Perspective Drawings

ID: 9424

Time required
35 minutes

Topic: 3–Dimensional Geometry

- *Construct 3–dimensional prisms and pyramids.*
- *Record the number of faces, edges, and vertices of prisms.*

Activity Overview

In this activity, students draw figures in one- and two-point perspective and compare and contrast the two types of drawings. They then create an isometric drawing and compare it to their drawings in perspective. An optional extension challenges students to use their skills to draw a brick wall in perspective.

Teacher Preparation

This activity is designed for use in a high school geometry classroom.

- *Perspective drawings can be taught at any time in a geometry curriculum, but are most appropriate after lessons on parallel and perpendicular lines, three-dimensional figures, and dilations.*
- *Throughout the activity, students use many drawing and construction tools, such as the **Segment**, **Parallel**, and **Perpendicular** tools. In this document, the first use of a tool is by name and accompanied by its location within the menu structure. For subsequent uses, the tool may be mentioned by name or its function, and the menu location is omitted.*
- *The screenshots on pages 1–4 demonstrate expected student results. Refer to the screenshots on page 5 for a preview of the student TI-Nspire document (.tns file).*
- ***To download the student .tns file and student worksheet, go to education.ti.com/exchange and enter "9424" in the quick search box.***

Classroom Management

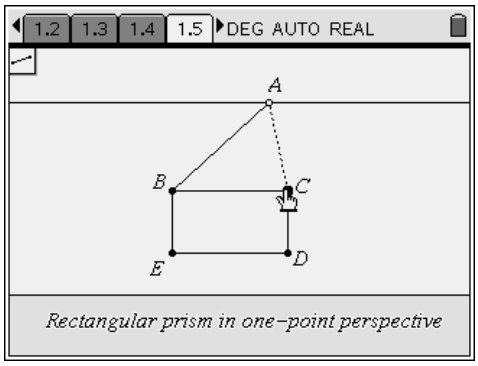
- *This activity is designed to have students explore **individually or in pairs**, with the teacher acting as facilitator. While students are constructing each drawing, be sure to walk to walk around the room and help as needed.*
- *The student worksheet GeoWeek27_Perspective_worksheet_TI-Nspire is intended to guide students through the main ideas of the activity and provide a place to record their answers.*
- *The TI-Nspire solution document (.tns file) GeoWeek27_Perspective_Soln shows the expected results of working through the activity.*
- *Information for an optional extension is provided at the end of this activity, both on the student worksheet and in the student .tns file. Should you not wish students to complete the extension, you may delete the extension from the student tns file and have students disregard that portion of the student worksheet.*

TI-Nspire™ Applications

Graphs & Geometry, Notes

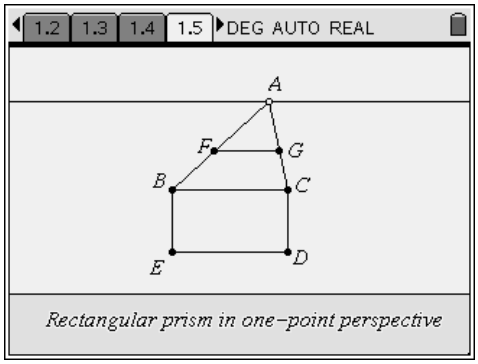
Problem 1 – One-point perspective

On page 1.5, students will find a vanishing point *A* along the horizon and a rectangle *BCDE*.



They are to use the **Segment** tool from the Points & Lines menu to draw $\overline{AB}$ and $\overline{AC}$. These two segments (and any other segment that joins a vertex of the prism to the vanishing point) are hereafter referred to as *vanishing segments*.

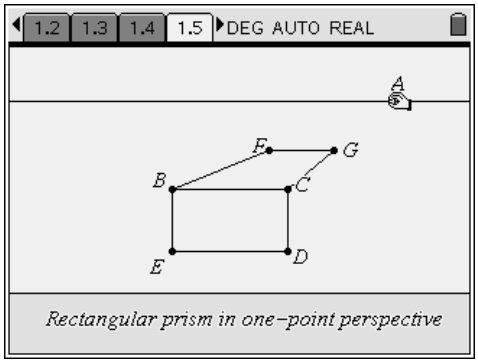
Next, they will create $\overline{FG}$ such that *F* is between *A* and *B*, *G* is between *A* and *C*, and $\overline{FG} \parallel \overline{BC}$ (Refer to the diagram at the right).



