CIRCUMFERENCE
Teacher Notes

References

Foundation	G3.5 Circles, G7.3 Circumference and area of a circle
Foundation Plus	G7.1 Circumference and area of a circle
Higher	G5.4 Area and Circumference of a circle
Higher Plus	—

Introduction

Students use TI-Nspire to explore the relationship between the radius, diameter and circumference of a circle.

Firstly they are able to "unroll" the circumference of a circle to form a straight line and get a feel for the length of a circumference (an alternative to the traditional method of measuring strings around cans.). Secondly they slide several identical circles to estimate how many diameters (three and a bit) make up the circumference.
This is followed by measuring c and d on the screen and dividing their lengths. They are then able to record on a spreadsheet the diameter and circumference lengths for various circles. Repeatedly dividing values of c and d leads to an understanding that the values are proportional, and the discovery of the value of π.
The next step is to compare radius with circumference and see that $c=2\pi r$.
Several "real-world" problems involving circumferences are included and also an extension problem involving rolling one circle around the inside or outside of a larger circle.

We would like to thank Nevil Hopley who was the source of the ideas behind the animations used in this activity.

Resources:

The main activity requires the TI-Nspire document ***Circumference.tns***. A second document, ***WheelsWithinWheels.tns*** provides the extension problem.

For the main activity there is a three-page student handout, including all the necessary key-presses.

TI-Nspire skills students will need

Transferring a document to the handheld.
Opening a document on the handheld.
Moving from one part of a split screen to another.
Very basic calculations on a Calculator page.

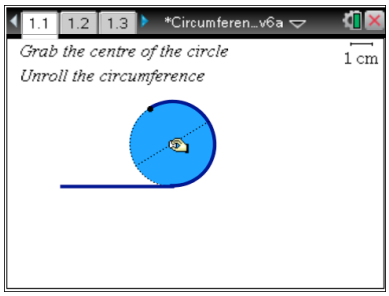
The activity

This activity is designed for use by students working individually on TI-Nspire handhelds, but it can also be demonstrated using the TI-Nspire Teacher Software projected onto a screen.

The nine sections of the student notes give detailed instructions including the key presses that are needed. Below are comments relating to each section and the extension problem.

1. Roll the circle

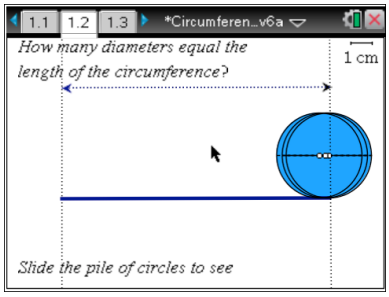
This is a carefully pre-programmed Geometry page.

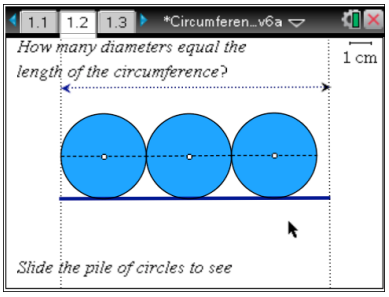


Rolling and unrolling the circumference is fun and strengthens the concept of what the circumference of a circle actually is – and how long it is.

2. Length of circumference

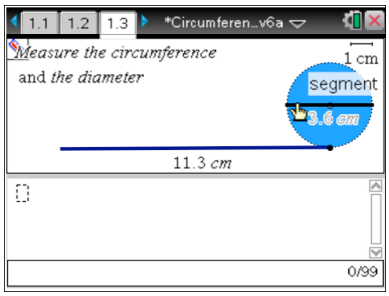
This page presents a pile of identically sized circles that can be slid along to help students see that the circumference is "three and a bit" times as long as the diameter.





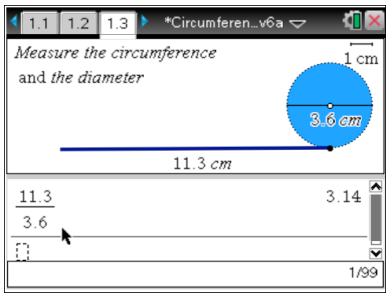
3. Measure the lengths

On page 1.3 students measure the lengths of the circumference and diameter.



4. How big is the bit?

At the bottom of page 1.3 is a blank Calculator page where students can divide the two measurements.



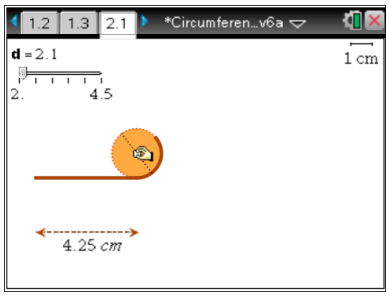
The settings for this TI-Nspire document have been set to Float 3 in order to show 3.14 as the approximate value of π.

