Lesson 2

Exploring Circles

Goals

- Compare (orally) different ways to measure a circle, and generalize the relationship between radius and diameter.
- Comprehend the terms "diameter," "center," "radius," and "circumference" in reference to parts of a circle.
- Describe (orally and in writing) the defining characteristics of a circle.

Learning Targets

- I can describe the characteristics that make a shape a circle.
- I can identify the diameter, center, radius, and circumference of a circle.

Lesson Narrative

In this lesson, students learn vocabulary for describing circles precisely. Students move from the informal idea of a **circle** as "a round figure" to the more formal definition that a circle is the set of points that are equally distant from the center, enclosing a circular region.

Students discover characteristics of a circle by examining examples and non-examples. They develop the idea that the size of a circle can be measured by its **diameter, radius, circumference**, or the enclosed area.

The last activity provides an optional opportunity for students to gain experience drawing circles with a compass. This helps prepare students for future lessons when they will use a compass to draw triangles with given side lengths. For classrooms that do not have access to compasses, a digital version of the activity is provided.

A note on using the terms diameter and radius:

A diameter is a line segment that goes from one edge of a circle to the other and passes through the center. A radius is a line segment that goes from the center to the edge of a circle. However, we also use the words diameter and radius to mean the lengths of these respective segments. Therefore, we will often use phrases like "What is the diameter of the circle?" to mean "What is the length of a diameter of the circle?"

Student Learning Goal

Let's explore circles.

Lesson Timeline

Warm-up	Activity 1	Activity 2	Activity 3	Lesson Synthesis	Cool-down (Assessment)
5 min	20 min	5 min	10 min	10 min	5 min

Access for Students with Diverse Abilities

- Action and Expression (Activity 2, Activity 3)

Access for Multilingual Learners

- MLR2: Collect and Display (Activity 1)
- MLR3: Critique, Correct, Clarify (Activity 3)
- MLR8: Discussion Supports (Activity 2)

Instructional Routines

- Card Sort
- MLR2: Collect and Display
- MLR3: Critique, Correct, Clarify
- Take Turns

Required Materials

Materials to Gather

- Compasses: Activity 3
- Rulers: Activity 3

Materials to Copy

- Sorting Round Objects Cards (1 copy for every 2 students): Activity 1

Required Preparation

Activity 3:
For the digital version of the activity, acquire devices that can run the applet.

Warm-up

How Do You Figure?

5 min

Activity Narrative

This *Warm-up* prompts students to compare two figures and use the characteristics of those figures to help them sketch a possible third figure that has various characteristics of each. It invites students to hold mathematical conversations and explain their reasoning. It gives the teacher an opportunity to hear how students use terminology and talk about figures and their properties.

There are multiple reasonable answers to the question, and students should be encouraged to be creative. The grid is provided to allow students the opportunity to discuss side lengths, find the area and perimeter of Figure A, and estimate the dimensions of Figure B.

Launch

Arrange students in groups of 2–4. Display the image of the two figures for all to see. Make sure students understand that they are to draw a third Figure, C, that has features of both Figures A and B but more closely resembles Figure A. Give students 2 minutes of quiet work time to sketch Figure C, and then give them time to share their thinking with their group. After everyone has conferred in groups, ask the group to share the characteristics used in generating different versions of Figure C, and ask them to show an example of one of the sketches.

Student Task Statement

Here are two figures.

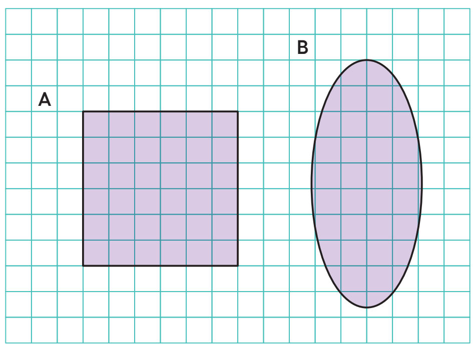
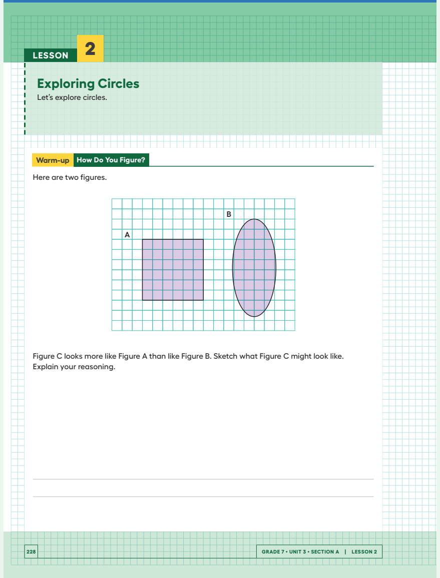
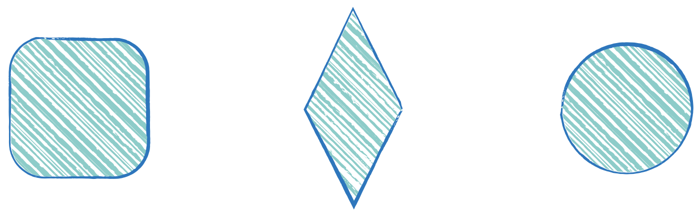


Figure C looks more like Figure A than like Figure B. Sketch what Figure C might look like. Explain your reasoning.

