GRADE 7 - MODULE 12 - CONSTRUCTIONS AND GEOMETRIC SHAPES

Big Ideas
Geometric shapes can be constructed by focusing on given measures of sides and/or angles. Three-dimensional figures have unique characteristics that can be analyzed by two-dimensional cross sections.
Vocabulary
plane sections, construction, horizontal, vertical, protractor, two-dimensional, three-dimensional, plane section, right rectangular prism, rectangular pyramid, parallel, perpendicular, lateral, base, parallelogram, rectangle, trapezoid.
Prior Learning
Students have worked with identifying two-dimensional and three-dimensional figures in previous grades.
Essential Questions
• What is the relationship between two-dimensional and three-dimensional figures? • How are 3D figures different from 2D figures? • What is a cross section of a figure and how will that help compute properties of the figure? • How can I use two-dimensional figures to find the measures of three-dimensional figures? • How many triangles can be constructed using the same three angle values? Explain your answer. • How many triangles can be constructed when given three side measurements? Explain your answer. • How many triangles can be constructed when given a side measure, the angle measure, and a side measure where the given angle measure is between the two sides? Explain your answer. • Define plane section. • Explain how a plane section is related to the base of a 3-dimensional figure if the cut is parallel to the base. • Explain how a plane section of a pyramid is related to the lateral sides if the figure is cut through the vertex.
Competencies
• Students will be able to describe the two-dimensional shape that results from slicing three-dimensional figures when the slice is parallel to the base. • Students will be able to draw triangles given three angle measures. • Students will be able to draw triangles given three side measures. • Students will be able to draw triangles given two side measures and the inscribed angle. • Students will be able to identify the conditions of a triangle which determine a unique triangle, more than one triangle, or no triangle. • Students will be able to use technology to draw geometric shapes with certain conditions. • Students will be able to describe the two-dimensional shape that results from slicing three-dimensional figures when the slice is cut perpendicular to the base. • Students will be able to describe the two-dimensional shape that results from slicing three-dimensional figures when the slice is cut at a slant to the base. • Students will be introduced to 3D solids and cross sections of 3D figures.
Misconceptions
• Students may have difficulty visualizing and describing the two-dimensional plane sections of 3-dimensional figures. • Students may find it challenging to understand that three angle measures can create an infinite number of triangles. • Students may have difficulty with representations of three-dimensional figures.
Resources from The Key Elements to Mathematics Success - KEMS Grade 7 for Building the Conceptual Understanding of this Module
KEMS Lesson 23 – Drawing and Constructing Triangles Additional Activities: Quiz – T605-T606 KEMS Lesson 24 – Plane Sections of 3-D Figures Additional Activities: Quiz – T705-T707, Chain Reaction T977-T978

NYS Next Generation Learning Standard	Examples
7.G.2 Draw triangles when given measures of angles and/or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. **Note**: Create triangles through the use of freehand drawings, materials (scaffolds may include: pipe cleaners, Legos®, and toothpicks), rulers, protractors, and/or technology.	Students draw geometric shapes with given parameters. Parameters could include parallel lines, angles, perpendicular lines, line segments, etc. Example 1: Draw a quadrilateral with one set of parallel sides and no right angles. Students understand the characteristics of angles and side lengths that create a unique triangle, more than one triangle or no triangle. Example 2: Can a triangle have more than one obtuse angle? Explain your reasoning. Example 3: Will three sides of any length create a triangle? Explain how you know which will work. Possibilities to examine are: 13 cm, 5 cm, and 7 cm; 3 cm, 3cm, and 3 cm; 2 cm, 7 cm, 7 cm Solution: "A" above will not work; "B" and "C" will work. Students recognize that the sum of the two smaller sides must be larger than the third side. Example 4: Is it possible to draw a triangle with a 90° angle and one leg that is 4 inches long and one leg that is 3 inches long? If so, draw one. Is there more than one such triangle? *(NOTE: Pythagorean Theorem is NOT expected – this is an exploration activity only)* Example 5: Draw a triangle with angles that are 70 degrees. Is this a unique triangle? Why or why not? Example 6: Draw an isosceles triangle with only one 80º angle. Is this the only possibility or can another triangle be drawn that will meet these conditions? Through exploration, students recognize that the sum of the angles of any triangle will be 180º.

Questions for 7.G.2

1. Draw a triangle with a 90-degree angle and one 45-degree angle. Make a prediction about the measure of the third angle.

2. Complete the chart below to determine if you can draw a triangle with the three given side measures.

Side Measures	Triangle? Yes or No	Explanation
2, 4, 5		
5, 8, 15		

3. If you are constructing or drawing a triangle and are given the side measure, the angle measure and the side measure, how many different triangles can be drawn or constructed? Explain your answer.

4. Complete the chart for triangle constructions.

Situation	Conclusion
Three angles are given: AAA	
Three sides of aa triangle are given: SSS	
When a side angle, side is given: SAS	

Answer Key for Questions for 7.G.2

1. A triangle has 3 angles. The three angles must have a total measure of 180 degrees. If one angle is a right angle (90 degrees) and the second angle is 45 degrees, then the third angle must have a measure of 45 degrees.