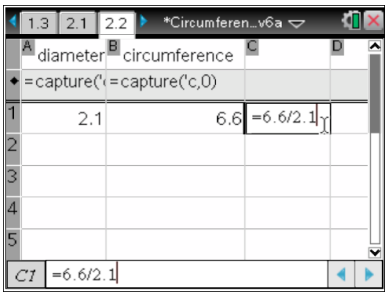
You could change this if you wish. (Press on 5 2 1).

5. Another circle

A similar page to before, but this time the measured length of the unrolled part of the circumference also appears.

The circumference and diameter are entered automatically on the Lists & Spreadsheets page using a TI-Nspire facility called Manual Data Capture.

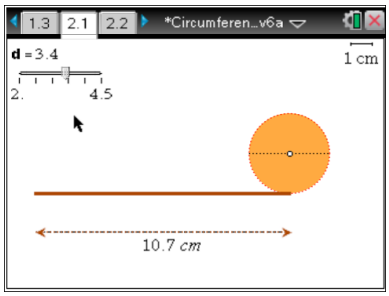


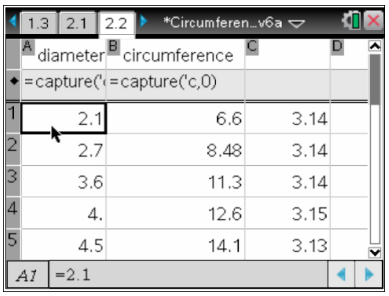


6. Yet more circles

Using the slider changes the diameter of the circle, so several more pairs of data can be entered in the table.

At this point you will probably want to intervene to discuss the number 3.14 and the name it is given in mathematics.

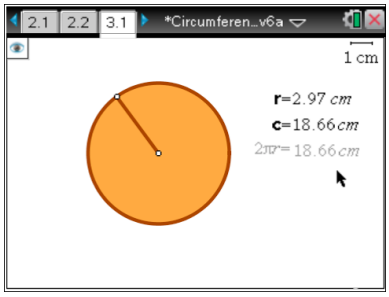




Occasionally, owing to rounding errors, dividing the displayed values produces answers such as 3.15. This can be discussed and altered by entering, for example, =B2/A2 rather than =10.7/3.4.

7. Using the radius

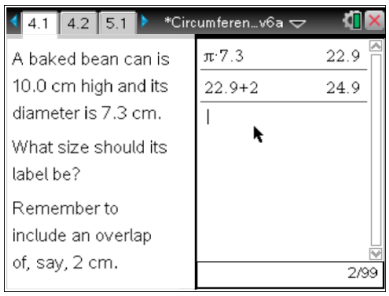
Here the radius rather than the diameter is used and the circumference is no longer unrolled but measured directly.

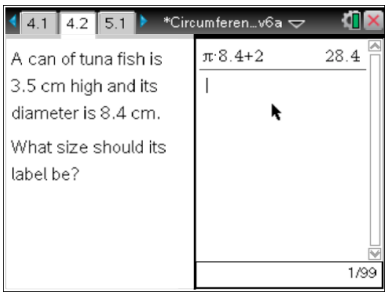


Initially the label 2πr and its calculated value are hidden.

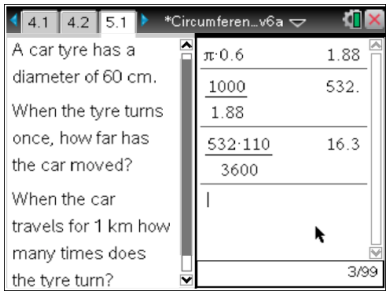
8. Circumference problems

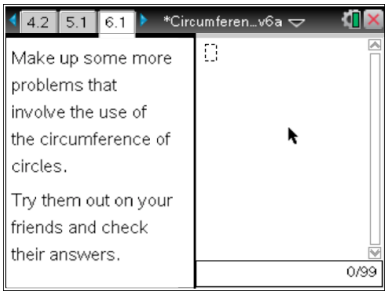
In each case the problem is displayed on a split screen. Students can use the Calculator application on the right hand side to help find the answers.





You may want to add similar "functional maths" problems of your own or encourage students to think up others for themselves.





Extension problem

The TI-Nspire document WheelsWithinWheels.tns provides a problem where the answer is counter-intuitive. As the smaller circle rolls right around the inside or outside of the larger circle, the number of times it turns on its axis is **not** simply the ratio of the radii!

This is an interesting problem to explore with more able students.