Using Mathematics Activity #1: A Helping of Pi

Learners can discover Pi for themselves using this activity developed by Melinda Riley for Grades 6-9 and sponsored by a 1996-97 Excellence in Education Grant.

Materials:

A variety of sizes of 5 or 6 hoola hoops

String

Meter sticks

Vocabulary Preview:

C = Circumference: the measurement of the outside of a circle.

R = Radius: the measurement of a circle from the center point to a point on the circle.

D = Diameter: the measurement of a circle from one point on the circle, through the center point, to the point on the circle on the opposite side.

Pi = 3.14: the number that is used in the formula to find the circumference of a circle determined based on how many degrees are in a circle.

Inquiry Questions:

1. Is there a way to calculate the circumference of a circle without actually measuring it?
2. Why might you want to know the circumference of a circle?
3. What everyday life applications does this activity support?
4. How might scientists and engineers use this information?

Activity:

1. Before learners come into the classroom, draw a large chalk circle in the middle of the room using a 4-5 foot piece of string attached to a central pivot point (the leg of a chair or desk).
2. Tell learners that they need to build a Leprechaun pen, sheep pen, or any number of suggested round enclosures. Inform them that their task is to find out how much fencing material they will need for their enclosure.
3. Ask the learners to brainstorm a variety of ways that they might determine the amount of material they will need to build their enclosure. Have them work in pairs and write their ideas in their notebooks.
4. Explain how scientists and mathematicians use proven formulas as tools to solve problems.
5. Tell learners how you drew the large circle in the room. Ask, "If I attached the string to a fixed point in the center of the circle, would that be considered the diameter or radius?" Share with learners that, if the radius is known, the formula to determine the circumference is $C=r^2\pi$ (write this formula on the board). Point to each symbol or letter to ensure that learners understand what each stands for.
6. "Since we know what the radius is (tell them what length of string you used), can we calculate the circumference?" Hopefully, they will see that they have all of information they need in order to perform the calculations. Let them work on solving the problem, then do the calculations again to check students' work.
7. Now, break the class into groups of 4 and give each group a hoola hoop, a meter stick, and string. Tell them that they will need the exact center point to be able to calculate the radius accurately. Ask them, "What might you do with the tools that you have to determine the circumference of your hoola hoop, using what you know about radius and diameter? Consider the formula and look back at the definitions of each vocabulary word."
8. Let them think for a while, then check to see if any groups discovered the formula $C=d\pi$. If they didn't, guide them to this step and have them determine the circumference of their hoops.
9. Have them use their string as a measurement device, laying their string around the outside of the hoop. Next, have them measure their strings to see if their string length matches what their formula said that the circumference would be.
10. List each group's measurements on the board. Discuss, debate, and justify whether each group's calculations were reasonable, explaining why or why not.
11. Go back to the application ideas that your students wrote in their notebooks. Ask them if they had any other ideas as they were doing this activity for science and engineering.

Technology:

Research what mathematician developed Pi and the formula for circumference.

Go to the Illuminations – Resources for Teaching Math website from the National Council of Teachers of Mathematics (NCTM) at illuminations.nctm.org.

Search for "circles" and click on "illustrations." Learners will be able to manipulate a circle of their own design and see what happens with the circumference.

Middle to High School:
Hypercoasters are about twice as tall as regular roller coasters. This larger scale adds new design challenges. Refer to the video below for more information.
https://youtu.be/DvRCxcrO-p0

Related Crosscutting Concepts:

- Patterns
- Scale, Proportion & Quantity

Related Disciplinary Core Ideas:

- Core Idea ETS1: Engineering Design
  - ETS1.A: Defining and Delimiting an Engineering Problem
  - ETS1.B: Developing Possible Solutions
  - ETS1.C: Optimizing the Design Solution