LESSON

Naming Angles

An **angle** is formed when 2 lines meet.

You can think of an angle as a turn about a vertex. The angle shows how far one **arm** is turned to get to the other arm.

The hour hand and the minute hand on a clock form an angle at the centre of the clock. What angle is formed by the hands on this clock?





You will need a drinking straw and grid paper.

To make an angle:

- Place the straw horizontally on the grid paper.
- Trace the bottom edge of the straw to make one arm.
- Use one end of the straw as the point of rotation. Rotate the straw.
- Trace the bottom edge of the rotated straw to make the other arm.
- ► Rotate the straw. Draw each angle:
 - a right angle
 - an angle less than a right angle
 - an angle greater than a right angle
- Trade drawings with another pair of students.
 Find a way to check their angles.

Show and Share

Compare the strategies you used to check the angles. Which strategy worked best? Did the length of the lines you drew affect the size of the angle?



Right angles and **straight angles** are all around us.



We name angles for the way they relate to a right angle or a straight angle.

An **acute angle** is less than a right angle.

Connect

An **obtuse angle** is greater than a right angle, but less than a straight angle. A **reflex angle** is greater than a straight angle.





Practice

Use a piece of paper with a square corner when it helps.

1. Which angle is an acute angle? A right angle? An obtuse angle? A straight angle? A reflex angle?



2. Name each angle as a right angle, an acute angle, an obtuse angle, a straight angle, or a reflex angle. How did you find out?



- 3. Your teacher will give you a large copy of these flags. List the flags with:
 - a) a right angle

b) an acute angle

c) an obtuse angle

- d) a reflex angle
- On each flag, label an example of each type of angle you find.



4. Draw a line segment on grid paper.

Visualize rotating the line segment about one of its end points.

Which type of angle is formed by each rotation?

- **a)** $a\frac{1}{2}$ turn
- **b**) $a\frac{1}{4}$ turn clockwise

c) a $\frac{3}{4}$ turn counterclockwise

Use tracing paper to check.

- 5. a) For each time below, which type of angle is formed by the hour hand and minute hand on a clock? How did you find out?
 - i) 2:15
 - **ii)** 3:35
 - iii) 9:00
 - iv) 12:30
 - **v)** 1:45
 - b) Would the size of each angle change if the minute hand was shorter? Justify your answer.



Steam Clock, Gastown, Vancouver



- 6. Find 5 angles in your classroom. Try to find one example of a right angle, an acute angle, an obtuse angle, a straight angle, and a reflex angle. Sketch each angle. Write where you found each angle, then label the angle with its name. How did you decide how to name each angle? Which angle was easiest to find? Why do you think so?
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- 7. Use square dot paper.

How many different angles can you draw on a 3-by-3 grid? Classify the angles. Show your work.

Reflect

When you see an angle, how can you tell which type of angle it is? How many ways can you find out? Use words and pictures to explain.

LESSON

Exploring Angles

These angles are both acute. Describe the angles.



Explore

You will need Pattern Blocks, an index card, a ruler, and scissors.

- Use a ruler to draw an acute angle on the card. Cut out the angle.
- Use the cutout as a unit of angle measure. Choose the green triangle. Estimate how many times your angle unit will fit in each of its angles. Measure each angle of the green triangle with your angle unit.

Record your measure in a table.

Repeat with each of the other Pattern Blocks.





Show and Share

Compare your angle measures with those of another pair of students. Did you get the same measures for the same block? Explain. What could you do so everyone does get the same measures for the same block? We can use a square piece of tracing paper or wax paper to make an angle measurer. The angle measurer is called a **protractor**.

Carefully fold the paper in half and make a crease along the fold.
 Fold the paper in half again so the folded edges meet. Make a crease.
 Fold in this way one more time. Cut or tear as shown.



1 fold

Connect

2 folds 3 folds

Open up the paper. It should look like this:



The protractor is divided into 8 equal slices. Each slice is 1 unit of angle measure. Label the slices from 0 to 7 clockwise and counterclockwise.

> To measure this angle, count how many units fit the angle:

- Place the protractor on the angle.
- Line up one arm of the angle with the base line of the protractor.

The vertex of the angle is at the centre of the base line.

• Use the scale, starting at 0, to count the units that fit between the arms.

The angle is between 1 unit and 2 units. The angle is about 1.5 units. vertex



Practice

You will need an 8-unit protractor.

