

Lesson 13: Draw it to scale

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.

The lesson is organised into three main parts:

- **Part 1: Plan and measure.** Each student sketches a rough floor plan of the classroom. In groups, they decide on necessary measurements to take, plan the steps and the tools for measuring, and carry out their plan.
- **Part 2: Calculate and draw.** Students select the paper to use for drawing, decide on a scale, and work individually to create their drawings. They choose their scale and method strategically, given their measurements and the constraints of their paper.
- **Part 3: Reflect and discuss.** In small groups, students explain their work, discuss and 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.

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 (e.g., moving furniture, taking turns, etc.).
 - What the class or individual students decide to include in the floor plans.
 - How much organisational support is given to students.
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- How student 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 optimise class time.

This activity can be modified so that students draw floor plans for different parts of the school—the cafeteria, the gym, the school grounds, and so on—and their drawings could later be assembled as a scale floor plan of the school. If this version is chosen, coordinate the scale used by all students before they begin to draw.

Addressing

- Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

Instructional Routines

- Group Presentations
- Compare and Connect
- Discussion Supports
- Think Pair Share

Required Materials

Blank paper

Graph paper

Measuring tools

Required Preparation

Make any available linear measuring tools available, which might include rulers, yardsticks, metre sticks, and tape measures, in centimetres and inches.

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
- centimetre graph paper
- $\frac{1}{4}$ inch graph paper
- $\frac{1}{5}$ inch graph paper

Student Learning Goals

Let's draw a floor plan.

13.1 Which Measurements Matter?

Warm Up: 5 minutes

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 they will be creating a scale drawing of the classroom. Their first job is to think about what 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.

Student Response

Answers vary. 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 organising students' responses by type rather than by items (e.g., listing "furniture" instead of "chairs," "desks," etc.). Some guiding questions:

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

13.2 Creating a Floor Plan (Part 1)

Optional: 15 minutes

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.

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 minimise 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.

Instructional Routines

- Discussion Supports
- Think Pair Share

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. Emphasise 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 means 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 (as 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 size of classroom and other factors).

Representation: Internalise Comprehension. Activate or supply background knowledge about measurement. Check to see that students are able to use measuring tools and record measurements accurately.

Supports accessibility for: Memory; Conceptual processing

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 omit important features like a door.
2. Swap 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 organise 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.

Student Response

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 which may come up include:

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- 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.

Speaking: Discussion Supports. As students describe their process for measuring features of the room, press for details in students' explanations by requesting that students challenge an idea, elaborate on an idea, or give an example of their measuring process. Provide a sentence frame such as: "It was challenging to measure ____ because" This will help students to produce and make sense of the language needed to communicate their own ideas.

Design Principle(s): Support sense-making; Optimise output (for explanation)

13.3 Creating a Floor Plan (Part 2)

Optional: 15 minutes

In this activity, students use the measurements 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 their drawing.

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.

Action and Expression: Internalise Executive Functions. Chunk this task into more manageable parts to support students who benefit from support with organisational skills in problem solving. For example, invite students to draw one section of the room at a time and monitor students to ensure they are making progress throughout the activity.

Supports accessibility for: Organisation; Attention

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
- Centimetre graph paper
- $\frac{1}{4}$ inch graph paper

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- $\frac{1}{5}$ 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.

Anticipated Misconceptions

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.

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 organise it so it can be followed by others.

Student Response

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.
 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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Student Response

1. Answers vary.
2. 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.

13.4 Creating a Floor Plan (Part 3)

Optional: 15 minutes

In the final phase of the drawing project, students reflect on and revise their work. Students who chose the same paper option confer in small groups to analyse and compare their floor plans. They discuss their decisions, evaluate the accuracy of their drawings, and then revise them as needed.

After revision, 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.

Instructional Routines

- Group Presentations
- Compare and Connect

Launch

Arrange students who use the same type and size of paper into small groups. Give them 8–10 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?

Student Task Statement

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

Student Response

Answers vary.

Activity Synthesis

Before debriefing as a class, give students 4–5 minutes of quiet time to reflect. Ask them to write down ideas for revising their floor plan and strategies for creating accurate scale drawings based on their conversation.

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 and ask students to reflect on these questions.)

- What are the differences in these drawings?
- How did different scales impact the final drawing?
- 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?

Representing, Conversing: Compare and Connect. Use this routine to prepare students for the whole-class discussion. Invite students to quietly circulate and read at least 2 other posters or visual displays in the room prior to the whole-class discussion. Give students quiet think time to consider what is the same and what is different about the visual displays of the floor plans created at a variety of scales and on different paper types or sizes. Next, ask students to find a partner to discuss what they noticed. Listen for and amplify observations that include mathematical language and reasoning about how the choice of scale, units, and paper affect the process of creating scaled drawings.

Design Principle(s): Cultivate conversation



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