

‘Round-N-‘Round We Go: A Math Adventure with Circles

Brief Overview:

In this unit, students will develop an understanding of attributes and properties of circles. Through exploration, students will make connections and discover the relationships between radius, diameter, and circumference. Furthermore, applications will be conducted through the construction and measurement of a variety of circles.

NCTM Content Standard/National Science Education Standard:

- Make and test conjectures about geometric properties and relationships and develop logical arguments to justify conclusions.
- Build and draw geometric objects
- Use geometric models to solve problems in other areas of mathematics, such as number and measurement

Grade/Level:

4th- 6th grade

Duration/Length:

3 days/ 60 minute class periods

Student Outcomes:

Students will:

- Analyze the properties of plane geometric figures.
- Identify and describe the radius, diameter, and circumference of a circle.
- Construct and measure a variety of circles using radius, diameter, and circumference.

Materials and Resources:

Day 1

- Index cards
- Neuschwander, Cindy. Sir Cumference and the First Round Table: A Math Adventure. Watertown, MA: Charlesbridge Publishing, 1997.
- Precut circles at least 4 inches in diameter, one for each student
- Student Resource sheet 1, copy per 3-4 students
- Teacher Resource 1
- Yarn

Day 2

- Construction paper
- Compasses
- Scissors
- Ruler/tape measure
- Yarn or string
- Student Resource 2
- Student Resource 3 (reteach only)
- Teacher Resource 2 and 3

Day 3

- Bubbles
- Bubble wands
- Food coloring
- White construction paper
- Ruler/tape measure
- Student Resource 4
- Summative Assessment (Student Resource 5, Teacher Resources 4 and 5)

Development/Procedures:

Lesson 1

Pre-Assessment

- Prompt students: “Imagine someone has never seen a circle before. How would you describe what a circle is to that person?”
- Have students write an independent answer on an index card.
- Have students share responses. Record on a class chart.

Launch

- Allow students to conduct a circle search in teams of 3 or 4. Students will look around the classroom for circles or circular objects and record findings in the first column of Student Resource 1.
- Have students share objects found.

Teacher Facilitation/Student Application

- Refer back to the original class chart from the preassessment to have students discuss how the objects they found fit their ideas about what a circle is.
- Read Sir Cumference and the First Round Table: A Math Adventure
 - Discuss vocabulary (radius, diameter, and circumference) as you read.
 - At end of the story, record new vocabulary on chart/ math board.
- Distribute the precut circles, one per student.
- Prompt students “Using the circle, how can you fold it to show the diameter ?” Have students share ideas and demonstrate using their circles.

- Ask students: “Now, how can we find the radius?” Give students time to explore. Share ideas and demonstrate.
- (Refer to Teacher Resource 1 for paper folding activity.)

Embedded Assessment

- As an exit ticket, have students use a different color to add their original description to tell more about the circle.
- This should be done on the original index card from preassessment.
- Have students share information they added to their card and record on the class chart in a different color.
- Collect index cards to review for student understanding.

Reteaching/Extension

- Above:
 - Explore circumference with students. Have them cut a length of string that will trace around a circle.
 - Explain to students that this distance around the outside of a circle is its circumference.
- Reteach:
 - Use the following on-line geoboard to have students create circles and show diameters and radii using different color bands.
 - http://nlvm.usu.edu/en/nav/frames_asid_127_g_2_t_3.html?open=activities&from=topic_t_3.html
 - Have students form a circle with one student in the middle to represent the center point with all other students equal distant from the center. Pass yarn around from student to student, having each student hold on to one length, to form a circle. Once outer circle is complete, pass it to the middle student to show the radius and from the middle student to someone on the opposite side of the circle to show the diameter.

Lesson 2

Pre-Assessment

Ask students to use a ruler to measure a uniform object, such as an index card, math book, or unsharpened pencil. This will allow the teacher to determine which students have the ability to correctly use rulers to measure. This will be applied when finding diameter and radius in this lesson.

Launch

Have students work with a partner to show understanding of circle properties by drawing circles then labeling diameters and radii on the circles using white boards. Monitor to see if students are correctly identifying radius and diameter. Do not be concerned if their circles are not perfect. The objective is to identify radius and diameter.

