8th Grade Mathematics

5 – Day Unit on:

Perimeter, Area and Volume etc. of Polygons, Circles and other 2-D and 3-D Shapes

Manipulatives/Tools Used:

- Hollow Geo-Solids
- Geometer’s Sketch Pad
- String/Yarn
- Calculators
- Algebra Tiles
- Overhead Projector
- Oranges
- World Maps

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Overview

The unit is meant to teach and to re-teach students radius, diameter, circumference, perimeter area (surface area) and volume. This unit is also supposed to show the students that technology can be incorporated in math very easily as well as that learning math with using manipulatives can actually be interesting, knowledgeable and fun at the same time. In addition, another goal of the unit is to help show students where they see and use geometry and any type of math in general in their everyday worlds. The unit is meant to aid the students in learning and relearning parts of mathematics through more visual, experimental and hands-on learning rather than strictly memorization.

On the first day, the students will:
• Review radius, diameter, perimeter and circumference through questioning as an opening activity with using sting and handouts with different shapes dawn on them
• Learn knew strategies to help differentiate between the meanings and representations of the terms
• Use problem solving skills to come to certain conclusions and guesses as to certain formulas for circumference and perimeter
• See and find relationships between diameter, radius and circumference and the introduction of $\pi$ through using the string and rulers
• Write a “ticket out” of the classroom to ensure they grasped the material for the days’ lesson.

On the second day, the students will:
• See where they might see and use geometry and math in the everyday world through the opening activity of listing careers and finding what they all have in common
• Review what area is and how to find it
• Be introduced/reintroduced to algebra tiles and shown how they can be used to multiply to get the area of a figure
• Learn how to use algebra tiles to estimate the approximate area of a figure that is not exactly a square or rectangle
• Find a relationship as to how well their estimating skills are, compared to the exact values found by a formula for circles
On the third day, the students will:

• Learn how to use Geometer’s Sketch Pad to their advantage in finding areas and perimeters of different 2-D objects
• Apply their knowledge from the past 2 lessons and their own previous knowledge to work independently on the packet that is handed out by the teacher, which is to be completed by the end of the class period
• Test their skills by solving the last problem that the teacher gives them after they finish the packet and hand it in as a ticket out to assess how the students are understanding the lesson

On the fourth day, the students will:

• Test themselves from the questions that they themselves wrote for homework from days 1 and 2 as an opening activity for the day
• Compare a sphere and a circle of the same diameter and make estimates as to how many times the surface area of a sphere is compared to a circle’s area of the same scale by using their past knowledge and their newly acquired skills
• Create 3-D objects to help them visualize and see hands on, the relationships between the surface areas of the 3-D objects and the areas of the 2-D objects
• Relate this information to other 2-D objects and their 3-D counterparts by seeing if they can apply the same patterns as the did with a sphere and a circle to say a cube and a square
• Practice their science skills and write down 2 observations/comment on the lesson and hand it in as the ticket out for the day to assess how the students are doing

On the fifth day, the students will:

• Be introduced to a new 3-D figure and this time try to relate it and compare it to the other 3-D figures
• Estimate the volumes of the objects they created in class
• Compare the volumes of the objects to the volume of a cube of the same scale in order to try to make better estimates and see if there is a pattern between the volumes and surface areas of the objects

Need to make observations of the days’ lesson as a ticket out
Objectives:

The overall set of objective for the unit are to get the students to recall, relearn and in some cases learn for the first time, the information about area, perimeter/circumference and volume etc. of polygons and other shapes and solids. The students are to start discovering and exploring more like they do in science class. Not only is this unit supposed to allow and help the students to remember the formulas and definitions for diameter, radius, area, perimeter/circumference, volume of certain shapes, but it will also allow them to be able to both “figure it out” if need be as well as truly understand where it comes from.

New York State Key Ideas Covered in the Unit:
- 1A, 1B, 1C, 1D
- 2D
- 3A, 3E, 3G
- 4A, 4B, 4C, 4D, 4E, 4F
- 5A, 5B, 5C, 5F
- 7A, 7B, 7C, 7D, 7H, 7K

NCTM Standards Covered in the Unit:
- Number and Operations
- Geometry
- Measurement
- Data Analysis and Probability
- Problem Solving
- Communication
- Connections
- Representation
 Brief Daily Objectives:

Day 1
The students are to use their previous knowledge to define perimeter, circumference, diameter and radius in their own words as best as they can. They will also explore why perimeter and circumference are defined as they are. They will also learn new ways to remember how to not mix up radius, diameter and circumference like many students so often do.

Day 2
The students will learn how to use Algebra Tiles to multiply area and will be able to see visually to help better understand why area is the space covered and why the units are squared. They will be able to use these algebra tiles to practice their estimating skills.