Student Workbook



Answers vary. Possible solutions:



- This first possibility for Figure C is almost identical to Figure A but with slightly rounded corners like Figure B. Both in size and shape, it is closer to Figure A.
- This second possibility for Figure C is a polygon (quadrilateral, parallelogram, and rhombus) like Figure A, but it is taller than it is wide like Figure B.
- This third possibility for Figure C resembles Figure A in that it is the same distance across the figure, from left to right or from top to bottom. Also like Figure A, it can be rotated, and it still look exactly the same. It looks like Figure B in that its sides are curved rather than straight line segments.

Activity Synthesis

After students have conferred in groups, invite each group to share the characteristics that were important to them in creating their third figure. Some important points to be brought out include

- Figure A is a polygon, and Figure B is not a polygon.
- Figure A has the same width and height while the height and width of Figure B are very different.
- The area of Figure A is 36 square units while the area of Figure B is about 30 square units.
- The perimeter of Figure A is 24 units. The perimeter of Figure B is hard to determine, but it is less, maybe about 22 units.

Encourage students to be as precise as possible as they describe why they chose the figure they drew.

Display the responses for all to see. Because there is no single correct answer to the question, attend to students' explanations and ensure that the reasons given are correct. During the discussion, prompt students to explain the meaning of any terminology that they use and to clarify their reasoning as needed.

Activity 1
Card Sort: Sorting Round Objects

20 min

Activity Narrative

In this partner activity, students take turns sorting pictures of objects. The purpose of this activity is to build on students' prior experience with circles and help them refine their definition of a circle. Monitor for different ways in which groups choose to categorize the objects, but especially for categories that distinguish between circles and non-circles.

Next, students compare the size of the circles to begin a discussion of what aspects of a circle can be measured. Finally, the teacher introduces the terms "diameter," "center," "radius," and "circumference," so students can identify these measurements in the pictures of the circular objects.

Because all of the objects pictured are three dimensional and circles are not, encourage students to focus on the circular (and non-circular) *aspects* of the objects. For example, the utility hole cover is actually a cylinder with a relatively short height, but the outline of the utility hole cover is circular. Some of the pictures could reasonably be placed into either category. For example, the outline of the pizza is not a complete circle, but the outline of a slice of pepperoni may be. The final categorization is not as important as students' reasoning about what makes something a circle. As students trade roles explaining their thinking and listening, they have opportunities to explain their reasoning and to critique the reasoning of others.

The use of the words "smallest" and "largest" is purposely vague to encourage students to reason about the measurable things in a circle. As they work, listen for how students define "size," the ways in which they determine the size, their estimation strategies, and any actual estimations. These will all be important in the whole-group discussion.

Launch

Arrange students in groups of 2–3. Distribute slips with the pictures of round objects. Give students 1 minute of quiet think time to come up with categories that they could use to sort the objects pictured, followed by 1 minute to share their ideas with their partner. Select students to share their ideas for sorting the objects into 2 categories. After a student suggests that the objects could be sorted by whether or not they are circular, instruct the students to do that.

Explain how to set up and do the activity. If time allows, demonstrate the steps with a student as a partner. Consider demonstrating productive ways to agree or disagree. For example, by explaining your mathematical thinking or asking clarifying questions.

After sorting is complete, pause the students' work for a quick whole-group discussion. Select groups to share one of the objects that they sorted into the *not circular* category. Ask students to explain why each of these objects is not circular. Start a list titled "Characteristics of a Circle" displayed for all to see. For each reason students give as to why one of the objects is not circular, add the related characteristic of a circle onto your list. Here is a table showing sample responses. The first two columns show what could be mentioned in the discussion, and the third column shows what could be added to your displayed list.

Instructional Routines

Card Sort

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Please log in to the site before using the QR code or URL.

Instructional Routines

MLR2: Collect and Display

ilclass.com/r/10690754

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Instructional Routines

Take Turns

ilclass.com/r/10573524

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Access for Multilingual Learners (Activity 1)

MLR2: Collect and Display
This activity uses the *Collect and Display* math language routine to advance conversing and reading as students clarify, build on, or make connections to mathematical language.

