

Title: Patterns Rule!

Brief Overview:

Using hands-on activities in real-life problem solving situations, students will identify rules used in patterns, find a rule using pattern values, write a rule as a function, and interpret functions of patterns. Students will be able to identify the rule in a pattern, construct a function table, write an equation for a function, and explain the rule.

NCTM Content Standard/National Science Education Standard:

1.0 Knowledge of Algebra, Patterns, and Functions

Grade/Level:

5-6

Duration/Length:

3-4 days, 60-70 minutes daily, with the assessment given on a separate day

Student Outcomes:

Students will:

- Represent, analyze, and generalize a variety of patterns with tables, graphs, words, and when possible, symbolic rules;
- Represent the idea of a variable as an unknown quantity using a letter or a symbol;
- Express mathematical relationships using equations;
- Model problem situations with objects and use representations such as graphs, tables, and equations to draw conclusions.

Vocabulary:

Arithmetic Sequence: *A sequence with a constant difference between consecutive terms (e.g., 2, 5, 8, 11... is an arithmetic sequence with a constant difference of 3).*

Core: the section of a pattern that repeats.

Elements (members): *individual objects in a set.*

Function: A relationship in which every value of x has a unique value of y (e.g., the relation $y = 2x + 1$ is a function because for every different x , there is one and only one y).

Geometric sequence: A sequence with a constant ratio between two consecutive terms (e.g., 1, 2, 4, 8, 16... is a geometric sequence with a ratio of 2).

Manipulatives: Tools, models, blocks, tiles, and other objects that are used to explore mathematical ideas and solve mathematical problems.

Pattern: A configuration of geometric shapes, numbers, or other objects arranged in such a way as to demonstrate a specific repeat in design or in the units by which consecutive values increase or decrease.

Set: a collection of objects.

Term: the location of an object or number in a pattern or sequence.

Materials and Resources:

Lesson 1

- Pattern Word Splash (Student Resource Sheet 1)
- Overhead Projector
- Sections of wrapping paper (enough for groups or individual students)
- Wrapping Paper Blocks (Student Resource Sheet 2)
- Crayons, markers
- Construction Paper
- Wrapping Paper Questions (Student Resource Sheet 3)
- Wrapping Paper Question Answer Sheet (Teacher Resource Sheet 1)
- Wrapping Paper Exit Card (Student Resource Sheet 4)
- Wrapping Paper Exit Card Answer Sheet (Teacher Resource Sheet 2)

Lesson 2

- Overhead Projector
- Pattern Block Equations (Student Resource Sheet 5)
- Pattern Block Equations Answer Sheet (Teacher Resource Sheet 3)
- Equation Treasure Hunt (Student Resource Sheet 6)
- Equation Treasure Hunt Answer Sheet (Teacher Resource Sheet 4)
- Student Journals

Lesson 3

- Input/Output Charts (Student Resource Sheet 7)
- Input/Output Chart with Values (Teacher Resource Sheet 5)
- Sentence Strips
- Overhead Projector
- Wrapping Paper Research (Teacher Resource Sheet 6)
- Wrapping Paper Research Answer Sheet (Teacher Resource Sheet 7)
- Chart Paper
- Markers

Lesson 4

- Square Pattern Blocks
- Triangular Pattern Blocks
- Growing Patterns (Student Resource Sheet 8)
- Growing Patterns (Teacher Resource Sheet 8)
- Triangle Grid Paper (Student Resource Sheet 9)
- Triangle Grid Paper Answer Sheet (Teacher Resource Sheet 9)
- Assorted Pattern Blocks
- Growing Patterns Exit Card (Student Resource Sheet 10)
- Growing Patterns Exit Card Answer Key (Teacher Resource Sheet 10)
- Student Journals

Development/Procedures:

Lesson 1 Identifying a Rule in a Pattern

Pre-Assessment (10 min) –

- Display pattern pictures such as pictures of various brick and block patio construction (repeating patterns) or of cut away sea shells designs (growing patterns) on the board. Pictures of quilts can be found on <http://dlstewart.com/clipart.html> . Using symbols you could also draw examples of repeating (ABAB) and growing patterns (2, 4, 8, 16...) on the board.
- Ask students to describe what they see.
- Divide the class into pairs or small groups.
- Distribute the **Word Splash** worksheet (Student Resource Sheet 1) and have student groups brainstorm math vocabulary dealing with patterns.
- Display a copy of the word splash on the overhead.
- Conclude the activity with students writing math vocabulary on the overhead copy of the word splash and explaining the vocabulary to the class.

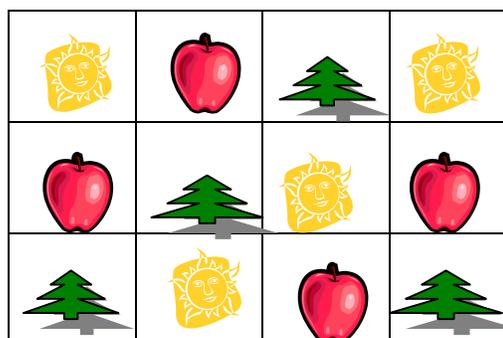
Launch –

- Distribute sections of wrapping paper.
- Ask students to identify the terms, the core, and the pattern.