Teacher Facilitation/Student Application

- Students will need their record charts from the day one scavenger hunt for circles. Using one of the found circles, model how to measure the circle for diameter and radius.
 - Find the center point. You can do this by measuring and drawing several diameters across the circle to find where all the lines intersect at a common point or by folding a circle into fourths to find the intersection of the folds.
 - Measure from side to side through center point. (diameter)
 - Measure from center point to any place on the circle. (radius)
- Students will work in their same groups to measure objects from the scavenger hunt chart and record both radius and diameter on Student Resource 1.
- Monitor to make sure students are measuring appropriately and recording on their chart.
- Share findings.
 - In discussion, make connection between diameter length and radius length.
 - “Do you notice a pattern in the columns for the radius and diameter of each object?”
 - “What pattern do you notice?”
 - Give students problems such as:
 - If you have a diameter of 10 cm, what would the radius be?
 - If you have a radius of 3 cm what would the diameter be?
 - “Do you think this pattern would continue for every circle? How can you prove it?”
- Model how to use a compass to create different circles to test our hypothesis.
 - Draw a circle with a radius of 3cm and a circle with a diameter of 10 cm. Were the students’ responses to the above questions correct? Did we prove it?
- Allow students to use compasses to practice and test results.
- Have students share ideas to create class definitions of diameter, radius, and circumference. (refer to Teacher Resource 2)
- Complete vocabulary activity, Hanging ‘Round with Circles. (Teacher Resource 3 and Student Resource 2)

Embedded Assessment

Use completed circle vocabulary globe to see that students correctly defined and labeled parts of the circle.

Reteaching/Extension

- Above:
 - Using selected objects from the scavenger hunt have students use string to measure the distance around the outside of the circle.
 - Measure the length of the string.
 - How does it compare to the length of the diameter?

- Lay the string across the circle from one side to the other through the center point. How many times can you do this? How does this compare to your findings from the step above?
- Reteach:
 - Use Student Resource 3 to provide more opportunities for students to measure radius and diameter.

Lesson 3

Launch

- Show Wassily Kandinsky's artwork to demonstrate to students how circles can be used to create art. If possible, have students point out different circles on the artwork and identify where the radius and diameter would be. If possible, have a student demonstrate how to measure the diameter of a circle. (This works well if you are able to project artwork onto a screen).
 - Best works to examine: "Yellow-Red-Blue" "Several Circles" "Composition VIII" and "Composition IX"
 - Works can be found at the following sites:
 - artchive.com/artchive/K/kandinsky.html
 - abcgallery.com/K/kandinsky/kandinsky.html

Teacher Facilitation/Student Application

- Pour a small amount of bubble solution into 4-5 cups.
- Add 4-5 drops of food coloring to each cup.
- Using bubble wands have students blow colorful bubbles onto plain white construction paper.
- Allow bubbles to settle and burst on their own.
- Use artwork to organize measurements of circles using Student Resource 4.
- Have students share their findings.
- Use data from question 6 about the largest circle to create a line plot ranging from the circle with the smallest diameter to the circle with the greatest.
- Give each student a die cut circle or circle post- it to record their data on the plot, placing the circle on the data point representing the correct diameter measurement for their largest circle.
- Use the plot to guide discussion using questions such as:
 - What was the largest circle? How do you know?
 - What was the smallest? How do you know?
 - What was the radius of the circle that occurred most often? Explain how you found your answer.
 - Which circle has the smallest/greatest circumference?

Summative Assessment:

Students will demonstrate understanding of the properties of a circle including radius, diameter, and circumference. They will also demonstrate understanding of

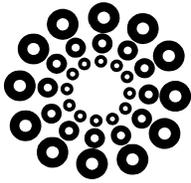
the relationship between the radius and the diameter. They will accomplish this using an ECR and selected response questions (Student Resource 4).

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Names _____ Date _____



Scavenger Hunt

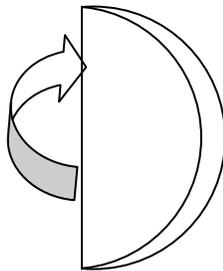
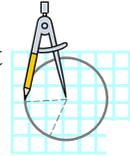
Your team has been invited to participate in a scavenger hunt. The purpose of our hunt is to find circles. As you hunt down and discover your circles, keep a record of them in the column under **Object**. Put only one item per box. For the hunt, you will only be filling information in the first column.