Student Workbook

1 **Card Sort: Sorting Round Objects**

Your teacher will give you some pictures of different objects.

1. How could you sort these pictures into two groups? Be prepared to share your reasoning.
2. Take turns with your partner to sort the pictures into the categories that your class has agreed on.
   a. For each match that you find, explain to your partner how you know it's a match.
   b. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.

   Pause here so your teacher can review your work.
3. What are some characteristics that all **circles** have in common?
4. Put the circular objects in order from smallest to largest.
5. Select one of the pictures of a circular object. What are some ways you could measure the actual size of your circle?

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picture(s)	reason it is not a circle	characteristic of a circle
clock	straight edges and vertices	round, no corners
rug	straight sides (and taller than it is wide)	no straight sides
boiled egg and platter	taller than they are wide	the same distance across in every direction: length, width, height, longest diagonal
pizza and speedometer	the outer edges would be circles if they went all of the way around, but they do not	closed figure
basketball	encloses a three-dimensional region	encloses a two-dimensional region

Next, instruct students to put the pictures of objects that are *not circular* off to the side and to focus on the objects that *are* circular for the rest of the activity.

Use *Collect and Display* to create a shared reference that captures students' developing mathematical language. Collect the language that students use to talk about the sizes of the circles. Display words and phrases such as "distance across," "distance around," "width," and "height."

Student Task Statement

Your teacher will give you some pictures of different objects.

1. How could you sort these pictures into two groups? Be prepared to share your reasoning.

Sample responses:

- Things I've seen before and things I haven't
- Bigger than my desk and smaller than my desk
- Circles and non-circles

2. Take turns with your partner to sort the pictures into the categories that your class has agreed on.

a. For each match that you find, explain to your partner how you know it's a match.

b. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.

Sample responses:

Circles:

- Outline of the wagon wheel, utility hole cover, grill, fan cover, bike wheel, glow necklace, orange slice, or dartboard
- Path of the yo-yo, propeller tip, or center pivot irrigation
- Edge of a pepperoni slice, or inside some numbers on the clock
- Equator of the basketball

Not circles:

- Outline of the clock, rug, boiled egg, platter, pizza, speedometer, or orange slice
- Surface of the basketball

Pause here so your teacher can review your work.

3. What are some characteristics that all **circles** have in common?

   Sample responses: Circles are round, closed plane figures. They do not have edges or vertices. Their length, width, and longest diagonal in any direction are all equal. The distance from the center to any point around the circle is always the same. Circles have 360 degrees and infinitely many lines of symmetry.

4. Put the circular objects in order from smallest to largest.

   Sample response: Pepperoni, glow necklace, dartboard, bike wheel, grill, utility hole cover, fan cover, wagon wheel, yo-yo trick, airplane propeller, center pivot irrigation.

5. Select one of the pictures of a circular object. What are some ways that you could measure the actual size of your circle?

   Sample responses:

   - The longest line across a circle.
   - The distance from the center to the edge (when the center of a circle is visible).
   - The perimeter around a circle.
   - How many square units fit inside a circle.
   - The largest square that fits inside or the smallest square that fits outside a circle.

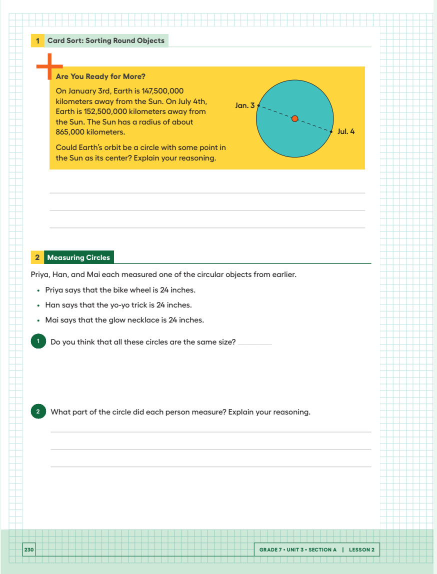
Building on Student Thinking

Some students may answer that the basketball is a circle, because the paper can only show a two-dimensional projection of the three-dimensional object. Tell them that a real basketball is a sphere, not a circle. If desired, prompt them to describe what *aspect* of a basketball is a circle. (The equator.)

Some students may think that the pizza and speedometer are circles, not paying attention to the fact that their circular outlines are not complete.

In the last part of the discussion, after introducing the terms, students may try to identify parts of a circle on the objects that were not circles. For example, they may think that the minute hand on the hexagonal clock represents the radius. Point out that the hand of the clock reaches closer to the midpoint of each edge than it does to each vertex, because the clock is not a circle.

Student Workbook


1 Card Sort: Sorting Round Objects

Are You Ready for More?

