

VITAL INFORMATION

Subject(s):	Mathematics
Topic or Unit of Study:	Circles
Grade/Level:	5
Objective:	<ol style="list-style-type: none">1. To understand the relationship between the circumference and diameter of a circle, π.2. To state the value of π, 3.14.3. To be able to find one value (circumference or diameter) given the other.
Summary:	Students measure the circumference and diameter of circles. Ratios are collected and averaged to arrive at a single value.

IMPLEMENTATION

Learning Context:	Students have just studied circles including radius, diameter, and circumference. We are wanting to calculate the distance that a bike travels with one turn of the pedals. We have data that specifies wheel diameter, but not circumference. We need to calculate it somehow.
Procedure:	<ol style="list-style-type: none">1. Divide the class into groups of two or three. Roles within the group are of recorder, measurer, and calculator. The roles might switch off during the lesson.2. Distribute one or more circles and string to each group.3. Have the recorder make a table with columns for an object number or description, and the circumference, diameter, and ratio.4. The measurer then measures. Diameters might be measured with a ruler, but circumferences require a string or measuring tape. The recorder can help hold the circles still. Use both English and metric units for measurements.5. The recorder writes down the data.6. The calculator can begin the division as the others work. When the others are finished, they can share in the task. Round to two decimal places.

7. The calculator averages the values for the ratio.
8. Groups add their ratios to a list for the entire class on the board.
9. The class observes that the value is relatively constant and the teacher gives it a name and a special symbol, pi.
10. Have the students give the formula for pi and write it on the board.
11. Find formulas to calculate diameter or circumference given the other quantity.
12. Practice two problems like this.

Differentiated Instruction:

Auditory reception deficit: The student may not understand what s/he hears. Confirm that the oral instructions have been understood by having the student repeat them back after groups have formed. The student's partner can help with this. Alternatively, distribute written instructions such as the procedure portion of the lesson plan, so that almost anything said is also written. Assessment can be written.

Visual reception deficit: The student may not understand what s/he sees. Instructions are oral, so the task should be understood. The student may have problems both with the measuring and any of the written materials. If it would help to have a really big circle and a really thick string, use one. Given a large button, brightly lit calculator, the student could serve as class auditor and check answers to the division. The numbers could be read out loud to the auditor and read off the display by the audited. Assessment can be oral.

Auditory association deficit: If the information heard cannot be used for thinking, reasoning, and problem solving, then the best strategy might be to get the applicable information written down. This is not done explicitly at the end for the formulas to calculate diameter or circumference, so these should be added. Assessment can be written.

Visual association deficit: If the information seen cannot be coordinated or compared, then it might be difficult to compare sizes of the circles or of the strings. These could be described orally by reading the measurements or converted to volume (small circles or strings are quiet and big ones are loud) or time (small circles or strings last just a short time and big ones last for a long time). It may be difficult to judge the numbers at the end for consistency. The standard deviation can be calculated. Then the sound 3.1 seconds long can be compared to the standard deviation of 0.1 seconds. Assessment can be oral.

Verbal expression deficit: If the student cannot put ideas into spoken words, then the group activity may be difficult and the partner will have to be patient. Not a great deal needs to be communicated; it could potentially be written. Assessment can be written. If verbal expression problems carry over into written expression, then question one of the assessment can be affected. Pi can be drawn by showing

the ratio being taken between the strings for circumference and diameter.

Manual expression deficit: If the student cannot motorically express ideas may have particular difficulty with the fine motor coordination needed to measure the circles. Curving a string tightly around a lid may not be possible for the student. Larger circles and larger strings/ropes can be used, but if gross motor coordination is also a problem, then the measurer's role may not be appropriate. If the student can write or type, then the recorder role could be assumed. If not, the then previously mentioned auditor role may be appropriate. Assessment can be oral.

Whenever possible, the teacher should not rely on these suggestions, but know the student well enough to know what works and what doesn't.

Sample Student Products:

Collaboration: Students will work collaboratively & individually. Students will work in groups of 2.

Time Allotment: 1 class period. 45 Min. per class.

Author's Comments & Reflections: See the differentiated instruction section for accommodations.

MATERIALS AND RESOURCES

Instructional Materials:

Resources:

- **Materials and resources:**
Circles of all sorts of shapes and sizes are required. Examples are lids from yogurt containers, bicycle wheels (the spokes make pie shapes), pizza pans, and especially pie pans. Circles can also be drawn with a compass or computer if necessary.

String is used to wrap around the circumference and span the diameter of the circles and rulers or tape measures are needed to find the length of the strings. Data is recorded with pencil and paper.

STANDARDS & ASSESSMENT

Standards:

 **AZ- Arizona Academics Standards**

- **Subject :** Mathematics
- **Subject/ Grade/ Domain :** GRADE 5
- **Strand Strand 1:** Number Sense and Operations
Every student should understand and use all concepts and skills from the previous grade levels. The standards are designed so that new learning builds on preceding skills and are needed to learn new skills. Communication, Problem-solving, Reasoning & Proof, Connections, and Representation are the process standards that

are embedded throughout the teaching and learning of mathematical strands.

- **Concept Concept 2:** Numerical Operations

Understand and apply numerical operations and their relationship to one another.

- **Performance Objective PO 14 :** Divide decimals.

- **Performance Objective PO 12 :** Add or subtract decimals.

- **Concept Concept 3:** Estimation

Use estimation strategies reasonably and fluently.

- **Performance Objective PO 3 :** Round to estimate quantities.

- **Performance Objective PO 4 :** Estimate and measure for area and perimeter.

- **Strand Strand 2:** Data Analysis, Probability, and Discrete Mathematics

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- **Concept Concept 1:** Data Analysis (Statistics)

Understand and apply data collection, organization and representation to analyze and sort data.

- **Performance Objective PO 5:** Identify the mode(s) and mean (average) of given data.

- **Strand Strand 3:** Patterns, Algebra, and Functions

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- **Concept Concept 3:** Algebraic Representations

Represent and analyze mathematical situations and structures using algebraic representations.

- **Performance Objective PO 1 :** Evaluate expressions involving the four basic operations by substituting given decimals for the variable.

- **Performance Objective PO 2 :** Use variables in contextual situations.

- **Strand Strand 4:** Geometry and Measurement

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- **Concept Concept 1:** Geometric Properties

Analyze the attributes and properties of 2- and 3- dimensional shapes and develop mathematical arguments about their relationships.

- **Performance Objective PO 9 :** Identify the diameter, radius, and circumference of a circle.

Assessment/Rubrics:

1. Have the students define pi in their own words.
2. Give sample values for circumference and diameter and ask what the value of pi is. Students can calculate the value or state a memorized value.
3. Ask what the circumference of a circle with a certain diameter is.
4. Ask the the diameter of a circle with a certain circumference is.

This is an informal assessment not meant to be graded, but letter grades could be

4 = A, 3 = B, 2 = C, 1 = D, 0 = F

If any questions are not answered correctly, reteach until they are.