Day 3
The students will be able to use their knowledge from the past 2 lessons along with the knowledge that they already know about computers and the packets that are made up from Geometer’s Sketchpad to find areas and perimeters of different shapes. They will still have to come up with conclusions and will have to think about whether what they found to be the perimeters and areas are actually correct because they will not be allowed to move on without the teachers’ approval.

Day 4
The students will relearn the formulas for volume of certain objects and will be able to understand why the units for volume are cubed. They will be able to find relationships between specific 3-D objects and their 2-D counterparts (i.e. – sphere and circle with same radius, cube and square with same side length).

Day 5
The students will be able to find patterns in volumes of 3-D shapes all of the same scale. They will use their estimation skills and will compare volumes based on the sizes of the objects as well as their previous knowledge of area etc.. They will be able to apply their knowledge for
things such as to describe why a globe is a better “picture” to use for sizes of the oceans than a flat, rectangular map.

*The only additional resources that were used in the making of this unit other than the ideas and experiences of the author himself, were the two maps from the following websites:*

http://go.hrw.com/atlas/norm.htm/world.htm

http://www.atlapedia.com/online/mapresources.htm

**Equipment Needed:**

- Chalk/Marker/Chart
- String/Yarn
- Scissors
- Ditto’s with Shapes (circles and polygons)
- Rulers
- Calculators
- Algebra Tiles (for overhead and for students)
- Computer Lab
- Geometry Sketch Pad
- GSP Packets
- Closing Activity for computer lab day (Day 3) on separate paper
- Homework Ditto for Day 3
- Oranges
- Paper
- Pyramid, Cube, Cone and Sphere hollow manipulative Geoprizms
- Pre-cut Card Boards to make shapes (pyramid, cube and sphere)
- Tape
- Pre-drawn Card Boards to make a Cone
- Four 2-liter bottles filled with water
- A Bucket
- Funnels
- Large Measuring Container
- Ditto with Rectangular Map of World and “Cut-up” Sphere picture
Day 1

Objectives:
- The students are to use their previous knowledge to define perimeter, circumference, diameter and radius in their own words as best as they can.
- The students will explore and be able to explain why perimeter and circumference are defined as they are.
- The students will understand why perimeter and circumference are measured in single units (not units squared or cubed)
- The students will also learn new ways to remember how to not mix up radius, diameter and circumference
- The students will use string as a manipulative to help “discover” the number Pi and how it fits into the formula for circumference

Standards:
- NCTM Standards Covered: Number and Operations, Geometry, Measurement, Data Analysis and Probability, Problem Solving, Communication, Connections and Representation
- NYS Key Ideas Covered: 1A, 1B, 1C, 2D, 4A, 4B, 4E, 4F, 5A, 5B, 5C, 7A

Materials:
- Chalk/Marker/Chart
- String/Yarn
- Scissors
- Ditto’s with Shapes (circles and polygons)
- Rulers
- Calculators

Opening Activity:
The students will be welcomed with a question on the board asking them to work alone and to come up with their own definitions for the following words: perimeter, circumference, diameter and radius. The directions will tell them to write their own answers down in their notebooks in the beginning of the day’s notes.

Main Activity:
The teacher will give the kids pieces of string, a pair of scissors and paper with circles, squares, quadrilaterals and triangles already pre-drawn on it. From here, the teacher will give the kids about 1 minute to “play” with the string and paper – more so that the teacher can observe what the kids think they are supposed to do with the
equipment. The teacher will then ask the students what each word from the opening activity is starting with perimeter and then ask what it measures along with asking for an example. After most students guess, the teacher will give an example such as; Perimeter is the length or the distance around some object and an example of this may be the fencing around a backyard, it goes all around the edges of the yard. Other examples may be the molding around a window or the wallpaper border around the top of a room. The next question to be asked will be what you call the perimeter of a circle. Tell the kids it starts with a “C.” Before giving the answer (if no student answered correctly), tell them to draw a dotted circle on their papers. Then tell them to trace on the dotted circle, a C. Now tell them (if they didn’t already guess it) that the C stands for circumference. Based on the drawing they just completed, they should be able to see and remember that circumference is the length or distance around a circle. The next word on the board that was not covered yet was diameter. Ask what diameter means. If the students do not recall, then the teacher will give the answer of the distance across a circle going through the center point. The teacher will have them draw another dotted circle on their papers and to draw a capital “D” on the circle. The | in D should go right down the center of the circle touching one end to the other. From this drawing, the kids should be able to see and remember that diameter is the distance across a circle, going through the center point. Lastly, the kids will draw one more dotted circle and the will be asked what the term radius means. This is the last term on the board and the students should guess that it is half the diameter. If not, then the teacher will tell them to draw a third dotted circle and now draw a capital “R” with the | in R going through the center. Now the teacher will ask again (if the kids did not get the answer before) what radius is. The teacher will point out that the short angled line, or the “leg” of the R, goes from the center point to the edge of the circle, they will also point out that it is exactly half of the diameter. The teacher will then ask why we went over radius and diameter. After a few responses, the teacher will tell the students that in order to get the circumference and area of a circle using formulas, they need to know either the radius or the diameter.