Teacher Facilitation –

- Tell the class that they are going to be developing designs for wrapping paper.
- Explain that they will work in groups to design wrapping paper.
- Draw a 3x3 grid on the board and demonstrate how to draw a pattern.
 - Each color equals a term
 - Each design will use one color for the graphic (i.e. a yellow sun)
 - Each term will repeat in a linear fashion using the same order. (i.e. A, B, C, --yellow sun, red apple, green tree)

A	B	C	A
B	C	A	B
C	A	B	C



Student Application –

- Divide the students into groups and assign them a specific number of terms (3, 4, 5). This is called a core.
- Allow students time to decide on their graphic and the colors they will use.
- Distribute the templates for students to use to draw the design (Student Resource Sheet 2).
- Students should cut these apart into individual grids.
- Suggest to the students that they divide the work so that they can complete the assignment in the allotted time.
- As groups complete their designs, distribute a piece of construction paper so they can glue their designs for discussion and display purposes. This makes a great bulletin board.
- Distribute a copy of **Wrapping Paper Questions** (Student Resource Sheet 3) to each group.
- Tell students they need to discuss these questions and be prepared to report their findings to the class. Answer key can be found on Teacher Resource Sheet 1 (Teacher Resource Sheet 1).

Embedded Assessment –

- Teacher observation of student understanding of vertical and diagonal patterns.
- Distribute the **Wrapping Paper Exit Card** (Student Resource Sheet 4) for students to complete. Answer key can be found on Teacher Resource Sheet 2 (Teacher Resource Sheet 2).

Reteaching/Extension –

- Reteaching:
 - Using 2 sided counters, work in small groups to show the relationship between the number of terms (multiple), the size of the grid (matrix) and the diagonals.
 - Model finding the rule.
- Extension:
 - Explain to students that each block is equal to a cm.
 - Using the rule for finding the diagonals, find 3 different widths that would show a diagonal pattern

Lesson 2: Finding a Rule Using Pattern Values

Pre-Assessment (5 min) –

- Display several examples similar to $12 + \quad = 36$ and $14 - \quad = 5$ on the board or by using an overhead.
- Elicit student responses.
- Evaluate student responses according to their level of understanding.

Launch (10 min) –

- Now display the equation, $\quad + \quad = 24$.
- Ask, what possible values could \quad and \quad have?
- Expect students to provide a whole range for example: $24 + 0$, $23 + 1$, $22 + 2$, $2 + 22$, and so forth.
- Remember to lead students into examples using the commutative property reminding them that although these equations seem to use the same numbers, the values for each symbol are different independently.
- For more advanced students, provide them with examples using negative numbers such as $26 + (-2) = 24$.

Teacher Facilitation (10 min) -

- Distribute Pattern Blocks and **Pattern Block Equations** worksheet (Student Resource Sheet 5) to students.
- Tell students to use their pattern blocks to create a design within the hexagon on their paper.
- Display **Pattern Block Equation** answer sheet (Teacher Resource Sheet 3) on the overhead.
- Ask a student to recreate a design on the overhead for the class to see.
- Model using the value chart (Teacher Resource Sheet 3) to create an equation.
- Model using substitution to solve the equation.

Student Application (25 min) –

- Distribute the **Equation Treasure Hunt** worksheet (Student Resource Sheet 6)
- Allow students time to complete.
- Share and discuss answers. Answers can be found on Teacher Resource Sheet 4.

Embedded Assessment (10 min) –

- Ask the students to answer the following question in their math journals, "If you added a 6th term to your input/output chart, how would that change the rule you discovered in our lesson?"

Reteaching/Extension –

- Extension: Have students go back to their input/output charts. Allow them to experiment with the chart by using more than two addend combinations such as a hexagon, a trapezoid, and a rhombus, but remind them that they must stay within the total number of shapes they choose. Ask them what rule they see now? Also, ask them how that rule compares to what they discovered previously.
- Reteaching: Work with small groups.
 - Modeling patterns
 - Using substitution to find the value of an equation.
 - Writing a rule

Lesson 3: Writing a Rule as a Function

Pre-Assessment (15 min) –

- Tell the class that they will be looking at numbers on input and output charts in order to find a pattern.
- Divide the students into 12 small groups
- Distribute **the Input/Output Charts** (Student Resource Sheet 7)
- Use the **Input/Output Answer Key** (Teacher Resource Sheet 5) to check and see if students are standing in the correct order.
- Instruct students to hold on to these charts as they will go over the rules later.

Launch (5 min) –

- Ask a student to summarize yesterday's wrapping paper activity.
- Explain that the 5th grade class still has some decisions to make about their wrapping paper fundraiser.
- Display the **Wrapping Paper Research** (Teacher Resource Sheet 6) on the overhead.
- Ask the students how they could organize this information so they could find a pattern and write a rule. (*An input/output chart*)
- Explain that input/output charts are also called function charts.

Teacher Facilitation (10 min) –

- With student help, model putting the data into a function chart. See Wrapping Paper Answer Sheet (Teacher Resource Sheet 7).
- Ask students to explain the rule.
- Explain that they can write this rule using a variable. Clarify that a variable is a letter or a symbol that is used to represent a number. The number it represents can change, based on the problem.
- Model writing the rule using variables.
- Model substituting values from the function table to check the rule.

Student Application (5 min) –

- Divide the students back into their 12 groups.

- Distribute sentence strips and markers.
- Instruct these students to rewrite the rule they wrote on their input/output tables using a variable.
- When all groups have finished, have each group hold up their rule and find another group with the same rule. There should be two groups for every rule.

Embedded Assessment (20 min) –

- Distribute chart paper.
- Instruct the groups to create a new function table for the rule. Tell the students that they must have at least 3 input/output pairs completed in their chart so that the pattern will be evident.
- Have groups complete their function tables and post them on the board.
- Tell students to choose another groups table to complete and write the rule.
- When all students are done with their chart, they are to rotate around the room looking at another group's charts and check their work.

