EXPLORATIONS

Activity 13

Yards of Tin

Overview

Students will work in cooperative groups to solve a problem involving surface area of cylinders. They will use data collected from a real-world example, the Lay Family Concert Organ in the McDermott Concert Hall in the Meyerson Symphony Center in, Dallas, Texas. The drawing used for the activity is an actual scale drawing produced by C.B. Fisk Inc., the builder of the instrument.

Focus

♦ Have the students take a cardboard cylinder, such as a toilet paper roll, and draw a line along its height. Have them cut the cylinder along this line and spread the cylinder out, making a rectangle.

♦ Have the students brainstorm ways the surface area of the cylinder could be calculated. Help the students relate the surface area of the cylinder to the area of a rectangle.

♦ Have them determine how they could measure the two dimensions needed (height and circumference). Discuss how circumference and diameter are related with the students.

Presenting the Problem

1. Review the four steps of problem solving with the students:
   – understanding the problem
   – making a plan
   – carrying out the plan
   – evaluating the solution

   Have the students read *The Problem* page and paraphrase the problem.

2. Discuss the information on the problem page. Help the students relate the toilet paper roll problem to solving the problem of finding the surface area of the pipes. Help them identify the cylindrical part of the pipes. The students will be finding the surface area of open cylinders.

3. The scale for the drawing is not given. The students have to determine the scale using the measurement of the left-hand pipe.

4. If groups have difficulty with the problem, use the *Things to Consider* page. This page provides guiding questions to help the students complete the problem-solving steps.

5. Have the students post their charts and present their results to the rest of the students.

Evaluating the Results

1. After the presentations are made, have students examine the various solutions presented. Ask:

    ♦ *How are the presentations similar?*

    ♦ *How are the presentations different?*

2. Ask them to compare the numbers used.

    ♦ *Did all groups use the same numbers?*

    ♦ *Why do you think this is so?*

3. Ask them to determine the reasonableness of the results.

    ♦ *Did each group answer the question?*

    ♦ *Do the numbers used make sense?*

4. Ask students to analyze the different ways groups used the calculator to solve the problem.

    ♦ *How did the results differ, if at all?*

5. Ask them to extend their thinking.

    ♦ *If one square foot of tin weights 3 lbs., about how much do these ten pipes weigh?*

Additional Information

Additional information about the Lay Family Concert Organ can be found at these websites:

www.tneorg.com/cbfisk/organs/op100_01.html

www.dallassymphony.com/organ.html

Activity 13

Yards of Tin

The Problem: How much tin will it take to make copies of the ten largest pipes of the Lay Family Concert Organ?

Quintadena, the wealthy troll, wanted a wind chime for her patio. She saw the pipes of the Lay Family Concert Organ and thought they would be just the right size. Unfortunately, the Dallas Symphony would not sell her the ten longest pipes. In fact, they didn't want to sell her any pipes at all. She needs your team to measure the pipes so she can have copies of them made.

The Facts

♦ There are 4,535 pipes in the organ, 70 of which can be seen.

♦ The longest pipe is over 32 feet tall. The shortest pipe is less than 2 inches tall.

♦ The pipe on the left side of the drawing plays low F#. The cylindrical part of the pipe is 22 feet tall.

♦ The diameter of each pipe is different. The diameter is approximately the width of the pipe as drawn on the diagram.

♦ Each pipe is made of a cylinder and a cone. The height of the cylindrical part of the pipe determines the pitch of the pipe. The longer the cylinder, the lower the pitch.

The Task

1. Your team will create a chart or graph showing the following information:

   ♦ The height of the cylindrical part of each of the ten longest pipes

   ♦ The diameter of each of the ten longest pipes

   ♦ The circumference of each of the ten longest pipes

   ♦ The surface area of the cylindrical part of each of the ten longest pipes

   ♦ The square footage of the tin needed to make the cylindrical parts of the ten longest pipes

2. Each person on the team will write an explanation of the team's solution. This explanation will answer these questions:

♦ How did you calculate the height of each pipe?

♦ How did you calculate circumference and surface area of each pipe?

♦ Would the method you chose to calculate the circumference and surface area work for any cylinder? How do you know?

♦ Do your calculations make sense? How do you know?

♦ If tin can be purchased in rolls that are 4 feet wide and 100 feet long, how could you estimate how many rolls it would take to make the pipes for Quintadena's wind chime?

Things to Consider

Understanding the Problem

Read the *Yards of Tin Problem* page, and then answer these questions.

♦ What do you need to know about each pipe to calculate the surface area?

♦ What numbers do you already have? What numbers do you still need?

Making a Plan

Before you make your plan, answer these questions.

♦ How will you find the numbers you need? How does knowing the height of the left pipe help you?

♦ A scale drawing is like a map. How do you use a map scale to find distances on a map? How can you find out the scale for this drawing? How will the scale for this drawing help you find the height of each pipe?

♦ What calculations will you need to answer the question?

Carrying Out the Plan

Before you begin planning your presentation, answer these questions.

♦ What does your presentation have to include? Do you have all of the necessary information? What other calculations do you need to make?

♦ How will you display your information? How could you use a chart to show the information? How could you use a graph? Which method of sharing your information does your group like the best? Why do you suppose that is true?

Evaluating the Solution

♦ Did you answer the question? How do you know?

♦ Does your answer make sense? Did the larger pipes have more surface area or less? How do you know?

♦ Did everyone in the group write an explanation?

Yards of Tin: Finding surface area

1. Beverly is working on scenery and props for the school play. She has to paint the exterior of open cylinders and two sizes of cubes. The paint can says that one quart of paint will cover 325 square feet. She has to paint 4 cubes that are 2 feet on each side, 4 cubes that are 3 feet on each side, and 4 open cylinders that are 1 foot in diameter and 3 feet tall. How much paint does she need?

