PBS Mathline®

The Elementary School Math Project

Bubble Mania

Math Grows Up (Measurement)

Objective

The students will measure the diameter, approximate the circumference, and determine the area of a soap bubble print.

Overview of the Lesson

Students are given opportunities to practice measurement skills as they examine a soap bubble print. Students follow a recipe to make a soap bubble solution. They use the soapy solution to blow large bubbles with a plastic drinking straw until they pop leaving behind a circular print. Students find the diameter, circumference, and area of the bubble print.

Materials

Teacher:

- Bubble wand, paper cup with bottom cut out, or other device to blow bubbles
- Bubble solution
- Cut-out of circle for board demonstration
- Ruler
- 1 sentence strip

Each group of four students:

- One plastic drinking straw
- One plastic container to hold bubble solution
- Water
- Liquid measuring cup
- Small cloth
- 1/4 cup dishwashing liquid
- 30 centimeter ruler
- 4 sentence strips
- Spoon or paint stirrer
- Laminated grid designating square units (approximately 45cm x 45cm)
- Activity Sheet: Centimeter Square Graph Paper

Procedure

Motivate students by blowing bubbles from a soap bubble solution and then asking them to suggest math activities that could relate to bubbles. Encourage students to think about the different types of measurement that they have used during the year.

Divide the class into groups of four. The recipe for the soapy solution, (2 cups water, 1/4 cup dishwashing liquid) as well as a plastic container, liquid measuring cup, and spoon or paint stirrer are on a tray for each group. Instruct students to make a soap bubble solution by first measuring the ingredients and then mixing the ingredients together.

After each group has made its soap bubble solution, reassemble the group for a demonstration. Place a cut-out of a circle on the board. (It is really a circular region, as a circle is the set of points equidistant from a given point.) Tell the class to pretend that this circle is a bubble. Use a 30 centimeter ruler to demonstrate the measurement of the diameter of a circle. The diameter of the circle is the widest part of the bubble that they could measure. (The diameter also passes through the center of the circle). Dip a cloth or paper towel into the soap bubble solution. Wet a student desk by rubbing the saturated cloth across the desktop to cover an area of about 18 inches in diameter. Dip a plastic drinking straw into the bubble solution and place it at a 45° angle on the wet desktop. Blow gently to form a bubble. Continue blowing until the bubble pops. After the bubble pops, a noticeable circular print made by the bubble will remain on the desktop. Use a ruler to measure the diameter of the bubble to the nearest centimeter. Have the students work in groups to follow the procedure that was demonstrated to make and measure the diameter of a bubble print.

After the students have completed the activity, discuss the results and have the students compare their bubble sizes. You may wish to see which bubble had the largest/smallest diameter and find the difference.

Tell the students that they are now going to measure the distance around the circle which is called the "circumference". Students should realize it is difficult to use a straight ruler in accomplishing this task. Have the students work in their groups to complete this task. The students can use a sentence strip approximately 20 inches (30 cm) long as a measuring tool. Demonstrate the same procedure in making a bubble print. Instead of a ruler, use the strip of paper to measure the diameter and place a "D", on the paper to indicate its length. Then bend the paper to fit around the circle. Write a "C", for circumference, where the paper wrapped around the circular bubble print one time.

After students have finished, discuss the results of the activity. Focus students' attention on the relationship of the diameter to the circumference. Ask students to estimate the relationship between the diameter and circumference. Have them respond to the question by holding up the appropriate number of fingers. If they measured correctly, the circumference should be about three times greater than the diameter. Ask students if the size of the bubble would have any effect on this relationship. Lead students to understand that the ratio would be the same for all sizes of circles.

Tell the students that they are now going to measure the area of the bubble. They will follow the same procedure as before except that this time they will use a square grid as their wet surface instead of a desk. After the bubble is blown and popped, students count the number of squares covered by the bubble. Partial squares can be estimated and combined to form whole squares. In the video, students used small centimeter cubes to outline the prints of their bubbles.

After students have completed the activity, results can be compared.

Mathematically Speaking. . .

In this lesson students experiment to find the relationship of the diameter to the circumference of the circle. They determine that it is approximately three times the diameter, $C \approx 3D$, or $1/3\ C \approx D$. (Some students may say that 1/3 the circumference is approximately equal to the diameter). You might see the formula written $C = \pi d$ where π is approximately 3.14.

