# Scale factor

This lesson comes after students have been introduced to naming and writing similarity statements for corresponding sides in similar figures.

This lesson has an explicit teaching focus. Students are first introduced to the definition of scale factor, then utilise their prior knowledge of corresponding sides to apply the scale factor and find the scale factor between 2 similar figures.

## Visible learning

### Learning intentions

* To understand and be able to determine the scale factor between 2 similar figures.
* To be able to use scale factors to find missing sides in similar figures.

### Success criteria

* I can identify and name corresponding sides of similar figures.
* I can use a scale factor to find missing sides in similar figures.
* I can use given information to determine the scale factor between 2 similar figures.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* identifies and applies the properties of similar figures and scale drawings to solve problems **MA5-GEO-C-01**

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Please use the associated PowerPoint *Scale factor* to display images in this lesson.

## Activity structure

### Warm up

1. Display the following ratios and ask students to write each ratio in its simplest form:

### Launch

1. Display Figure 1.

Figure 1 – two trees



1. Tell students this photo was taken in the afternoon.
2. When planted, the trees had identical heights of 0.7 metres.
3. At the time of the photo being taken, the left tree (Tree A) was 1.7 metres tall, and the right tree (Tree B) was 1.25 metres tall.
4. Ask students 2 questions:
5. How much taller is Tree A than Tree B?
6. How many times taller is the tree on the left than the tree on the right?
7. Using the example of the trees, introduce scale factor as how many times larger one object is than another. You could say Tree A is 1.3 times larger than Tree B or the scale factor from Tree B to Tree A is 1.3.

The purpose of this launch is to help students define *scale factor*. We want to understand *scale factor* so that we can express proportion in conversation. For example, ‘one tree is 45 cm taller than the other’ might not be as impactful as ‘Tree A is 1 times taller’ or ‘Tree B is about the height of Tree A’.

This is especially useful when we get to very small and large measurements.

### Explore

This activity is intended to illustrate *scale factor* on a linear model, which should assist students that are thinking additively.

#### **What is scale factor?**

1. Set up this Desmos activity ([bit.ly/desmosclassroomstrategy](https://bit.ly/desmosclassroomstrategy)) and share the student code with the class: [Scale factor mini golf](https://teacher.desmos.com/activitybuilder/custom/5dc15f09c2706737ce01664f?collections=featured-collections,5d9386f6383d2d0c53a026b5).

The task is called Dilation mini golf. It’s important to define dilate, as prompts will often use dilate to describe the scale factor being applied. For this task you can define dilate as ‘multiply by’.

**Note:** on slide 6, a length of 10 ft is used. This could cause confusion for students if not addressed.

1. Model the first slide to the class. Have students press **Try it** and perform a [Think-Pair-Share](https://app.education.nsw.gov.au/digital-learning-selector/LearningActivity/Card/645) to discuss what Scale Factor: 4 means.
2. Have students complete the following sentence scaffold with a partner:  
   The total distance is made up of \_\_ segments. So, the total distance is \_\_\_ segments long.
3. Have students complete the activity.

You can limit students to certain slides in Desmos using the **Pacing** feature in the teacher dashboard. You might like to only use one or 2 slides for the whole class instead of the entire activity.

### Summarise

#### Faded examples worksheets

1. Print and distribute Appendix A.
2. Explain the first example to students and model how to interact with faded examples ([bit.ly/fadedexamplesstrategy](https://bit.ly/fadedexamplesstrategy)).
3. When students are finished, have them write notes to their future selves on ‘how to find missing lengths when you know the scale factor’.

### Apply

1. Print and distribute Appendix B.
2. Explain the first example to students and model how to interact with faded examples ([bit.ly/fadedexamplesstrategy](https://bit.ly/fadedexamplesstrategy)).
3. When students are finished have them write notes to their future selves on: ‘how to find the scale factor’ ([bit.ly/notesstrategy](https://bit.ly/notesstrategy)).

