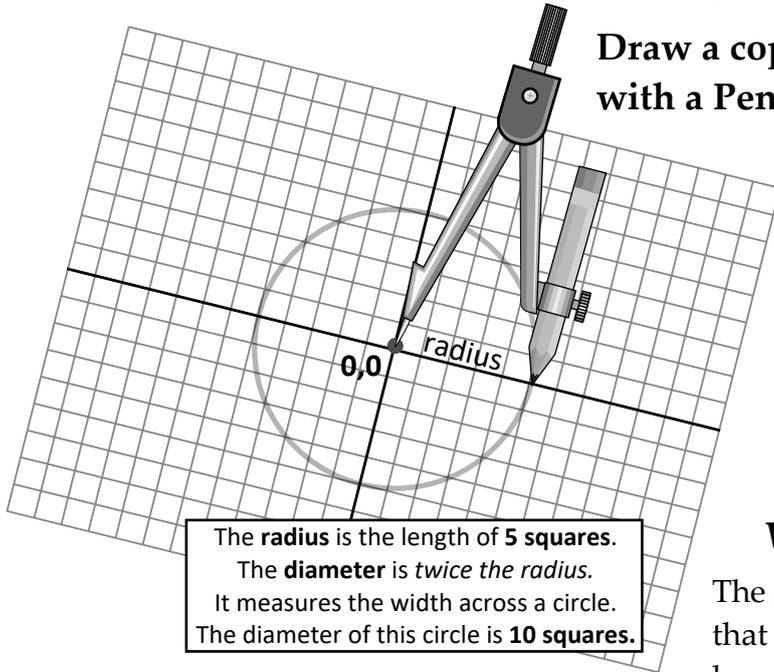


The Circle: (A) Unplugged Activity



The **radius** is the length of **5 squares**.
 The **diameter** is *twice the radius*.
 It measures the width across a circle.
 The diameter of this circle is **10 squares**.

Draw a copy of this Circle on squared paper with a Pencil and Compass

START by opening the Compass between the sharp pointed centre to the sharp tip of the pencil. Be careful!

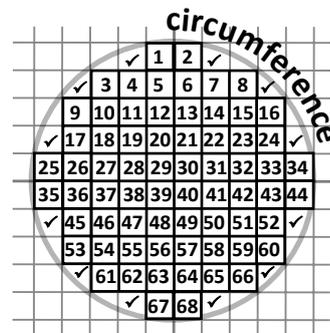
The **radius** is the *distance* between the *point* of the compass and the *tip* of the pencil. You can *measure* the radius by counting the number of squares on the paper between the two points.

What is Area of this circle?

The **area of the circle** is the number of squares that are inside the pencil line. The pencil line is known as the **circumference**.

Find its approximate Area by counting squares:

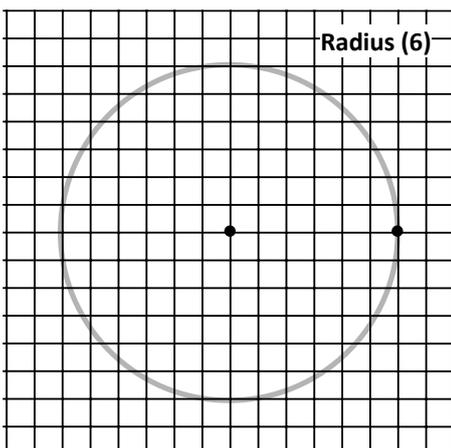
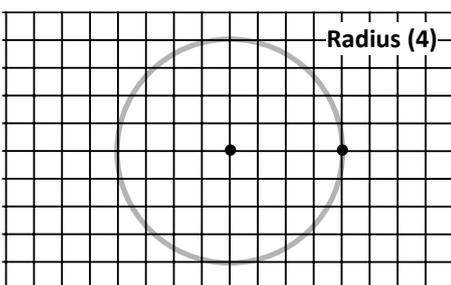
- (1) Number every whole square *inside* the circle, and make a *tick* mark in the squares that are *half or more* inside the circle. Ignore those that are less than half inside the circle (mostly outside the circle).
- (2) Count all squares numbered or *ticked* to find its *area*.
- (3) What is the *area* of this circle which has a *radius* of 5 squares. (The squares are the *unit of measurement*)



