Educational Epiphany ™
Districtwide PLC Protocol for **Mathematics**

Teacher/Teacher Team: Mr. Samuel F.	
Grade/Course: Geometry	
Date: Week of August 21, 2023	

#	Planning Question	Teacher/Teacher Team Response	
		Geometry Coherence Tool: Access the foundational standards to make connections to previously taught skills during the lesson introduction.	
1	Which **state standard** is your lesson progression addressing?	**Lesson 1.3 – Using Midpoint and Distance Formulas** **G.CO.D.11** Perform formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). **Foundational Standards:** 7.G.A.2	**Lesson 1.4 – Perimeter and Area in the Coordinate Plane** **G.GPE.A.3** Understand the relationship between the Pythagorean Theorem and the distance formula and use an efficient method to solve problems on the coordinate plane. **G.MG.A.1** Use geometric shapes, their measures, and their properties to model objects found in a real-world context for the purpose of approximating solutions to problems. ★ **Foundational Standards:** 6.G.A.1, 7.G.B.3, 7.G.B.5, 8.G.C.6
2	What **mathematical concepts** are embedded in the state standard?	• Bisect an angle using a compass. • Construct perpendicular lines, including the perpendicular bisector of a line segment. • Construct a line parallel to a given line through a point not on the line. • Use the virtual compass and line tool in dynamic geometry software to construct various geometric objects. • Develop methods using a variety of appropriate tools (compass, straightedge, string, reflective device, paper folding, etc.) to perform precise geometric constructions. • Explain informally why and how these construction methods work. • Understand the importance of precision in these constructions and attend to precision when performing geometric constructions.	• Explain the relationship between the Pythagorean Theorem and the distance formula. • Choose the most efficient method to find the distance between two points in a coordinate system and use it to solve problems. • Use geometric shapes, their measures, and their properties to describe and approximately model objects in a real-world context. • Apply geometric methods to solve real-world problems.

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3	What teacher **knowledge, reminders, and misconceptions** are assumed in the standard?	**Knowledge:** • Students must be allowed to experiment with the construction tools to develop their own method to perform these constructions rather than just be given specific instructions to follow. They will need a basic understanding of the expected outcome. • It is through the process of the construction and particularly discovering the method that students will develop a deeper understanding of the properties of these objects. • Students will want to use a ruler to bisect a line segment or a protractor to bisect an angle, but when performing these formal constructions, students should not use tools that measure. Instead, they need to focus on the properties of the figures in the construction. Likewise, when students are using dynamic geometry software, they should avoid using automatic commands for bisecting and performing other constructions and use the virtual compass and line tool instead. • Requiring students to perform constructions by hand will help them discover the need for precision, which is essential in performing these constructions or they will not work. For example, a perpendicular bisector construction may not end up exactly in the middle or exactly perpendicular if the student does not use the same holes in the compass during the construction. Dynamic geometry software may help students perform the constructions precisely, particularly for students who struggle with using the tools precisely, but it is important that students also experience performing constructions by hand. • Developing the process of the methods leads to a deeper understanding of why and how each method works. Therefore, it is important that students be required to show their understanding by informally explaining what their chosen method does and why it works. **Reminders:** • In grade 7 (7.G.A cluster), students begin to experiment with mathematical tools to construct geometric figures and explore their relationships. In this course, students learn to use these and additional tools to perform constructions to explore and demonstrate geometric properties and help students visualize geometric theorems. • It is important that students understand that constructions serve a purpose. Therefore, pairing this standard with others throughout this course, including G.CO.A.3 and G.CO.D.12, will help students see the why behind these valuable skills. **Misconceptions:** • Students frequently want to resort to using a ruler and protractor. The teacher needs to make the constraints for use of a particular tool clear.	**Knowledge:** • Instruction should allow students to explore using the Pythagorean Theorem to find the distance between two points graphed on the coordinate plane. • It may be easier for students to use numerical coordinates at first. However, to help students generalize the process, the given points can be (x_1, y_1) and (x_2, y_2) . • When applying the Pythagorean Theorem, they should discover that to find a, the length of the horizontal leg, they can subtract the x coordinates of the endpoints $(x_2 - x_1)$ which are also the x coordinates of each original point. They should also discover that to find b, the length of the vertical leg, they can subtract the y-coordinates of the endpoints $(y_2 - y_1)$ which are also the y coordinates of the original points. When substituting each expression into the Pythagorean Theorem, $a^2 + b^2 = c^2$ becomes $(x_2 - x_1)^2 + (y_2 - y_1)^2 = c^2$, with c representing the hypotenuse which is the distance between the original two points. When isolating c, students will see the distance formula: $c = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$, while in the distance formula, *c* is usually replaced by *d* to represent distance. • By allowing students to discover this connection between the two formulas, students should be able to flexibly move between these two methods. They can then explore applications for each method such as finding the area of circles or polygons graphed on the coordinate plane. They can also be challenged to solve problems given coordinates that are not graphed. Students should be given the opportunity to choose which method is the most efficient and explain why. • Students apply geometric concepts learned in this and previous grades to solve real-world geometric application problems • Throughout the course, students should be exposed to a variety of real-world situations that require the application of geometric concepts to solve. Often, the challenge for students is to identify which concept is needed to address the problem. Therefore, instruction should intentionally provide problems that require students to analyze the context to decide what is needed to solve. Examples may include the need to calculate area, volume, surface area, or verifying parallel lines or angle measures. By modeling the situation with geometric figures, students can more easily recognize an appropriate solution method. **Reminders:** • In grade 8, students were introduced to the Pythagorean Theorem as a method to find a missing side length of a right triangle (8.G.B.4). They also used it to find the distance between two