Reteaching/Extension –

- For reteaching, meet with students in small groups. Reuse the input/output charts from the pre-assessment activity.
- For extension, challenge this group of students start with the function and use substitution to create a function table.
- A further extension would require the students to graph their table of values from their various growing patterns.

Lesson 4: Interpreting Functions of Patterns

Pre-Assessment (10 min) –

- Introduce the lesson with a question, "Does anyone know how patterns can grow?" Develop student responses using a KWL chart.

Launch (15 min) –

- Have the students work in small table groups of 2 to 4 students.
- Using **Growing Patterns** (Student Resource Sheet 8) with square block patterns, ask the students to create the next 2 larger squares.
- Walk around the room and observe student progress.
- Discuss the patterns. Ask how their blocks seemed to grow? Ask how many blocks they used? Note the quality of student answers

Teacher Facilitation (5 min) –

- Display an overhead of activity (Student Resource Sheet 8) and invite the students to compare their answers with that of the overhead

- Model the next two square block patterns using the same overhead of activity sheet (Student Resource Sheet 8). Answers can be found on Teacher Resource Sheet 8.

Student Application (20 min) –

- Using **triangle grid paper** (Student Resource Sheet 9), ask the students to see how many growing triangular patterns they could create using no more than 50 smaller triangles. Answers may be found on Teacher Resource Sheet 9.
- When finished with their drawings, ask students to analyze and record how many triangles make up each growing triangle. Have them record this information as a table of values on student provided notebook paper.
- Have the students describe a rule for predicting any triangle in the sequence.

Embedded Assessment (10 min) –

- Give the students the **Growing Patterns Exit Card** (Student Resource Sheet 10) and ask them to predict the number of smaller triangles in the next larger triangle of their sequence. Answer key can be found on Teacher Resource Sheet 10.

Reteaching/Extension –

- For reteaching, meet with students in small groups. Use the square pattern block as seen in the launch activity to rebuild the growing patterns. Use a table of values to carefully record and discuss each term and growing block pattern. Then give the students the triangle activity again.
- For extension, challenge this group of students to build additional growing patterns using other pattern blocks. Have them analyze how many smaller blocks make up these new growing patterns as they grow. Have the students develop a table of values to carefully record these new results. Ask these students to describe their results in their math journals. Additionally, ask these students to compare their new findings with previous results.
- A further extension would require the students to graph their table of values from their various growing patterns.

Summative Assessment: (Student Resource Sheet 11)

Students will:

- Write an equation and calculate the value of a pattern block design given a value table for selected variables.
- Complete a value table and write a rule by interpreting the table.
- Create a rule for a function given a repeating pattern.

Answers can be found on Teacher Resource Sheet 11.

Resources

1. Cuevas, Gilbert J. and Yeatts, Karol: Navigating Through Algebra in Grades 3-5, National Council of Teachers of Mathematics, 2003.
2. Peak, Cynthia and Stewart, Kelly and Walker, Kathryn: “20 Thinking Questions for Pattern Blocks”, Wright Group/McGraw Hill, 1995.
3. “Tesselate!” from <http://www.shodor.org/iinteractivite/activities/index.html#geo>
4. “Stomp, Look and Listen” from <http://pbskids.org/cyberchase/parentsteachers/results.html?topic=Patterns>
5. “Tesselations” from <http://www.mathcats.com/crafts.html>

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Now, create a table of values for the patterns above.

Write a rule for your table of values.

Explain why your rule always works.

3. The pattern below has 5 terms. Using the repeating pattern below, describe any vertical and diagonal patterns.

AB	ABC	ABCD	ABCDE	ABCDEA	ABCDEAB
CD	DEA	EABC	ABCDE	BCDEAB	CDEABCD
EA	BCD	DEAB	ABCDE	CDEABC	EABCDEA
BC	EAB	CDEA	ABCDE	DEABCD	BCDEABC

Describe your observations below:

Wrapping Paper Extended Constructed Response

The 5th grade class needs to raise funds for their upcoming field trip. They have decided to design and sell their own wrapping paper. In order to maximize their profit, they have decided to limit the number of colors in their designs. If they use one color, the cost will be \$2. If they select 2 colors, the cost will be \$5. If they use 3 colors, the cost will increase to \$10.

Part A

What will be the cost if they use 4 colors?

What will be the cost if they make 5 color selections?

Create an organized table to help you answer these questions.

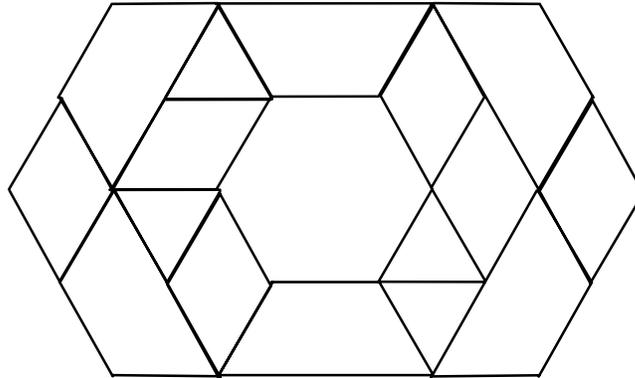
Part B

- *Use what you know about [mathematical concept(s)] to explain why your answer is correct.*
- *Write an equation that states a rule for what you have discovered.*

Summative Assessment Answer Key

Note: for this assessment you will need a set of pattern blocks.

