Perimeter of Australia
Teacher Notes

TI-Nspire CAS   Investigation   Student   90min

Problem Statement:

What is the perimeter of Australia? The answer to this question depends on the purpose. The driving distance is significantly different from the sailing distance which is different again from the coastal distance. The driving distance restricts movement to roads. Sailing incorporates an extra distance for clearance from the shore. Coastal distance can include islands increasing the perimeter by more than 60%. For the purpose of this activity the calculation is approximate to give an indication for anyone preparing a driving or sailing venture around Australia.

Number & Algebra – Year 9: Patterns and Algebra

Find the distance between two points located on a Cartesian plane using a range of strategies, including graphing software (ACMNA214)

ScOT: Intervals

Equipment

For this activity you will need:

- Internet Access (To answer specific questions)

  If the internet is unvailable, the questions referring to coastal and road distances around Australia can be provided for students. The benefits of doing the internet research is that students see a variation in 'official' distances.

- TI-nspire CAS document – Perimeter of Australia

- TI-nspire CAS

Introduction – Setting up the calculations

Open the Perimeter of Australia document.

Press the **Home** key, select **My Documents** and navigate to the Perimeter of Australia activity and open the document.
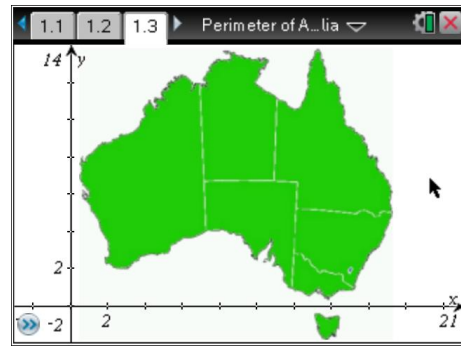
Author: Peter Fox
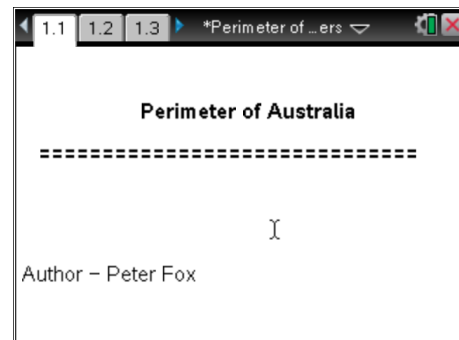
Page 1.2 contains a brief introduction for the activity.

Navigate to page 1.3 by pressing **CTRL** + **Right Arrow**.

The graph contains a map of Australia. The object is to place a set of points around the mainland of Australia.

More points increase accuracy at the expense of more calculations, so choose points carefully.
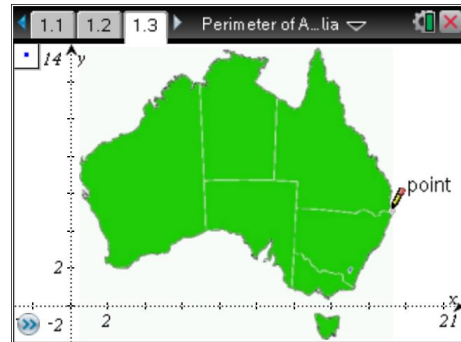
Use the **menu** and select **Points and Lines** followed by **Points**.

The mouse changes to a pencil. Place at least 12 points around Australia that represent a dot-to-dot outline, without excluding too much of the land features.

The order of the points does not matter.

Press **escape** once all the points have been placed.

To display the coordinates of each point, place the mouse over the top of one of the points and press **CTRL + Menu**. From this menu select **Coordinates and Equations**.

Repeat this process for each of the plotted points.

If the screen becomes too busy, work with just a selection of points at a time.

Working with three to four points at a time, including distance calculations works well.
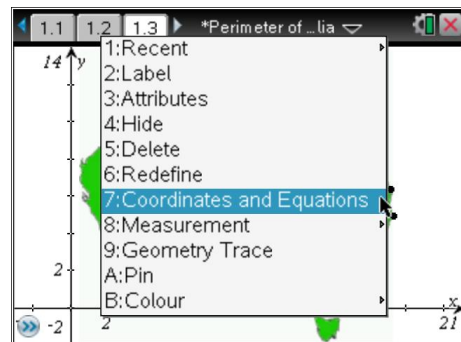
- Once the distances have been calculated they should be hidden.
- Most of the coordinates attached to the calculations can also be hidden once the calculations are completed.
- Points should remain in view and not hidden.

Note:

CTRL + Menu is equivalent to a right mouse click on a computer.

Recording Results

1. Record all your results in a table (as shown below). Record the points in order with their corresponding state in the table. At this point only the first two columns will be completed. A sample set of data is included below. Do NOT use the sample data in your calculations.

   The table should be updated continuously to avoid clutter on the calculator screen. Students may also benefit from a sketch of their map with points labelled accordingly.

   Note: Coordinate points will vary from student to student.

State/Territory	Coordinates	Formula with Points	Computed Distance	Scaled Distance
QLD	(17.2, 6.38)			
QLD	(13.2, 13.7)			
QLD				
NT				

The next step is to write the formula for calculating the distance between two points on the Cartesian plane.

Press **menu** , from the **Actions** menu select **Text**.

