



*Drexel-SDP GK-12 ACTIVITY*

## Activity Template

### **Subject Area(s)**

Measurement, science & technology

### **Associated Unit**

Engineering

### **Activity Title**

“The blueprint of design”

### **Grade Level**

6th-8th

### **Time Required**

1 class period

### **Group Size**

Individual

### **Expendable Cost per Group**

US \$0

### **Summary**

Students will learn the important components of engineering technical drawings. They will practice looking at a three-dimensional object and then drawing it from different perspectives (top, front, side and isometric views). Students will also have to measure every length of the object to develop an appropriate scale to properly convey the object on a piece of paper. Finally students will learn how to label their drawing the way engineers do including dimensions and an information box.

## **Engineering Connection**

Engineers have a standard way of drawing the objects they design. It is important to do so that way the people who manufacture the parts can easily understand how to make interpret the drawings.

## **Keywords**

Blueprint, Dimension, Isometric view, Orthogonal Projection, Perspective, Scale

## **Educational Standards**

- Science: 3.6.7.B
- Math: 2.3.5.B
- Math: 2.3.8.F
- Math: 2.3.8.G
- Math: 2.2.11.E

## **Pre-Requisite Knowledge**

- None-required

## **Learning Objectives**

After this lesson, students should be able to:

- Identify the main components of an engineering technical drawing.
- Learn how to make an isometric drawing.
- Demonstrate capability of drawing an orthogonal projection from a three-dimensional object.
- Learn how to make an appropriate scale on a technical drawing.

## **Materials List**

Each group needs:

- Drawing paper
- Pencil w/eraser
- Metric ruler
- Wooden blocks
- 30/60 degree set square

## **Introduction / Motivation**

This lesson can begin by displaying a few engineering drawings of easily recognizable machines, for example a sports car, space shuttle, a screw, etc, and then asking the students what the object is. Students should also recognize some of the similarities between the drawings (an information box, scale, different views, 4 squares). It should be stressed to the students that they do not have to be artists or know how to draw to accomplish this activity. It is however necessary for engineers to make these drawings so another person can understand the part they are trying to make. Even though engineers now use computer programs to make technical drawings the format is still the same.

## Vocabulary / Definitions

Word	Definition
Blueprint	A photo of a technical drawing with white lines on a blue background
Dimension	A measurement of something, for example length, width, or height
Isometric View	A drawing that shows the plane of a 3D drawing at an equal angle to each of the three axes
Orthogonal	Composed of right angles – provides a 2D graphic view of an object.
Perspective	The appearance of an object from a particular point of view
Projection	The representation of a line on a flat surface
Scale	A ratio representing the size of a drawing in relation to the real object

## Procedure

### Background

There are many concepts to learn about a complete engineering drawing such as sectioning, threading, establishing a tolerance, labeling diameters and radii, etc, but for this lesson we are only focusing on projecting an object on to a paper to get a grasp of drawing the isometric view and orthogonal views.

To draw the isometric view you must use the 30/60 degree triangle. The first thing is to draw the vertical lines that are visible from the front. Then with the triangle draw the sides of the object at 30 degrees from the horizontal. Then you draw the back verticals and then the lines that form the top view at 30 degrees from the horizontal.

To draw each view you must imagine you are looking at the object from a far away distance so if there was a light shining behind it you would only be able to see that face (Figure 1). All visible lines are drawn with thick straight lines. Objects in the back are drawn with dashed lines.

Dimensions should be labeled for each view depending on the scale used. Dimension lines are made a short distance away from the object and have arrowheads on its ends. They are thin lines parallel to the object. Two projection lines, perpendicular from the edge of the object to the dimension line, show where the line starts and finishes. The dimension is written at the midpoint of the dimension line.

The information box or legend needs the following information in the form of a 2 column table at the bottom right corner of the drawing: title of drawing, name of engineer, checked by a second party, version number, date completed, scale, projection system, company name

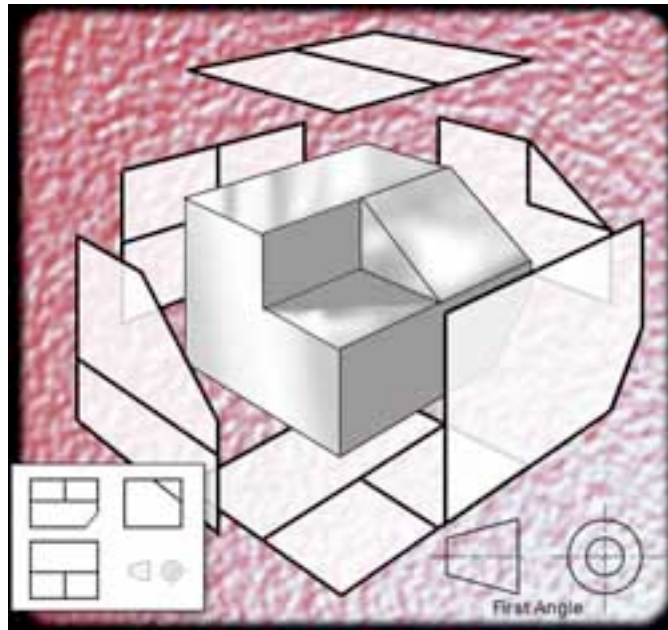


Figure 1: Top picture shows the isometric view of an object and then orthogonal projections from each view. The first angle drawing is shown as an insert.

### Before the Activity

- Gather an assortment of small wooden blocks
- Have enough engineering paper or graphing paper for each student

### With the Students

- Pass out a handful of wooden blocks to each group of students and have them form a stable object.
- Measure the dimensions of each wooden block in centimeters.
- Have students fold the graphing paper into 4 squares and then draw lines along the folds to separate the sections.
- Draw a small square on the bottom right corner of the page that will serve as the information box.
- Draw the isometric view first on the top right part of the paper.
- Draw the top view on the top left part of the paper.
- Draw the side view on the bottom left part of the paper.
- Draw the front view on the bottom right part of the paper.
- Label the dimensions of each line on the top, side and front views.

### Troubleshooting Tips

Make sure to explain really well the concept of visualizing going from 3 dimensions to 2 dimensions. Some students might have a difficult time drawing a side view or front view as a projection.

## **Investigating Questions**

1. Why do engineers draw objects from different points of view?
2. Why is it important to specify the scale on a technical drawing?
3. What happens if the manufacturer of a particular part cannot understand a certain part of the drawing?

## **Assessment**

### **Pre-Activity Assessment**

*Title:* Class discussion

Have a PowerPoint presentation ready with different technical drawings and have the students find the similarities between the drawings. See if they can identify the common elements of a technical drawing.

### **Activity Embedded Assessment**

*Title:* Checkpoint

After each student is finished making their drawing have them trade drawings with the person closest to them and see if they can make the object from the wooden blocks by only using their drawing.

### **Post-Activity Assessment**

*Title:* Class discussion

Once everyone has finished their drawings ask the students what else they could do their drawings so they would provide more detail.

## **Activity Scaling**

- For lower grades, make one large wooden structure and place it on a table in the middle of the classroom so everyone can see it.
- For upper grades, pass out wooden blocks to each student or group and have each student or group make their own structure to draw.

## **References**

1. [http://www.ider.herts.ac.uk/school/courseware/graphics/engineering\\_drawing/](http://www.ider.herts.ac.uk/school/courseware/graphics/engineering_drawing/)
2. <http://pergatory.mit.edu/2.007archive/Resources/drawings/>

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