Object	Diameter (cm)	Radius (cm)

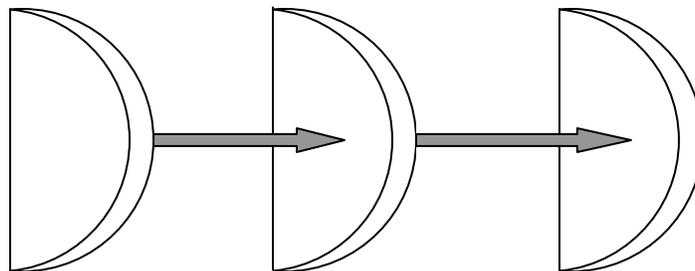
Hanging 'Round with Circles

Directions for Vocabulary Globe

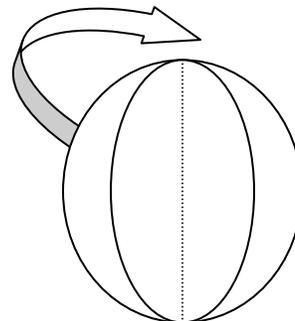
1. You have three pieces of construction paper. You will use one piece for each circle.
2. Use the compass to create three different circles with a diameter of eight inches.
3. Measure, draw, and cut out your three circles.
4. On one circle, draw and label the radius using a red crayon or marker. Then write the definition for radius on your circle.
5. On the second circle, draw and label the diameter using a blue crayon or marker. Then write the definition for diameter on your circle.
6. On the third circle, draw and label the circumference using a purple crayon or marker. Then write the definition for circumference on your circle.
7. Fold each circle in half with definition and illustration on inside.



8. Put two circles together by laying one on top of the other while still folded. Attach with glue. Repeat with the third circle.



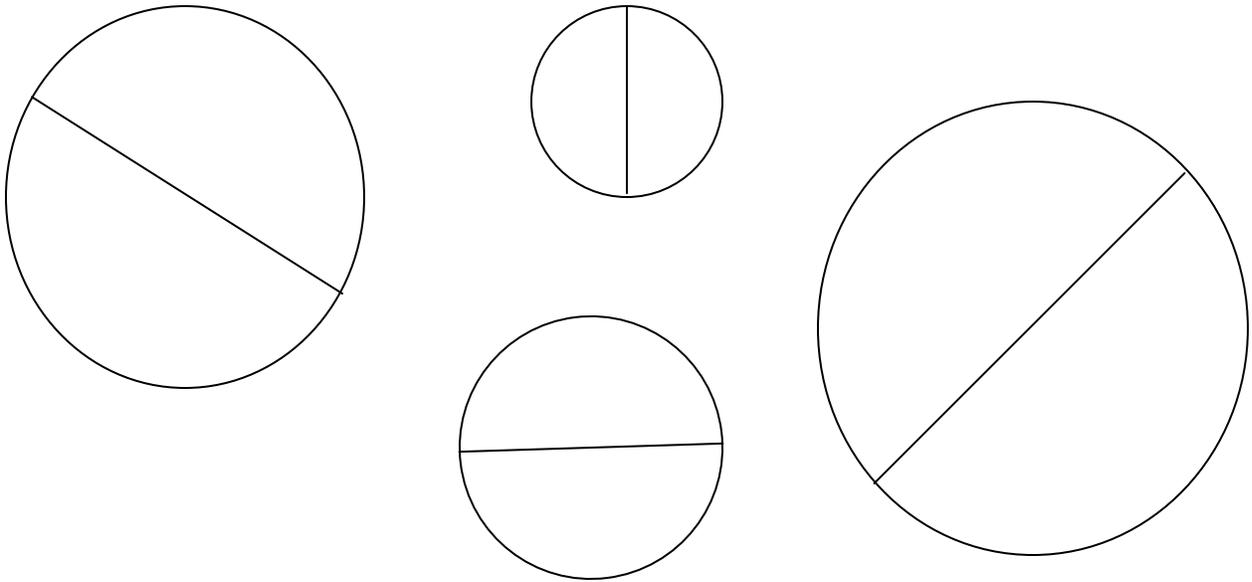
9. Open the flaps and connect the front and back of the circle "booklet" to create a sphere.



