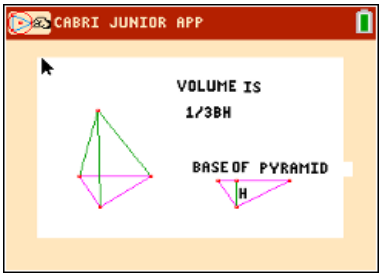
Math Objectives

- Students will define right and oblique three dimensional figures.
- Students will calculate the volume for prisms, pyramids, cylinders, and cones.
- Students will try to make a connection with how to understand these topics in IB Mathematics courses and on their final assessments.



Vocabulary

- Prism
- Oblique
- Right Prism
- Pyramid

About the Lesson

- This lesson is aligning with the curriculum of IB Mathematics Applications and Interpretations SL/HL and IB Mathematics Approaches and Analysis SL/HL
- This falls under the IB Mathematics Core Content Topic 3 Geometry and Trigonometry:

  3.1: (b) Volume and surface area of three-dimensional solids including right pyramid, right cone, sphere, hemisphere and combinations of these solids.

  As a result, students will:

- Apply this information to real world situations.

Teacher Preparation and Notes.

- This activity is done with the use of the TI-84 family as an aid to the problems.

Activity Materials

- Compatible TI Technologies: TI-84 Plus*, TI-84 Plus Silver Edition*, TI-84 Plus C Silver Edition, TI-84 Plus CE

** with the latest operating system (2.55MP) featuring MathPrint™ functionality.*

Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials

Lesson Files:

Student Activity

Volume-Student-84CE.pdf

Volume-Student-84CE.doc

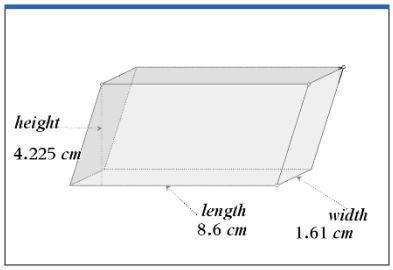
In this activity, students define right and oblique three dimensional figures and calculate the volume for prisms, pyramids, cylinders, and cones. The will use multiple representations to explore properties of area and volume. This investigation offers opportunities for review and consolidation of key concepts related to area and volume.

Teacher Tip: Although there is no file to download to the handheld, this activity is meant to be done from different perspectives. Have the students alter the dimensions of the solids given to see what conclusions they can make about the volumes they find.

Problem 1 – Rectangular Prisms

Using the prism to the right, answer the following.

1. Describe when the prism is a *right* prism.



Solution: A prism is right when the joining edges and faces are perpendicular to the base faces. This applies if and only if all the joining faces are rectangular.

2. Describe when the prism is an *oblique* prism.

Solution: A prism is oblique when the joining edges and faces are not perpendicular to the base faces.

3. Find the volume of the pictured rectangular prism. Record the dimensions of the prism below.

Base length = ____**8.6 cm**_____ (***l***) Base width = ___**1.61 cm**_____ (***w***)

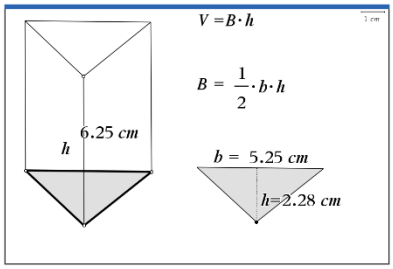
Area of the Base = ____**13.846 cm^2**_____ (***B***)

Prism height = ____**4.225 cm**_____ (***h***) Prism Volume = __**58.5 cm^3**_____ (***V***)

Teacher Tip: This is a perfect time to adjust the dimensions and discuss the volumes students get.

Problem 2 – Triangular Prisms and Pyramids

4. Using the prism below, describe why it is called a *triangular prism*.



Solution: A triangular prism is made up of two triangular bases and three rectangular sides.

5. Find the volume of the pictured triangular prism and record the dimensions below.

Triangle base = ___**5.25 cm**_____ (***b***) Triangle height = __**2.28 cm**_____ (***h***)

Area of Triangle = ___**5.985 cm²**_____ (***B***)

Prism height = ___**6.25 cm**_____ (***h***) Prism Volume = ___**37.4 cm³**_____ (***V***)

6. Describe what the difference is between a *prism* and a *pyramid*. Find the portion of the volume of a prism that is the volume of a pyramid with the same base and height.

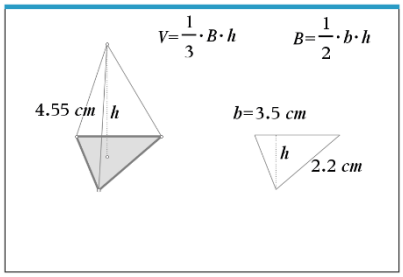
Solution: Both a prism and a pyramid are three dimensional solids that have flat faces and base, but a prism has two identical bases whereas a pyramid has only one base and a connecting point.