To do this, they will need to do the following:

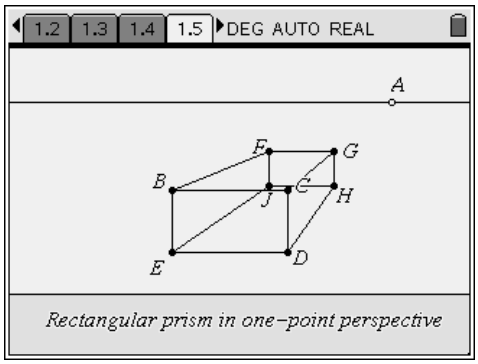
- Place a point *F* on $\overline{AB}$.
  (**MENU > Points & Lines > Point On**)
- Construct a line through *F* parallel to $\overline{BC}$.
  (**MENU > Construction > Parallel**)
- Plot point *G* at the intersection of the parallel line and $\overline{AC}$.
  (**MENU > Points & Lines > Intersection Point(s)**)
- Hide the line. (**MENU > Tools > Hide/Show**)
- Draw $\overline{FG}$.

Students can now hide the vanishing segments, $\overline{AB}$ and $\overline{AC}$, and draw $\overline{BF}$ and $\overline{CG}$. The front and top faces of the rectangular prism have been constructed.



Ask students if they are satisfied that this drawing completely represents a rectangular prism. Have them drag point *A* to either the far left or far right and ask students what is wrong with the drawing. (The rectangular prism does not have a face on either side.)

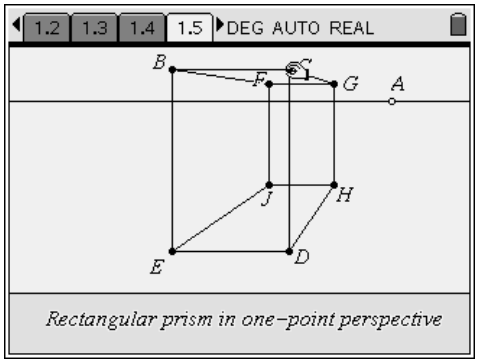
To complete the prism, students next need to construct $\overline{AD}$ and $\overline{AE}$. Then, using the **Perpendicular** tool (**MENU > Construction > Perpendicular**), construct two lines perpendicular to $\overline{FG}$—one through *F* and the other through *G*. The vertical "back" edges $\overline{GH}$ and $\overline{FJ}$ may then be created by plotting the intersection points, hiding the lines, and constructing the segments as needed.



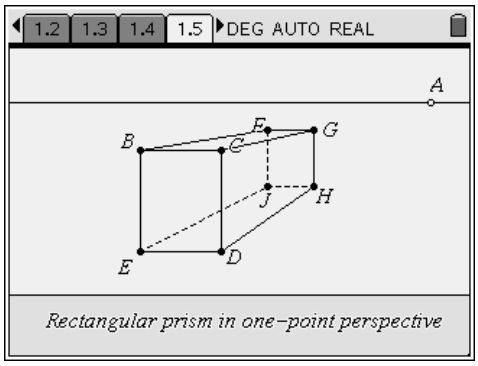
To show all six edges, students should draw a segment connecting *H* and *J*. Once all of the vanishing segments are hidden, students will find they need to also construct segments $\overline{DH}$ and $\overline{EJ}$.

Allow students a few minutes to explore the figure by dragging point *A* along the horizon or dragging an edge or vertex of the prism. (Vertices *C*, *D*, and *F* may be dragged without rotating the prism.)