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		• If students are not precise in a construction, it may not appear to work. The teacher needs to emphasize the importance of precision. Alternatively, using dynamic geometry software could alleviate some of these difficulties.	points in a coordinate system (8.G.B.5). In this high school course, students will extend their understanding of the application of Pythagorean Theorem to find a distance and generalize it to find the distance between any two points in a coordinate system and thus discover the distance formula. • G.MG.A.1 along with G.CO.D.12 addresses the concept of using geometry to visualize a situation for the purpose of solving a problem. As students solve real-world problems that involve two- and three-dimensional objects throughout this course, they should recognize that geometric shapes can be used to model real-world objects. **Misconceptions:** • Students often mistakenly assume that they can count a diagonal distance on the coordinate plane like they do with horizontal or vertical distances. To avoid this common misconception, have students measure and compare a side length and diagonal of a square and connect this comparison to the square units on a coordinate plane. They can then calculate the length of the diagonal of one square unit using the Pythagorean Theorem $(1^2 + 1^2 = c^2)$ to see that the length of the diagonal is actually $\sqrt{2}$ which is longer than 1 unit or approximately 1.41 units. • Students may be troubled by the fact that in the real world, objects cannot be perfectly modeled by geometric solids. Students should be encouraged to consider that while a geometric model is not perfect, it can provide an approximation that yields useful information.
4	What **objective(s)** must be taught? In what order? Why?	**PBO:** • **SWBAT** use a variety of tools and methods (compass, straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.) **IOT** perform formal geometric constructions. **Lesson objectives**: • I can find lengths of segments. • I can construct a segment bisector. • I can find the midpoint of a segment.	**PBO:** • **SWBAT** use the Pythagorean Theorem to find a distance between any two points **IOT** solve problems on the coordinate plane. • **SWBAT** generalize the Pythagorean Theorem to the Distance Formula **IOT** use the most efficient method to find the distance between two points. • **SWBAT** use geometric shapes, their measures, and their properties **IOT** describe and model objects in a real-world context. **Lesson objectives:** • I can classify and describe polygons. • I can find perimeters of polygons in the coordinate plane. • I can find areas of polygons in the coordinate plane.
5	What **academic language** must be taught before the teacher models for students? How will the academic	**Academic Language:** • **Use** – take, hold, or apply • **Variety** – more than one; several • **Method** – a step of a procedure of an experiment • **Compass** – a tool used for drawing and drafting to create arcs,	**Academic Language:** • **Use** – take, hold, or apply • **Pythagorean Theorem** – a theorem that states that in a right triangle, the square of the length of the hypotenuse equals the sum of the squares of the lengths of the legs $(a^2 + b^2 = c^2)$

