$A = \ell w$

$A = \frac{1}{2}h(B+b)$
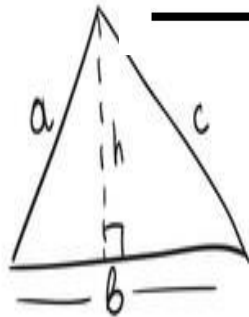
$P = 4S$
$A = S^2$

IMHOTEP'S
LEGACY ACADEMY

$P = a + b + c$
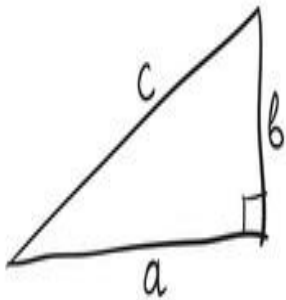$A = \frac{1}{2}bh$

$C = \pi d$
$C = 2\pi r$
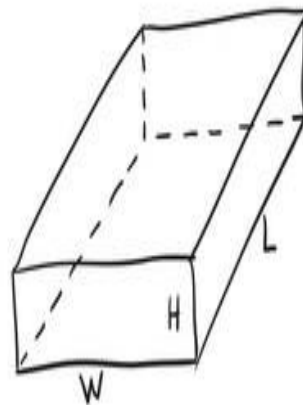$\pi = 3,14$
$A = \pi r$

$V = \frac{4}{3}\pi r^3$

$V = LWH$
$S = 2LH + 2LW + 2WH$

$P = a + b + c$
$a^2 + b^2 = c^2$
$A = \frac{1}{2}ab$

Area & Volume
Activity 6.9

$V = S^3$

$V = \frac{1}{3}\pi r^4$
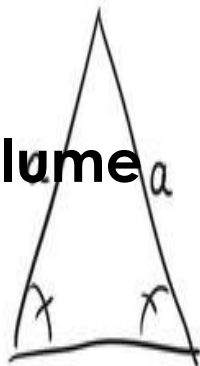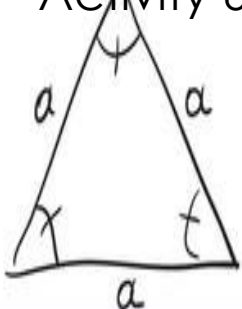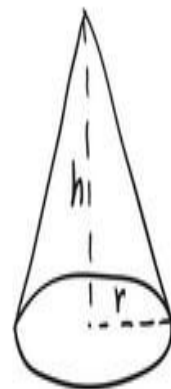
$V = \pi r^2 h$
$SA = 2\pi r^2 + 2\pi rh$

Reviews and Updates

Activity	Revision	Author	Date
Activity Plan Created		Jeffrey Lyn	May 22h, 2019

Area & Volume

Objectives:

1. To demonstrate volumes of various shapes and their formulas.
2. To learn about methods of calculating volume.
3. To apply formulas in everyday life.

Keywords/concepts: Volume, Area, Displacement,

Curriculum Outcomes:

Grade Six: M03.03, M03.04, M03.05, M03.06, M03.07

| Segment	Details
African Proverb Cultural Icon (10 min.)	Where you will sit when you are old shows where you stood in youth. **Benjamin Banneker**
Pre-test (5 min.)	Explain to students that area is amount of space occupied in a 2D region and that volume is the amount of space an object occupied in a 3D region. Explain that volume consists of three dimensions: length, width and height. Introduce the various formulas for basic shapes i.e. Sphere, cylinder and pyramid.
Demo One (10 min)	Equal Volume Objects. Explain that despite being of different shape, certain objects can have equal volume. Pour colored water into various shapes and watch as all shapes hold the same amount of water.
Activity 1 (15 min.)	Volume Displacement.
Demo Two (10 min)	Pizza Optimization. Medium vs Large.
Activity 2 (20 min.)	Triangle matching. Students are to construct a hexagon out of smaller triangles with all the words matching their respective definitions.
Activity 3 (35 min.)	Cylinder Battle. Series of questions of common day events that students need to apply formulas to solve in order to beat the other team.
Post-test (5 min.)	Area and Volume word search

Suggested Interpretation of the proverb

It is important to work hard when you are young so that you can enjoy your old age in comfort.

