Teachers Explanatory Notes
TI-15 Explorer™: Area and Perimeter

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While Perimeter and Area are different there are also connections between them.

This unit of work will attempt to clarify the two concepts while examining what happens when one is kept constant and the other changes. The idea that for a given perimeter there is a maximum area (or for a given area there is a minimum perimeter) is not new but is interesting and useful.

To examine different areas for a given perimeter quickly is an issue but by using a calculator that keeps the information and redisplays it on call makes things easier.

The first two sessions of this unit use only rectangles with integer dimensions.

Session 1

Introductory Activity 1:

The aim for the students here is to be the one who can fit the most rectangles onto their grid paper. They need to know this from the start so they can plan on how to draw on their grid paper.

Each student has a piece of 1.5 cm grid paper (BLM 1 included below). The teacher rolls a 10 sided die or draws a card from a deck (with court cards removed), this represents a number of squares on the grid paper. Students have to draw and shade a rectangle (no irregular shapes) with that number of squares on their grid paper (whole numbers only), if they cannot fit a particular rectangle in then they leave it out. This continues until students can not fit any more rectangles on their grid paper. The student with the most rectangles wins.

An interesting extension of this activity is to have students calculate the perimeter of EACH shape and then sum the perimeters. The highest (or lowest) sum wins. (This is easier with cm grid but reduce the total area or you will be playing all day!)

Introductory Activity 2: Exploring Perimeter with a fixed Area

1. On a piece of cm grid paper (BLM 2 included below) ask students to draw as many rectangles with an area of 12 cm^2 as they can, without resorting to fractions.

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2. Students record the length and breadth of each rectangle and use this information to calculate the perimeter.

3. Students record this information in their workbooks in a table like the one below.

   Area = 12 cm^2

Length in cm	Breadth in cm	Perimeter in cm

Significant Questions:

Ask students to first write their answers to these questions in their workbooks then discuss the answers as a group.

- What did you notice about the perimeter as the area changed?
- Can you see a pattern?
- Can you see a quick way to calculate the perimeter?
- Can you describe the shape with the smallest perimeter?
- What happens to the perimeter if the shape is irregular, for example a "T" or an "L" or an "H" shape? W1

Complete **Part 1 of Worksheet 1** – for a worked example go to slide 9 in PowerPoint. PPT

Session 2

a) Exploring Area with a fixed Perimeter

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1. On a piece of cm grid paper ask students to draw as many rectangles with a perimeter of 12 cm as they can, without resorting to fractions.

2. Using the TI-15 Explorer™ calculator calculate the area of each rectangle by multiplying length × breadth. Do not clear your answers.

3. Using the scroll feature of the calculator scroll back through all the answers.

4. Students use this information to complete the table below.

   Perimeter = 12 cm

Length in cm	Breadth in cm	Area in cm^2
5	1	5
4	2	8
3	3	9
2	4	8
1	5	5

Significant Questions:

- Can you see a pattern?
- What can you say about the area as the shape changes?
- Can you describe the shape with the greatest area?

Session 2(b)

1. Write "= 9" on the board and ask the students how many ways they can make the number 9 by adding two positive integers. *(Answers should be: 1 + 8 = 9, 2 + 7 = 9, 3 + 6 = 9, 4 + 5 = 9, 5 + 4 = 9, 6 + 3 = 9, 2 + 7 = 9, 1 + 8 = 9)*

Significant Questions:

- Is say, 2 + 7 = 9 the same as 7 + 2 = 9?
  Answer: Maybe, mathematically speaking the answer is yes, it is, but what happens if you have a long narrow back yard you might want a 2 m by 7 m garden not a 7 m by 2 m garden.
- Are there situations where it might be useful to know about both?

2. Now ask students to calculate as many areas as possible for a rectangle with a perimeter of 18 cm using only positive integers. [Also acknowledge those students who suggest solutions using rational numbers and discuss the fact that using rational numbers (fractions) an infinite number of areas are possible]. Tell students not to clear their answers.

3. Students now use the scroll keys to scroll back through their answers and note the largest and smallest areas.

4. On a sheet of cm grid paper under the heading of "Perimeter = 18" students draw the rectangles with the largest and smallest areas and write the areas inside the respective rectangles.

Significant Questions:

- Can you see a connection with the numbers that add to 9 and the area of a rectangle with perimeter of 18?
- Can you see a connection between the shape of the rectangle and its area?
- Are there any situations where a "square" is not the shape with the maximum area?

Student Review:

In your books write down the mathematics you have learnt today.

- What did you learn from the activities?
- What did you learn about Areas and Perimeters?
- What sort of patterns did you see?
- In what way are perimeter and area different?
- Can you use the perimeter to find the area?
- What additional information do you need?