	language be **taught and assessed**?	circles or other geometric figures • **Perform** – carry out, accomplish, or fulfill • **Formal** – characterized by precise respect for form • **Geometric** – related to geometry • **Construction** – a geometric figure made with only a straightedge and compass. **Instructional Practice 2:** Strategies used to teach unfamiliar words will include: • 30 – 30 – 30 (common math-related word parts in the text, problem or objective) • Point of Use Annotation of the Performance Based Objective • Universal Language of Literacy • Word and Definition Walls • Word Parts • Context Clues • Point of Use Annotation of the Text (in Real Time)	• **Distance** – an amount of space between two things or people • **Solve** – to apply an operation(s) in order to find a value; to find an answer • **Coordinate Plane** – a plane containing the "x" and the "y" axis • **Generalize** – make a broad statement • **Distance Formula** – the distance between any two points $(x1,\ y1)$ and $(x2,\ y2)$ is $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ • **Efficient** – to do without wasting time • **Method** – a step of a procedure of an experiment • **Geometric Shape** – the characteristic surface configuration of an object • **Measure** – the size, amount, or degree of something • **Property** – a mathematical rule; a character or attribute that something has • **Describe** – give an account in words of (someone or something) that includes all the relevant characteristics • **Model** – representation of a concept; to draw, show or explain mathematically • **Real-World** – relating to a concrete setting • **Context** – the surrounding or background information used to determine, specify, or clarify the meaning of an event or other occurrence **Instructional Practice 2:** Strategies used to teach unfamiliar words will include: • 30 – 30 – 30 (common math-related word parts in the text, problem or objective) • Point of Use Annotation of Performance-Based Objective • Universal Language of Literacy • Word-and-Definition Word Walls • Word Parts • Context Clues • Point of Use Annotation of the Texts (In Real Time)
6	What **activities/practice problems** are you planning to use for **Launch the Lesson, Explore It, Examples & Self-Assessment, and Practice** portions of the lesson? What did you learn from working the problems **in advance** of using them in class with	**<u>Technology Integration Suggestions: Big Ideas Platform</u>** • Dynamic Classroom • Resources: Digital Example Videos • Resources: Everyday Connections Video Series • Lesson Example PowerPoints • Resources: Explorations (Dynamic) **For technology integration resources and suggestions, please click here.**	**<u>Technology Integration Suggestions: Big Ideas Platform</u>** • Dynamic Classroom • Resources: Digital Example Videos • Resources: Everyday Connections Video Series • Lesson Example PowerPoints • Resources: Explorations (Dynamic) **For technology integration resources and suggestions, please click here.**

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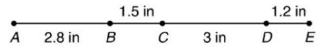
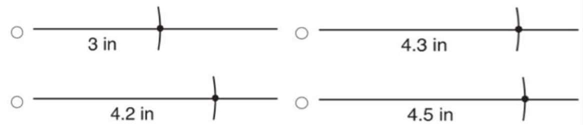
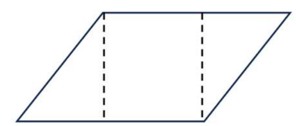
	students?	**Monday 08/21/2023** Do Now **Dmitri wants to draw a line segment which is congruent to $\overline{BD}$.**  **What image shows the correct construction?**  • Assessment **Student Work Analysis #1 – August 21, 2023** Name: ______________________________ Period ___ <u>Problem</u> **CONNECTING CONCEPTS** Point S is between points R and T on $\overline{RT}$. Use the information to write an equation in terms of x. Then solve the equation and find RS, ST, and RT. <u>Expectations</u> • Sketch and label. • Set up an equation. • Solve and justify steps. • Completion of Lesson 1.2 Assignment – Practice 1.2 • Using Segment Addition Postulate – Review Problems 4, 23, 31, 33, 34 **Tuesday 08/22/2023**	**Friday 08/25/2023** **Do Now 08/25/2023** (5 Minutes) Name: ___________________________ Period ____ Find the distance between $R(0, 1)$ and $S(6, 3.5)$. <u>**Agenda**</u> •Classify and describe polygons. •Find perimeters of polygons in the coordinate plane. •Find areas of polygons in the coordinate plane. **PBO** • 30 – 30 – 30 (common math-related word parts in the text, problem, or objective) • Point of Use Annotation of the Performance Based Objective • Universal Language of Literacy • Word and Definition Walls **Laurie's Notes** **Launch the Lesson**  ? "How does the area of the parallelogram compare to the areas of the two triangles and rectangle? ? "Is the perimeter of the parallelogram equal to the sum of the perimeters of the two triangles and rectangle? Explain."

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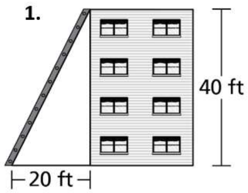
Do Now 08/22/2023 (5 minutes)

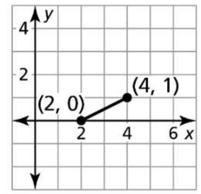
Name: ____________________________ Period ____

Find the slope.

1.



2.



Lesson 1.3 Using Midpoint and Distance Formulas

Agenda

- Construct a segment bisectors
- Find length of segments

PBO

- 30 – 30 – 30 (common math-related word parts in the text, problem, or objective)
- Point of Use Annotation of the Performance Based Objective
- Universal Language of Literacy
- Word and Definition Walls

Laurie's Notes

Launch the Lesson

Question

What are some distances you know?

- **1 mile = __5,280__ feet**
- **I feet = __12__ inches**
- **1 kilometer = __1,000__ meters**
- **How many miles is your house from Overton High? _________**

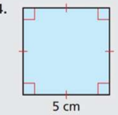
Note: Not all distances are lengths of segments.

1.4 Perimeter and Area in the Coordinate Plane

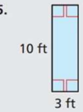
REVIEW & REFRESH

In Exercises 44–47, find the perimeter and area of the figure.