Benjamin Banneker
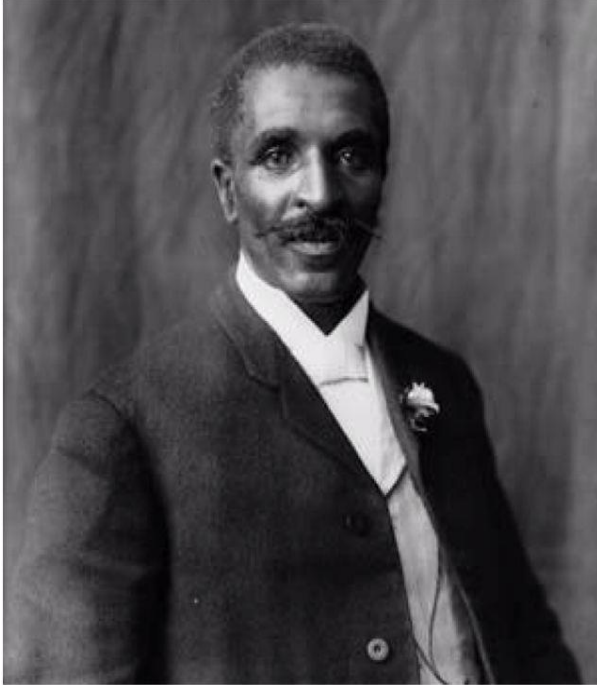
Benjamin Banneker, a mostly self-educated man in mathematics and astrology, is best known for building America's first clock—a wooden device that struck hourly. Sometime in the early 1750s, Benjamin borrowed a pocket watch from a wealthy acquaintance, took the watch apart and studied its components. After returning the watch, he created a fully functioning clock entirely out of carved wooden pieces. The clock was amazingly precise and would keep on ticking for decades. As the result of the attention his self-made clock received, Banneker was able to start up his own watch and clock repair business. Using his rich understanding of trigonometry and astronomy, he accurately predicted a solar eclipse in 1789.

Background Information

Displacement

Water displacement happens when an object is submerged in a fluid and the fluid is pushed out of the way (or displaced) to make room for the object. The amount of water displaced is directly related to the volume of the object.

Volume

Volume is the quantity of three-dimensional space occupied by a liquid, solid, or gas. Common units used to express volume include liters, cubic meters, gallons, milliliters, teaspoons, and ounces, though many other units exist.

Area

In geometry, area can be defined as the space occupied by a flat shape or the surface of an object. The area of a figure is the number of unit squares that cover the surface of a closed figure. Area is measured in square units.

The origin of the word area is from 'area' in Latin, meaning a vacant piece of level ground. The origin further led to an irregular derivation of area as 'a particular amount of space contained within a set of boundaries'. We often find the area of the room floor to determine the size of the carpet to be bought. Covering the floor with tiles, covering the wall with paint or wallpaper or building a swimming pool are other examples, where in the area is computed.

Demo 1: Volume is Relative

Purpose: To demonstrate the concept of volume

Items	Quantity (10 students)
Erlenmeyer flask	1
Beaker	1
Food Coloring	4 colors
Round Bottom Flask	1
Graduated Cylinder	2

Procedure:
1) **To be done prior by mentor:** Fill a beaker, Erlenmeyer flask, round bottom flask and graduated cylinder with 80 mL water and add food coloring until colored.
2) Take predictions from students as to which object is holding the most water.
3) Pour each object into the empty graduated cylinder and record its volume.
4) Show that all objects can hold the same volume of water. What reason would you want to have various equal volume but varying shapes? (Design constraints: fuel tanks, pools)

Volume Predictions

Object	Number of Students
Erlenmeyer flask	
Beaker	
Graduated Cylinder	
Round Bottom Flask	

Activity One: Volume of Displacement

Purpose: To compare the displacement volumes to actual volumes

Item	Quantity (10 students)
Measuring Cylinders	10
Water	Enough to fill 10 beakers
Large Bowl	10
Beaker	10
4 items	10
Rulers	10

Procedure:

1. Measure 4 items that are small enough to fit in a beaker and there's a formula to easily calculate its volume. (i.e. erasers,) Record this value.
2. Place the beaker in the center of a large bowl and fill the beaker to the brim with water. Ensure that no water spills into the bowl.
3.Place your item into the water slowly and allow water to spill out into the bowl.
4.Remove the beaker from the bowl with the object still inside. Carefully pour the water from the bowl into the measuring cylinder and record its volume. Record this number.
5. Is there a difference from your calculated number? If so, what is it?

Item	Initial Calculation	Water Displacement (mL)	Difference (mL)

Demo 2: Pizza Optimization

Purpose: To illustrate how knowing basic area and trigonometry formulas are useful in everyday life

Item	Quantity (10 students)
Whiteboard	1
Dry-erase markers	2 colors

Procedure:

1) **TO BE DONE BY MENTOR: Take a vote as to what students would prefer, 1 large pizza or 2 medium pizzas.**

2) **Use area of a circle formula to prove that 1 large pizza has more surface area and therefore a better deal for than two medium 12'' pizzas.**

Activity Two: Triangle Matching

Purpose: Demonstrate radiation

Items	Quantity (10 students)
Triangle Pieces	10

Procedure:
1) Count triangle pieces to ensure that there are 24 triangles
2) Match Bolded letters with their definitions, picture, equation or number equivalent.
3) Construct a hexagon with all triangle pieces.

