Math Link 15: Problem Solving

Motivate Ask students to think about and explain what they know about scale drawings. Then ask them to think about the following problem.

You've decided to redesign some TSN office spaces. You want to expand a small conference room so that its length will be twice as great as it is now and its width will be $1\frac{1}{2}$ times as great as it is now. You want to know how many times greater than the old area will the area of the new room be.

To solve this problem, make a scale drawing of the old conference room. On a piece of graph paper, use a ruler to draw a rectangle that is 3 inches long by $2\frac{1}{2}$ inches wide, and label the length and width.

Teach and Model

- Remind students that blueprints are *scale drawings*. The actual dimensions of objects are usually not labeled on blueprints. In order to find the actual size, you must measure the size on the drawing and use the scale. Have students measure the length and width of their rectangle with a ruler. Remind them to line up the end of the line with the edge of the ruler. Ask them to mark the measurements on the rectangle.
- Tell students that on their scale drawing, $\frac{1}{2}$ inch equals 2 feet. Have them add the scale to the bottom of their drawings.
- ***What steps do we need to take to solve this problem?***
- Students may offer various suggestions for steps. Try to elicit the correct sequence from them, which should be:

  1. Calculate the actual length and width in feet of the current room.
  2. Using the length and width, calculate the area of the current room.
  3. Figure out the length and width of the proposed enlarged room.
  4. Calculate the area of the proposed enlarged room.
  5. Compare the current room's area with the area of the enlarged room.

- Ask students how they can find the actual length and width of the current room. They may have some of their own ideas. ***Since you know the scale is $\frac{1}{2}$ inch equals 2 feet, you can use proportions to figure out how many feet $2\frac{1}{2}$ inches and 3 inches represent. Remember, it will be easier to use decimals here.*** (2.5 instead of $2\frac{1}{2}$ inches and 0.5 instead of $\frac{1}{2}$ inch).
- Write the proportion for width on the board and ask students to cross-multiply. Do the steps aloud. ***Remember, two sides of a proportion must be equal. If on one side inches represent feet, then on the other side inches must also represent feet. In this case, the scale ratio is $\frac{0.5 \text{ in.}}{2 \text{ ft}}$, so the other side has to be $\frac{2.5 \text{ in.}}{x \text{ ft}}$.***

$$\frac{0.5}{2} = \frac{2.5}{x}$$

$$0.5x = 2 \times 2.5$$

$$0.5x = 5$$

$$x = \frac{5}{0.5}$$

$$x = 10 \text{ feet}$$

- On the board, write the proportion for length and ask students to do the steps aloud.

$$\frac{0.5}{2} = \frac{3}{x}$$

$$0.5x = 2 \times 3$$

$$0.5x = 6$$

$$x = \frac{6}{0.5}$$

$$x = 12 \text{ feet}$$

- Continue with the rest of the steps. ***What is the size of the current room?*** (10 feet by 12 feet) ***What is the area of the current room?*** (120 sq. ft) ***How can you find the length of the enlarged room?*** (multiply 12 feet by 2 to get 24 feet) ***How can you find the width of the enlarged room?*** (multiply 10 by $1\frac{1}{2}$ to get 15 feet) ***What is the area of the enlarged room?*** (360 sq. ft) ***How many times greater is this than the area of the current room?*** (three times)
- ***In addition to redesigning some office space, you've decided to build a TSN Shop next to the street level studio. The shop will be 40 feet long by 32 feet wide.***
- Tell students that they need to make a scale drawing of the shop, but they don't yet know how many inches to make the length and width on the blueprint.
- ***This is the opposite of what we just did. In the first problem, we knew the scale size, and had to find the actual length and width. Now we know the actual length and width and need to figure out the scale size.***
- ***We can use proportions again to solve this problem. If the ratio for the scale is $\frac{0.5 \text{ in.}}{2 \text{ ft}}$, then what proportion should we set up to find the scaled length of the room?***
- Write on the board: Length: $\frac{0.5}{2} = \frac{x}{40}$. Remember, since this time we are looking for how many inches to make the length and width on our scale drawing, we place the x in the numerator.
- Solve the problem aloud with students by cross-multiplying.

$$2x = 0.5 \times 40$$

$$2x = 20$$

$$x = 10$$

- ***What proportion can we use to find out how wide to make the store on the scale drawing?*** $\frac{0.5}{2} = \frac{x}{32}$ Solve the problem aloud with students.

$$2x = 0.5 \times 32$$

$$2x = 16$$

$$x = 8 \text{ inches}$$

- ***How large should the scale drawing of the shop be?*** (10 in. long by 8 in. wide) Ask students to use another sheet of graph paper to make a scale drawing of the store.