Students also need experiences in finding area of shapes. Using the square unit grid reinforces the concept that the measurement of area is not linear, as in finding the diameter or circumference, but rather is measured in square units. At this stage of learning, it is not necessary for students to compute the exact area of a circle but rather have experiences counting whole square units and approximating partial units.

Extensions & Connections

Have the students build a Bio-Dome to practice measurement skills. See the directions for building a Bio-Dome. Note the Bio-Dome in the video has a rectangular base and is used to reinforce student understanding of the concept of area.

Have the students collect and graph the class data concerning the diameter, circumference, and area of the bubble prints. Using a calculator, they could also determine the median and mean of the data.

Have students design and execute a "fair" experiment comparing the size of bubbles of three different brands of dishwashing liquid.

Encourage students to design an experiment to compare bubble size using different recipes for the soap bubble solution.

Resources

Soap Films and Bubbles: Activities to Integrate Mathematics and Science (AIMS). (1987). Fresno, California.

Ideas for Online Discussion

(*Some ideas may apply to more than one standard of the* ***NCTM Professional Standards for Teaching Mathematics.)***

Standard 1: Worthwhile Mathematical Tasks

- To what extend are the underpinnings of algebraic concepts developed?
- How does the bubble task expand the knowledge of the students?
- In a heterogeneous group of students, how does the teacher design this activity so the side range of learning styles and abilities are addressed?

Standard 2: Teacher's Role in Discourse

- Sensing when to intervene is an important aspect of teaching. At which point does the teacher intervene, and would you have chosen the same strategy?

