The learner will understand and use properties and relationships in geometry.

3

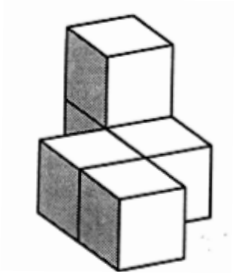
3.01 Using three-dimensional figures:

a) Identify, describe, and draw from various views (top, side, front, corner).

A. **Going Up** (Blackline Masters III - 5 through III - 6)
Materials needed: color cubes, cooperative task cards. Students will build three-dimensional models from clues shared in a collaborative setting. Collaborative pairs usually work best. You may give the student the whole sheet or copy them onto cardstock and use as cards. When a group has completed one; they get another. After completing the task, students work individually to draw side, top, and end views of the model.

Extension: There will always be one group who flies through the activity. Have them make new task cards and try to stump the teacher. They love it!

B. Give students different 3-dimensional objects. Have them fold a paper into fourths. In each of the spaces ask them to draw their object from different perspectives. Coordinate the activity with the art teacher.



C. Construct all the possible 3-D figures that can be made by connecting four cubes. Do an orthographic or isometric drawing to represent each possibility. Examine the drawings to find duplicates. Solve the same problem using five cubes.

Notes and textbook references

D. Design and 3-D Drawings (Blackline Masters III - 32 through III - 37)

Materials needed: snap cubes or other interlocking cubes.
This activity works best in cooperative pairs. Students will first look at the drawing of a 3-D figure and build the figure. From this figure the student will draw the front, left, right, and top views of the figure. It is important that the student keep the front of the figure facing them and from there work to see the top, left, and right. If they have difficulty seeing it by holding it in their hands, have them set it on a table and then look at it while it is stationary.

After students have been successful with drawing the views of the figures, they will go the other way. They will be given the top, left, right, and front views and will have to build the figure from these views. Students have the most difficulty once the views get more difficult. Remind them to always start with the front view and build from there.

If students finish early, have them create additional cards.

Helpful hints:
-Build the figures yourself first. You want to understand the thought process the students may go through. You also will want to have an idea about what the answer will look like.
-Some of the cards may have more than one answer. Determine this on a case by case basis.
-When they build the models have them show you in order: "Front" then "Right" then have them go back to the front view, then "Left", then back to the front view, then "Top".
This allows for easier viewing and so they don't get confused rolling the figure around in their hands.

Extension:
After they build a figure have them calculate the volume, surface area, or base perimeter of the figure.

Since seventh grade students take the North Carolina Writing Test where they may be required to write point-of-view essays, this math activity can be connected to the Language Arts notion of point-of-view/ perspective. Two people can be looking at the same object or same issue and see it completely differently. Mathematics teachers can collaborate with Language Arts teachers to teach these complimentary notions at the same time of the year.

E. How Do You See It? Put a 3-dimensional object in the center of the room. Allow children to sit in different places around the classroom. Have them draw the object as it appears from where they are sitting. Collect and scramble drawings. Let children look at different drawings and discuss where the person might have been sitting.

Notes and textbook references

F. **No Peeking!** Place a shield on an overhead projector so that students cannot see the shape on the overhead. Project the image on a screen and have students describe what they see. This will introduce them to the idea of seeing three-dimensional shapes from different perspectives. Give a 3-dimensional shape to each student. Have them place the shape on a piece of paper and trace around that part (or face) of the shape touching the surface of the paper. Then, place a different face on the same paper and repeat the process. Continue doing this until every face of the shape has been traced onto the paper. The shapes and drawings are then placed in a central area and students try to match each shape with its drawing. These materials might be left up for students to return to as time allows, a kind of station format. When students are able to perform this task, they might try to draw the faces on a shape in such a way that shows how the faces are connected to each other. If this is done correctly, the shape can be "rolled" from one face to another. Building blocks and Geoblocks provide a variety of 3-dimensional shapes appropriate for these activities. Evaluating student progress: Have students draw pictures and write descriptions of 3-dimensional objects from different points of view. For example, draw what an ice cream cone would look like when viewed from the top, side, and bottom. Some students will find it difficult to see these 3-dimensional shapes in a 2-dimensional way. An ice cream cone viewed from the top should look like a circle, assuming the scoop of ice cream is pretty much a sphere. Place samples of student's drawings and descriptions in their portfolios for comparison with later efforts.

