Lesson 13

Draw It to Scale (Optional)

Goals

- Compare, contrast, and critique (orally) scale drawings of the classroom.
- Generate an appropriate scale to represent an actual distance on a limited drawing size, and explain (orally) the reasoning.
- Make simplifying assumptions and determine what information is needed to create a scale drawing of the classroom.

Learning Targets

- I can create a scale drawing of my classroom.
- When given requirements on drawing size, I can choose an appropriate scale to represent an actual object.

Lesson Narrative

This culminating lesson is optional. Students use what they have learned in this unit to create a scale floor plan of their classroom.

First, students plan and measure. In groups, they decide on necessary measurements to take, plan the steps and the tools for measuring, and carry out their plan. Next, students make calculations and draw. They choose their scale and method strategically, given their measurements and the constraints of their paper. Then, students reflect and discuss. In small groups, students explain their work, compare their floor plans, and evaluate the decisions they made in creating the scale drawing. As a class, they reflect on how the choice of scale, units, and paper affected the drawing process and the floor plans created.

Access for Students with Diverse Abilities

- Representation (Activity 1)
- Action and Expression (Activity 2)

Access for Multilingual Learners

- MLR7: Compare and Connect (Activity 3)
- MLR8: Discussion Supports (Activity 1, Activity 2)

Instructional Routines

- MLR7: Compare and Connect
- MLR8: Discussion Supports

Required Materials

Materials to Gather

- Blank paper: Activity 1
- Measuring tools: Activity 1
- Graph paper: Activity 2

Required Preparation

Activity 1:
Make any available linear measuring tools available, which might include rulers, yardsticks, meter sticks, and tape measures, in centimeters and inches.

Activity 2:
Prepare at least three different types of paper for each group, which could include:

- $8\frac{1}{2} \times 11$ printer paper
- 11×17 printer paper
- centimeter graph paper
- $\frac{1}{4}$ inch graph paper
- $\frac{1}{5}$ inch graph paper

Lesson Timeline

5 min	15 min	15 min	15 min
Warm-up	Activity 1	Activity 2	Activity 3

Lesson 13

Draw It to Scale (Optional)

Lesson Narrative (continued)

Depending on the instructional choices made, this lesson could take one or more class meetings. The amount of time needed for each part might vary depending on factors such as:

- The size and complexity of the classroom, and whether measuring requires additional preparation or steps (such as moving furniture, taking turns, etc.).
- What the class or individual students decide to include in the floor plans.
- How much organizational support is given to students.
- How the students' work is ultimately shared with the class (not at all, informally, or with formal presentations).

Consider further defining the scope of work for students and setting a time limit for each part of the activity to focus students' work and optimize class time.

Student Learning Goal

Let's draw a floor plan.

Warm-up

Which Measurements Matter?

5 min

This *Warm-up* prepares students to create a scale floor plan of the classroom. Students brainstorm and make a list of the aspects of the classroom to include in a floor plan and the measurements to take.

Students are likely to note built-in fixtures, like walls, windows, and doors, as important components to measure. They may also include movable objects like furniture. As students work, identify those who list positions of objects (e.g., where a blackboard is on a wall, how far away the teacher's desk is from the door, etc.). Invite them to share later.

Launch

Tell students that they will be creating a scale drawing of the classroom. Their first job is to think about which parts of the classroom to measure for the drawing. Give students 2 minutes of quiet think time to make a list, followed by 3 minutes of whole-class discussion. Ask students to be specific about the measurements they would include on the list.

Student Task Statement

Which measurements would you need in order to draw a scale floor plan of your classroom? List which parts of the classroom you would measure and include in the drawing. Be as specific as possible.

Sample responses:

- The lengths of walls
- The size and location of windows and doors
- The size and location of fixed and movable furniture
- The measurements of different floor materials in the classroom

Activity Synthesis

Invite students to share their responses with the class, especially those who included measurements between objects in their lists. Record and display students' responses for all to see and to serve as a reference during the main activity. Consider organizing students' responses by type rather than by items (e.g., listing "furniture" instead of "chairs," "desks," etc.). Some guiding questions:

- *"Which parts of the classroom must be included in a scale floor plan? Which parts are less important?"*
- *"What measurements do we need?"*
- *"In addition to the lengths of walls and objects, what else would be helpful to know?"*

  If no one mentioned the positions of objects, ask how we know where to place certain objects on the drawing.
- *"Should we include vertical measurements? Why or why not?"*

Inspire Math

Movie Monsters video

Go Online

Before the lesson, show this video to review the real-world connection.