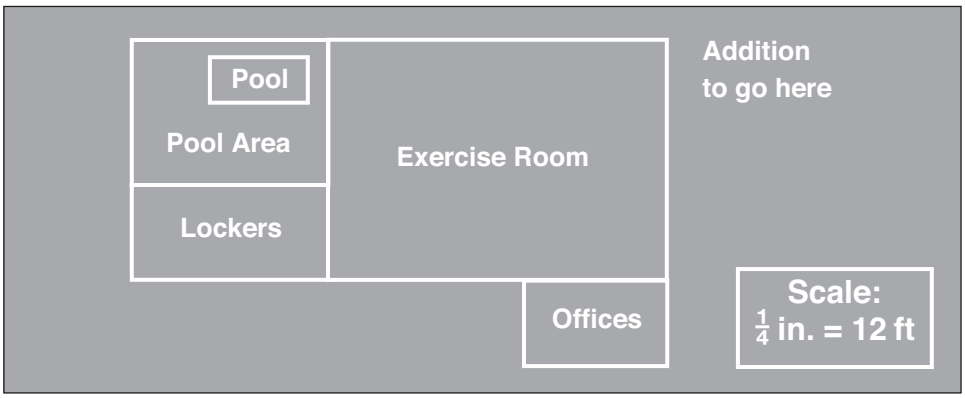
Practice and Apply Have students complete Math Link 15: **Blueprint for Fun**. As they work, copy the following problem onto the board for all students to complete independently. Then invite them to play the corresponding **Gridlock** game.

Make scale drawings of any five objects in the classroom given the scale $\frac{1}{4}$ inch = 2 inches.

Math Link 15: Blueprint for Fun

You are looking into purchasing an old health club and converting it into TSN Fun Zone, a children's sports and play center. The blueprint of the health club is shown below. If TSN buys the health club, it would do the following:

- Add a 45 × 35 foot addition to the building.
- Convert the pool to a sand pit for younger children by reducing the width of the pool by $\frac{1}{2}$ and the depth by $\frac{1}{3}$.
- Increase the length of the offices by $1\frac{1}{2}$ the current length.



Use your ruler to find the lengths and widths of each section of the health club on the blueprint. Record the horizontal measure for each section as the length. Then use proportions to find the actual length and width of each section. Next find the actual area of each section.

Section of Health Club	Length on Blueprint	Width on Blueprint	Actual Length	Actual Width	Actual Area
Lockers	*1 in.*	*0.5 in.*	*48 ft*	*24 ft*	*576 sq. ft*
Pool Area (with pool)	*1 in.*	*0.75 in.*	*48 ft*	*36 ft*	*1,728 sq. ft*
Pool	*0.5 in.*	*0.25 in.*	*24 ft*	*12 ft*	*288 sq. ft*
Exercise Room	*1.75 in.*	*1.25 in.*	*84 ft*	*60 ft*	*5,040 sq. ft*
Offices	*0.75 in.*	*0.5 in.*	*36 ft*	*24 ft*	*864 sq. ft*

If the pool is currently 6 feet deep, what is the volume? *1,728 cubic feet*

What will the volume of the sand pit be? *576 cu. ft*

How much area will be added to the offices? *432 sq. ft*

What is the current total square footage of the health club? *576 + 1,728 + 5,040 + 864 = 8,208 sq. ft*

What will the square footage be after the addition is put on and the offices are expanded? *10,215 square feet*

Show your work here:

24 ÷ 2 = 12 ft long
6 × $\frac{1}{3}$ = 2 ft
6 – 2 = 4 ft (new depth)
12 × 12 × 4 = 576 cu. ft

Show your work here:

(45 × 35) + 432 + 8,208
1,575 + 432 + 8,208 = 10,215

In your Math Journal, write about jobs or careers in which you might need to be able to read a scale drawing.