G. **Boxing Around** Students bring in boxes that are rectangular prisms.

Step 1: 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.

Step 2: Have students place their nets in one grouping in the classroom and their rectangular prisms in another. Label the nets with letters and the rectangular prisms with numbers. Have students match the net to its corresponding rectangular prism.

Notes and textbook references

b) Build from various views.

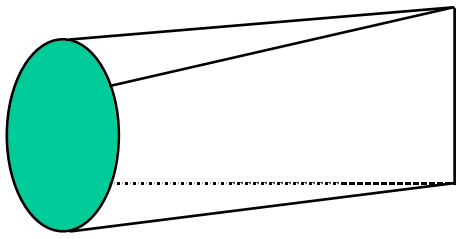
A. Using 10 snap cubes, have pairs of students build a 3-D model. The models should be no more than three cubes high. The pairs should then draw the orthographic drawing (top, front, and side views). Have pairs exchange their drawings with another group and build the 3-D figure from the orthographic drawings. As students become proficient, they should use more cubes and build more complex models.

B. **Build a Model** (Blackline Master III - 7 through III - 10) Objective 3.01b (Build from various views) and Objective 3.01a (Identify, describe, and draw from various views) go hand in hand. The strategy from 3.01a Design and 3-D Drawings will cover both objectives. That activity should be done before the student attempts to build the more complicated figures on the Build a Model Blackline Master.

Once students have mastered the two figures have them move to the seven figures on Blackline Masters III - 8 through III - 10.

C. **Building with Geoblocks** (Blackline Masters III - 8 through III - 10) The worksheets show the top, side (end), and front views of geoblock constructions. Students work to reconstruct the block figures from the drawings.

D. **Shape Challenge** Ask your students to make a shape from clay or other materials that looks like a circle from the top, a rectangle from the front, and a triangle from the side. Can you think of a real world object that has a shape close to this? (It is very similar to a toothpaste tube.)

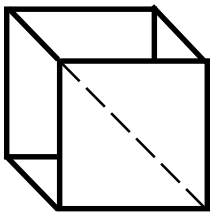


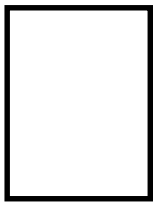
c) Describe cross-sectional views.

Notes and textbook references

A. Play Doh Shapes Have students create three-dimensional shapes (cubes, prisms, spheres, pyramids, etc) out of play doh or clay. Using dental floss, have students cut the shapes to create a cross-sectional view. Students should record their work by drawing the cross-sections created from each cut.

For example:





Given a cube, cut across the middle as shown. The resulting cross-sectional view is a rectangle.

B. Matching Cross-Sectional Views to Three-Dimensional Figures Using Blackline Master III - 28, have students match the cross-sectional views to the three-dimensional shapes that could be cut to form them.

Notes and textbook references

3.02 Identify, define, and describe similar and congruent polygons with respect to angle measures, length of sides, and proportionality of sides.

A. **Coordinating Change** (Blackline Masters III - 1 through III - 4) Students construct a plane figure by plotting the coordinates of its vertices on grid paper. The students then determine the area and perimeter of the figure. Next, the students change the shape by making described changes in the coordinates. They describe the changes made in the shape as well as changes in area and perimeter.

Notation used in this activity shows what happens to vertex ***A*** in the original figure by naming it ***A′*** in each variation of the original figure. Vertex ***B*** becomes ***B′***, etc.

B. Give each pair of students two identical rubberbands and two sheets of graph paper. On one sheet of graph paper, have the pair construct a simple figure. Knot the two rubberbands together. Put one end of the new rubberband on the paper to the left of the figure, far enough away so that the rubberband knot is on the figure. Put a pencil on the other end of the rubberband. Move the pencil so that the knot traces the figure. (Don't have any slack in the rubberbands. Keep it taut, with stretching.) Use this method to enlarge the figure on another sheet of graph paper. Using the grid, determine how much the figure was enlarged. Make generalizations and conjectures.

