Repeated Patterns, Growing Patterns and Functions

Brief Overview:

Throughout this lesson students will be exposed to repeating patterns, both numeric and non-numeric, functions and function tables, and growing patterns. Students will use manipulatives, pictures, motions, games and verbal cues to give them a better understanding of patterns and how they can identify them in the real world.

NCTM Content Standard/National Science Education Standard:

Understand patterns, relations, and functions

- Describe, extend, and make generalizations about geometric and numeric patterns;
- Represent and analyze patterns and functions, using words, and tables.

Grade/Level:

Grade 3 (This lesson will specifically address the needs of the Second Language Learners)

Duration/Length:

Three lessons – 60 minutes per lesson

Student Outcomes:

Students will:

- Identify, describe, extend, and create numeric patterns.
    - Represent and analyze numeric patterns using skip counting.
    - Represent and analyze numeric patterns using skip counting backwards.
    - Complete a function table using a given addition or subtraction rule.
- Identify, describe, extend, and create non-numeric patterns.
    - Represent and analyze growing patterns using symbols, shapes, designs or pictures.
    - Represent and analyze repeating patterns using symbols, shapes, designs or pictures.

Materials and Resources:

- Lesson 1 Materials
    - Two of Everything (A Chinese Folktale) by Lily Toy Hong

    - Sweet Clara and the Freedom Quilt by Deborah Hopkins
    - Beanbag or soft object to pass
    - Pattern Blocks or Colored Tiles
    - Cash register tape or sentence strips, or any variety of paper

- Lesson 2 Materials
    - Game Board Playing tokens (1 per student)
    - Number Generators (2 per group)

- Lesson 3 Materials
    - One Grain of Rice: A Mathematical Folktale by Demi
    - Pattern Blocks
    - Colored Tiles

Development/Procedures:

Lesson 1 Represent and analyze numeric patterns using skip counting forwards and backwards. Represent and analyze repeating patterns using symbols, shapes, designs or pictures.

Pre-Assessment

- Distribute day 1 pretest (Student Resource 1)

Launch

- There are two options to launch the lesson for day one of teaching patterns.
    - Option 1 – Read Two of Everything (A Chinese Folktale) by Lily Toy Hong
    - Option 2 – Read Sweet Clara and the Freedom Quilt by Deborah Hopkins

Teacher Facilitation

- Introduce and model concept of repeated patterns by using a hand rhythm.
    - Example: Snap, Snap, Clap (Students will echo the hand rhythm. Everyone will then continue the rhythm together.)
    - Identify the "Snap, Snap, Clap" as the core of the pattern.
- Introduce a simple color pattern by using pattern blocks or colored tiles, and a strip of paper that has squares on it for pattern place holders (Student Resource 2)
    - Model coloring and labeling of a repeated pattern using AB, ABC, ABBA, etc. pattern names.
    - Identify the core of the pattern.
- Introduce a skip counting game. (There are two variations.)

    - Variation 1 – Begin with students standing in a circle. Model handing the beanbag to the person on their right. Next, model being the leader, the person who explains the skip counting rule and the beginning number. (Example – "The rule is counting by 5's." "Five." Then the leader hands the beanbag to the person on the right to continue the skip counting pattern. Begin a new pattern when the beanbag gets back to the leader. To make this game more challenging. The Rule could be counting by 2's, but the beginning number could be 24 instead of 2.)
    - Variation 2 – Begin with students standing in a circle. Model counting in sequence beginning with the leader, saying the number 1, with the next person saying the number 2 and so on. Next, the leader explains the skip counting rule. If the rule is 5, the class will clap on every multiple of 5. (Example – The leader will begin with 1, the person on their right would say 2, the person on their right would say 3, then 4, then 5 (Everyone else claps.)
- Model skip counting using a 100's chart. (Student Resource 3.) Pick a number to skip count by. (Example – Teacher will pick 3 as the number and shade every third number or every multiple of 3 on the 100's chart. Once all of the numbers are shaded, students should begin to see a pattern. Then use cash register tape, sentence strips or any variety of paper to record all of the multiples of 3 that were shaded.)

Student Application

- Students will create a repeated rhythmic pattern using their hands. Have the students explain what their core pattern is before other students repeat.
- Students will be able to create and record a pattern using colored tiles or pattern blocks on their strips of paper.
- Students will choose their favorite pattern from the colored tiles or pattern blocks and they will record and color their pattern on Student Resource 2. Students will then name their finished pattern using AB, ABC, ABBA, etc. terminology.
- Students will continue playing one of the skip counting games. Students will have an opportunity to be the leader in each of the games and create the rule for the class to follow.
- Students will use distributed 100's charts (Student Resource 3) to create a skip counting pattern using a rule they have created. Students will color every multiple of their number, and then they will record the multiples on cash register tape, sentence strips or any variety of paper.