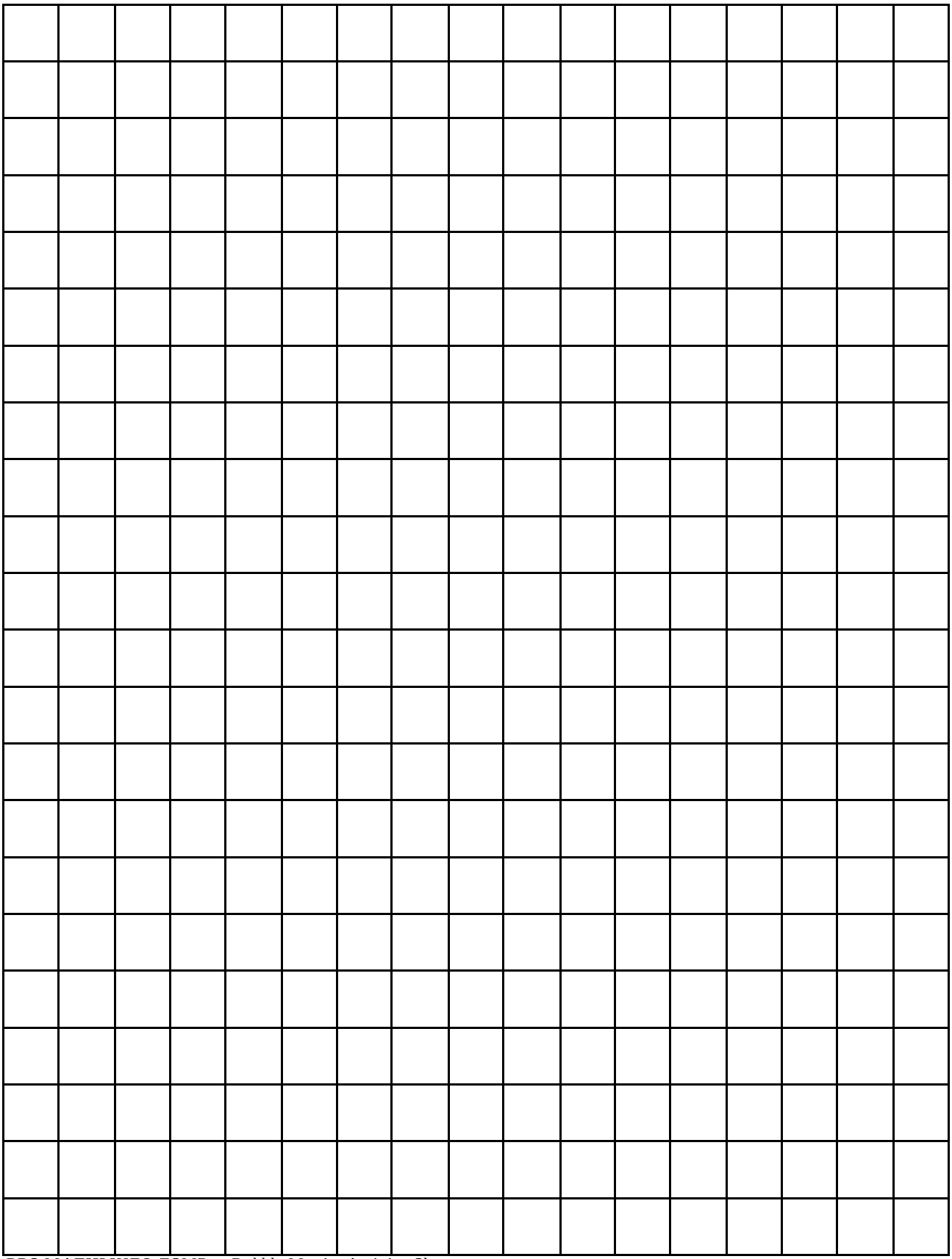
Standard 3: Students' Role in Discourse

- When students try to convince one another of the validity of their reasoning in their particular group, they are communicating mathematically. This is a key component to every math class. How do you encourage this and what do you do to improve how they explain their reasoning?

Standard 5: Learning Environment

- What evidence do you see to indicate that this classroom is set up to encourage student investigation, collaboration and risk-taking without confrontation?
- The Bio-Dome reviews finding the area of the rectangular base. Do experiences like this help students see the relevancy of mathematics?

CENTIMETER SQUARE GRAPH PAPER



BIO-DOME

Directions for Building a Bio-Dome

1. Obtain a clear piece of 4 mil polyethylene film, approximately 12'x24'.

2. Fold it in half so you have a double thickness 12 feet long. Trim ends with scissors so they will be even when taping.

3. Seal the three open sides with a 2-3 inch wide piece of masking tape. Asbestos or refrigeration tape can be used. It need not be completely airtight.

4. Make a 4 foot tube of the same plastic film which will fit around a large window fan.

5. Cut a slit in the dome and tape the air supply tube to the dome.

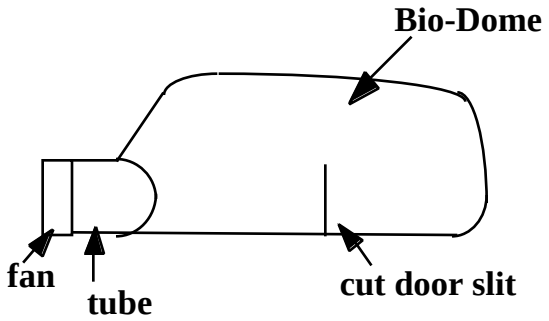
6. Tape the face of the fan to the open side of the tube. After taping the tube to the fan, turn it on. The dome will inflate in about three minutes.