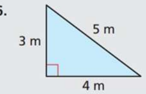
44.



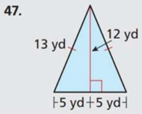
45.



46.



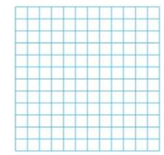
47.



EXPLORE IT! Finding the Perimeter and Area of a Quadrilateral

Work with a partner.

a. Use a piece of graph paper to draw a quadrilateral *ABCD* in a coordinate plane. At most two sides of your quadrilateral can be horizontal or vertical. Plot and label the vertices of *ABCD*.



b. Make several observations about quadrilateral *ABCD*. Can you use any other names to classify your quadrilateral? Explain.

c. Explain how you can find the perimeter of quadrilateral *ABCD*. Then find the perimeter. Compare your method with those of your classmates.

d. Explain how you can find the area of quadrilateral *ABCD*. Then find the area. Compare your method with those of your classmates.

Number of sides	Type of polygon
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	Nonagon
10	Decagon
12	Dodecagon
n	*n*-gon

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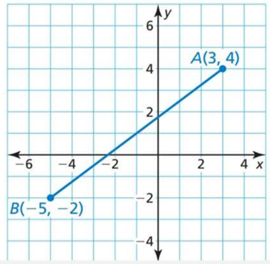
EXPLORE IT! Finding Midpoints of Line Segments

Work with a partner.

Plot any two points A and B. Then graph $\overline{AB}$. Identify the point M on $\overline{AB}$ that is halfway between points A and B, called the *midpoint* of $\overline{AB}$. Explain how you found the midpoint.



KEY IDEAS

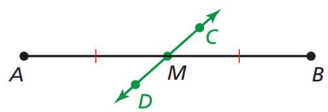
Midpoints and Segment Bisectors

The **midpoint** of a segment is the point that divides the segment into two congruent segments.

M is the midpoint of $\overline{AB}$.

So, $\overline{AM} \cong \overline{MB}$ and $AM = MB$.

A **segment bisector** is a point, ray, line, line segment, or plane that intersects the segment at its midpoint. A midpoint or a segment bisector *bisects* a segment.

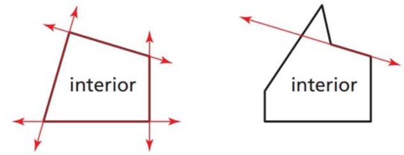


$\overleftrightarrow{CD}$ is a segment bisector of $\overline{AB}$.

So, $\overline{AM} \cong \overline{MB}$ and $AM = MB$.

The number of sides determines the type of polygon, as shown in the table. You can also name a polygon using the term n-gon, where n is the number of sides. For instance, a 14-gon is a polygon with 14 sides.

A polygon is *convex* when no line that contains a side of the polygon contains a point in the interior of the polygon. A polygon that is not convex is *concave*.



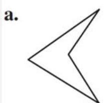
convex polygon   concave polygon

EXAMPLE 1 Classifying Polygons

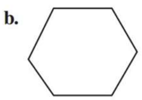
WATCH

Classify each polygon by the number of sides. Tell whether it is *convex* or *concave*.

a.



b.



SOLUTION

a. The polygon has four sides. So, it is a quadrilateral. The polygon is concave.

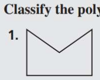
b. The polygon has six sides. So, it is a hexagon. The polygon is convex.

Check for Understanding

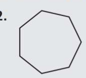
SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Classify the polygon by the number of sides. Tell whether it is *convex* or *concave*.

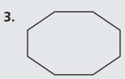
1.



2.



3.



4. MP **REASONING** Can you draw a concave triangle? If so, draw one. If not, explain why not.

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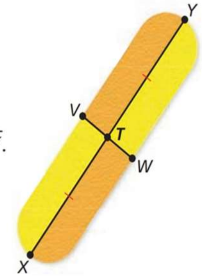
EXAMPLE 1 Finding Segment Lengths

In the skateboard design, $XT = 39.9$ cm. Identify the segment bisector of $\overline{XY}$. Then find XY.



SOLUTION

The design shows that $\overline{XT} \cong \overline{TY}$.
So, point T is the midpoint of $\overline{XY}$ and $XT = TY = 39.9$ cm.
Because $\overline{VW}$ intersects $\overline{XY}$ at its midpoint T, $\overline{VW}$ bisects $\overline{XY}$.

Set up an equation to find XY.

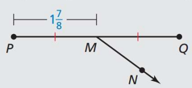
$XY = XT + TY$	Segment Addition Postulate
$= 39.9 + 39.9$	Substitute.
$= 79.8$	Add.

▶ $\overline{VW}$ is the segment bisector of $\overline{XY}$, and XY is 79.8 centimeters.

