

Do You Measure Up?

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Approximate Timeline: Two-three weeks

Area(s) of Core Content: Mathematics (Geometry)

Organizers:

Why do I need to know how to measure things?

Targeted Standards:

Academic Expectation 1--Apply Communication and Math Skills:

- 1.5 - 1.9 Students use mathematical ideas and procedures to communicate, reason, and solve problems.

Demonstrators for Academic Expectation 1.5-1.9

- Model problem solving situations using oral, written, concrete, pictorial, graphic, simple algebraic methods.
- Communicate the meanings of number, space, change, data, and measurement verbally, pictorially, symbolically, and concretely.
- Use deductive/inductive reasoning to synthesize information related to problems, making conjectures, exploring, validating, and convincing others.

Academic Expectation 2--Mathematics:

- 2.9 Students understand space and dimensionality concepts and use them appropriately and accurately.

Demonstrators for Academic Expectation 2.9

- Use attributes to classify and analyze regular and irregular figures in 2 and 3 dimensions.
- Visualize different representations of 2 and 3-dimensional geometric figures.

- 2.10 Students understand measurement concepts and use measurements appropriately and accurately.

Demonstrators for Academic Expectation 2.10

- Extend the concepts of length, area, volume, mass, weight, capacity, time, angle, perimeter, money, circumference, and temperature using measurement tools and models.
- Determine the area of irregular shapes by subdivision using manipulatives.
- Develop, through investigation, the formulas for perimeter, area, and volume.

Secondary Standards: *will be taught but not formally assessed in culminating assessment*

Academic Expectation 1--Apply Communication and Math Skills:

- 1.16 Students use computers and other kinds of technology to collect, organize, and communicate information and ideas.
 - Demonstrators for Academic Expectation 1.16
 - Analyze relationships/patterns to draw inferences using technology.
 - Integrate the use of a variety of technologies.
 - Expand knowledge by identifying and using technology for a specific purpose.

Academic Expectation 6--Integration of Knowledge:

- 6.3 Students expand their understanding of existing knowledge by making connections with new knowledge, skills, and experiences.
 - Demonstrators for Academic Expectation 6.3
 - Discover relationships among existing knowledge and new ideas, objects, and actions.

Essential Questions:

Grade Six:

1. What are the basic terms and shapes used in geometry?
2. How can you measure two-dimensional shapes?

Grade Seven:

1. How can I develop and use formulas to measure two-dimensional shapes?
2. What are the characteristics of three-dimensional figures?
3. How can I measure three-dimensional figures?

Grade Eight:

1. How can I apply the formula for two-dimensional shapes in developing and finding the surface area of three-dimensional shapes?
2. How can I find volume of three-dimensional shapes?

Culminating Performance:

Sixth Grade:

Students will design a sketch of a stained glass window. They will submit an initial plan which includes at least four named geometric shapes. The plan will find the area and perimeter of the four named geometric shapes. Students will create the stained glass window using materials (markers, construction paper, tissue paper, colored pencils/baby oil, crayons, Paint software) provided in class.

Seventh Grade:

Students will create a visual representation/product of two and three-dimensional objects (such as PowerPoint, brochure, mobile, or other approved by the teacher) describing each object using appropriate characteristics. The characteristics of the two-dimensional objects should include perimeter/circumference, area, radius and diameter. The characteristics of the three-dimensional objects should include the number of edges, faces, and vertices as well as the surface area and volume.

Eighth Grade:

- A. Students will design and construct packages that will contain four and eight congruent spherical objects. This package design must minimize surface area, be easily stackable, and attractive in design.
- B. Open Response (“Popcorn Box” prompt from Competency Assurance document)

You need a container for a box of popcorn. You cannot find a box anywhere in your house, but you did come across a flat piece of cardboard that measures $8\frac{1}{2}$ inches by 11 inches. You need to make a rectangular open top box that will hold the most popcorn by cutting out equal size squares from each corner of the cardboard and folding the flaps.

Calculate the size of the square you should cut out from each corner to make a box with the largest volume.
Determine how the volume of the box changes as you change the dimensions.

Show evidence of how you arrive at the solution with the largest possible volume and verify your reasoning.

- C. Students will also complete an objective test covering surface area and volume of three-dimensional shapes.