In the text box, enter the expression for the distance between two points: $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
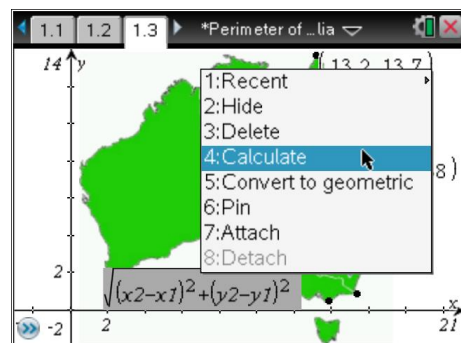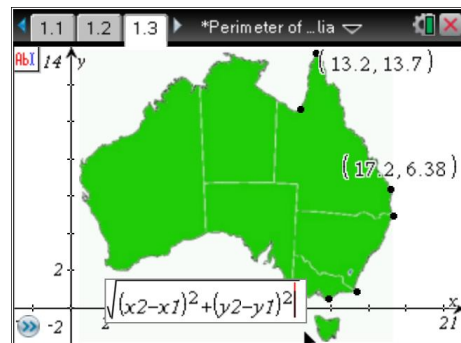
Note that the *subscript* on the x and y coordinates does not appear smaller on the calculator screen.

ie: $x2$ should be read as x_2

Once the formula has been entered, move the mouse over the formula, the word *text* will appear.

Press **CTRL + menu**, from this menu select **calculate**.

The mouse will change to a magnifying glass with a small question mark inside.

Move the mouse to highlight x_1 (x1). Click on the corresponding coordinate for x_1 and the proceed to click on x_2 followed by y_1 and y_2 as directed by the help text attached to the mouse.

When all four variables have been identified the answer is computed automatically and remains attached to the mouse.

Move the mouse a suitable location to display the distance and click the mouse to place the measurement.

This activity requires that students repeatedly identify the correct coordinate points for the formula. The calculator does the actual calculation. Repetition is provided through the range of points around the perimeter of Australia.

Note:

As more calculations are completed the screen may become very busy. To hide measurements, hover over them with the mouse and press **CTRL** + **menu** and select **Hide**.

Hidden measurements can be displayed again by using the **menu** key, select **Actions** followed by **hide/show** and then select the measurements to be hidden or displayed.
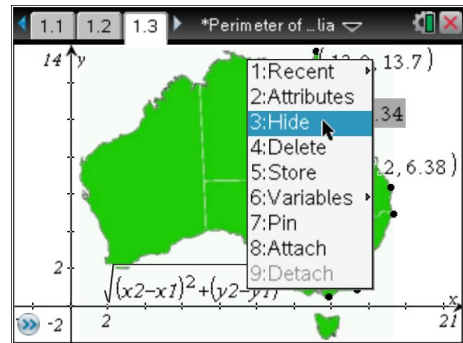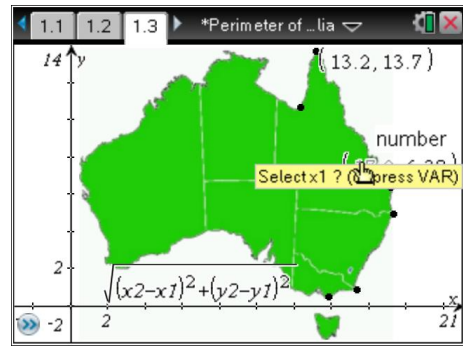
2. The calculations must be recorded in the table. A sample set of calculations have been provided. The scale distance will be computed later.
    Complete the calculations for all your points on the mainland.

    Answers will vary for this table, depending on the location of the points chosen by the student. The inclusion of the "formula with points" in the table is to ensure students can translate what they are doing on the calculator to pencil and paper techniques also.

State/Territory	Coordinates	Formula with Points	Computed Distance	Scaled Distance
QLD	(17.2, 6.38)			
QLD	(13.2, 13.7)	$\sqrt{(17.2 - 13.2)^2 + (6.38 - 13.7)^2}$	8.34	
QLD				
NT				

3. The scaled distance on the map is 1unit : 240km. Use this scale to convert each of the computed distances into an actual distance and include these in the table.

   Each graph distance should be multiplied by 240 to determine the kilometre (actual) distance.

4. Determine the total distance around mainland Australia using your approximation.

   Approximations typically vary between 10,000km and 20,000km depending on the number and location of the individual points.

5. Produce another table of values and include measurements for Tasmania.

   Approximations typically vary between 600km and 1500km, depending on the number and location of individual points.

6. Calculate the total distance around Australia and comment on your total would be affected if other islands and bays around Australia's coastline were to be included.

   Approximations typically vary between 11,000km and 22,000km. The inclusion of extra islands and bays significantly increases the total perimeter.

7. Use the internet to research the coastal distance around Australia and compare this value with your answer.

   The coastal perimeter of Australia is approximately 35,900km. This measurement will be significantly higher than students will obtain (without error) as the approximation removes thousands of kilometres of inlets and bays. Consider Melbourne's Port Phillip bay, the distance across the opening is only a couple of kilometres whilst the trip around the bay is more than 250km.

8. Use the internet to research the road distance around Australia and explain why your measurement varies from this distance.

   The road distance around Australia is approximately 14,532km. This distance is a lot closer to that measured by students as the roads typically miss many of the extreme points, bridges negate harbours or bays.

9. Which mode of transport would your approximation best suit?

   A light aeroplane visiting cities around the coast line would travel much closer to the predicted distance, similarly with a yacht sailing around the coastline. Both these modes of transport can operate in a direct line of sight.