# *Unit 6 Measurement

Content Area: **Mathematics**
Course(s): **Geometry CP, Geometry Honors**
Time Period: **April**
Length: **8 Blocks**
Status: **Published**

## Transfer Skills

Previous coursework: know area, perimeter, surface area, and volume formulas and use them in real world applications, describe cross sections, informally derive the relationship between area and circumference of a circle, find area of irregular figures in real world applications, break down 3-D figures into nets

By the end of this unit: Students should be able to provide an informal explanation for area and circumference of a circle, and volume of a circle, pyramid, and cone using a variety of methods. Comparing the affect of manipulating dimensions and real world applications involving density and design are a big focus.

Instructional strategies:

- Project and problem based coursework is ideal for this unit- check the resources for ideas.
- Remember that the focus is not how to use the formulas, but where they come from.
- If time allows, review how to find the area and perimeter of figures on the coordinate plane.
- (+) = denotes Honors only skill

## Enduring Understandings

The formulas for circular 2-D and 3-D shapes are derived from other geometric concepts.

Area and volume problems arise in many fields, such as shipping, efficiency, and optimization.

## Essential Questions

Where do the formulas for circular 2-D and 3-D shapes come from?

How do volume and area apply to real life?

## Content

Circumference and perimeter

Area Formulas- basic

Area formulas- regular polygons (+)

Area of circles and sectors

Volume of prisms and cylinders

Volume of pyramids, cones, and spheres

Relating 2D and 3D figures

Density and other application problems

Opportunities for Algebra Review:

- Dimensional Analysis
- Evaluating Expressions

## Skills

Develop the formula for circumference of a circle.

Determine the circumferences of a circle and the perimeter of various polygons (including irregular polygons).

Use informal arguments to explain where the area formula for parallelograms, triangles, and trapezoids come from.

Apply the formulas for parallelograms, triangles, and trapezoids.

Develop the formula for area of regular polygons (+)

Determine the ares of regular polygons (+)

Construct regular polygons (+)

Develop and apply the formula for area of a circle.

Determine the area of sectors.

Use appropriate vocabulary to describe prisms.

Calculate the volume of prisms and cylinders.

Develop and apply the formula for volume of pyramids and cones

Calculate volume of spheres

Describe the cross sections formed by a cut to a solid.

Determine the 3-D shape created after rotating it a 2-D about an axis.

Use 3-D shapes to describe objects in application problems.

Solve density problems involving area and volume

Solve design problems using 2-D and 3-D shapes.

## Resources

Pearson Resources:

CB 10-7, 11-1, 11-2, 11-3, 11-4, 11-5, 11-6, 11- 7, 12-6, 8-3, 10-1, 10-2, 10-3, 3-4

Online Resources:

http://www.shmoop.com/common-core-standards/math-geometry-geometric-measurement-dimension.html

http://www.shmoop.com/common-core-standards/math-geometry-modeling-geometry.html

http://fawnnguyen.com/2013/02/13/from-listerine-to-fuji-water.aspx

http://mrmeyer.com/threeacts/youpourichoose/

http://www.yummymath.com/2012/penny-wars/

http://map.mathshell.org/materials/lessons.php?taskid=439&subpage=concept

http://map.mathshell.org/materials/lessons.php?taskid=216&subpage=concept

http://map.mathshell.org/materials/lessons.php?taskid=213&subpage=concept

## Standards

**NJSLS 2016**

**Geometry**

**GEOMETRICE MEASUREMENT AND DIMENSION**

**A. Explain volume formulas and use them to solve problems**

1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a

cylinder, pyramid, and cone. Use dissection arguments, Cavalieri's principle, and informal limit arguments.

2. (+) Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures.

3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

**B. Visualize relationships between two-dimensional and three-dimensional objects**

4. Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

**MODELING WITH GEOMETRY**

**A. Apply geometric concepts in modeling situations**

1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

**Mathematics | Standards for Mathematical Practice**

**1 Make sense of problems and persevere in solving them.**

Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt. They consider analogous problems, and try special cases and simpler forms of the original problem in order to gain insight into its solution. They monitor and evaluate their progress and change course if necessary. Older students might, depending on the context of the problem, transform algebraic expressions or change the viewing window on their graphing calculator to get the information they need. Mathematically proficient students can explain correspondences between equations, verbal descriptions, tables, and graphs or draw diagrams of important features and relationships, graph data, and search for regularity or trends. Younger students might rely on using concrete objects or pictures to help conceptualize and solve a problem. Mathematically proficient students check their answers to problems using a different method, and they continually ask themselves, "Does this make sense?" They can understand the approaches of others to solving complex problems and identify correspondences between different approaches.

**3 Construct viable arguments and critique the reasoning of others.**

Mathematically proficient students understand and use stated assumptions, definitions, and previously established results in constructing arguments. They make conjectures and build a logical progression of statements to explore the truth of their conjectures. They are able to analyze situations by breaking them into cases, and can recognize and use counterexamples. They justify their conclusions, communicate them to others, and respond to the arguments of others. They reason inductively about data, making plausible arguments that take into account the context from which the data arose. Mathematically proficient students are also able to compare the effectiveness of two plausible arguments, distinguish correct logic or reasoning from that which is flawed, and—if there is a flaw in an argument—explain what it is. Elementary students can construct arguments using concrete referents such as objects, drawings, diagrams, and actions. Such arguments can make sense and be correct, even though they are not generalized or made formal until later grades. Later, students learn to determine domains to which an argument applies. Students at all grades can listen or read the arguments of others, decide whether they make sense, and ask useful questions to clarify or improve the arguments.

**4 Model with mathematics.**

Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace. In early grades, this might be as simple as writing an addition equation to describe a situation. In middle grades, a student might apply proportional reasoning to plan a school event or analyze a problem in the community. By high school, a student might use geometry to solve a design problem or use a function to describe how one quantity of interest depends on another. Mathematically proficient students who can apply what they know are comfortable making assumptions and approximations to simplify a complicated situation, realizing that these may need revision later. They are able to identify important quantities in a practical situation and map their relationships using such tools as diagrams, two-way tables, graphs, flowcharts and formulas. They can analyze those relationships mathematically to draw conclusions. They routinely interpret their mathematical results in the context of the situation and reflect on whether the results make sense, possibly improving the model if it has not served its purpose.

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| MA.K-12.1 | Make sense of problems and persevere in solving them. |
| MA.K-12.3 | Construct viable arguments and critique the reasoning of others. |
| MA.K-12.4 | Model with mathematics. |
| MA.G-GMD.A.1 | Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. |
| MA.G-GMD.A.2 | Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. |
| MA.G-GMD.A.3 | Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. |
| MA.G-GMD.B.4 | Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. |
| MA.G-MG.A.1 | Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). |
| MA.G-MG.A.2 | Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). |

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| MA.G-MG.A.3 | Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios). |