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Student Workbook

LESSON 13

Draw it to Scale

Let's draw a floor plan.

Warm-up Which Measurements Matter?

Which measurements would you need in order to draw a scale floor plan of your classroom? List which parts of the classroom you would measure and include in the drawing. Be as specific as possible.

1 Creating a Floor Plan (Part 1)

1. On a blank sheet of paper, make a rough sketch of a floor plan of the classroom. Include parts of the room that the class has decided to include or that you would like to include. Accuracy is not important for this rough sketch, but be careful not to leave out important features like a door.
2. Trade sketches with a partner and check each other's work. Specifically, check if any parts are missing or incorrectly placed. Return their work and revise your sketch as needed.
3. Discuss with your group a plan for measuring. Work to reach an agreement on:
   - Which classroom features must be measured and which are optional.
   - The units to be used.
   - How to record and organize the measurements (on the sketch, in a list, in a table, etc.).
   - How to share the measuring and recording work (or the role each group member will play).
4. Gather your tools, take your measurements, and record them as planned. Be sure to double-check your measurements.
5. Make your own copy of all the measurements that your group has gathered, if you haven't already done so. You will need them for the next activity.

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Instructional Routines

MLR8: Discussion Supports

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Access for Students with Diverse Abilities (Activity 1, Launch)

Representation: Internalize Comprehension.
Activate or supply background knowledge. Demonstrate how to use measuring tools and record measurements accurately for students who are unfamiliar with measuring items longer than a ruler.

Supports accessibility for: Conceptual Processing, Language

Activity 1
Creating a Floor Plan (Part 1)

15 min

Activity Narrative

The purpose of this activity is for students to make preparations to create their scale drawings. They sketch a rough floor plan of the classroom. In groups, they plan the steps for making measurements and then carry out their plan. As students choose which aspects of the classroom they will include in their scale drawing, they are modeling with mathematics.

Some things to notice as students work:

- As they draw their sketch, encourage them to focus on big-picture elements and not on details. It is not important that the sketch is neat or elaborate. What matters more is that it does not omit important features like the door.
- As they make plans for measuring and recording, encourage them to work systematically to minimize omissions and errors.
- Urge students to measure twice and record once. It is better to take a little more time to double check the measurements than to find out during drawing that they are off.

Launch

Give students 1–2 minutes to read the task statement individually and to ask any clarifying questions. Consider displaying a floor plan sketch of another room in the school. Emphasize that the sketch serves a similar purpose as an outline in writing. It does not need to be to scale, accurate, or elaborate, but it should show all the important pieces in the right places so it can be a reference in creating the scale drawing.

Arrange students in groups of 2–4. Smaller groups mean that each individual student can be more involved in the measuring process, which is a benefit, but consider that it might also make the measuring process more time consuming (since it would mean more groups moving about in a confined space).

Distribute blank paper and give students 4–5 minutes to draw a sketch and to share it with a partner. Provide access to measuring tools. Give students another 4–5 minutes to plan in groups and then time to measure (which may vary depending on the size of classroom and other factors).

Student Task Statement

1. On a blank sheet of paper, make a *rough sketch* of a floor plan of the classroom. Include parts of the room that the class has decided to include or that you would like to include. Accuracy is not important for this rough sketch, but be careful not to leave out important features like a door.
2. Trade sketches with a partner and check each other's work. Specifically, check if any parts are missing or incorrectly placed. Return their work and revise your sketch as needed.

3. Discuss with your group a plan for measuring. Work to reach an agreement on:
   - Which classroom features must be measured and which are optional.
   - The units to be used.
   - How to record and organize the measurements (on the sketch, in a list, in a table, etc.).
   - How to share the measuring and recording work (or the role each group member will play).
4. Gather your tools, take your measurements, and record them as planned. Be sure to double-check your measurements.
5. Make your own copy of all the measurements that your group has gathered, if you haven't already done so. You will need them for the next activity.

Answers vary.

Activity Synthesis

After groups finish measuring, ask them to make sure that every group member has a copy of the measurements before moving on to the next part.