C. (Blackline Masters III - 13 through III - 21)
In developing the concept of similarity, students must learn to check the proportionality of sides as well as the congruency of corresponding angle measures. In this investigation, students should cut out the triangle and quadrilateral patterns for use in determining which shapes are similar to the shapes on the similarity investigation sheet. Prompt students to compare corresponding angles by placing the angles on top of each other and to check proportionality of sides by examining how many times each side of one figure will fit on the one being investigated.

Notes and textbook references

D. Sorting Activity (Blackline Master III-11)

Materials needed per group: Two pieces of yarn approximately 30 inches in length, a set of cards from the blackline cut apart.

Procedure: Students will arrange the string on their table to resemble the two overlapping circles of a Venn diagram. Cards will be divided among the members of the group. Allow the students to sort their cards according to categories that they devise. You may need to prompt them after a while. (These may include: contains a right triangle, contains an obtuse angle, contains parallel lines, quadrilaterals, shows two similar figures which are not congruent, shows two figures with line symmetry, shows two congruent figures.)

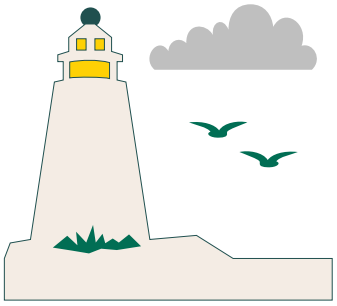
The students will spend some time sorting the cards according to categories. Some cards may fall in the intersection and some may fall outside both circles. The point of the activity is for students to discuss with each other how they determine whether the figures fit into the category or not. The discussion may clear up some misconceptions that students often have. For example, some think that all triangles are similar or that all rectangles are similar.

When most groups have finished, allow them to present their findings. Groups will come up with different solutions to the problem, and the discussion will be about WHY they put the cards where they did.

Alternate materials/procedure: If you do not have yarn – you can draw a Venn Diagram on the board and have them do the work at their tables and then come to the board and tape them up. Have students explain what their categories are and why they put the cards where they did.

E. Let Your Little Light Shine (Blackline Master III - 31)

Have students list ordered pairs labeled on the graph. Discuss and decide on a rule to reduce the lighthouse(i.e. divide each coordinate by three). List the new ordered pairs and then draw the smaller lighthouse on the same sheet or a new sheet of graph paper.



Notes and textbook references

F. The Fan Club (Blackline Masters III - 29 and III - 30)

The task is designed to allow students to develop the concept of similar figures. It is important to note that many students have the misconception that similar shapes are shapes that are the same, but different sizes. This activity should help students conclude that similar shapes have corresponding angles that are congruent and the ratio of sides are proportional.

You must set the stage for this activity by telling a story about Ann who is the president of a fan club and she only allows members in the club who are like her. The students' task is to decide which of the other characters Ann will allow in the fan club and why. The students need to calculate the coordinates of the other characters. Each character is created using Ann's coordinates as the x and y. Each character must be graphed including Ann. For discussion purposes it may be helpful for students to cut out the figures.

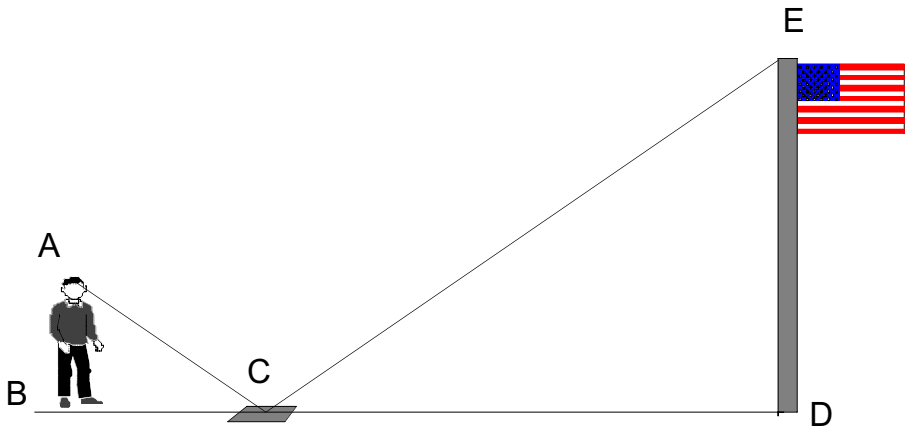
Some discussion questions may include:
Which characters look the same (or similar) and why?
Who would Ann allow into the fan club and why?
What do you observe when you compare Ann's right ear to the other characters' right ears? the angle of Ann's smile to the others?
How many times does the width of Ann's leg fit into the legs of the other characters?