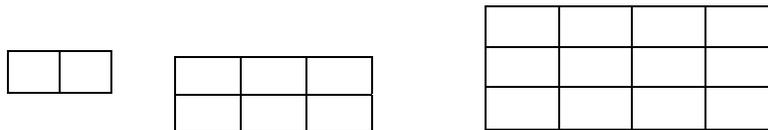
3. Use your pattern blocks to build the design below.



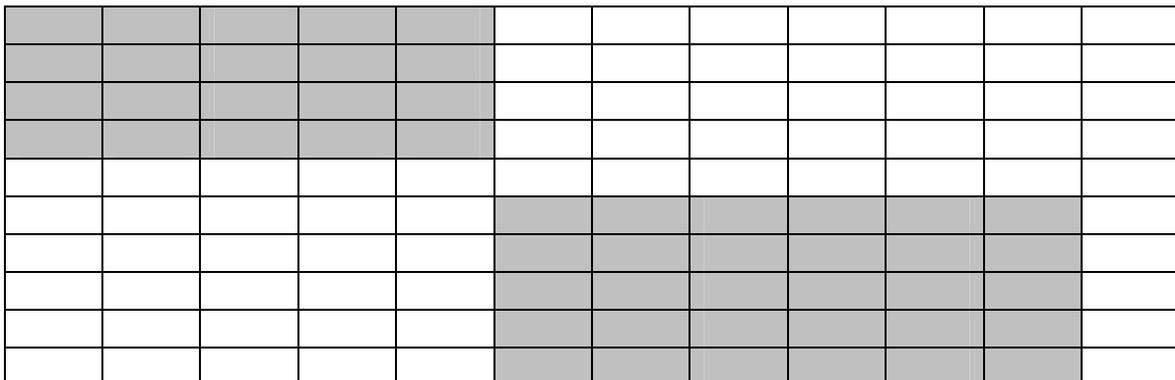
Write an equation for the design and calculate its total value. (Let the smallest triangle equal one unit.)

Ans. $4g+6b+6r+1y = 52$

4. Analyze the growing pattern below. .



Use the grid below to create the next two terms.



Now, create a table of values for the patterns above.

Terms	1	2	3	4	5	
Squares	2	6	12	20	30	

Write a rule for your table of values.

$$n(n + 1) = f(n)$$

Explain why your rule always works.

Sample Responses:

For every new term you add one new box and one new row. If you add “one” to your term number and then multiply that answer by the term number, you will get the total number of blocks.

You double the previous term and then add one to get the new total of blocks.

3. The pattern below has 5 terms. Using the repeating pattern below, describe any vertical and diagonal patterns.

AB	ABC	ABCD	ABCDE	ABCDEA	ABCDEAB
CD	DEA	EABC	ABCDE	BCDEAB	CDEABCD
EA	BCD	DEAB	ABCDE	CDEABC	EABCDEA
BC	EAB	CDEA	ABCDE	DEABCD	BCDEABC

Describe your observations below:

Ans. A vertical pattern occurs at the 4th grid. A right to left diagonal occurs on the 3rd grid. A left oriented diagonal occurs on the 5th grid. Since there are 5 terms, the pattern begins to shift when there is one less or one more possible members on the grid. For example, grid 3 only has 4 cells and shows a diagonal shift to the right. Grid 3 has one less possible member than grid 4. Further exploration will reveal, that this pattern is repeated with each multiple of 5 member terms.

Wrapping Paper Extended Constructed Response

The 5th grade class needs to raise funds for their upcoming field trip. They have decided to design and sell their own wrapping paper. In order to maximize their profit, they have decided to limit the number of colors in their designs. If they use one color, the cost will be \$2. If they select 2 colors, the cost will be \$5. If they use 3 colors, the cost will increase to \$10.

Part A

What will be the cost if they use 4 colors?

What will be the cost if they make 5 color selections?

Create an organized table to help you answer these questions.

Ans. The cost for 4 colors would be \$17. The cost for choosing 5 colors would be \$26.

