Épreuve de section européenne

Folding Paper in Half

Imagine you have a very large piece of paper, and you fold it in half. Then you fold it in half again, and you continue folding it until you have done so 50 times. How thick will the result be ? A common answer is that it would be about as thick as a telephone directory. But writer Malcolm Gladwell says that it would in fact take up the distance between earth and the sun.

Suppose you start with a sheet that has thickness t and width w. If you always fold in the same direction, you end up with a narrow strip with a constant thickness. With each fold, the thickness doubles, so the thickness after N folds would be 2^N times t. The resulting width would be 2^N times w. The ratio of thickness to width would be 2 times . This means that if you start with a sheet of paper that's 11 inches wide and about 0.001 inch thick, then after seven folds, the folded wad is thicker than it is wide !

If you fold in alternating directions, using up a sheet's width and height, you might be able to squeeze out an extra fold. In this case, the thickness would still double with each fold, but the width would be cut in half only every second fold.

Adapted from *sciencenews.org* and from *The Guardian*.

Questions

1. Explain the reason why "the thickness after N folds would be 2^N times t" and "the width would be 2^N times w." What kind of sequence are they ?
2. Using the ratio of thickness to width, prove that "if you start with a sheet of paper that's 11 inches wide and about 0.001 inch thick, then after seven folds, the folded wad is thicker than it is wide !".
3. Suppose one piece of paper is 0.003 inches thick. If it were possible to fold the paper 15 times, determine the thickness in pages that your paper stack (= pile) would have.
4. Note : an inch is a unit of length equal to one twelfth of a foot and 1 mile = 5280 feet (= 63360 inches). The moon is 286,000 miles away. How many folds would it take to form a stack that would reach the moon ?