**Youth Explore Trades Skills Design and Drafting – 2D Drawing**

**Orthographic Drawing**

### Description

In this activity, the teacher will introduce orthographic projection, in which a multi-view drawing shows how the sides of an object are related to each another. Students will use a title-blocked piece of paper to complete this activity. Students will also continue to improve their skills by practising using different lineweights and lettering techniques.

### Lesson Objectives

The student will be able to:

* Complete a board set-up
* Identify and appropriately use drafting tools
* Create an orthographic projection of an object
* Differentiate lineweights
* Refine lettering techniques

### Assumptions

The student will:

* Have basic knowledge of drafting tools and equipment
* Have a foundational understanding of how to appropriately use drafting equipment
* Have created a title block with which to complete this activity

# Terminology

**Border lines**: thick, dark lines used to create a solid border around a blank page.

**Drafting board**: a flat, smooth surface usually covered in vinyl to which paper is affixed. The drafting board has square, parallel edges that allow a T-square to slide easily.

**Drafting brush**: used to sweep away debris from a drawing so it does not smear the full drawing.

**Eraser shield**: a micro-thin piece of metal with cut-outs that allow the user to erase detailed sections of a drawing without erasing the rest of the drawing.

**Guide lines**: thin, light lines drawn using the lettering guide for evenly spaced letters.

**Layout lines**: very light lines used to lay out measurements before those measurements are drawn in heavy dark lines.

**Lettering guide**: used to assist in the drawing of uniform lines to draw consistent, evenly-spaced lettering.

**Lineweight**: the thickness and darkness of drawn lines.



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**Masking tape** (drafting dots): holds drawing paper and/or vellum to the drafting board so the paper does not shift while drawing.

**Object lines**: solid lines used to indicate object shapes.

**Orthographic projection**: a multi-view representation of a three-dimensional object. Placement of the views depends on how the parts of the object work together.

**Pencil**: a drawing utensil with a mechanical or solid core (lead). Leads range from hard to soft: 6H, 4H, 2H, H, HB, 2B, 4B, 6B. H is very hard with a fine point and B is extremely soft with a blunt point. A hardness of 2H will be used for these activities.

**Steel rule**: a straightedge made of rigid material, divided into specific increments, found both in metric and imperial units.

**Title block**: comprised of the information boxes found on the bottom right-hand corner of a drawing, the title block indicates drawing details such as the title, author name, scale, and date a drawing was created.

**Triangles** (right angle and isosceles): made of hard, clear plastic, they are used to draw lines at vertical and set angles (45°–90°–45°, 30°–60°–90°).

* 1. **square**: a precision drawing instrument that is used as a guide for other drafting equipment. Has a 90° angle where the head and blade attach.

### Estimated Time

60–90 minutes

### Recommended Number of Students

20, based on the *BC Technology Educators’ Best Practice Guide*

### Facilities

* + - Regular classroom space with desks/chairs for all students
    - Drafting boards would be ideal. However, smooth, clean, flat surfaces will also suffice.

### Tools

* + - T-square
    - Steel rule
    - Triangles (right angle and isosceles)
    - Eraser shield
    - Drafting brush
    - Masking tape (drafting dots)
    - Drafting board
    - Lettering guide
    - 2H mechanical pencil
    - Architectural scale

### Materials

* Handout with instructions for students (take directly from this document; copy and print the text under “Teacher-led Activity”)
* Title block drawing page (created in Introduction to Title Blocks activity)
* Wooden block from the Scale and Dimensioning activity

# Teacher-led Activity: Orthographic Projection Notes

|  |  |
| --- | --- |
|  |  |
| **Figure 1—**Imagine the object in a glass box | **Figure 2—**Each side of the object is a flat surface plane |

|  |  |
| --- | --- |
|  |  |
| **Figure 3—**Views of the orthographic projection | **Figure 4—**Each side of the object is a flat surface plane |

