# Easy As Pi

**Question**: How can we determine the value of Pi.

**Kentucky Core Content**:

**MA-M-1.1.2** Students will describe properties of, define, give examples of, and/or apply to both real-world and mathematical situations: Irrational numbers (square roots and pi only)

**MA-M-1.2.3** Students will perform the following mathematical operations and/or procedures accurately and efficiently, and explain how they work in real-world and mathematical situations: Apply ratios, proportional reasoning, and percents (e.g., constant rate of change, unit pricing)

**MA-M-1.3.1** Students will show connections and how connections are made between concepts and skills, explain why procedures work, and make generalizations about mathematics in meaningful ways for the following relationships: How whole numbers, natural numbers, integers, fractions, decimals, percents, and irrational numbers (square roots and pi only) relate to each other (e.g., convert between forms of rational numbers, compare, order)

**MA-M-2.3.1** Students will show connections and how connections are made between concepts and skills, explain why procedures work, and make generalizations about mathematics in meaningful ways for the following relationships: How measurements and measurement formulas are related or different (perimeter and area; rate, time, and distance; circumference and area of a circle)

**MA-M-3.1.1** Students will describe properties of, define, give examples of, and/or apply to both real-world and mathematical situations: Meaning of central tendency (mean, median, mode)

**Objectives**:

Students will be able to:

1. Explain the irrational number Pi.
2. Calculate Pi as the ratio of the circumference of a circle to the diameter.

**Materials**:

Per pair of students:
Measuring tapes
Calculator
Pencil and paper

Per class:
Multiple objects with at least one circular face (ex: CDs, records, paint buckets, salad bowls, bicycle tires, etc.)

**Procedure/Time**:

This activity will take two 50 minute class periods.

1. Before beginning the activity, the teacher should put the objects to be measured in various locations around the classroom.

2. The students should break into pairs and get a measuring tape. The pairs of students then go around the room and measure the circumference and diameter of the objects and record this information on their worksheets (see EASY AS PI worksheet below). If necessary, the teacher can give them specific amounts of time at each 'station' to get their measurements.

3. After all measurements are collected, students return to their seats to finish the worksheet questions. The teacher might want to write all of the student P values on the board for the section on finding the entire class data.

**Assessment**:
Students will be assessed through the completed worksheets (see *Easy as Pi* handout below) and an informal in class discussion of the activity and the class results.

**Teacher Notes:** Students will tend to linger at each station if there is a chance. Separate the stations as much as possible and do not allow more than one pair of students at each station. Try giving the students only 2-3 minutes at each station to collect their measurements. Encourage students not to copy other student's data as it makes the activity less accurate.

# EASY AS PI

NAME:_____PERIOD:_____DATE:_____

In this activity, you and a partner will be measuring the circumference and the diameter of several circular objects around the room. You will then find the ratio of the circumference to the diameter for each object and record all of the information in the chart below, rounding to the nearest thousandth.

1. Do you think that there will be any patterns with these ratios? Do you think that larger objects will have larger ratios and smaller objects will have smaller ratios? Do you think all the ratios will be the same? Write your hypothesis here:

| Object | C = circumference (mm) | D = diameter (mm) | P = C/D (mm) |
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2. What did you notice about the values of P?

3. How did this compare to your hypothesis?

Now, using the P values from your chart, find the mean, median and mode P values:

Mean P value: _____
Median P value: _____
Mode P value: _____

Next, find the mean, median and mode P values for the data from the entire class:

Mean P value: _____
Median P value: _____
Mode P value: _____

From http://mathforum.org/dr.math/faq/faq.pi.html :

By definition, pi is the ratio of the circumference of a circle to its diameter. Pi is always the same number, no matter which circle you use to compute it.

For the sake of usefulness people often need to approximate pi. For many purposes you can use 3.14159, which is really pretty good, but if you want a better approximation you can use a computer to get it. Here's pi to many more digits: 3.14159265358979323846.

Pi is a very old number. We know that the Egyptians and the Babylonians knew about the existence of the constant ratio pi, although they didn't know its value nearly as well as we do today. They had figured out that it was a little bigger than 3; the Babylonians had an approximation of 3 1/8 (3.125), and the Egyptians had a somewhat worse approximation of 4*(8/9)^2 (about 3.160484), which is slightly less accurate and much harder to work with. Pi (rather than some other Greek letter like Alpha or Omega) was chosen as the letter to represent the number 3.141592... because the letter [π] in Greek, pronounced like our letter 'p', stands for 'perimeter'.

Pi is an infinite decimal. Unlike numbers such as 3, 9.876, and 4.5, which have finitely many nonzero numbers to the right of the decimal place, pi has infinitely many numbers to the right of the decimal point. If you write pi down in decimal form, the numbers to the right of the 0 never repeat in a pattern. Some infinite decimals do have patterns - for instance, the infinite decimal .3333333... has all 3's to the right of the decimal point, and in the number .123456789123456789123456789... the sequence 123456789 is repeated. However, although many mathematicians have tried to find it, no repeating pattern for pi has been discovered - in fact, in 1768 Johann Lambert proved that there *cannot* be any such repeating pattern.

As a number that cannot be written as a repeating decimal or a finite decimal (you can never get to the end of it) pi is *irrational:* it cannot be written as a fraction (the ratio of two integers).

4. From your data, which was closest to pi: the mean, the median, or the mode?

5. From the class data, which was closest to pi: the mean, the median, or the mode?

6. Which object(s) had a P value closest to pi?

7. Was the P value for every object EXACTLY pi?

8. What might have caused the values to be different?