

# STEM-CAPSTONE PROJECT

**Lesson Name:** Circles

**STEM challenge** – Finding the value of Pi

**Level/grade** - VIII

**Overview:**

In this STEM Activity, students will examine circular objects and discover about their sizes and finding the value of pi and learning real life applications of circle.

**Problem Statement:**

Sara describes the circular objects that are all around us. At the time, she wondered why camera lenses are circular.

**Learning objectives:**

- ❖ Describe the relationship between the circumference and the diameter of the circle.
- ❖ Determine whether the diameter or the circumference is longer.
- ❖ Recognize that all circles have the same relationship between circumference and diameter.
- ❖ Find the value of pi

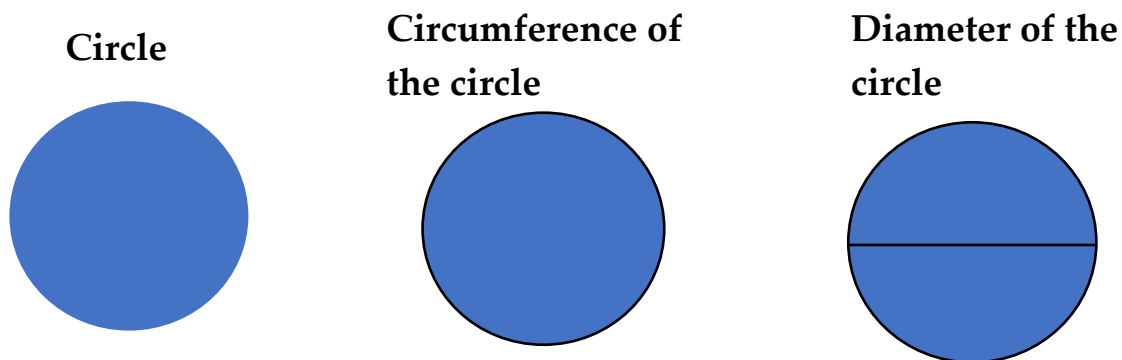
**Materials Required:**

- ❖ Three different circular objects of different size (Large coins, round containers lids, bicycle wheel)
- ❖ A roll of twine or ribbon
- ❖ Scissors
- ❖ Optional: Tape, such as masking tape

**Background Information:**

- ❖ In Geometry, a circle can be defined as a closed-shape, two-dimensional shape, curved shape.

- ❖ **Circle** – A circle is a set of all points in a plane which are at a fixed distance from a fixed point.
- ❖ The fixed point is the centre of the circle and the fixed distance is the radius of the circle.
- ❖ The word circumference comes from the Latin word circum (which means around) and ferre (to carry). It can refer to the line bordering the circle as well as to the length of this line.
- ❖ Diameter is also the longest distance across the circle and a line that bisects the circle.



- ❖ The ratio of the circumference to the diameter of a circle is a constant, meaning it is the same for all circles, no matter how large or small the circles are.
- ❖ There are numerous uses for circles in architecture, landscaping, graphics, infrastructure, transportation and another field.
- ❖ The use of circles is evident even in the manufacturing of spheres (balls, balloons, globes), cylinders (pipes, candles,) and cones) ice cream cones, party hats, traffic cones)
- ❖ Circles can even be a valuable tool when gardening, as they help determine how much space plants need to grow around them.
- ❖ All circle calculations use the constant  $\pi$  ( $pi$ ). The circumference divided by the diameter gives  $\pi$ . This works for all circles because they are mathematically similar.
- ❖ The circumference is a length and is measured in units, including centimetre and metres.
- ❖ Pi is an irrational number. An approximate value of pi is used in calculations; 3.142 and 3.14 are commonly used.

## Procedure:

- ❖ Take three different sized circular objects.
- ❖ Cut a piece of ribbon equal to the object's circumference.
- ❖ Cut a second piece of ribbon equal to the object's diameter.
- ❖ Continue this process for circles of various sizes to find a relationship between the circumference and diameter that holds true across all your instances.
- ❖ Start your exploration with a medium-size circle.
- ❖ Hold the end of a piece of ribbon with your thumb on a spot on the rim of the circular object to make a piece of ribbon that is the circumference of the object.
- ❖ Use tape to temporarily secure the ribbon's beginning to the circular object. Then, wrap and cut the ribbon around the piece of tape.

Can you see that the length of your piece of ribbon is exactly the length of the circumference of circular object?

- ❖ To measure the diameter, you need the length of a straight line that starts at a point on the circumference, goes through the centre of the circle, and ends at its other side.
- ❖ To create a piece of ribbon with the longest length across the circle use a finger to hold the end of a new piece of ribbon on a point on the edge of the circular object.
- ❖ Make a straight line of this ribbon across the circle to another point on the circumference of the circle. Now move the second point along the circumference—to the left and right. Do this until you find the longest straight spanned piece of ribbon possible. When you move the end of the ribbon away from this point, the spanned piece of ribbon gets shorter again.
- ❖ Cut off the piece of ribbon where it was longest. The ribbon length is equal to the diameter of this circle.

Did you observe that the longest length across the circle went through the centre of the circle?

Which distance is longer—the diameter or the circumference? Is it longer by a lot or a little?

❖ Verify if the longer piece is twice as long as the shorter piece.

If you fold the longer piece of ribbon in half, does it fit the length of the other piece?

Do you get an exact or an approximate fit? How would you describe your findings in words like "twice as long" or "three times as long"?

❖ Repeat the procedure using a circular object of a different size.

❖ Continue finding the circumference and diameter until you have thoroughly investigated a small, medium, and large circle.

Can you find a relationship that is the same for all the tested circles? Is it an exact or an approximate relationship? If you found a relationship, do you think you have enough data to conclude that your relationship is the same for all circles?

❖ Finally, we get that the circumference was little more than three times the diameter of the circle for each circle. No matter how small or big the circle was.

### **Process with time allocation:**

First 20 minutes: Explaining the concept

Next 30 minutes: STEM activity

## **STEM Connect:**

**Science** – Optics (lenses)

**Technology** – Camera lenses, Circles are used in graphics to rotate items on computer screens and convert 2D concepts into 3D representations.

**Engineer**

- ❖ The invention of the wheel transformed society and our methods of transportation. Design Ferris Wheel, clocks, due to their symmetrical property.
- ❖ Architects use circles when designing buildings, especially when designing decorative features like domes, arches, round beams, and curved surfaces.

**Mathematics** – Geometry-Circles, Ratios, measurements

## **Assessment:**

1) Look around the house to locate some circular objects and make an estimate of the length of the diameter and the circumference of these objects.

Which one was easier to estimate for you, the diameter or the circumference?

Which one would be easier to measure with a ruler?

Can you now estimate the other one with the relationship you discovered?