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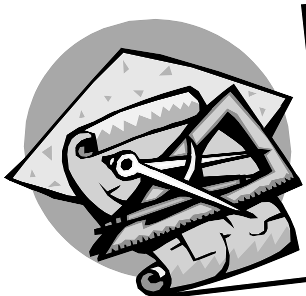

MATH Literacy News

GEOMETRY IN THE ADULT EDUCATION CLASSROOM

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For many adults, geometry is a math topic that immediately makes sense to them and gives them confidence in their ability to learn. It is also true, however, that many adults associate geometry, like algebra, with failure. Measurement, a foundation skill for geometry, is also an essential life skill, one that adults use in many different but familiar contexts.

Measurement is not an end in itself. It is a tool used in many contexts: home, work and community. We measure many different attributes of physical objects and time in many different ways in many different contexts. Measurement is essential to our sense of ourselves and our orientation to the world. Because measurement is used so often and in so many contexts, many learners have great confidence in their measurement skills. For ESL learners, teaching measurement is very important as a cross-cultural component of mathematics and second language learning, since many of these learners have used the metric system much more than the U.S. (standard) system. Measurement skills can be critically important.

Some adult learners identify geometry with failure. Other learners recognize their excellent everyday skills in geometry, although they may or may not use the term "geometry" in relation to these skills. Some adult learners don't see geometry as useful, however, geometry is and can be related to all aspects of life: home, school, work, and community. Geometry and spatial sense describe the physical world.

Implications for Teaching and Learning:

- **We must use exact and estimated measurements to describe and compare phenomena to increase the understanding of the structure, concepts, and process of measurement.** Despite the fact that competence in measurement is vital, some adult learners have difficulty selecting and determining appropriate units of measure, as well as appropriate tools of measurement. Concrete activities with non-standard and standard units help learners develop an understanding of the many measurable attributes of physical objects (length, time, temperature, capacity, weight, mass, area, volume, and angle). This is a natural way of building a vocabulary for measurement and for comprehension of what it means to measure.
- **We must address the impact of measurement skills on self-efficacy and self-reliance.** Math is everywhere and to be independent and survive on a limited budget, one needs to be able to do things oneself and find the best values along the way.
- **Measurement skills should be extended to concept areas such as volume, proportion, and problem solving.**
- **We must increase the awareness of acceptable tolerances (margins, upper and lower limits) and the consequences of being within and outside of these tolerances.** In the workplace, everything is measured. Someone has to understand what upper and lower limits are, and how to input data. Much is computerized but the results are only as good as the information inputted.
- **The place to start is the learner's strengths. Instruction must be practical and useful for learners to overcome their fears regarding geometry.** Opportunities must be provided for learners to make connections between instruction and real-life situations common to their lives.
- **Finally, it is necessary to focus on hands-on problem solving and to give special attention to developing spatial sense in order for learners to develop an understanding of geometric principles.** Spatial reasoning includes not only geometry, but also measurement and

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realize that this kind of reasoning, this part of mathematics, often helps students who have talents in this direction realize and accept that they do have mathematical potential.

CLASSROOM ACTIVITIES

MEASUREMENT

There is a tendency to teach students **how** to measure rather than teaching what it **means** to measure. Here are some ideas that help foster understanding.

Introduction: Have students measure a piece of paper using one inch square tiles. *How long is the paper? How wide? What would be easier than using the square tile over and over again?* (Students can put marks on the paper for each inch.) *When using a standard sheet of typing paper, what about the shorter side?* (This paper is 8 1/2 by 11 inches.) *What about the extra distance at the end of the short side?* (Students will put numbers for each inch within the inch area. They are often surprised that a standard ruler puts the number at the END of each inch.)

***Enlarged Inch*:** Students often have trouble understanding what the lines mean on a ruler. In this activity, the student will pretend that the length of one inch has been magnified to the length of a larger piece of paper. Start by folding the paper in half end to end. *How many sections does your paper have? Draw a line along the fold and label it ½ to indicated that it is ½ way along the paper.* The student can measure something (his/her desk?) using this enlarged half inch!

The paper is then folded again in half. Shorter lines are drawn on each of those folds and labeled ¼ and ¾. The paper can be folded again and again in order to put eighths and sixteenths on the enlarged inch. (Most rulers don't go beyond sixteenths.) With each step, compare the enlarged inch with a standard ruler.

