Lesson 3

Restaurant Floor Plan

Goals

- Choose an appropriate scale and create a scale drawing for a restaurant floor plan.
- Use proportional reasoning to solve problems about the area or volume of different elements of a floor plan and explain (orally) the solution method.

Lesson Narrative

In this optional lesson, students create a scale drawing of the floor plan for a restaurant and solve problems involving proportional reasoning about the area or volume of different elements within the floor plan.

Students can adapt an outline of their floor plan to make it easier for them to incorporate other requirements, such as the spacing between tables and the maximum distance between the tables and the food pick-up area. This gives them an opportunity to make sense of the problem. Students choose tools strategically when deciding how to make their scale models, including using a compass to draw a circle representing the 60-foot restriction or making physical scale models of tables. This lesson relies on skills developed in Unit 1, Unit 3, and Unit 7.

Student Learning Goal

Let's design the floor plan for a restaurant.

Access for Students with Diverse Abilities

- Engagement (Activity 2)

Access for Multilingual Learners

- MRL7: Compare and Connect (Activity 1)

Required Materials

Materials to Gather

- Blank paper: Activity 1
- Compasses: Activity 1
- Geometry toolkits: Activity 1
- Graph paper: Activity 1
- Index cards: Activity 1

25 min Activity 1

15 min Activity 2

Activity 1
Dining Area

25 min

Activity Narrative

The purpose of this activity is for students to create a scale drawing for a restaurant floor plan. Students use proportional reasoning to consider how much space is needed per customer, both in the dining area and at specific tables. They try to find a layout for the tables in the dining area that meets restrictions both for the distance between tables and from the dining area to the kitchen. Students choose their own scale for creating their scale drawing and choose tools strategically when deciding how to make their scale drawings.

When trying to answer the last two questions, students might want to go back and modify the shape of their dining area from their previous answer. This is an acceptable way for students to make sense of the problem and persevere in solving it.

Monitor for students who design different styles of floor plans:

- Food pick-up area in a corner, side, or the middle of the restaurant
- Tables set up individually, in rows, or in groups
- Indoor and outdoor seating

Each of the floor plans can fit the parameters of this activity. Highlight that there is not one exact floor plan that will be successful.

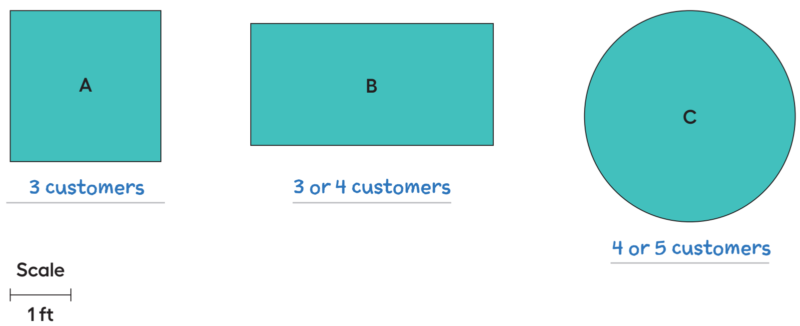
Launch

Provide access to a variety of materials, such as blank paper, index cards, graph paper, geometry toolkits, and compasses. Give students quiet work time followed by partner discussion.

Select work from students with different strategies, such as those described in the *Activity Narrative*, to share later.

Student Task Statement

1. Restaurant owners say it is good for each customer to have about 300 in^2 of space at their table. How many customers would you seat at each table?



