# Fence It, Paint It: Circles and Composite Shapes

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|---|---|---|---|
| **Teacher** | | **Class** | Year 8 |
| **Subject** | Maths | **Topic** | Area and circumference of circles |
| **Date** | | **Room** | |
| **Lesson length** | 60 minutes | **Country** | United Kingdom |

Students learn to find circumference and area of circles and composites. They dissect a running-track shape to solve perimeter and area problems.

## Curriculum links

- calculate and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes

## Learning objectives

- Students will find circumference of circles from radius or diameter using pi accurately.
- Students will find areas of circles and semicircles using pi times radius squared.
- Students will solve perimeter and area problems for composite shapes with semicircles.

## Success criteria

- I can work out circumference with C equals pi times diameter.
- I can work out area with A equals pi times radius squared.
- I can find perimeter and area of a rectangle with semicircles.

## What students already know

2-minute check: show a 5 cm by 3 cm rectangle. Ask: what is its perimeter? What is the link between radius and diameter of a circle?

## Key words

| | |
|---|---|
| **circumference** | distance all the way round a round shape, like a fence [2] |
| **radius** | length from the middle dot to the edge of a circle [4] |
| **diameter** | length straight across through the middle, double the radius [4] |
| **area** | amount of flat space inside a shape, counted in squares [4] |
| **semicircle** | half of a round shape cut straight through its middle |
| **pi** | special number about 3.14 linking width across to distance round [3][5] |

## Materials

- Slides 1-12 with projector and speakers
- Printed running-track shape and window shape, one set per pair
- Highlighters, rulers and calculators, one set per pair
- Mini whiteboards and pens
- Worksheet Task D (Work out the area, perimeter or circumference of each shape) copies, one each

## Before the lesson

- Print running-track shape (rectangle with a semicircle on each end) and window shape, one set per pair
- Test Video clip 1 (0:51-3:54) on slide 6 and Video clip 2 (2:13-4:11) on slide 8
- Set out highlighters, rulers and calculators and load Slides 1-12

- Copy Worksheet Task D (Work out the area, perimeter or circumference of each shape) for independent practice

## Lesson outline

**0–10 min** **Starter** 10 min · Whole class

*To recall fence means perimeter and paint means area and hook the track problem.*

**YOU DO**

1. Show Slide 1 title and read the running-track hook to the class.
2. Show Slide 2 mystery and ask pairs to decide fence or paint for two quick jobs.
3. Take answers on mini whiteboards and confirm circumference for fence, area for paint.
4. Link answers to today's goal of perimeter and area with semicircles.

**STUDENTS DO**

1. Listen to the track hook and study Slide 2.
2. Hold up fence or paint for each job and explain choice to partner.
3. Share one answer with the class.

**Say:** This running track is a rectangle with a semicircle stuck on each end. What is the distance one lap and the area inside? I go round once to fence it. I cover all of it to paint it. Fence is perimeter, paint is area.

**Ask:** If we walk one lap right round the track, are we fencing or painting? (Fencing, we need perimeter, the distance round.) · If we paint the whole inside of the track, are we fencing or painting? (Painting, we need area, the space inside.) · What is the special word for the perimeter of a circle? (Circumference, the perimeter of a circle is called its circumference [2].)

**Check understanding:** Scan whiteboards for fence and paint sorts; if mixed, re-model with the clock face needing paint plus edging and repeat with one more example.

**Support:** Give sentence starters: We need area because we are covering the inside. **Stretch:** Ask students to suggest a job that would need both fence and paint for the track.

Use: Slides 1-2

10–22 min **Teaching** 12 min · Whole class

*To teach circumference and area formulas from radius and diameter.*

**YOU DO**

1. Talk through Slide 3 chain and Slide 4 big idea using a drawn circle.
2. Play Video clip 1 and ask students to spot the two circumference forms and the area form.
3. Model one full-circle example on the board with pi = 3.14.
4. Use Slide 7 cards to check radius, diameter, circumference and area meanings.

**STUDENTS DO**

1. Watch, note the formulas C = pi x d and A = pi x r squared.
2. Copy the worked 4 cm example step by step.
3. Chant back radius, diameter and formula links when asked.