Check for Understanding

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Identify the segment bisector of $\overline{PQ}$. Then find PQ.

1. 

2. 

3. **VOCABULARY** If a point, ray, line, line segment, or plane intersects a segment at its midpoint, then what does it do to the segment?

Laurie's Notes

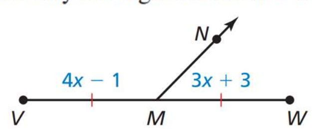
❓ "What do midpoints and segment bisectors have in common?"

❓ "Can a segment have more than one midpoint?"

❓ "Can a segment have more than one bisector?"

EXAMPLE 2 Using Algebra with Segment Lengths

Identify the segment bisector of $\overline{VW}$. Then find VM.



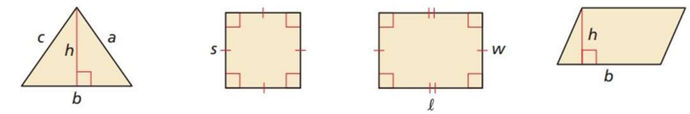
SOLUTION

Finding Perimeter and Area in the Coordinate Plane

READING
You can read the notation $\triangle DEF$ as "triangle D E F."

You can use the formulas below and the Distance Formula to find perimeters and areas of polygons in the coordinate plane.

Perimeter and Area



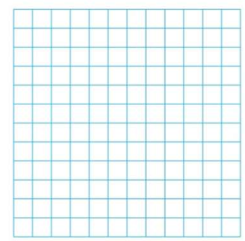
Triangle	Square	Rectangle	Parallelogram
$P = a + b + c$ $A = \frac{1}{2}bh$	$P = 4s$ $A = s^2$	$P = 2\ell + 2w$ $A = \ell w$	$A = bh$

EXAMPLE 2 Finding Perimeter in the Coordinate Plane

Find the perimeter of $\triangle DEF$ with vertices $D(1, 3)$, $E(4, -3)$, and $F(-4, -3)$.

SOLUTION

Step 1 Draw the triangle in a coordinate plane by plotting the vertices and connecting them.



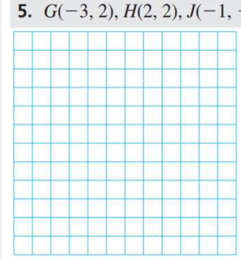
Step 2 Find the length of each side.

Check for Understanding

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Find the perimeter of the polygon with the given vertices.

5. $G(-3, 2)$, $H(2, 2)$, $J(-1, -3)$



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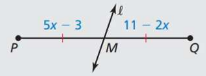
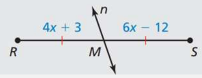
SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

4. Identify the segment bisector of $\overline{PQ}$. Then find MQ.



5. Identify the segment bisector of $\overline{RS}$. Then find RS.

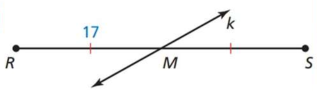


Practice

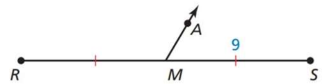
1.3 Practice WITH CalcChat® AND CalcView®

In Exercises 1–4, identify the segment bisector of $\overline{RS}$. Then find RS. *Example 1*

1.



2.



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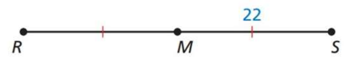

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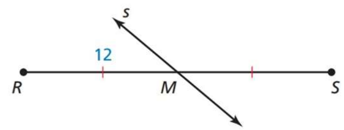
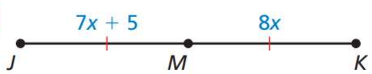


In Exercises 5 and 6, identify the segment bisector of $\overline{JK}$. Then find JM. *Example 2*

5.



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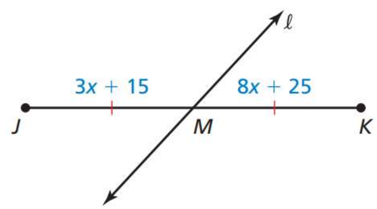
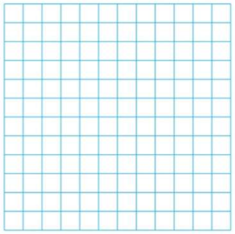


Exit Ticket

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Find the perimeter of the polygon with the given vertices.

6. $Q(-4, -1)$, $R(1, 4)$, $S(4, 1)$, $T(-1, -4)$



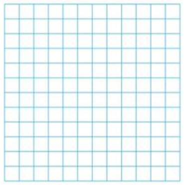
EXAMPLE 3 Finding Area in the Coordinate Plane

Find the area of $\square JKLM$ with vertices $J(-3, 5)$, $K(1, 5)$, $L(2, -1)$, and $M(-2, -1)$.