3.03 Use scaling and proportional reasoning to solve problems related to similar and congruent polygons.

Notes and textbook references

A. Mirror, Mirror (Blackline Masters III - 22 and III - 23)

Materials: Mirror with a point marked on it, tape measure, and calculator. Find the height of a basketball goal, flagpole, or other tall object using similar figures and mirrors. It is important that the surface where the mirror rests is level; therefore, an indoor object might be best. A light fixture in the gym could be a good object to use.



Have students use similar figures to solve indirect measurement problems. They can measure the heights of buildings, trees, and flagpoles by using measurements involving the length of the shadows cast.

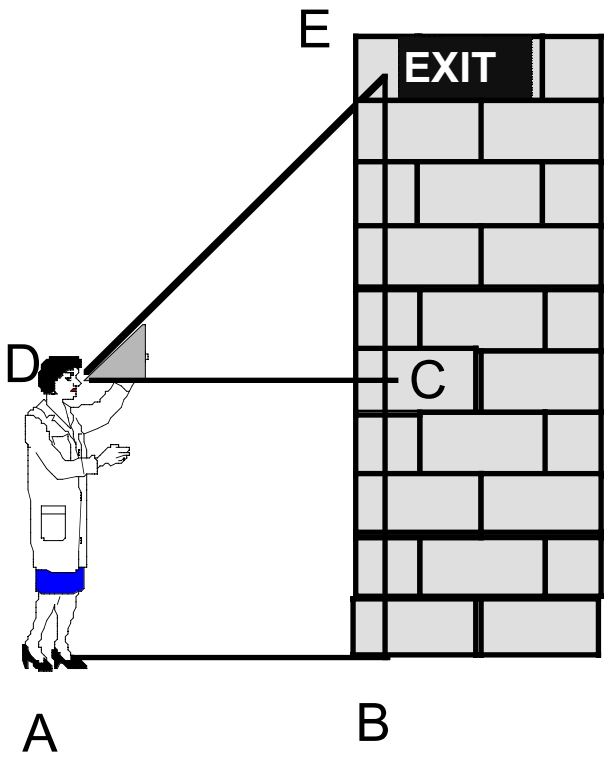
B. Carolina Capers (Blackline Master III - 24)

Materials: Carolina Capers handout, ruler, and calculator. Students will use properties of similar figures to find missing measurements.

Extension: This problem may also be adapted to find the measures of rectangles in the larger flag, the size of the letters, star, etc. Students can also find the area and perimeter of the original flag. These measurements can then be expressed as ratios. The activity could be adapted to include historical landmarks such as the Outerbanks lighthouses, the Wright Brothers' monument, and the U.S.S. North Carolina.

Notes and textbook references

C. Students may use the following technique to measure heights indirectly. Fold a square piece of paper along a diagonal to form a 45°- 45°- 90° triangle. Sight along the fold (diagonal) to the top of the object to be measured. Keep the bottom of the paper horizontal. The measurer may have to move closer to or away from the object until the line of sight is right. When the object can be sighted according to these directions, measure the distance from the measurer to a point directly below the object. Then the height of the object can be calculated. In the figure below, AB is the same distance as the measurement from the eye to point C. The distance from the observer's eyes to the ground is the same as the distance BC.



