3·5 Using a Compass

Objectives To review compass skills and explore angles formed by intersecting lines.

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1 Teaching the Lesson

Key Concepts and Skills

- Investigate vertical, opposite, and adjacent angles. [Geometry Goal 1]
- Use angle relationships to determine angle measures. [Geometry Goal 1]
- Copy, measure, and construct line segments using a compass, straightedge, and ruler. [Measurement and Reference Frames Goal 1]
- Explore the relationship between radius and diameter measurements. [Measurement and Reference Frames Goal 2]

Key Activities

Students use a compass to draw circles, copy line segments, and estimate lengths. They measure vertical and adjacent angles formed by intersecting lines.

Ongoing Assessment: Recognizing Student Achievement
Use Mental Math and Reflexes. [Operations and Computation Goal 2]

Ongoing Assessment: Informing Instruction See page 180.

Key Vocabulary

radius ◆ diameter ◆ vertical (or opposite) angles ◆ adjacent angles

Materials

Math Journal 1, pp. 72 and 73
Student Reference Book, pp. 139, 164, and 165 (optional)
Study Link 3•4
Geometry Template ◆ compass ◆ one 2 ft by 2 ft sheet of paper ◆ chalk ◆ per partnership: 5 ft length of string or rope ◆ ruler

2 Ongoing Learning & Practice

Playing *High Number Toss: Decimal Version*

Student Reference Book, pp. 32, 33, and 321
Math Masters, p. 511
per partnership: 4 each of number cards 0–9 (from the Everything Math Deck, if available)
Students practice reading, writing, and comparing decimals.

Math Boxes 3•5

Math Journal 1, p. 74
Students practice and maintain skills through Math Box problems.

Study Link 3•5

Math Masters, p. 83
Students practice and maintain skills through Study Link activities.

3 Differentiation Options

READINESS

Reading a Ruler

Math Masters, p. 84
ruler
Students review the divisions and marks on an inch ruler and measure line segments.

ENRICHMENT

Inscribing a Regular Hexagon in a Circle

Student Reference Book, p. 168
Math Masters, p. 85
compass ◆ straightedge ◆ crayons or colored pencils
Students inscribe a regular hexagon in a circle, reproduce a design, and make their own designs.

ELL SUPPORT

Building a Math Word Bank

Differentiation Handbook, p. 142
Students add the terms *radius* and *diameter* to their Math Word Banks.

Advance Preparation

For Part 1, prepare a 2 ft by 2 ft square of paper and prearrange playground use for the students' large compass drawings.

***Teacher's Reference Manual,* Grades 4–6** pp. 43, 209–211

Getting Started

Mathematical Practices
SMP2, SMP3, **SMP5,** SMP6, **SMP7,** SMP8
Content Standards
5.NBT.2, 5.NBT.3b

Mental Math and Reflexes ★

FACTS PRACTICE

Use slate procedures and write all problems on the board or Class Data Pad so students can visually recognize the patterns.

●○○ 7 ∗ 8 56
70 ∗ 8 560
70 ∗ 80 5,600
700 ∗ 80 56,000

●●○ 42 ÷ 7 6
420 ÷ 7 60
4,200 ÷ 7 600
42,000 ÷ 7 6,000

●●● 560 ÷ 70 8
5,600 ÷ 700 8
56,000 ÷ 7,000 8

Math Message

Draw the largest and the smallest circle you can draw with your compass. What is the radius of the largest circle?

Study Link 3•4 Follow-Up

Allow students five minutes to compare their answers and resolve any differences.
Survey students for important things to remember when measuring with the half-circle or full-circle protractors.

Ongoing Assessment: Recognizing Student Achievement

Mental Math and Reflexes ★

Use the **Mental Math and Reflexes problem sets** to assess students' ability to solve extended multiplication facts mentally. Students are making adequate progress if they correctly respond to the multiplication problems. Some students may also be successful with the division problems.

[Operations and Computation Goal 2]

1 Teaching the Lesson

Math Message Follow-Up

WHOLE-CLASS ACTIVITY
ELL

Review the following definitions. To support English language learners, write the definitions along with labeled drawings on the board or Class Data Pad.

- The **radius** of a circle is any line segment from the center of the circle to any point on the circle.
- The **diameter** of a circle is any line segment that passes through the center of the circle and has its endpoints on the circle.
- In any circle, the length of a diameter is twice the length of a radius.
- *Radius* and *diameter* are also used to name length. For example, the radius of the circle is 2 inches and the diameter is 4 inches. Ask volunteers to use these terms to explain their solution strategies.

Adjusting the Activity

Have students review and practice the two methods for drawing circles explained on *Student Reference Book,* page 164.