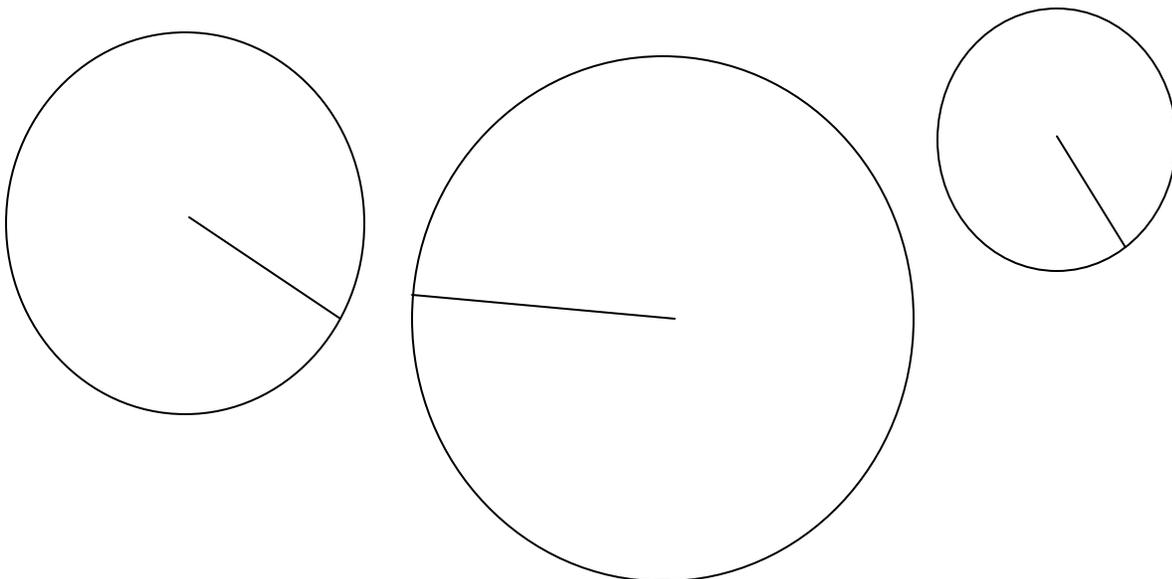
10. Attach string to top of the sphere.

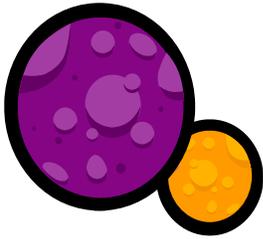
Measuring Circles for Diameter and Radius

Directions: Use your ruler to measure the diameter of each circle below to the nearest centimeter. Label the measurement along the diameter.



Directions: Use your ruler to measure the radius of each circle below to the nearest centimeter. Label the measurement along the radius.





TITLE

Artist _____

Use the circles you have created on your artwork to answer the following questions.

1. How many circles have you created that have a diameter of less than 4 centimeters?

2. How many circles have you created that have a diameter of greater than 6 centimeters?

3. How did you find your answers for questions 1 and 2?

4. Choose one of your circles with a diameter less than 4 centimeters. Measure it.

What is its diameter? _____ What is its radius? _____

5. Choose one of your circles with a diameter greater than 6 centimeters. Measure it.

What is its diameter? _____ What is its radius? _____

6. Find your largest circle. Measure it to find the radius _____ and

the diameter. _____

BONUS QUESTION: Use the diameter of your largest circle to determine the circumference.

Name:

Pizza Time!

Max and his friends went out for pizza after school. The waiter brought the pizza to their table. Max noticed that the pizza was a perfect circle so he measured the diameter and found it to be 8 inches.



Part A *What is the radius of the pizza that Max and his friends had?*

Part B

- *Use what you know about the properties of circles to explain why your answer is correct.*

Part C

- *If Max had ordered a pizza with a diameter of 12 inches, what would be the new radius?*

Where would you find the circumference on a circle?

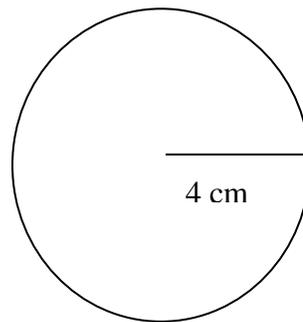
- Ⓐ Across the middle of the circle
- Ⓑ From the center of the circle to the outer edge
- Ⓒ Around the outside boundary of the circle
- Ⓓ At the center point of the circle

If the radius of a circle is 24 centimeters, what is the diameter?