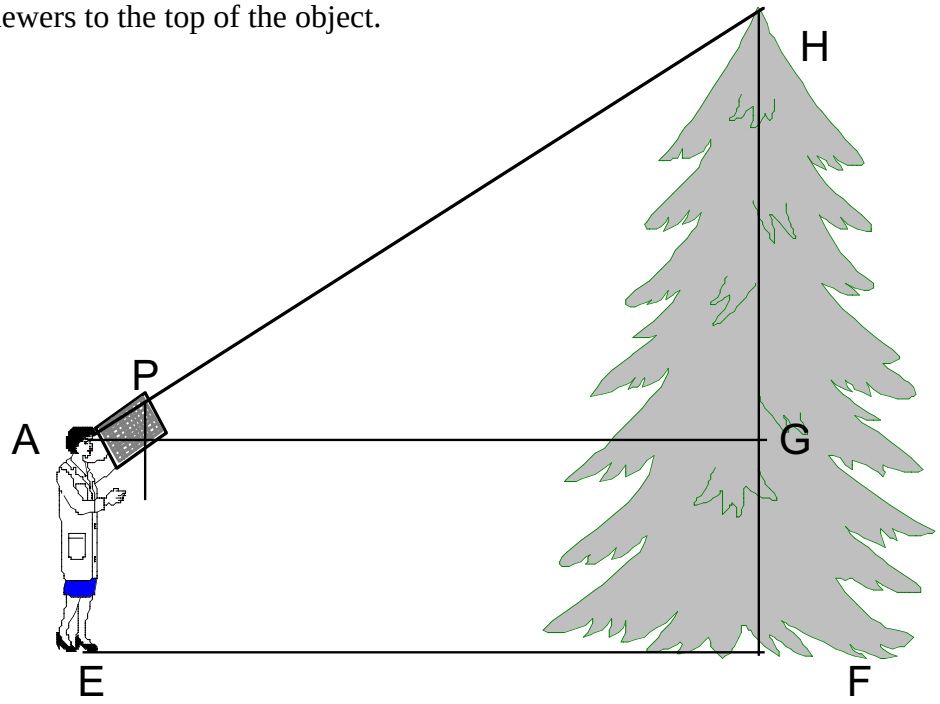
D. Computer software such as Geometer's Sketchpad, Geometric Supposer, and even graphics programs such as PowerPoint can enable students to create and explore similar figures.

E. **Attack of the 50 Foot Woman** (Blackline Master III - 25)
Materials: rulers or tape measures for measuring at home, calculators, blackline master. Students are asked to imagine a world where the women are 50 feet tall. They use measurement and proportion to calculate how big other items in their world would be. You may choose to provide the measurements of standard items for your students, or have them measure some items at home in order to complete the sheet.

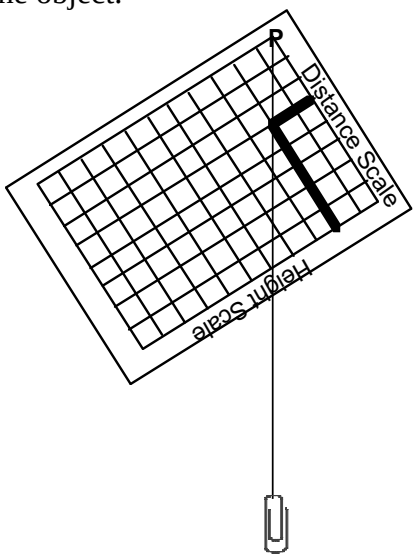
Notes and textbook references

F. Hypsometer (Blackline Master III - 12)

Materials: Hypsometer pattern printed on cardstock, string, tape measure and weight. On the Hypsometer sheet, cut out the viewfinders and fold them as indicated so the viewer can sight through both holes. Attach a string to point P and a weight to the other end of the string. Sight through the viewers to the top of the object.



Measure the distance, EF, from where the viewer is standing to the base of the object. EF = AG. The distance from the eye to the ground is the length of AE and GF. While keeping the Hypsometer sighted at the top of the object, a second student locates the distance EF on the distance scale. From that point on the distance scale, trace along the line perpendicular to the distance scale until it intersects the string. From that point, trace a perpendicular line to the height scale. Add the measurement from the scale to AE to determine the actual height of the object.



Notes and textbook references

G. Review Similar Figures (Blackline Masters III - 26 and III - 27) These sheets can serve to review problems involving similar figures.