READING
You can read the notation $\square JKLM$ as "parallelogram J K L M."

SOLUTION

Step 1 Draw the parallelogram in a coordinate plane by plotting the vertices and connecting them.



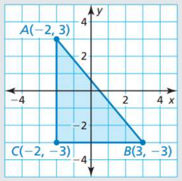
Step 2 Find the length of the base and the height.

Check for Understanding

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Find the area of the polygon with the given vertices.

7.



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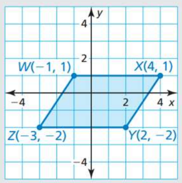
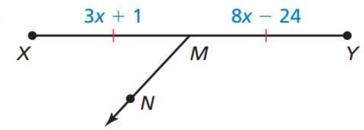


Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

In Exercises 7 and 8, identify the segment bisector of $\overline{XY}$. Then find XY. ▶ *Example 2*

7.



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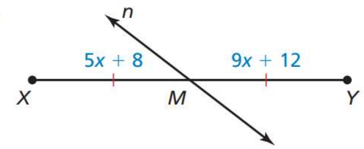


Wednesday 08/23/2023

Do Now 08/23/2023 (**5 minutes**)

Name: ____________________________ Period ____

ANALYZING RELATIONSHIPS The length of $\overline{XY}$ is 24 centimeters. The midpoint of $\overline{XY}$ is M, and point C lies on $\overline{XM}$ so that XC is $\frac{2}{3}$ of XM. Point D lies on $\overline{MY}$ so that MD is $\frac{3}{4}$ of MY. What is the length of $\overline{CD}$?

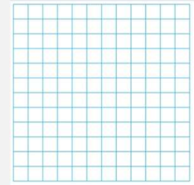
Expectations
- Provide a sketch
- Form an equation
- Solve the equation and substitute to find $\overline{CD}$.

Agenda
- Use the midpoint formula
- Solve problems using the midpoint formula

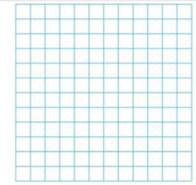
PBO
- 30 – 30 – 30 (common math-related word parts in the text, problem, or objective)
- Point of Use Annotation of the Performance Based Objective
- Universal Language of Literacy
- Word and Definition Walls

Find the area of the polygon with the given vertices.

9. $N(-1, 1)$, $P(2, 1)$, $Q(2, -2)$, $R(-1, -2)$



10. $K(-3, 3)$, $L(3, 3)$, $M(3, -1)$, $N(-3, -1)$

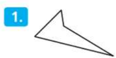


Practice

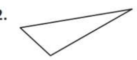
1.4 Practice WITH CalcChat® AND CalcView®

In Exercises 1–4, classify the polygon by the number of sides. Tell whether it is *convex* or *concave*. ▶ *Example 1*

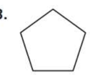
1.



2.



3.



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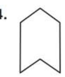
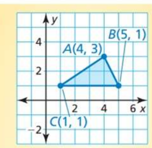


In Exercises 5–10, find the perimeter of the polygon with the given vertices. ▶ *Example 2*

Exit Ticket

19. ERROR ANALYSIS Describe and correct the error in finding the area of the triangle.



$b = |5 - 1| = 4$

$h = \sqrt{(5-4)^2 + (1-3)^2} = \sqrt{5}$

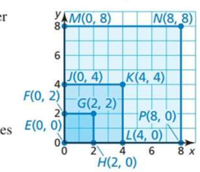
$A = \frac{1}{2}bh = \frac{1}{2}(4)(\sqrt{5}) = 2\sqrt{5}$

The area is $2\sqrt{5}$ square units.

20. MP REPEATED REASONING Use the diagram.

a. Find the perimeter and area of each square.

b. What happens to the area of a square when its perimeter increases by a factor of n?



Homework

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

Laurie's Notes

Launch the Lesson

? "What do midpoints and segment bisectors have in common?" "How are they different?"

? "Can a segment have more than one midpoint?" "Can a segment have more than one bisector?" "Can a line have more than one midpoint?"

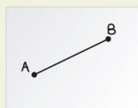
Explore It!

CONSTRUCTION **Bisecting a Segment** WATCH

Construct a segment bisector of $\overline{AB}$ by paper folding. Then label the midpoint M of $\overline{AB}$.

SOLUTION

Step 1

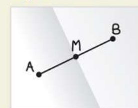


Draw a segment
Use a straightedge to draw $\overline{AB}$ on a piece of paper.

Step 2

Fold the paper
Fold the paper so that B is on top of A.

Step 3



Label the midpoint
Label point M. Compare AM, MB, and AB.
$AM = MB = \frac{1}{2}AB$

Using the Midpoint Formula

You can use the coordinates of the endpoints of a segment to find the coordinates of the midpoint.