On January 3rd, Earth is 147,500,000 kilometers away from the Sun. On July 4th, Earth is 152,500,000 kilometers away from the Sun. The Sun has a radius of about 865,000 kilometers.

Could Earth's orbit be a circle with some point in the Sun as its center? Explain your reasoning.

Jan. 3

Jul. 4

2 Measuring Circles

Priya, Han, and Mai each measured one of the circular objects from earlier.

- Priya says that the bike wheel is 24 inches.
- Han says that the yo-yo trick is 24 inches.
- Mai says that the glow necklace is 24 inches.

1. Do you think that all these circles are the same size? ________
2. What part of the circle did each person measure? Explain your reasoning.

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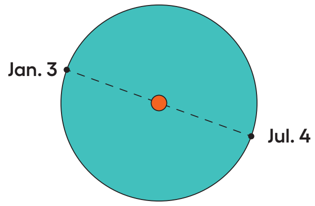
Are You Ready for More?

On January 3rd, Earth is 147,500,000 kilometers away from the Sun. On July 4th, Earth is 152,500,000 kilometers away from the Sun. The Sun has a radius of about 865,000 kilometers.

Could Earth's orbit be a circle with some point in the Sun as its center? Explain your reasoning.



Sample response: No, the diameter of the Sun is less than 2 million kilometers. Even subtracting 2 million kilometers from the largest distance between Earth and the Sun and adding 2 million kilometers to the shortest distance between Earth and the Sun, the distances are still different. So no matter what point in the Sun is chosen to be the center of the orbit, the distances are not the same and so the orbit is not circular.

Activity Synthesis

The goal of this discussion is to introduce terms that describe measurable aspects of circles. Invite students to share their reasoning and estimates about the relative sizes of the circles. Make sure that students articulate which *aspect* of the objects are circles (for example, the outline of the utility hole cover or the path of the yo-yo trick), because all of the objects are actually three dimensional.

Ask students to defend their order by estimating how big each circle is. Wait for the ambiguity of "what part of the circle are we measuring" to come up, or point out that different students are (likely) using different attributes when discussing the size of the circle. Challenge students to explain their answers with more precision.

Next, introduce the terms "diameter," "center," "radius," and "circumference" as they relate to the parts being measured. Some important points to cover include:

- **Circles** are one-dimensional figures that enclose a two-dimensional region.
- The size of a circle can be described using the length of its **diameter**—a segment with its endpoints on the circle that passes through the center. Any two diameters of the same circle have the same length. We will often use phrases like "What is the diameter of the circle?" to mean "What is the *length* of a diameter of the circle?".
- The **circumference** is the length around the circle.
- A **radius** is a line segment from the *center* of a circle to any point on the circle. Its length is half of the diameter.

Direct students' attention to the reference created using *Collect and Display*. Update the reference to include additional phrases such as "diameter," "center," "radius," and "circumference."

Consider asking students to identify pictures from the activity that draw attention to the radius, to the diameter, and to the circumference, and ask how they decided. Invite students to borrow language from the display as needed. For example:

- The radius is depicted in the wagon wheel, yo-yo trick, pivot irrigation, orange slice, dartboard, and airplane propeller.
- The diameter is depicted in the wagon wheel, dartboard, and grill.
- The circumference is depicted in all the circles but is especially prominent in the glow necklace and yo-yo trick.

Give students a minute to write down what each of the new terms means, using words or diagrams.

Finally, display the picture of the grill, utility hole cover, or bike wheel for all to see. Draw students' attention to some of the other lines (chords) that are not a diameter or radius. Ask whether these lines depict the diameter or radius and why not.

Activity 2

Measuring Circles

5 min

Activity Narrative

The purpose of this activity is to continue developing the idea that we can measure different attributes of a circle and to practice using the terms "diameter," "radius," and "circumference." Students reason about these attributes when three different-sized circles are described as "measuring 24 inches" and realize that the 24 inches must measure a different attribute of each of the circles. Describing specifically which part of a circle is being measured is an opportunity for students to attend to precision.

Launch

Keep students in the same groups. Give students 2 minutes of quiet work time followed by partner discussion.

Student Task Statement

Priya, Han, and Mai each measured one of the circular objects from earlier.

- Priya says that the bike wheel is 24 inches.
- Han says that the yo-yo trick is 24 inches.
- Mai says that the glow necklace is 24 inches.

1. Do you think that all these circles are the same size?

   The three objects are not the same size. They are each measuring different parts of the circle.

2. What part of the circle did each person measure? Explain your reasoning.

   Priya is most likely measuring the diameter of the bike wheel because a radius of 24 inches would be very large for a bike wheel, and a circumference of 24 inches would be very small. Han is most likely measuring the radius of the yo-yo trick because a diameter or circumference of 24 inches would be very small. Mai is most likely measuring the circumference of the glow necklace because a radius or diameter of 24 inches would be very large.

