Math
Unit 1
Describing the World Around Us

- How can we use mathematics to describe the world around us?

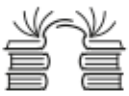
Sample Lesson Plans

Sample Lesson Plan Icons

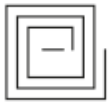

Teacher Alert (Watch Out!)

Language Action Point


FYI About Students


Interdisciplinary


Differentiate – Extend


Differentiate – Amplify


Formative Assessment


Technology

Describing the World Around Us
Lesson 1: Symbols

The purpose of this lesson is to familiarize students with the concept of symbols. Students will identify what everyday symbols communicate and extend their learning to include symbols used in mathematics.

ESSENTIAL QUESTION(S)	How can we use mathematics to describe the world around us?
GUIDING QUESTION	How do we use symbols to describe the world around us?

DAILY QUESTION	What are symbols and how are they used in mathematics?
CONTENT TARGETS	I can identify symbols used in my daily life and in math. I can explain their purpose.
STANDARDS FOR MATHEMATICAL PRACTICE	MP6: Attend to precision
LANGUAGE TARGETS	I can name symbols. I can compare quantities using the word forms for *greater than* and *less than*. **Symbols:** *This is a symbol for* _____. **Comparing numbers:** _____ *is greater than* _____. _____ *is less than* _____.
VOCABULARY	**abstract academic concepts:** symbol* **comparing numbers:** describe, compare, greater than* (larger, largest, bigger, biggest, taller, tallest, longer), less than* (smaller, smallest, shorter, shortest), equal/equal to* (same), quantity* (amount)
MATERIALS	Familiar Symbols Cards Large index cards^ Cuisenaire Rods Exit Ticket

^Not provided in lesson materials.

GENERAL NOTES

Symbols are a critical math concept because they are a component of math language, showing the relationship between numbers or directing us what to do with numbers. Students will work with symbols across all units, including work with variables in unit three.

In this lesson, students work with familiar symbols as a more concrete entry into more abstract math symbols. They will use language frames to communicate the meaning of those symbols. By the end of the lesson, students will know that in math we use a combination of symbols, words, and numbers.

CCSS Reading Standard 7 requires students to be able to represent information visually and in words to understand that we can represent the same information in different forms. Symbols are one form of representation, that students should be able to match with its representation in words (e.g., + means *add*).

OPENING

WARM-UP:

- Using the **Familiar Symbols Cards**, show the symbol for the stop sign.
- Ask students: "Have you seen this before? What do you do when you see this?"
- Present the word ***symbol***, and introduce the language frame: *This is a symbol for* _____. Hold up the stop sign and say: "This is a ***symbol*** for stop."
- Distribute a set of **Familiar Symbols Cards** to each pair of students. Direct students to share with a partner what the symbol means.
- Introduce the word/phrase for each symbol by holding up the **Familiar Symbols Cards** for each symbol, saying the word *aloud* and asking students to **chorally repeat**. Ask students to show the meaning if they know this word.
- Direct partners to work together to match the ***symbol*** to the word it represents.
- When students find the match to the English word, they should use the language frame *This is a symbol for* _____. Students should also be encouraged to say/write the word for the ***symbols*** in their home language.
- Debrief the activity. Suggested questions include:
  - Which of the ***symbols*** have you seen before? Which ones were new?
  - Where did you see the ***symbol***?
  - What does the ***symbol*** mean?

Now, the goal is for students to transition to using the English vocabulary. Briefly elicit/teach the meanings.

Use the Bridges academic language cards and illustrated academic language picture cards to help students with terms like *describe* and *compare*. Then when those terms are encountered in future lessons, you can show the cards to prompt students to perform those actions.

CONNECT:

- Explain that in just like in everyday life, we use ***symbols*** to help us communicate in math.
- Ask students: "What are some ***symbols*** we use in math?"
- Show or write on the board a few symbols in math, such an addition sign. Ask students what this means. Many students will know this, although not all.
- Explain that another way we use ***symbols*** is to help us ***describe*** and ***compare amounts (quantities)*** and numbers. Explain that now they will be using ***symbols*** to ***describe*** and ***compare quantities***, or how much.
- Show students two handfuls of counters (such as counting chips, beans, pennies). Ask students: "Which is more? Which is less?" Elicit responses from students.
- Discuss with students how to say more/less in home language.
- Then introduce the terms ***greater than/less than*** as another way in math to talk about more/less.
- Return to the two piles as you point and say: "This is ***greater than*** that. This is ***less than*** that."