KEY IDEA

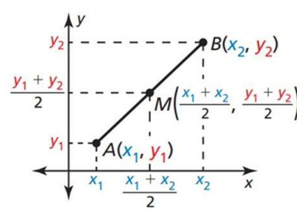
The Midpoint Formula

The coordinates of the midpoint of a segment are the averages of the x-coordinates and of the y-coordinates of the endpoints.

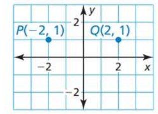
If $A(x_1, y_1)$ and $B(x_2, y_2)$ are points in a coordinate plane, then the midpoint M of $\overline{AB}$ has coordinates

$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right).$$

$$M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right).$$



COLLEGE PREP **In Exercises 21 and 22, use the diagram.**



21. Determine which point is the remaining vertex of a triangle with an area of 4 square units.

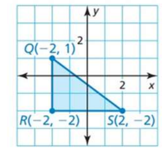
Ⓐ $R(2, 0)$ Ⓑ $S(-2, -1)$
Ⓒ $T(-1, 0)$ Ⓓ $U(2, -2)$

22. Determine which points are the remaining vertices of a rectangle with a perimeter of 14 units.

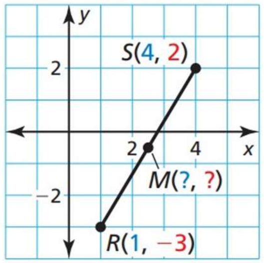
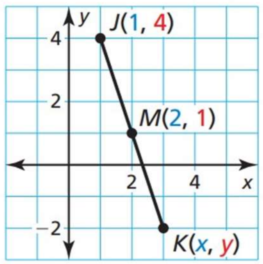
Ⓐ $A(2, -1)$ and $B(-2, -1)$
Ⓑ $C(-1, -2)$ and $D(1, -2)$
Ⓒ $E(-2, -2)$ and $F(2, -2)$
Ⓓ $G(2, 0)$ and $H(-2, 0)$

28. **CONNECTING CONCEPTS** The lines $y_1 = 2x - 6$, $y_2 = -3x + 4$, and $y_3 = -\frac{1}{2}x + 4$ intersect to form the sides of a right triangle. Find the perimeter and the area of the triangle.

29. **MAKING AN ARGUMENT** Will a rectangle that has the same perimeter as $\triangle QRS$ have the same area as the triangle? Explain your reasoning.



Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

		EXAMPLE 3 Using the Midpoint Formula **a.** The endpoints of $\overline{RS}$ are $R(1, -3)$ and $S(4, 2)$. Find the coordinates of the midpoint M. **SOLUTION** Use the Midpoint Formula. $M\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$  ▶ The coordinates of the midpoint M are **b.** The midpoint of $\overline{JK}$ is $M(2, 1)$. One endpoint is $J(1, 4)$. Find the coordinates of endpoint K. **SOLUTION** Let (x, y) be the coordinates of endpoint K. Use the Midpoint Formula. **Step 1** Find x. **Step 2** Find y.  ▶ The coordinates of endpoint K are $(3, -2)$. **Check for Understanding** **SELF-ASSESSMENT** 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else. **The endpoints of $\overline{AB}$ are given. Find the coordinates of the midpoint M.** **6.** $A(1, 2)$ and $B(7, 8)$ **7.** $A(-4, 3)$ and $B(-6, 5)$ **The midpoint M and one endpoint of $\overline{TU}$ are given. Find the coordinates of the other endpoint.** **8.** $T(1, 1)$ and $M(2, 4)$ **9.** $U(4, 4)$ and $M(-1, -2)$ **Practice**	

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

1.3 Practice WITH CalcChat® AND CalcView®

In Exercises 13–16, the endpoints of $\overline{CD}$ are given. Find the coordinates of the midpoint M. *Example 3*

13. $C(3, -5)$ and $D(7, 9)$

14. $C(-4, 7)$ and $D(0, -3)$

15. $C(-2, 0)$ and $D(4, 9)$

16. $C(-8, -6)$ and $D(-4, 10)$

In Exercises 17–20, the midpoint M and one endpoint of $\overline{GH}$ are given. Find the coordinates of the other endpoint. *Example 3*

17. $G(5, -6)$ and $M(4, 3)$

18. $H(-3, 7)$ and $M(-2, 5)$

Exit

19. $H(-2, 9)$ and $M(8, 0)$

20. $G(-4, 1)$ and $M\left(-\frac{13}{2}, -6\right)$

Thursday 08/24/2023

Agenda
- Use the distance formula
- Solve problems using the distance formula

PBO
- 30 – 30 – 30 (common math-related word parts in the text, problem, or objective)
- Point of Use Annotation of the Performance Based Objective
- Universal Language of Literacy
- Word and Definition Walls

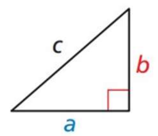
Launch the Lesson

Using the Distance Formula

You can use the Distance Formula to find the distance between two points in a coordinate plane. You can derive the Distance Formula from the *Pythagorean Theorem*, which you will see again when you work with right triangles.