Colors	1	2	3	4	5
Money	2	5	10	17	26

Part B

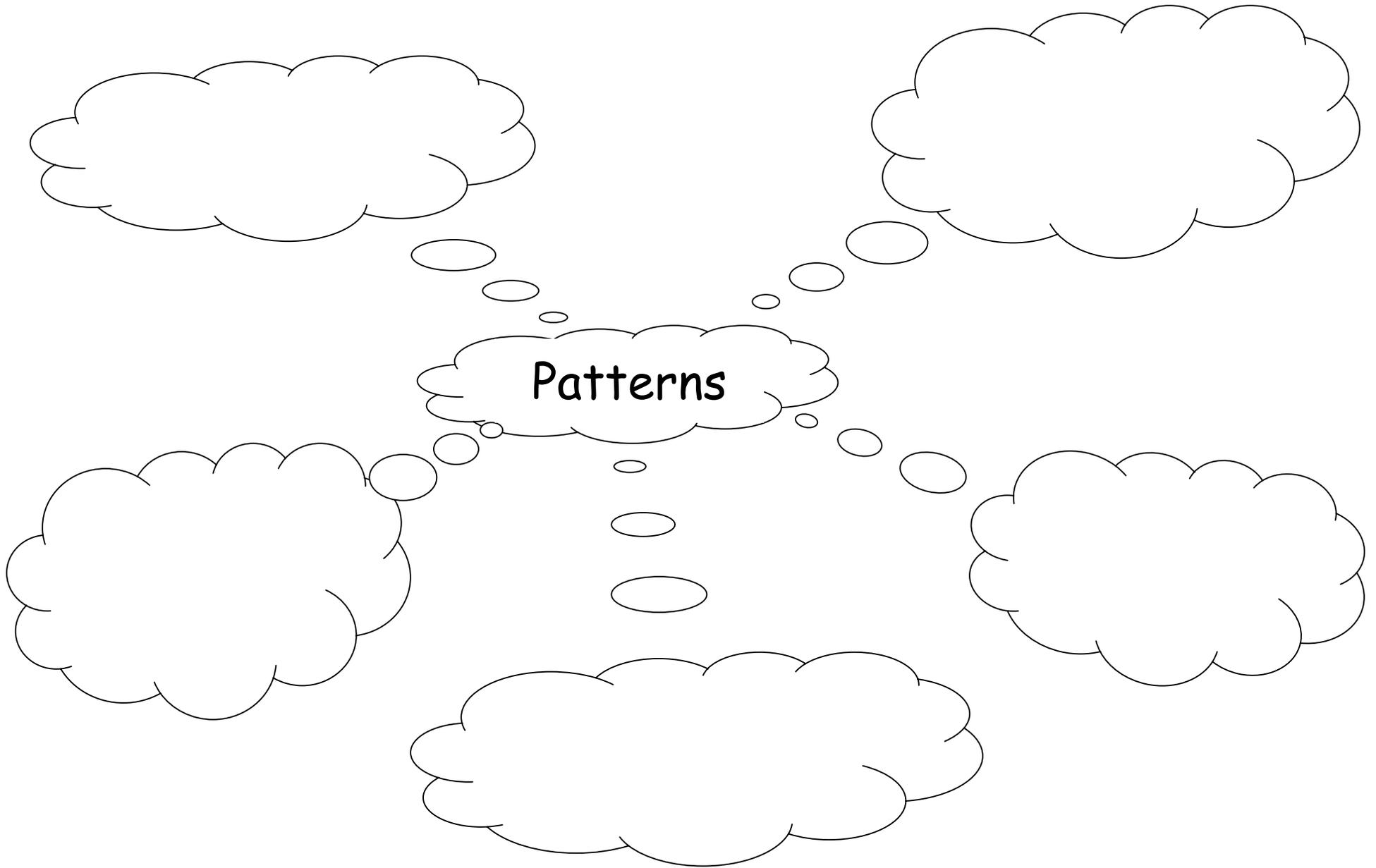
- *Use what you know about [mathematical concept(s)] to explain why your answer is correct. **My answer is correct because whenever I double the color number and add one, I get the first three-dollar amounts. I believe my other answers are correct because they follow the same rule.***

- *Write an equation that states a rule for what you have discovered.*

$$\underline{\quad}n^2 + 1 = f(n)$$

**MSA Extended Constructed Response “Kid Speak”
Mathematics Rubric
Grades 4 through 8**

Score	
3	<p>My answer shows I completely understood the problem and how I solved it:</p> <ul style="list-style-type: none"> • I used a very good, complete strategy to correctly solve the problem. • I used my best math vocabulary to clearly explain what I did to solve the problem. My explanation was complete, well-organized and logical. • I applied what I know about math to correctly solve the problem. • I used numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem.
2	<p>My answer shows I understood most of the problem and how I solved it:</p> <ul style="list-style-type: none"> • I used a good strategy to solve the problem. • I used math vocabulary and my explanation was mostly complete, well-organized and logical. • I was able to apply some of what I know about math to solve the problem. • I tried to use some numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem.
1	<p>My answer shows I knew only a little about the problem and how I solved it:</p> <ul style="list-style-type: none"> • I used only part of a good strategy to solve the problem. • I needed to use better math vocabulary and my explanation needed to be more complete, organized or more logical. • I needed to apply more about what I know about math to solve the problem. • I tried to use some numbers, words, symbols or pictures (or a combination of them) to show how I solved the problem, but I may not have been correct in what I used.
0	<p>My answer shows I didn’t understand the problem and how I solved it:</p> <ul style="list-style-type: none"> • I didn’t use a good strategy to solve the problem. • My strategy wasn’t related to what was asked. • I didn’t apply what I know about math to solve the problem. • I left the answer blank.



Wrapping Paper Blocks

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Wrapping Paper Questions

1. Look at your patterns. Is there a relationship between your number of terms and the grid size?

2. What do you notice about the design?
 - a. When do you get a vertical pattern?

 - b. When do you get a diagonal pattern? Which way does it run?

3. Can you use your knowledge of patterns to describe the relationship between the grid and your diagonals?



Wrapping Paper Questions

1. Look at your patterns. Is there a relationship between your number of terms and the grid size?

Yes, the pattern is random unless your grid size matches your number of terms.

2. What do you notice about the design?

Answers may vary, but discuss how the pattern changes or develops from one grid to the other.

- a. When do you get a vertical pattern?

When the grid size is equal to the number of terms.

- b. When do you get a diagonal pattern? Which way does it run?

When your grid size is either one more or one less than the number of terms, the diagonal runs to the right or to the left.

3. Can you use your knowledge of patterns to describe the relationship between the grid and your diagonals?

Number of Terms -1 = diagonal to the right

Number of Terms +1 = diagonal to the left

WRAPPING PAPER EXIT CARD

Using the information found by designing your wrapping paper, write a rule that describes where the vertical and diagonal patterns would be found for a 6 term pattern.

