

Lesson 1: How to Draw in 2-D and 3-D

Teach your students how to sketch polygons and objects in perspective.

by Andrew Brosnan and Jenny Parma; curriculum by Build SF staff

Math and art come together in this first lesson, which gets students to think about shapes and objects from different perspectives. The information here prepares students for sketching and graphically rendering their ideas in future lessons.

Before beginning this lesson, define the project's goals. Will students build a playable course from their designs? If so, when and where? Or will students just learn about some basic techniques? Be sure to discuss with students about the project's agenda, keeping an open communication channel throughout the curriculum.

Engaging Students

Get your students interested in the lesson by asking them the following questions:

- » Ask for definitions and examples of 2-D, 3-D, orthographic drawing, polygons, and perspective. (See the glossary for definitions.)
- » Ask them to find specific polygons in the classroom or in their lives. For example, a stop sign or the chalkboard.
- » Ask for examples of movie studios that make films primarily in 2-D (Disney's older films) and primarily in 3-D (Pixar).

Project Application: 2-D Drawing

Ask students to draw a rectangle and another polygon of their choice in 2-D – first in free-hand and then using a ruler and graph paper. Here are tips for practicing certain skills:

- » To practice perimeter and area, assign students lengths and widths for the rectangle.
- » To practice calculation, try changing the measurements.
- » To practice estimation, convert from standard measurement to metric measurement and back again.
- » To help struggling students, have them practice drawing a polygon until they're more comfortable using a pencil, a ruler, and graph paper.

LESSON OBJECTIVES AND MATERIALS

OBJECTIVES

- » To define and recognize a variety of polygon
- » To represent the same shape in 2-D and 3-D in order to practice three-point perspective drawing

MATERIALS

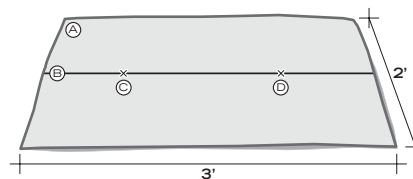
- » graph paper
- » protractors
- » pens and pencils
- » rulers
- » objects or graphics representing different polygons

Project Application: 3-D Perspective Drawing

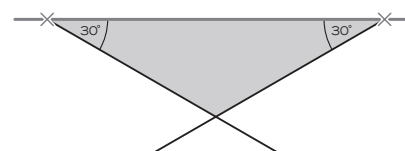
Perspective drawing requires finding the vanishing point and drawing rays that extend from that point. Get your students to draw a 3-D rectangle in perspective by asking them to follow these steps:

- Using a piece of 2- by 3-foot blank paper or graph paper (A), oriented horizontally (landscape style), draw a line that bisects the paper (B). This is the horizon line.
- Make a small "x" on the left edge (C) and on the right edge (D) of the horizon line. These are the vanishing points, the two points to which all visual lines lead.
- Use a protractor (or estimate) to draw a 30-degree angle at each vanishing point, extending the rays of the angle toward the bottom of the paper until they meet to create a large isosceles triangle.
- Form the base of a 3-D rectangle by drawing a dark, 1.75-inch horizontal line from the bottom point of the triangle to the left. Then draw a dark, one-inch line from the bottom point of the triangle to the right.
- Draw a 1-inch vertical line from the bottom point of the triangle up.
- Draw a 2-inch line extending from the top of the vertical line toward the left vanishing point (the first "x"), but the line should not connect to the vanishing point. Repeat for the right vanishing point.
- Draw a vertical line that connects the left edge of the bottom line (the base of the rectangle) to the left edge of new line you created in step 7. Repeat for the right edge.
- Complete the 3-D rectangle by drawing a line from the top of the right vertical line to the left vanishing point. Then repeat the process by connecting the left vertical line to the right vanishing point.