6th Grade Scoring Guide

Criteria	4	3	2	1
Required number of geometric shapes	More than four different geometric shapes	Four different geometric shapes	Two to three different geometric shapes	One or no geometric shapes
Initial Plan	Contains accurate measurements of the area and perimeter of the geometric shapes.	Contains mostly accurate measurements of the area and perimeter of most of the geometric shapes.	Contains some accurate measurements of the area and perimeter of some geometric shapes.	Contains few or no accurate measurements of the area and perimeter of the geometric shapes.
Visual Appearance	The window is exceptionally attractive in terms of design, layout, color, and neatness.	The window is attractive in terms of design, layout, color, and neatness.	The window is acceptably attractive though it may be a bit messy.	The window is distractingly messy or very poorly designed. It is not attractive.
Notes:				

7th Grade Scoring Guide

	4	3	2	1
Organization	<ul style="list-style-type: none"> ▪ Attractive and well organized ▪ Clearly communicates concepts and ideas 	<ul style="list-style-type: none"> ▪ Well organized ▪ Communicates concepts and ideas 	<ul style="list-style-type: none"> ▪ Somewhat organized ▪ Communicates some concepts and ideas 	<ul style="list-style-type: none"> ▪ Not organized ▪ Does not communicate concepts and ideas
Product	<ul style="list-style-type: none"> ▪ Product is expressed in a creative, colorful medium ▪ Product is pre-approved. 	<ul style="list-style-type: none"> ▪ Product is expressed in a creative or colorful medium ▪ Product is pre-approved. 	<ul style="list-style-type: none"> ▪ Product is expressed with some creativity or color ▪ Product is not pre-approved, but shows some thought or effort. 	<ul style="list-style-type: none"> ▪ Product is expressed with no creativity or color ▪ Shows lack of thought or effort
Number of Components	Must include at least 3 different triangles, 3 different quadrilaterals, 3 different geometric solids and a circle.	Product contains 7-9 required components.	Product contains 4-6 required components.	Product contains 3 or fewer required components
Concept Accuracy	All two and three-dimensional characteristics are accurate.	All two-dimensional characteristics and some three-dimensional characteristics are accurate.	Most two-dimensional characteristics and no three-dimensional characteristics are accurate.	Some or no two-dimensional characteristics and no three-dimensional characteristics are accurate.
Notes:				

8th Grade Scoring Guide—Part A				
Criteria	4	3	2	1
Design Plan	Correctly find the surface area and volume for cylinder, rectangular prism and cube.	Minor errors in surface area or volume OR uses Guess and Check to find the correct dimensions for the surface area and volume of the cylinder, rectangular prism and cube.	Surface area or volume is incorrect.	Surface area and volume are incorrect.
Package Choice	Choose the correct package which minimizes surface area.	Choose a package that does not minimize surface area (too large).	Choose correct package based on incorrect calculations.	Chose an incorrect package (too small).
Package Appearance	Package's dimensions are correct and the package is attractive.	Package's dimensions are correct but package is unattractive.	Package's dimensions are incorrect, but attractive.	Package's dimensions are incorrect and unattractive.
Notes:				

8th Grade Scoring Guide—Part B	
4	<ul style="list-style-type: none"> Completed all parts of the question accurately.
3	<ul style="list-style-type: none"> Completed all parts of the question with minor errors.
2	<ul style="list-style-type: none"> Accurately calculated the size of the squares or correctly determined how the volume of the box changed.
1	<ul style="list-style-type: none"> Showed minimal understanding of the concept.

Evaluation Component

Pre/posttests for each grade level will include multiple choice and short answer questions created by the teachers are attached at the end.

Technology Standards

- T1.1 Demonstrate ethical use of electronic resources
- T4.2 Demonstrate appropriate basic care of computers and other technology
- T4.5 Navigate within an operating system or software
- T5.10.1 Manipulate data using a graphing calculator
- T5.6 Enter and edit word processing information
- T5.6.2 Create and edit various types of documents (e.g., portfolio piece, technical writing)
- T5.7 Enter and edit spreadsheet information
- T6.1 Select appropriate software for a task.
- T6.5 Create a presentation or product using application software.

Knowledge:

- MA-M-2.1.1 Basic geometric elements that include points, segments, rays, lines, angles, and planes
- MA-M-2.1.2 Two-dimensional shapes including circles, regular polygons, quadrilaterals (square, rectangle, rhombus, parallelogram, trapezoid), and triangles (acute, obtuse, right, equilateral, scalene, isosceles)
- MA-M-2.1.3 Common three-dimensional shapes including spheres, cones, cylinders, prisms (with polygonal bases), and pyramids (with polygonal bases)
- MA-M-2.2.1 Identify characteristics (e.g., sides, vertices, angles, faces, edges, congruent parts) of two-dimensional and three-dimensional shapes
- MA-M-2.2.2 Use appropriate tools and strategies (e.g., combining and subdividing shapes) to find measures of both regular and irregular shapes
- MA-M-2.2.5 Use formulas to find area and perimeter of triangles and quadrilaterals, area and circumference of circles, and surface area and volume of rectangular prisms
- MA-M-2.2.6 Estimate and determine measurement of angles
- MA-M-2.3.1 How measurements and measurement formulas are related or different (perimeter and area; rate, time, and distance; circumference and area of a circle)
- MA-M-2.3.2 How two-dimensional and three-dimensional figures are related as seen in different orientations (e.g., top view, side view, three-dimensional shapes drawn on isometric dot paper)
- MA-M-2.3.3 How proportional figures are related (scale drawings, similar figures)

Skills/Abilities:

- M-6-GM-1 find perimeter of regular and irregular polygons in metric and U.S. customary units.
- M-6-GM-2 read and use measurement tools (e.g., rulers, scales).
- M-6-GM-3 find area of plane figures composed of squares and rectangles through subdividing and measuring and use square units appropriately.