Have fun with this quick activity! Offer the smaller amount and try to give that one to students. When they say they want the offer, ask why. Then teach more/less.

Although *more/less* is not mathematically precise vocabulary, this is a way to use more familiar language as bridge to mathematical concept of greater than/less than.

- Introduce two amounts that are ***equal*** to illustrate the concept.
- Have students brainstorm other words that also mean ***greater than, less than,*** and ***equal to***.
- Show and describe the symbols for <, >, =. Use the language frame: *This is a symbol for* _____. Explain to students that in math, these ***symbols*** replace those words.

When encountering words that have many synonyms or that may be difficult to teach, a helpful strategy is to create word clusters so that students can see relationships between words (e.g., big/small: antonyms, big/tall: synonyms, etc.).

These symbols can be difficult to remember for non-ELLs as well. Consider the explanation that the point of the inequality symbols (greater than/less than signs) will always point to the amount that is less.

WORK TIME

PREPARE:

- Have students draw <, >, and = on **large index cards**.
- Refer students to their **Cuisenaire Rods**.
- **Model** how students would place the symbols between various size **Cuisenaire Rods** to make comparisons about their size. Use the language frame _____ *is greater than/less than* _____.

- Have students practice writing sentences with the <, >, and = symbols, as well as the words.

INTERACT:

- Students will work in small groups to practice placing the appropriate sign between various **Cuisenaire Rods** and rod formations.

This is a meaning-making activity, so do not require English. Encourage students to share what this means in home language.

While students are completing the activity, take the opportunity to assess whether they are placing signs correctly and using the language frame. Allow students to substitute words from the word clusters for *greater than/less than* as appropriate.

EXTEND:

- **Think-pair-share:** Why do we use symbols? Debrief as a whole class. Chart student responses. Elicit things like: *helps communicate ideas, it's faster, easier for people who do not read,* etc.

CLOSING

REVIEW TARGETS:

- Draw student attention to targets.
- Invite students to show whether they met the lesson targets by using the **thumb-o-meter** protocol.

ASSESS:

- **Exit Ticket:** Briefly **model** how to create a new symbol card for another symbol that you know. Ask students to create their own new symbol "card" or set of "cards" that could be added to the deck of symbols cards. Students should draw a symbol and write the sentence that defines what the symbol is used for:
  - *This is a symbol for* _____.

Assess if students are able to communicate the meaning for a symbol of their choosing.

Describing the World Around Us
Lesson 2: Which One Is Bigger?

The purpose of this lesson is for students to continue with the concepts and symbols to compare quantities and objects—greater than, less than, equal to. *Students will continue to work with Cuisenaire Rods and begin to work with number lines to compare numbers using the symbols <, >, =.*

ESSENTIAL QUESTION(S)	How can we use mathematics to describe the world around us?
GUIDING QUESTION	How do we use symbols to describe the world around us?

DAILY QUESTION	How do we compare objects and numbers using mathematical symbols?
CONTENT TARGETS	I can compare quantities and objects using the terms and symbols for *equal, greater than,* and *less than*.
LANGUAGE TARGETS	I can compare numbers using the word forms for *equal to, greater than*, and *less than*. I can compare objects by using the words *longer, shorter, bigger,* and *equal.* **Comparing numbers:** _____ *is equal to* _____. _____ *is greater than* _____. _____ *is less than* _____. **Comparing lengths:** _____ *is longer than* _____. _____ *is shorter than* _____. _____ *is bigger than* _____. _____ *and* _____ *are equal.*
VOCABULARY	**abstract academic concepts:** symbol **comparing numbers:** set, greater than* (larger, bigger, longer), less than*, (smaller, shorter), equal to* (same), compare*, number line*
MATERIALS	Student Activity Sheet 1 - Warm-Up Student Activity Sheet 2 Centimeter Rulers Number Line^ Cuisenaire Rods (provided in Lesson 1) Math Symbols Graphic Organizer

^*Not provided in lesson materials.*

GENERAL NOTES

It is important to create a multilingual word wall around the vocabulary in this lesson. Students will need to reference these words often, and the words in home language on the wall is the best way to support this.