Embedded Assessment

- Use the student created rule from Student Resource 2 as an informal assessment of non-numeric patterns.

- Use the 100's chart and cash register tape, sentence strips or any variety of paper as an informal assessment of numeric skip counting patterns.

Lesson 2 Complete a function table using a given addition or subtraction rule.

Pre-Assessment

- Students will be presented with an incomplete 100's skip counting chart. The students will complete the chart, and record the function rule and all of the multiples at the bottom of the chart. (Student Resource 4)

Launch

- You and the students will play a game called "Guess the Function." Use Teacher Resource 1a-c with input and output numbers of a function table. Reveal one number at a time on the function table. The students will raise their hands and state the rule.

Teacher Facilitation

- Model a partner game. First, tell students an addition or a subtraction rule. Teacher will split the class into two equal groups. Distribute yellow cards (Teacher Resource 2) that have the input on them to one group. Distribute blue cards (Teacher Resource 3) with the output on them to the second group. Explain to the students that the yellow cards have 1 blue match and the blue cards have only 1 yellow match, just like a function table, there is only one true answer. Tell students what the function rule is before students begin to find their match/partner. Once students have found their match/partner they high-five and put their hands in the air. This game has 3 variations.
- Model playing "Function Fun Board Game"
    - (Place students into groups of two and distribute game boards (Student Resource 5), tokens, number generators and Function Assessment (Student Resource 6a-b)

Student Application

- Students will play "Function Fun Board Game" with a partner. Students will record the roll on their number generators in the input column, students will apply the rule and record how many places their token moved in the output column.

Embedded Assessment

- Evaluate the recording sheet from the "Function Fun Board Game" to identify student understanding of function tables.

Reteaching/Extension

- Extension Activity: Students that have shown mastery of the skills incorporated in the lesson will work individually on a function table that lists a rule and input values only to solve the output, and vice versa. (Students Resource 7)

- Reteaching Activity: Student will use dots on the Student Resource Sheet to assist in solving the output of each function. (Student Resource 8)

Lesson 3 Represent and analyze growing patterns using symbols, shapes, designs or pictures.

Pre-assessment

- Distribute a piece of paper to each student. Students will be presented with a task of writing down or drawing pictures of everything they know about growing patterns (Student Resource 9)

Launch

- Read One Grain of Rice: A Mathematical Folktale by Demi

Teacher Facilitation

- Distribute colored tiles and prepare to tell a story about growing patterns. Students will model their colored tiles after the information given in the story, or will copy your colored tiles if students are unsure of the concept of growing patterns. (Teacher Resource 4)
- Demonstrate and model ways to create a growing pattern using pattern blocks and colored tiles. Also discuss ways the pattern can be displayed in a table.

Student Application

- Students will be able to create a growing pattern with 3 steps of the pattern already given. (Student Resource 10)
- Students will record their steps in a table.

Embedded Assessment

- Use the table of recorded steps to identify student understanding of growing patterns.

Summative Assessment:

Distribute Student Resource 11 (summative assessment). Use this document to assess individual student understanding of the objectives of the learning unit.

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Appendix A: Teacher Resources

Teacher Resource 1a-c – Overlay of function tables
Teacher Resource 2 – Function Input Cards
Teacher Resource 3 – Function Output Cards
Teacher Resource 4 – Growing Pattern Story