The students will now take the strings and the scissors that they received in the beginning of class and cut the string out to the lengths of the radius and diameter of the circles. They will then measure with a ruler and mark the sizes down on their papers. The students will be asked what they notice about the strings of the radius and the diameter. The responses should be unanimous that one is double the size of the other. The teacher will have the students use the remaining string and try to measure the circumference of the circle. Once the kids cut the circumference and measure and record it on their papers, then they will compare it to the radius and diameter strings and find out about how many R strings and D strings they need to equal a circumference. The students can use the rest of the string to cut out more radius strings and diameter strings as needed. They should see that it takes more than 3 strings of the diameter and more than 6 strings of the radius to get the circumference.

Closing Activity:

Since the period will be close to over the teacher will ask the students if they remember or recall the number \[\pi\]. The teacher will tell them that \[\pi\] is a number that is used much in dealing with circles for circumference and area and that its numerical representation is most commonly approximated as 3.14. After hearing this information
and using what observations they previously had, the students will try to come up with an equation for the circumference of a circle. After walking around and looking at the students’ formulas, the teacher will give the answer that circumference is $\pi \times$ diameter. An easy way to remember this is almost like a rhyme; $\pi \times D = C$. The teacher will then wrap up class with asking the kids to write on a piece of paper what radius, diameter, circumference and perimeter are and will hand this paper in as their “ticket” out of the class.

**Homework:**

The students will find and write down 3 – 5 different places in their every day life that they see circles. They will also have to find the perimeter of three different road signs such as a Stop sign, a Street sign, a No Parking sign, a Rail Road sign etc.. They will also have to come up with, write, answer and hand in two questions they made up using the perimeters they found.
Day 1 Notes

Sheet with circles handout:

- 1st circle: \( R = 1 \text{ in} \), \( D = 3 \text{ in} \), \( C = 9.42 \text{ in} \)
- 2nd circle: \( R = \_ \text{ in} \), \( D = 1 \text{ in} \), \( C = 4.71 \text{ in} \)
- 3rd circle: \( R = 2 \text{ in} \), \( D = 4 \text{ in} \), \( C = 12.56 \text{ in} \)

Definitions for the “Ticket Out”:

- Radius – the diameter and the distance from the edge of a circle to the center
- Diameter – 2 times the radius and distance from one edge to the other edge of a circle going through the center point
- Perimeter – the distance around an object, like molding around a room
- Circumference – the distance around a circle (a circle’s perimeter)

Homework:

- The 3-5 places could be: RR signs, CD’s, Basketball Hoop, wheels on a car, coins
- Signs – perimeter of signs will vary depending on what signs they measure
- Questions will vary depending on what the students find
Day 2

Objectives:
- The students will be able to apply the lesson to everyday life and to careers
- The students will learn how to use Algebra Tile manipulatives to multiply area
- The students will see why the units for area are squared
- The students will be able to visually see and work hands on in order to better understand why area is the space covered beyond just memorization
- The students will be able to explain why the units for area are squared
- The students will be able to use these algebra tiles to practice their estimating skills in estimating area of 2-D objects

Standards:
- NCTM Standards Covered: Number and Operations, Geometry, Measurement, Data Analysis and Probability, Problem Solving, Communication, Connections and Representation
- NYS Key Ideas Covered: 1A, 1B, 1C, 2D, 4A, 4B, 4E, 4F, 5A, 5B, 5C, 7A

Materials:
- Chalk/Marker/Chart
- Algebra Tiles (for overhead and for students)
- Calculators
- Shape Ditto from previous lesson

Opening Activity:
The students will be welcomed with a question on the board asking them to work alone and to think about and write down what the following jobs have in common: Painters, Carpenters, Rug Layers, Concrete Workers and Blanket/Drape Makers.

Main Activity:
After going over the homework from the night before, the teacher is to ask the students what they thought the jobs had in common from the opening activity. After the teacher called on a few students for their responses, the teacher will segue into the next question of, “What is area?” which will essentially answer the question in the opening activity. Some kids may remember and spit out things like “the inside of something,” or, “a wall.” After hearing these answers, the teacher is to tell the students that the area of something is the amount of space it covers. An example that the teacher might use would be an area rug, it covers a certain area of your floor. The class will then go straight into a review of how to find the area of a quadrilateral. Most all the kids should have been able to tell that it was length times width. From this, the teacher will go into the area of a triangle and the area of a circle. The triangle the students should respond to saying it is base times height. As for the circle, allow the students to think at their desks for about a minute and then give them the hint that it has to do with Pi and tell them to let it fester in their heads while the class continues on in the lesson. The teacher will show the students how to use algebra tiles to multiply to find the area. The teacher will demonstrate by
using algebra tiles for the overhead. The teacher will explain that the single, small squares represent 1 square unit, the long rectangles of 10 represent 10 square units and the large squares of 100 represent 100 square units.