- Ⓐ 12 centimeters
- Ⓑ 36 centimeters
- Ⓒ 48 centimeters

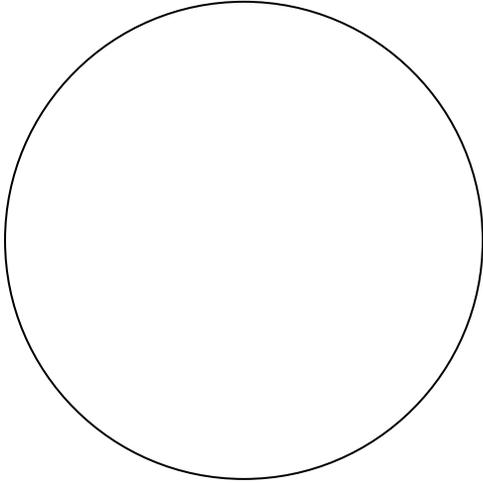
What is the diameter of the circle of the circle shown?

- Ⓐ 8 in
- Ⓑ 8 cm
- Ⓒ 16 cm
- Ⓓ 2 cm

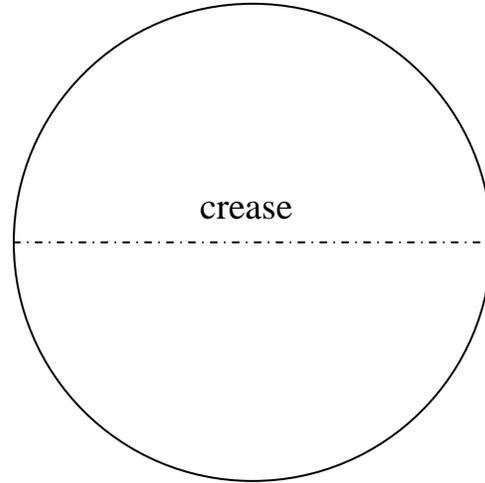


Paper Folding Activity

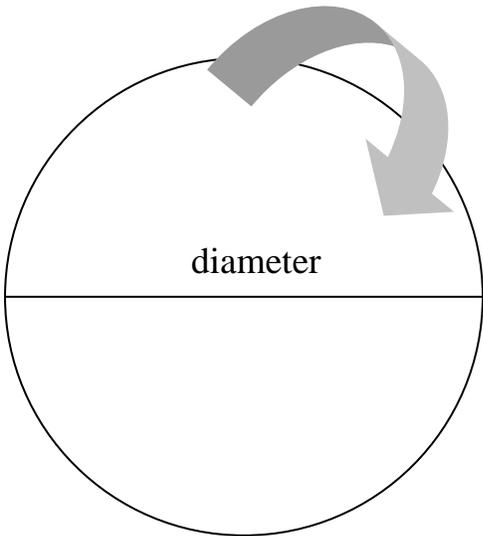
1. Begin with tagboard circle.



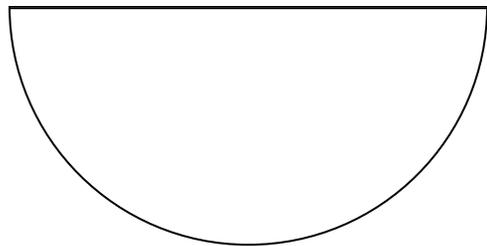
2. Crease along a diameter.



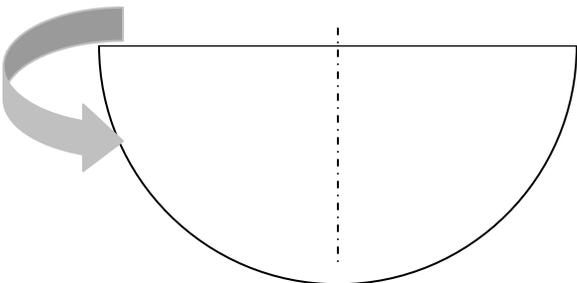
3. Fold along diameter.



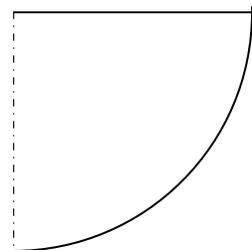
4. Display semicircle.