**Say:** Double the radius to get the diameter. Times by pi to get round the outside. Square the radius then times by pi to get the inside. We use C = 2 x pi x r or C = pi x d [1] and A = pi x r squared [5].

**Worked example:** Radius 4 cm, pi = 3.14. Diameter = 2 x 4 = 8 cm, because diameter is exactly twice radius [4]. Circumference C = pi x d = 3.14 x 8 = 25.12 cm. Area A = pi x r squared = 3.14 x 16 = 50.24 cm squared.

**Ask:** Diameter 10 cm, pi = 3.14. What is the circumference and why? (31.4 cm, because C = pi x d = 3.14 x 10 [5].) · Radius 3 cm, pi = 3.14. What is the area and why? (28.26 cm squared, because A = pi x 9 = 3.14 x 9 [5].)

**Check understanding:** Mini whiteboards: radius 5 cm, find diameter and circumference; if many halve or double wrongly, re-draw centre to edge and across through centre [4].

**Support:** Display diameter is twice radius [4], so halve diameter first before using radius in area. **Stretch:** Ask for circumference from a given area by working back to radius.

Use: Slides 3-7, Video clip 1 (0:51–3:54)

22–42 min **Main activity** 20 min · Pairs

*To find perimeter and area of composite shapes made with semicircles.*

**YOU DO**

1. Show Slide 8 and play Video clip 2, stressing when the straight edge counts.
2. Model the running track with highlighter round only the outside edge.
3. Hand out printed running-track and window shapes, highlighters and calculators.
4. Circulate, prompting pairs to make a full circle from two ends for C = pi x d [5] and A = pi x r squared [5].

**STUDENTS DO**

1. Highlight the outside edge of each shape, leaving join lines unhighlighted.
2. Calculate perimeter as straights plus full circle, and area as rectangle plus circle.
3. Label working with metres and square metres and display for checking.

**Say:** Highlight only the outside edge to get perimeter. Two ends make one full circle. Add the two straight sides for distance round. For space inside, add rectangle area plus full circle area. Find radius, halve diameter if needed.

**Worked example:** Track: rectangle 20 m by 10 m, semicircle radius 5 m each end. Diameter = 10 m. Outside curves = pi x d = 3.14 x 10 = 31.4 m [5]. Perimeter = 20 + 20 + 31.4 = 71.4 m. Area = 20 x 10 + pi x 25 = 200 + 78.5 = 278.5 m squared.

**Ask:** Why do we not count the diameter line where the semicircle joins the rectangle in perimeter? (It is inside the shape, not on the outside edge round it.) · How do the two semicircle ends help us calculate quickly? (Two halves make one full circle, so use C = pi x d and A = pi x r squared once [5].)

**Check understanding:** Check highlighted perimeters and two-part area working; if joins are counted, re-colour one shape together and redo one perimeter.

**Support:** Colour the diameter line where the semicircle joins the rectangle to show it is inside and not counted in the perimeter. **Stretch:** Give a shape with a semicircular hole removed and ask students to subtract and to adjust the perimeter to include the inside curve.

Use: Slides 8-9, Video clip 2 (2:13–4:11)

42–50 min **Independent practice** 8 min · On their own

*To practise choosing and using area, perimeter or circumference alone.*

**YOU DO**

1. Hand out Worksheet Task D (Work out the area, perimeter or circumference of each shape) and read the first shape instruction together.
2. Remind students of Slide 10 steps: label, pick formula, halve if needed, add straights.
3. Set 8 minutes for three shapes with pi = 3.14 and calculators.
4. Stop at 6 minutes to give a one-minute hint on units.

**STUDENTS DO**

1. Work alone on Worksheet Task D to work out the area, perimeter or circumference of each shape.
2. Show radius, formula, substitution and units for each answer.
3. Tick finished shapes and star one unsure answer.

**Say:** Label radius and diameter first. Pick C = pi x d or A = pi x r squared. Halve for semicircles where needed. Give answers in cm and cm squared.