Access for Students with Diverse Abilities (Activity 2, Student Task)

Action and Expression: Develop Expression and Communication. Invite students to talk about their ideas with a partner before writing them down. Display sentence frames to support students when they explain their ideas. For example, "That could/couldn't be true because ..." or "I agree because ..."

Supports accessibility for: Language, Organization

Access for Multilingual Learners (Activity 2, Synthesis)

MLR8: Discussion Supports. Display sentence frames to support whole-class discussion: "I agree because ..." or "I disagree because ..."

Advances: Speaking, Conversing

Building on Student Thinking

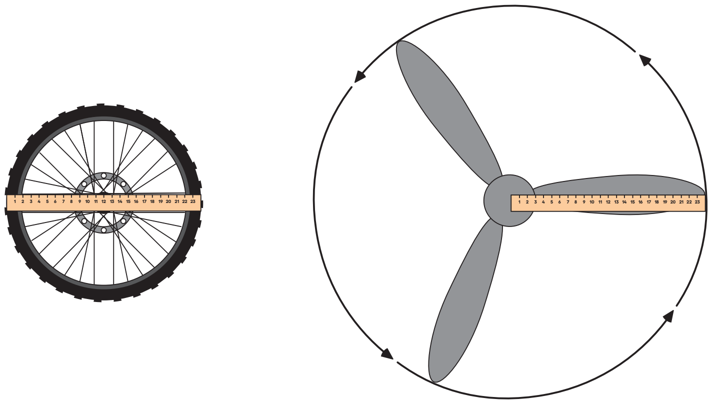
Students may think that all of the objects are the same size because they are focusing only on the "24 inches." Ask students to describe each of the objects to make it clear they are not the same size.

Activity Synthesis

The goal of this discussion is for students to describe the relationship between the radius and diameter of a circle.

Ask one or more students to share their choices for diameter, radius, or circumference as the measurement of the three circles. Prompt students to explain their reasoning until they come to an agreement.

Consider displaying this image of the bike wheel and the airplane propeller drawn to the same scale during the discussion.



Ask students:

- *"What do you notice about the size of these two circles?"*

  The airplane propeller's path is twice as wide as the bicycle wheel.

- *"What is the diameter of the airplane propeller? How do you know?"*

  48 inches, because $24 \cdot 2 = 48$

- *"What is the radius of the bicycle wheel? How do you know?"*

  12 inches, because $24 \div 2 = 12$

- *"How can we express the relationship between the radius and diameter of a circle with an equation?"*

  $d = 2r$ or equivalent

- *"Is this relationship proportional? How do you know?"*

  Yes, the equation is of the form $y = kx$. The constant of proportionality is 2.

The relationship between the circumference and the diameter will be addressed in future lessons.

Activity 3: Optional
Drawing Circles

10 min

Activity Narrative

There is a digital version of this activity.

The purpose of this activity is to reinforce students' understanding of the terms "diameter," "center," and "radius" and also for students to practice using a compass. Students are asked to draw circles with a given radius or diameter, including one where they make the radius of the circle match another length they have already drawn.

Before using the compass, students first attempt to draw a circle freehand. Then, they recognize the compass as a strategic tool for drawing circles and transferring lengths. Students will apply this understanding in a later unit, when they construct a triangle given the lengths of its three sides.

If this is a student's first time using a compass, direct instruction may be needed on how to use one. The circles that students draw may not be perfect, but as they gain more experience with a compass, they will improve.

In the digital version of the activity, students use an applet to draw circles with a virtual compass and ruler. The applet allows students to see that a circle is made out of all the points that are the same distance from a given point. Use the digital version if physical compasses are not available. Additionally, the digital version may reduce barriers for students who need support with fine-motor skills and students who benefit from extra processing time.

Launch

Distribute rulers. Give students a few minutes of quiet work time for the first two questions. If a student asks for a circular object to trace, graph paper, a protractor, or a compass, make that available. After drawing Circles A and B, but before drawing Circles C and D, ask students:

"What was difficult about drawing the circles?"

"How could you make your drawings more precise?"

"What tools might be helpful?"

Once students realize that a compass would be a good tool for this task, distribute compasses to all students. Highlight the connection between the usefulness of a compass and the fact that any point on a circle is the same distance from the center.

Student Task Statement

Draw and label each circle.

1. Circle A, with a diameter of 6 cm.

   Answers vary.

2. Circle B, with a radius of 5 cm.

   Answers vary.

   Pause here so your teacher can review your work.

3. Circle C, with a radius that is equal to Circle A's diameter.

   Answers vary.