   To solve this problem, you need to know how to calculate surface area. Each face of a cube is a square. There are 6 faces on a cube. If each face is 1 square foot, then there are 6 square feet of surface area on a one foot cube. How much surface area is there on each 2-foot cube?

   To find the area of one face, multiply 2 x 2.

Press:	The display shows:
2 ⊠ 2 Enter	

   Since there are six congruent faces on a cube, you can multiply the surface area of one face by 6 to get the surface area for the whole cube.

Press:	The display shows:
2 ⊠ 2 ⊠ 6 Enter	

   Try this process again for the 3-foot cubes.

   Now calculate how much surface area is on 4 cubes of each size.

2. The surface area of a cylinder is a little different. Roll a piece of paper into a tube. This is an open cylinder. To find the area of the cylinder, you need to know the circumference of the circle (which is the same as one edge of the paper) and the height (which is the same as the other edge of the paper). To find the circumference of the circle, multiply the diameter by π.

Press:	The display shows:
1 ⊠ π Enter	

   To find the number the calculator used for π, enter F↔D.

Now multiply the answer times the height of the cylinder.

Press:	**The display shows:**
⊠ 3 ⌷Enter⌷	

The answer is the surface area of one open cylinder in square feet. (Use the ⌷Fix⌷ key to limit the number of decimal places showing.) What is the surface area of four cylinders?

What is the total surface area that needs to be painted? How many quarts of paint does Beverly need to complete the scenery for the play?
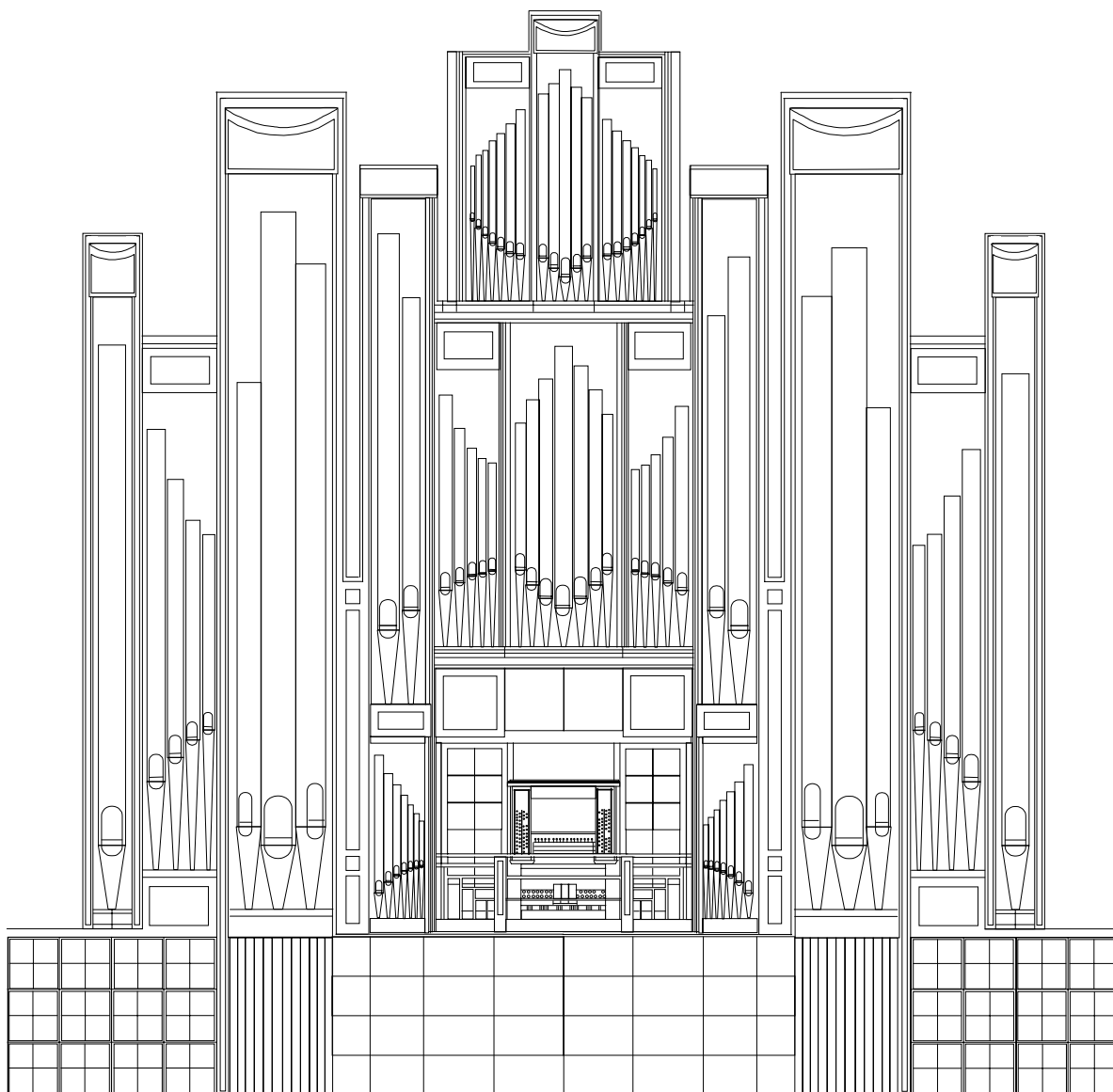
The Lay Family Concert Organ   C.B. Fisk, Opus 100

The Dallas Symphony Orchestra

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