Full = 68
 (✓) mostly inside = 12
approx. area = 80 squares

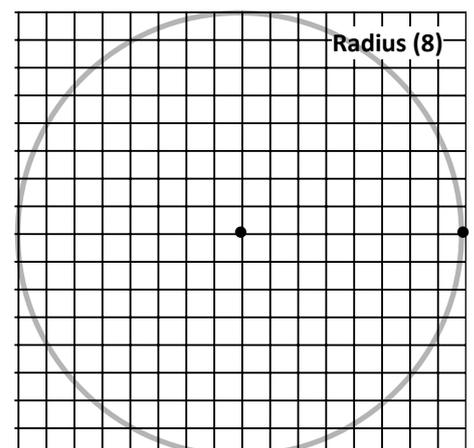
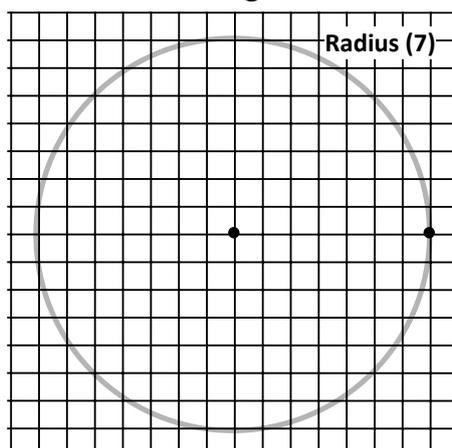
Extra Practice

Choose which of these Circles you want to copy. Draw them on squared paper and find the area of each by counting the full squares and squares of half or more than half.



The length of the Circumference of the Circle

The **circumference** is the length of the line that the pencil draws. That's not easy to measure because it is a curved line. Think of it as *how many squares long if the curve was stretched into a straight line*. Can you think of a way to measure the circumference? See p.3. An ancient mathematician discovered that it is **always** the same number of times (*greater than 3*) around a circle than across it.



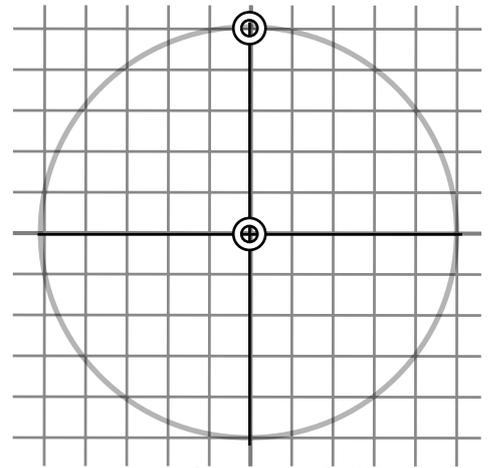
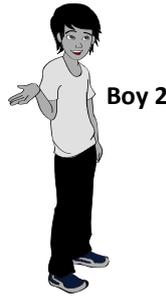
The Circle: (B) Code the Circle in SCRATCH

<https://scratch.mit.edu/projects/371392777>

Step-by-step: 1 - 7 Draw the Circle

1. **The Xy-grid-20px** backdrop. Get this backdrop from the Sprite library.

2. **The Pen sprite:** I like to see the drawing point of the pen, so I create my own donut pen sprite, a very small circle with no fill and a thick outline. Carefully set its Costume centre in the Scratch Graphics Editor.



Each grid square is 20px

3. The radius variable



The boy sprite will give instructions and announce solutions

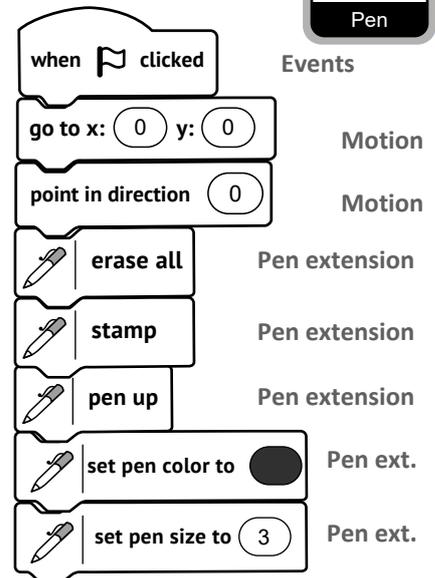
Make and name the **radius variable**. Set it to slider readout (pictured above) and set min value to 2 and max to 5. These are inside the stage limits.

4. Create the Pen set up script.

When the **green flag** is clicked, the first script sets the pen colour, size and its Up mode. It also sets the pen direction to 0° and its position to centre 0, 0. The last block in the first script should **broadcast the command Draw**.

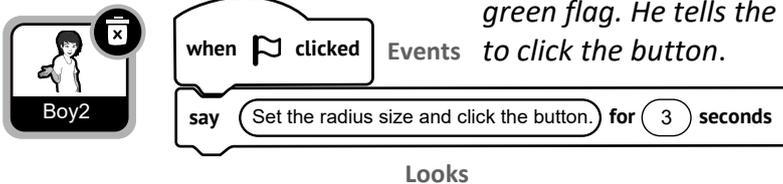
4. Create the Pen set up script.