7. Find the volume of the pyramid pictured below. Record the dimensions of the pyramid.

Triangle base = ___**3.5 cm**_____ (***b***) Triangle height = ___**2.2 cm**_____ (***h***)

Area of Triangle = ___**3.85 cm²**_____ (***B***)

Pyramid height = ____**4.55 cm**_____ (***h***) Pyramid Volume = __**5.84 cm³**_____ (***V***)



8. Describe how the triangular prism and triangular pyramid are alike. Describe how they are different.

Solution: Both are three dimensional solids that have flat faces and base, but a prism has two identical bases whereas a pyramid has only one base and a connecting point.

9. Describe how their volume formulas are alike and different.

Solution: Both formulas contain the area of the base (B) times the height, but the volume of a pyramid multiplies this product by one third.

Teacher Tip: Problem 2 is a great place to have some student lead discussion and listen to their thoughts and explanations about prisms, pyramids, and their volumes.

Problem 3 – Cylinders and Cones

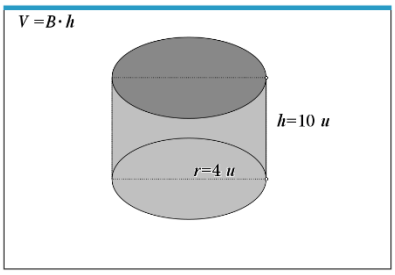
10. Using the pictured cylinder below, record the steps you would perform to find its volume:

(1)_____

Solution: Find the area of the circular base of the cylinder $(A = \pi r^2)$.

(2)_____

Solution: Multiply the area of the base by the height.



11. Record the dimensions below and find the volume of the pictured cylinder.

Circle radius = ___**4 u**_____ (***r***)

Area of Circle = ____**50.3 u²**_____ (***B***)

Cylinder height = ___**10 u**_____ (***h***)

Cylinder Volume = __**502.7 u³**_____ (***V***)

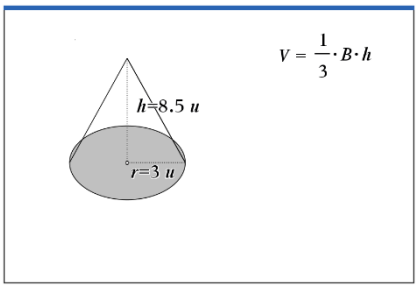
12. Find the volume of the cone pictured below. Record the dimensions of the cone below.

Circle radius = ___**3 u**_____ (***r***)

Area of Circle = ___**28.3 u²**_____ (***B***)

Cone height = ___**8.5 u**_____ (***h***)

Cone Volume = ___**80.1 u³**_____ (***V***)



13. If a cone and a cylinder have the same radius and the same height, describe how the volume of the cone is related to the volume of the cylinder.

Solution: If a cone and a cylinder have the same radius and the same height, then the volume of the cone is one-third the volume of a cylinder.

Describe how this relates to the prism and pyramid formulas when the prism and the pyramid have the same base and the same height.

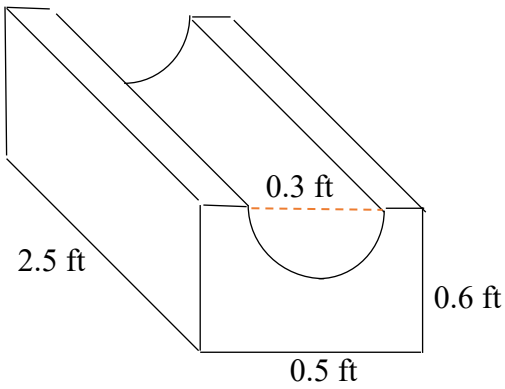
Solution: If a prism and a pyramid have the same base and the same height, then the volume of the pyramid is one-third the volume of a prism.

Further IB Application

Abigail is building a flower box out of a rectangular block of wood for her windowsill. She will take this block and carve out a cylindrical trough. See diagram below. The length of the flower box is 2.5 ft, the width is 0.5 ft, and the height is 0.6 ft. The cylindrical trough will have a diameter of 0.3 ft.

Find the volume of the flower box, after the trough has been carved out, in cubic inches.

Diagram not to scale.



Solution: Volume of rectangular prism – volume of the half cylinder trough

$$V = (2.5)(0.5)(0.6) - \frac{1}{2}\left(\pi\left(\frac{1}{2}\cdot 0.3\right)^2(2.5)\right)$$

$$V = 0.75 - 0.08835\ldots$$

$$V = 0.662\ ft^3$$

$$V = (0.662)(1728) = 1143.936\ or\ 1140\ in.^3$$

Teacher Tip: Please know that in this activity there is a lot of time dedicated to students talking with one another and sharing their thoughts with the class. The goal here is to not only review and apply volume, but also to generate discussion.

***Note: This activity has been developed independently by Texas Instruments and aligned with the IB Mathematics curriculum, but is not endorsed by IB™. IB is a registered trademark owned by the International Baccalaureate Organization.*