Instructional Routines

MLR3: Critique, Correct, Clarify

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Access for Multilingual Learners (Activity 3)

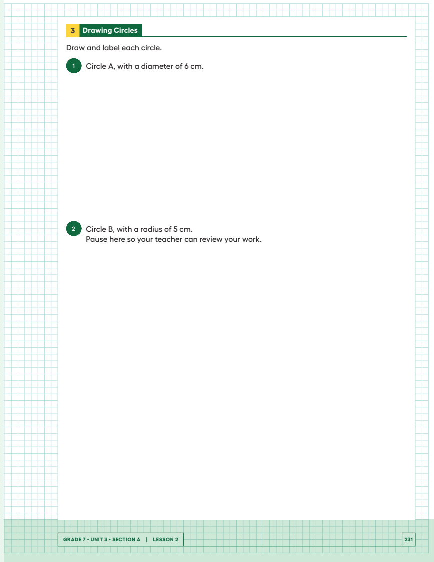
MLR3: Critique, Correct, Clarify
This activity uses the *Critique, Correct, Clarify* math language routine to advance representing and conversing as students critique and revise mathematical arguments.

Access for Students with Diverse Abilities (Activity 3, Student Task)

Action and Expression: Provide Access for Physical Action.
Provide access to tools and assistive technologies such as the digital applet.

Supports accessibility for: Visual-Spatial Processing, Conceptual Processing, Organization

Student Workbook



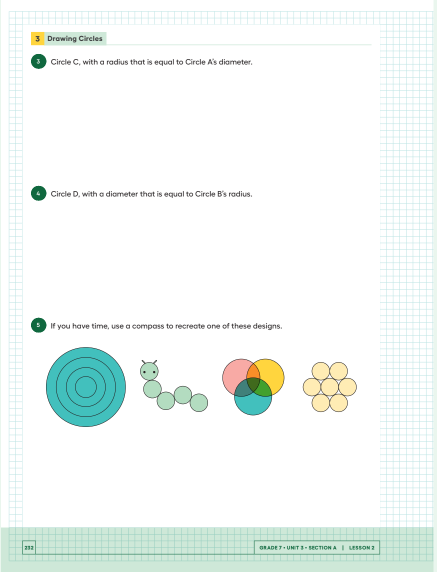
3 Drawing Circles

Draw and label each circle.

1 Circle A, with a diameter of 6 cm.

2 Circle B, with a radius of 5 cm.
Pause here so your teacher can review your work.

Student Workbook


3 Drawing Circles

3 Circle C, with a radius that is equal to Circle A's diameter.

4 Circle D, with a diameter that is equal to Circle B's radius.

5 If you have time, use a compass to recreate one of these designs.

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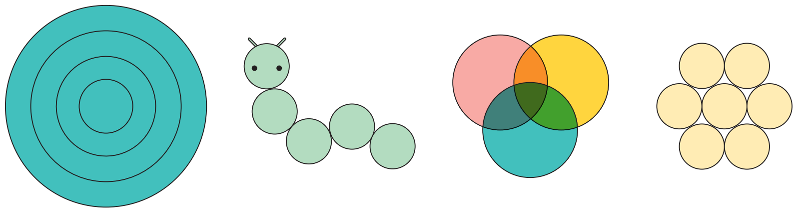
4. Circle D, with a diameter that is equal to Circle B's radius.

Answers vary.

5. If you have time, use a compass to recreate one of these designs.

Images should look like (or almost like) the images given.



Building on Student Thinking

Some students might think that they need a protractor to draw a circle. Allow them access to one. They may trace the outline of the protractor twice with tracings of straight sides coinciding. Ask them whether their traced shape meets all of the characteristics of a circle that were listed in the previous activity.

When students start using the compasses, they may draw a circle with a radius of 6 cm instead of a diameter of 6 cm for Circle A. Remind them what "diameter" means and ask them to measure the diameter of their circle. When they realize that it is incorrect for Circle A, tell them not to erase it yet. They might realize later that this is the answer for Circle C.

When recreating the given designs, students might struggle to know where to place their compasses. For the first design, the non-pencil end of the compass stays in the same place the whole time. For the second, third, and fourth designs, guide students to think about where to put the non-pencil end so that the circles will end up where they should go. For the second and fourth design, they should line up the pencil end of the compass on a point on the circle(s) they have already drawn. Similarly for the third design, students should line up the non-pencil end of the compass on a point of the circle(s) they have already drawn.

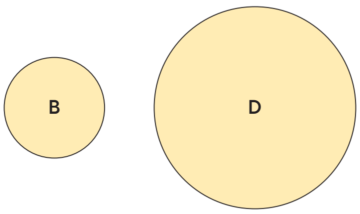
Activity Synthesis

The main goal for this discussion is to reinforce the relationship between radius and diameter. Ask selected students to share their strategies for drawing Circles C and D. Highlight the relationship that $d \div 2 = r$ for diameter d and radius r after each.