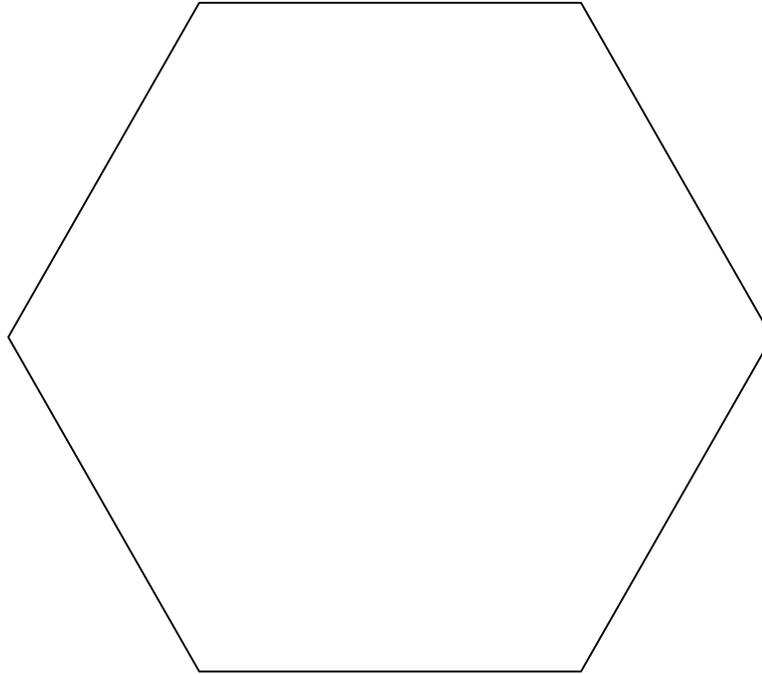
WRAPPING PAPER EXIT CARD ANSWER KEY

Using the information found by designing your wrapping paper, write a rule that describes where the vertical and diagonal patterns would be found for a 6 term pattern.

*When the grid = 5, the diagonal will slant to the right.
When the grid = 7 the diagonal will slant to the left. When the grid and the terms are equal (6) there will be a vertical pattern.*

Pattern Block Equations

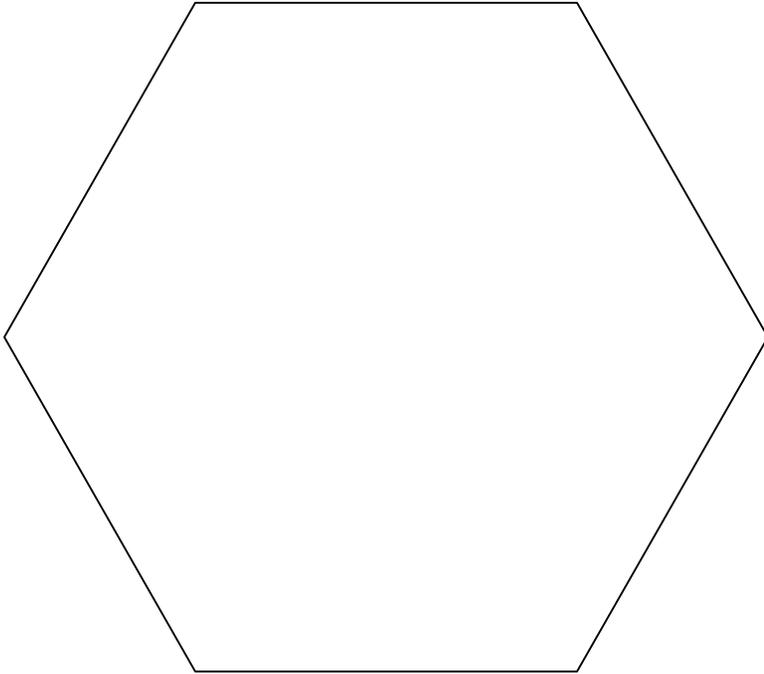
My Design



My Pattern Block Equation:

Pattern Block Equations

My Design



My Pattern Block Equation:

Value Chart

Green Triangle	1
Blue Parallelogram	2
Red Trapezoid	3
Yellow Hexagon	6

Equation Treasure Hunt



Directions: Find the following and write the equations:

1. A design that used more pieces than yours

Your equation:

Found equation:

2. A design that used less pieces than yours

Your equation:

Found equation:

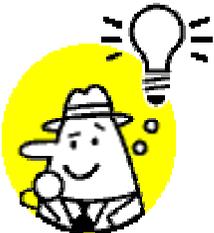
3. A design that is equal in value to yours

Your equation:

Found equation:



4. After looking at several other designs, what do you notice about the value of the class's designs?



5. What do you think would happen if everyone would use the same number of pattern blocks?

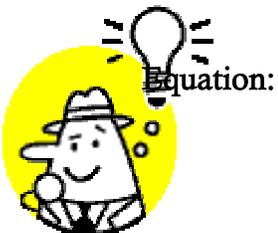
6. Choose a total of 10 red, yellow, green, or blue blocks. Create another shape and draw it below. Use substitution to write the equation

Your equation:

7. **NOW**, compare your shape to another student's. Draw the other student's shape below and write the equation.

Equation:

8. **ONE MORE TIME**: compare your shape to another student's. Draw the other student's shape below and write the equation.



9. What conclusion can you make about the value of designs using 10 pieces?

10. Can you write a rule?

11. An input/output table has been created using the values for pattern blocks.
Use substitution to find the value of the pieces.

