# Measures: Surface Area / Volume

***Mathematics and Millennials – 6th***

## Geometry - 1

**Geometry recognizes closed & convex solids.**
**Do you remember the names of the (6) solids?**

**Closed Solids have all faces touching.**
**Open Solids have one or more faces not touching.**

**Convex Solids has all faces going outward**
**Concave Solids have at least one face going inward.**

## Geometry - 2

**Most important as we study Geometry Solids:**
**What are 3 major components of solids?**

**Faces are smooth and continuous surfaces.**
**Edges are straight line segments.**

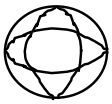
**Vertices are points common to Edges & Sides.**
**Do all Geometry Solids have these attributes?**

## Definition: TSA & V

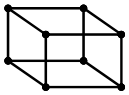
**Total Surface Area** is the sum of face areas.

**Volume** is total region contained within a solid.

**Rounded 3D solids**

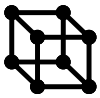


**Lateral 3D solids**

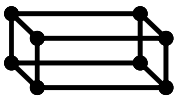


## Lateral 3D Solids

**Cube**



**Prism**



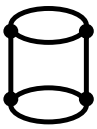
**Pyramid**

3D Images have Surface Area and Volume!

## Circular 3D Solids

**Sphere**

**Cylinder**



**Cone**

3D Images have Surface Area and Volume!

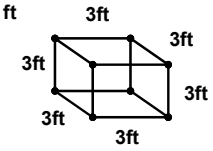
## Cube: Surface Area

**Cube has All (6) Sides are Equal:**

Surface Area = Ft + Bk + Tp + Bm + Rt + Lt

TSA = 9+9 + 9+9 + 9+9 = ____ sq ft

Side Area = Edge x Edge



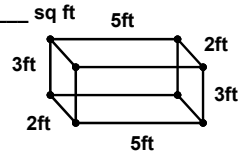

## Prism: Surface Area

**Opposite Sides are Equal:**

Surface Area = Ft + Bk + Tp + Bm + Rt + Lt

TSA = 15+15 + 10+10 + 6+6 = ____ sq ft

Side Area = Edge x Edge




## Pyramid: Surface Area

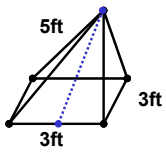
**Four Sides & Base:**

Surface Area = S+S + S+S + BASE

TSA = 6 + 6 + 6 + 6 + 9 = ____ sq ft

Triangle = 1/2 x B x H  Base = E x E

Side Altitude = 4ft



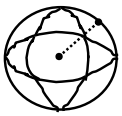
## Sphere: Surface Area

**Total Surface Area is a smooth surface:** R=3ft

Total Surface Area = $4 \times Pi \times R^2$

TSA = (4) (Pi) (RxR)

TSA = (4)(3.14)(3x3) ~ 113.04 sq ft



Pi (*TT*) is not exactly 3.14 thus (~) means an estimate!

## Cylinder: Surface Area

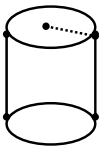
R = 3ft

Total Surface Area = Top+Bottom+Side

TSA is sum of T + B + S areas

TSA = $Pix R^2 + Pix R^2 + PixDxH$

TSA = Pix9+Pix9+Pix6x5 ~ 150.72 sqft



S=5ft

D = 6ft

Pi (*TT*) is not exactly 3.14 thus (~) means an estimate!

## Cone: Surface Area

Side Altitude = 8ft

TSA = Total of Side & Base:

T.Area = 1/2 C x H  B.Area = $PixR^2$

TSA = 1/2(3.14)(6)(8)+(3.14)(9) ~ 103.62 sqft

C = Circumference of Base = TT x D

R = 3ft  D = 6ft

Pi (*TT*) is not exactly 3.14 thus (~) means an estimate!

## Definition: TSA & V

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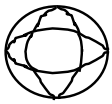
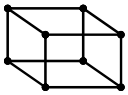
**Volume** is total region contained within a solid.

**Rounded 3D solids**



**Lateral 3D solids**



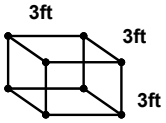
## Cube: Volume

**Capacity (Cubic) of a Cube:**

Volume = Side x Side x Side

V = 3 x 3 x 3 = ____ cu ft

Volume = Length x Width x Height



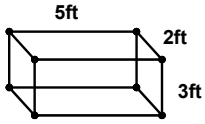

## Prism: Volume

**Capacity (Cubic) of a Prism:**

Volume = Length x Width x Height

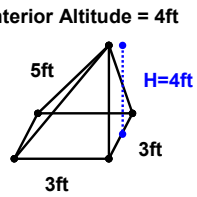
V = 2 x 5 x 3 = ____ cu ft

Volume = Length x Width x Height



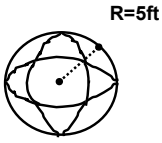
## Pyramid: Volume

Capacity (Cubic) of a Pyramid:
Volume = 1/3 x B.Area x Height
V = 1/3 x 3x3 x 4 = ____ cu ft
V = 1/3 Base Area x Height




## Sphere: Volume

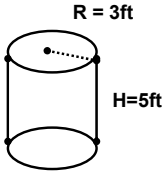
Capacity (Cubic) of a Sphere:
Volume = Total region within
V = (4/3)(3.14)(5x5x5) ~ 522.03 cu ft
Volume = 4/3 x TT x $R^3$




Pi (*TT*) is not exactly 3.14 thus (~) means an estimate!

## Cylinder: Volume

Capacity (Cubic) of a Cylinder:
Volume = Area of Base x Height
Volume = Pi x 9 x 5 ~ 141.3 cu ft
Volume = Pi x $R^2$ x H

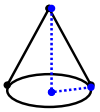



Pi (*TT*) is not exactly 3.14 thus (~) means an estimate!

## Cone: Volume

Capacity (Cubic) of a Cone:
Volume = 1/3 x B. Area x Height
Volume = 1/3x(3.14)x25x10 ~ 261.67 cuft
Volume = 1/3 x Pi x $R^2$ x H

Interior Altitude = 10ft



R = 5ft

Pi (*TT*) is not exactly 3.14 thus (~) means an estimate!

## Today's Digital Kids - 1

A Real World view of SA & V for 3D solids would be measuring actual objects & calculating Surface Area and Volume using a calculator! Calculators help Pi!

Go to Lowe's or Home Depot! They will gladly cut up 2x4's and PVC pipe to create pieces of 3D objects for students to actually measure for real objects.

## Today's Digital Kids - 2

Have students bring to class solid objects such as: Softballs, Baseballs, Tennis & Golf Balls, Pop Cans and Styrofoam cups or whatever they can find!

Styrofoam cups are a challenge since students must determine the dimensions of Cone the cup might have been produced from originally. It can be done!

## Tomorrow's Engineers - 1

Extend investigations into Real World solid objects!

Imagination is needed for objects not perfect!
Measure & Determine best value for each SA & V!

Have students compare their measured SA & V,
against a required value. Required to manufacture!

Real World Engineering! What is Percent of Error?

## Tomorrow's Engineers - 2

Percent of Error: |Difference Actual & True / True Value|
A True Value may be a required value to manufacture!

Measured: SA = 5.25 sq units V = 2.94 cu units
Required: SA = 5.00 sq units V = 3.00 cu units
Difference: D in SA = .25 sq units D in V = - .06 cu units

P of E: SA= |.25/5| = 5% P of E: V = |-.06/3| = 2%
Why is |N| needed? Is P of E acceptable to manufacture?

## Conclusion