Use *Critique, Correct, Clarify* to give students an opportunity to improve a sample written response for Circle D by correcting errors, clarifying meaning, and adding details.

- Display this first draft:

"Circle D should be bigger than Circle B because diameters are bigger than radii."



Ask,

“What parts of this response are unclear, incorrect, or incomplete?”

As students respond, annotate the display with 2–3 ideas to indicate the parts of the writing that could use improvement.

- Give students 2–4 minutes to work with a partner to revise the first draft.
- Select 1–2 individuals or groups to read their revised draft aloud slowly enough to record for all to see. Scribe as each student shares, and then invite the whole class to contribute additional language and edits to make the final draft even more clear and more convincing.

If time permits, display students’ recreations of the designs from the last question.

- Looking at the first design, ask

“What is the same about all of these circles? What is different?”

They all have the same center, but different radii, diameters, and circumferences.

- Looking at the second, third, or fourth design, ask

“What is the same about all of these circles? What is different?”

For the circles in each design, they all have the same radius, diameter, and circumference, but different centers.

Lesson Synthesis

Share with students:

“Today we clarified what a circle really is. We also talked about different ways to measure circles.”

To review the new vocabulary, consider asking students:

“What is a circle?”

all the points that are the same distance from a center point

“What is radius?”

the distance from the center to any point on the circle

“What is diameter?”

the distance across the circle, going through the center

“What is the relationship between radius and diameter?”

For any circle, the diameter is always twice the length of the radius.

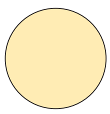
“What is circumference?”

the perimeter of the circle

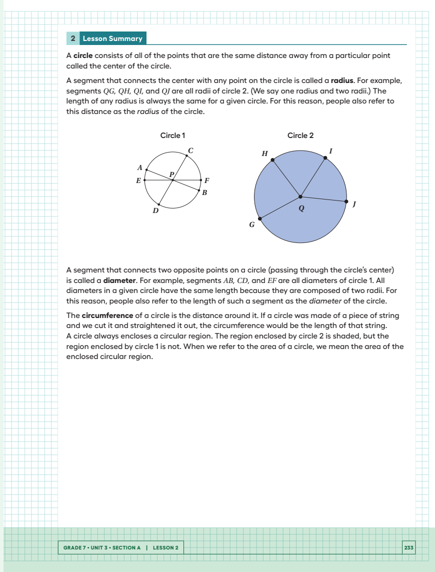
“What tool is useful for drawing circles?”

a compass

If desired, use this example to review the fact that the circular region enclosed by a circle is not actually a part of the circle itself.



Student Workbook



"What color is this circle?"

black, because the circle is just the points along the edge

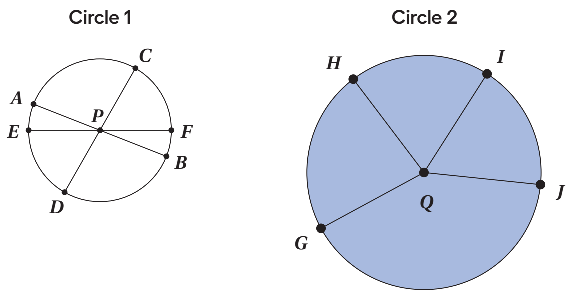
"Why is the area that is shaded yellow not actually a part of the circle?"

Those points are closer to the center of the circle than the black edge is.

Lesson Summary

A **circle** consists of all of the points that are the same distance away from a particular point called the *center* of the circle.

A segment that connects the center with any point on the circle is called a **radius**. For example, segments QG, QH, QI, and QJ are all radii of Circle 2. (We say one radius and two radii.) The length of any radius is always the same for a given circle. For this reason, people also refer to this distance as the *radius* of the circle.



A segment that connects two opposite points on a circle (passing through the circle's center) is called a **diameter**. For example, segments AB, CD, and EF are all diameters of Circle 1. All diameters in a given circle have the same length because they are composed of two radii. For this reason, people also refer to the length of such a segment as the *diameter* of the circle.

The **circumference** of a circle is the distance around it. If a circle was made of a piece of string and we cut it and straightened it out, the circumference would be the length of that string. A circle always encloses a circular region. The region enclosed by Circle 2 is shaded, but the region enclosed by Circle 1 is not. When we refer to the area of a circle, we mean the area of the enclosed circular region.

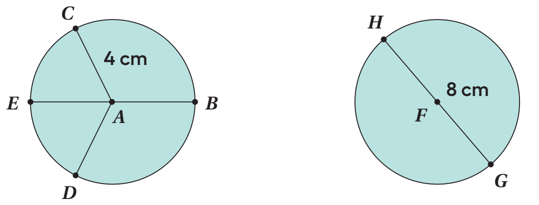
Cool-down

Comparing Circles

5 min

Student Task Statement

Here are two circles. Their centers are A and F.