M-6-GM-5 estimate and find angle measurement and segment measurements.
M-6-GM-7 identify properties and classify line segments, rays, planes, and points.

M-6-GM-8 recognize regular polygons; special quadrilaterals including squares, rectangles, rhombuses, trapezoids, and parallelograms; and special triangles including acute, obtuse, scalene, and isosceles.

M-6-GM-9 identify characteristics of lines (e.g., parallel, perpendicular).

M-7-GM-1 find circle measurements (radius, diameter, circumference, area) and the relationships among them.

M-7-GM-2 develop and use the formulas for area of triangles, parallelograms, and trapezoid; relate to the formula for area of rectangles ($l \times w$).

M-7-GM-3 investigate fixed area with changing perimeter and fixed perimeter with changing area.

M-7-GM-4 investigate area of polygons and other two-dimensional shapes.

M-7-GM-5 identify and classify characteristics of two-dimensional shapes, such as regular and irregular quadrilaterals, special triangles, and regular polygons.

M-7-GM-7 represent three-dimensional geometric figures with special attention to developing spatial sense (e.g., top view, side view, three-dimensional shapes drawn on isometric dot paper).

M-8-GM-3 develop and apply formulas for volume and surface area of cubes, cylinders, and rectangular prisms; and investigate relationships between and among them.

M-8-GM-4 develop and apply proportionality and relationships between scale models and actual figures.

Critical Resources:

6th grade:

- Glencoe Mathematics Course 1 (1998)
- Covering and Surrounding, Connected Mathematics, Dale Seymour Publications
- Shapes and Designs, Connected Mathematics, Dale Seymour Publications
- Graphing calculators
- Computer
- LCD Projector
- Internet websites:
- Illuminations: <http://illuminations.nctm.org/index2.html>
- Stained glass examples
- Paint software
- "Geometry in the World" PowerPoint files
- Stained glass materials: Construction paper, tissue paper, markers, crayons, colored pencils, baby oil
- Tiles
- Grid paper
- Toothpicks

- ShapeSet, from Connected Math Project
- Ruler

7th grade:

- Glencoe Mathematics Course 2 (1998)
- Graphing calculators
- Internet websites:
- Illuminations: <http://illuminations.nctm.org/index2.html>
- “Geometry in the World” PowerPoint files
- Grid paper
- Computer
- LCD Projector
- 3-D Shape Set
- PowerPoint
- Publisher
- Word

8th grade:

- Glencoe Mathematics Courses 3 (1998)
- Filling and Wrapping, Connected Mathematics, Dale Seymour Publications
- Internet websites:
- Illuminations: <http://illuminations.nctm.org/index2.html>
- “Geometry in the World” PowerPoint files
- Computer
- LCD Projector
- Various spherical objects
- Grid paper
- Rulers
- Tape
- Glue
- Construction paper
- Several centimeter cube blocks

Instructional/Assessment Activities:

6th Grade

Topic 1

Objective:

- Introduce students to basic geometric terms used to describe attributes within different stained glass windows: point, line, line segment, ray, angle classifications, and polygon names.

Description:

- The teacher will introduce basic geometric terms using: Internet websites (Stained Glass Gallery: <http://www.light-romance.on.ca/galleries.htm>) to view different stained glass window designs, and “Geometry in the World” PowerPoint files.

Assessment:

- Students will create a stained glass window using Paint software. The teacher will converse with students as they work using basic geometric terms.

Topic 2

Objective:

- Introduce students to basic polygon terms.

Description:

- Students will work through Shapes and Designs Investigation 1, and Glencoe Course 1, Lesson 9-5.

Assessment:

- Mathematical Reflections for Shapes and Designs Investigation 1, and Glencoe Course 1, Lesson 9-5 assignments.

Topic 3

Objective:

- Explore area and perimeter.

Description:

- Students will work through Covering and Surrounding Investigations 1 – 6.

Assessment:

- Mathematical Reflections and ACE assignments for Covering and Surrounding Investigations 1 – 6.

Topic 4

Objective:

- Create a design sketch for a stained glass window project. The design will contain at least four named geometric shapes with their area and perimeter.

Description:

- Using grid paper, students will design a stained glass window. Within the design, students will need to identify at least four different geometric shapes. Also, students will find the area and perimeter of the four different geometric shapes.

Assessment:

- 6th Grade Scoring Guide

Topic 5

Objective:

- Create a stained glass window project.