Shapes	Value
10Y	
9Y + 1R	
8Y + 2R	

12. Look at the “Shapes” side of the table. What pattern do you see?



13. Continue adding shapes using this same pattern and find the values of those terms.

14. What relationship do you see? Write a rule for that relationship.

Teacher Resource Sheet 4

Equation Treasure Hunt

Directions: Find the following and write the equations:

1. A design that used more pieces than yours

Your equation:

Answers will vary



Found equation:

2. A design that used less pieces than yours

Your equation:

Answers will vary

Found equation:

3. A design that is equal in value to yours

Your equation:

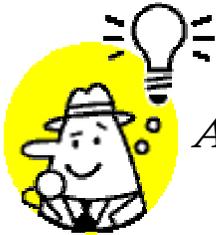
Answers will vary

Found equation:



4. After looking at several other designs, what do you notice about the value of the class's designs?

When making a large hexagon design using red, green, orange, and blue pattern blocks, all of the designs have the same value.



5. What do you think would happen if everyone would use the same number of pattern blocks?

Answers may vary

Teacher Resource Sheet 4

6. Choose a total of 10 red, yellow, green, or blue blocks. Create another shape and draw it below. Use substitution to write the equation

Your equation:

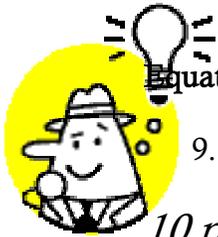
7. **NOW**, compare your shape to another student's. Draw the other student's shape below and write the equation.

Answers will vary

Equation:

8. **ONE MORE TIME**: compare your shape to another student's. Draw the other student's shape below and write the equation.

Answers will vary



Equation:

9. What conclusion can you make about the value of designs using 10 pieces?

10 piece designs vary in value.

10. Can you write a rule?

The value of the design increases with the number of high value pieces.

11. An input/output table has been created using the values for pattern blocks. Use substitution to find the value of the pieces.

Shapes	Value
10Y	60
9Y + 1R	57
8Y + 2R	54
7Y + 3R	51
6Y + 4R	48



12. Look at the “Shapes” side of the table. What pattern do you see?

The Y’s are decreasing by 1 and the R’s are increasing by 1.

13. Continue adding shapes using this same pattern and find the values of those terms.

See answer key above

14. What relationship do you see? Write a rule for that relationship.

As the Y’s increase by 1 and the R’s increase by 1 the values decrease by a constant of 3.

Term 1 – 3 = Term 2

Student Resource Sheet 7

Input/Output Charts

Directions: Cut the following charts apart and pass out one chart per student group.

Input	Output
0	1
1	4
2	7
3	
4	
5	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
6	19
9	28
10	31
15	
17	
20	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Student Resource Sheet 7

Input	Output
0	0
1	2
2	4
3	
4	
7	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
9	18
10	20
15	30
18	
18	
25	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Student Resource Sheet 7

Input	Output
0	0
1	4
2	8
3	
4	
5	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
8	32
9	36
10	40
11	
12	
13	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Student Resource Sheet 7

Input	Output
0	0
1	1
2	4
3	
4	
5	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
6	36
7	49
8	64
9	
10	
11	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Student Resource Sheet 7

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
0	1
1	3
2	5
3	
4	
5	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
6	13
7	15
10	21
12	
15	
40	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Student Resource Sheet 7

Input	Output
100	50
68	34
46	23
32	
24	
8	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
150	75
120	60
98	49
86	
78	
56	

Complete the table.

Use words to write a rule for finding the output when you know the input.

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input/Output Charts
Answer Key

Directions: Cut the following charts apart and pass out one chart per student group.

Input	Output
0	1
1	4
2	7
3	10
4	13
5	16

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by 3, then add one

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
6	19
9	28
10	31
15	46
17	52
20	61

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by 3, then add one

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
0	0
1	2
2	4
3	6
4	8
7	14

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by two

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
9	18
10	20
15	30
18	36
21	42
24	48

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by two

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
0	0
1	4
2	8
3	12
4	16
5	20

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by 4

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
8	32
9	36
10	40
11	44
12	48
13	52

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by 4

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
0	0
1	1
2	4
3	9
4	16
5	25

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by itself

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
6	36
7	49
8	64
9	81
10	100
11	121

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by itself

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
0	1
1	3
2	5
3	7
4	9
5	11

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by 2 and add one

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
6	13
7	15
10	21
12	25
15	31
40	81

Complete the table.

Use words to write a rule for finding the output when you know the input.

Multiply the input by 2 and add one

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
100	50
68	34
46	23
32	16
24	12
8	4

Complete the table.

Use words to write a rule for finding the output when you know the input.

Divide the input by 2

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.

Input	Output
150	75
120	60
98	49
86	43
78	39
56	28

Complete the table.

Use words to write a rule for finding the output when you know the input.

Divide the input by 2

Write the shaded output number on the back of this paper and silently line up from least to greatest in front of the class.



Wrapping Paper Research

Different papers have different costs. Our research has found that we can buy either plain white paper or pastel colored paper.

Plain white paper costs \$.02 per sheet, 10 sheets cost \$.20, and 50 sheets cost \$1.00. The distributor told us that we can also buy this paper in 100, 500, and 1,000 sheet quantities, but he did not have the price handy. He did say that these quantities were priced using the same pattern the lower quantity paper was priced.

Pastel colored paper costs \$.05 per sheet, \$.50 for 10 sheets, \$2.50 for 50 sheets. Again, we can buy this paper in 100, 500, and 1,000 sheet quantities and the price follows the same pattern.



Wrapping Paper Research

Different papers have different costs. Our research has found that we can buy either plain white paper or pastel colored paper.

Plain white paper costs \$.02 per sheet, 10 sheets cost \$.20, and 50 sheets cost \$1.00. The distributor told us that we can also buy this paper in 100, 500, and 1,000 sheet quantities, but he did not have the price handy. He did say that these quantities were priced using the same pattern the lower quantity paper was priced.