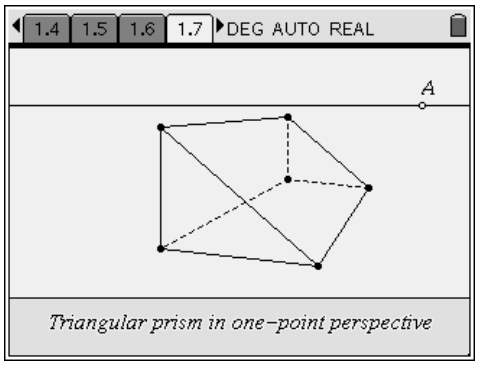
Depending on the topics you have recently covered in class, you can now have students identify parallel, intersecting, and skew lines; count faces, vertices, and edges; or discuss the similarity or rectangles *BCDE* and *FGHJ.*



When students have finished exploring their prisms, they may wish to hide or dash the edges that would not be visible if the figure were not transparent. The appearance of the edges may be altered using the **Attributes** tool (**MENU > Tools > Attributes**).

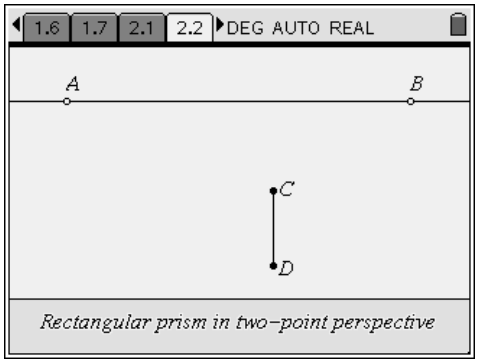


On page 1.7, students are to create a triangular prism in one-point perspective on their own. (The triangle may be created using the **Triangle** tool from the Shapes menu.) Be sure to circulate around the room and assist students as needed.



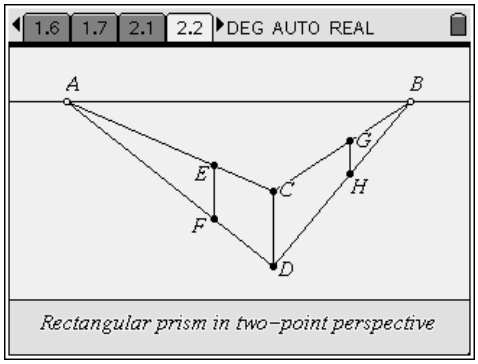
Problem 2 – Two-point perspective

On page 2.2, there are two vanishing points, *A* and *B*, signifying this rectangular prism will be drawn in two-point perspective. Students should begin by drawing a *vertical* line segment, $\overline{CD}$, which will be the front edge of the prism.



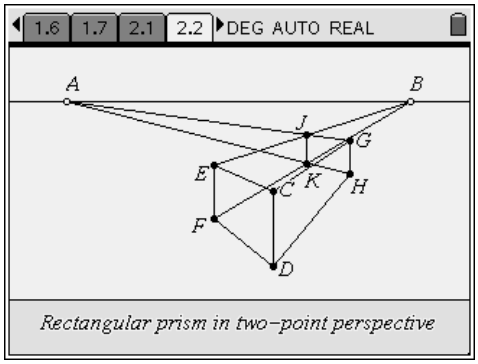
To ensure the line is vertical, students should construct a perpendicular line to the horizon, and then create $\overline{CD}$ on this line—using the line's defining point as point *C*. Constructed in this manner, the segment may be moved after the line is hidden—dragging point *C* translates the segment; dragging point *D* changes the segment's length.

Next, students will then use the **Segment** tool to draw the vanishing segments $\overline{AC}$, $\overline{AD}$, $\overline{BC}$, and $\overline{BD}$. Then they should use the **Point On**, **Parallel**, **Intersection Point(s)**, **Hide/Show**, and **Segment** tools (as they did in Problem 1) to construct the vertical edges, $\overline{EF}$ and $\overline{GH}$, of the left and right faces.



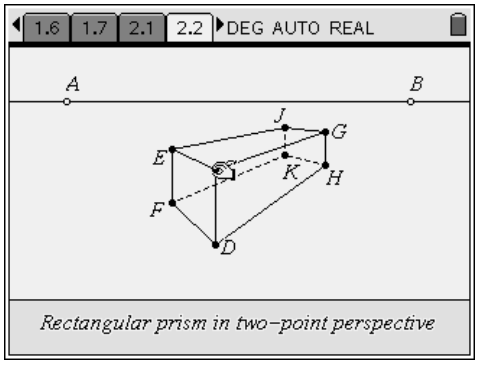
The top and bottom edges of those faces, $\overline{CE}$, $\overline{CG}$, $\overline{DF}$, and $\overline{DH}$ may be drawn as well.