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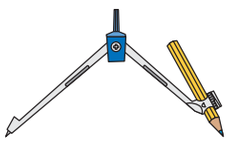
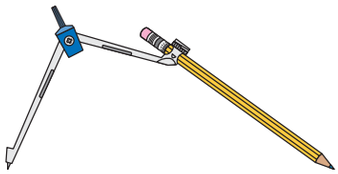
Demonstrate how to obtain a larger separation by adjusting the compass pencil. Clamp a full-length pencil in the compass with the eraser as close to the clamp as possible. (*See below.*) Then open the compass to its largest separation, and draw a very large circle on the 2 ft by 2 ft sheet of paper. This adjustment allows you to draw a circle with an 8-inch radius (16-inch diameter), even with a small compass.



Normal use

For drawing small arcs and circles



For drawing large arcs and circles

Adjusting the Activity

ELL

Ask partners to explore drawing large and small circles on the school playground or sidewalk using string and chalk. This activity provides an opportunity for students to physically experience the roles of the compass anchor and the pencil point and reinforces the importance of keeping the anchor and the clamped pencil in set positions as students draw.

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Copying Line Segments

PARTNER ACTIVITY

(*Math Journal 1,* p. 72)

Ask volunteers to explain the difference between a ruler and a straightedge.

- A ruler has a scale along at least one edge and is used to measure lengths.
- A straightedge is a tool for drawing straight lines but is not used for measuring.
- A ruler can be used as a straightedge, even when you're not using it to measure something.

Assign partners to complete Problems 1 and 2 on the journal page. Circulate and assist.

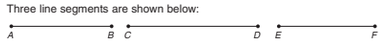
Student Page

Date Time

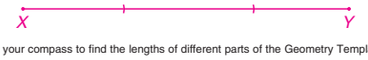
LESSON 3•5 **Copying Line Segments and Finding Lengths**

1. Use your compass and straightedge to copy line segment $\overline{AB}$. Do not measure the line segment with a ruler. Label the endpoints of the new line segment as points *M* and *N*. Line segment $\overline{MN}$ should be the same length as line segment $\overline{AB}$.

2. Three line segments are shown below:



Use your compass and straightedge. Construct one line segment that is as long as the three segments joined together end to end. Label the two endpoints of the long line segment *X* and *Y*.



Use your compass to find the lengths of different parts of the Geometry Template.

Example: Find the length of the longer side of the rectangle on the Geometry Template.

Step 1 Open the compass to the length of the longer side.

Step 2 Don't change the opening on your compass. Hold the compass against the inch ruler with the anchor at 0. Read the length. The length is about 1 inch.

3. The length of the longer side of the trapezoid is about 1 inch(es).

4. The diameter of the full-circle protractor is about 2 inch(es).

5. The distance between the center of the full-circle protractor and the center of the Percent Circle is about $4\frac{3}{4}$ inch(es).

6. Use your compass and a ruler to find two other lengths. Be sure to include units.

Part Measured	Length

Math Journal 1, p. 72

Student Page

Date Time

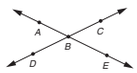
LESSON 3·5

Adjacent and Vertical Angles

Angles that are "next to" each other are called **adjacent angles.** Adjacent angles have the same vertex and a common side.

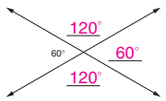
When two lines intersect, four angles are formed. The angles opposite each other are called **vertical angles** or **opposite angles.**

1. a. Angles *ABD* and *CBE* are vertical angles. Name another pair of vertical angles.
∠*ABC* and ∠*DBE*



b. Angles *ABC* and *CBE* are adjacent angles. Name two other pairs of adjacent angles.
Sample answers: ∠*CBE* and ∠*EBD*; ∠*DBA* and ∠*ABC*

2. The two lines at the right intersect to form four angles. One angle has been measured. Use your full-circle protractor to measure the other three angles. Record your measurements on the drawing.



3. On a blank sheet of paper, draw two lines that intersect. Measure the four angles. Record the measures on your drawing. Answers vary.

4. What do you notice about the measures of pairs of vertical angles?
Sample answer: They are the same.

5. What do you notice about the measures of pairs of adjacent angles?
Sample answer: They total 180°.

Try This

6. For any pair of adjacent angles formed by two intersecting lines, the sum of the measures is always 180°. Explain why. Sample answer: The adjacent angles form a straight angle, which always measures 180°.

***Math Journal 1*, p. 73**

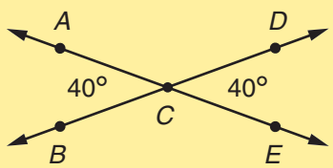


Figure 1

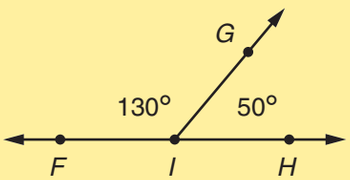


Figure 2

Students might benefit from reviewing the procedure for copying a line segment on page 165 of the *Student Reference Book*. The construction for Problem 2 can be done by following two steps. Draw a line segment that is longer than the three line segments arranged end to end. Then copy each of the three line segments onto the longer line segment, end to end.

