Activity Title: Using the Monte-Carlo Method to Calculate Pi

Materials:

1 min timer.

1 circle-in-square cutout for each student

Pencils

Intro:

“We will be calculating Pi today. Does anyone know the value of pi?”

If someone gives an answer, write it on the board. Otherwise write 3 on the board. If there is an objection tell them we are going to find a better answer.

Directions:

Distribute cutouts to each student and explain the process.

Over the course of 1 minute, each student will randomly place dots on the paper by poking it with the pencil. They can make as many or as few as they would like, there is no limit.

Start one minute timer

Once the timer finishes, tell students to stop, ask them to perform two tasks (independently):

1. Count the total number of dots on the whole paper square
2. Count the total number of dots only inside the inscribed circle, e.g. not in the corners of the square.
3. Ask students to compute the fraction P= $\frac{\text{Dots in Square}}{\text{Dots in Circle}}$ and then write their values on the board.

Once all students complete this process, regroup and ask students what they notice about the numbers. They may or not look pi-like, but they should be close to pi/4. Regardless of student response, compute the average of these values, and multiply by four. This will be the approximation for Pi.

Finally, explain why this process works:

Draw the circle-in-square, label radius r and side of square s=2r

Write quotient of area formulas: $\frac{\pi r^2}{4r^2}$ and simplify.

The process of randomly placing dots, and counting the total number is an approximation for the area of both shapes. So when we compute that fraction, we get an approximation for pi/4.

Wrap up:

Lead discussion with questions about activity:

Ask students what would happen if we made dots for less time? More time?

If the answer is inaccurate, ask students why they think this might be. If it is “accurate”, ask students how we know this is the correct answer.

What other ways of calculating pi do you know? (Maybe none.)