Construction Steps for Air Supply

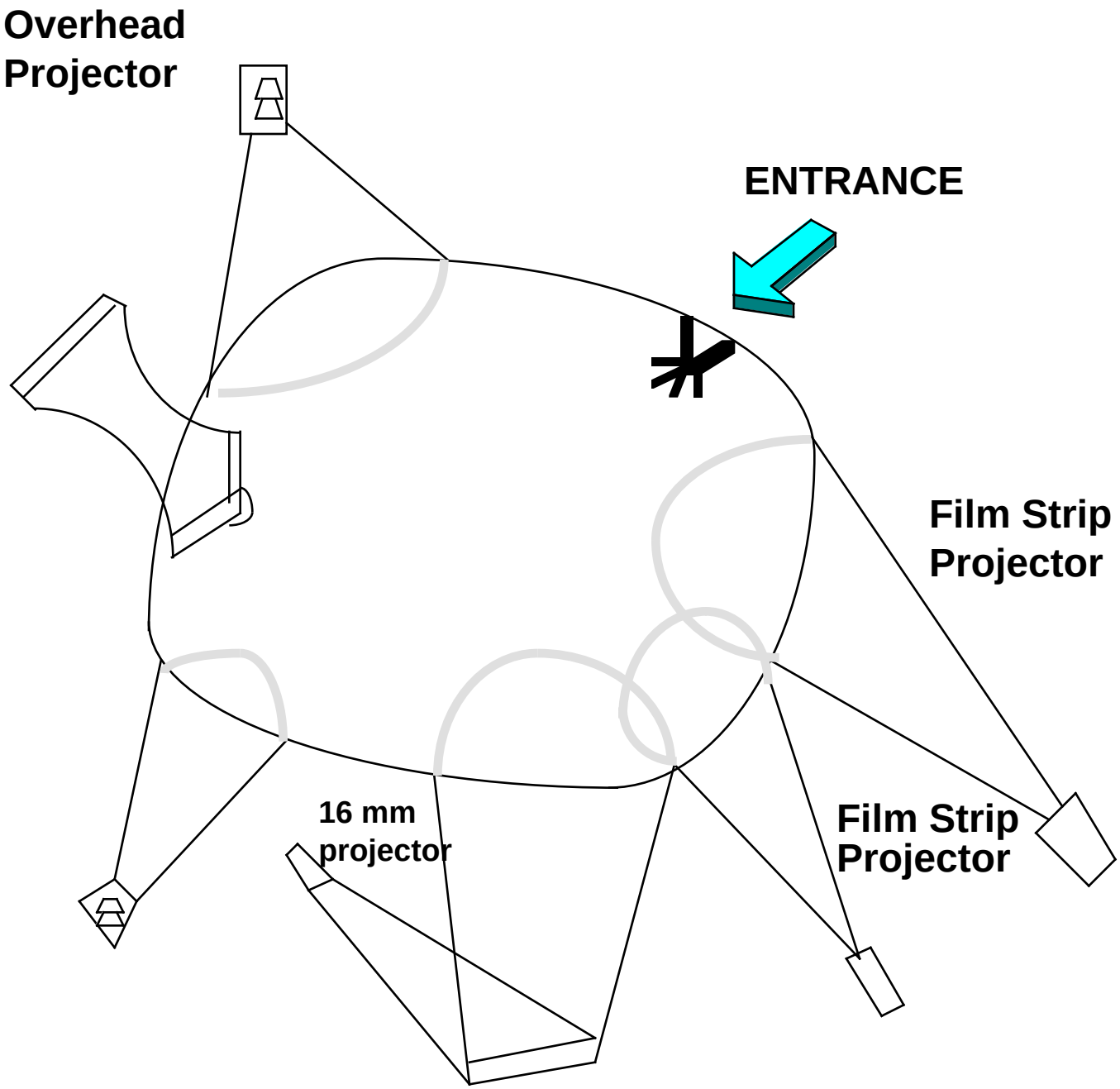
1. Measure the distance around the fan. This is how wide the piece of 4 mil plastic film has to be. NOTE: It is advisable to add about six inches to the total measurement so it will fit around the fan easily.

2. The tube should be cut to an approximate length of four feet.

3. Tape the two edges together, leaving two open ends. One of the ends will be taped to the dome and the other will be taped to the fan.



Bio-Dome Set-up Extension



Extensions for Using Bio-Dome

Production Notes:

1. Obtain three to four filmstrip or filmloop projectors with accompanyimg filmstrips or filmloops that concern themselves with your chosen theme (the sea in this case).

2. You could cover the inside floor with carpet to add a soft feeling.

3. To make it ankle deep with pastel-blue balloons is more like water.

4. Blue and green crepe paper streamers and Christmas tinsel hang from the dome and gently sway in the air currents.

5. Two overhead projectors. Use dark blue acetate on the stage. Place a clear flat-bottom glass bowl on the acetate and add six to eight goldfish. Focus these fish on the bubble.

6. The record, The Sea (RCA) by Rod McKuen and the Sebastian Strings along with Anita Kett is used as background music and words.

7. The bubble is initially dark inside. A black polyethylene film cover to throw over the bubble. The particiapant-observers enter into the dark. All projectors are turned on. At the appropriate time in the introduction the black plastic film is slowly drawn back.

8. The effect within the bubble is best if the room in which the bubble is located can be blacked out.

9. If you can find an air freshener that smells like the sea or its's suroundings, it coul be sprayed (a tiny bit) into the fan. It will carry the smell throughout the inside of the buble.

10. A 16 mm movie about the sea can also be projected on the bubble provided that it is first projected into a large mirrow and reflected.