Description:

- Using the grid paper design, students may choose from a variety of materials (construction paper, tissue paper, markers, crayons, colored pencils/baby oil) to make their stained glass window project.

Assessment:

- 6th Grade Scoring Guide

7th grade

Knowledge that students should already have:

How to find the perimeter of a 2-D shape

How to find the area of a rectangle and parallelogram

Lesson 1:

Objective: To know how and why geometry/measurement is used in the world;
Review prior knowledge

Description: Use “Geometry in our World” PowerPoint slides; class discussion

Assessment: Students will participate in class discussion

Lesson 2:

Objective: To estimate the area of irregular figures

Description: Students will draw an outline of foot on grid paper and use the mean of the inner and outer measure to estimate the area.

Assessment: Students will complete practice worksheet 9-6 (Mathematics: Applications and Connections; Glencoe course 2)

Lesson 3:

Objective: Find the area of triangles and trapezoids.

Description: Students will develop and use the formulas for area of a triangle and trapezoid from the area formulas for rectangles and parallelograms.

Assessment: Students will complete practice problems applying the formulas. (Mathematics: Applications and Connections; Glencoe course 2, p. 358)

Lesson 4:

Objective: Find the area of circles.

Description: Students will develop and use the formula for area of a circle. (Mini-Lab p. 359, Mathematics: Applications and Connections; Glencoe course 2)

Assessment: Students will complete practice problems (P. 361, Mathematics: Applications and Connections; Glencoe course 2).

Lesson 5:

Objective: Introduce 3-D shapes

Description: Students will explore the characteristics of different 3-D shapes using the 3-D shape set – faces, edges, bases

Assessment: Students will participate in class discussion

Lesson 6:

Objective: Find the surface area of rectangular prisms

Description: Students will determine the surface area using “unfolded” rectangular prisms.

Assessment: Students will complete practice problems (p. 385; Mathematics: Applications and Connections; Glencoe course 2).

Lesson 7:

Objective: Find the surface area of a cylinder

Description: Students will determine the formula for surface area of a cylinder using “unfolded” cylinders.

Assessment: Students will complete practice problems (p. 390; Mathematics: Applications and Connections; Glencoe course 2).

Lesson 8:

Objective: Find the volume of a rectangular prism

Description: Students will use formula to determine the volume of rectangular prisms.

Assessment: Students will complete practice problems (p. 396; Mathematics: Applications and Connections; Glencoe course 2).

Lesson 9:

Objective: Find the volume of cylinders

Description: Students will use the formula to find the volume of a cylinder.

Assessment: Students will complete practice problems (p. 399-400; Mathematics: Applications and Connections; Glencoe course 2).

Lesson 10:

Objective: Review

Description: Students will use “Illuminations” to review learned material; review

Assessment: Students will participate in class discussion.

Presentation of project

Posttest

8th Grade

Day 1

Objective: Students will be able to find the perimeter and circumference of circles.

Description: Students will take a pre-test on the area, surface area, and volume of two-dimensional and three-dimensional shapes. (Circles, triangular prisms, rectangular prisms, cubes, pyramid, cones, cylinders)

Read Sir Circumference and the Dragon of Pi to the students. Discuss the concept of Pi and using the formula for the finding the circumference and area of a circle.

Assessment: Practice worksheets 7-8 and 12-1.

Day 2

Objective: Students will explore the relationship between the surface area of a box and the total area of the unit squares needed to wrap the box.

Description: This activity has been taken from Fillings and Wrappings unit, investigations 1.1 and 1.2. The two sections have been combined to save on time.

Using the program Illumination from the web, discuss which two-dimensional objects are in the three dimensional objects. As students discover the shapes, review how to find the area of these shapes. Use the program to make the objects “flat” to show the number of rectangles and squares in each one.

In pairs, students will be given several 3-D objects drawn flat on grid paper. Students will cut these objects out, find the dimensions, and find the surface area. Students will then use grid paper to draw several “flat” 3-D cubes and rectangular prisms. By counting the number of squares in each object, students will determine the surface area of each figure. After several different drawings, students will determine the procedure to find the surface area of a rectangular prism and cube. From the ACE questions on pages 10 – 13 of Fillings and Wrappings, students will complete problem 8 with their partners. As a class, discuss problems 2-6 orally.

Discuss that the bases on the prisms can change into other shapes, such as the triangle. Review the formula for finding the area of a triangle. Apply this to triangular prisms.

Assessment: Page 477 of textbook (4-12) and practice worksheet 12-4.

Day 3

Objective: Students will determine which rectangular prism has the least and greatest surface area for a fixed volume.

Description: Students will complete Fillings and Wrappings, Investigation 2.1. Teacher will make an overhead of problem 2.1.

Assessment: Investigation 2, ACE questions, 1-5, 7-9.

Day 4

Objective: Students will be able to find the volume of rectangular prisms.