Sample responses:

- Table A could seat 3 customers because $30 \cdot 30 = 900$ and $900 \div 300 = 3$
- Table B could seat 3 or 4 customers because $48 \cdot 24 = 1152$ and $1152 \div 300 = 3.84$

Instructional Routines

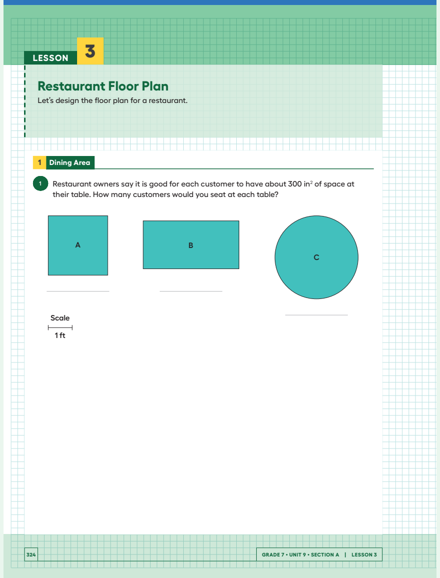
MLR7: Compare and Connect

ilclass.com/r/10695592
Please log in to the site before using the QR code or URL.

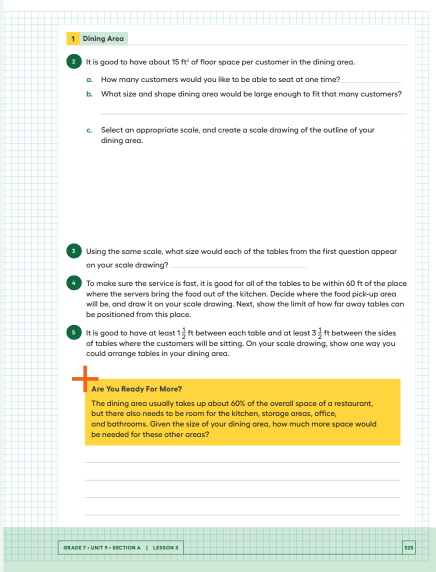
Access for Multilingual Learners (Activity 1, Narrative)

MLR7: Compare and Connect
This activity uses the *Compare and Connect* math language routine to advance representing and conversing as students use mathematically precise language in discussion.

Student Workbook



Student Workbook


1 Dining Area

2 It is good to have about 15 ft^2 of floor space per customer in the dining area.

a. How many customers would you like to be able to seat at one time?

b. What size and shape dining area would be large enough to fit that many customers?

c. Select an appropriate scale, and create a scale drawing of the outline of your dining area.

3 Using the same scale, what size would each of the tables from the first question appear on your scale drawing?

4 To make sure the service is fast, it is good for all of the tables to be within 60 ft of the place where the servers bring the food out of the kitchen. Decide where the food pick-up area will be, and draw it on your scale drawing. Next, show the limit of how far away tables can be positioned from this place.

5 It is good to have at least $1\frac{1}{2}$ ft between each table and at least $3\frac{1}{2}$ ft between the sides of tables where the customers will be sitting. On your scale drawing, show one way you could arrange tables in your dining area.

Are You Ready For More?

The dining area usually takes up about 60% of the overall space of a restaurant, but there also needs to be room for the kitchen, storage areas, office, and bathrooms. Given the size of your dining area, how much more space would be needed for these other areas?

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- Table C could seat 4 or 5 customers because $\pi \cdot 21^2 \approx 1385$ and $1385 \div 300 = 4.61\overline{6}$

2. It is good to have about 15 ft^2 of floor space per customer in the dining area.

a. How many customers would you like to be able to seat at one time?

Sample response: About 80 customers

b. What size and shape dining area would be large enough to fit that many customers?

Sample response: The dining area could be a rectangle with sides 30 ft and 40 ft. This would give an area of 1,200 ft^2, which is enough space for 80 customers because $80 \cdot 15 = 1200$.

c. Select an appropriate scale, and create a scale drawing of the outline of your dining area.

Sample response: Using a scale where 1 cm represents 2 ft, the scale drawing would be a rectangle 15 cm wide and 20 cm long.