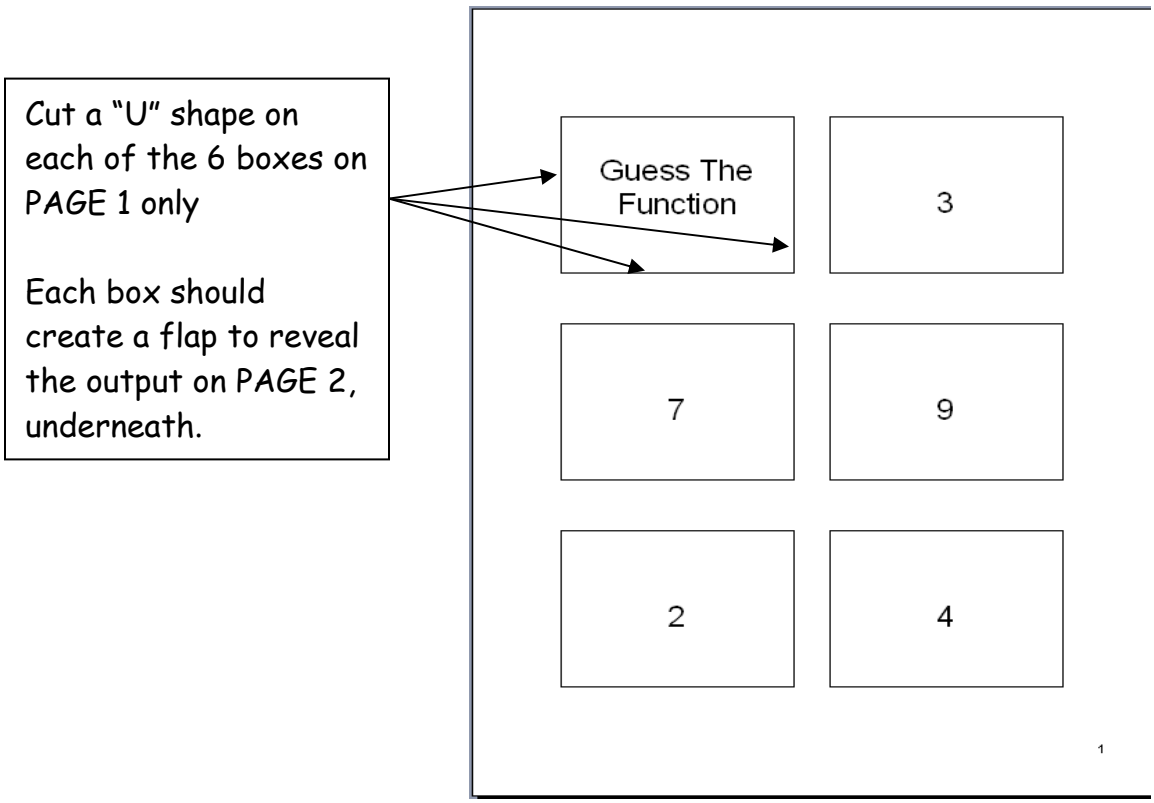
Appendix B: Student Resources

Student Resource 1 – Pre-assessment
Student Resource 2 – Repeated Pattern Squares
Student Resource 3 – 100's Chart
Student Resource 4 – Semi-completed 100's Chart
Student Resource 5 – Function Fun Game Board
Student Resource 6 – Function Fun Game Assessment
Student Resource 7 – Extension Function Table
Student Resource 8 – Remediation Function Table
Student Resource 9 – Write It and Draw It – Growing Patterns
Student Resource 10 – Growing Patterns
Student Resource 11 – Summative Assessment

Using Teacher Resource 1 A – 1 C

Print both pages on card stock. Cut out the boxes on the first page in a "U-shape" so they create flaps. Put the second page underneath and tape or glue together.

Each flap can be lifted to reveal the output. The input will be listed on the top page.



Guess The Function

3

7

9

2

4

+ 8	11
15	17
10	12

Guess The Function

3

7

9

2

4

X 5	30
35	45
10	20

Guess The Function

3

7

9

2

4

+ 12	15
19	21
14	16

Input Cards – Rule + 6 (Print on Yellow Paper)

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15

Input Cards Set 1 – Rule x 2 (Print on Yellow Paper)

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15

Input Cards – Rule + 11 (Print on Yellow Paper)

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15

Output Cards Set 1 – Rule + 6 (Print on Blue Paper)

7	8	9
10	11	12
13	14	15
16	17	18
19	20	21

Output Cards Set 2 – Rule x 2 (Print on Blue Paper)

2	4	6
8	10	12
14	16	18
20	22	24
26	28	30

Output Cards Set 3 – Rule + 11 (Print on Blue Paper)

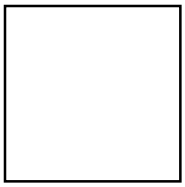
12	13	14
15	16	17
18	19	20
21	22	23
24	25	26

Growing Pattern Story

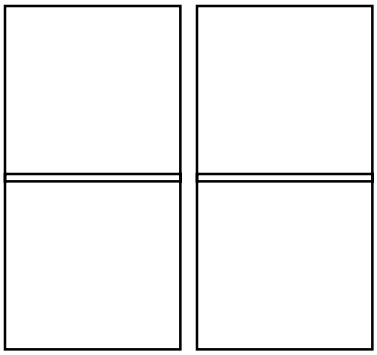
Directions: Use this story during your "Teacher Facilitation" of growing patterns. Use colored tiles to model the building of a growing pattern during the story. Concurrently, the students will be individually building the pattern at their desks.

Story:
Once upon a time there was a family called the "Square Family."

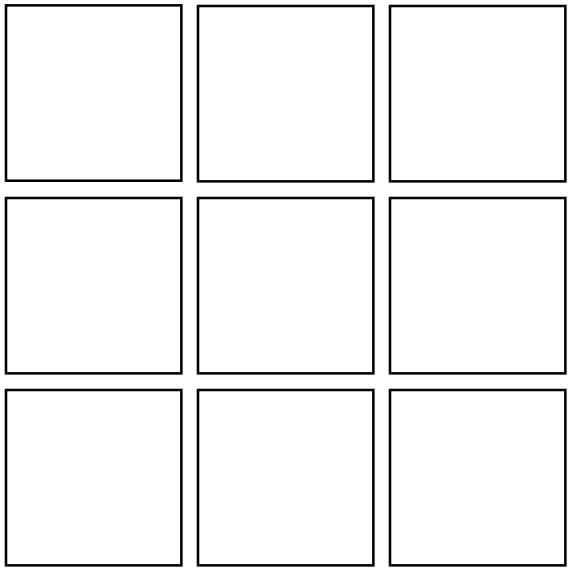
The family started out with Mr. Square. He lived in a square house all by himself.