Students should now hide the four vanishing segments, and then draw four more: from *E* and *F* to *B* and from *G* and *H* to *A*.



The intersection of the upper two vanishing segments and that of the lower two vanishing segments should be plotted and a segment drawn between them to form the last vertical edge, $\overline{JK}$.

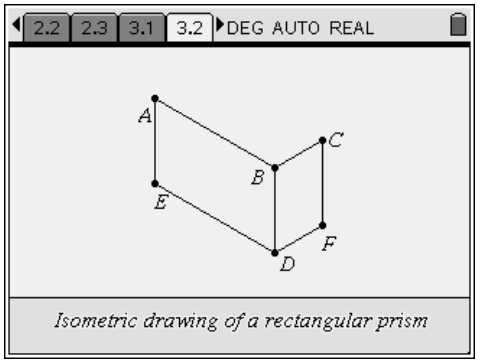
The vanishing segments may then be hidden so that students can draw the remaining edges of the prism.



As before, allow students some time to drag edges, vertices, and vanishing points, observing how the prism changes as they do so. (Dragging point *C* is very interesting!) Again, students can either hide or dash any "hidden edges."

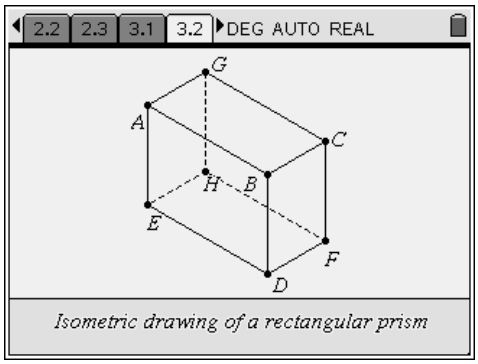
Problem 3 – An isometric drawing

On page 3.2, students will construct an isometric drawing of a rectangular prism. The three segments shown represent the three "front" edges of the prism, and each of the angles the segments form measures 120°. Students should first use the **Parallel**, **Intersection Point(s)**, **Hide/Show**, and **Segment** tools to construct $\overline{AE}$, $\overline{CF}$, $\overline{DE}$, and $\overline{DF}$, as shown in the diagram to the right.



They may then use the same sequence of tools once more to construct the remaining edges: $\overline{AG}$, $\overline{CG}$, $\overline{EH}$, $\overline{FH}$, and $\overline{GH}$.

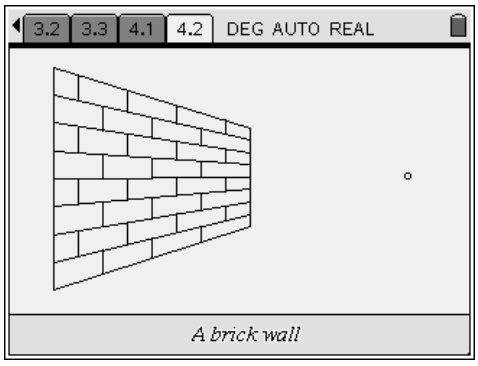
After completing the isometric drawing, students should compare it to the perspective drawings from Problems 1 and 2. As a similarity, students may identify that right angles "in real-life" do not actually measure 90° in the drawings. As a difference, all parallel lines "in real-life" are parallel in an isometric drawing, whereas in perspective drawings, *some* parallel lines actually "meet" at the vanishing point.



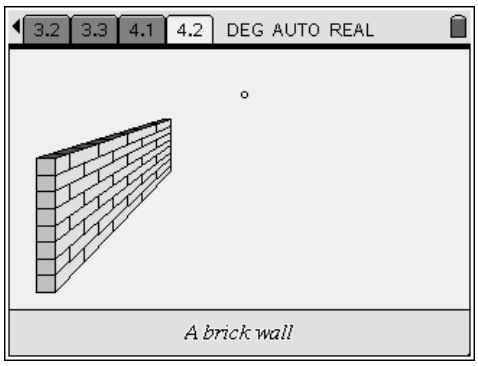
Problem 4 – Extension

Challenge students to use the divided segment and vanishing point on page 4.2 to draw "a brick wall" in one-point perspective.

