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Measurement Tasks for the Middle Grades

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Introduction

Although measurement is one of the most useful mathematics topics for the average citizen, national and international exams point to measurement as a weakness for middle school students. (Mullis, et al, 2000) A problematic feature of measurement education is the lack of challenging and meaningful measurement experiences for students. This article includes eight measurement activities for middle school students that we have used successfully. There are also a variety of other resources developed by the National Council of Teachers of Mathematics (NCTM) for teaching measurement in the middle grades. (See [1], [3], [5], in the References.)

Teacher Notes on Tasks

Activity 1: You Think a Gallon of Gas Is Expensive?

This activity has students comparing the costs of various liquids to a gallon of gasoline. Students are often amazed at the results, and this activity provides opportunities for students to practice conversion of units. The prices in the table need updating on a regular basis, or, as an alternative, they can be left blank and the students can investigate and find the prices themselves. After

the activity, you can tell the students "Be glad cars don't run on *Nyquil,* or *Scope,* or *Whiteout,* or perfume or . . . "

Activity 2: How "True" is the Roll?

This activity requires students to design and carry out a measurement experiment. Teachers can supplement this activity with a discussion of the importance of taking several measurements as well as introduce concepts of accuracy, precision, relative error, and significant digits. For a discussion of these topics, see Collier and Thompson, [2].

Activity 3: How Big is Antarctica?

This activity is taken from the Programme for International Student Assessment [PISA] (OECD, 2002). This activity helps students to develop a richer understanding of area by finding the area of an irregular figure, and ultimately, to realize that not all math problems have ready-made formulas. One method of solution is for students to place a grid over the continent and estimate the area. You can follow up this activity by providing your students with other irregular figures so that they can practice measuring strategies and estimation skills.

Activity 4: Wheelchair Ramps

Wheelchair ramps have numerous regulations; for example, ramps cannot be too steep, must be perpendicular to the curb, have a level landing, etc. This activity requires students to apply their measurement skills to explore slope and other ratios in an authentic situation. Have students investigate current regulations for wheelchair ramp slopes and compare these to their own measurements. For guidelines, see ADA accessibility guidelines for buildings and facilities at http://www.access-board.gov/adaag/html/adaag.htm.

Activity 5: Straw Box Activity

This activity provides students a hands-on experience with volume by designing and constructing a box or package using card stock. To practice the metric system, have students construct the packages in both customary and metric units.

Activities 6 & 7: Joe Dirt and Waterbed Fiasco

These tasks have the benefit of being intriguing to students while also involving a significant amount of measurement knowledge; in particular, conversions. The waterbed task is an open-ended problem that lends itself to a rich investigation.

Activity 8: Create a Unit

Many students rarely get the opportunity to see how mathematics is created or to create mathematics for themselves. This

activity has students creating their own measures. Be ready for some creative ideas from you students! For additional ideas on creating a unit, visit Russ Rowlett's website on measurement at http://www.unc.edu/~rowlett/units/

The Activities

You Think a Gallon of Gas is Expensive?

Using the cost given, compute the cost per gallon. Now, is a gallon of gas expensive?

Common Price	**Price Per Gallon**
Regular Gasoline $2.89 for one gallon	$2.89
Diet Snapple $1.29 for 16 ounces	
Lipton Ice Tea $1.19 for 16 ounces	
Gatorade $1.59 for 20 ounces	
Ocean Spray $1.25 for 16 ounces	
Pepsi at football game $3.00 for 20 ounce	
Milk $3.19 per gallon	$3.19
Brake Fluid $3.15 for 12 ounces	
Vick's Nyquil $8.35 for 6 ounces	
Pepto Bismol $3.85 for 4 ounces	
Whiteout $1.39 for 7 ounces	
Scope $0.99 for 1.5 ounces	
Evian water $1.49 for 9 ounces	

What item was most expensive per gallon? Did that surprise you?

What other items could you add to the list?

How "True" is the Roll?

Are all golf balls true in how they roll across a green? You task is to design an experiment to test a company's claim that their golf balls have a roll that is "true."

