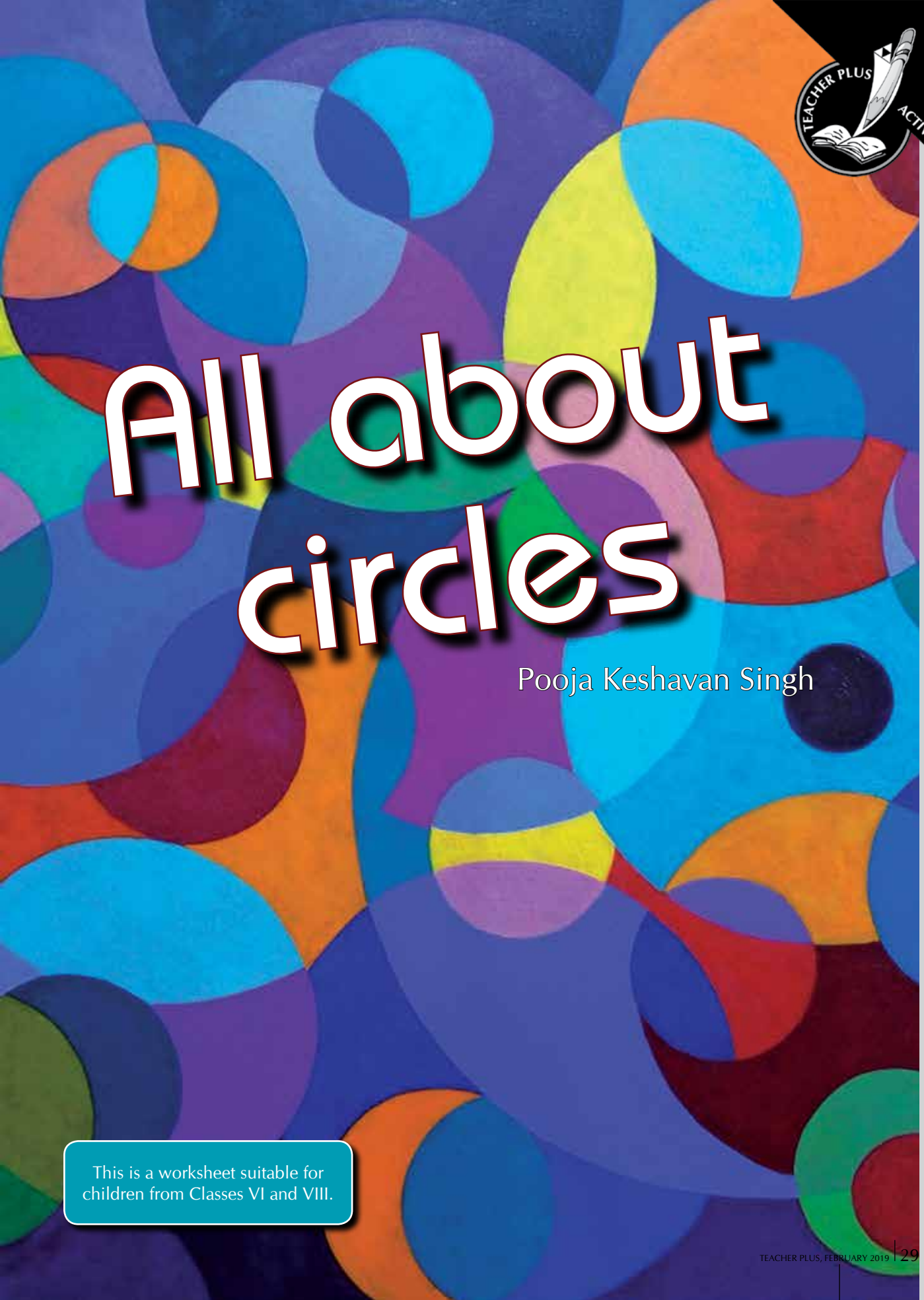


All about circles

Pooja Keshavan Singh

This is a worksheet suitable for children from Classes VI and VIII.