One day Mr. Square met a nice lady, they decided to get married and have two children. They lived in a larger house with one bedroom for each person.



Time passed and the Square Family started to grow again. The children decided they wanted to get 3 dogs and 2 cats. Once again the Square Family's house grew so each member of the square family and their pets had their own bedrooms in the Square House.



If the square family keeps getting larger at the same rate, how many bedrooms will be in the **square house** after it grows again?

Name _____ Date _____

Pretest Lesson One

Fill in the pattern.

1) 7, 14, __, 28, 35

   a) 16
   b) 24
   c) 21
   d) 36

2) 90, 80, 70, __, 50

   a) 65
   b) 60
   c) 50
   d) 75

3) 6, __, 12, 15, 18

   a) 3
   b) 14
   c) 10
   d) 9

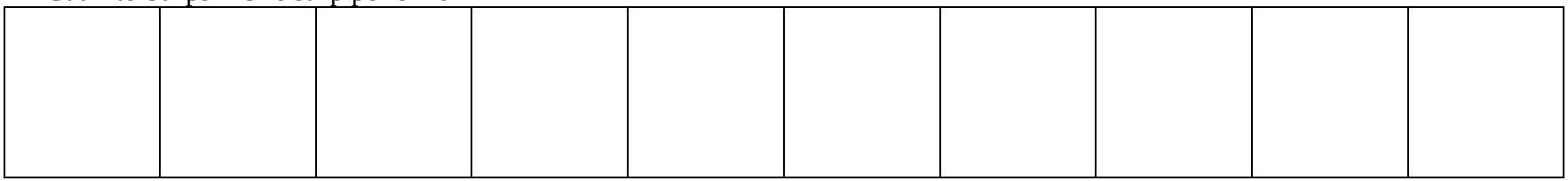
4) AA, BB, AA, __, AA, BB

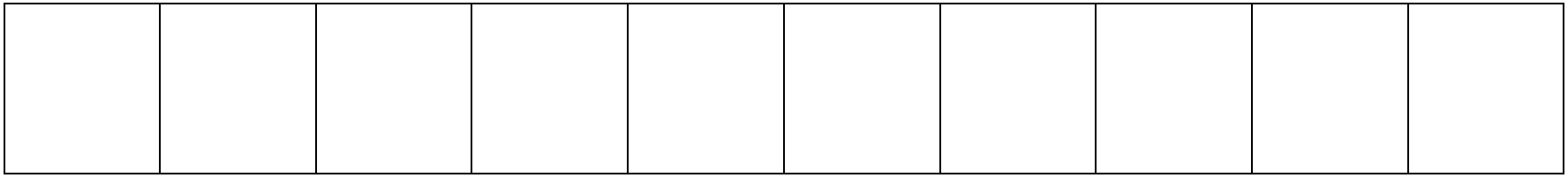
   a) BB
   b) AA
   c) BA
   d) AB

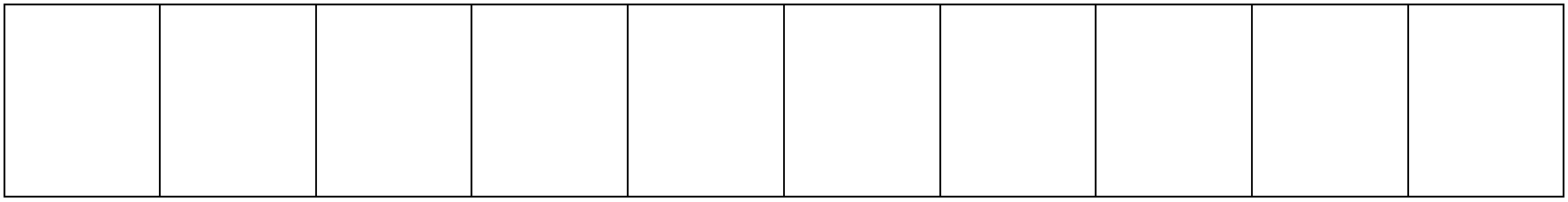
5) RRR, GGG, YYY, RRR, GGG, ___

   a) RRR
   b) GGG
   c) RGY
   d) YYY

**Cut into Strips – One strip per child







100's Chart

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

100's Chart

WHAT'S MY FUNCTION?_____

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Record Multiples:
3, 6, 9, 12,

Function Fun

End

Start

Board Game

Name _____ Date _____

Partner's Name _____

Function Fun Game Board "Moves"

Sum Rolled	Function Rule _____	Spaces you moved on the Game Board

Person Who Won the Game _____

Function Fun Game

Materials: 1 Marker/Token for each player, 2 number generators, 1 Function Fun Playing Board, 1 Function Fun Game Board "Moves" sheet

Directions: Before students begin playing, they must agree on an addition function rule. (For example – you can pick + 6 as a function rule and write that on your game board.)