Pastel colored paper costs \$.05 per sheet, \$.50 for 10 sheets, \$2.50 for 50 sheets. Again, we can buy this paper in 100, 500, and 1,000 sheet quantities and the price follows the same pattern.

PLAIN WHITE PAPER

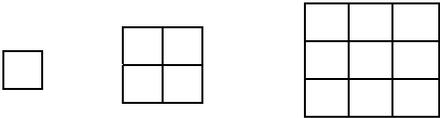
INPUT	OUTPUT
1	\$.02
10	\$.20
50	\$1.00
100	\$2.00
500	\$10.00
1,000	\$20.00

PASTEL COLORED PAPER

INPUT	OUTPUT
1	\$.02
10	\$.20
50	\$1.00
100	\$2.00
500	\$10.00
1,000	\$20.00

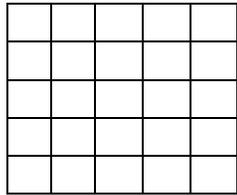
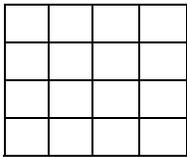
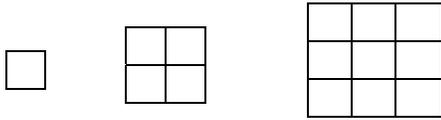
Growing Patterns

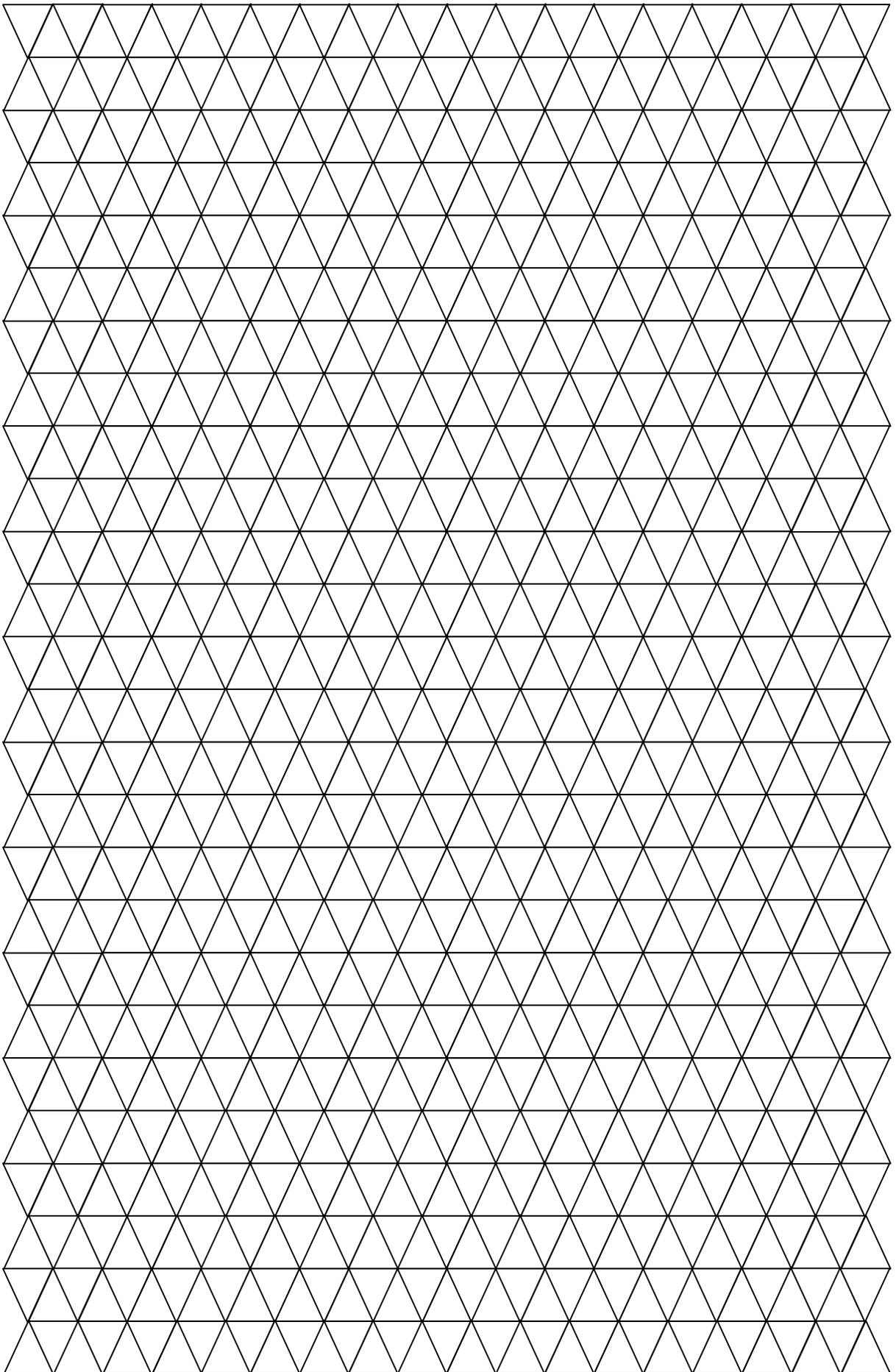
Instructions: Create the next 2 larger patterns.



Growing Patterns

Instructions: Create the next 2 larger patterns.





GROWING PATTERNS

Exit Card

Predict the number of smaller triangles in the next larger triangle of your sequence from today's triangle lesson.

GROWING PATTERNS

Exit Card

Predict the number of smaller triangles in the next larger triangle of your sequence from today's triangle lesson.

Answer: 100 (10 x 10)