The teacher will do a simple multiplication with the students to show them that area is 2 dimensional as well as that area can be found by using these algebra tiles. The teacher will break up the students into groups of 4 and pass out a package of algebra tiles to each student so they can all combine their tiles to find areas. While the teacher is doing this, the students will take out their papers with the circles and squares etc from the previous lesson and their rulers. This sheet will have the diameter, radius, circumference and perimeter of most the shapes found by the students from the previous lesson.

The students will find the areas of the shapes (except for the circles) by using the formulas we remembered in the beginning of class. After each group agreed and after they raised their hand to get the teachers approval signature, they can move on to find the areas using the algebra tiles. They will place the small 1 square unit pieces in the shapes and try to count about how many units fit in each shape. After they find these, they will record this on their papers as well. When all groups have completed all of the areas of the shapes with the algebra tiles (this time, the circle IS included) the class will together make predictions as to a possible relation (if any) between area and perimeter. The groups will all make some sort of general statements out loud to the class about their findings with the area and how the formula (which gives the exact area) and the algebra tiles (which give an estimate) come close to the same measurement. Then as a class, the teacher will ask for the areas that people found and estimated for the circles. After about 5-6 people raise their hands with answers, then the teacher will again ask the students what the formula for the area of a circle is. If no other guesses, then the teacher will tell the students that the area of a circle is $\pi \times R^2$

Closing Activity:
Since the teacher gave the students the formula for the area of a circle, as a wrap up question and a ticket out of the room, the students are to figure out the true area of the circle and compare it to what they found by using the algebra tiles. They will then write this on a half sheet of paper to be handed in, along with the percentage of how far off they were from the true value. The teacher will tell them that to find the percentage that they were off, the students have to take the smaller value and divide it by the larger value. They will then take that percentage and subtract it from 100 to find out how far off they were.

Homework:
The students will have to make up 2 questions involving the use of area formulas. The students will also have to come up with an explanation why the area of a triangle is \_ \_ \_ that if a polygon with the same base and height. The last question that the students will have to solve is to try to come up with an explanation and formula for a trapezoid.
Opening Activities Answer:

- All the professions need to know how to find Area to do the jobs correctly

Area Formula’s:

- Formula for Area of a Triangle: 
  \[ \text{Base} \times \text{Height} \quad \text{OR} \quad \frac{(\text{Base} \times \text{Height})}{2} \]

- Formula for area of a Quadrilateral: 
  \[ \text{Base} \times \text{Height} \quad \text{OR} \quad \text{Length} \times \text{Width} \]

Ticket Out Questions:

- Answers will vary. If about %80 of the students get within about %85, then most of them understood the lesson. If less than that had a decent estimate of about %80, then the teacher will spend more time on the topic of estimation in the upcoming lessons.

Homework:

- Questions will vary depending on the students
- Explanations will probably say something like cutting up a triangle and filling in the quadrilateral with the same base and height measurements and seeing how many times it can be filled up
- The Trapezoid formula, the students will probably write down something about cutting up the trapezoid into triangles and quadrilaterals and finding the areas of the separate pieces, then adding them up.
Day 3

Objectives:
• The students will use Geometer’s Sketch Pad as a manipulative to help see how area and perimeter are found
• The students will use their knowledge from the past 2 lessons along with the knowledge that they already know about computers (and the packets that are made up from Geometer’s Sketch Pad by the teacher) to find areas and perimeters of different shapes
• The students will still have to come up with conclusions and will have to think about whether what they found to be the perimeters and areas are actually correct
• The students will improve their computer skills and be introduced to different computer programs that aid in learning mathematics and making math fun

Standards:
• NCTM Standards Covered: Number and Operations, Geometry, Measurement, Problem Solving, Communication and Representation
• NYS Key Ideas Covered: 1A, 1D, 3A, 3E, 4A, 4C, 4D, 5A, 5B, 5C, 7C, 7H

Materials:
• Computer Lab
• Geometry Sketch Pad
• GSP Packets
• Closing Activity on separate piece of paper
• Homework Ditto

Opening Activity:
The students will be welcomed with a question on the board asking them to write down a question that they had based on the lesson after letting the past two days settle in. The students are to write the question down and hand it in within the first 3 minutes of class.

