emcsquared: Building Houses

Title: Building Houses * Adapted from Exploring Houses in NCTM's *Navigating Through Algebra in grades 6-8*	**Grade:** 6 **Authors**: Nicole Ferguson & Gayle Herrington	**BIG Idea:** Understanding Patterns

Prior Knowledge Needed:

M3A1. Students will use mathematical expressions to represent relationships between quantities and interpret given expressions.
a. Describe and extend numeric and geometric patterns.

M4A1. Students will represent and interpret mathematical relationships in quantitative expressions.
a. Understand and apply patterns and rules to describe relationships and solve problems.

GPS Standards:

M6A2. Students will consider relationships between varying quantities.
a. Analyze and describe patterns arising from mathematical rules, tables, and graphs.
b. Use manipulatives or draw pictures to solve problems involving proportional relationships.

M6P5. Students will represent mathematics in multiple ways.
a. Create and use representations to organize, record, and communicate mathematical ideas.

Objectives:

To assess students'…
- understanding of pattern development;
- ability to use a table and organize information
- choice of strategy (e.g., draw a picture, use recursion, write an explicit rule) to make a prediction.

Essential Questions:
- Can you write a rule that gives the total number of pieces needed to build any house in this sequence?

- Can you find and describe a relationship between the house number and the total number of shapes?

Materials:

- Blackline master *Exploring Houses* (see *Resources* section)
- Access to virtual pattern blocks or actual pattern blocks if computers are not available (see *Resources* section)
- Computer lab or laptops
- Digital projector
- Interactive board (i.e. SmartBoard)

Task:

Students will work individually to build the first four houses in the sequence in figure 1.1 using virtual pattern blocks.

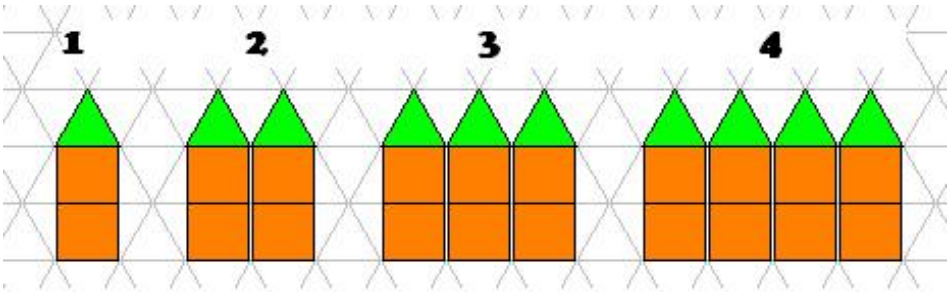

Figure from Exploring Houses in NCTM's *Navigating Through Algebra in grades 6-8*

Students will complete the following tasks:

1. For each house, determine the total number of pieces needed. How many squares and triangles are needed for a given house? Organize you information in some way.
2. Describe what house 5 would look like. Draw a sketch of this house.
3. Predict the total number of pieces you will need to build house 15. Explain your reasoning.
4. Write a rule that gives the total number of pieces needed to build any house in this sequence.

Description and Teacher Directions:

This activity focuses on patterns. Students will create rules to describe the change they see occurring from step number to step number, or house to house. Two kinds of rules can describe change -- recursive and explicit. Recursive rules tell how a pattern changes from any given step to the next step. Explicit rules determine the number of elements in a step from the step number.

Using a tabular representation will help students create recursive and explicit rules. See below.

Step Number	Total Number of Blocks
1	3
2	6
3	9
4	12

Students will naturally develop recursive rules, and this is an important step toward understanding explicit rules. Allow your students to create recursive rules. However, recursive rules are not always efficient.

Teacher Commentary:

The task went well. The kids worked really hard to figure out the rule. I had to keep reminding them that a rule (or formula) should work EVERY time in that given situation.

Some of the students even attempted to write a formula using variables. Now that I think about it, most of the students were writing recursive rules vs. explicit. I wish I would have discussed the concept of variables and how to write expressions a little bit more before giving the students this task.

But overall, I'd say the task was a great learning experience for me and the students.

Consider if one wanted to know how many blocks are in the 100th house. Using recursive rules, the number of blocks in the 99th house would have to be known. Help students see the limits of recursive rules.

Recursive rule: the number of blocks in the previous house (or step number) + 3

To help students move their thinking toward an explicit rule, build the tabular representation in a new way. See below.

Step Number	Total Number of Blocks
1	3
2	(3) + 3
3	(3 + 3) + 3
4	(3 + 3 + 3) + 3

The values in parentheses represent the total number of blocks for the previous step number. By showing the repeated addition, students can more easily see why multiplication is needed to create the explicit rule. The number of "3s" in each step is equal to the step number.

Explicit rule:

Total Number of Blocks = 3*step number
Symbolically, this rule could be expressed as t = 3s

Use observations as an informal assessment. Take note of the students' strategies as they explain how they determined the pattern. Sample questions to probe student thinking include:
How many blocks do you think will be in the 6^{th} step (or house 6) of the pattern?

What do you think the next step (or house) will look like?

How many new blocks are added with each step (or house)?

For every triangle that you add, how many squares are needed?

What patterns do you see in your drawings?

If I tell you the step (or house) number, can you tell me the total blocks needed?

- Do students build each pattern and notice the changes from one pattern to another?
- How do students organize their information?
- When students make predictions about other houses in the pattern, do they “add 3” multiple times (recursive) to predict the number of pieces needed or do they see a relationship between the house number and the number of pieces needed to make the house (explicit)?

Can students describe the rule in words? Using symbols?

Modifications/Extensions:

Extensions

Have students make a graph in Microsoft Excel or on an online graphing calculator. You can add ordered pairs to either. Students can explore two examples of direct variation from the house pattern using ordered pairs (step, total blocks) OR (number of triangles, number of squares). In each example, have students explain the relationship between the table, drawing and graphs.

Resources:

Virtual Pattern Blocks - option 1
http://nlvm.usu.edu/en/nav/frames_asid_170_g_2_t_3.html?open=activities&from=category_g_2_t_3.html

Virtual Pattern Blocks - option 2
http://ejad.best.vwh.net/java/patterns/patterns_j.shtml

Worksheet

Assessment Item [Building Houses].doc

Assessment Item Answers