The student with the birthday closest to today's date gets to roll first.

1. The first student rolls the number generators and records their sum in the first column on the moves sheet.

2. The first student uses the function rule and puts the new number in the last column.

3. The first student gets to move the number of spaces that was recorded in the last column.

4. Now it is time for the second player to take their turn. They will roll the number generators and record the sum in the first column.

5. The second student uses the function rule and puts the new number in the last column.

6. Finally the second student gets to move the number of spaces that was recorded in the last column.

7. Student keep taking turns until a player lands on the end space.

Name _____ Date _____

Function Table

Function Rule + 4	
8	
10	
3	
15	
13	

Function Rule + 25	
10	
25	
0	
100	
11	

Function Rule – 8	
9	
26	
14	
20	
8	

Function Rule x 2	
7	
11	
4	
9	
6	

Function Rule x 5	
2	
9	
12	
8	
4	

Function Rule _____	
3	15
7	19
8	20
4	16
9	21

Name _____ Date _____

Function Table

Function Rule + 8		
1	oooo oooo	
5	oooo oooo	
9	oooo oooo	
4	oooo oooo	
3	oooo oooo	

Function Rule + 4		
2	oooo	
6	oooo	
7	oooo	
5	oooo	
2	oooo	

Function Rule + 10		
4	ooooo ooooo	
2	ooooo ooooo	
9	ooooo ooooo	
6	ooooo ooooo	
8	ooooo ooooo	

Function Rule + 5		
6	ooooo	
9	ooooo	
4	ooooo	
2	ooooo	
8	ooooo	

Function Rule – 3		
4	oooo	
6	oooooo	
8	oooo oooo	
12	oooooo oooooo	
5	ooooo	

Function Rule - 7		
9	ooooooo	
12	oooooo oooooo	
8	oooo oooo	
15	oooooo oooooo ooo	
11	oooooo ooooo	

Name _____ Date _____

Explain what you know about **growing patterns**. You can use words or pictures to help you with your explanation.

_____

_____

_____

_____

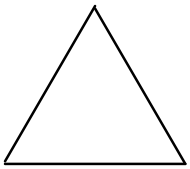
_____

Name _____ Date _____

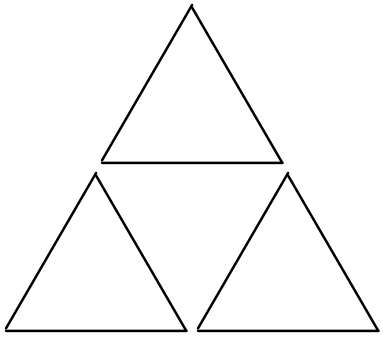
Growing Pattern 1

Use what you know about growing patterns to complete the pattern by drawing a picture.

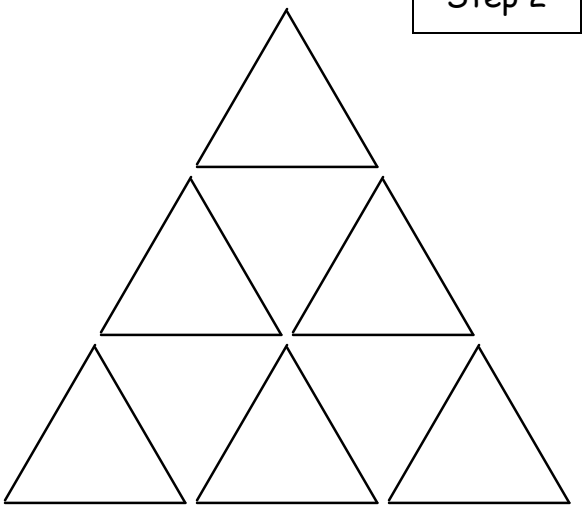
Complete the table with the data you have gathered in your picture.



Step 1



Step 2



Step 3

Step Number	Pattern Blocks Added	Total Pattern Blocks Used
1	1	1
2	2	3
3	3	6
4		

Make a prediction: How many pattern blocks will be in the **6th step** of the pattern? _____

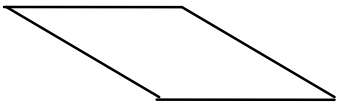
Step 4

Name _____ Date _____

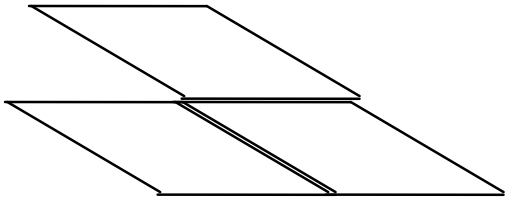
Growing Pattern 2

Use what you know about growing patterns to complete the pattern by drawing a picture.