5. At this point students should attempt **Part 2 of Worksheet 1**. For a worked example go to slide 10 in PowerPoint. W1 PPT

6. Ask students to comment on the areas and shapes.

7. Give out the assignment ***Nana's Garden*** due in 1 week (approx). Students could do this as a group project if you wish. A marking rubric is attached if you wish to use it. W2

8. The **Assessment Task *Calf Paddock*** is then given out, allow at least 40 minutes for students to complete the task. The task is best done as a small group activity (3-5 students) and individual students can be assessed by observation using the accompanying rubric. This activity has been around for a long time but it is a very useful activity. AT

Please Note: Two assessment rubrics are provided. To use these:

Print a copy of the rubric ensuring that there is sufficient space under each category to write students names. (You will have to remove the notes text box).

As you observe your students working in class note their names or initials under the appropriate category. For example if you notice Ben Smith explaining why the greatest area of the free standing calf pen is 81m^2 then you would write Ben Smith's name in the B column.

Rubrics can be used as a guide for observational assessment or as a guide for marking assessment tasks.

Session 3: Exploring Area and Perimeter of other shapes

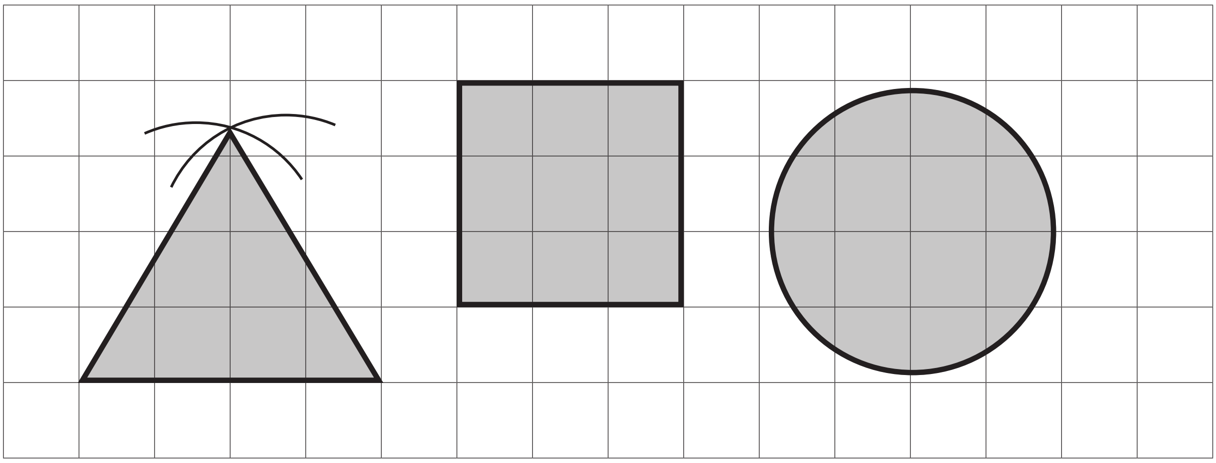
To complete this session students should have knowledge of the area and circumference of a circle. Ideally they should have completed the National Statements of Learning Support Initiative Unit "Pieces of π".

1. Remember last lesson where the rectangle with a perimeter of 12 cm with the greatest area was a 3 x 3 square.
   Discuss wether or not there is another shape that would have the same perimeter but a greater area.
   How about a triangle with perimeter 12 cm and a circle with circumference 12?

2. Ask students to construct these shapes on a piece of cm grid;

   a) An equilateral triangle with sides of 4 cm
   b) A square with 3 cm sides
   c) A circle with a radius of 1.91 cm (1.9 cm is near enough)

   e.g.



3. Students calculate the perimeter of each shape [Note: the perimeter of a circle is the same as the length of its circumference].

   a) Triangle P = 4 + 4 + 4 = 12 cm

   b) Square P = 3 + 3 + 3 + 3 = 12 cm

   c) Circle C = 2 × π × 1.91 = 12 cm approx

4. Students calculate the approximate area of each shape by counting the squares inside each shape and complete the table below.

   P = 12

Shape	Approximate Area
Equilateral Triangle	*7 cm^2*
Square	*9 cm^2*
Circle	*11 cm^2*

   Typical answers are in italics.
   (Actual areas are: Triangle; 6.928 cm^2, Square; 9 cm^2 and Circle; 11.459 cm^2)

5. Challenge students to construct a shape with a perimeter of 12 cm and an area greater than 11.5 cm^2. (You can offer whatever incentive you like, as the task is impossible, but don't leave it too long to enlighten your students). Can you show that it is impossible?

6. Discuss other polygons such as hexagons, octagons, dodecagons, etc.
   Which do you think would have the greatest area?

7. Discuss regular and irregular shapes.

8. Revisit ***Calf Paddock*** but this time ask the students to try shapes other than rectangles Refer to PowerPoint slides 14 & 15 for diagrams. PPT

9. Extension task:

   Callum is working as a jackeroo and he has been sent out with a crew to assemble a portable stockyard.

   The stockyard panels are each 3 m long and he has 40 of them to use for the yard.

   What is the biggest area of stockyard that Callum can construct?

   Provide students with graph paper, scissors, rulers, tape and any other concrete materials you may have at hand that might be useful (e.g. strips of paper, matchsticks or tooth picks cut to 3 cm).

   Allow students to work in groups.

BLM 1 for Introductory Activity 1:

BLM 2, cm grid