2.

Side Measures	Triangle? Yes or No	Explanation
2, 4, 5	Yes	The third side is always less than the sum of the first two sides.
5, 8, 15	No	The third side is not always less than the sum of the first two sides.

3. Only 1 - When the angle is between the two sides and the sides are the same and the angle is the same the triangles will always be congruent.

4.

Situation	Conclusion
Three angles are given: AAA	Infinite number of possible triangles. Triangles are similar
Three sides of aa triangle are given: SSS	If the third side is less than the sum of the first two sides, one triangle can be constructed. If the third side is more than the sum of the first two sides, a triangle cannot be constructed.
When a side angle, side is given: SAS	Only one triangle can be constructed. The angle is between the two sides.

Tasks for 7.G.2

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Extra Questions for Warm-ups and Homework for 7.G.2

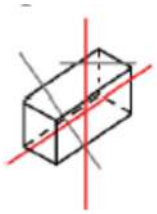
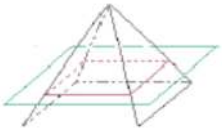
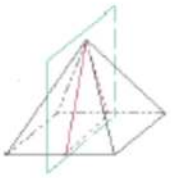
1. Draw two triangles. Each triangle should have angles that measure 30 degrees, 60 degrees and 90 degrees. Is it possible to draw triangles with different side lengths using the same angle measures? Explain your answer and use a model.

2. Trade homework assignments with a partner and compare the triangles you created using the angle measure of 30, 60 and 90 degrees. How many possible triangles can be drawn using those angle measures? Discuss with your partner.

3. Compare the triangle you drew for homework and the triangle your partner drew. What conclusions can you draw about drawing triangles that have the same side lengths? Use your model to defend your answer.

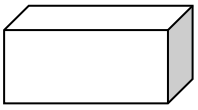
4. Explain the differences and similarities of two- and three-dimensional figures

5. Discuss your homework answers with your partner and draw a representation of a 2-dimensional and a 3-dimensional figure.

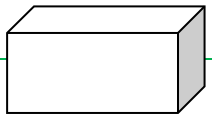
NYS Next Generation Learning Standard	**Examples**
7.G.3 Describe the two-dimensional shapes that result from slicing three-dimensional solids parallel or perpendicular to the base. **Note**: Focus of standard is on plane sections resulting from the slicing of right rectangular prisms and right rectangular pyramids.	Students need to describe the resulting face shape from cuts made parallel and perpendicular to the bases of right rectangular prisms and pyramids. Cuts made parallel will take the shape of the base; cuts made perpendicular will take the shape of the lateral (side) face. Cuts made at an angle through the right rectangular prism will produce a parallelogram;   If the pyramid is cut with a plane (green) parallel to the base, the intersection of the pyramid and the plane is a square cross section (red).  If the pyramid is cut with a plane (green) passing through the top vertex and perpendicular to the base, the intersection of the pyramid and the plane is a triangular cross section (red).  If the pyramid is cut with a plane (green) perpendicular to the base, but not through the top vertex, the intersection of the pyramid and the plane is a trapezoidal cross section (red).

Questions for 7.G.3

1. If a right rectangular prism is sliced vertically in relationship to the base, what is the shape of the 2-dimensional figure of the slice?



2. If a right rectangular prism is sliced horizontally in relationship to the base, what is the shape of the 2-dimensional figure of the slice?



3. When a slice is perpendicular to the rectangular base and through the vertex of a rectangular pyramid, what is the shape of the slice?

Answer Key for Questions for 7.G.3

1. The vertical slice is a parallelogram. It could be a square or a rectangle.

2. The horizontal slice is a parallelogram. It is a rectangle.

3. Triangle

Tasks for 7.G.3

*Teacher Note: Please read the Commentary section for the Illustrative Math Tasks. Some tasks will be instructional requiring more teacher modeling and direction. Others will provide the opportunity for students to demonstrate their knowledge of a concept.

Illustrative Math Task: Cube Ninjas! (7.G.3)
https://tasks.illustrativemathematics.org/content-standards/7/G/A/3/tasks/1532

Extra Questions for Warm-ups and Homework for 7.G.3

1. Describe the possible plane sections (2 dimensional representations) or a rectangular prism and draw each representation.

Works Referenced in the Development of the Module	
Common Core State Standards Initiative www.corestandards.org	Ohio Department of Education http://education.ohio.gov/Topics/Learning-in-Ohio/Mathematics
Illustrative Mathematics Project https://illustrativemathematics.org/	North Carolina Math Tools for Teachers https://tools4ncteachers.com/
Mathematics Assessment Project https://www.map.mathshell.org/index.php	Smarter Balanced Assessment Consortium https://smarterbalanced.org/
PARCC http://parcconline.org/	Utah Education Network https://www.uen.org/core/math/
NOYCE Foundation: https://www.insidemathematics.org/	