# Movie magic

In this lesson, students move from using scale factor between similar figures to using scale in non-routine ways. Students explore scale models used in *The Lord of the Rings* and *Harry Potter* movies and answer questions using a scale given as a ratio.

## Visible learning

### Learning intentions

* To develop students’ understanding of scale
* To solve problems involving ratios and scales

### Success criteria

* I can describe how scale is used in real life situations
* I can solve scale problems using ratios

### 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 *Movie magic* PowerPoint to display images in this lesson.

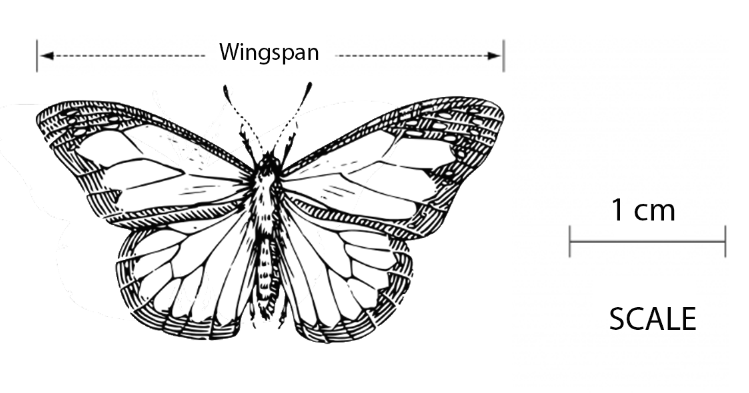
## Activity structure

### Warm up

1. Print and distribute Figure 1.

The size you print will affect the answer, so measure and come up with your own answer once you’ve printed.

Figure 1 – butterfly scale drawing



‘[Butterfly Wings Insect](https://pixabay.com/vectors/butterfly-wings-insect-antenna-40234/)’ by [Clker-Free-Vector-Images](https://pixabay.com/users/clker-free-vector-images-3736/) is licensed under the [Pixabay License](https://pixabay.com/service/terms/).

1. Ask students to:
2. predict what questions might be asked about this image.
3. pair up and answer their partner’s question.
4. Ask students to share their questions with the class.
5. Explain to students ‘What is the actual wingspan of the butterfly?’, presented similarly to Figure 1, was a HSC question (Std2 M7 2005). If students haven’t already suggested this as a possible question, answer it as a class.
6. As a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)), define ‘scale’.
7. How many meanings does it have? (for example, scale mountain, scales on fish, enlarge or shrink, weighing device)
8. Who would use scale? Why?

Scale has many origins. Its relationship to measurement came about in late 14th century, where the term ‘scala’ meaning ladder or flight of stairs was transformed to mean a series of marks laid down to determine distance along a line.

### Launch

1. Ask students if they have seen the *Lord of the Rings* or *Hobbit* movies. You might like to show a short video clip or look at some photos.
2. What’s interesting about the *Lord of the Rings* sets, particularly the shire (where the movies often start) is that it was filmed in New Zealand. The set was destroyed after the original trilogy of movies, but with the more recent *Hobbit* trilogy, they built a permanent set that you can visit.

|  |  |  |
| --- | --- | --- |
| Hobbit hole  ‘[Hobbit hole "Bag End" in Hobbiton](https://web.archive.org/web/20161030181123/http:/www.panoramio.com/photo/114371310)’ by David Broad is licensed under [CC-BY-3.0](https://creativecommons.org/licenses/by/3.0/) | Hobbit hole  '[Hobbit Hole -- Hobbiton Movie Set, Matamata, New Zealand 2016](https://www.flickr.com/photos/joeross/50796543118)' by Joe Ross is licensed under [CC BY-SA 2.0](https://creativecommons.org/licenses/by-sa/2.0/) | Hobbit hole  '[Hobbit hole](https://www.flickr.com/photos/joeross/50796454758)' by Joe Ross is licensed under [CC BY-SA 2.0](https://creativecommons.org/licenses/by-sa/2.0/) |

1. The hobbit holes are built in 3 different scales, 100% human scale, 90% human scale, and 60% human scale.
2. Ask students why they would have built 3 different scale houses.
3. The reason was to trick the viewer into thinking characters were larger or smaller than in real life. Hobbits, small characters, were filmed in front of the 100% human scale houses, whilst Gandalf, a very tall wizard, was filmed in front of the 60% human scale houses to give the impression that he was much taller.
4. Film makers use scale to trick the viewer all the time.
5. Ask students if they have seen the Harry Potter movies. You might like to show a short video or look at some photos.
6. When students saw exterior shots of Hogwarts, the school in the Harry Potter movies, they were seeing a small-scale model of the building. The model was built for the first movie, ‘Harry Potter and the Philosophers Stone’ and has been used in every one of the Harry Potter movies since.
7. Ask students why the film makers would create a model rather than building or using an existing castle. What are the benefits of using a scale model when filming?

You could display the Hogwarts scale model (Figure 5), or you could show [Superb Model Hogwarts Castle Filming Miniature in the Snow (0:15)](https://bit.ly/Hogwarts_scale_model): (<https://bit.ly/Hogwarts_scale_model>) which shows people surrounding the model which will help students understand the scale

Figure 2 – Hogwarts scale model



’[The Making of Harry Potter 29-05-2012](https://www.flickr.com/photos/karen_roe/7544154984/)’ by Karen Roe is licensed by [CC BY 2.0](https://creativecommons.org/licenses/by/2.0/)

### Explore

1. Present the following statement to students: ‘The Hogwarts Castle model was built to a 1:24 scale.’
2. This means if a length is 5 cm wide, in the movies it would appear 24 times larger: 120 cm or 1.2 m.
3. Print and distribute Appendix A. Students need to know the scale used was 1:24.
4. Model calculating the ‘real’ size of a brick length as an example.
5. In order to calculate ‘window height’ students will have to apply the inverse operation. Encourage students to solve this problem on their own or with a partner and reflect as a class on strategies used.

