Play doughometry & Measurement: Teaching Notes

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GRADE RANGE: 6-8

MATHEMATICAL TOPICS: measurement, estimation, geometry, area, circumference, surface area and volume

MATERIALS:
For students: can of play dough, plastic knife
For Teacher: Demo tray

Discussion of the Mathematics
Using play dough or clay enables one to create modified versions of circles, cylinders, spheres, etc. These versions will be, obviously, approximations, but, nevertheless, will allow the student to thereby discover, prove, and make conclusions about such concepts as circumference, volume, and even density. It serves as a therapeutic tool for all ages. Activities can range from k-12, but the focus of this section will be on grades 6-8.

Implementation
It is a good idea to have desktops cleaned and cleared before working. A sheet of paper may be placed underneath to maintain cleanliness.
Buy cans of play dough in bulk- Dozens of cans require minimal storage space and can be distributed quickly. Try to assign each student his/her own can/color. This may help avoid the temptation to waste the play dough by eating or throwing it.
Plastic knives for shaping are easily acquired and are safe.

In referring to a "cord", as in a length of "string", introduce the term "chord", but be sure to distinguish between the two words.
When molding spheres according to a given diameter, students can use a long straight pin, or a piece of spaghetti, sticking it through the surface to the core to measure the diameter of the sphere. Another strategy is to cut the sphere in half to measure across, then reconstruct the sphere.
If you have already worked with the spreadsheet and each student has access, students can set up their own. If not, whole class may use single computer and screen while each student inputs data.

Questions to Ask Students
Were your estimates close to the actual length of the cords?
Did you estimates tend to be longer or shorter than the actual lengths?
How long would a circumference be in order to construct a circle with a given diameter?
How does the diameter of a circle compare to the circumference?
Do you see a relationship between the diameter and the circumference?
What math tem describes the crust of a pizza? How is the crust different from the region inside the “circumference”?

**Students’ Typical Responses**
There may be confusion between cm and mm. As students attempt to measure incorrectly, the nature of the activity may help them realize and fellow students will help each other avoid the error.
Students often confuse diameter with radius. Emphasize the distinction between the two.
Some students may make silly objects with the play dough and get “off task”. Try to encourage them to accomplish the class objective.

**Credit**

2003 Yearbook, NCTM
# Rolling Lengths, forming circles

1. Practice making a cord, like a length of string. For each cord you make, estimate the length. Then measure each segment (with a ruler) to check your estimates.

<table>
<thead>
<tr>
<th>Cord</th>
<th>Estimated length</th>
<th>Actual length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Given the target measurements below, roll out cords, trying to achieve those measurements. After you have those cords, use your ruler to compare the target with the actual measurement.

<table>
<thead>
<tr>
<th>Cord</th>
<th>Target length</th>
<th>Actual length</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10 mm</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>60 mm</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3.4 cm</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>12.1 cm</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>250 mm</td>
<td></td>
</tr>
</tbody>
</table>

3. Using the cords from number 2, make a circle with each cord. Estimate the diameter, then measure with ruler.

<table>
<thead>
<tr>
<th>Length of cord (Circumference)</th>
<th>Estimated diameter</th>
<th>Actual diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

4. Try to construct a circle, given a target diameter.

<table>
<thead>
<tr>
<th>Target diameter</th>
<th>Estimated length of cord (Circumference)</th>
<th>Actual Circumference</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>33 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 cm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78 mm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 cm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Area of Pizza

1. With a partner, construct different sizes of “pizza”, one with an “x” inch diameter and one with a “y” inch diameter.
2. Now, use your knife to mark off a centimeter grid. Put a “pepperoni” on each square cm. (We’ll call these “bites”.)

Like this:

3. How many more “bites” do you think the larger pizza has? (How many times bigger is it?)

4. Now count the bites
   - x in. diameter pizza “bites” (square centimeters)
   - y in. diameter pizza “bites”

5. Compare the pizzas of the students’ in your class.
   - Number inches in diameter pizza
   - “bites”

6. Use your computer program GSP to compare the areas of each of the circles above. Then,
make a conclusion about circles, and how their radii and diameters affect their area. What happens to the area when the diameter of a circle doubles?
Comparing Spheres

1. Create 2 obviously different size “balls” (spheres).
2. Cut each sphere in half.
3. Measure the diameter of each. Sphere 1 sphere 2
   Diameter ________ ________
4. How many times bigger is the diameter of sphere 2?________
5. How many times bigger do you think the volume (how much play dough) of sphere 2 is? (Make a hypothesis.)
6. Now use your GSP to record the diameters of the other spheres in the class.
7. Now break up larger into smaller spheres.
8. How many smaller spheres could you make?_____________________
9. Were you surprised by these findings? Why or why not?______________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
10. What conclusion can you make about the diameter of a sphere compared to its volume?___________________________________________________________
   ___________________________________________________________________
11. Work with a partner. Mold a sphere with a diameter of 2 inches. Make 2 spheres with diameters of 1 inch each.
12. Are the two small spheres the same as the larger? Try to design an experiment to figure this out. Show what you did and what found out. Use the space below to write about it and diagram.
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
Density

1. Make two spheres, one of 1 in diameter, and one of 2 inch diameter
2. Weigh each sphere:
   1 inch diam.=________________
   2 inch diam.=________________
3. Is the larger sphere doubled in weight? In volume?
4. Do they have the same density? (D=M/V)
   \[ V = 4 \times \pi \times \text{“} r \text{ squared”} \]
More With Spheres-
Circumference

1. Construct a sphere.

2. Measure the diameter of the sphere. \( D = \)_______________
3. Construct a cord to go around a sphere. (This is the circumference.)
4. Measure the circumference of the sphere. \( C = \)_______________
5. Form a larger sphere and do the same as for the smaller sphere.
   \( D = \)_______________ \( C = \)_______________

6. How many times greater is the circumference of the larger sphere?
7. What can you say about the comparison of the diameter of a sphere to the circumference of a
   sphere?______________________________________________________________

8. Why would this be true?
Cylinder

1. Flatten out a rectangle (Use a knife to square the sides and angles)
2. What 3-d figure can be partially made with this rectangle?
3. How could you make a top and a bottom (bases)? Try to make the bases using what you know about cylinders
4. Now start with the two bases (circular)
5. Measure the diameter, multiply by pi.
6. The result from #5 would be the length of the rectangle (This is the Lateral Area)
7. Work with a partner. Fill the cylinder with spherical marble-sized balls. Count them. (This is like the approximate volume)
8. Make a cylinder which has double the height and half the diameter.
9. Predict the volume. (How many marbles?) (Do you think it will be the same?)
10. Repeat #7 for the larger cylinder. Were your predictions close to your findings? Explain what you found.
11. Construct a spreadsheet comparing the height, radius and volume of several cylinders from the class. Use the formula for the volume of a cylinder.
12. Compare, predict and conclude! Write your observations.