Complete the table with the data you have gathered in your picture.



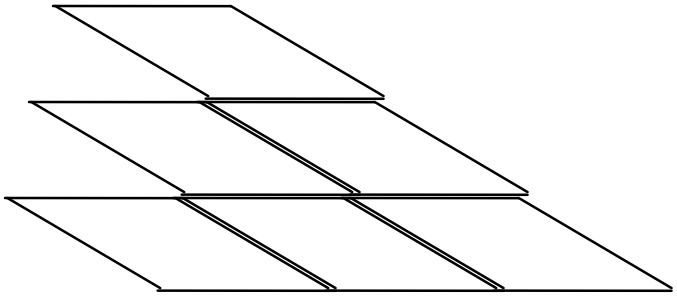
Step 1



Step 2

Step Number	Pattern Blocks Added	Total Pattern Blocks Used
1	1	1
2	2	3
3	3	6
4		

Make a prediction: How many pattern blocks will be in the **6th step** of the pattern? _____



Step 3

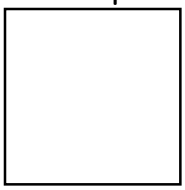
Step 4

Name _____ Date _____

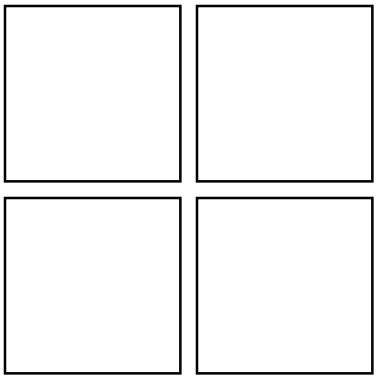
Growing Pattern 3

Use what you know about growing patterns to complete the pattern by drawing a picture.

Complete the table with the data you have gathered in your picture.



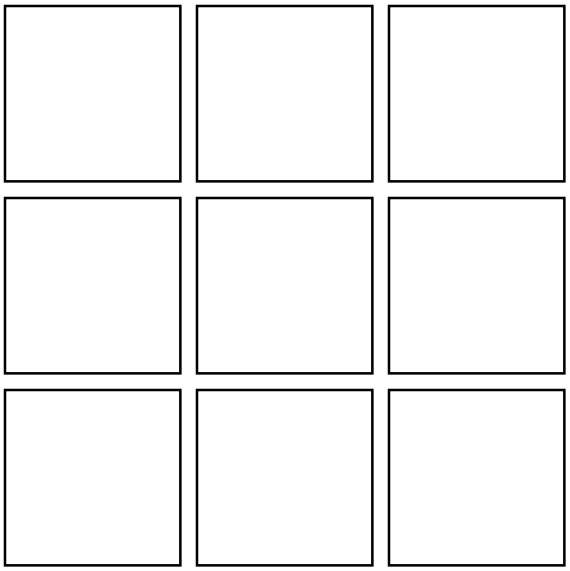
Step 1



Step 2

Step Number	Pattern Blocks Added	Total Pattern Blocks Used
1	1	1
2	3	4
3	5	9
4		

Make a prediction: How many pattern blocks will be in the **6th step** of the pattern? _____



Step 3

Step 4

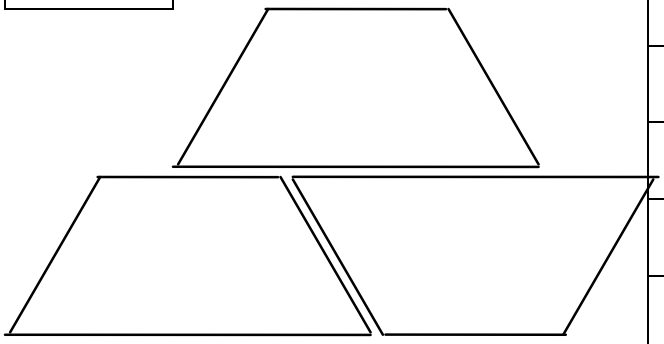
Name _____ Date _____

Growing Pattern 4

Use what you know about growing patterns to complete the pattern by drawing a picture.

Complete the table with the data you have gathered in your picture.