**Ask:** How do you know to use C = pi x d here, not area? (The question asks for distance round, so perimeter/circumference, not covering inside.) · You are given diameter 14 cm for area. What first? (Halve to radius 7 cm, then A = pi x 49, because area uses radius squared [1].)

**Check understanding:** Collect books or scan answers; if formulas are swapped, point back to fence for C and paint for A and redo one together.

**Support:** Give a checklist: underline radius or diameter, write r = ? before calculating. **Stretch:** Ask students to write what the question could be if the answer is 50.24 cm squared.

Use: Worksheet Task D (Work out the area, perimeter or circumference of each shape)

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50–60 min **Plenary** 10 min · Whole class

*To fix semicircle perimeter errors and check all three objectives.*

**YOU DO**

1. Show Slide 11 question and ask pairs to discuss the trap in one minute.
2. Model the semicircle radius 4 cm perimeter fully on the board.
3. Run Slide 12 quick quiz with whiteboards using pi = 3.14.
4. Close by matching answers back to the three success criteria.

**STUDENTS DO**

1. Discuss Slide 11 in pairs and vote on what is missing.
2. Answer quiz questions on whiteboards and compare units.
3. Self-assess with thumbs up against I can statements.

**Say:** A semicircle needs half the circle plus the straight across. Halve the area but do not halve all the perimeter. Add straight edges to perimeter. Use Slide 10 steps every time.

**Worked example:** Semicircle radius 4 cm. Diameter = 8 cm. Half circumference = pi x 8 / 2 = pi x 4 = 12.56 cm. Perimeter = 12.56 + 8 = 20.56 cm. Area half = pi x 16 / 2 = 50.24 / 2 = 25.12 cm squared. Missing part in pi x 4 alone is the straight diameter edge.

**Ask:** A semicircle radius 4 cm. Is perimeter pi x 4? What is missing? (No, that is only the curve; add the diameter 8 cm for the straight edge.) · When do we halve and when do we not halve for a semicircle? (Halve the circle area and circle curve, but add the full straight edge to perimeter.)

**Check understanding:** Whiteboard quiz on Slide 12; if semicircle perimeters miss the diameter, re-teach with highlighter on the straight edge and re-quiz.

**Support:** Show the two parts in different colours: curve in one colour, straight in another. **Stretch:** Ask students to explain what happens to area when radius is doubled, using pi x r squared.

Use: Slides 10-12

## Common mistakes

| Mistake | How to spot it | How to fix it |
|---|---|---|
| Using diameter in A = pi x r squared instead of radius | Area far too big, about four times expected, no halving step seen | Underline radius or diameter, write r = d / 2 first, then use A = pi x r squared [1][5] |
| Giving semicircle perimeter as half circumference only | Answer equals pi x r only, straight edge missing from sketch | Highlight the outside including the diameter, add half C = pi x d [5] plus diameter |
| Mixing area and circumference formulas or units | cm squared for distance round or cm for covering, or C = pi x r squared | Ask fence or paint: fence is circumference in length units like metres, paint is area in square units [4] |

## Support

- Colour the diameter line where the semicircle joins the rectangle to show it is inside and not counted in the perimeter.
- Provide multiplication grid and table for radius, radius squared and times pi with whole-number radii.

## Stretch

- Give a shape with a semicircular hole removed and ask students to subtract and to adjust the perimeter to include the inside curve.
- Ask students to design where inner circle and outer ring have equal areas and explain with pi x r

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squared.

## For the LSE or teaching assistant

Stay with the highlighted track pair work: prompt highlighter round outside only, check r = d / 2 is written, scribe formula steps if needed.

## Check for understanding

| Question | Answer |
|---|---|
| Diameter 10 cm, pi = 3.14. Circumference? | 31.4 cm, because C = pi x d. |
| Radius 3 cm, pi = 3.14. Area? | 28.26 cm squared, because A = pi x 9. |
| Rectangle 20 m by 10 m with a semicircle radius 5 m on each end. Perimeter and area? | Perimeter 71.4 m; area 278.5 m squared. |

## Homework

Complete Worksheet Task C (Practice questions: Find areas of circles and composite shapes. Use pi = 3.14).

## Sources


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