Description: Students will need several boxes and centimeter cubes. In pairs, students will use the centimeter cubes to fill the bottom row (length) with the cubes and the number in the column (width). They will

determine how many layers (height) will fill the box. Students will use several boxes and complete the table below.

BOX	Row (Length)	Column (Width)	Layers (Height)	Surface Area	Total Cubes in Box (Volume)
A					
B					
C					
D					

Have students determine the relationship between the length, width, height, and volume of the box. Students will determine the formula to find the volume of a rectangular prism.

Assessment: Investigation 3.1, ACE questions 1-8.

Quiz: Check Up 1 from Fillings and Wrappings.

Day 5

Objective: To find the volume of a cylinder.

Description: Students will do Investigation 4.1 of Fillings and Wrappings. In partners, students will also complete ACE questions 10 and 11.

Assessment: Textbook, page 484, 12-17, Practice Worksheet 12-6.

Day 6

Objective: Students will find the surface area of cylinders.

Description: Students will do Investigation 4.2. Include problem 13 from ACE questions.

Assessment: Practice worksheet 12-5.

Day 7

Objective: Students will be able to see the relationship between the volumes of spheres and cylinders.

Description: Teacher will demonstrate the activity in Investigation in 5.1. Students will determine the formula for the volume of a sphere and cylinder.

Assessment: Practice worksheet 12-6.

Day 8

Objective: Students will be able to see the relationship between the volumes of cones and cylinders.

Description: Teacher will demonstrate the activity in Investigation 5.2. Students will determine the formula for the volume of a cone and cylinder. Do ACE problem 8 with a partner.

Assessment: ACE questions 1-4.

Day 9

Objective: Students will be able to find the volume of pyramids.

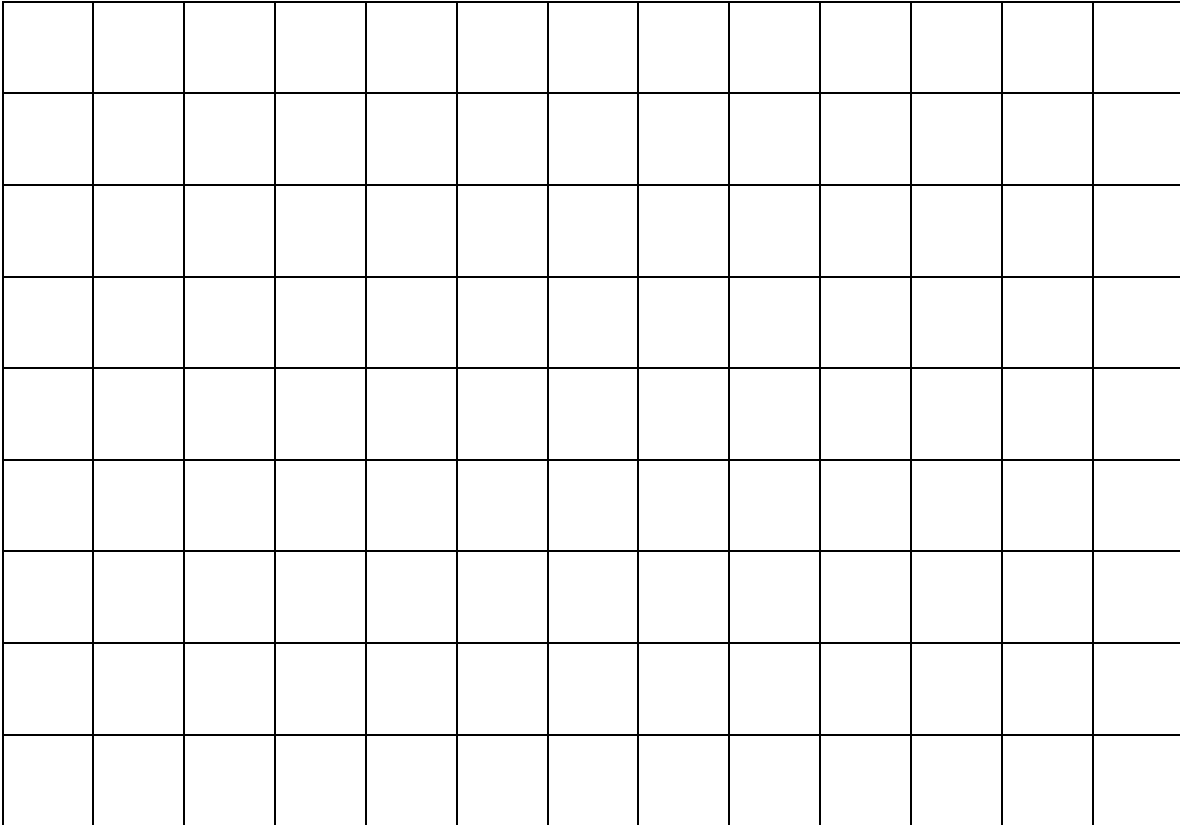
Description: Students will do ACE problem 12 in groups to determine the shapes in pyramids. Discuss the formula for finding the volume. Discuss why the B is capitalized in the formula.

