

Slice of Pi

Area and Circumference of a Circle

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Grade Level	10th Grade
Subject	Mathematics
Course	Geometry

Essential Question

How can one part of a circle help determine the measure of another part?

Summary

This lesson has students explore how the properties of a circle, including area and circumference, relate to one another and to the world around them. The goal is for students to analyze the dimensions of a circle and correlate these to familiar, real-world situations.

Snapshot

Engage

Students engage in an Agreement Circles activity to make predictions related to ratios of a circle.

Explore

Students visit a series of stations to analyze the ratio between circles' circumference and diameter.

Explain

Based on their findings, students determine which of two pizzas with different diameters is more cost-effective.

Extend

Students broaden their knowledge by solving a real-world problem involving ratio and area of a circle.

Evaluate

Students complete a Caption This activity to reflect on what they have learned.

Standards

ACT College and Career Readiness Standards - Mathematics (6-12)

G507: Compute the area and circumference of circles after identifying necessary information

Oklahoma Academic Standards for Mathematics (Grades 9, 10, 11, 12)

G.C.1.1: Apply the properties of circles to solve problems involving circumference and area, approximate values and in terms of p, using algebraic and logical reasoning.

Attachments

- Circle-Ratio-Claim-Evidence-Reasoning-Slice-of-Pi - Spanish.docx
- Circle-Ratio-Claim-Evidence-Reasoning-Slice-of-Pi - Spanish.pdf
- Circle-Ratio-Claim-Evidence-Reasoning-Slice-of-Pi.docx
- Circle-Ratio-Claim-Evidence-Reasoning-Slice-of-Pi.pdf
- Extend-and-Evaluate-Slice-of-Pi - Spanish.docx
- Extend-and-Evaluate-Slice-of-Pi - Spanish.pdf
- Extend-and-Evaluate-Slice-of-Pi.docx
- Extend-and-Evaluate-Slice-of-Pi.pdf
- Lesson-Slides-Slice-of-Pi.pptx

Materials

- Lesson Slides (attached)
- Rulers and measuring tapes
- A collection of round objects for students to measure
- Circle Ratio Claim Evidence Reasoning handout (attached, one per pair of students)
- Extend and Evaluate handout (attached, one per student)
- Paper
- Pencils
- Speaker

Engage

Teacher's Note: Lesson Preparation

Before students arrive, set up for the Engage and Explore activities.

1. In the middle of the classroom, set up a circle large enough so that students can gather inside the circle if they agree with a statement you present or stay outside the circle if they disagree. Use tape, string, or whatever you have available to create the circle. (If you don't have room for the circle inside the classroom, you could instead set it up outside or in the hallway.)
2. Set up stations, each with different circular objects (candles, coffee cans, paper plates, paper towel rolls, etc.) and a measuring tape.

Follow along with the lesson using the attached **Lesson Slides**. Display **slide 3** as students are entering the classroom. Students will begin the lesson by engaging in an Agreement Circles activity based on the following statement:

No matter the size of a circle, the ratio of its measurements is the same.

Teacher's Note: Ratio Review

If students aren't all familiar with what a ratio is, do a quick review so that everyone is on the same page. You can review by using a different shape. For example, a ratio could be the length over the width of a rectangle. That will get students to think about ratios without giving away too much.

Instruct students to move inside the circle if they agree with the statement or stay outside the circle if they do not agree. Have students find a partner who made the same choice and discuss why they decided to be on the inside or outside of the circle. Encourage them to use mathematical language in their discussion.

Teacher's Note

Consider using a speaker to play music during the Agreement Circles activity like you would for a game of musical chairs. Having students mingle during the interval of music to facilitate conversation between a variety of student pairs.

After students wrap up their discussions, display **slide 4** to share the lesson's Essential Question: *How can one part of a circle help determine the measure of another part?* **Slide 5** identifies the lesson's learning objectives. Review these to the extent you feel necessary.

Explore

Go to **slide 6**. Pass out a copy of the **Circle Ratio Claim Evidence Reasoning** handout to each pair of students. Using the CER: Claim, Evidence, and Reasoning strategy, pairs will first make a claim based on their agreement or disagreement with the statement. They should write this in the Claim section.

Next, pairs will go around the room to three different stations to measure different sized circles and record their findings in the Evidence section.