The **Number Line** will be an important tool throughout Bridges Math, but keep in mind that students who are not familiar with school will most likely not understand the **Number Line** right away. Use the **Cuisinaire Rods** to conceptually connect to the **Number Line** by having students place **Cuisenaire Rods** above the **Number Line**, which is also in a centimeter scale**.** The teacher can **model** this by placing the white rod against the **Number Line** and showing that it has a length of 1, then repeating with the other rods. After this, they should practice in pairs, using other concrete items. For example, students may place the correct number of paperclips under each number, then connect the clips and stretch out the chain. Ask: "What do you notice?"

Guide students to build on their intuitions and create an order principle for the **Number Line**: Numbers increase in value from left to right (go up, get bigger), and decrease from right to left (go down, get smaller).

Consider further scaffolding of number relationships by first asking students to identify equal/ unequal. Then, if unequal, ask if greater than/less than.

Use synonyms often to support students in connecting everyday language to academic language (greater than = bigger; less than = smaller; increase = go up, get bigger; decrease = go down, get smaller).

OPENING

WARM-UP:

- Direct partners to spread a ***set*** of **Cuisenaire Rods** on the table and order them from *smallest* to *biggest*. Ask them to orally make sentences using ***greater/bigger than*** and ***less/smaller than****,* using the language frames:
  - _____ *is greater than* _____.
  - _____ *is less than* _____.
  - _____ *is longer than* _____.
  - _____ *is shorter than* _____.
  - _____ *is bigger than* _____.
- Invite partners to share out some of these sentences, with which other students state whether they agree or disagree.
- Students complete **Student Activity Sheet 1 - Warm-Up**.
- Review the warm-up activity and monitor correct placement of the symbols.

Students are becoming familiar with **Cuisenaire Rods** and will use this manipulative throughout the unit. Make sure to allow time for students to explore the **Cuisenaire Rods** across lessons to become familiar with the various rod colors and length. These will not always be suggested in a lesson, but think of different ways the rods can be used to support number relationships.

CONNECT:

- Explain that these are just three ***symbols*** that we use to help us express relationships in math. They will be learning many more in this unit and the rest of the year. ***Symbols*** also help us to ***compare*** not just the sizes of the **Cuisenaire Rods**, but also help us make comparisons between numbers and the quantity they represent. Today we will use our ***symbols*** to make comparisons with numbers.

Some students might understand that numbers and letters are symbols. Explain that the number *5* means five countable things (e.g., dots, paperclips) and the letter *b* means a sound (say /b/). Emphasize that we don't even think about these as symbols because they are everywhere in everyday life.

WORK TIME

PREPARE:

- Begin with a mini-lesson/**<u>modeling</u>:** Introduce students to the **Number Line**. Allow students to walk along the **Number Line** and count the numbers as they go. Ask students what they notice about the **Number Line**. If no students present the observation "Numbers get ***bigger/greater*** when you move to the right," elicit this idea from students through questioning:
  - Do the numbers change as you walk?
  - How do they change?
- Show students that when you want to determine if a number is ***greater than, less than***, or ***equal to*** another you can use its placement on the **Number Line** to help you. **<u>Model</u>** as necessary. Let students know that the **Number Line** is another tool, like **Cuisenaire Rods**, that can help them solve problems in mathematics.

While it requires some prep work in advance, creating a **Number Line** on the floor of the classroom for students to move along provides an important kinesthetic aspect to learning the concepts of working with a **Number Line**.

Some students may just be learning the left-to-right orientation for reading and therefore may struggle with the order principle, although it is common for many non-SIFE to struggle with this concept as well. Also, be aware that some students may struggle with the concept of zero and the fact that it has a place on the N**umber Line**.

INTERACT:

- Students work in pairs to complete **Student Activity Sheet 2**.

As students work, circulate to assess, assist, and provide corrective feedback as necessary.

Students should, at minimum, know their numbers to 20. If students are struggling to still count numbers above 20, the problem sets can be modified to only include numbers up to 20.

You can also have students make dots underneath the numbers on the **Number Line** or **model** the quantities with manipulatives to help concretize the idea that the quantities are increasing.

EXTEND:

- Introduce students to **Math Symbols Graphic Organizer**. Explain to students that when they discover words that stand for the various ***symbols*** they should add them to their graphic organizer.
- **Model** for students by adding words to <, >, or = symbols. Words should be added as they are used in each lesson (e.g., ***less than***, ***shorter than***, ***smaller***, ***shorter***).

