

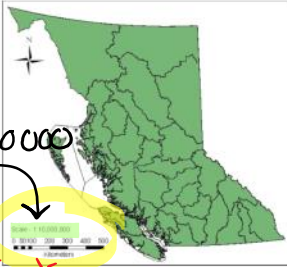
## 2.2 Enlargements & Reductions

November 5, 2018 7:04 PM

### 2.2 ENLARGEMENTS & REDUCTIONS

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Most maps and many technical diagrams include a scale.

A scale shows the **ratio of the distance on the diagram (map, model, etc.) to the actual distance.**

For example on a map a scale might be 1 cm on the map is equal to 10 km.

It might be represented as **1 cm : 5 km** like the map of Victoria below:

Scale  
1 : 10 000 000

ratio shows 2 different measurements are equal

1 cm : 10 km same as 1 : 1 000 000

same units, don't have to write the unit.

$$10 \text{ km} = \frac{1000000}{1000} \text{ cm}$$

$$\frac{10 \text{ km}}{1000} = \frac{1000 \text{ m}}{1000} = 1 \text{ m}$$

$$(10)(1000)(100)$$

#### TERMS TO KNOW:

TERM	DEFINITION	EXAMPLE
SCALE	The relationship between a distance in a drawing to the <u>actual distance</u>	eg. map scale
SCALE REDUCTION	The multiplier is used to <b>REDUCE</b> (make smaller) the size of an object	eg. animal, architect's plans, models of cars
SCALE FACTOR (multiplier)	The number of times larger or smaller the image is.	eg. can be a fraction, decimal or ratio
SCALE ENLARGEMENT	The multiplier is used to <b>Enlarge</b> (make bigger) the size of an object.	eg. scientific diagram, bug drawings

#### Example #1

What would the scale 1 cm : 10 m mean?

means that 1 cm on the map is equal to 10 m in "real life" (actual size)

$$1 \text{ cm} : 10 \text{ m}$$

$$1 : 1000$$

both units are cm.



map/diagram = image  
real life = actual

① When we work with scale we are usually trying to **represent big items**, like a city, on a smaller surface like a map. This is an example of a **scale reduction**.

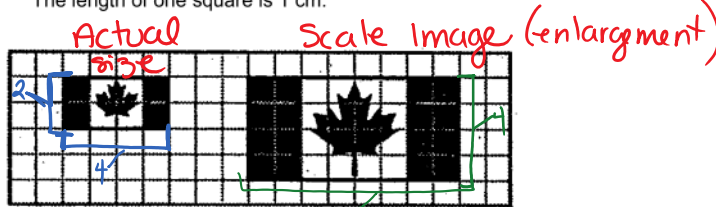
What would be another example of when you would use a **scale reduction**?

- models of cars or planes
- building/architect drawing.

② When we are trying to **show small things** (like an animal cell) that are not practical to draw to actual size because they are too tiny we are using a **scale enlargement**.



**Investigation:** Consider the **enlargement** of a Canadian flag below. The length of one square is 1 cm.



a) What are the dimensions of the original, smaller flag? H = 2 W = 4

What are the dimensions of the scale diagram? (enlarged flag) H = 4 W = 8

b) Compare the matching lengths in the scale diagram and original diagram. How much bigger is the enlargement?

$\frac{H}{W} = \text{actual} : \frac{2}{4} \xrightarrow{\times 2} \frac{4}{8} \text{ enlargement}$  ← "multiplier" The dimensions of the enlargement are twice (2x) the actual flag.

Matching **measured lengths on the original diagram** and scale diagram are called **corresponding lengths**.

When we compare the measurements between these two diagrams we are finding the:

scale factor.