Assessment: Practice worksheet 12-7 and textbook page 489 (7-12).

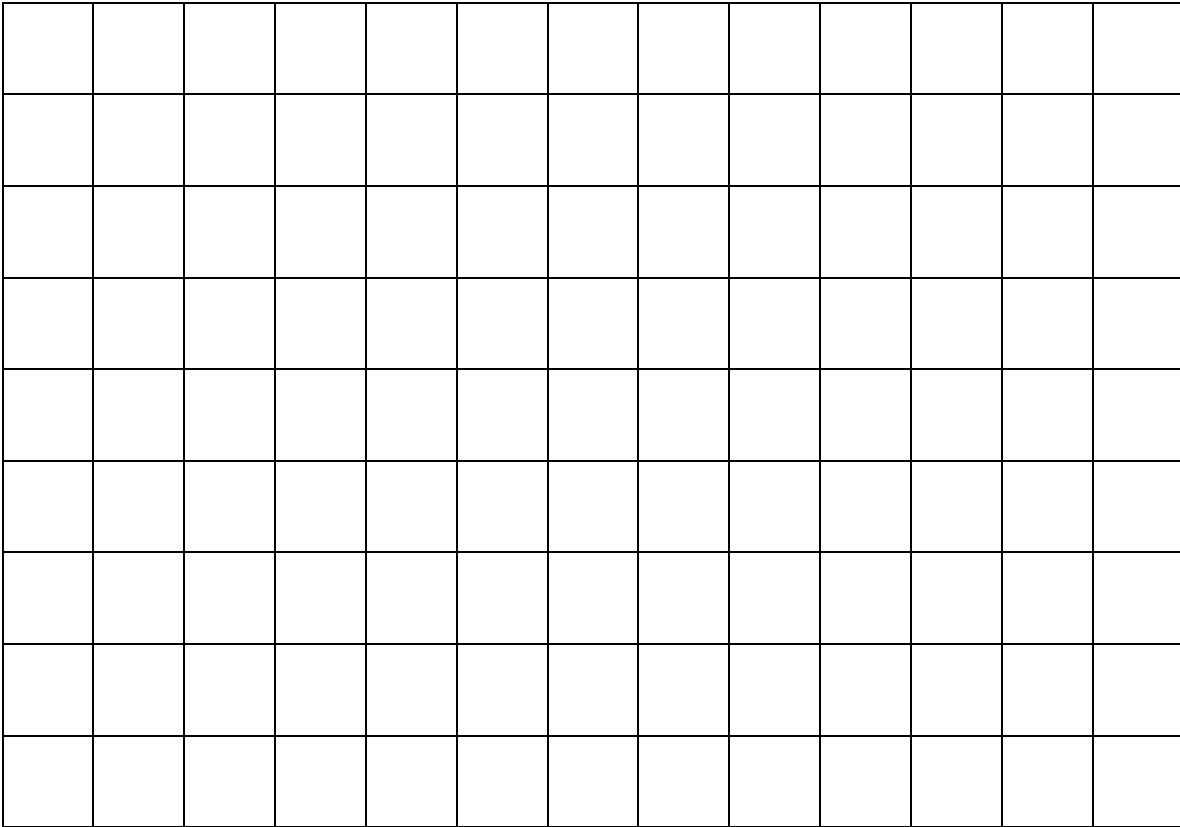
Name: _____ Date: _____

Do You Measure Up?
6th Grade Pre and Post Test

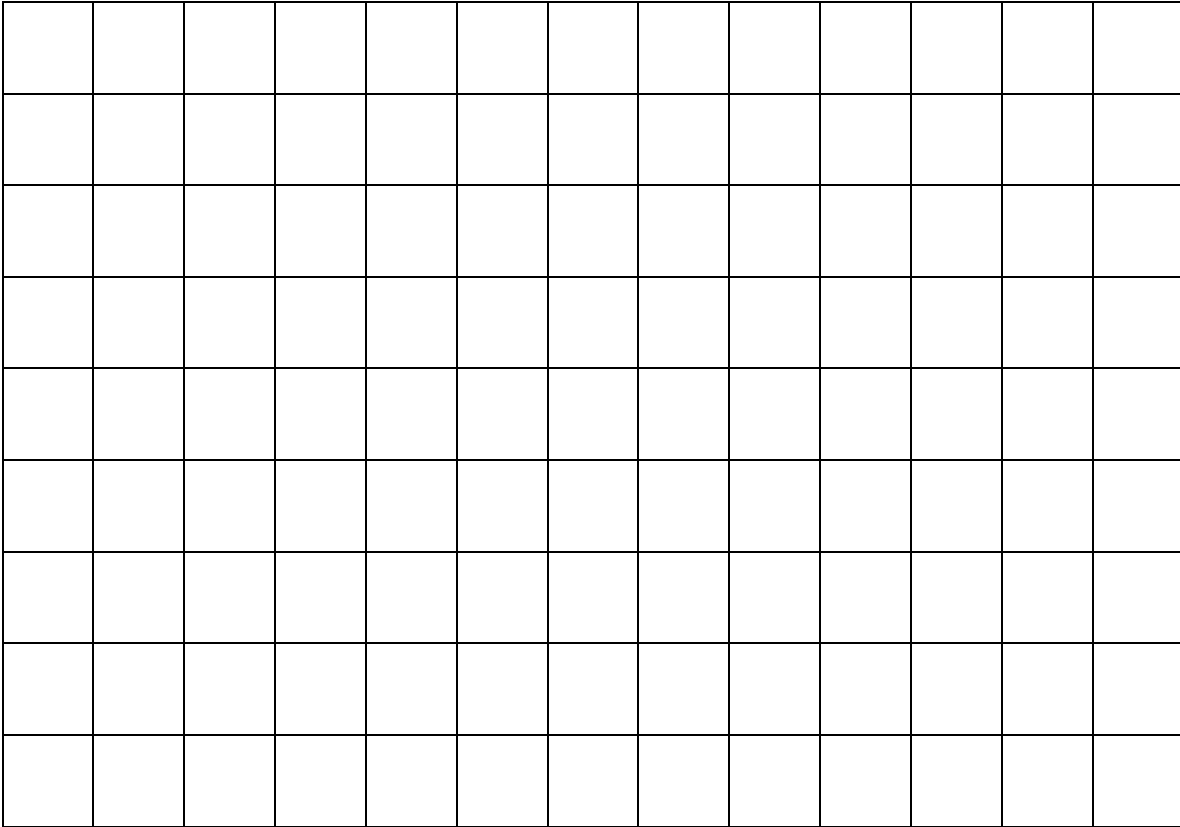
1. The squares on this grid are 1 centimeter long and 1 centimeter wide. Outline two different figures with an area of 12 square centimeters and a perimeter of 16 centimeters.



2. On grid paper, sketch all the rectangles that can be made from exactly 16 square tiles.

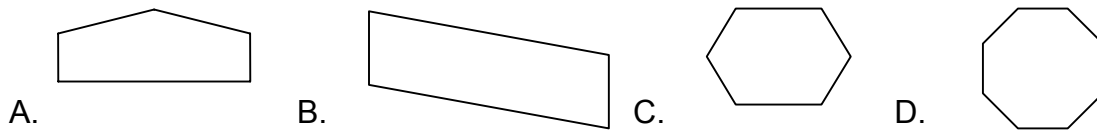


3. On grid paper, sketch all the rectangles with a perimeter of 16 units that can be made from square tiles.



4. Which figure is a hexagon?

4. _____



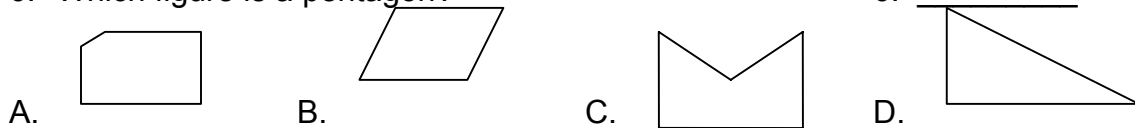
5. How many sides does a decagon have?