Finding Lengths with a Compass

PARTNER ACTIVITY

(*Math Journal 1,* p. 72)

For Problems 3–6 on the journal page, students measure lengths and distances with a compass and a ruler. Work through the example with the class and make sure students understand what they are to do. Each measurement is a two-step operation.

1. Set the compass opening to the length that will be measured.
2. Hold the compass against the inch ruler with the anchor at 0. Measure the length of the compass opening. This is the desired length.

Circulate and assist.

Ongoing Assessment: Informing Instruction

Watch for students who solve the problems by measuring. Emphasize that they should use their rulers only as straightedges for these problems.

Measuring Angles Formed by Intersecting Lines

PARTNER ACTIVITY

(*Math Journal 1,* p. 73)

Have students work with partners to complete the journal page. Circulate and assist.

Bring the class together to share results. Survey the class for true statements about the angles formed by two intersecting lines. When two lines intersect, the measures of the angles opposite each other are equal and are called **vertical** or **opposite angles** (*See Figure 1*); angles that are next to each other and have a common side are called **adjacent angles.** (*See Figure 2.*)

For Problem 6, point out that when two lines intersect, the sum of the measures of two adjacent angles is 180°. Ask students how they might confirm this without measuring the angles. When two lines intersect, two adjacent angles form a straight angle, and the measure of a straight angle is 180°.

To review *parallel* and *perpendicular lines,* ask students to identify examples of parallel and perpendicular lines found in the classroom. Write students' responses on the board.

Adjusting the Activity

Discuss the example of angles formed by intersecting lines on page 139 of the *Student Reference Book* and the Check Your Understanding problems.

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2 Ongoing Learning & Practice

Playing *High Number Toss: Decimal Version*

PARTNER ACTIVITY

(*Student Reference Book,* pp. 32, 33, and 321; *Math Masters,* p. 511)

High Number Toss: Decimal Version provides students with the opportunity to apply their knowledge of place value and standard notation to form, write, read, and compare decimals. Provide students with a reminder box on the board noting that < means *is less than* and > means *is greater than.*

After each round, ask students to record the decimals they formed on *Math Masters,* page 511, and use <, >, and = to compare them. If necessary, refer students to *Student Reference Book,* pages 32 and 33 to review comparing decimals.

Math Boxes 3•5

INDEPENDENT ACTIVITY

(*Math Journal 1,* p. 74)

Mixed Practice Math Boxes in this lesson are paired with Math Boxes in Lesson 3-7. The skills in Problems 5 and 6 preview Unit 4 content.

Writing/Reasoning Have students write a response to the following: *In Problem 5, will there be an even or an odd number of factors?* Sample answer: There will be an even number of factors because 48 is not a square number.

Study Link 3•5

INDEPENDENT ACTIVITY

(*Math Masters,* p. 83)

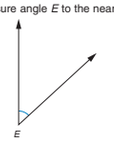
Home Connection Students identify acute, obtuse, right, vertical (or opposite), and adjacent angles. They measure the angles in a triangle.

Student Page

Date Time

LESSON 3•5 **Math Boxes**

1. Measure angle *E* to the nearest degree.



The measure of angle *E* is about 47°.

2. Key: ☆ = 1 day absent

Student	Days Absent
Lucca	☆ ☆
Marissa	☆ ☆ ☆
Chandler	☆
Emma	☆ ☆ ☆ ☆

a. Who was absent the most? Emma

b. Who was absent two days? Lucca

c. How many days was Chandler absent? 1 day

d. Was any student absent more than five days? No

3. Round 14.762 to the nearest ...

tenth. 14.8

whole number. 15

hundredth. 14.76

4. Complete each pattern.

25, 43, 61, 79, 97

87, 65, 43, 21, –1

21, 35, 49, 63, 77

64, 56, 48, 40, 32, 24

61, 66, 71, 76, 81, 86

5. List all the factors of 48.

1, 2, 3, 4, 6, 8, 12, 16, 24, 48

6. Write the prime factorization for 54.

2 * 3 * 3 * 3

Math Journal 1, p. 74

Study Link Master

Name Date Time

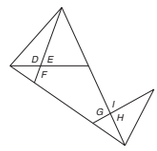
STUDY LINK 3•5 **Angles in Figures**

Circle *acute, right,* or *obtuse* for each angle in triangle *ABC*. Then measure each angle.