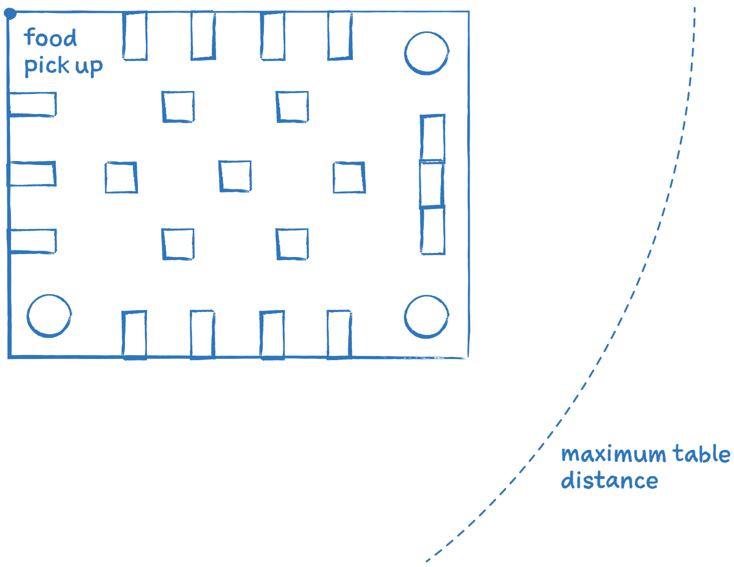
3. Using the same scale, what size would each of the tables from the first question appear on your scale drawing?

Sample response:

- Table A would be a square with sides 1.25 cm.
- Table B would be a rectangle with length 2 cm and width 1 cm.
- Table C would be a circle with a diameter of 1.75 cm.

4. To make sure the service is fast, it is good for all of the tables to be within 60 ft of the place where the servers bring the food out of the kitchen. Decide where the food pick-up area will be, and draw it on your scale drawing. Next, show the limit of how far away tables can be positioned from this place.

Sample response: The food pickup area could be a point in the top left corner of the rectangular dining area. A circle centered on this point with a radius of 30 cm represents the maximum distance to a table.



5. It is good to have at least $1\frac{1}{2}$ ft between each table and at least $3\frac{1}{2}$ ft between the sides of tables where the customers will be sitting. On your scale drawing, show one way you could arrange tables in your dining area.

Are You Ready for More?

The dining area usually takes up about 60% of the overall space of a restaurant, but there also needs to be room for the kitchen, storage areas, office, and bathrooms. Given the size of your dining area, how much more space would be needed for these other areas?

Sample response: If the dining area is 1,200 ft^2, then the other areas would need about 800 ft^2 of space. The fact that the dining area takes up about 60% of the entire restaurant area can be represented with the equation $0.6x = 1200$, where x represents the area of the entire restaurant. The entire restaurant would cover about 2,000 ft^2, because $x = 1200 \div 0.6 = 2000$. The other areas of the restaurant would be about 800 ft^2, because $2000 - 1200 = 800$ or $0.4 \cdot 2000 = 800$.

Activity Synthesis

Provide each student access to a variety of materials for designing their floor plans. This can include blank paper, index cards, graph paper, geometry toolkits, and compasses.

Activity 2

Cold Storage

15 min

Activity Narrative

The purpose of this activity is for students to apply proportional reasoning in the context of area and volume to predict the cost of operating a walk-in refrigerator and freezer.

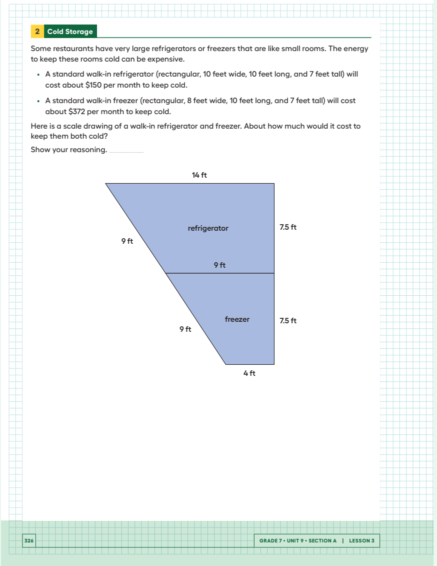
Launch

Arrange students in groups of 2. Give students 1 minute of quiet think time followed by time to work with their partner to solve the problem.