Note to the teacher

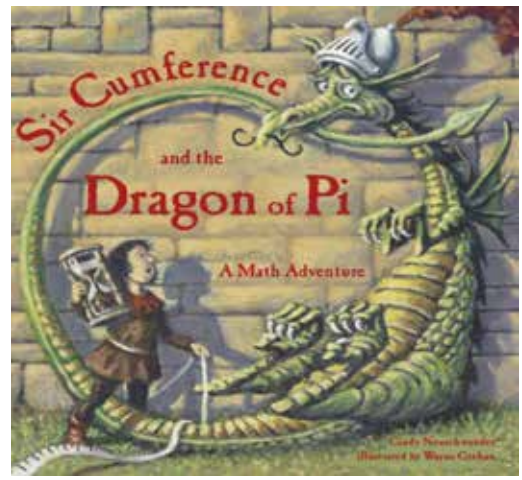
This group of activities discusses the circumference and area of a circle. It starts with an adventure story and introduces children to the constant ratio, Pi. Many activities have been included to help the children solve the problem of the protagonist.

After this, the fascinating history of the number Pi is discussed briefly, followed by some activities. We then proceed to the area of a circle and find it through an activity. There are also opportunities to solve related problems.

Teachers are urged to emphasize the correct usage of units for circumference and area while solving problems and even otherwise.

Activity 1

We start with a story of 'Sir Cumference and Dragon of Pi'. This is a story by Neuschwander (1999). The story is available online on YouTube at https://youtu.be/xJ4MbU8928c.



The story revolves around a boy named Radius whose father, Sir Cumference, has been transformed into a fire-spitting dragon by accident. Radius has to figure out in one day's time the right dosage of a magic potion that will turn his father back into a human being. The dosage puzzle is as follows: *"The Circle's measure: Measure the middle and circle around, Divide so a number can be found, Every Circle great and small, The number is the same for all. It is also the dosage, so be clever. Or a dragon he will stay...forever"*

On the first day, the teacher can narrate the story till here and leave the children with this problem. Allow them to come up with solutions to help their friend Radius.

Activity 2

On day two, let the children bring measuring tape and scales to class. Give them different materials like circular vessels, tyres, potted plants, discs to find the ratio between the perimeter of the circle (circumference) and diameter. Try to include a disc of diameter 1m. They may need the teacher's assistance at the beginning as they work together in groups and start measuring.

When they start arriving at the ratios, encourage them to compare the results with others.

Activity 3

On day three, begin with the story of Radius from where you left. Narrate to the students how Radius made sense of the problem and approached it.

After completing the story, you can discuss more about the ratio between the circumference and diameter, Pi. That is, this ratio is constant for every circle. You can use the data the students collected on day two.

Activity 4

Now it's time to compute the circumference of circles if we know their radius or diameter. Children can use the relation $C/2r = \pi$ Here are a few problem sums.

1. A circular park has a circumference of 352 m. Find its diameter.
2. The diameter of a silver semicircle is 140 cm. Find the perimeter of this semicircle.
3. The difference between the circumference and diameter of a circle is 15 cm. Find the radius of the circle (Pi = 22/7).
4. For covering a distance of 11 km, a wheel has to rotate 2500 times. Find its diameter.

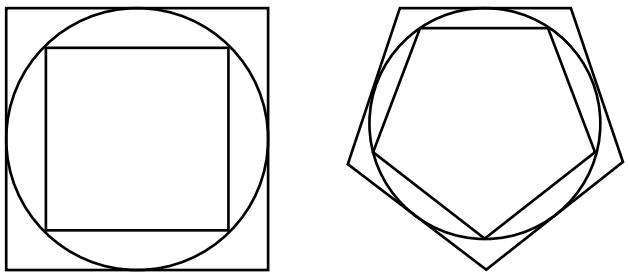
Activity 5

Continuing with Pi, we introduce children to the mystery of Pi. The history of the number Pi is very intriguing. The students can collect some resources available online and discuss their findings with each other. I recount a short history here.

According to sources, human civilizations were aware of Pi as early as 2550 BC. The teacher is requested to draw a timeline of AD and BC to show the actual time gap from today.

The Great Pyramid at Giza, which was built between 2550 BC and 2500 BC, has a perimeter of 1760 cubits and a height of 280 cubits, which gives it a ratio of 1760/280, or approximately 2 times pi. (One cubit is about 18 inches, though it was measured by a person's forearm length and thus varied from one person to another).

The earliest textual evidence of pi dates back to 1900 BC; both the Babylonians and Egyptians had a rough idea of the value. The Babylonians estimated pi to be about 25/8 (3.125), while the Egyptians estimated it to be about 256/81 (roughly 3.16).