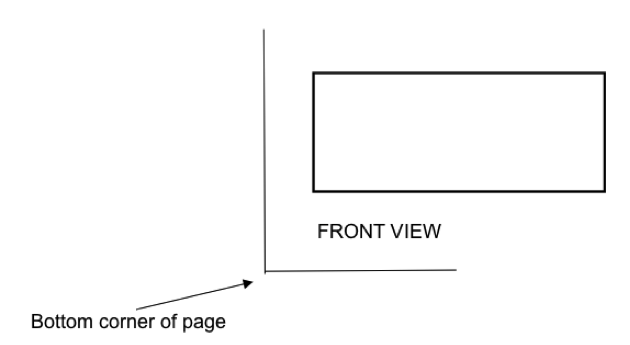
The front, top, and right sides are the most common views used in orthographic projections. When selecting views to include, be sure to include enough that the object could be constructed from the chosen views.

1. Gather all materials listed above.
2. Using the T-square and masking tape/drafting dots, align title-blocked paper to your drafting board and securely tape down (Figure 5).



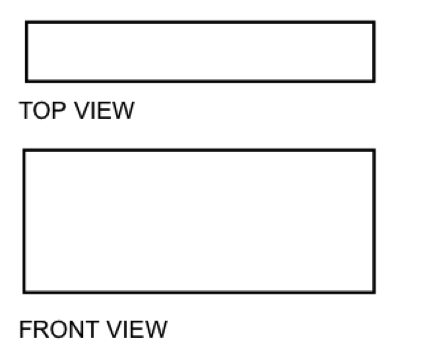
**Figure 5—**Secure paper to board

1. Draw the same wooden block used in the Scale and Dimensioning activity (50 mm × 100 mm × 150 mm block). Have students measure and then scale down the dimensions to fit the drawing space. Students should start by drawing the front view in the bottom left-hand corner of the page. This should be done using object lines (Figure 6). Any hidden details should be drawn using a hidden line. Remind students to leave enough space under the drawing to insert a label.



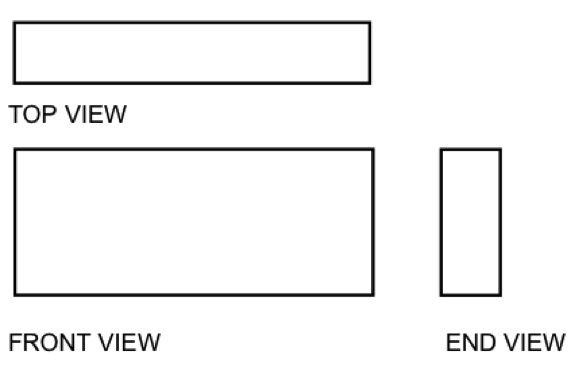
**Figure 6—**Front view

1. Students should draw the top view next. This view should be drawn in the top left-hand corner of the page, aligned with the front view projection (Figure 7). Be sure to leave a 25 mm space below for a label. Using the T-square to align the shapes will ensure their correct layout.



**Figure 7—**Top view and front view

1. Finally, draw the right-side view or end view projection in the bottom right-hand corner of the page (Figure 8). Align this view with the bottom line and top line of the front view. Leave a 25 mm space between the front view and the end view.



**Figure 8—**Top view, front view, and end view

1. Complete the activity by filling in the title block as follows:

|  |  |
| --- | --- |
| ACTIVITY # 5 | NAME |
| DATE |
| ORTHOGRAPHIC PROJECTION | SCALE OF DRAWING 1:2 |
| PAGE 1 OF 1 |

# Extension Activity

Further drawing practice: draw more orthographic projections using different wooden shapes as reference.

# Assessment

* + Student participation in discussion/demonstration
  + Completion of drawing:
    - Lines are drawn correctly.
    - Orthographic views are aligned and evenly spaced on the page.
    - Corners of borders are closed (lines cross at corners).
    - Lettering is done to a high quality (all uppercase).
    - Title block is filled out correctly with appropriate information.

### Appendix Acknowledgment

© Camosun College. Trades Access Common Core: *Competency D-3: Read Drawings and Specifications* pp. 57–60 as a reference for further details on orthographic drawing. The Trades Access Common Core resources are licensed under the Creative Commons Attribution 4.0 Unported Licence ([http://creativecommons.org/licenses/by/4.0/),](http://creativecommons.org/licenses/by/4.0/)) except where otherwise noted.