5. _____

A. 8 B. 9 C. 10 D. 11

6. Which figure is a pentagon?

6. _____



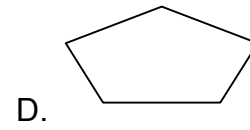
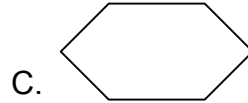
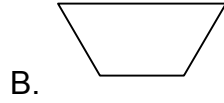
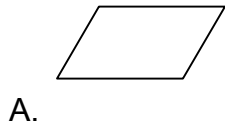
7. How many sides does an octagon have?

7. _____

- A. 6 B. 10 C. 5 D. 8

8. Which figure is a parallelogram?

8. _____



Name: _____ Date: _____

Do You Measure Up?
7th Grade Pre and Post Test

1. Find the perimeter of a square with side $3\frac{3}{4}$ feet. 1. _____
A. 15 ft B. 16 ft C. $15\frac{1}{4}$ ft D. $16\frac{1}{2}$ ft

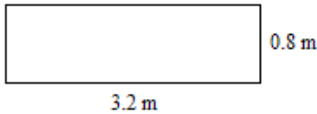
2. Find the circumference of a circle whose radius is 2.75 feet. 2. _____
A. 18.84 ft B. 17.27 ft C. 17 ft D. 18 ft

