EXPLORATIONS

Activity 10

# Set Design

## Concepts/Skills

- Proportional reasoning
- Problem solving

## Materials

- TI–15
- Student activity pages (pp. 68 - 71)
- Paper, 12" x 18"
- Pencils
- Rulers
- Photograph of the teacher or one of the students
- Using the TI-15 (p. 72)

### *Overview*

Using the dimensions of the stone carvings on Mt. Rushmore, students will create a proportional representation of the carvings for a stage backdrop.

### *Focus*

- Show students a photograph of your face or that of a student who is in the room. Measure the length of the nose in the photograph, then measure the length of the real nose.
- Discuss with students how knowing those two numbers can help determine the width of the actual mouth by measuring the mouth in the photograph. Record the possible ways to calculate the width that the students propose. Try each of the ideas by measuring the mouth in the photograph and calculating the mouth's length. After several calculations have been completed, measure the mouth and determine which approach worked best.
- Using the best approach, calculate the size of the eye or the height of the forehead. Check the calculated measure with the actual measure.

### *First Things First*

For students not be ready for the open-ended problem, start with the *First Things First* activity page.

### *Presenting the Problem*

Present the problem from the *Set Design* activity page. Discuss the final product with the students, making sure they understand the parameters of the problem and the final product. Students will *not* actually create the stage backdrop. Instead, they will create a scale-model drawing of the backdrop with calculations for determining the full-scale size. For example, if you had a 3" x 5" picture postcard of Mount Rushmore, you could measure each of the

facial features, then increase the measurements proportionally to cover a 12" x 20" piece of paper.

### *Evaluating the Results*

After students have created the scale drawing for the backdrop, have them present their results to the class. Students will probably not use the same calculations to create their drawings.

Have students discuss the various calculations used. The final products may be very different but still meet the required criteria.

Have each group discuss how they used the TI-15 to solve the problem.


Name _____

Date _____

# Activity 10

# Set Design: First Things First

## *The Problem*

Your cousin, Shaniqua, has a wonderful dollhouse. For her birthday, you decide to make a replica of her favorite quilt to put in the dollhouse. The quilt is 86" x 82". The real bed is 60" x 80". The doll bed is 3" x 4". How big should the quilt be?

## *Working the Problem*

What is the relationship between the real bed and the doll bed?
Since the doll bed is made to scale, it has the same proportions as the real bed. The ratio of the short side to the long side is the same for both beds.

1. Enter the two sides of the bed as a fraction. A ratio can be written as a fraction.

   Enter **3** [n] **4** [d] [Enter]. Can you simplify the fraction?
   How do you know?

   What is the fraction in simplest terms?

2. Now use the width and length of the real bed.

   Enter **60** [n] **80** [d] [Enter]. Can you simplify this fraction?
   How do you know?

   What is the fraction in simplest terms?

3. If the two beds are proportional, then both of their ratios are the same.
   Are the ratios the same?
   How does simplifying the fraction help you know the answer?

To make the doll quilt, you need a rectangle that is proportionally the same as the real quilt, but small enough to fit the doll bed. One way to calculate how small it needs to be is to use the dimensions of the real bed and the doll bed. By finding the ratio between the two beds, you can calculate the dimensions of the doll quilt.

4. Take the short sides of the real bed and the doll bed.
   Enter **3** [n] **60** [d] [Enter].
   Is the fraction in simplest terms?

   What is the fraction in simplest terms?

   This fraction tells you the ratio between the real bed and the doll bed. The doll bed is $\frac{1}{20}$ the size of the real bed. So the quilt needs to be $\frac{1}{20}$ the size of the real quilt.

5. Once you know the ratio, you can calculate the length of each side. One way to calculate is to multiply by the ratio of any two similar sides. The ratio for the two beds is $\frac{1}{20}$. For example, the long side of the real bed is 80". To calculate the long side of the doll bed, multiply 80 by $\frac{1}{20}$. Enter **80** [×] **1** [n] **20** [d] [Enter].
   What answer do you get?

   Does your answer make sense?

   How can you calculate the length of the sides of the doll quilt? You can use the same procedures as you did to find the short side of the doll bed. One side of the real quilt is 86 inches.
   Enter **86** [×] **1** [n] **20** [d] [Enter]. What answer do you get?

   Does it make sense?

6. How can you calculate the length of the other side of the quilt? Try it and see what happens.

   Do your answers make sense?

   How do you know?

   How big should you make the doll quilt?

Student Activity

Name _____

Date _____

# Activity 10

## Set Design

### *The Problem: How big can the Mt. Rushmore faces be to be used as a background for a stage?*

The local historical society is going to present a program on President's Day. They have decided to use Mt. Rushmore as the focal point of their presentation. Your team has been asked to design a stage set showing the four Presidents as they are carved on Mt. Rushmore. The historical society president wants the stage set to be proportionate to the sculptures on Mt. Rushmore.

### *The Facts*

- The approximate sizes of the faces on Mount Rushmore are listed in the table below. The height measurement is the height of the face, including the beard on Lincoln. The nose length is measured from a point between the eyebrows to the tip of the nose. The eye span is the distance from the outside corner of one eye to the outside corner of the other eye. The mouth measurement is from one corner of the mouth to the other corner and does not include Roosevelt's moustache.

| | Washington | Jefferson | Roosevelt | Lincoln |
|---|---|---|---|---|
| Height | 60 feet | 54 feet | 60 feet | 70 feet |
| Nose length | 20 feet | 20 feet | 20 feet | 22 feet |
| Eye span | 30 feet | 30 feet | 30 feet | 28 feet |
| Mouth | 18 feet | 18 feet | 16 feet | 18 feet |

- People's faces are generally proportional. The following might help you create the backdrop:
  - The eyes are halfway between the top of the head and the chin.
  - The bottom of the nose is halfway between the eyes and the chin.
  - The mouth is halfway between the nose and the chin.
  - The corners of the mouth line up with the centers of the eyes.
  - The tops of the ears line up with the centers of the eyes.
  - The bottoms of the ears line up with the bottom of the nose.

- The backdrop is 16 feet high and 24 feet wide.
- The faces on Mount Rushmore follow the side of the mountain. Some adjustments may need to be made to make the faces on the backdrop.

### *The Task*

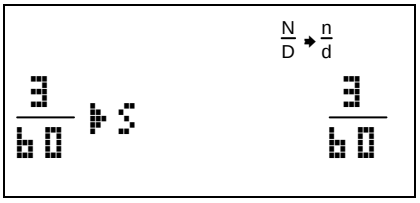
1. Your team is to create a scale drawing of the backdrop. Your drawing will be on 12" x 18" paper. The drawing should show the following:
   - Ovals for the faces
   - Eyes, nose, and mouth on each face
   - The dimensions that will be used on the actual backdrop
   - The scale used for the drawing
2. Each person on the team needs to answer the following questions:
   - How did your team decide on the scale for the backdrop? For the scale drawing?
   - How would the scale drawing change if a different scale was used?
   - How would you go about creating the scale drawing of the Mount Rushmore faces on the 16 by 24-foot backdrop?
3. Your team needs to be prepared to show the scale drawing and explain how the measurements were calculated.

## Using the TI-15

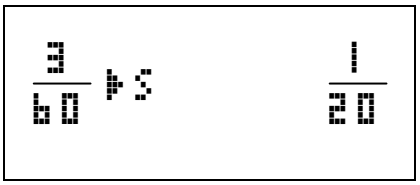
Activity 10

### Set Design

3 [n] 60 [d] [Enter]




[Simp] [Enter]




80 [×] 1 [n] 20 [d] [Enter]