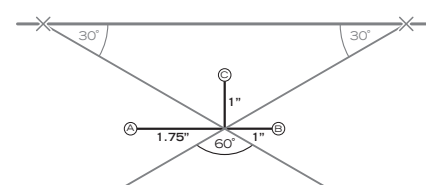
STEP 1 + 2



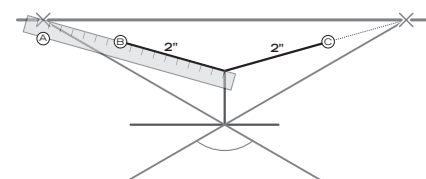
STEP 3



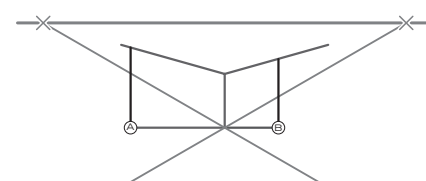
STEP 4 + 5



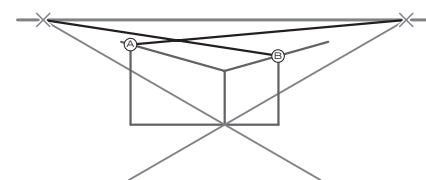
STEP 6



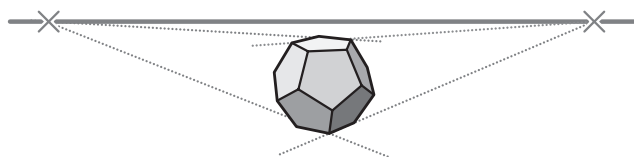
STEP 7



STEP 8



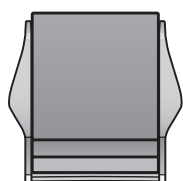
COMPLEX POLYGON WITH 2-POINT PERSPECTIVE



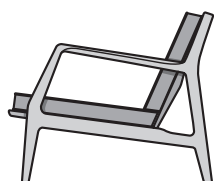
Project Application: Introduction to Orthography

Help your students visualize objects from the three views of orthographic drawings: plan, side, and front. You will further develop orthographic drawings in Lesson 4. Here are some pointers to whet your students' orthographic appetite:

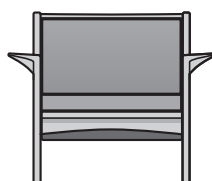
- » Ask students how many ways they think they can draw their polygon.
- » Form groups, and ask each group to look at the same complex item (a chair, a bike, or a backpack) from a different viewpoint—one group from top down (the **plan** view), another group from the side (the **side** view), and another group in front of the object (the **front** view). Discuss what students do and don't see from each angle.



PLAN



SIDE



FRONT

- » Explain what each different view means and its relationship to orthographic drawing.
- » Ask students why architects create multiple illustrations of a building in different perspectives. How do multiple designs help in planning the building? Why is this important to investors and in the construction process?

Student Assessment

At the end of this lesson, you should have a good idea of each student's understanding and skill level with polygons, drawing in perspective, and the other concepts covered. Here are some guiding points to help assess each student.

The student's mastery of the subject matter is

- » **Excellent:** Students can differentiate between true polygons and other shapes and represent them accurately (2-D and 3-D are correctly drawn) and with a sense of composition.
- » **Good:** Students can differentiate between true polygons and other shapes and represent them accurately.
- » **Fair:** Students often spot polygons but mislabel some shapes; drawings are inaccurate or lack the depth of three dimensions.
- » **Poor:** Students do not differentiate between polygons and other shapes; 3-D drawings look 2-D.

RELATED TERMS

- » **Polygon:** A closed shape with three or more sides, such as a triangle, square, or pentagon.
- » **2-D:** A description of an object that has only two dimensions, usually just length and width.
- » **3-D:** A description of an object that has three dimensions, usually length, width, and height.
- » **Orthographic drawings:** A series of related drawings from multiple viewpoints (usually top, side, and front) that show a three-dimensional object in two dimensions.
- » **Perspective:** A method of seeing and drawing that allows artists to represent three-dimensional scenes in two dimensions.

KEY POINTS

Review the following concepts before beginning this lesson:

- » Geometry
- » Orthography
- » Perspective drawing