Pi: Reciting Pi

Key Learning Content

This film begins with footage of an attempt to recite the digits of Pi (π) to thousands and thousands of decimal places. Pi is defined as the ratio of a circle's circumference to its diameter. The formula for the area of a circle is also given on screen. The film explains that Pi is an irrational number, which means that it cannot be expressed exactly as a fraction, and that it has an infinite, non-recurring decimal expansion. Although computers have been used to calculate the first five trillion digits of Pi, for most practical purposes far fewer digits are necessary.

Core Outcomes

Learning Points

- Be able to find circumferences and areas of circles using relevant formulae.
- Be able to recognise that a terminating decimal is a fraction.

Suggested Activities

- Use formulas for circumference and area of circles to solve simple problems.
- Express all reciprocals $1/n$ as a decimal, up to n=20.
- Explore the maximum number of recurring digits that is possible in the decimal expansion of $1/n$.
- Memorise the first 20 squares, and the first 10 cubes.

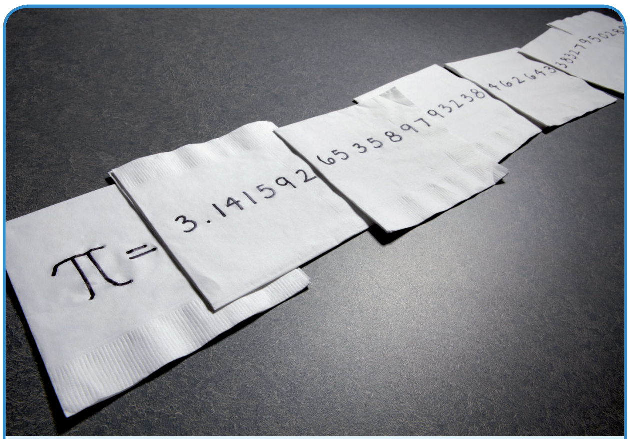
Extension Outcomes

Learning Points

- Be able to understand that Pi is an irrational number.
- Be able to recognise that a recurring decimal is a fraction in the form a/b for non-zero integers a, b.

Suggested Activities

- Convert recurring decimals to fractions.
- Find irrational numbers other than Pi.
- Prove that root 2 is irrational.



Pi is the ratio of a circle's circumference to its diameter.

Related Films

To use before the lesson plan:

Calculating Pi: Archimedes

This film describes the ingenious method used by Archimedes over 2000 years ago to estimate the value of Pi.

To use after the lesson plan:

Irrational Numbers: Pythagoras

This film explains that irrational numbers such as Pi have intrigued mathematicians for thousands of years; for some they were a matter of life and death.

Chinese Development of Maths

This film tells how Chinese mathematics developed independently from the west, yet included the calculation of Pi correct to seven decimal places.

Can You Trust Your IQ?

This film asks: What is intelligence, and can it be measured?

Guide Lesson Plan

Introduction

Show the expansion of Pi on screen up to the first 40 or 50 digits. Ask students to memorise the digits as far as they can, looking for any patterns in the numbers. Then test who can remember the most.

Show Film

Pi: Reciting Pi

Main Activity

Foundation

Explain and illustrate the difference between finite, recurring and non-recurring decimals. Get students to write the fractions ½, ⅓, ¼...$^1/_{20}$ as decimals, using the correct notation for recurring decimals. For those that recur, count the number of recurring digits and look for any pattern in the length. Ask if there must be a limit to the number of recurring digits in the decimal expansion of $1/n$. Explain that mathematicians have proved that Pi is an irrational number and ask what this implies about its decimal expansion.

Main Activity cont ...

Advanced

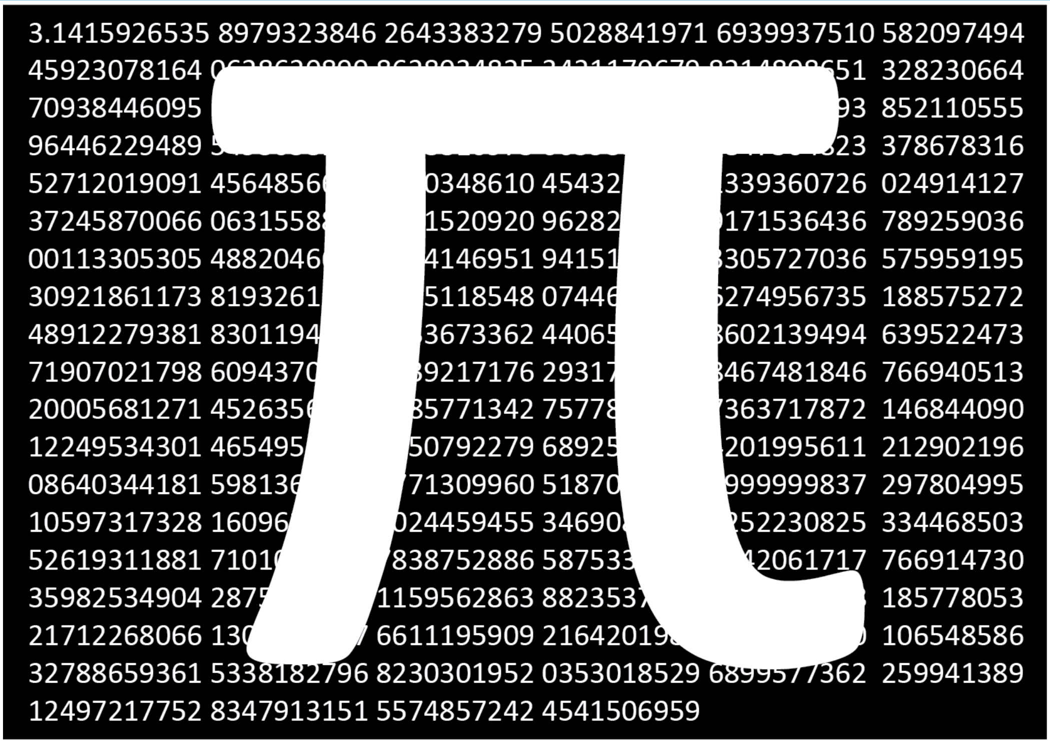
Define rational and irrational numbers, and demonstrate the link between rational and irrational numbers and different types of decimal expansion. Get students to convert recurring decimals to fractions. List examples of irrational numbers. Prove that the square root of 2 is irrational using proof by contradiction.

Extension Activity

The film suggests that only the first 38 decimal places of Pi are needed to calculate the properties of any circle in the observable universe. Carry out calculations with Pi and work out what difference the 39th decimal place makes (e.g. area of a circular patio, circumference of the Earth, distance of orbit around the Sun).

Optional Extra

If the decimal expansion of Pi is infinite and never recurs, some mathematicians have suggested that the expansion of Pi will contain, somewhere, the digits of your birthday in order (e.g. 15.9.01 for 15th September 2001). Using the internet, research this possibility, and find out if your birthday digits are in Pi. Would you expect this result to hold for all infinite, non-recurring decimals?



Pi fascinates mathematicians because it cannot be expressed exactly as a fraction, which means it is infinitely long.