Main Activity:
The teacher will tell the students that the answer above in the opening activity was actually the true value of the area of the circle they were supposed to find the previous day. After this, the students will follow along in the packet that is given to them by the teacher. They will be working with the program Geometer’s Sketch Pad in finding the areas and perimeters of different shapes. The packet (enclosed) will familiarize the students with the program and will guide them step by step as to how to make their constructions and measurements.

Closing Activity:
There is a final question that the students are to finish and have the teacher check before they are allowed to pack up and leave for the class after the packet is finished. This question is NOT IN THE PACKET but the student needs to find the teacher and show the third project and get it signed off before getting this last activity. The students
will have to draw a simple face with the GSP program and find the area of the eye with respect to the rest of the face. They will be able to do this by also shading in the regions that they are using – i.e.: the eye could be green and the rest of the face could be yellow. This will also be checked and signed off by the teacher at the end of class. This will be their “ticket out” for the day to assess how well the students are grasping the material.

**Homework:**  
The teacher will give a handout of various shapes made from Geometer’s Sketch Pad and will have to find the perimeter and area of all the shapes. They will have to show all work for each question. They will have about 5 shapes to find results for.
**Introduction to Geometry Sketch Pad**

Open GSP. From here, you can click anywhere on the screen with your mouse to continue. Maximize the screen for the GSP first by clicking the maximize box in the upper right corner. Then in the lower right corner of the document titled “Untitled 1”, click and drag to enlarge this document as well. You will see a list on the left-hand side of the screen showing different tools. This is called the toolbar and looks something like so;

- an arrow tool:
- a point tool:
- a compass tool:
- a straightedge tool:
- a text tool:

If you notice in the lower right hand corners of the tool icons, some of them have little arrows. This means that if you hold down the mouse button after clicking on the particular icon tool, it will allow you to have some choices as to what you want to use. For instance, the straightedge tool will allow you to choose from a segment, a ray or a line.

Across the top, you have another menu bar. This may be familiar to you because of what it contains and how it looks.

To save things, go to the **File** menu at the top of the page and go to **File** > **Save As**.

You will also be able to use, and will use often, the other menus. Go to **Edit** to undo a construction (a drawing). If you use **Undo** to get rid of something when you do not want it, it will help to not use as much memory and keep the program from closing or freezing up.

Another thing to take note to is under the **Edit** menu. You can change your settings such as degrees or radians, and you can change from rounding to the hundredths, the tenths etc. The last thing you can change is the unit of measure that you are using. You can use either cm or inches.

If you want to change the color of text or the lines, you can go under **Display** and then to **Line Width** and **Color**. This will let you change from thin to thick lines and from color to color easily so you do not get so confused when there are multiple lines and points on the screen.

You will see more with **Construct** further into the packet. You will be using this often for **Intersection**, **Point On Segment**, **Midpoint**, **Segment**, **Perpendicular Line**, **Parallel Line**, etc.

The **Transform** menu will be of use later in the year while working with translations. You will be able to translate, rotate, dilate, and reflect an object or objects using this menu.

**Measure** will be used to find **Distance**, **Length**, **Area**, **Perimeter**, **Angle**, **Slope**, and is also used to find among other things. By using calculate, you can find things like the sum of the angles in a polygon.
The **Graph** menu will mostly be used for **Show Grid**, **Hide Grid**, **Snap Points** and **Plot Points...** allows you to move points on the graph directly to an exact coordinate without guessing if a points x-coordinate is at 2 or 2.1.

The first thing that you want to do is to open up GSP as described above, then go to the **Graph** menu at the top of the screen. As you look at the list of operations, you will come across one that says **Show Grid**, click it. You should now see a graph on the screen.

From here, go back to the **Graph** button and go to **Plot Points...**. Click this and you will be able to type in points manually to save time, rather than looking on the graph to plot the points with the point tool .. Plot the points (3,1), (3,5) and (5,1), then press enter. When finished, click done.

*After all constructions, go to the arrow tool and click in an open area.*

Doing this will deselect all points. You will now see these three points on your graph along with two other points. The one point is the origin, and the second point is to the right of the origin on the x-axis. If you click and hold on the point on the right, you can adjust the scale of your graph.

To label these points if they are already not labeled, you can go to the tool bar and click on the text tool . You should get a finger as your pointer and after the finger turns black, you should be able to click on the points that you want to label. To change the labels that you already have, you need to use the arrow tool , and double click on the letter. This will allow you to change or to re-label the point or line etc..

You can now go to **Construct** at the top menu bar and click it to get your choices. Before doing this however, highlight the three points that you made and then go to **Construct**, then to **Segment**. You should see a triangle on your screen connecting the three points that you made.

STOP HERE!