The **scale factor** of the scale diagram can be determined by the fraction:

$$\text{SCALE FACTOR} = \left( \frac{\text{LENGTH ON SCALE DIAGRAM}}{\text{LENGTH ON ACTUAL OBJECT}} \right) = \frac{\text{IMAGE}}{\text{ACTUAL}} \div$$

\* A scale factor can be represented as a **fraction, ratio, or decimal**

**Scale Factor:**

diagram or drawing

- If the image is **LARGER** than the object, the **scale factor > 1**, this is an **Enlargement**
- If the image is **SMALLER** than the object the **scale factor < 1**, this is a **Reduction**
- If the image and the object are the **same size**, the **scale factor = 1**

**PRACTICE** Scale Factor =  $\frac{\text{image}}{\text{actual}}$

Write each scale factor as a decimal and state whether it will create an enlargement or a reduction. (Round your answer to 2 decimal places)

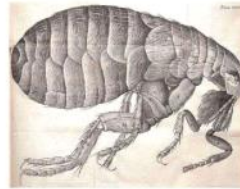
7. $\frac{200}{1000} = \frac{\text{image}}{\text{actual}}$ image < actual reduction $200 \div 1000 = 0.2 < 1$	8. $\frac{350}{50} = 350 \div 50 = 7$ $7 > 1$ = enlargement	9. $\frac{140}{200} = 140 \div 200 = 0.7$ $0.7 < 1$ = reduction	10. $\frac{20}{1000} = 20 \div 1000 = 0.02 < 1$ = reduction
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Often, we are given units of length in our diagrams.  
In order to calculate the scale factor the **units must be the same. \*\*CONVERSIONS!\*\***

**Example #2:** The drawing of a flea was printed in a pamphlet regarding pet health. The actual length of a flea is 3 mm.

- a) Use a ruler to carefully measure the length of the flea in the scale diagram.

$4.8 \text{ cm} = \text{image length.}$



4.8 cm

- b) Determine the scale factor of the diagram.

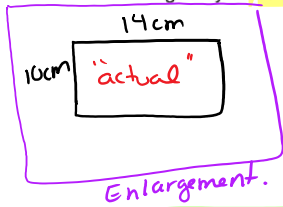
Scale Factor =  $\frac{\text{image}}{\text{actual}} = \frac{4.8 \text{ cm}}{3 \text{ mm}}$

Convert Units:  
 $\frac{4.8 \text{ cm} \times 10 \text{ mm}}{1 \text{ cm}} = 48 \text{ mm}$   
 $= \frac{48 \text{ mm}}{3 \text{ mm}}$  units cancel out

**CAN NOT calculate S.F. with different units.**

Scale Factor = 16  
"multiplier"

**Example #3:** Joel drew a picture of Victoria's Inner Harbour that is to be enlarged to poster size for display in the Empress Hotel lobby. If the original drawing was 14 cm by 10 cm and was enlarged by a scale factor of  $\frac{5}{2}$ , determine the dimensions of the enlargement.



scale factor =  $\frac{5}{2} = 2.5$  ← enlargement is 2.5x bigger

Actual L = 14 cm W = 10 cm  
 Enlargement L = 14(x2.5) W = 10(x2.5)  
 L = 35 cm W = 25 cm

\* Scale diagrams are enlargements if the scale factor is greater than 1.  
 When using scale diagrams as reductions, we use the same methods as enlargements.

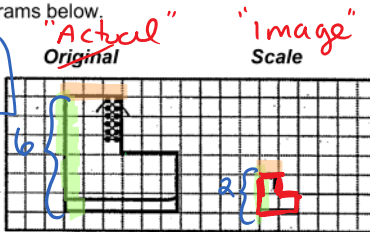
$$\text{Scale Factor} = \frac{\text{Length on scale diagram/image/object}}{\text{Length on original/actual image/object}}$$

If the scale factor is between 0 and 1, there is a reduction.