Access for Students with Diverse Abilities (Activity 2, Student Task)

Engagement: Develop Effort and Persistence.
Chunk this task into more manageable parts. If students are unsure how to begin, suggest that they find the volume of the standard refrigerator and freezer before trying to find the cost of cooling the refrigerator and freezer in the problem. Check in with students to provide feedback and encouragement after each chunk.
Supports accessibility for: Attention, Social-Emotional Functioning

Student Workbook

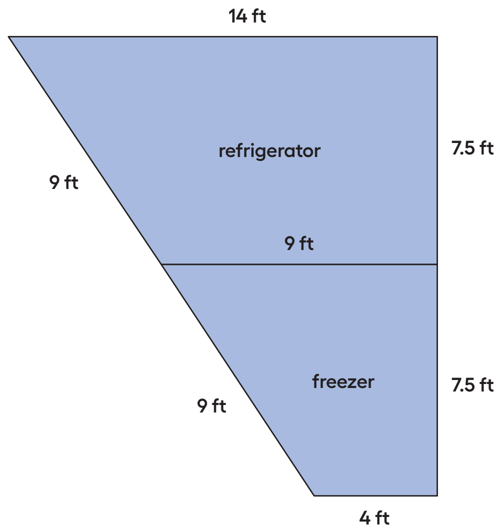


Student Task Statement

Some restaurants have very large refrigerators or freezers that are like small rooms. The energy to keep these rooms cold can be expensive.

- A standard walk-in refrigerator (rectangular, 10 feet wide, 10 feet long, and 7 feet tall) will cost about \$150 per month to keep cold.
- A standard walk-in freezer (rectangular, 8 feet wide, 10 feet long, and 7 feet tall) will cost about \$372 per month to keep cold.

Here is a scale drawing of a walk-in refrigerator and freezer. About how much would it cost to keep them both cold? Show your reasoning.



Sample response:

The total cost to keep both of these rooms cold would be about \$352 per month.

- The walk-in refrigerator covers an area of 86.25 ft^2 because it can be decomposed into a rectangle with an area of 67.5 ft^2 and a triangle with an area of 18.75 ft^2.
- The walk-in freezer covers an area of 48.75 ft^2 because it can be decomposed into a rectangle with an area of 30 ft^2 and a triangle with an area of 18.75 ft^2.
- Let's assume that the refrigerator and freezer shown in the drawings are also 7 ft tall, like the ones given in the example. That means their volumes are 603.75 ft^3 and 341.25 ft^3, respectively, because $86.25 \cdot 7 = 603.75$ and $48.75 \cdot 7 = 341.25$.
- In the example, the refrigerator costs \$0.21 per cubic foot to operate for one month because $150 \div (10 \cdot 10 \cdot 7)$, and the freezer costs \$0.66 per cubic foot because $372 \div (8 \cdot 10 \cdot 7)$.
- The refrigerator in the drawing would cost about \$126.79 to operate for one month because $603.75 \cdot 0.21 = 126.7875$, and the freezer in the drawing would cost about \$225.23 because $341.25 \cdot 0.66 = 225.225$.
- $126.79 + 225.23 = 352.02$.

Activity Synthesis

The goal of this discussion is for students to practice explaining the assumptions they made and the strategies they used to solve the problem.

First, poll the class on their estimates for the cost of operating the refrigerator and freezer. Discuss whether or not the different answers seem reasonable.

Next, select students to share their strategies for breaking the problem up into smaller parts.

Discuss what assumptions students made about proportional relationships while solving the problem. (For example, there is a proportional relationship between the volume of a walk-in refrigerator and the cost to keep it cold.)