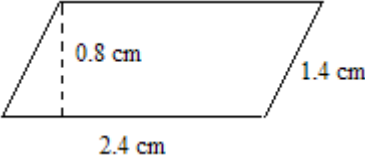
3. Estimate the area of the figure below 3. _____



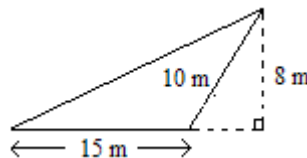
- A. 16 units²
B. 38 units²
C. 26 units²
D. 40 units²

4. Find the area of the rectangle with a length of 12.5 ft and a width of 8.0 ft. 4. _____
A. 100 ft² B. 41 ft² C. 50 ft² D. 20.5 ft²

5.  5. _____
A. 2.56 m² B. 3.0 m²
C. 8.0 m² D. 4.0 m²

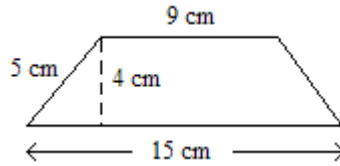
6.  6. _____
A. 2.0 cm² B. 3.36 cm²
C. 7.6 cm² D. 1.92 cm²

7. Find the area of the triangle at the right. 7. _____
A. 47 m² B. 75 m²
C. 60 m² D. 165 m²



8. Find the area of the trapezoid at the right.

- A. 96 cm^2 B. 30 cm^2
C. 60 cm^2 D. 48 cm^2



8. _____

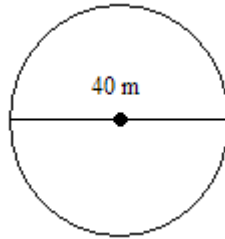
9. Find the area of a circle with a radius of 6 feet. Use 3.14 for π .

- A. 113.04 ft^2 B. 37.68 ft^2 C. 452.16 ft^2 D. 28.26 ft^2

9. _____

10. Find the area of the circle shown at the right. Use 3.14 for π .

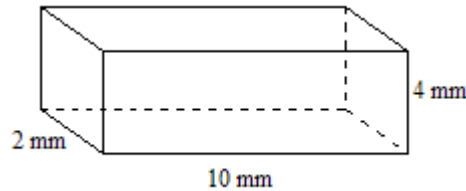
- A. $5,024 \text{ m}^2$ B. 125.6 m^2
C. $1,256 \text{ m}^2$ D. 314 m^2



10. _____

11. Find the surface area of the rectangular prism at the right.

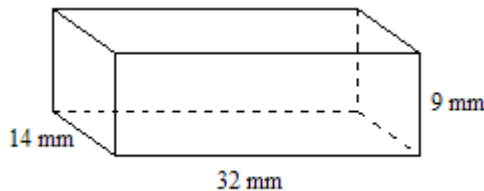
- A. 68 mm^2 B. 136 mm^2
C. 80 mm^2 D. 32 mm^2



11. _____

12. Find the volume of the rectangular prism at the right.

- A. 862 mm^2 B. $1,724 \text{ mm}^2$
C. $4,032 \text{ mm}^2$ D. 110 mm^2



12. _____

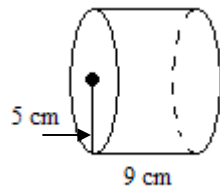
Name: _____ Date: _____

**Do You Measure Up?
8th Grade Pre and Post Test**

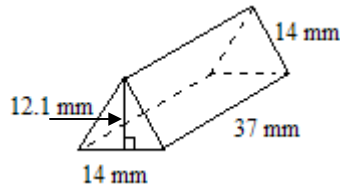
1. What is the circumference of a circle with a radius of 8 in?
2. What is the area of a circle with a radius of 10 in?

Find the surface area of each shape.

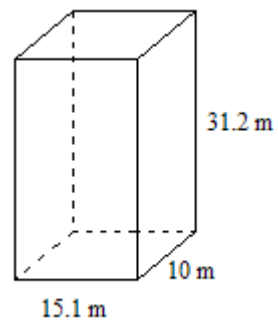
3.



4.

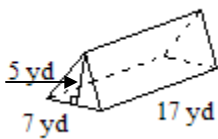


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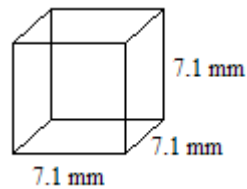


Find the volume of each shape.

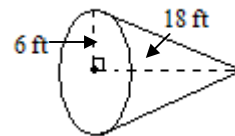
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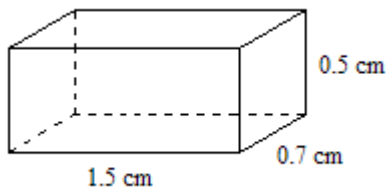
7.



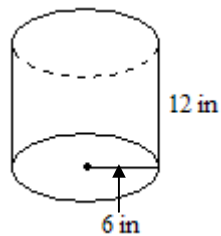
8.



9.



10.



11.

