

Problem Solving

Orbit (continued)

For example, if you wish to put a turtle in orbit you can try this:

First, type: EARTH 0 0

(stamps earth at the HOME position)

Next, type:

ORBIT 0 70 210

Turtle number 0 moves 70 turtle-steps away from the planet, turns right, and travels in an orbit that is 210 steps all the way around. Too bad, this orbit causes the turtle to crash into the earth.

To help the student discover a better number for :CIRCUM, a transparency with a circle on it can help check whether an orbit is concentric or not.

Eventually, with the constraint to hold the distance at 70, the student should come up with:

ORBIT 0 70 437

which is a good concentric orbit. A formula would be useful, and students are encouraged to look for some pattern to discover :CIRCUM as other values for :DISTANCE are used.

Eventually, a "discovered" formula can be used as input. If, for example, you as a student are challenged with a :DISTANCE of 47, then the input for :CIRCUM can be $6.28 * :DISTANCE$, thus...

ORBIT 0 47 $6.28 * :DISTANCE$

An intriguing way to learn the formula, don't you think? The difference between this and the textbook approach is that students see a real need for the formula, not an artificial one, as for an exam, or to do today's problems, or for when they grow up. The need is now, for my planet!

The Tool procedures can be modified for single turtle systems. The ORBIT procedure below needs inputs only for distance and circumference.

```
TO EARTH
HT PU SETX -10
PD REPEAT 36 [RT 5 FD 1.8 RT 5]
PU SETX 0 ST
END
```

```
TO ORBIT :DISTANCE :CIRCUM
HT PU SETX :DISTANCE PD
REPEAT :CIRCUM [FD 1
LT 360 / :CIRCUM] ST
END
```

Activities

The Power of 2

by Ihor Charischak

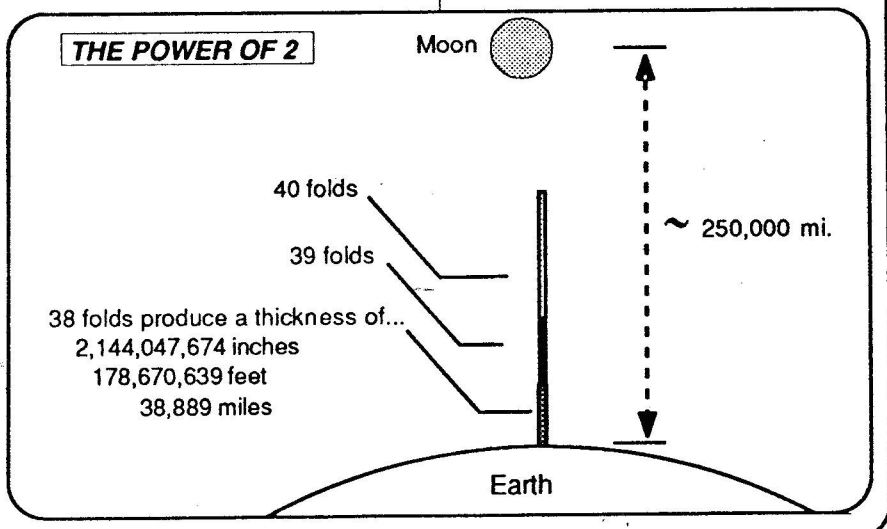
Unisys, a merger of Sperry and Burroughs, used the expression "The Power of 2" in a recent ad to indicate the merged entity would be greater than the sum of the two former companies. It reminded me of a math parlor trick I have used to help students understand the power of the number 2.

I challenge my class to imagine folding a piece of paper in half indefinitely. How many folds would it take to build a tower that would reach the moon? Guesses usually range from millions to billions. Rarely does anyone come close to the correct answer: less than 50.

By the 5th or 6th fold, folding the paper is no longer physically possible. So we continue with theoretical folding.

folds	thickness
5	1/4"
6	1/2"
7	1"

Everyone understands that each fold doubles the thickness of the paper. Nevertheless, when great distances are involved, the power of the process of repeated doubling is not appreciated. A few Logo procedures which draw the picture below can have a solid impact on a class.



Here are classic student Logo exercises that can yield rich insights:

1) Draw a square and inscribe or circumscribe a circle.

If you start with only Logo primitives, students will be obliged to make some discoveries about the relationship of radius to circumference. This is a middle or high school activity. If you start with the tool procedures for circles and arcs as recommended by Abelson, Watt, and others, it is an exercise in standard geometry, and simple enough to give to 4th and 5th graders.

2) Develop a procedure for Absolute Value.

This problem is valuable for algebra students who are reasonable literate in Logo. It is one of many useful comparisons of Logo and Algebraic functions. Compare:

$$|x| = -x \text{ if } x < 0$$

$$x \text{ if } x \geq 0$$

with:

```
to abs :x
if :x < 0 [op -:x] [op :x]
end
```

For a practical application, have your students write a procedure to produce two randomly directed vectors, and a second procedure to output the angle formed that is equal to or less than 180°. They will be obliged to deal with the idea of absolute value.