The learner will understand and use measurement involving two- and three-dimensional figures.

2

Notes and textbook references

2.01 Draw objects to scale and use scale drawings to solve problems.

A. Using Scale Drawings (Blackline Master II - 1)
Working with a partner, have students measure the length and the width of the classroom. Using the measurements, draw the room's outline on centimeter grid paper. The scale to use is 1 square = 1 square foot. Then, ask students: "If 1 square = 1 square foot, could five student desks and the teacher's desk fit length to length, along the width of the classroom?" Color in the squares to show the arrangement of furniture in the classroom. Have students design a layout that contains 25 student desks, a teacher desk, and two tables.

B. Cartoon Math (Blackline Masters II - 15 and II - 16)
Students will use a cartoon to draw a scale drawing. The students will copy the original drawing by drawing each new square with the corresponding square of the original. Have students use a larger scale for larger drawings. Another option would be to assign different scale factors to different students. A rubric is including for scoring.

C. Draw or trace a map of a country you are studying. Using a ruler, divide the country you are studying into square centimeters. Now enlarge your drawing by creating graph paper to fit your desired proportions (i.e., 3-centimeter squares, 4-centimeter squares, etc.). Looking at each square individually, draw the country on the enlarged grid.

D. Bird's Eye Travel in North Carolina (Blackline Master II - 2)
Materials: road map of North Carolina for each group (2-3 students), ruler or meter stick, copies of the questions.
Students use their knowledge of proportion and scale to find the distances between interesting places in North Carolina.

Notes and textbook references

E. **Space Shuttle Landing Field** (Blackline Master II - 3) Students will use a map of the Kennedy Space Center to answer questions regarding scale drawing, length, and area. Many maps such as this one can be found in magazines and on the internet. Take advantage of the ones you find to create problems for your students to solve.

F. **Model of Mars Pathfinder** Students can find patterns and instructions for building a model of Mars Pathfinder at the web site: **http://mars.jpl.nasa.gov/classroom/students.html**
The scale is 1:17. Estimate the size and area of various parts of the real Mars Pathfinder.

G. **Biltmore House** Students can find a floor plan of the Biltmore House by going to the web site: **http://biltmore.com** and clicking on Biltmore House and then Virtual Tour. When examining the downstairs view, it can be seen that the indoor swimming pool is 53 feet long and 27 feet wide. Use this scale to help estimate the dimensions and areas of other rooms in the house.

H. **GeoBlock Construction –** Have students work in groups to construct a castle or other building from GeoBlocks or snap cubes. After construction, have students determine a scale for their building model that would allow the them to find the actual size of the castle.

2.02 Solve problems involving volume and surface area of cylinders, prisms, and composite shapes.

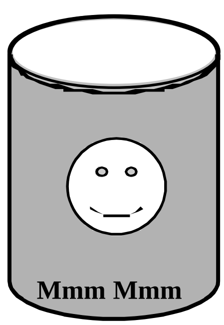
Notes and textbook references

A. **Surface Area and Volume** (Blackline Masters II - 4 through II - 7)

Materials needed: scissors, tape, isometric dot paper, black line masters copied onto heavy paper or card stock for each of the shapes, including two copies for large rectangular prism. Students working in groups will use the cardstock patterns to create 3-dimensional models. They will then find the surface area and volume of each shape built. The grid on the cardstock is useful in helping students compute surface area and volume. Next, the students are asked to form new 3-d shapes by combining two of the original shapes. They are given a list with the surface area and volume of a new shape, and they are then asked to figure out how to build this shape. The students will record their solutions on isometric dot paper (Blackline Master II - 7).

B. **Soups On!** (Blackline Master II - 17)

Materials needed: Soup can with label intact, scissors, ruler. Students remove the label from a soup can. They can find the area of the label and relate it to the area of the side of the can. How does this relate to the formula for finding the surface area of a cylinder? Help students see that the length and width of the rectangle are the circumference and height of the can. Also help them notice that they still need to add the area of the top and bottom of the can to determine the surface area. Using the blackline students will explore the difference between soup cans: one with a top, and one without. Extensions may include: Finding the surface area of wastebaskets, a curved phone booth (it is half a cylinder), and Pringles cans. Students should be able to understand the separate parts of the formula $2\pi r^2+2\pi rh$.



Notes and textbook references

C. Models for Volume of a Prism (Blackline Master II - 8)

Materials needed: scissors, tape, blackline master printed on heavy paper or card stock, centimeter cubes. Have students work in groups to construct the models on the master page. If needed, students can use centimeter cubes to fill in each shape to determine its volume. Have them predict the volume of a prism made from stacking 2, 5, or 10 congruent shapes into a taller prism.

This activity helps develop the concept that the volume of a prism is the area of the base (the volume of a layer that is only one deep) times the height.

Extension: Have the students generalize their findings to develop a formula for the volume of a cylinder.

D. Water Towers At the web site: **http://www.howstuffworks.com/water.html** students can find an article on how water towers work. There are several pictures there including a shot of the water tower in Kitty Hawk, NC. Have students investigate the size of local water towers and determine how much paint it would take to paint the outside of the tank.

E. Harold's Can Design (Blackline Master II - 9)

Students calculate the surface area of several different cans with a volume of 500 ml to determine a height which provides minimum surface area.