PERIMETER AND AREA

Introduction: Often teachers assume that students have the background needed to study a topic formally, when students have gaps in knowledge and vocabulary. Often **area** and **perimeter** are confusing to students. Put the words on a board or large sheet of paper and discuss their meanings. Questions to ask might include:

- ◊ *What do you know about these two concepts?*
- ◊ *For what things in our lives do we need perimeter measurements?* (fences, wallpaper boarders, molding, fringe)
- ◊ *For what things in our lives do we need area measurements*? (pastures, sod, paint, carpeting, tiles, material for sewing)
- ◊ *How do we measure area?* (Area is spatial. We use square inches (draw one), square feet (draw one), square yards (draw one), square millimeters, square meters, etc.)
- ◊ *How do we measure perimeter*? (Perimeter is a distance measure, a **line**ar measurement. This is the measurement we are most used to. Perimeter is as if we are taking steps around something. How many steps do we need to walk around it?)
- ◊ *How can we remember which is which*? {pe**RIM**eter: what is the rim of a glass?)

This discussion might take ten or fifteen minutes. It will eliminate much confusion.

***Fences and Pastures*:** In a discussion, relate perimeter to fences in that they both surround a space on all sides, and have an area (or pasture) within it. Students are given pieces of paper cut into shapes and must determine how many one inch rods (can be made out of toothpicks or paper) would go around each shape. Then students are given larger rods to measure the same figure. *Will it take the same number of the larger rods to measure the perimeter of the figures? Why does it take fewer of the larger rods?*

Students are then asked to use the one inch rods to build a rectangle, and then square tiles are fit inside. *What is the number of square tiles, the area, that is needed to fill each pasture? Why do different people have different number of square tiles for the same number of fence (perimeter) pieces?*

Once students can count the sides of the square tiles, the one inch rods are not necessary. Take 24 square tiles and see how many different rectangles can be made. Make a chart of the area (all will be the same), the dimensions, and the perimeters. Discuss why perimeter and area may use the same numbers but are different. An example such as the perimeter of a *comb,* that an ant is walking around, gives a good visual that a perimeter may be large, but the area small! Teachers note: a square has the smallest perimeter for the same amount of area.

Students can put on graph paper the rectangles formed. The dimensions of the rectangles are also the factors of 24!

***Floor Plans*:** Floor plans can be obtained from local newspapers or home magazines. They can be copied, enlarged and have dimensions added if needed. Looking at these house plans, teachers can review or reinforce the concepts of area and perimeter. Students will practice finding the perimeters for baseboards and wallpaper borders, and area for carpeting and concrete. Square feet and square yards can be discussed and explored.

***Square Inch*:** Visualization is important in geometry and manipulatives can be simple yet extremely helpful. Have each student cut a square inch out of paper. Have the students look at the square inch and identify it. It is written inch. Discuss what a square foot would be. *How many square inches are in one square foot?* Many students will think there are 12 square inches in a square foot! Hand out square foot pieces of paper. (These are not as easy to make; most paper is 8 ½ by 11 inches.) *How many of your square inches would fit on this square foot?* Encourage the students to put the square inch on the square foot to measure it. Most students will see that it will take many more than 12 square inches to fill the square foot! A large square yard can be drawn on the black board or a chart. How many square feet will fit into the square yard? How many square inches will fit into the square yard? Students who have experienced these activities seem to have fewer problems with the geometry problems dealing with carpeting, tiling, etc. Give the student the tiny square inch as a bookmark so he/she can **see** the figure!

ANGLES

Adult education students often come to class with some knowledge of angles. Most students know what a "360" or "180" is when talking about cars! Students know or learn that triangles have 180 degrees, however they don't always really believe it! Students can cut out triangles from paper, any size, any shape. Have the students draw the sides with a ruler in order to make sure the angles are accurate. Color the tips of each angle and rip them from the triangle. No matter what size or shape triangle, putting the three angles together will make a straight 180 degree line.

CIRCLES

Students can carefully measure the circumference and diameter of many different circles (lids, cans, etc.) Using a tape measure is easiest, but using taut string and a ruler is also possible. Students wrap the string around the jars lids, tubes, cans, etc. and mark the circumference and then measure using a ruler. Yarn, or other stretchy material, doesn't do an accurate job! After making a chart, the students can use a calculator to determine and record the ratio of circumference to diameter. With careful measurement, the results should be close to 3.1 or 3.2. Pi is an irrational number (it never ends) that is close to 3.1415926. What is most important about this activity is that students will develop a clear understanding that pi is the ratio in any circle, no matter what the size!

In conclusion, there are many other hands-on activities that will help adult students master geometry and spatial sense. Other ideas can be found in the bibliographical materials listed. Another resource is the National Institute for Literacy's Science and Numeracy Special Collection of websites. This can be found at http://literacynet.org/sciencelincs/ Remember, geometry is an area that can be actively, concretely explored. It can and should be an area of success.

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