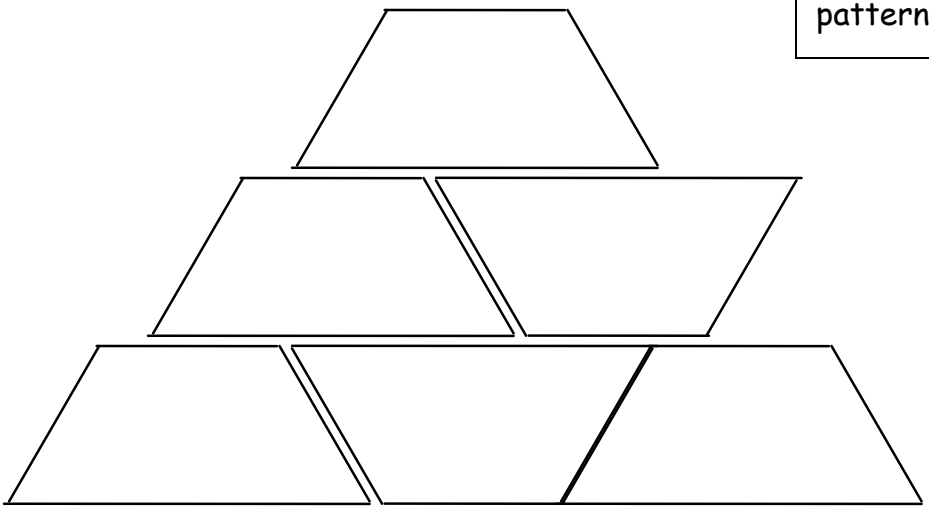
Step 1



Step 2

Step Number	Pattern Blocks Added	Total Pattern Blocks Used
1	1	1
2	2	3
3	3	6
4		

Make a prediction: How many pattern blocks will be in the **6th step** of the pattern? _____



Step 3

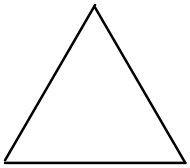
Step 4
Draw on the back

Name _____ Date _____

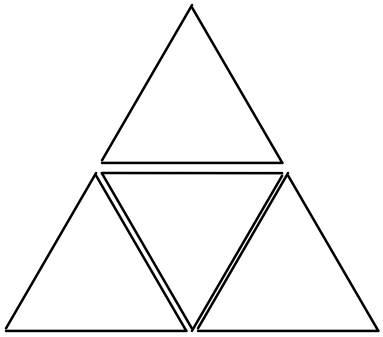
Growing Pattern 5

Use what you know about growing patterns to complete the pattern by drawing a picture.

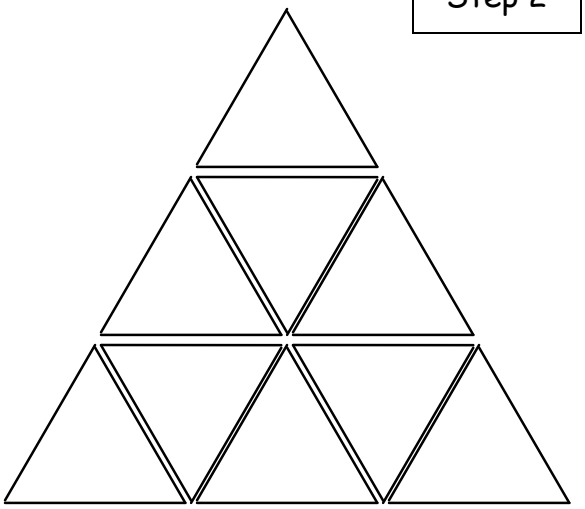
Complete the table with the data you have gathered in your picture.



Step 1



Step 2



Step 3

Step Number	Pattern Blocks Added	Total Pattern Blocks Used
1	1	1
2	3	4
3	5	9
4		

Make a prediction: How many pattern blocks will be in the **6th step** of the pattern? _____

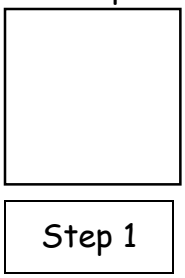
Step 4

Name _____ Date _____

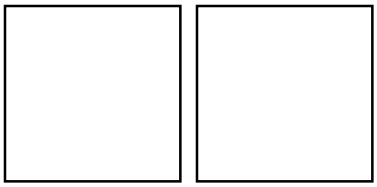
Growing Pattern 6

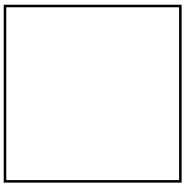
Use what you know about growing patterns to complete the pattern by drawing a picture.

Complete the table with the data you have gathered in your picture.

