

Patterns and Functions

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Susan Looney, Ed.D.

looneyconsulting@comcast.net

www.looneymathconsulting.com

Polina Sabinin, M.Sc. & Ed. ABD

polina@sabinin.info

www.sabinin.info

Types of patterns

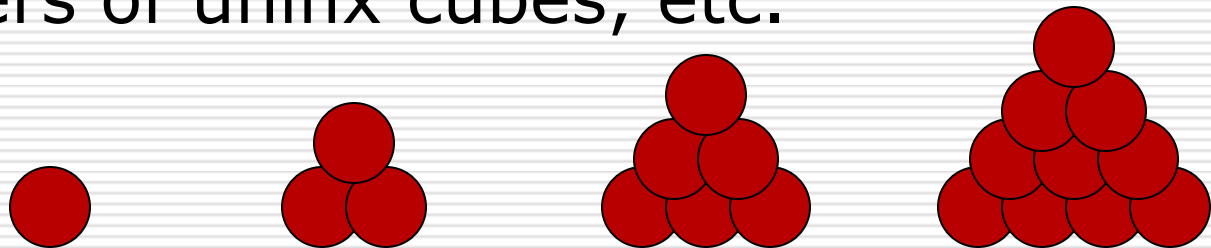
□ Repeating patterns

- Activities: continue, take one out of the middle, what would precede the pattern?



□ Growing patterns

- Activities: even and odd numbers, towers of unifix cubes, etc.



Goals: MA and NCTM

MA Frameworks:

- Kindergarten – recognizes and extends patterns
- Grade 1 – creates and extends patterns
- Grade 2 – **Describes rules** for patterns (words)
- Grade 3 – Describes rules for patterns
- **Generalizes** simple patterns using **models, pictures, and input-output tables**
- Grade 4 – Describes rules for **number patterns**
 - Solves problems with **variables and input-output tables**
 - Constructs and interprets **line graphs**
- Grade 5 - **Solves problems** involving variables and input-output tables
- Grade 6 – solves problems involving input-output tables
 - **Solves linear equations using models, tables, and graphs**

NCTM Focal Points

- Kindergarten – **identify, duplicate and extend** simple number patterns and sequential and growing patterns as preparation for creating rules that describe relationships
- Grade 4 - continue identifying, describing, and extending numeric patterns and nonnumeric growing or repeating patterns
 - **Develop an understanding of the use of a rule** to describe a sequence of numbers or objects
- Grade 5 – **use patterns, models and relationships to write and solve simple equations**
 - Create and analyze **line graphs**
- Grade 6 – find possible **rules for patterns of figures or stacks of objects** and develop formulas
 - Write **mathematical expressions for situations**
 - **Use variables appropriately**
 - **Construct and analyze tables** to describe simple relationships ($3x = y$)

Continuum of Development

- Repeating patterns
 - Growing patterns
 - Describe in words
 - Use of t-chart to organize data
 - Use of variables as a fixed unknown
 - Use of variables in a formula
 - Graph of relationship between two variables
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Complete the table below.

Using words, write a rule for finding the output when the input is given.

Let y stand for the input. Let z stand for the output. Write a rule for finding the output when the input is y .

Input	Output
1	10
2	20
3	30
6	
y	

Continue the pattern below.

Find figure 4 and figure 8.

Let f stand for the figure number. Let z stand for the total number of stars.

Write a rule for finding the total number of stars for any figure.

* * * * *

Figure 1

* * * * *

figure 2

* * * * *

* * * * *

figure 3

* * * * *

* * * * *

figure 4

figure 8

Rule:

Finding a generalization

- Most middle school students use recursion and guess and check Lanin 2000
 - Many guess at the rules quickly Mason 1996
 - Can continue patterns, but have difficulty forming generalizations English and Warren 1998
 - 75% of fifth graders interviewed could describe a rule in words Smith 2003
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Format of Patterns

- ❑ Tables and pictures: 12 year olds successful with continuing and generalizing shape patterns Pegg and Redden 1990
 - ❑ Middle school students success when patterns presented in a table Olive & Blanton 2002
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Strategies used

- Recursion: considers variables independently and relies on knowing the previous step of the pattern
 - Covariation: considers the two variables of the pattern simultaneously to determine their relationship
 - Students more likely to use covariation when given patterns in the format of a table – Looney 2003
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Functions: an example

- ❑ For helping him across a street, an old man tells you that he has 3 magic pennies.
- ❑ He would like to give you the penny of your choosing.



Penny #1



- If you put this penny under your pillow, then the next morning there will be a thousand more pennies.
 - So, on day 1 there will be one penny, on day two – 1001 pennies, on day 3 – 2001 pennies, and so on.
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Penny #2



- If you put this penny under your pillow, then the next morning you will see that the penny doubled.
 - So, on day 1 there will be one penny, on day two – 2 pennies, on day 3 – 4 pennies, and so on.
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Penny #3



- If you put this penny under your pillow, then the next morning you will see that more pennies appeared. Every night the number of new pennies is 200 more pennies than the night before.
 - So, on day 1 there will be one penny, on day two – 201 pennies, on day 3 – 601 pennies, and so on.
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Which is the best penny?

□ If the penny loses its magic after

- 1 week?
- 2 weeks?
- 3 weeks?



What do the Penny functions describe?

- Relationships between what two variables?
 - Which is the input (independent) variable?
 - Which is the output (dependent) variable?
 - Can you always tell which of the variables is an the input and which is the output?
 - What do we do when we cannot tell?
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How did you make sense of the Penny functions?

- Multiple representations of functions
 - Tables
 - Graphs
 - Equations
 - Words
 - Connections
 - Differentiated instruction
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Activities to develop understanding

- Function Box
 - Guess my Rule
 - Function Junction
 - Function Concentration
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