For students who are ready for an added layer of complexity to the task, provide them with either larger numbers (e.g., 7,396 and 572) and/or non-variable expressions and equations to compare (e.g., 2+3<9-2).

CLOSING

REVIEW TARGETS:

- Review the practice problems asking students to show or explain how they arrived at their answers. Encourage students to orally explain as much as possible, using their work as a visual aid and the language frames:
  - _____ *is greater than* _____.
  - _____ *is less than* _____.
  - _____ *is equal to* _____.
- Draw student attention to targets.

ASSESS:

- Use the **equity sticks** protocol to spot check student understanding. Write two numbers on the board and ask students what is the relationship between the numbers. Give students a minute to jot. Pick a stick and call on that students to tell you the relationship. Invite students to show with the thumb-o-meter whether they met the lesson targets.
- Offer specific praise and suggestions to improve.
- Examination of student work can reveal if students are correctly placing the symbols. Monitoring students as they work will allow you to determine how they are arriving at their solutions. Are they leveraging the **Number Line**? Do they need to use manipulatives such as counters, or make pictorial representations such as tally marks to help them represent the quantities? Do they appear to be randomly placing symbols to just complete the activity?

Describing the World Around Us
Lesson 16: Area

The purpose of this lesson is for students to develop an understanding of area as the amount of space within the boundary of any two-dimensional surface and to find the area of quadrilaterals by counting square units.

ESSENTIAL QUESTION(S)	How can we use mathematics to describe the world around us?
GUIDING QUESTIONS	How do I use multiplication to find the area of a quadrilateral?

DAILY QUESTION	How do we find the area of a quadrilateral?
CONTENT TARGETS	I can calculate the area of quadrilaterals using repeated addition. I can understand that the square shape is the most efficient way to measure the area of a rectangle. **Standards for Mathematical Practice:** **MP.1** Make sense of problems and persevere in solving them. **MP.3** Construct viable arguments and critique the reasoning of others. **MP.4** Model with mathematics.
LANGUAGE TARGETS	I can describe how I found the area of a quadrilateral. **Summarizing and Informing:** *To find the area, I _____. Second, I _____. Third, I _____.* **Problem Solving**: *The area of _____ is _____.*
VOCABULARY	**area:** area*, perimeter* (distance around), rectangle, square, quadrilateral*, triangle, square units*
MATERIALS	A variety of cut-out shapes (triangles, circles, quadrilaterals, etc.)^ Student Activity Sheet 16 Various non-square items /manipulatives (e.g., beans, cut out circles, pattern blocks, etc.) Square-Inch Tiles^ Exit Ticket

^Not provided in lesson materials.

GENERAL NOTES

The area model is a widely used model for teaching the concept of multiplication and what it means to multiply. This lesson has been designed to introduce the concept of area as well as provide an age appropriate context to teach the concept of multiplication.

This lesson is also intended to provide an opportunity for students to see how the process of counting can be shortened by grouping, which lays the foundation for repeated addition and eventually multiplication.

OPENING

WARM-UP:

- Shape sort: Provide students with **a variety of cut-out shapes** that include triangles, circles, and various quadrilaterals (squares, rectangles, trapezoids, rhombi).
- Lead students in an **echo reading** of the cards to practice pronunciation of the shapes.
- **Model sorting** objects into groups based on like characteristics. For example, think aloud as you sort classroom objects into different groups (books, markers, etc).
- Direct students to **sort** and group the shapes according to their attributes.
- Debrief: Ask students name and justify the groups how they chose to group.
  - Listen for: *These shapes have …*
- Based on student responses, guide students to see that one way to classify shapes is according to their sides. Shapes with four sides are called ***quadrilaterals***, shapes with three are called ***triangles***. Explain that students will be working with ***quadrilaterals***.

Allow students to justify their groups using home language and gestures, as they haven't yet learned vocabulary to describe polygons.

Underline *quad* in quadrilateral, explaining that *quad* means “four.” Show other pictures and words with *quad* that are concrete (quadruplets, quadriceps). Do the same for *tri* (tricycle, triplets).

This activity is designed to provide students with an experience to learn the names of common shapes and their attributes as well as to define the attributes of a quadrilateral. To support their work in Unit 1, the definition of quadrilateral can be limited to: "a quadrilateral is a shape that has four sides." Angle measure of quadrilaterals need not be included at this point in the year.