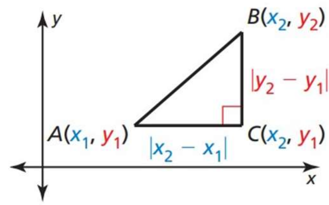
Pythagorean Theorem

$c^2 = a^2 + b^2$



Distance Formula

$(AB)^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2$

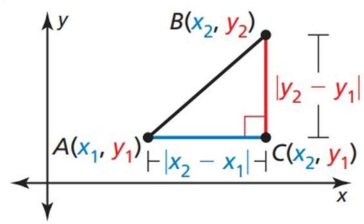


KEY IDEA

The Distance Formula

If $A(x_1, y_1)$ and $B(x_2, y_2)$ are points in a coordinate plane, then the distance between A and B is

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$



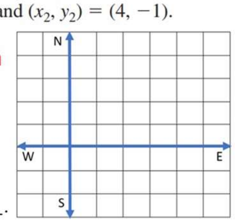
EXAMPLE 4 **Using the Distance Formula**

Your school is 4 miles east and 1 mile south of your apartment. A recycling center, where your class is going on a field trip, is 2 miles east and 3 miles north of your apartment. Estimate the distance between the recycling center and your school.

SOLUTION

You can model the situation using a coordinate plane with your apartment at the origin (0, 0). The coordinates of the recycling center and the school are $R(2, 3)$ and $S(4, -1)$, respectively. Use the Distance Formula. Let $(x_1, y_1) = (2, 3)$ and $(x_2, y_2) = (4, -1)$.

$RS = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ Distance Formula



▶ So, the distance between the recycling center and your school is about _____.

Check for Understanding

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

10. In Example 4, a park is 3 miles east and 4 miles south of your apartment. Estimate the distance between the park and your school.

Practice

1.3 Practice WITH CalcChat® AND CalcView®

In Exercises 21–28, find the distance between the two points. *Example 4*

21. $A(13, 2)$ and $B(7, 10)$ **22.** $C(-6, 5)$ and $D(-3, 1)$

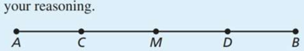
23. $E(3, 7)$ and $F(6, 5)$ **24.** $G(-5, 4)$ and $H(2, 6)$

25. $J(-8, 0)$ and $K(1, 4)$ **26.** $L(7, -1)$ and $M(-2, 4)$

27. $R(0, 1)$ and $S(6, 3.5)$ **28.** $T(13, 1.6)$ and $V(5.4, 3.7)$

37. **MAKING AN ARGUMENT** Your friend claims there is an easier way to find the length of a segment than using the Distance Formula when the x-coordinates of the endpoints are equal. He claims all you have to do is subtract the y-coordinates. Do you agree with his statement? Explain your reasoning.

38. **HOW DO YOU SEE IT?**
$\overline{AB}$ contains midpoint M and points C and D, as shown. Compare the lengths. If you cannot draw a conclusion, write *impossible to tell*. Explain your reasoning.



a. AM and MB **b.** AC and MB
c. CM and MD **d.** MB and DB

39. **CRITICAL THINKING** The endpoints of a segment are located at (a, c) and (b, c). Find the coordinates of the midpoint and the length of the segment in terms of a, b, and c.

Exit Ticket

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

		ERROR ANALYSIS In Exercises 29 and 30, describe and correct the error in finding the distance between $A(6, 2)$ and $B(1, -4)$. 29. ✗ $AB = (6-1)^2 + [2-(-4)]^2$ $= 5^2 + 6^2$ $= 25 + 36$ $= 61$ 30. ✗ $AB = \sqrt{(6-2)^2 + [1-(-4)]^2}$ $= \sqrt{4^2 + 5^2}$ $= \sqrt{16 + 25}$ $= \sqrt{41}$	
7	What **manipulatives** might be integrated into the lesson? What did you learn from using the manipulatives **in advance** of using them in class with students?	Compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, protractor, etc. **Reference:** Interactive Manipulatives • Didax Virtual Manipulatives	Compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, protractor, etc. **Reference:** Interactive Manipulatives • Didax Virtual Manipulatives
8	What **graphic organizer(s)** might support students' conceptual understanding of the process outlined by the performance-based objective(s)?	**Reference:** • Graphic Organizer Templates • Google Drawing Graphic Organizers • Teacher Vision	**Reference:** • Graphic Organizer Templates • Google Drawing Graphic Organizers • Teacher Vision

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