Pen set up is activated on the green flag

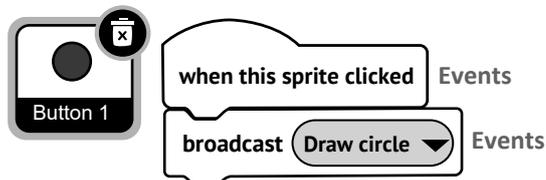


5. Create the Boy 2 short start-up script.

the Boy is activated on the green flag. He tells the player to click the button.

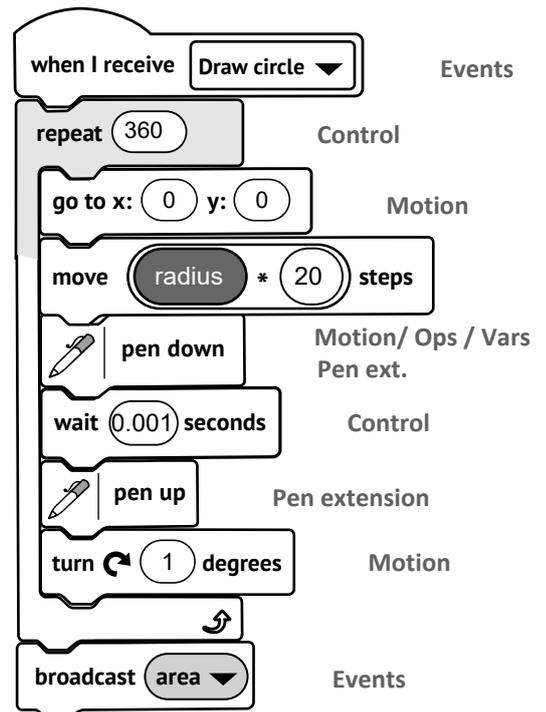


6. Code a Button



When the button is clicked it sends out the Draw broadcast to be receive by the Pen.

7. Script 2 of 2 on the Pen: Draw circle



7. The pen receives the 'Draw circle' broadcast from the button. Immediately the **repeat by 360** begins iterating. It moves from centre 0, 0 to **radius x 20** steps and places a **dot (with down, up)** to start plotting the circle. It makes a **turn of 1°** before beginning the next iteration.

During 360 very fast iterations the circle draws. After the loop when pen starts finishes drawing, it sends the 'area' broadcast to the boy sprite.

Step-by-step continued: 8, 9 Calculate the Area and Circumference of Circle

The sprite receives the broadcast 'area' from the pen after it has completed drawing the circle. When the sprite receives the broadcast it calculates the **area** of the circle, based on the value of the **radius variable** as set by slider. In this example it is set to 5. It returns double-digit values in visible grid squares units. Without the grid, SCRATCH would answer in tens of thousands of invisible pixels.

8. Code the solution algorithm for Area

It uses a combination of 2 **join** Operators to concatenate (*join*) numeric data and text strings. Drag two **join** blocks from the Operators palette. Insert one of them into the first input window of the the other. The holding text *apple* and *banana* will show three windows, *apple banana banana*. Type the words **Area is** into window 1 and the word **squares** into window 3.

Area is 79 squares

2 **join** Operators combine to give three input windows

Area is **round** (3.142 * radius * radius) squares for 5 seconds

Click me and I'll tell you its circumference

Looks/ Operators/ Variables

Scratch calculates this solution and reports it here as 79.

Slide this **solution algorithm** into the middle window

The Solution Algorithm for Area:

- Area of this circle is *pi* by radius by radius (3.142 x 5 x 5 approx. 79)
- The **round** Operator makes it a *whole number* (removing any decimals)
- This is slipped into the middle of the three **join, join** windows
- When inserted into **say for (5) seconds**, the sprite announces the solution in a speech balloon.
- Text in a **join** block is known as *string data*. When typing *string data* in the input window, you should start and end with a space. Insert the *numeric data* combination in the middle window.