CONNECT:

- Invite students to share the definition for ***perimeter*** in their own words, from last week. Ask students to explain how to find the ***perimeter*** of the shapes they just sorted.
- Ask why we sometimes need to find the ***perimeter*****,** eliciting real-world examples of two-dimensional objects (e.g., a rug, a window).
- Then explain that sometimes we don’t need to know the ***distance around*** an object, but rather how much space there is inside.
- Draw students’ attention to the learning targets.

For students requiring an extra challenge, consider providing them with the categories and having them select the shapes to match the categories. The rigor of the categories can be adapted to students’ needs (e.g., shapes with parallel lines, shapes with congruent sides).

WORK TIME

PREPARE:

- Explain that today we will be working with ***quadrilaterals***.
- Ask students to think of real-life ***quadrilaterals*** and share.
- Say: "***Area*** is a measure of the space inside a region or how much it takes to cover a region. Today you will work on ways to find the ***area*** of different ***quadrilaterals***."
- Hold up a piece of paper and ask a volunteer to show you ***perimeter*** by tracing the edges on the paper.
- Then show ***area*** using your hand, making clear that it is the space inside to build to concept. **Think-pair-share**: Ask students to think about real-life situations that would require them to know the ***area*** of the different ***quadrilaterals*** they named above.
    - Listen for: *We need to know the area of a … for …*
- Chart/record student responses and provide language where needed.
- Guide students to understand that we use ***area*** for many real life applications such as gardening/farming, construction, tiling, arranging living space, etc.

Allow them to struggle to think of examples. Give clues only if they are stuck to identify things like room, table, yard, etc.

This is simply a frame to support student brainstorming around real life applications of area, using any language. Hear student responses but move through this activity to get to targets.

INTERACT:

- Using **Student Activity Sheet 16**, provide students **various non-square manipulatives** such as counters, beans, or paperclips to try and quantify the area by covering the various shapes.

It may be helpful to provide students with images of real life instances where one would find area.

One of the important conventions of measurement is that there cannot be gaps or overlaps in units when measuring. As students are working, observe their work to see that they are tiling appropriately.

- Debrief this experience with students: "Were you able to find the ***area***? Did you find the whole ***area***? What were some problems that you had?" Students should be noticing that it is almost impossible to accurately account for the all of the area since the irregular shapes can't meet end to end, leaving space in between. Students might also say that this took a long time, which is bringing them toward the understanding that counting unit by unit is not an efficient strategy.
- Provide **Square-Inch Tiles** for students to tile the same shapes on **Student Activity Sheet 16**.
- Have students repeat the process, this time covering the area of the shapes with the tiles.
- Discuss how tiling with ***squares*** is different than tiling with arbitrary shapes or manipulatives. Elicit the concept of ***square units*** by asking students what they notice about the way we covered the polygons this time. Explain that when we express ***area*** it is always in ***square units.***

Model for students how to cover the area of one of the shapes using their counters.

CLOSING

- Debrief the lesson by asking students to explain how they found the area of their quadrilaterals as well as the areas they have found.
    - *To find the area, I _____.*
    - *Second, I _____.*
    - *Third, I _____.*
    - *The area of _____ is _____.*
- Some students may have counted individual squares, while others may have grouped. Discuss what would be most efficient. Have students revise their work to express all of their calculations as repeated addition.

REVIEW TARGETS:

- Draw student attention to targets.
- Invite students to show with the **thumb-o-meter** protocol whether they met the lesson targets.

ASSESS:

- Remind students that today they learned how to find the ***area*** of different ***quadrilaterals***.

Have students complete a simple **Exit Ticket** that asks them to find the area of a quadrilateral and show how they got their answer. Observe whether students are counting singular squares or if they are using repeated addition or multiplication. This will provide important information about your students' readiness for multiplicative thinking. Use this data to inform your lesson for the next day.

Describing the World Around Us
Lesson 18: Arrays and Commutative Property

The commutative property of multiplication will be explored as students realize that a rectangle that has dimensions 2 inches by 4 inches has the same area as a 4-inch by 2-inch rectangle.

ESSENTIAL QUESTION(S)	How can we use mathematics to describe the world around us?
GUIDING QUESTION	How do I use multiplication to find the area of a quadrilateral?