Before you are allowed to go further, you must find the teacher and they must sign you off on their sheet that you were correct so far on what you have done. Once the teacher signs you off, you maybe continue with the packet.

Again, in a new area, make a new quadrilateral by using the point tool . You still have to highlight all four points and go to **Construct**, then to **Segment**. Label the points if they are not already labeled. You are going to find the perimeter and area of the object. You can do this by going to the endpoints of the figure you just made and highlight all the points. Then you go to your menu bar to **Measure** Length and go to **Calculate...**. This will put the lengths of the sides on your left hand of the screen. Do this for all four sides. You can see that this measures the length even if you choose to move the points. Choose **Measure** at the menu bar again and now go to **Calculate...**. You will now have a screen that looks something like so;
From here, click on the measure of the sides on the left side of the graphing screen to put them into the calculate screen and add them up. Now, drag the points on the quadrilateral around and you will be able to see all of the individual lengths moving.

Now, you click on the individual points of the quadrilateral and go to Construct, then to Quadrilateral Interior.

This will shade in the quadrilateral and allow you to find the perimeter by going to Measure, then Perimeter. Notice how the two numbers, the calculated number and this new perimeter number, are the same.

STOP HERE!

Again, stop here and get the approval signature from the teacher in order to move on.

Lastly, draw a circle and find the circumference and area of it by using the same types of techniques as the previous problems. By this time, you should have enough practice to do so, if not, feel free to ask and raise your hand at any time for help. The teacher will be with you in a moment.

STOP HERE!

You must again get the teachers approval signature so you can get the closing activity.
On separate paper, find the areas and perimeters, in cm’s, of the following 4 objects:
(hint: break up some of the objects into triangles and polygons)

For the last object, find the perimeter of the rectangle and the circles in cm. Then find the area of the rectangle, without the circles in cm.
Day 3 Notes

Opening Activities Questions:

• Questions will vary depending on what the students wrote down the previous days

The Geometer’s Sketch Pad Packet:

• The Packet is attached. It is three pages in length

Extra Question Answers (Ticket Out Question):

• Eye should be roughly no more than about %10 of the face and no less than about %4 of the face. If the numbers are far off as compared to these specifications, then the estimate would be unreasonable and should be tried again

Homework Handout:

1\textsuperscript{st} shape: Area = 7.065 cm\(^2\) \hspace{1cm} \text{Circumference} = 9.42 cm
2\textsuperscript{nd} shape: Area = 10.28 cm\(^2\) \hspace{1cm} \text{Perimeter} = 14.2 cm
3\textsuperscript{rd} shape: Area = 12.6 cm\(^2\) \hspace{1cm} \text{Perimeter} = 13.5 cm
4\textsuperscript{th} shape: Area = 26.83 cm\(^2\) \hspace{1cm} \text{Perimeter} = 22.2 cm
5\textsuperscript{th} shape: Perimeter of rectangle = 28.2 cm
\hspace{1cm} \text{Circumference of 1 circle} = 3.14 cm
\hspace{1cm} \text{Area of 1 circle} = .785 cm\(^2\)
\hspace{1cm} \text{Area of rectangle – circles} = 34.72 cm\(^2\)
Day 4

Objectives:
- The students will construct 3-D manipulatives of objects to help find surface area
- The students will relearn the formulas for surface area of certain objects
- The students will be able to understand why the units for area are squared
- The students will sharpen their estimation skills as far as judgement is concerned when being provided with only few pieces of information
- The students will be able to find relationships between specific 3-D objects and their 2-D counterparts (i.e. – sphere and circle with same radius, cube and square with same side length).

Standards:
- NCTM Standards Covered: Number and Operations, Geometry, Measurement, Data Analysis and Probability, Problem Solving, Communication, Connections and Representation
- NYS Key Ideas Covered: 1A, 1B, 1C, 2D, 3A, 4A, 4B, 5A, 5B, 5C, 5F, 7D

Materials:
- Oranges
- Chalk/Marker/Chart
- Paper
- Pyramid, Cube and Sphere hollow manipulative Geoprizms
- Pre-cut Card Boards to make shapes (pyramid and cube)
- Tape
- Rulers
- Calculators

Opening Activity:
The students will be welcomed with multiple questions on the board that were all questions that the students handed in for the opening activity for the previous day. The teacher will put anywhere from 13 to 15 questions up and each student will have to write down answers to at least 8 of them on a piece of paper to be handed in. This will allow the teacher to monitor how well the lessons have been going and how well the students are grasping the material. It will also allow the teacher to make alterations or spend more time on a particular subject if need be.