- 1. Use your protractor to measure the angles in:
 - a) the yellow hexagon b) the by the b
- b) the blue rhombuse) the green triangle
 - d) the orange square

- c) the red trapezoid
- f) the tan parallelogram

 Use your protractor to measure each angle below. Record the measures.



3. Use your protractor to measure the angles in each polygon below. Record the measures.



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4. Use a ruler. Draw an angle.Use the protractor to measure the angle.Explain how you did it. Show your work.

- 5. How many units will fit in each angle below?
 - a) a right angle b) a straight angle
 - c) a reflex angle d) an angle one-half the size of a right angle

For which angle were you able to find more than one answer? Explain.

Reflect

You have used two different angle measurers in this lesson. What are the advantages and disadvantages of each angle measurer? Which angle measurer do you prefer? Justify your choice.



Measuring Angles

In Lesson 2, you used an 8-unit protractor to measure angles. To measure angles more accurately, we use a **standard protractor**. The standard protractor divides a straight angle into 180 congruent slices. Each slice is 1 **degree**. We write 1°. The protractor shows angle measures from 0° to 180°. From now on, we will refer to a standard protractor as a protractor.



What is the measure of each angle?





You will need a ruler.

- ► Use a ruler to draw an angle.
- ► Have your partner:
 - use the 45°, 90°, and 180° angles above as reference angles to estimate the size of the angle
 - record the estimate
- Trade roles. Continue until you have 6 different angles. Try to make angles that are acute, right, and obtuse.
- Order the estimates from least to greatest.

Show and Share

Share your work with another pair of students. How did you estimate the size of each angle? How did the estimate of one angle help you estimate the measure of another angle?

Connect

A protractor has 2 scales so that we can measure angles opening different ways.

> To measure this angle using a protractor:

Step 1

Place the protractor on top of the angle. The vertex of the angle is at the centre of the protractor. One arm of the angle lines up with the base line of the protractor.

Step 2

Find where the other arm of the angle meets the protractor. Since the arm along the base line passes through 0° on the inner scale, use the inner scale. Follow the inner scale around. The angle measures 60°.

 This diagram shows when you would use the outer scale to measure an angle.







Since the arm along the base line of this angle passes through 0° on the outer scale, use the outer scale. The angle measures 120°. We can use a protractor to measure this reflex angle. A reflex angle is the outside angle of an acute, right, or obtuse angle.

Step 1

Use the protractor to measure the inside angle. The inside angle measures 135°.

Step 2

A complete turn is 360°.



To find the measure of the reflex angle, we subtract: $360^{\circ} - 135^{\circ} = 225^{\circ}$



► We name angles according to their measures in degrees.

The measure of an **acute angle** is less than 90°.

The measure of a **right angle** is 90°.

The measure of an **obtuse angle** is between 90° and 180°.



The measure of a **straight angle** is 180°.

The measure of a **reflex angle** is between 180° and 360°.



The measure of one-half a right angle is 45°.



To estimate the measure of an angle, we can use 45°, 90°, and 180° as reference angles.

Practice

1. What is the measure of each angle? Explain how you know.



- 2. For each angle:
 - Choose an appropriate reference angle: 45°, 90°, 180° Estimate the size of the angle.
 - Use a protractor to find the angle measure. How close was your estimate to the actual measure? Explain.
 - Name each angle as acute, right, obtuse, or straight.



3. Which of these angles do you think measures 45°? Check your estimates with a protractor. What did you find out?



4. Measure each angle.

Do the angles in each pair have the same measure?



Do the lengths of the arms affect the measure of the angle? Explain. Does the position of the angle affect the measure? Explain.

- 5. How can you tell whether you used the correct scale on the protractor to measure an angle? Include an example in your explanation.
- **6.** Use a protractor to find the measure of each reflex angle. How can you check that your measure is correct?



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- 7. Use a protractor to solve each riddle.



- a) I have 4 equal angles.
 Each angle measures 90°.
 Which letter am I?
- b) I do not have any angles that measure 90°.
 I have 3 angles that measure 60°.

I have 2 angles that measure 120°. Which letter am I?

- c) I have 2 right angles.I have 1 acute angle.I have 1 obtuse angle.Which letter am I?
- d) Make up your own letter riddle. Trade riddles with a classmate. Solve your classmate's riddle.
- 8. Name 4 objects in your classroom that have:
 - a) an angle greater than 100°
 - **b**) an angle less than 60°
 - Use a protractor to check your answers.
- A student measured this angle and said it measured 60°. Do you agree? Explain.







How can you use a piece of paper to help estimate the measure of an angle? Look around your home for examples of angles with different sizes. Sketch each angle and estimate its measure.