A possible drawing is shown here, where all points have been hidden to allow for better visibility.



Interested students may take it one step further and create the wall such that is three dimensional, and even use the **Polygon** tool from the Shapes menu in conjunction with the **Attributes** tool to provide shading!



Perspective Drawings – ID: 9424

(Student)TI-Nspire File: *GeoWeek27_Perspective.tns*

1.1 1.2 1.3 1.4 DEG AUTO REAL

PERSPECTIVE DRAWINGS

Geometry

One- and two-point perspective and isometric drawings

1.1 1.2 1.3 1.4 DEG AUTO REAL

In this activity, you will explore different ways to represent a three-dimensional figure in a two-dimensional drawing.

Using tools available in the *Graphs & Geometry* application, you will construct a prism in three different ways and identify the drawings' similarities and differences.

1.1 1.2 1.3 1.4 DEG AUTO REAL

In *perspective drawings*, solid figures are drawn to more closely resemble **how they appear** when you look at them.

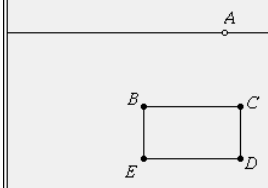
Suppose you stand next to a straight, flat road and look down the road to the horizon. The edges of the road are parallel, and yet they appear to meet! The point at which they "meet" is called a *vanishing point*.

1.1 1.2 1.3 1.4 DEG AUTO REAL

For *one-point perspective*, a face of the solid figure is directly facing your line of sight, and there is one vanishing point.

On page 1.5, construct a rectangular prism in one-point perspective as directed on your worksheet, using point *A* as the vanishing point.

1.2 1.3 1.4 1.5 DEG AUTO REAL



Rectangular prism in one-point perspective

1.3 1.4 1.5 1.6 DEG AUTO REAL

For more practice, use point *A* to construct a *triangular* prism in one-point perspective on page 1.7.

(You do not need to label vertices in your drawing.)

1.4 1.5 1.6 1.7 DEG AUTO REAL

Triangular prism in one-point perspective

1.5 1.6 1.7 2.1 DEG AUTO REAL

In *two-point perspective*, none of the faces of the object are directly facing you, and there are two vanishing points along the horizon.

On page 2.2, follow the directions on your worksheet and use points *A* and *B* to construct a rectangular prism in two-point perspective.

1.6 1.7 2.1 2.2 DEG AUTO REAL

Rectangular prism in two-point perspective

1.7 2.1 2.2 2.3 DEG AUTO REAL

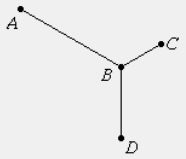
Describe the similarities and differences between drawing in one-point perspective and drawing in two-point perspective.

2.1 2.2 2.3 3.1 DEG AUTO REAL

An *isometric drawing* shows a "corner view" of an object. For an isometric drawing of a rectangular prism, the top, right, and left faces may always be seen.

On page 3.2, construct an isometric drawing of a rectangular prism, as directed on your worksheet.

2.2 2.3 3.1 3.2 DEG AUTO REAL



Isometric drawing of a rectangular prism

2.3 3.1 3.2 3.3 DEG AUTO REAL

Describe any similarities and differences between an isometric drawing and a perspective drawing.

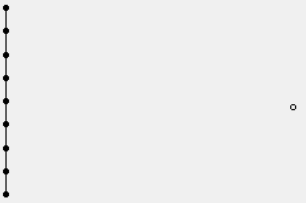
3.1 3.2 3.3 4.1 DEG AUTO REAL

Extension

On page 4.2, use the vanishing point on the right to draw a brick wall in one-point perspective.

The segment and points on the left represent the leftmost edge of the wall.

3.2 3.3 4.1 4.2 DEG AUTO REAL



A brick wall