5. Crease and fold along radius.



6. Display radius.



Definitions of Circle Vocabulary

Radius: a straight line extending from the center of a circle to the circumference (outer edge) or surface: *The radius of a circle is half the diameter.*

Diameter: a straight line passing through the center of a circle and meeting the circumference or surface at each end; a line segment connecting two points on the circle and passing through the center.

Circumference: the outer boundary of a circular area; the distance around a circle

Definitions adapted from:

www.dictionary.com

Nichols, Eugene D. and Sharon L. Schwartz. Mathematics Dictionary and Handbook. Honesdale, PA; Nichols Schwartz Publishing, 1998.

Directions for Vocabulary Booklet

11. Distribute three pieces of construction paper to each student.
12. Use the compass to create three different circles with a diameter of eight inches.
13. Use one circle to write the definition of radius and to illustrate an example.
14. Use one circle to write the definition of diameter and to illustrate an example.
15. Use one circle to write the definition of circumference and to illustrate an example.
16. Fold each circle in half along the diameter. Put two circles together by laying one on top of the other while still folded. Attach with tape or staples. Connect the third circle to the two remaining halves to create a sphere.
17. Attach string to top of the sphere.

Pizza Time!

Max and his friends went out for pizza after school. The waiter brought the pizza to their table. Max noticed that the pizza was a perfect circle so he measured the diameter and found it to be 8 inches.



Part A *What is the radius of the pizza that Max and his friends had?*

4 inches

Part B

- *Use what you know about the properties of circles to explain why your answer is correct.*
- *If Max had ordered a pizza with a diameter of 12 inches, what would be the new radius?*

Answers will vary, but should include:

PART B

1. Diameter is the distance across from one side of circle to the other through the center
2. Radius on a circle is $\frac{1}{2}$ of the diameter

PART C

3. Changing the diameter also changes the radius to 6 inches.
4. 6 inches is half of 12 inches (the new diameter)

Where would you find the circumference on a circle?

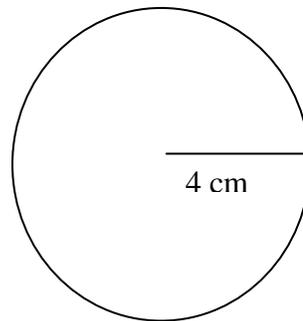
- Ⓐ Across the middle of the circle
- Ⓑ From the center of the circle to the outer edge
- Ⓒ *Around the outside boundary of the circle***
- Ⓓ At the center point of the circle

If the radius of a circle is 24 centimeters, what is the diameter?

- Ⓐ 12 centimeters
- Ⓑ 36 centimeters
- Ⓒ *48 centimeters***

What is the diameter of the circle of the circle shown?

- Ⓐ 8 in
- Ⓑ *8 cm***
- Ⓒ 16 cm
- Ⓓ 2 cm



MSA Extended Constructed Response “Kid Speak” Mathematics Rubric Grades 4 through 8

Score	
3	<p>My answer shows I completely understood the problem and how I solved it:</p> <ul style="list-style-type: none"> • I used a very good, complete strategy to correctly solve the problem. • I used my best math vocabulary to clearly explain what I did to solve the problem. My explanation was complete, well-organized and logical. • I applied what I know about math to correctly solve the problem. • I used numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem.
2	<p>My answer shows I understood most of the problem and how I solved it:</p> <ul style="list-style-type: none"> • I used a good strategy to solve the problem. • I used math vocabulary and my explanation was mostly complete, well-organized and logical. • I was able to apply some of what I know about math to solve the problem. • I tried to use some numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem.
1	<p>My answer shows I knew only a little about the problem and how I solved it:</p> <ul style="list-style-type: none"> • I used only part of a good strategy to solve the problem. • I needed to use better math vocabulary and my explanation needed to be more complete, organized or more logical. • I needed to apply more about what I know about math to solve the problem. • I tried to use some numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem, but I may not have been correct in what I used.
0	<p>My answer shows I didn’t understand the problem and how I solved it:</p> <ul style="list-style-type: none"> • I didn’t use a good strategy to solve the problem. • My strategy wasn’t related to what was asked. • I didn’t apply what I know about math to solve the problem. • I left the answer blank.