### Summarise

1. Have students write notes to their future selves ([bit.ly/notesstrategy](https://bit.ly/notesstrategy)) for applying scale when written as a ratio.

**Example responses**  
The tree from the Hogwarts model was 14 cm tall.  
The ratio used was 1:24 which means its ‘real’ size would be 24 times longer.  
  
14x24=336 cm  
So the tree is 336 cm in real life.  
  
The window height in real life was 5 m tall.   
The ratio used was 1:24 which means it’s scale model would be th of its length.  
5 x =0.21 m

It’s important that students understand that units stay the same, they could convert units before or after scaling.

### Apply

1. Print and distribute Appendix B.
2. Students should complete the task individually.

## Assessment and Differentiation

### Suggested opportunities for differentiation

**Explore**

* If working from the provided activities is not accessible for your students, have them use the same 1:24 scale to find how small, real things in the classroom or around the school, would be.
* Teachers could also choose to simplify the scale to 1:20 or even 1:10 to assist students in their calculations.
* Challenge students to generalise a rule for the result when multiplying by a scale factor greater than 1 and less than 1.

**Extension**

* Print or display [Appendix C – extension component](#_Appendix_C), for the Hagrid’s shack task.

### ****Suggested opportunities for assessment****

* Students could complete Appendix C as an exit ticket.
* Review students’ notes to future self and ensure they have correct procedures for both enlargement and reduction.

## Appendix A

### Hogwarts scale model

Each of the measurements below was taken from the scale model.

Convert each length into its ‘real’ size. (Round answers to 2 decimal places if required.)

|  |  |  |
| --- | --- | --- |
| Object | Scale model | ‘Real’ size |
| Brick length | 1 cm |  |
| Chimney height | 64 cm |  |
| Window height |  | 5 m |
| Bridge length |  | 18 m |
| Tree height | 14 cm |  |
| Dome roof diameter |  | 7.5 m |

## Appendix B

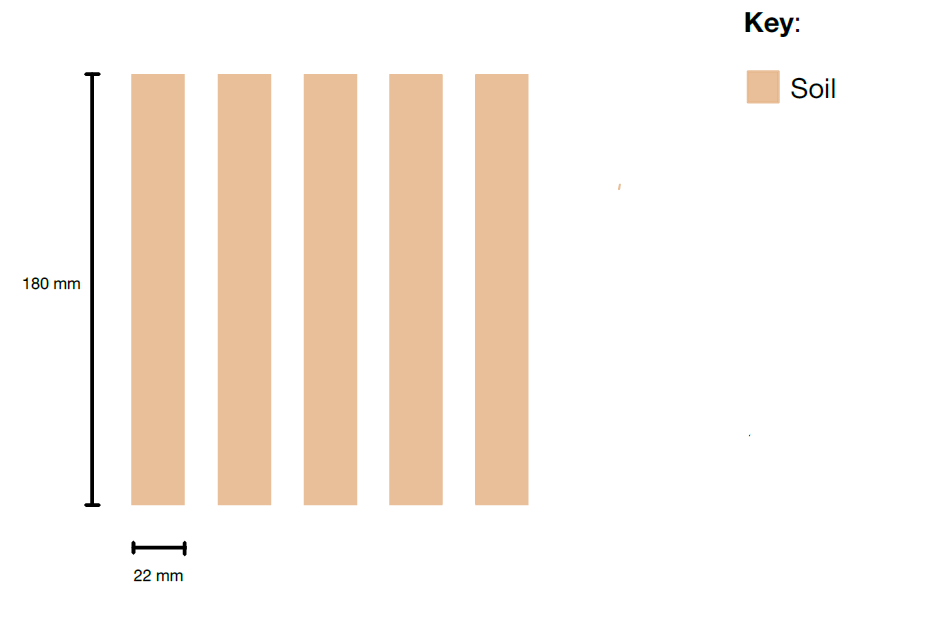
### Hagrid’s shack

#### Task

Hagrid’s shack is a well-known location on Hogwarts grounds. Next to his shack is plot of land where Hagrid grows crops.

The set designers had to build a farm that was based on the scale model already built.

Given the scale drawing below calculate the total area to be filled with soil.



## Appendix C

### Extension component

The set designers want to plant the maximum number of pumpkins in the soil. Each pumpkin will grow to have a diameter of 50 cm.



What is the maximum number of pumpkins that can be planted?

## Suggested solutions

### ****Appendix A – Hogwarts scale model****

|  |  |  |
| --- | --- | --- |
| Object | Scale model | ‘Real’ size |
| Brick length | 1 cm | 24 cm |
| Chimney height | 64 cm | 1536 cm = 15.63 m |
| Window height | 20.83 cm | 5 m |
| Bridge length | 75 cm | 18 m |
| Tree height | 14 cm | 336 m = 3.36 m |
| Dome roof diameter | 31.25 cm | 7.5 m |

### ****Appendix B – Hagrid’s shack****

Length = 180 x 24 = 4320 mm = 4.32 m

Width = 22 x 24 = 528 mm = 0.528 m

Area = 4.32 x 0.528 x 5 = 11.4 m2

### ****Appendix C – Extension component****

With the width being 50 cm, only 1 pumpkin will fit width ways.

432/50=8.64

So 8 pumpkins will fit in each row therefore, 40 pumpkins altogether.

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