Buffon's Approximation

Recommended Age Group: 8th-12th grade

Time commitment: 20 minutes

Supplies Needed for each group (2 or 3 students per group is recommended):

- 12" x 12" Mini Dry Erase board (shower board is very cheap and works just as well)
- A dozen pins
- Marker
- Ruler

Preparation:

- None

Background:

Georges Compt de Buffon discovered that, given a block of wood (or a floor) having equally spaced parallel lines distance *d* apart, the probability of a needle of length *l* <= *d* was *(2*l)/(pi*d).* When *d* = *l* (the distance between the parallel lines = the length of the needle), the probability was exactly 2/pi. This is a fun activity to show students a) how to calculate pi and b) the prevalance of pi in the world around us.

Presentation:

Tell the students that, in honor of Pi Day, they will be learning how to calculate pi. Explain that before they had calculators, they had slide rules, and before they had slide rules, they just had trees and dirt.

Take one of the students' "trees and branches" (dry erase board and the needles) and some of the students' "dirt" (marker). Explain that in order to calculate pi with trees and dirt, they would cut the branches so that they we all the same length (show the needles). With the dirt they would draw lines on the tree that were equal in distance apart as the length of all the branches they had cut (illustrate this by drawing marker lines across the board that are as far apart as the needles are long.

(Depending on your class, here you can tell them about Buffon and his discovery. A good explanation of the mathematics behind the formula is at http://mathworld.wolfram.com/BuffonsNeedleProblem.html. The mathematics involves calculus as well as other disciplines. The rest of the activity can be performed without all of the detail.)

Hand the board back to the student and explain that they will be able to create a wooden calculator today that will help them calculate pi. Instruct them to follow Buffon's lead and score their dry erase board with parallel lines that are as far apart as the needle is long.

Let the pin-dropping begin! If there is room, it is better to have them stand above the board so they can be sure to drop it directly onto the board. A total of about 200 drops should be enough for a reasonable estimate, but you know the attention span of your own class. :) Have them keep track of how many times the needle crosses a line and how many times it misses them all. Also make sure to have them pick up the needle each time they drop it so that the already-fallen needles don't meddle with the needle being dropped.

After they have recorded their hits and misses, the math is very simple:

#hits/(#hits+#misses) = 2/x

By solving for x, they will get a reasonable approximation for pi!

Note: Make it more challenging by making the distance between the lines greater than the length of the pins. (See **Background**.)