Explain the following:

(1) How you set up your experiment?
(2) How you collected data to test the golf balls?
(3) How you knew (decided) whether a golf ball's roll was true or not?

How Big is Antarctica?

Estimate the area of the continent Antarctica, using the map provided. Explain the strategies you use.

Wheelchair Ramps

Measure the slope of a wheelchair ramp in your neighborhood. Record your measurements in the table below; remember to include the units! Also record the measurements of your classmates.

	Rise	**Run**	**Slope (rise/run)**	**Location**
1.				
2.				
⋮				
19.				
20.				

Once you have collected the data from your classmates, respond to the following questions:

(1) How consistent are the slopes of the ramps?
(2) What might account for any lack of consistency?
(3) Conduct research on measurement regulations concerning wheelchair ramps.
(4) Regarding the data collected and the regulations, what can you conclude about the wheelchair ramps in your data set?

Straw Box Activity

Task: Using an 8 $\frac{1}{2}$ by 11 inch sheet of card stock, design a package [box] to hold 50 straws.

You need to include the following information on the package:

- Name of the company
- Number of straws
- Length of straws
- Diameter of the straws

Additional Packaging Options:

- Decorate the package for marketing purposes
- Include a picture of a straw on the package
- Include a clever title or saying on the package
- Decorate the package with a mathematical logo

To decorate the package, you may want to use computer graphics to print the information onto the box *in advance* of crafting the box.

Complete the table below (include the units!)

Dimensions of Package	
Volume of Package	
Surface Area of Package	

(1) How well do the 50 straws fit in the package?
(2) Describe how you converted the piece of card stock into the package by drawing a "net" of the box. (i.e., draw a picture of the card stock (with all of the pieces cut out) prior to folding the card stock to construct the box. This picture should include dotted lines to indicate where the card stock is folded.)
(3) List and briefly describe the measures you used in this project. For example, you may have used length, surface area, volume, font size, etc.

Joe Dirt

Joe ordered a truck load of topsoil for landscaping. The truck will bring nine cubic yards of topsoil. If he wants to spread the topsoil six inches deep over his flower beds, how many square feet can he cover?

Waterbed Fiasco

A child calls his Mom at work and says "Did you know that your waterbed has enough water to fill the house to a depth of six

inches!" Could there really be that much water in the waterbed? Investigate different size waterbeds and different size houses.

Create a Unit

People occasionally create new measurement units to help with their work or to communicate a measure to the public. Someone may want a unit to describe something presently unmeasured, such as smell. Or, they may want to create derived units (i.e., combinations of current units such as miles per hour) to come up with a better description of a situation (e.g., wind chill factor for how cold it feels outside using temperature and wind).

Your task is to create a new unit. Indicate whether your unit is a simple or derived unit. Explain how your unit may be useful. After you've created your unit, explain how it might be useful to others. Is there currently anything like the unit you have created? For additional ideas on creating a unit, visit Russ Rowlett's website on measurement at http://www.unc.edu/~rowlett/units/

References

[1] Clements, D.H. (Ed.). (2003). *Learning and teaching measurement: 2003 yearbook.* Reston, VA: NCTM.

[2] Collier, R., & Thompson, T. (2005). The search for significance: Accuracy in measurement and computation. *Alabama Journal of Mathematics,* Fall 2004, Vol. 28, no. 2, 29-36.

[3] Geddes, D. (1994).. *Measurement in the middle grades: Curriculum and evaluation standards for school mathematics addenda series, grades 5-8.* Reston, VA: NCTM.

[4] Mullis, I.V.S., Martin, M.O., Gonzalez, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S. J., & Smith, T.A. (2000). *TIMSS 1999 International Mathematics Report: Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.* Chestnut Hill, MA: Boston College

[5] NCTM (2005). *Navigating through measurement in grades 6-8.* Reston, VA: Author

[6] Organization for Economic Cooperation and Development (2002). *Sample tasks from the PISA 2000 assessment of reading, mathematical, and scientific literacy.* OECD: Paris

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