

Patterning Math Lab 5

Today, you have the opportunity to return to several questions that have been introduced over the past several weeks, as well as some new questions. These questions give you practice with problem-solving and modeling, with emphasis on the math and physics topics we have covered.

You should work at your own computer and keep your own notes, but are welcome to consult with your classmates.

You may work on any of these questions, in any order you choose.

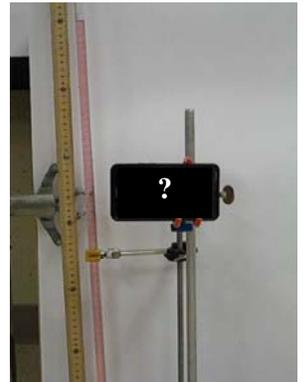
As you work through these questions, pay attention to:

- the patterns that you see (both math and physics patterns and patterns in your process),
- the concepts, skills, and tools that you use, and
- the connections between math and physics.

All videos and pictures are available in the program share, under Handouts: Math Lab 5.

How Long to Fill to the Mark?

In the first week of the program, you saw a video of a tube being filled with colored water. What will the reading on the clock be when the liquid reaches the point shown (the 30 cm mark on the meter stick)? Video: Tube Fill movie



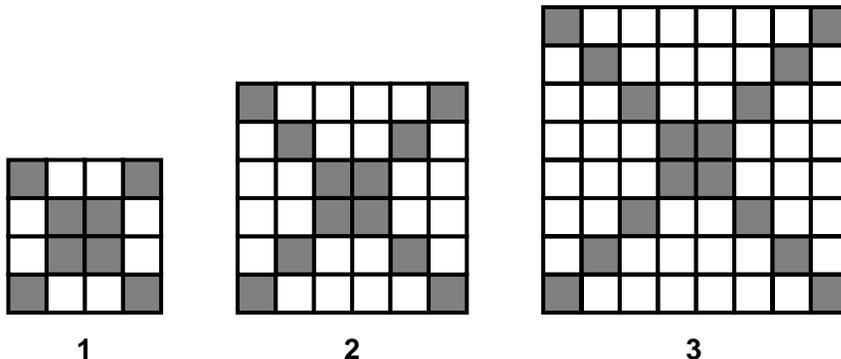
When Will They Pass I?

You have worked with battery powered cars. The video Buggies Pass shows two buggies moving towards each other: one moving to the right and one moving to the left. Where will the buggies pass each other? Give a location with respect to the meter stick.

Building Boxes

Consider the following series of patterns of white and grey boxes. Assume the series of patterns continues.

- How many total boxes would be in the 9th pattern in the series?
- How many grey boxes would be in the 12th pattern in the series?
- What number pattern in the series has 100 grey boxes?
- How many white boxes would be in the 15th pattern in the series?
- What number pattern in the series has 1680 white boxes?



When Will They Pass II?

A motorcycle moving at constant speed 30 m/s on a straight road passes a stationary police car. At that instant, the police car begins to move with constant acceleration 3 m/s^2 in the same direction as the motorcycle. Determine when and where the police car catches up to the motorcycle, and how fast the police car is going at that time. Use algebra as well as position vs. time and velocity vs. time graphs.

Will He Make the Shot?

View the movies associated with the images below. In each case, determine whether he will make the shot. (note: you can Insert: Picture into LoggerPro just like you Insert:Movie)



Basketball Shot I



Basketball Shot II

Rectangleabola

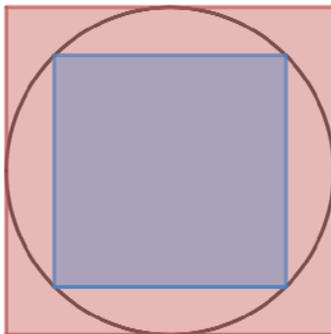
Open the following Desmos file <https://www.desmos.com/calculator/n5glqe5twi>

Press the play button for the a slider and watch what happens. You can also slide the slider manually. What's the area of the rectangle when $a = 0$? What's the area of the rectangle when $a = 2$? Somewhere in between, the area of the rectangle must have a maximum value – why? Determine the dimensions of the rectangle with maximum area.

Circles and Squares

(this one is just for fun, though it's an amazing pattern & gives you great practice with the Pythagorean Theorem)

The picture below shows a circle inscribed in a square (side length 1), with a square inscribed in the circle. Determine the ratio of the area of the inner square to the ratio of the outer square.



The picture below continues the pattern in the previous picture, with circles in squares in circles. Imagine this goes on forever. What is the sum of the area of all the squares?

