Engineering

Area and perimeter

Content and alignment

The use of geometry in engineering is widespread, in particular with learners being able to read plans, and accurately measure materials of various shapes. Objects are described in geometric terms, including terms such as area, perimeter, circumference, and hypotenuse. Engineers are required to fluently interpret and predict weights and volumes based on their knowledge of measurements. However, for many learners this is a challenge, as many are unaware of the relationship between these concepts. This can lead to a difficulty making sense of the more complicated mathematics engineering learners will be working with on a daily basis. One area that causes difficulty is the relationship between the perimeter and the area, particularly when applied to circles. This resource offers several strategies to support learners' understanding of the relationship.

Intent

The intent of this resource is to provide learners with a visual example of the relationship between the perimeter and the area. It provides opportunity for learners to discuss the relationship and begin to recognise the unique features of circles. It is best used as an introduction to area. This sequence is suitable for learners of any skill level.

Sequence

There are three parts to this sequence. Learners will:

1. discuss the relationship between the perimeter and area
2. explore the relationship between area and perimeter
3. identify which shapes result in the greatest area.

1. Discuss the relationship between the perimeter and area

What you will need: A piece of string for each learner, about 30 - 40cm long.

Hand out the string to each learner and ask them to tie the string in a loop. Then show the learners that the perimeter is fixed. Ask the learners to discuss the following question:

"Given that the perimeter does not change, does the area change, based on the shape of the string?"

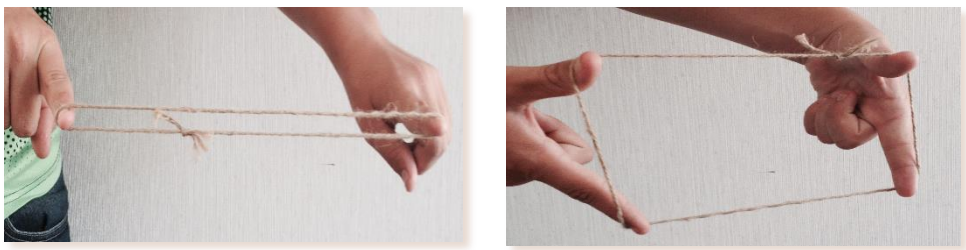

Image 1. Even though the perimeter does not change, does the area change? You might be surprised at the learners' answers.

Allow learners to discuss this in groups.

While this question may seem fairly easy for you, by listening to the learners' explanations you will get an insight into their thinking. Many learners may have difficulty explaining how it is that while the outside length does not change, the inside area does. Use this activity to generate ideas from the learners on how they could prove it one way or another.

Encourage learners to visualise filling the area inside the string with small object, such as marbles. Would more marbles fit in one shape than the other? Demonstrating this with physical objects in the class helps consolidate the idea for learners.

2. Explore the relationship between perimeter and area

The following activity helps learners explore the notion that a fixed perimeter can accommodate multiple area measurements. The following example is best presented in the format of a scenario. The following has been used successfully.

Scenario: The engineering company you work for has built a new workshop. Because of your good work your employer is allowing you to go to the workshop before anyone else and mark out your own personal work area. This area will contain your tools, desk and work floor. However, you are told that you must 'tape' out your area and that you must only use 24 metres of tape. You can make any shape, but only 24 metres of tape. What is the best way to use the tape?

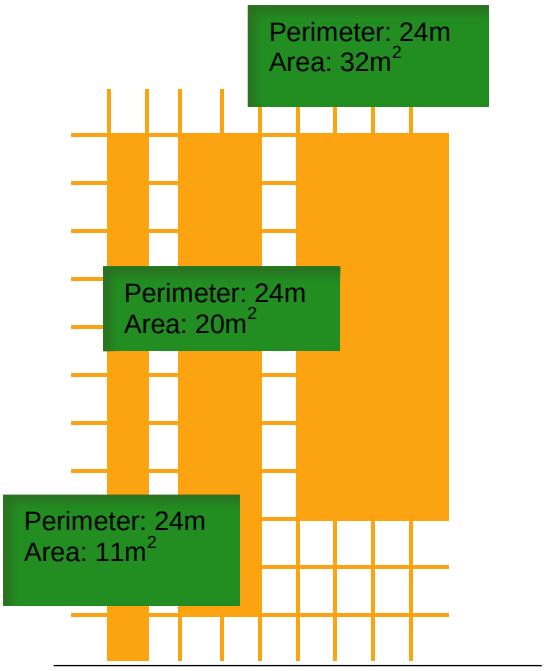

Fig 1. Example of some of the different areas that can be made with a 24m perimeter.

Once the learners have been given the scenario hand out graph paper (see **Engineering: Grid sheet for use with area and perimeter**). This paper is for learners to explore
different shapes and compare the areas. Inform each learner that a gridline represents one metre and each square one square metre. Learners explore in pairs how different shapes produce different areas. Allow plenty of time for learners to explore all the options.

Once the learners have completed the task ask groups to share their findings. Which shape resulted in the largest area?

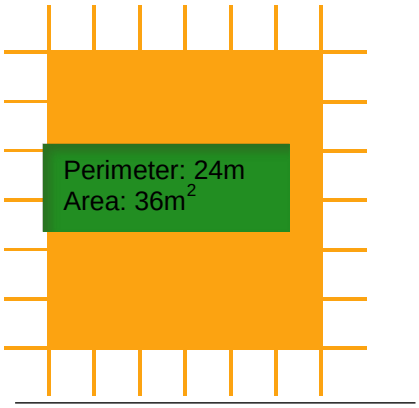

Fig 2. Further example of the different areas that can be made with a 24m perimeter.

3. Identify which shapes result in the greatest area

If the learners are not yet sure, begin to draw the shapes on the whiteboard and table the information. For example:

Perimeter	Area
1 by 11	$11m^2$
2 by 10	$20m^2$
4 by 8	$32m^2$
6 by 6	$36m^2$

If possible a grid can be displayed on the white board using a data projector. This allows learners to come to the front of the class to draw and explain their shape. The learners will begin to see that the square shape results in a greater area.

This process can be repeated with a perimeter of 32m. This time have the learners table their results. For example:

1 by 15 = 15 m^2

2 by 14 = $28m^2$

Learners may ask if there is another shape that can be made that will result in a larger area. This may be a good time to introduce the circle, and discuss its effective use of space.

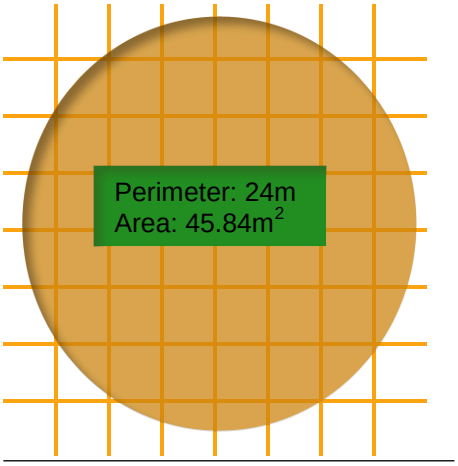

Fig 3. Example of the area of a circle with perimeter of 24m.

Summary

The relationship between the perimeter of an object and its area is counter-intuitive for many learners. Through using tactile, hands-on materials such as string, learners can begin to see the relationship. Secondly, using graph paper allows learners to explore the relationships in groups. Finally, making the connections clear by writing a table on the whiteboard which shows the direct relationship provides learners with a system with which they can further explore.