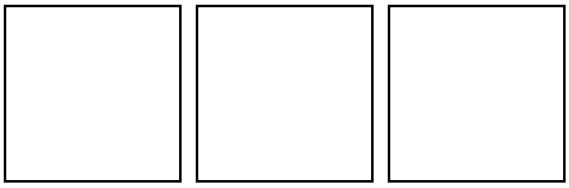


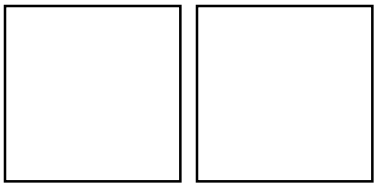
Step 1

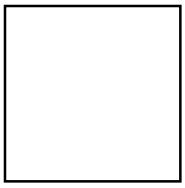




Step 2







Step 3

Step Number	Pattern Blocks Added	Total Pattern Blocks Used
1	1	1
2	2	3
3	3	6
4		

Make a prediction: How many pattern blocks will be in the **6th step** of the pattern? _____

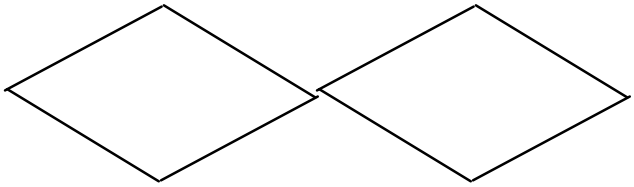
Step 4

Name _____ Date _____

Growing Pattern 7

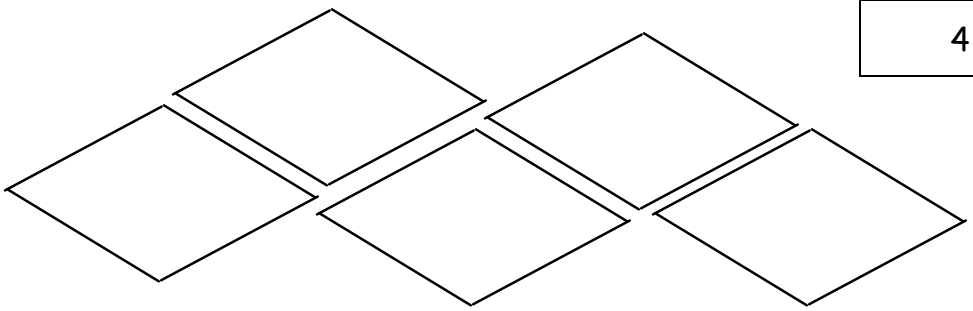
Use what you know about growing patterns to complete the pattern by drawing a picture.

Complete the table with the data you have gathered in your picture.



Step 1

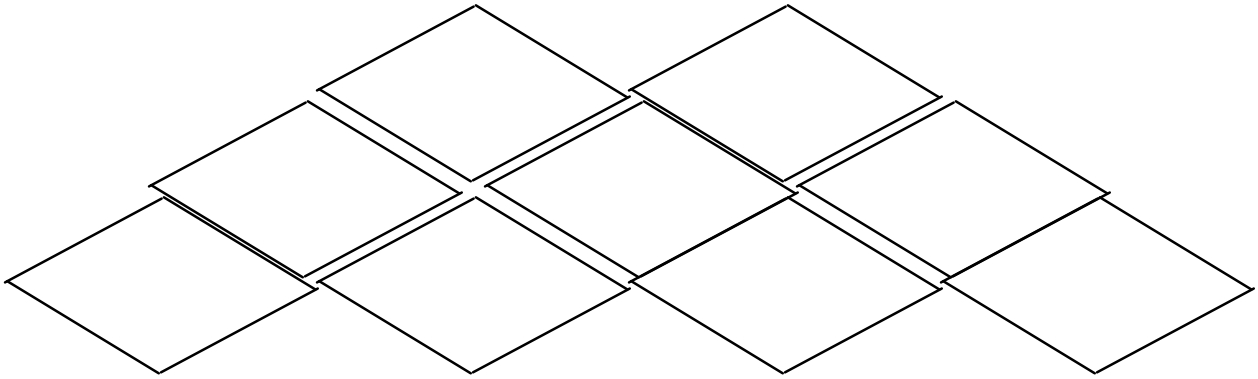
Step Number	Pattern Blocks Added	Total Pattern Blocks Used
1	2	2
2	3	5
3	4	9
4		



Step 2

Make a prediction: How many pattern blocks will be in the **6th step** of the pattern?

_____



Step 3

Step 4
Draw on back

Name _____ Date _____

Patterns, Relations and Functions Assessment

1. Complete the pattern

   22, 30, 38, 46, _____, _____, _____

   a. 47, 48, 49
   b. 50, 55, 60
   c. 52, 60, 68
   d. 54, 62, 70

2. Complete the pattern

___, ___, ___

a. 

b. 

c. 

d. 

3. What is the rule for the function table?

In	3	9	4	6	N
Out	9	27	12	18	

a. 3 + N
b. N – 3
c. N + 6
d. 3 x N

4. If the pattern continues, how many stars will be in the fourth step of the pattern?

First Second Third Fourth

a. 5
b. 9
c. 10
d. 14

Brief Constructed Response

The students in Mrs. Brown's class have all traveled to a special country during their travel fair. They have created a function table to record how many stamps each person has in their passport.

Step A
Complete the function table

Number of Passports	Number of Passport Stamps
3	9
5	11
9	15
2	
8	

Step B
Use what you know about patterns and functions to explain why your answer is correct. Use words and/or numbers in your explanation.