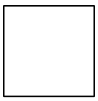
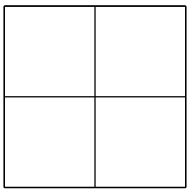
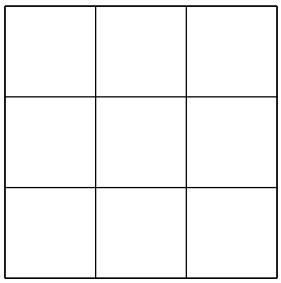
MthT 491 Toothpick Squares

From Mark Driscoll, **Fostering Algebraic Thinking: A Guide for Teachers Grade 6-10** [**Driscoll**].

Below is a pattern of "growing" squares made from toothpicks.







1. Study the pattern and draw a picture of the next likely shape in the pattern.
2. How many small squares make up the new square?
3. How many small squares would make up a large square which has 10 toothpicks on each side?
4. Write a rule which will allow you to find the number of small squares in any large square.
5. Find a rule which would allow you to find the *number of toothpicks* in any large square.

JL Additions:

6. How many toothpicks are on the outside of the large square?
7. How many small squares are on the outside of the large square?
8. How many toothpicks touch the outside of the large square?

Constructing Big Cubes from Small Cubes

Now use "small cubes" one centimeter on each edge to construct "big cubes." For the large cube, call the *edge length* n, the number of small cubes along one edge.

We ask the questions:

1. For $n = 1, 2, 3, 4$, draw the large cube made by putting together the small cubes.
2. How many small cubes make up the new cube? Try $n = 1, 2, 3, 4$.
3. Write a rule which will allow you to find the number of small cubes in any large cube.
4. Can we construct a large cube constructed from exactly 144 small cubes?
5. Look at all the edges of the large cube. How many of the small cubes contain a piece of at least one of the edges of the large cube?
6. Suppose all the small cubes which have at least one face on the outside of the large cubes are blue. All the other small cubes are red. In large cubes of edge length $1, 2, 4$, how many small cubes are blue?
7. Find a rule which would allow you to find the *number of blue cubes* in any large cube.
8. Find a rule for the total outside *surface area* of the large cube of edge length n. For *large* n, Compare your rule with the rule for the number of blue cubes.