DAILY QUESTION	How does the order of the dimensions affect the area of a rectangle?
CONTENT TARGETS	I can understand the Commutative Property of multiplication. I can understand how the Commutative Property is related to area.
STANDARDS FOR MATHEMATICAL PRACTICE	MP.7: Look for and make use of structure.
LANGUAGE TARGETS	I can describe the Commutative Property of multiplication. **Problem solving:** _____ *times* _____ *is equal to* _____ *times* _____. *The dimensions of the rectangle are* _____ *inches by* _____ *inches. The rectangle is* _____ *by* _____. *This rectangle is* _____ *inches by* _____ *inches. This rectangle is* _____ *inches by* _____ *inches. The area is (the same/not the same).*
VOCABULARY	**multiplication:** factor*, product*, multiply* **area:** area*, square units*, length* (how long), width* (how wide), dimensions*, rectangle*, square*
MATERIALS	Base Ten Blocks (provided in Set 1, Lesson 3) Cuisenaire Rods (provided in Set 1, Lesson 1) Grid paper^ Array Game Rules Sheet Array Game Student Recording Sheet Student Multiplication Table Square-inch Tiles^ Dice (one pair for every two students)^ Colored pencils or markers (optional)^

^Not provided in lesson materials.

GENERAL NOTES

The Commutative Property will be explored as students realize that a 2" x 4" rectangle has the same area as a 4" x 2" rectangle. They will learn this via games, which are a fun and interactive way to learn math. So much academic content, skills, and language is new and challenging for SIFE. Games allow students to interact using authentic language and to regulate their own learning.

Many students are experts in games from the home country. Many boys who struggle to engage in academic classes quickly engage in learning games.

OPENING

WARM-UP:

- Introduce students to the concept of arrays by **modeling**. Connect your model to similar visual and pictorial representations of numbers using materials from other lessons (e.g., **Base Ten Blocks**, **Cuisenaire Rods**).
- Using **grid paper**, have students create an array for the ***factors 2*** and 5. Choose a student to share their array with the class. Discuss how this student made his/her array and show how it represents an ***area*** of 10 ***square units***, explaining that the ***product*** of 2 and 5 is 10.
- Then, ask other students who drew the array differently to share their method with class. Point out that no matter how an array was made, 2 and 5 always remain the two ***factors*** of 10.
- Ask students: "Do you think we can switch these numbers and get the same ***area***?"
- Have students write a sentence to state whether they agree that this is possible for all numbers or if it is only limited to the example that was modeled.
- **Think-pair-share:** Direct students to share ideas with their partner using the following sentence starter: "I think it is possible/not possible because ..."
- Share several responses.

Sentence starters can be provided when the goal is sharing meaningful ideas, not accurate English language production. The starter supports thinking, and students complete the sentence using any language.

CONNECT:

- Review work from previous lesson by reminding students that finding ***area*** and using arrays are one way to understand why we need multiplication in the world. Today, they will continue their work with multiplication by playing a game.

WORK TIME

PREPARE:

Students will play a game called "The Array Game" in pairs, each with their own **Array Game Student Recording Sheet**. Each player rolls the **dice** and colors in an area on the grid indicated by the **dice**. (For example if they roll a 2 & 4, they would draw either a 2 x 4 or 4 x 2 ***rectangle***, and write the product inside the ***rectangle***). The team that colors in the most ***squares*** on their grid after two rounds (20-25 minutes total) is the winner.

- Step 1: Explain to students that they will be playing a game today that will help them to practice their multiplication facts and also help them to determine whether their prediction was true or not as they work through this activity.

- Step 2: Project the **Array Game Rules Sheet** and the **Array Game Student Recording Sheet** on the board. Explain the rules for play, and then **model** for students how to complete a round of play.

If your students are too distracted by manipulatives to follow a model, you may want to distribute manipulatives to students after you have modeled in front of the room.

Some students may still not understand the rules even after you model a round of play. It may be helpful to allow students to play a practice round first to ensure understanding.

INTERACT:

- Step 3: Distribute the **Array Game Rules Sheet** and the **Array Game Student Recording Sheet**. Be sure to have a whole-class display of the rules on the board, and allow students to read along on their pages or the board.
- Provide students with the opportunity to ask any clarifying questions.
- Set a time limit (about 10 minutes) for Round 1 to see who fills the most ***squares*** on their board. Count up the unused ***squares*** to see who has the most colored ***squares*** (winner). Round 2 (about 10-15 minutes) would allow students a fresh start as to how they will want to fill their board. They may then have questions as to how else they can fill up their board.
- Allow for approximately 20-25 minutes for game play. During this time, teachers can circulate the room to assist, assess students, and observe the strategies they are using to engage in the game.