Teacher's Note: Measurement

At this point, don't reveal the formula for circumference or tell students what to measure. Consider instead giving them an example, such as the perimeter and length of a side of a square, to get their minds turning. Let them know the easiest way to compare measurements is to convert their ratios to decimals.

Without giving too much detail, you might choose to talk about precision and measurements. Students might prefer to use inches as their measurement unit, but ask them if there is another way to measure to get a more accurate measurement.

Sample Student Responses

If students are correctly measuring the circumference and diameter of the circle and set up the ratio as circumference over diameter, they should get a value close to pi (approximately 3.14) every time.

Explain

Go to **slide 7**. As a class, discuss the following question:

> Going back to the statement, "No matter the size of a circle, the ratio of its measurements is the same," does your CER statement support this statement or not?

Ask students to present their findings and back up their CER statements through evidence-based reasoning from their measurements and calculations. Make sure students are aligned with the understanding that no matter the size of a circle, the ratio of its circumference to its diameter is always the same and equal to pi.

Go to **slide 8**. Have students look at the definitions while you draw a circle on the board. Have them talk about similarities and differences of the definitions and how they will apply to problems moving forward. While talking about the definitions, stress that not all problems will give them the radius or diameter of the circle, but they should have enough information to find those values on their own.

Go to **slide 9**. On their own piece of paper or however notes are taken in your classroom, have students work individually or with a partner to try to solve the problem. Before they begin, talk about which formula they should think about using and why. Once it is clear that the area formula is their better option, walk around the room while they are figuring out which pizza is more cost effective. If students are struggling, guide them by asking which numbers should be in the formula and why? Can you use any measurement? Once the students have solved the problem, have them help you walk through the problem. By understanding how to break down this particular scenario, it will help them as the next scenario increases in difficulty.

Extend

Teacher's Note: ACT Preparation

The problem presented in this section is similar to problems students might encounter on the ACT. As they work through the problem, help students be mindful of this fact and understand the importance of using the circumference and area of a circle in order to solve more difficult problems presented on standardized tests.

Go to **slide 10**. Pass out a copy of the **Extend and Evaluate** handout to each student.

Without much prompting, present students with the second pizza scenario:

> Lucy and Harry ordered two different size pizzas. What fraction of Lucy's 6-inch diameter pizza contains the same amount of pizza as one slice of Harry's 12-inch diameter pizza of the same thickness cut into 12 equal slices?

Have students work through the problem, either with a partner or individually, using the space provided on their handout. Remind them that there are several components to this problem and it requires application of ratios as well as the area of a circle.

Teacher's Note: Guiding Questions

Refrain from working through the problem with students step-by-step, but feel free to move around the room as students work and ask guiding questions. Ask students what information they know from the problem and what they could try next to come up with the solution. Make it clear that it's perfectly fine to fail one or more times trying to figure it out. This is good practice for students to think critically so that they can be prepared for more difficult math courses and more difficult problems on standardized tests.

Evaluate

Go to **slide 11**. Bring the lesson to a close by having students complete a Caption This activity.

There are four photos on the slide. Ask students to select one photo and caption it using words and concepts that they have used in their learning.

Direct students to their Extend and Evaluate Handout to complete this activity. Students should enter the letter of the picture they chose in the box and write their caption in the remaining space.

Teacher's Note: Guiding Questions

Because they haven't seen these photos before, students might be confused about how they connect to the lesson. To guide their learning, consider asking the following questions:

1. What mathematical terms have we talked about in this lesson? Do those terms relate to the pictures in any way?
2. How can you describe the size of the pictured items to a friend who hasn't taken geometry?

This activity will wrap up the lesson and give you an idea of what students have learned, how they can apply the vocabulary regarding circles to another scenario, and what gaps you need to address moving forward.

Teacher's Note: Too Easy?

Depending on the level of your students, you could approach the activity in different ways. For some students, picking a picture and writing a caption might be too easy. For students who need more of a challenge, one possible extension activity could be to select two pictures and write about how they align. They will still use the terminology they learned from the lesson but take a deeper dive into how different objects connect to one another.

Resources

- K20 Center. (n.d.). Agreement circles. Strategies. https://learn.k20center.ou.edu/strategy/157
- K20 Center. (n.d.). Caption this. Strategies. https://learn.k20center.ou.edu/strategy/82
- K20 Center. (n.d.). Claim, evidence, reasoning (CER). Strategies. https://learn.k20center.ou.edu/strategy/156