Main Activity:  
The teacher will hold up an orange and trace around it on the board to show them both a sphere (the orange) and a circle with the same exact diameters. The students will then be asked what they can measure on a sphere. If the students get stuck, the teacher is to prompt them by asking if they can measure perimeter or area or volume etc. When the students get to area, the teacher will tell them that it is also called surface area for a 3 dimensional figure and it has does have the same basic premise as far as the space it
covers or the space around something. The students will be asked to guess what might be coming next in class. After a handful of guesses, the teacher will move onward and ask, “how many times can we fill the area of this circle with using the peel of this orange?” The teacher will wait for a bit for guesses and then write them on the front board. The kids will start on task after the teacher passes out oranges, paper towels and paper to trace their oranges on. The kids will then peel the oranges and fill in the circles as many times as they can. After the teacher walks around for a while monitoring progress and making sure not to lose anyone behind, He or She will get the kids back together as a class and pass out baby wipes for their hands and start to discuss their findings. They will be allowed to eat the rest of their orange for the remainder of class. When the kids say what they found, they will be asked to come up with some sort of an explanation or conclusion for their findings. After a couple comments, the teacher will ask the students what might have happened if they had to peel a cube…how many times would they be able to fill in the squares? The students should realize that since there are 6 sides to a cube and each side is a square, that if they “peeled” a cube, they would be able to fill up 6 squares because a cube is made from 6 squares. The teacher will then ask about a 4-sided pyramid (plus bottom) versus a cube if the base of the pyramid is the same as the sides of the cube. See what the kids come up with as far as estimates. Then the teacher will ask what the difference in surface area might be between the two objects. At this point, the teacher will pass out pre-cut pieces of marked cardboard and tape to each group of 4 students. The students will each receive 3 sheets for the cube and 1 sheet one and _ of sheet 2 for the pyramid. The students will then assemble the figures. (The pyramid and cube that the students assemble are the same scale as the teacher has in hollow plastic containers).

**Closing Activity:**

After the figures are assembled, students will measure with rulers the surface areas of the cube and the pyramid, along with the perimeters. After discussing what was measured, as a class we will copy down all of our data on the front chart to save and use for the next day. The students again will be faced with a “ticket out” question. The question will be to write down 2 observations and 1 estimate as to what the relation is between the pyramid measurements and the cube measurements.

**Homework:**

The students will have to find 6 completely different 3-D shapes in their everyday world and measure and find their surface areas. The students will also have a take home quiz made up from the questions that they handed in from the first two lessons’ homework’s. Since it is a take home quiz, they will have about 10 – 15 questions depending on the length and difficulty of the questions.
Cube should be assembled like:
Pyramid should be assembled like:
Day 4 Notes

Opening Activities:

- Questions will vary depending on what the students handed in the previous days for homework.

Main Activity Questions:

- How many times can you fill in a circle with the peel of an orange if the orange and the circle are of the same scale?
  The answer is 4 times. The formula for area of a circle is \( \pi \times R^2 \)
  The formula for surface area of a sphere is \( 4 \times \pi \times R^2 \)

Closing Activity Questions:

- What would the difference be between the surface area of a cube and the surface area of a pyramid of the same scale?
  Surface Area of our cube is 600 cm\(^2\)
  Surface Area of our pyramid is 320 cm\(^2\)
  % difference: The pyramid is \( 55\frac{1}{3} \) that of the cube

Ticket Out Question:

- The students will have to make observations that are relevant and not just things like the cube’s surface area is bigger. That does not have anything to do with the lesson and could have been observed before hand. Things that are relevant would be something with the percentage of the surface area of the pyramid versus the cube.

Homework Questions:

- Shapes could have been things like: a soccer ball, a cup, a fireplace log, a pencil, a mattress or a book etc.
  The surface areas will vary depending on the objects
• The quiz will be made up from the remaining questions that the students handed in for the first 2 days homework
Day 5

Objectives:

- The students will use models to help visually see and understand reasons for volume and surface areas of solid objects
- The students will see why the units for volume are cubed because they are 3-D
- The students will be able to find patterns in volumes of 3-D shapes all of the same scale.
- The students will use their estimation skills and will compare volumes based on the sizes of the objects as well as their previous knowledge of area etc..
- The students will be able to predict the volume before filling with a liquid to find it just by knowing the objects dimensions
- The students will be able to apply their knowledge for things such as to describe why a globe is a better “picture” to use for sizes of the oceans than a flat, rectangular map.

Standards:

- NCTM Standards Covered: Number and Operations, Geometry, Measurement, Data Analysis and Probability, Problem Solving, Communication, Connections and Representation
- NYS Key Ideas Covered: 1A, 1B, 1C, 3A, 3G, 4A, 4B, 4F, 5A, 5B, 5C, 5F, 7B, 7K

Materials:

- Scissors
- Pre-drawn Card Boards to make a cone
- Tape
- Chalk/Marker/Chart
- Pyramid, Cube, Cone and Sphere hollow manipulative Geoprizms
- Four 2-liter bottles filled with water
- A Bucket
- Funnels
- Large Measuring Container
- Rulers
- Calculators
- Ditto with Rectangular Map of World and “Cut-up” Sphere picture
**Opening Activity:**

The students will be welcomed scissors, pre-drawn cardboard and tape and will make a model of a cone. This cone will have the same scale as the previous figures that the students made in the previous lessons. Each student will get a full sheet 1 and _ of sheet 2.