You may decide to have some students do this from the beginning.

As the grids fill up, players will roll totals that will not fit on the grid. You can allow them to break up the factors. For example a student might identify that 6 x 4 is the same as 2 x 4 and 4 x 4. This reinforces the distributive law of multiplication.

Some students will still struggle with recalling their multiplication factors, while others may struggle to correctly draw/place the arrays. Some possible supports for these students may include providing a multiplication chart or providing tiles for students to concretely fashion the array before drawing.

EXTEND:

- After students have completed the game, ask: “Now that you have drawn many arrays, I want you to think about the question from this morning: Can you switch the ***factors*** and get the same ***area***?”
- Allow students to change their sentences using the sentence starter: “I think it is possible/not possible because …"
- Students should first write, then orally share their responses. To help them justify their work, prompt students to use the language frame from this lesson and the previous lesson:
  - *The dimensions of the rectangle are _____ inches by _____ inches.*
  - *The rectangle is _____ by _____.*

- *This rectangle is _____ inches by _____ inches. This rectangle is_____ inches by _____ inches. The area is _____ (the same/not the same).*
- *Adding _____ and _____ and _____ and _____ is equal to _____ by/times _____.*

- Explain that this concept is called the Commutative Property and, just like in addition, it also extends to multiplication. The order in which we ***multiply*** does not affect the ***product***.
- Discuss its usefulness in helping to solve multiplication problems. Say: "If you know the ***product*** for one set of ***factors*** (e.g., 2 x 3), then you also know the answer for 3 x 2."
- If desired, have students record the term *Commutative Property* in their notebooks using the **Frayer model**, or add it to your word wall (if applicable).

CLOSING

REVIEW TARGETS:

- Draw student attention to targets.
- Students should create their own statement explaining the commutative property of multiplication using the language frame:
  - _____ *times* _____ *is equal to* _____ *times* _____.

ASSESS:

- Student work on the recording grid can be examined to determine whether students correctly calculated the products and correctly modeled them with an array. A checklist can also be used to record student's use of mathematical vocabulary and/or language frames during the lesson.
- If desired, assign homework: Students write two math sentences to represent each rectangle that they drew (e.g., 4 x 3 = 12 and 3 x 4 = 12). You will use these as a starting point for the next class.

A checklist can also be used to record student's use of mathematical vocabulary and/or language frames during the lesson.

Describing the World Around Us
Lesson 20: Perimeter and Area

The purpose of this lesson is to review both area and perimeter concepts. Students will also investigate the relationship between the two measures.

ESSENTIAL QUESTION(S)	How can we use mathematics to describe the world around us?
GUIDING QUESTION	How do we use multiplication to find the area of a quadrilateral?

DAILY QUESTION	What is the connection between the area and the perimeter of a rectangle?
CONTENT TARGETS	I can compare the area and perimeter of a rectangle.
STANDARDS FOR MATHEMATICAL PRACTICE	MP1: Make sense of problems and persevere in solving them MP2: Reason abstractly and quantitatively MP5: Use appropriate tools strategically MP6: Attend to precision MP7: Look for and make use of structure MP8: Look for and express regularity in repeated reasoning
LANGUAGE TARGETS	I can compare and contrast the area and perimeter of a rectangle. **Comparing and contrasting:** *To measure perimeter, first _____, then _____. We use _____ for perimeter.* *To measure area, first _____, then _____.* *We use _____ for area. When the area _____, the perimeter _____.* *The areas of these shapes are _____. The perimeters of these shapes are _____.*
VOCABULARY	**area:** area*, length* (how long), width* (how wide), dimensions*, perimeter* (distance around), rectangle*, square*, quadrilateral*, square units*, linear units*, measure* **multiplication:** factor*, product*, area*
MATERIALS	Student Activity Sheet 20 Square-Inch Tiles^ Centimeter Grid Paper (provided in Set 4, Lesson 19) Rubric

^Not provided in lesson materials.

GENERAL NOTES

In this lesson, students will review the concepts of both perimeter and area. Students will be able to compare both measures and learn that the area of a rectangle is maximized as it approaches a square, and that the perimeter decreases as the rectangle approaches the shape of a square.

This lesson is designed for 1-2 class periods, depending on your students' needs.

