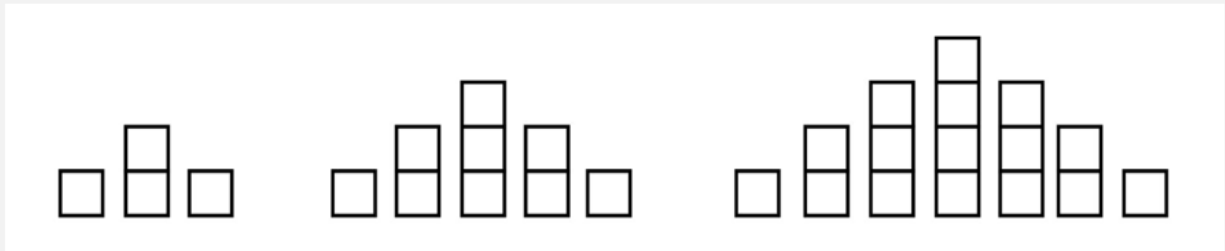


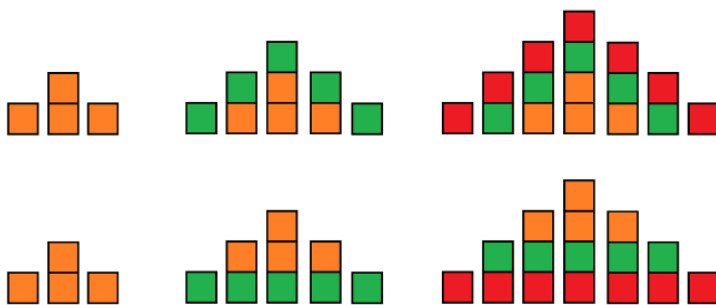
PATTERNS



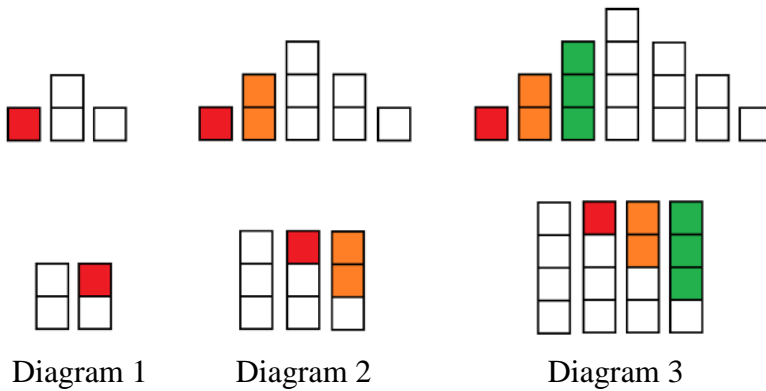
Source: [Youcubed](#)

- (a) Describe how you see the shapes growing.
- (b) How many squares will you see in the fifth diagram?
- (c) How many squares will you see in the n th diagram?
- (d) Will there ever be a diagram with exactly 200 squares? If not, which diagram contains the closest to 200 squares?

A couple of ways to “see” or describe this:

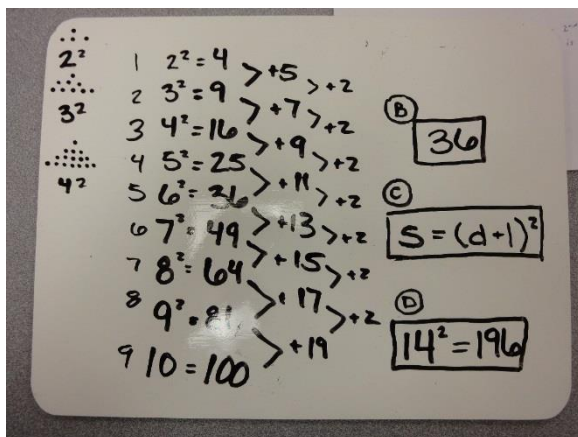


The top row shows a new layer of color coming from the top (like raindrops) while the bottom row shows a new layer of color coming from the bottom. Both are valid and describe different ways of seeing the same thing. Here is another:

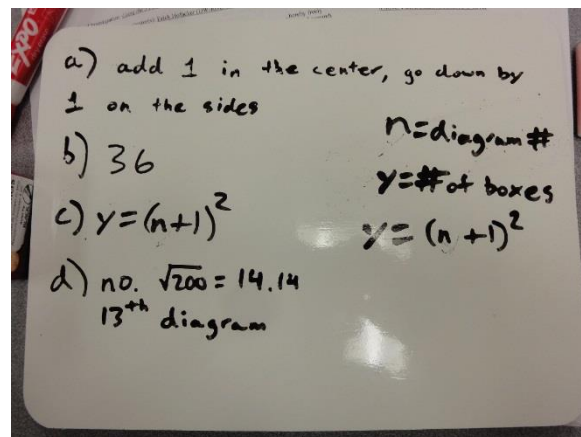


This one shows that you can move a square (or several squares) to always transform the pyramid shape into a large square array. This ties to our formula later on...

Board 1:



Board 2:



Board 1 shows a lot of relevant mathematics. Notice that the second order difference is constant (they are all 2s) and this means our relationship is quadratic. For diagram 1, we get $4 = 2^2$ squares, for diagram 2, we get $9 = 3^2$ squares, for diagram 3, we get $16 = 4^2$ squares, and so on. If d is the diagram number and s is the number of squares, we get $s = (d + 1)^2$. For example, notice that Diagram 3 (so $d = 3$) has $s = (3 + 1)^2 = 4^2 = 16$ squares. This 4 by 4 array can be seen in the rearrangement of the pyramid into a square.