Using Scale in Drawings
(Notes on using ratios and proportions)

SCALE FACTOR
Figures that are congruent have exactly the same size and shape. They have a 1:1 ratio to each other. IF figures are similar, then they have the same shape, but not necessarily the same size. This means that the parts of corresponding figures could be enlarged or reduced, but each part is enlarged/reduced the SAME AMOUNT. This enlargement/reduction is called a SCALE FACTOR. When a manufacturer makes a product, he usually makes a drawing first. The ratio of the lines on a drawing to the corresponding lines on the real objects is called the scale of the drawing. If the width of a window on a blueprint is 3 inches, and the corresponding width of the actual window is 36 inches, then the ratio is 3: 36 or 1: 12. So the scale of the blueprint is 1/12.

For the tooth model in the dentist’s office, the model may be 8 times for the actual size of a tooth. That means that if the width of an actual tooth is 1 cm, the width on the tooth model is 8 cm. So the ratio is 8:1, and the scale of the model is 8/1.

Key point
For a scaled-down drawing, the fraction, or ratio, will be less then one.
For a scaled-up drawing, the fraction, or ratio, will be greater then one.

Different ways to write the scales
A scale is simply a ratio, and therefore can be written in different ways. The most commonly used methods of writing a scale are: as a fraction and as a comparative graphic scale.

For example; a line on a drawing that is one inch long, but is represents a real measurement of 1 foot (which equals 12 inches) could be written as a fraction (1/12) or it could have been written as a comparison ratio (1: 12).

Architects often write the scale of a drawing with fractional parts (such as ½, ¼, or 1/8) of an inch, for example: ½ inch represents 1 foot. Engineers and surveyors may use decimal parts of an inch, such as 0.1 inch : 1 foot, or 0.5 inch : 1 foot.

Making Scale Drawings
Instead of a scale drawing, sometimes you may have only a simple sketch with dimensions, as shown in Figure 1, but most times a scale drawing is required. This section takes you through the steps needed to make a scale drawing of any object by taking you through the steps needed to make a scale drawing of this sketch. You will use the centimeter markings on your ruler, since that will make it easier to work with decimal measurements.

Figure 1
Choosing the scale
1. In constructing a scale drawing the first step is to choose a scale.
   To decide on a good scale, you need to know two measurements:
   -the longest measurement on the object you are drawing
   -the longest line segment you can draw on the paper you are going to use for the drawing.

Look at Figure 1 and find the longest dimension on the sketch. If you are using ordinary notebook paper, the page size measures about 21 cm by 27 cm. In order to leave ample space for margins and writing on the page, let’s select 15 cm as the longest line segment you will draw. You can use the 15 cm line segment to represent the 60-foot dimension shown in the sketch. Use these two lengths together to choose your scale. (If these two lengths happen not to be even numbers, you should round them first to create your scale.) Begin by writing a ratio like this:

   **Longest line you can fit on your paper : longest dimension you need**

In this example, this ratio is 15 cm : 60 ft. Reduce the ratio so that the first term is one. You can do that by dividing both terms of the ratio by a common factor of 15 to get the scale of 1 cm : 4 ft. At this point, you will use a proportion to determine how big the make each line that you will draw.

A Proportion is a mathematical equation with two equivalent ratios. An example of a proportion that you could use if you assume that you want to draw the line that is 16 ft. and the scale factor is 1:4 like it is in this problem. Set up this proportion to do it this way:

\[
\frac{1 \text{ cm}}{4 \text{ ft}} = \frac{x}{16 \text{ ft}}.
\]

**SUMMARY**
Many of the things we want to observe carefully, or study in more detail, are too large, too vast or too small. We can however build models or draw blueprints and patterns that represent these objects faithfully, regardless of their initial size. When we make models and drawings that are smaller or larger copies of the real object, we refer to the copies as a scale models or scale drawings.

Some of the important facts you need to keep in mind when you work with scale drawings are:
- The ratio of the length of line segments on a drawing to the corresponding line segments on the real object is called the **scale of the drawing**.
- Two-dimensional figures that are exactly the same size and shape are called congruent figures. The corresponding measurements of two congruent figures are in 1 : 1 ratio to each other.
- The corresponding measurements of an actual –size model and the real object are in 1 : 1 ratio to each other.
- A scaled down model is smaller than the real object. A scaled up model is larger than the real object.
- Similar figures or models have exactly the same shape, but they are not always the same size. When two figures or models are similar, the ratio of every pair of corresponding dimensions on those two figures is the same.
- Before you write the scale as a fraction or ratio of terms without units, convert the measurements so that the units in both terms are the same.
- To construct a scale drawing, first choose an appropriate scale. To decide on an appropriate scale, you need to know two measurements:
  - The longest measurement on the object you are drawing
  - The longest line you can draw on the paper you are going to use for your drawing.
- The ratio of the longest line on the paper to the longest measurement may be a good scale to use when you construct a scale drawing.