OPENING

WARM-UP:

- In pairs, have students ***measure*** and calculate the ***perimeter*** and ***area*** of a ***rectangle***. Invite students to share their answers.
- **Think-pair-share**: Direct partners to explain their process, using the following questions and language frames:
    - How do we ***measure perimeter****?*
        - *To measure perimeter, first _____, then _____.*
    - What units do we use to ***measure perimeter****?*
        - *We use _____ for perimeter.*
    - How do we ***measure area****?*
        - *To measure area, first _____, then _____.*
    - What units do we use to ***measure area****?*
        - *We use _____ for area.*

CONNECT:

- Elicit from students what they did yesterday. Explain that in the last lesson we saw that two ***rectangles*** can have the same ***area***, but different ***perimeters***. Ask students how that is possible, by showing an example. Explain that today we are going to explore that relationship a little bit further.

WORK TIME

PREPARE:

- **Model** the task on **Student Activity Sheet 20** that students will need to do. Provide an example of a ***rectangle*** with a given ***area***. Invite students up to draw different ***rectangles*** with that ***area***, and to explain their thinking using length and width.

Whenever possible, model with an original example in the front of the room, so that students can then apply this example to the task they will be assigned. This allows students to attend to your model, before handing out the worksheet.

INTERACT:

- Distribute **Student Activity Sheet 20** and additional sheets of **Centimeter Grid Paper** that students will use during their investigation. Students should work in pairs or small groups.

The problems chosen correspond to the previous lesson's problems. Students can refer to their notes from the previous lesson to assist them in completing this investigation.

- Circulate and observe as students are working on the problems. Support students by asking questions and prompting, without rescuing them and giving answers. Allow students to struggle productively, which builds stamina and resilience when faced with a challenge.
- Use the catch and release strategy to give students time to work, and then call them back to process and discuss their thinking as a whole class. For example, consider having students complete page 1 as partners. Then call them back to discuss the questions on the top of page 2.

At this point in the instructional sequence, students may not be able to read and answer questions independently. Catch and release is a way to release parts of tasks to partners then catch them to process together the parts of the task that need more support.

- It may take several periods to allow students sufficient time to work through all problems. In the share, students will then have an opportunity to see if the patterns they found were surfaced through their classmates' investigations as well. A stations- or centers-based approach can also allow students to rotate through different problems at different tables.

EXTEND:

- Questions to ask students to help them recognize a pattern in the table:
  - Do you notice a pattern between the ***lengths*** and the ***widths***?
  - Look back at the different arrays you drew.
  - What happens to the sides of the ***rectangle*** when the ***perimeter*** gets smaller?
  - What happens to the ***area*** of the ***rectangle*** as the ***lengths*** and ***widths*** change?
  - What do you notice about the ***perimeter*** of the ***squares*** compared with the ***perimeter*** of other ***rectangles*** with the same ***area****?*

Possible modifications include: make the numbers used for perimeter and area smaller; make the attribute that is being measured explicit and offer clear direction for this; allow oral answers for questions to reduce writing load. Provide color tiles for students who may still need to use manipulatives arrays.

Some students may fail to recognize the pattern that exists. To aid in the pattern recognition, students can be presented with a modified table that contains an extra column where students are asked to find the difference between the length and the width.

For students who are ready to advance, ask them to apply their new understanding by solving the following problem: Describe how you would construct a rectangle with the largest possible perimeter given an area of 25 square units?

Pattern recognition is very important across all subjects. All teachers should support students in noticing patterns and describing patterns.

CLOSING

REVIEW TARGETS:

- Revisit the language targets from the beginning of class, discussing students' observations from the investigation.

- *When the area _____, the perimeter _____.*
- *The areas of these shapes are _____.*
- *The perimeters of these shapes are _____.*

- Guide student discussion towards the content goals of the lesson. Students should see that as the difference in the ***factors*** gets smaller, the ***rectangle*** approaches a ***square*** and the ***perimeter*** decreases. They should also see that a ***square*** maximizes the ***area*** while having the smallest ***perimeter***.

The quality of student discussion is also an opportunity to assess students' oral communication skills, proper use of mathematical vocabulary, as well as general understanding of the concepts in this investigation.

Students may fail to recognize a pattern solely from the numbers in the table, or may require additional classroom time. It might be helpful to consider technology such as math visualization software and applications that would allow students to more explicitly model the relationship.

ASSESS:

- Collect and evaluate student work using the **Rubric** provided.