**Appendix**

**Describe drawing projections**

LEARNING TASK 4

Architectural drawings are made according to a set of conventions, which include particular views (fl plan, section, etc.), sheet sizes, units of measurement and scales, annotation, and cross-referencing.

**Types of views used in drawings**

The two main types of views (or “projections”) used in drawings are:

* pictorial
* orthographic

**Pictorial views**

Pictorial views show a 3-D view of how something should look when completed. There are three types of pictorial views:

* perspective
* isometric
* oblique

#### Perspective view

A perspective view presents a building or an object just as it would look to you. A perspective view has a *vanishing point*; that is, lines that move away from you come together in the distance. For example, in Figure 1, we see a road and line of telephone poles. Even though the poles get smaller in their actual measurement, we recognize them as being the same size but more distant.

**Figure 1 —** Perspective view

#### Isometric view

An isometric view is a three-dimensional view. The plumb lines are vertical. The horizontal lines are set at 30 degree angles from a line parallel to the bottom of the page. Isometric views have no vanishing point, so the objects do not appear as they would in a perspective view.

Lengths are exact on isometric drawings only when the item is parallel to one of the axes of the drawing. Figure 2 shows an isometric view of a simple object, as well as the lines that represent the three dimensions.

30º

30º

**Figure 2 —** An isometric view

#### Oblique view

An oblique view is similar to an isometric view, except that the face or front view is drawn to exact scale and the oblique lines are extended at a 30 degree to 45 degree angle to create a three-dimensional representation (Figure 3).

45º

**Figure 3 —** Oblique view of the object in Figure 2

## Multi-view (orthographic) drawings

Pictorial drawings are excellent for presenting easy-to-visualize pictures to the viewer, but there are some problems. The main problem is that these drawings cannot be accurately drawn to scale. Also, they cannot accurately duplicate exact shapes and angles. As this information can be essential, another form of drawing is used, one that has several names, including *orthographic projection*, *third angle projection*, *multi-view projection*, and *working drawing*. Each projection is a view that shows only one face of an object, such as the front, side, top, or back. These views are not pictorial.

To interpret or read these drawings you must first understand how the views in a multi- view drawing are developed and how each view relates to the other views. The best way to

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understand the principle of orthographic views is to suspend the object you wish to draw inside an imaginary glass box. If you were to look at the object through each side of the box and draw onto the glass the view of the object you see through the glass, you would end up with a sketch similar to that shown in Figure 4.

The view through each side of the glass box shows only the end view of one side of the object. All lines are straight and parallel because the original object has sides that are straight and parallel. Each view represents what you see when you look directly at the object.

**Figure 4 —** Multi-view through a glass box

If you were to open up the glass box, as shown in Figure 5, each view would be in the correct position for a true orthographic drawing. Each view is given a name that refl ts its position in relation to the other views.

Top-side view

Front-side view

Bottom-side view

**Figure 5 —** Box opened to produce orthographic views

When the imaginary glass box is flattened as shown in Figure 6, you can see that each view is in line with the adjacent view. Then the edges of the box are removed and you have a six-view

orthographic drawing of the original object (Figure 7). These six views are called the six principal orthographic views. This view alignment is important and is always consistent in orthographic projection. You will seldom need to show views of all six sides of an object; usually it is sufficient to show just two or three. You should remember the names of these six views and understand how they are obtained in case you ever need to show an object that cannot be truly represented in two or three views.

|  |  |  |  |
| --- | --- | --- | --- |
|  | | Top (plan) view |  |
| Back view | Left view (elevation) | Front-side view (elevation) | Right view (elevation) |
|  | | Bottom view |  |

**Figure 6 —** Drawing with the glass box flattened out

Top (plan) view

Back view

Left view (elevation)

Front-side view

(elevation)

Right view (elevation)

Bottom view

**Figure 7 —** Orthographic views of the object in Figure 2

Unless the object is very complex, only the front, top, and right-side views are necessary. If the object has a uniform thickness, only one or two views are necessary. You should not show more views than are necessary. The front, left, back, and right views are also referred to as elevations.

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