See full hexagon on the page below

Cylinder

Equal

Volume

Graduated Cylinder

Geometry

The Study of Shapes

H2O

3D

Area of a triangle

Water

Length, width, depth

0.5*Base*Height

The Earth

Sphere

Meter

Unit of measurement

Square Pyramid

8 edges

8 Sides

Octagon

8cm*6cm*4cm

192cm^3

Pyramid

5 sides

Radius *2

Diameter

L x L x L

Cube

The Sun

6.088*10^12 km^2

π

3.14

Icosahedron

20 faces

cm^3

Volume

Formula

A mathematical Rule

Black

Excellence

2D

Plane

2.01cm^2

Triangle

3 Sides

cm^2

Area

Circle

π*r*r

Radius

Diameter /2

1000mL

1 L

Solid

State of Matter

V

Activity Three: Graduated Cylinder Battle

This activity will allow students to apply concepts learned in this module.

Item	Quantity (10 students)
Food Coloring	2 colors
Measuring cylinders 1000mL	2
Beakers	4
Water	Enough to fill both measuring cylinders
Electronic Scale	2

Question	mL	Answer
1.How many faces does a square pyramid have?	50	5
2. If one side of a cube is 4 cm long, what is its volume?	150	64cm3
3. What is the formula for the area of a triangle?	100	0.5*B*H
4. How many dimensions can we see?	10 0	3
5. A square has a side that is 8 cm long. A triangle has a height that is 4 cm and base that is 16 cm. Which has more area AND how much more?	250	Square: 32cm2 more
6. What is the formula for the volume of a sphere?	50	4/3 * pi * r^3
7. If your shoe is 25 cm long and 9cm wide how much area can you cover in 3 steps?	250	675cm2
8. Is a physical prism 1, 2 or 3 dimensional?	50	3
9. If the area of a triangle is 50 cm² and its base is 10cm long. What is its height?	150	10cm
10. What is Benjamin Banneker famous for making?	150	The Clock
11. What shape has 8 sides?	50	Octagon
12. Which has more "pizza" 2 large pizzas or 5 medium pizzas?	100	Medium Pizzas
13. If a circle has a diameter of 17cm what is its radius?	50	8.5 cm
14.If a circle has a radius of 37cm what is its diameter?	50	74 cm
15. What dimension usually makes objects 3 dimensional?	100	Depth
16. How many cubes with a side of 3 cm long fully fit in a cube box with a side 8cm long?	200	18

17.What is the area of the INNER circle of a Toonie ?	100	Approx. 2.01 cm^2
Bonus: Closest guess wins		
What is the area of the sun?	200	6.088×10^{12} km^2

Procedure:

1. Have Students split into two teams (red and blue) to answer questions. Students will have approximately one minute to solve decide on an answer.

2. Place each cylinder on a scale and zero it.

3. Students will compete by answering questions outlined below. With each correct answer one member of each team will pour how many mL of their respective team color into the opposing team's cylinder as indicated by the question until one of them weighs 1000g = 1kg. If Questions are exhausted team with the lowest weight wins.

Post Work

Print off the Word search worksheet on the following page.

Y	C	Y	P	U	B	N	M	G	V	L	T	E	A	L
U	J	B	P	B	G	M	B	N	S	Y	A	P	A	A
N	T	N	E	M	E	C	A	L	P	S	I	D	T	Z
F	U	E	X	A	H	V	D	A	D	D	P	Q	R	P
N	K	B	Q	J	K	X	C	Z	I	W	M	U	I	Y
G	O	F	K	W	D	E	L	W	M	C	N	B	A	V
H	L	W	L	S	L	D	R	A	E	X	L	X	N	F
L	I	F	W	U	J	Y	L	E	N	X	Y	G	G	J
R	U	F	H	K	Y	U	S	R	S	Q	Y	R	L	A
B	J	U	K	D	M	P	X	A	I	V	A	A	E	Z
V	P	S	F	R	H	L	P	O	O	E	P	Q	Z	Z
W	R	X	O	E	F	L	R	L	N	R	J	L	M	I
O	S	F	R	D	B	C	U	B	E	G	U	M	A	P
Z	Y	E	C	H	J	M	J	I	U	C	L	Q	T	Q
Y	Q	G	Y	V	E	R	L	N	R	R	O	O	W	V

AREA

VOLUME

CUBE

SPHERE

FORMULA

DISPLACEMENT

PIZZA

TRIANGLE

BEAKER

DIMENSION