Archimedes' Polygons

The Ancient Greek mathematician, Archimedes of Syracuse (287-212 BC) is considered to be the first to calculate an accurate estimation of the value of pi. He accomplished this by finding the areas of two polygons: a polygon that was inscribed inside a circle and a polygon inside which a circle was circumscribed (see figure). The value of Pi lies between these two lengths. Archimedes didn't calculate the exact value of pi, but rather came up with a very close

approximation – he used 96-sided polygons (the more sides a polygon has, the better the estimate of Pi) to come up with a value that fell between 3.1408 and 3.14285.

Encourage students to find out more about Pi.

Activity 6

After reading up about Pi, students may come and tell the teacher, "Did you know that the exact value of Pi has not been calculated even after so many years?"

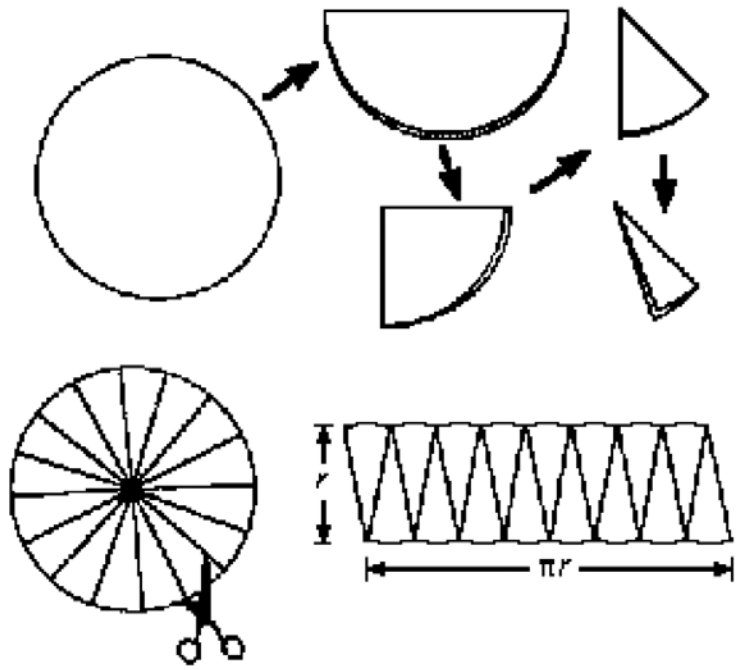
The teacher can now encourage students to calculate the value of Pi to see how it is never ending and never repeating. After calculating it for at least 150 places, allow children to find patterns in the sequence of numbers. Let children decorate their class with their findings by writing the value of Pi on paper ribbons and placing them on boards.

Thus, we conclude that we work an approximate value of Pi. This is because Pi has a decimal representation that has not terminated even after calculating it for three trillion places.

Activity 7

Area of a circle
Give cut-outs of circles of radius 7 cms to all children and ask them to guess the area of the circles. Allow them to cut the circles in whatever way suits them.

After they are done, show them a different method of cutting. Align the pieces as shown in the figure below and ask the students to guess the area.



The class can together derive the area as $A = \pi r^2$.

Activity 8

Now it's time to compute the area of the circles if we know their radius or diameter. Children can use the relation $A = \pi r^2$. Here are a few problem sums.

1. A circle has an area of 2100 sq. cm. Find its radius.
2. A flower bed in circular shape has a diameter of 28 cm. Find its area.
3. Find the area of a ring whose inner radius is 5 cm and outer radius is 12 cm.
4. Find the area swept by the hour hand of a clock between 6:00 pm to 6:30 pm. Given that the length of the hour hand is 14 cm.

Activity 9

Here are problem sums that have both area and circumference questions.

1. The circumference of a circle is 352 cm. Find its area.
2. Area of a circle is 1848 sq. cm. Find the circumference.
3. Given that the diameter of a semicircle is 21 cm. Find its area and perimeter.
4. Consider a square of side 'a' cm. Now taking each of the four corners of the square as centres, draw circles with radius as half of the side of the square. After drawing these four circles on the four sides of the square some area would be left inside the square. Find that area.

Pooja is currently pursuing her Ph. D from the University of Delhi in mathematics pedagogy. She has been a teacher of mathematics and mathematics teacher educator for many years. She believes mathematics can be learnt by any child provided a teacher can find ways to teach it effectively. She can be reached at <poojakeshavan@yahoo.com>.