## Assessment and Differentiation

### Suggested opportunities for differentiation

**Warm up**

* If students have had limited exposure to ratios, they might benefit from expressing each of the ratios given using a colour mixing game (<https://trycolors.com/games/guess-mix>.)
* Challenge students to write as many of their own ratios as they can that are also equivalent to 2:3.

**Launch**

* Have students create 2 towers using centicubes and compare these using the same additive and multiplicative strategies.

**Apply**

* Have students measure 2 similar objects in the classroom, eg, pencils, and determine the scale factor from one to the other. This will likely produce a decimal scale factor.
* When students have finished Appendices A and B. have them find the scale factor of the original figure that was on the right. Students should identify this is the reciprocal scale factor, rather than repeating the process.

### Suggested opportunities for assessment

* Assess students’ additive and multiplicative thinking in *Launch* discussions.
* Review students’ notes to future self.
* With a teacher account you can view students’ progress in Desmos in real time or after the activity. You could start the next lesson by reviewing a slide students struggled with.

## Appendix A

### Scale factor faded examples – triangles

Determine the missing lengths in the following sets of similar figures by using the scale factors provided. In each set, the original figure is on the left.

Note: the diagrams below are not drawn to scale.

1. Scale factor = 2

Two similar triangles side by side. Triangle 1 is labelled with vertices ABC, side AB is 4 units, BC is 6 units, AC is 7 units. 
Triangle 2 is labelled with vertices DEF, side DE is 10 units, EF is unknown, FD is 8 units. 

1. Scale factor = 4

Two similar triangles
ABC has sides 4,5,6
DEF has only side DF which is 16 and corresponds to AC

|  |  |
| --- | --- |
|  |  |

1. Scale factor = 9

Two similar triangles
ABCand DEF.  ABC has sides 4,5,6


|  |  |  |
| --- | --- | --- |
|  |  |  |

1. Scale factor =

Two similar triangles
ABC has sides 40,50,60
DEF is similar to ABC

|  |  |  |
| --- | --- | --- |
|  |  |  |

1. Scale factor = 6

*Why do we not write similarity statements for circles?*

Two circles.  Circle 1 has diameter AB = 6.2cm
Circle 2 has diameter CD with no measurement.


1. Scale factor = 1.5

2 similar 6 sided polygons.
QRSTUV has sides QR = 3m, RS = 7m, ST = 9m, TU=3m, UV = 5m and VQ = QR
DEFABCD is similar to QRSTUV

1. Scale factor =

Two triangles 
DEF is similar to CBA
DF = 4km and DE = 3km

## Appendix B

### Find scale factor faded examples

Determine the scale factor and find any missing lengths in the following sets of similar figures.

Note: the diagrams below are not drawn to scale

Two similar triangles
ABC with sides 4,6,7
DEF with sides 8,12,14
DE corresponds to AB

|  |  |
| --- | --- |
| Method 1 | Method 2  So, we can write the equation  Where is the scale factor  Solving the equation gives:  Scale factor |

Two similar triangles
ABC with sides 4,6,7
DEF with sides 12,?,21
EF corresponds to 

1. 2 quadrialaterals 
   ABCD is similar to  EFGH
   AB = 3cm BC = 5 cm CD = AB AD = 7cm
   EH = 7.5cm FG = EH
2. ABCD~QTSR

Two quadrilaterals. ABCD is similar to QTSR
AB=36 cm CD = 18cm BC=54 cm ST=9 cm

Two similar circles
Circle on the left has radius 24.3 cm
Circle on the right has 8.1 cm

2 squares
The first with area 9cm squared and the second has an area of 144 cm squared. 

## Sample solutions

### Launch

How much taller is the tree on the left than the tree on the right? 0.45 metres

How many times taller is the tree on the left than the tree on the right? This is the opportunity to introduce the idea of scale factor. so the left tree is 1.36 times taller, or approximately times taller.

### Appendix A

1. Full example is given

### Appendix B

1. Full example is given.

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