At Home

LESSON

Drawing Angles

Without using a protractor, how could you draw a 90° angle? A 45° angle? A 135° angle?



You will need a ruler and a protractor.

Angle Aim!

The object of the game is to draw angles as close as possible to the given measures. Decide who will be Player A and Player B.

- Player A writes an angle measure. Without using a protractor, Player B draws an angle as close as possible to Player A's measure. Players switch roles and repeat the activity.
- Players measure each other's angle.
 The player whose angle is closer to the stated measure gets 1 point.
- > Players play 4 more rounds. The player with more points after 5 rounds wins.



Game

Show and Share

Share the strategies you used to draw your angles with your partner. How did you use estimation to help you draw the angles? How could you draw the angles more accurately?

Connect

To draw an angle with a given measure, we use a ruler and a protractor.

- ► To draw an angle that measures 145°:
 - Use a ruler. Draw a horizontal line. Use the line as one arm of the angle.
 - Place the protractor on the arm. One end of the arm is at the centre of the protractor.

The arm lines up with the base line of the protractor. Start at 0° on the arm along the base line. Count around the protractor until you reach 145°.

Make a mark at 145°.



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base line

You can measure from 0° to 180° clockwise or counterclockwise. Remember to start at 0° when you draw an angle.

- Remove the protractor. Draw a line to join the end of the arm at the centre of the protractor with the mark at 145°. Label the angle with its measure.
- ► To draw an angle that measures 280°:

A 280° angle is a reflex angle.

So, draw the angle that makes up a complete turn: $360^{\circ} - 280^{\circ} = 80^{\circ}$ Then, 280° is the outside angle.



 $280^{\circ} + 80^{\circ} = 360^{\circ}$

Practice

1.	Use a ruler and a p Draw an acute and a) 20°	protractor. gle with each r b) 15°	neasure. c)	75°	d) 50°	
2.	Use a ruler and a p Draw an obtuse ar a) 120°	protractor. ngle with each b) 155°	measure. c)	95°	d) 170°	
3.	 Use a ruler and a p Draw a horizontal Each angle you dra a) Using AB as on b) Use the line you of another ang c) Use the line you of another ang Draw a 105° an d) Without using a of the angle for and the line you how did you find 	protractor. line segment a aw should hav e arm, draw a u drew in part le. Draw a 55° a u drew in part le. gle. a protractor, fin med by the he u drew in part nd out? Measu	AB. e its verte 70° angle. a as one a angle. b as one a nd the me orizontal l c. re to chec	ex at A. arm arm asure ine ck.		
4.	Use only a ruler to a) 90° b) a little less than c) about 45° d) a little more that e) a little less than How can you check Show your work.	draw an angle n 90° an 90° n 180° k to see if you	e that you are correc	think mea	asures:	
	 Copy these line Using each line Label each ang How did you de a) 	e segments. Us as one arm, d le with its mea ecide which sc b) —	e a ruler a raw a 50° asure. ale to use c)	nd a proti angle. ?	ractor. d)	
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6. Use a ruler and a protractor.

Draw an angle with each measure.

a) 205°	b) 200°	c) 270°
d) 320°	e) 350°	f) 300°

- 7. Draw an acute angle. Without using a protractor, draw an angle that is 90° greater than the angle you drew.
 Measure the angle with a protractor to check. Explain how you drew the angle.
- 8. a) Without using a protractor, draw a 90° angle. How can you use this angle to draw a 180° angle? How are the two angles related?
 - b) Without using a protractor, draw a 180° angle.How can you use this angle to draw a 90° angle?A 45° angle?How are the three angles related?
 - Show your work.
- 9. a) Draw an obtuse angle.Use a protractor to find its measure.Label the angle with its measure.
 - b) Use tracing paper to copy the angle. Rotate the angle $\frac{1}{4}$ turn clockwise about its vertex. Measure the angle. What do you notice?
 - c) Choose a different rotation.Predict what would happen to the size of the angle under this rotation.Rotate the angle to check. How can you explain this?
- 10. Is it possible to draw a reflex angle so the other angle formed

by the arms is:		
a) acute?	b) obtuse?	c) straight?
Use examples t	o explain.	

Reflect

Explain how to use a protractor to draw an angle of 315°. Use words and pictures to explain. How could you draw an angle of 315° without using a protractor?

Math Link

Science

It takes about 365 days for the Earth to make one complete revolution around the Sun. The number of degrees in a complete turn is 360°. So, the Earth travels about 1° around the Sun each day.