The sprite invites to be clicked to report the CIRCUMFERENCE of the circle

9 Code the solution algorithm for Circumference

Its Circumference is about 31 square units long

when this sprite clicked

Again use two **join** Operators inside a **say ()** block. Insert text the solution combination concatenate numeric data and text strings in a **say ()** block

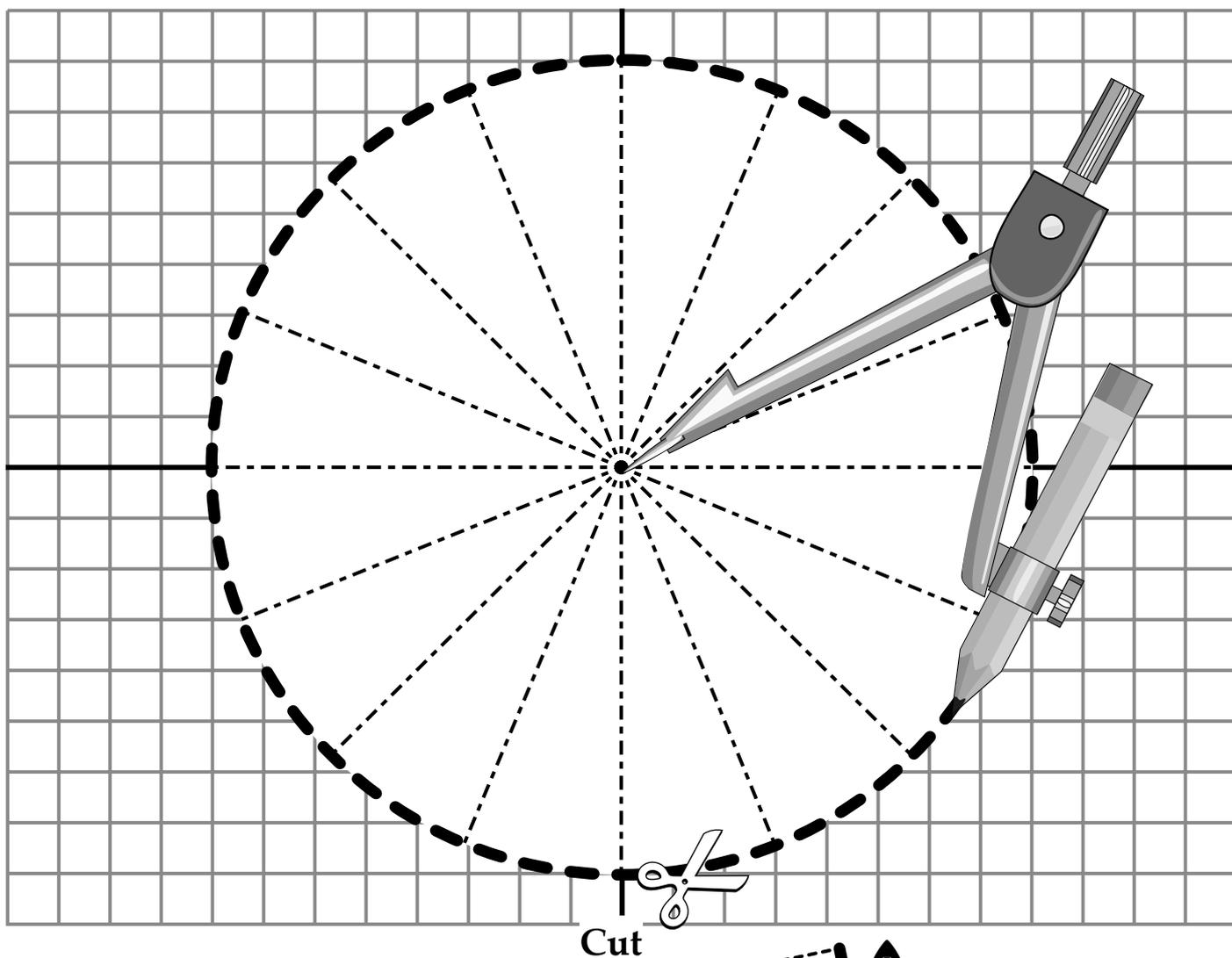
say join join (Its Circumference is about) round (radius * 2 * 3.142) (square units long)

lead-in text Solution algorithm label text

The Solution Algorithm for Circumference:

- At its centre is (diameter) which is radius by 2 by *pi* (5 x 2 x 3.142 = 31)
- The **round** Operator makes it a *whole number* (removing any decimals)
- This is slipped into the middle of the three **join, join** windows

How to Approximate the Circumference of a Cut-out Paper Circle



Cut

Fold precisely

Measure

1. Draw a large circle of a fixed radius with pencil and compass.
2. Cut carefully along the pencil line.
3. Fold precisely in half.
4. Fold in half again from the centre.
5. Continue making as many precise half-folds as possible.
6. Measure the **arc of the segment** and **multiply** by the number of folds. The answer is an approximation of the circumference.
7. Confirm that the *circumference* is just over 3 times longer than the *diameter*.
- (8. **Try this:** Draw around a cylinder to get a circle. Wrap a strip of paper around it. Measure the length of paper. e.g. use a tin of beans).