**Main Activity:**

The teacher will hold up a cone that was made by a student and ask the kids once again what can be found. They should reply that you are able to find the surface area and volume. The teacher will wait for a moment and then ask them to guess what the surface area of the cone is. Give the students a couple minutes for this because they will try to use their knowledge from the previous 4 days and formulas they learned to solve the problem. The teacher will tell the students to recall what the surface area was for the cube, the pyramid and the sphere, all of the same scale. Volunteers will be asked for and they will have to give their answers and an explanation of how the student reached the conclusion. The teacher will then write the formula for finding surface area of a cone. Once the kids do the formula and find the surface area, they will compare it to the cube, pyramid and sphere to see if any predictions held up.

The teacher will then say something like, “Since we have been talking mostly on area and perimeter and circumference, what about the volumes of these objects?” The teacher will give the students a few minutes to ponder and give guesses after they get into groups of 4. At this time, the teacher will hold up the hollow plastic shapes that all of the students’ shapes where modeled from and say that as a class, there will be an experiment with the volumes. It is important to reinforce that the shapes’ scales are all the same. The teacher will have about four 2-liter pop bottles filled with water and a few small funnels to pour the water in through. The teacher will first fill the cube and empty the contents of the cube into an extra large measuring container. Before the teacher tells the class the volume, the students will be asked to write down a guess. The volume will be recorded on the class chart and the next object will be filled. The students will find out what the volume of the cube was and try to make educated guesses as to what the volumes of the other objects will be based on their previous knowledge and what they just observed. The water will be poured into the new object, then into the measuring container, then into the cube. The volume will be recorded on the class chart. The process will be continued until all objects have been measured. Between each measuring, the teacher should encourage comments from the students as well as new predictions for the next object.

**Closing Activity:**

The students are to take all the information that they acquired from the chart based on the perimeter, circumference and area of the cube, pyramid, sphere and cone and come up with some sort of an explanation or observation for the measurements. The students will be allowed to work as groups of 2 for this but each one is to have at least one thing to share with the class when the teacher goes around to each student and ask for
a comment. Without giving an answer, the student is not free to leave when the class is finished. All students are to participate with some sort of answer as their daily ticket out.

**Homework:**

Giving the students a copy of a world map that is rectangular, the students are to come up with an observation on what is “wrong” with the map as compared to cutting up a real sphere. Also, the students should tell about how much of the rectangular map is “added” and not really there.
The Cone should be assembled like:
Explain what “looks” wrong with the second map compared to the first. Make an estimate using your previous knowledge and the knowledge you have just acquired from the past five days to come up with about how much (%) of the world was added and what it probably was (land, water etc). Must Show All Work!!!
Main Activities Questions:

• **Surface Area Formulas:**
  - Cube: \(6 \times (L \times W)\)  
    - our model = \(600 \text{ cm}^2\)
  - Pyramid: \((L \times W \text{ of base}) + 4 \times (B \times \text{edge of triangle})\)  
    - our model = \(340 \text{ cm}^2\)
  - Sphere: \(4 \times \pi \times R^2\)  
    - our model = \(314 \text{ cm}^2\)
  - Cone: \(\pi \times R \times \sqrt{R^2 + H^2}\)  
    - our model = \(175.53 \text{ cm}^2\)

• **Volume Formulas:**
  - Cube: \(L \times L \times L\)  
    - our model = \(1000 \text{ cm}^3\)
  - Pyramid: \(L \times W \times H \times \frac{1}{3}\)  
    - our model = \(333 \frac{1}{3} \text{ cm}^3\)
  - Sphere: \(\frac{4}{3} \times \pi \times R^3\)  
    - our model = \(523 \frac{1}{3} \text{ cm}^3\)
  - Cone: \(\frac{1}{3} \times \pi \times R^2 \times H\)  
    - our model = \(287.833 \text{ cm}^3\)

**Ticket Out Question:**

• Answers will vary. Again, it must be relevant to the lessons and observations such as volume is cubed and area is squared will not be accepted.

**Homework Question:**

• A good answer might be something like there is too much water added and it makes the oceans, Europe, Asia and Antarctica appear larger than they actually are. The students should then give a percentage of how much is actually added. An answer of about \(\%20 + – \%5\) would be accepted. Work MUST be shown!

The work should be in words as well as numerical calculations.