Consider briefly discussing what was challenging about doing the measuring. A few important issues that may come up include:

- Making sure that the measuring device stays in a straight line.
- It is hard to be accurate when the measuring device needs to be used *multiple* times in order to find the length of something long, such as a wall.
- Taking turns with other groups that are trying to measure the same thing.
- The measurements are not exact and need to be rounded.

Activity 2
Creating a Floor Plan (Part 2)

15 min

Activity Narrative

In this activity, students use the measurements that they just gathered to create their scale floor plans. Each student selects one of the paper options, decides on a scale to use, and works individually to create a scale drawing. As students determine a scale that will work for their measurements and size of paper, they are making sense of problems and persevering in solving them.

Support students as they reason about scale, scaled lengths, and how to go about creating the drawing. Encourage all to pay attention to units as they calculate scaled lengths. Ask students to think about the different ways that we can write a scale. If they struggle, remind students that a scale can be written in different units or written without units.

Access for Multilingual Learners (Activity 2, Synthesis)

MLR8: Discussion Supports. Display sentence frames to support whole-class discussion: "It was challenging to measure _____ because ...", "I agree because ...", and "The next time I take measurements, I will ..."

Advances: Speaking, Conversing

Instructional Routines

MLR8: Discussion Supports

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Access for Student with Diverse Abilities (Activity 2, Launch)

Action and Expression: Internalize Executive Functions.
To support development of organizational skills in problem-solving, chunk this task into more manageable parts. For example, invite students to draw one section of the room at a time and monitor students to ensure that they are making progress throughout the activity.

Supports accessibility for: Organization, Attention

Building on Student Thinking

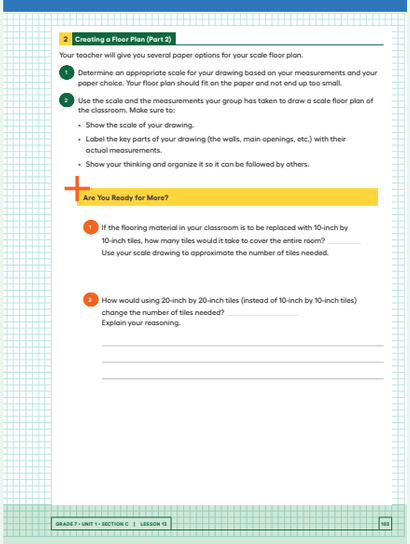
Some students may pick a scale and start drawing without considering how large their completed floor plan will be. Encourage students to consider the size of their paper in order to determine an appropriate scale before they start drawing.

Access for Multilingual Learners (Activity 2, Synthesis)

MLR8: Discussion Supports.
Display sentence frames to support small-group discussion: "First, I _____ because ..." and "Why did you ... ?".

Advances: Speaking, Conversing, Representing

Student Workbook


2 Creating a Floor Plan (Part 2)

Your teacher will give you several paper options for your scale floor plan.

1. Determine an appropriate scale for your drawing based on your measurements and your paper choice. Your floor plan should fit on the paper and not end up too small.
2. Use the scale and the measurements your group has taken to draw a scale floor plan of the classroom. Make sure to:
   - Show the scale of your drawing.
   - Label the key parts of your drawing (the walls, main openings, etc.) with their actual measurements.
   - Show your thinking and organize it so it can be followed by others.

Are You Ready for More?

1. If the flooring material in your classroom is to be replaced with 10-inch by 10-inch tiles, how many tiles would it take to cover the entire room? _____ Use your scale drawing to approximate the number of tiles needed.
2. How would using 20-inch by 20-inch tiles (instead of 10-inch by 10-inch tiles) change the number of tiles needed? _____ Explain your reasoning.

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Launch

Distribute at least three different types of paper for each group, which could include:

- $8\frac{1}{2} \times 11$ printer paper
- 11×17 printer paper
- Centimeter graph paper
- $\frac{1}{4}$-inch graph paper
- $\frac{1}{5}$-inch graph paper

Ask each group member to select a paper for their drawing. Encourage variation in paper selections. Explain that they should choose an appropriate scale based on the size of their paper, the size of the classroom, and their chosen units of measurement. This means that the floor plan must fit on the paper and not end up too small (e.g., if the paper is 11 × 17 inches, the floor plan should not be the size of a postcard).