1. What is the same about the two circles? What is different?

   Because they are both circles, they are both round figures, without corners or straight sides, enclosing a two-dimensional region, that are the same distance across (through the center) in every direction. Both circles are the same size. They have the same diameter, radius, and circumference. The only difference is which additional segments (radii) are drawn.

2. What is the length of segment AD? How do you know?

   Segment AD is 4 cm long because it is also a radius of the circle.

3. On the first circle, what segment is a diameter? How long is it?

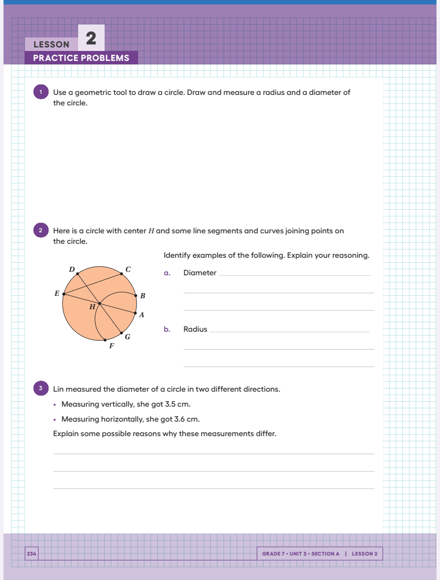
   The diameter, segment EB, is 8 cm long.

Responding To Student Thinking

Points to Emphasize
If students struggle with identifying radius and diameter, revisit the vocabulary when opportunities arise over the next several lessons. For example, make sure to invite multiple students to share their thinking about how they solved the problem in this activity:

Unit 3, Lesson 4, Activity 2 Hopi Basket Weaving

Student Workbook



LESSON 2
PRACTICE PROBLEMS

1 Use a geometric tool to draw a circle. Draw and measure a radius and a diameter of the circle.

2 Here is a circle with center H and some line segments and curves joining points on the circle.

Identify examples of the following. Explain your reasoning.

a. Diameter

b. Radius

3 Lin measured the diameter of a circle in two different directions.

- Measuring vertically, she got 3.5 cm.
- Measuring horizontally, she got 3.6 cm.

Explain some possible reasons why these measurements differ.

GRADE 7 • UNIT 3 • SECTION A | LESSON 2

Lesson 2

Practice Problems

5 Problems

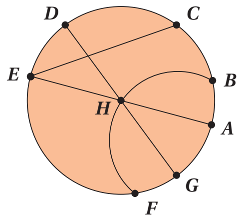
Problem 1

Use a geometric tool to draw a circle. Draw and measure a radius and a diameter of the circle.

Answers vary.

Problem 2

Here is a circle with center H and some line segments and curves joining points on the circle.



Identify examples of the following. Explain your reasoning.

a. Diameter

Segments AE and DG

They are line segments that go through the center of the circle with endpoints on the circle.

b. Radius

Segments AH, DH, EH, and GH

They are line segments that go from the center to the circle.

Problem 3

Lin measured the diameter of a circle in two different directions.

- Measuring vertically, she got 3.5 cm.
- Measuring horizontally, she got 3.6 cm.

Explain some possible reasons why these measurements differ.

Two diameters of a circle should have the same length.

Sample reasoning:

- These measurements could be rounded, not exact.
- The thickness of the circle could have affected the measurements.
- Lin did not measure across the widest part when measuring vertically.
- The shape is not quite a circle, because a perfect circle is very hard to draw.

Problem 4

from Unit 2, Lesson 1

A small batch of lemonade used $\frac{1}{4}$ cup of sugar added to 1 cup of water and $\frac{1}{4}$ cup of lemon juice. A larger batch is going to be made using 10 cups of water. How much sugar should be added so that the large batch tastes the same as the small batch?

2.5 cups of sugar, the larger batch is 10 times larger (for the water $10 \div 1 = 10$) and $10 \cdot \frac{1}{4} = 2.5$

Problem 5

from Unit 2, Lesson 13

The graph of a proportional relationship contains the point (3, 12). What is the constant of proportionality of the relationship?

4

Student Workbook

2 Practice Problems

4 from Unit 2, Lesson 1

A small batch of lemonade used $\frac{1}{4}$ cup of sugar added to 1 cup of water and $\frac{1}{4}$ cup of lemon juice. A larger batch is going to be made using 10 cups of water. How much sugar should be added so that the large batch tastes the same as the small batch?

5 from Unit 2, Lesson 13

The graph of a proportional relationship contains the point (3, 12). What is the constant of proportionality of the relationship?

Learning Targets

+ I can describe the characteristics that make a shape a circle.
+ I can identify the diameter, center, radius, and circumference of a circle.