F. Gift Box Dilemma (Blackline Master II - 10)

Students explore how to make boxes to fit cylindrical objects and calculate the surface area of these boxes.

G. Cones and Cylinders (Blackline Masters II - 11 and II -12)

These cutouts can be used to make a cylinder and cone with congruent bases and heights. Fill the cone and cylinder with rice to demonstrate that the volume of the cylinder is 3 times the volume of the cone.

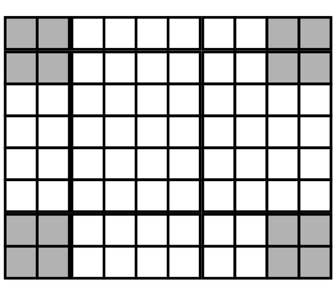
H. **Cylinders Surround Us** (Blackline Master II - 13)
Olive jars, wire, and pencils are some of the common cylinders explored on this sheet. Students will need calculators. Interesting pencil facts are found at the Musgrave Pencil Company web site: http://www.pencils.net/facts.cfm (yes that is cfm). One problem on this sheet involves the volume of a cone. Another way to use this sheet rather than simply giving it to the student would be to cut the problems up and hand out a different problem to each student. Each student could create a poster with the problem, a picture, and their work clearly shown.

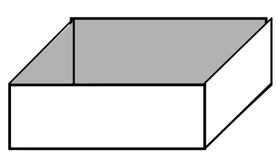
Note:
Truncated:A truncated solid is a solid cut off a given solid by two non-parallel planes

I. **A Look at Water Towers and Other Big Containers**
(Blackline Master II - 14) Students calculate the volume of water towers and funnels. They also will convert cubic feet to gallons. The shapes used are cylinders, hemispheres, and truncated cones.

J. **Candy Boxes** Present students with this problem:
A certain candy company makes fudge cut into pieces that are one cubic inch in volume. That is, each piece is one inch long, one inch wide, and one inch deep. The company wants to make a package that holds 36 pieces of candy. List the dimensions and draw nets for three different boxes the company could use to package the candy. Investigate the cost of making boxes out of cardboard and plastic. Which of your designs costs the least? the most?

K. **Maximizing Volume -** Materials needed: grid paper, scissors, tape. Students should work in groups for this activity. Give each group several sheets of grid paper and instruct them to make a variety of boxes by cutting square corners out of the sheet and folding it to make a lidless container. Have students calculate the volume of each "pan," and try to find a "pan" which would contain the maximum volume.

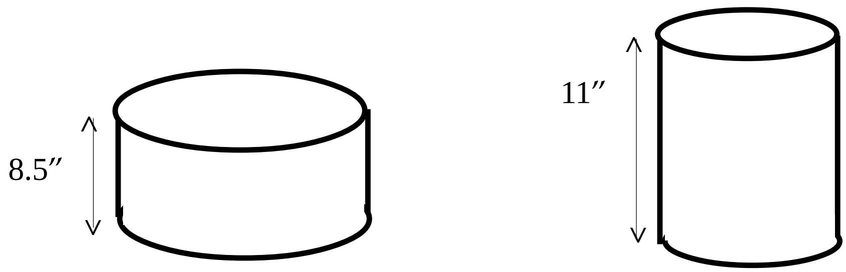




Notes and textbook references

Notes and textbook references

L. Paper Cylinders Give each student a clean sheet of typing paper (or have them pull an 8.5″ x 11″ sheet of paper from their notebooks). Have the students fold the paper into a cylinder with height of 11″. Then have the students fold the paper the other way so that the cylinder has a height of 8.5″.



Ask the students if the lateral surface area (area of the side) of each cylinder is the same. [Because the lateral surface areas are from the same sheet of paper, they are, in fact, the same.] You may also choose to ask them if the entire surface area of each cylinder is the same. [If the area of the base circles are included, then the surface areas are not congruent because the areas of the circles are not the same.]
Ask the students if the volume of each cylinder is the same. Have students explore this question in small groups. They may use cm cubes to fill each cylinder and compare results or they may use mathematical reasoning to come to their conclusions. [The volumes of these cylinders are not the same because the base areas are not congruent. The area of a circle is πr^2. Thus, the radius which is larger in one cylinder is squared, increasing the area of that circle disproportionately to the other one.]
Have students share their conclusions using varying strategies.

M. Volume Review (Blackline Masters II - 18 and II - 19)
These sheets may be used to review volume problems from this strand. It is important to focus on the meaning of volume -the three-dimensional space inside of an object - with students. Rather than teaching formulas for specific figures (ex. Volume of a rectangular prism = $L \times W \times H$), focus on the general case of all prisms, namely that volume is the area of the base times the height, $V = Bh$. This is readily illustrated in Blackline Master II - 18 where the objects are cut into layers.

N. Developing the Concept of Surface Area Students bring in boxes that are rectangular prisms. Have students trace around the faces of the boxes on centimeter grid paper. Students should then assemble these faces to create a net of each figure. Have students use the nets to determine the surface area of each figure. Students can simply count the squares to find the surface area. They can also use area formulas to determine the area of each face and add them together. As students explore, they should notice that opposite faces have the same areas. This can lead to more sophisticated techniques to determine their own formulas for surface area of rectangular prisms.

Notes and textbook references

Notes and textbook references