Stepping Up Too

Purpose:
Participants will build a "Two-Step" pyramid and analyze the blocks needed for each row and the total pyramid. This will lead to geometric interpretations and representations of functions.

Overview:
In small groups, participants will build and explore a simple step pyramid giving rise to multiple opportunities for mathematical modeling. They will have the option of using multiple representations for exploration including graphical, tabular and functional.

TExES Mathematics Competencies. The beginning teacher:

II.04.A Uses inductive reasoning to identify, extend, and create patterns using concrete models, figures, numbers, and algebraic expressions.

II.04.B Formulates implicit and explicit rules to describe and construct sequences verbally, numerically, graphically, and symbolically.

II.04.D Gives appropriate justification of the manipulation of algebraic expressions.

II.06.B Demonstrates an understanding of the connections among geometric, graphic, numeric, and symbolic representations of quadratic functions.

II.06.C Analyzes data and represents and solves problems involving exponential growth and decay.

TEKS Mathematics Objectives. The student is expected to:

5.06.A Describe relationships mathematically. The student is expected to select from and use diagrams and number sentences to represent real-life situations.

6.04. Generate formulas to represent relationships involving perimeter, area, volume of a rectangular prism, etc., from a table of data.

6.05 Formulate an equation from a problem situation.

6.8.B Select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter and circumference), area, time, temperature, capacity, and weight.

7.2.C Use models to add, subtract, multiply, and divide integers and connect the actions to algorithms

7.4.A Generate formulas involving conversions, perimeter, area, circumference, volume, and scaling.

7.4.B Graph data to demonstrate relationships in familiar concepts such as conversions, perimeter, area, circumference, volume, and scaling

7.4.C Describe the relationship between the terms in a sequence and their positions in the sequence.

Terms.
Area, function, sequence

Materials.
For each small group of participants:

- Transparency
- Activity Sheet for each participant
- Centimeter cubes

Transparency.

- *Stepping UpToo*

Activity Sheet(s).

- *Stepping Up Too*

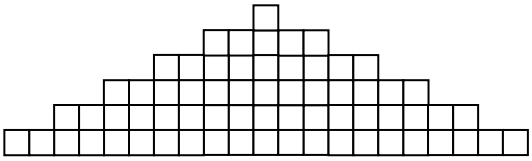
Procedure:

Steps	Questions/Math Notes
1. Read aloud the Stepping Up Too (Transparency #??) two times. Allow participants to ask questions about the problem situation described. Ask participants to work in groups of 4 to use their centimeter cubes to build a step pyramid of the type described and to begin exploring some of the mathematics of the situation.	To stimulate reflection, ask participants build a table showing the number of blocks required for each row and the total required to build the pyramid of that many rows. Ask: *Is there a way to predict what happens in a 7 row pyramid? A 9?* *How can we organize our work to make prediction easier? (Encourage a table layout).*
2. Circulate among the groups as they work the problem. Encourage each group to complete their table of results until ten rows of the pyramid are in place. Ask participants to graphically represent the changes in area using graph paper.	
3. Select several small groups to present their findings and graphics.	*How is your graphic reflected in the problem situation?* *Which portions of the functional representation are shown in your graphic?*

Geometric Illustration of Stepping Up – One by One

This representation shows a table for the first six rows of the Two-Step pyramid.

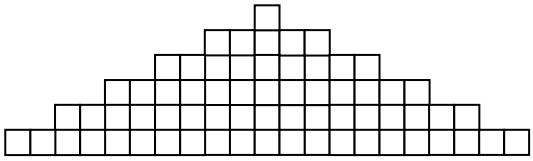
Row	Blocks in Row	Blocks in Pyramid
1	1	1
2	5	6
3	9	15
4	13	28
5	17	45
6	21	66



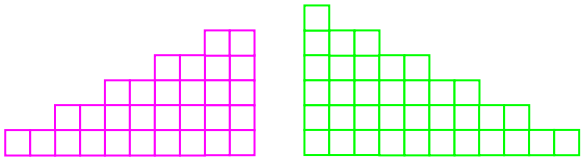
The number of blocks in any given row is easily seen to be 4(R-1) + 1, where R is the row number. Likewise, the total number of block making up a step pyramid of R rows may be shown to be R(2R-1).

A nice geometric interpretation of this last observation may be shown like this:

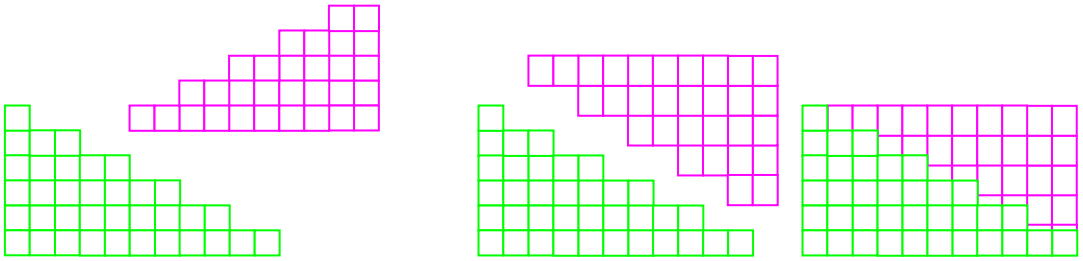
Begin with the step-pyramid as shown above



Split it into two parts



Flip one of the two parts and fit together to make a rectangle with sides of R and 2R-1



A **B** **C**

As this picture also shows, the area of the rectangle thus generated is also equal to $2R^2 - R$, thus we have shown the equivilant equation which is often generated.