1. ∠*ABC* (acute) right obtuse m∠*ABC* = 12°
2. ∠*CAB* (acute) right obtuse m∠*CAB* = 65°
3. ∠*BCA* acute right (obtuse) m∠*BCA* = 103°

Use the figure at the right to do Problems 4–6. Sample answers:

4. Name a pair of adjacent angles. ∠*D* and ∠*E*
5. Name a pair of vertical angles. ∠*D* and ∠*F*
6. Name a pair of opposite angles. ∠*G* and ∠*H*



Practice

7. 7,568 + 9,217 = 16,785
8. 415 − 207 = 208
9. 326 * 45 = 14,670
10. 68 ÷ 4 = 17
11. 78 ÷ 7 → 11 R1

Math Masters, p. 83

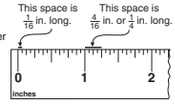
Teaching Master

Name Date Time

LESSON 3·5 **Reading a Ruler**

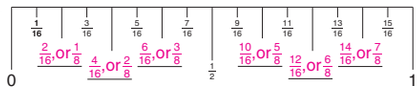
On rulers, inches are usually divided into halves, quarters, eighths, and sixteenths with marks that are different sizes. There are different ways to name a length. Look at the ruler to the right and give two other names for $\frac{1}{2}$ inch.

$\frac{2}{4}$ in., or $\frac{4}{8}$ in.



Fill in the blank spaces on each ruler. Identify these marks on your ruler.

1.



Scale: 6 inches represents 1 inch

2.

Scale: 3 inches represents 1 inch

Use your ruler to measure the line segments. Give two names for each line segment.

3. $1\frac{1}{4}$ in. $1\frac{2}{8}$ in.

4. $1\frac{7}{8}$ in. $1\frac{14}{16}$ in.

Use the ruler pictured to determine the length of the line segment. Give two names for the length of the line segment.

5. $1\frac{3}{4}$ in. $1\frac{6}{8}$ in., or $1\frac{12}{16}$ in.

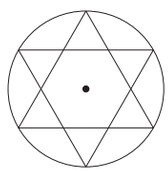
Math Masters, p. 84

Teaching Master

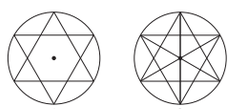
Name Date Time

LESSON 3·5 **Designs with a Compass and a Straightedge**

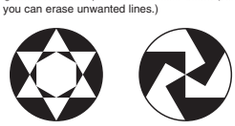
If you know how to inscribe a hexagon in a circle, you can make a 6-pointed star, or **hexagram,** inside a circle.



1. On a separate piece of paper, make a 6-pointed star. (*Hint:* Mark the circle as you do for a hexagon. Connect every other mark.)
2. Divide the angles of your star in half as shown below.



3. Color your design in some pattern.
4. Reproduce the following designs, using a compass and a straightedge to draw hexagons and hexagrams. Then find patterns and color them. (*Hint:* Use a pencil and draw lightly so you can erase unwanted lines.)



Math Masters, p. 85

3 Differentiation Options

READINESS

INDEPENDENT ACTIVITY

15–30 Min

Reading a Ruler

(*Math Masters,* p. 84)

To explore measuring with a ruler, have students find equivalent measures and measure line segments in different ways. When students have finished the page, discuss how they solved Problem 5.

ENRICHMENT

INDEPENDENT ACTIVITY

15–30 Min

Inscribing a Regular Hexagon in a Circle

(*Student Reference Book,* p. 168; *Math Masters,* p. 85)

Art Link To further explore straight-edge constructions, have students follow the steps on page 168 of the *Student Reference Book* to inscribe a regular hexagon in a circle. Then follow the directions to complete *Math Masters,* page 85. Invite students to create their own designs with inscribed hexagons, hexagrams, and coloring patterns for display in the classroom.

Portfolio Ideas

ELL SUPPORT

SMALL-GROUP ACTIVITY

30+ Min

Building a Math Word Bank

(*Differentiation Handbook,* p. 142)

To provide language support for properties of circles, have students use the Word Bank Template found on *Differentiation Handbook,* page 142. Ask students to write the terms *diameter* and *radius,* draw pictures relating to each term, and write other related words. See the *Differentiation Handbook* for more information.

Name Date Time

High-Number Toss: Decimal Version Record Sheet

Circle the winning number for each round. Fill in the Score column each time you have the winning number.

Player 1 _____ (Name) **Player 2** _____ (Name)

Round	Player 1	<, >, =	Player 2	Score
Sample	0. 6 5 4	<	0. 7 5 3	0.753 − 0.654 0.099
1	0.___ ___ ___		0.___ ___ ___	
2	0.___ ___ ___		0.___ ___ ___	
3	0.___ ___ ___		0.___ ___ ___	
4	0.___ ___ ___		0.___ ___ ___	
5	0.___ ___ ___		0.___ ___ ___	
			Total Score	