**Example #4:** Determine the scale factor for the diagrams below.

scale factor =  $\frac{\text{image}}{\text{actual}} = \frac{2}{6} = \frac{1}{3}$

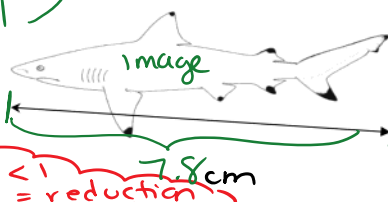
\* choose a corresponding side to compare  
 ∴ the scale factor  $\frac{1}{3} < 1$  so, reduction



**Example #5:** A great white shark can reach a length of 7 m in the wild. What scale factor was used to reduce the shark to the image below?

scale factor =  $\frac{\text{image}}{\text{actual}} = \frac{7.8 \text{ cm}}{7 \text{ m}}$

\*convert units!  
 $\frac{7 \text{ m}}{1 \text{ m}} = \frac{700 \text{ cm}}{1 \text{ m}} = 700 \text{ cm}$   
 $\text{SF} = 0.01$



$0.01 < 1$   
 = reduction

As we have discussed, scales can be given as a fraction or decimal.

Scale factors can also be represented as a ratio. ex. 7.8 cm : 7 m  
 image : actual.

**For Example**

1:150 means 1 unit on the diagram represents 150 units of actual length.

**Example #6:** On a map of Canada, a ratio scale of 1:40 000 000 is given.

a) What does the scale 1:40 000 000 mean?

1 unit on the map = 40 000 000 units in real life.  
(means image  $\times$  40 000 000 = actual)

b) The measured distance between Vancouver and Calgary on the map is 2.5 cm. What is actual distance

i. In centimetres?

↑  
"image"

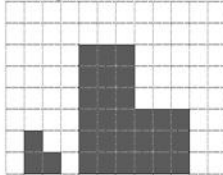
ii. In metres?

iii. In kilometres?

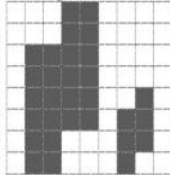
Find actual distance

**PRACTICE**

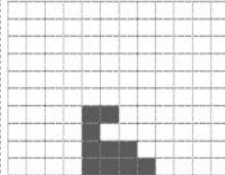
1. Determine the scale factor for each scale drawing. The original image is on the left.



2. Determine the scale factor for each scale drawing. The original image is on the left.



3. Draw the figure below with a scale factor of 2. Is this an enlargement or a reduction?



Determine the scale factor or the actual size. Round your answer to 2 decimal places.

25. A grey nurse shark is 358cm long. National Geographic has a photograph of the same shark and in the picture the shark measures 5.2cm.

Determine the scale factor.

$$\begin{array}{r} \text{Photo} = 5.2 \text{ cm} \\ \text{Real life} = 358 \\ \hline \text{Scale factor} = \frac{5.2}{358} \\ 0.01 \end{array}$$

26. A drawing of a bedbug is 2.2cm long. The actual size is 0.95cm. Determine the scale factor.



27. This is a picture of a prehistoric scorpion. The drawing measures at 2.5 centimeters long. If the scale factor is 1/110, determine the actual length of a prehistoric scorpion.



Determine the scale drawings dimensions. (Round your answer to 2 decimals)

28. James is creating replica of a Bell 412 rescue helicopter from a photograph with a width of 2.8cm and a total length of 17cm. Determine the new dimensions if the scale factor is 8.

Photo → Replica

$$\begin{array}{l} 2.8 \text{ cm} \times 8 = 22.4 \text{ cm} \\ 17 \text{ cm} \times 8 = 136 \text{ cm} \end{array}$$

The new dimensions are 22.4cm wide & 136cm long.

29. Vince is creating a replica of an AW 139 rescue helicopter from a photograph with a blade diameter of 13.8cm. How long will the replica blade length be if the scale factor is  $\frac{9}{4}$ ?

factor is  $\frac{9}{4}$ ?

30. In the photo the wingspan of Boeing 777 is 6.1cm long and the height of the plane is 1.9cm tall. Randal plans to make a replica using a scale factor of 3.8. Determine the new dimensions.



ASSIGNMENT #2  
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Required questions

1, 2, 3, 4, 5, 8, 10

Extra practice

6, 9

Extension