Give students quiet time to create their floor plan. If the classroom layout is fairly complex, consider asking students to pause after they have completed a certain portion of the drawing (e.g., the main walls of the classroom) so their work may be checked. Alternatively, give them a minute to share their drawing-in-progress with a partner and discuss any issues.

Student Task Statement

Your teacher will give you several paper options for your scale floor plan.

1. Determine an appropriate scale for your drawing based on your measurements and your paper choice. Your floor plan should fit on the paper and not end up too small.
2. Use the scale and the measurements your group has taken to draw a scale floor plan of the classroom. Make sure to:
   - Show the scale of your drawing.
   - Label the key parts of your drawing (the walls, main openings, etc.) with their actual measurements.
   - Show your thinking and organize it so it can be followed by others.

Answers vary.

Are You Ready for More?

1. If the flooring material in your classroom is to be replaced with 10-inch by 10-inch tiles, how many tiles would it take to cover the entire room? Use your scale drawing to approximate the number of tiles needed.

   Answers vary.

2. How would using 20-inch by 20-inch tiles (instead of 10-inch by 10-inch tiles) change the number of tiles needed? Explain your reasoning.

   It would reduce the number of tiles. Each 20-by-20 tile covers 4 times the area of each 10-by-10 tile, so it would take about $\frac{1}{4}$ as many tiles.

Activity Synthesis

Small-group and whole-class reflections will occur in the next activity.

Activity 3: Optional
Creating a Floor Plan (Part 3)

15 min

Activity Narrative

In the final phase of the drawing project, students reflect on their work. Students who chose the same paper option confer in small groups to analyze and compare their floor plans. They discuss their decisions, evaluate the accuracy of their drawings, and consider what revisions they might make. As students consider how they could improve their scale drawing, they are modeling with mathematics.

Then, students debrief as a class and discuss how the choice of scale, units, and paper affected the drawing process and the floor plans they created.

Launch

Arrange students who use the same type and size of paper into small groups. Give them 4–5 minutes to share and explain their drawings. Display and read aloud questions such as the following. Ask students to use them to guide their discussion.

- *"What scale did you use? How did you decide on the scale?"*
- *"Do the scaled measurements in each drawing seem accurate? Do they represent actual measurements correctly?"*
- *"Did the scale seem appropriate for the chosen paper? Why or why not?"*
- *"What was the first thing you drew in your drawing? Why?"*
- *"How did you decide on the objects to show in your drawing?"*
- *"What aspects of your drawings are different?"*
- *"How could each floor plan be revised to better represent the classroom?"*

Next, arrange students who used different sizes of paper into small groups. Give them 4–5 minutes to compare and discuss their drawings.

Student Task Statement

1. Trade floor plans with another student who used the same paper size that you used. Discuss your observations and thinking.
2. Trade floor plans with another student who used a different paper size than you used. Discuss your observations and thinking.
3. Based on your discussions, record ideas for how your floor plan could be improved.

Answers vary.

Instructional Routines

MLR7: Compare and Connect

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Student Workbook


3 Creating a Floor Plan (Part 3)

1. Trade floor plans with another student who used the same paper size that you used. Discuss your observations and thinking.
2. Trade floor plans with another student who used a different paper size than you used. Discuss your observations and thinking.
3. Based on your discussions, record ideas for how your floor plan could be improved.

Learning Targets
- I can create a scale drawing of my classroom.
- When given requirements on drawing size, I can choose an appropriate scale to represent an actual object.

Access for Multilingual Learners (Activity 3, Synthesis)

MLR7: Compare and Connect. After the gallery walk, lead a discussion comparing, contrasting, and connecting the different representations. Ask:

"How do these different representations show the same information?"
"What kinds of additional details or language helped you understand the displays?"
"Were there any additional details or language that you have questions about?"

To amplify student language, and illustrate connections, follow along and point to the relevant parts of the displays as students speak.

Advances: Representing, Conversing

Lesson Synthesis

Though much of the discussion will take place within the groups, debrief as a class so students can see floor plans created at a variety of scales and on different paper types or sizes. Display a range of scale drawings for all to see and discuss the following questions. (Alternatively, consider posting all students' work for a gallery walk.)

💬 *"What is the same about these drawings? What is different?"*

"How did the size of paper impact the choice of scale?"

"What choices were really important when creating the scale drawing?"

"Would these choices be the same if you were doing a different room in the school? Or some other building?"