students solve and create problems involving the area of circles.

*Note: It is very common for students in grade 7 to still confuse 2-D shapes and 3-D objects. This is especially common when working with the area of circles. Take advantage of all opportunities to have the students to reflect upon what makes something 2-D or 3-D, as well as what the units for 2-D tell them about the type of measurement and what they are measuring.* |