Title: Patterns, Relationships and Functions—Grow Pattern Growwwwwwwwwww!

Brief Overview:

This Concept Development unit starts with the concrete objective of having students create and continue growing patterns and moves to the abstract objectives. The end goal of our lesson is to have students complete function tables based on a given rule.

NCTM Content Standard:

Students will be able to

Algebra

- Understand Patterns, relationships, and functions

Numbers and operations

- Understand numbers, ways of representing numbers and number relationships

Grade/Level:

Grades 4/5

Duration/Length:

Three days (45 minutes each day)

Student Outcomes:

Students will:

- Identify numeric and non-numeric patterns
- Describe growing patterns
- Extend growing patterns
- Find the rule for function tables
- Create a function table to organize data

Materials and Resources:

- Vocabulary Terms (TR1.1)
- Teacher Transparency (TT1)
- Teacher Transparency (TT2.1)
- Teacher Transparency (TT2.2 a, b, c)
- Teacher Transparency (TT 3.1), (TT 3.2)
- Teacher check list (TR1.2)
- Brief Constructed Response (SR1)(TR1.3)
- Super-Duper Challenge (SR2)(TR 2)
- Missing in Action (SR3.1), (TR3.1)
- Extended constructed Response (SR 3.2) (TR3.2)
- Construction Paper
- Notebook Paper
- MSA Rubric (3-8)
- Extra! Extra! Figure it out! (EL1)
- Extra! Extra! Figure it out! (EL2)
- Extra! Extra! Figure it out! (EL 3)
- Summative Assessment (SA1) (TSA1)

- Re-teach Flash Cards (RT1.a) (RT 1.b)
- Re-teach Lesson (RT 3)

Development/Procedures:

Lesson 1 Numeric and Non-Numeric Patterns

Preassessment – Give students patterns blocks. Tell them to make patterns. Ask students to make a pattern that is growing. Then ask students to make repeating patterns.

Launch - Have volunteers describe patterns in geometric terms, such as hexagon, rhombus, triangle, and trapezoid. Students will list the characteristics of each of the shapes (identify number of sides, angles, etc.)

Teacher facilitation – Have several growing patterns on the overhead or chalkboard (TT1). Have students continue patterns at their desks. Discuss these questions with students: 1.) Are these patterns? 2.) Do they grow? 3.) Describe the patterns using the correct geometric terms. As they are describing patterns, the teacher will introduce the vocabulary terms at the appropriate times (TR1.1).

Student Application – Put students in pairs. Have each child create a growing pattern with 5 terms. Have partners switch patterns and extend them 2 more terms. Then place students into small groups, to share and explain their patterns. Teachers will have a checklist for checking student accuracy (TR1.2). Students will receive a 3 if they have mastery of the concepts, a 2 if they have partial mastery of the concepts, and a 1 if they need more help.

Embedded Assessment – Have children complete the Brief Constructed Response (SR1, TR1.3)

Re-teach – Students will create three growing patterns using flash cards (RT1.a, RT1.b). Then students will explain the growing pattern and extend it two terms.

Extension – Student will look at 4 different patterns and decide if they are growing patterns. Have students explain answers and reasons (EL1).

Lesson 2 Growing Patterns

Preassessment - Create a growing pattern with three or four terms using pattern blocks. Have students rotate counter-clock wise to extend their classmates pattern two terms.

Launch – Use the growing patterns in the preassessment. Distribute blank sheets of paper for each group. Have students travel to every sixth student desk. The students will then copy the pattern and extend it two terms. They will do this at three more desks.

Teacher facilitation – Teacher creates the pattern on the overhead (TT2.1). Students will write their predictions on paper for the next 4 terms. Have students describe the patterns in relation to the numbers. Possible questions to ask: Can you describe this pattern using numbers? What type of growing pattern do you see? What can you tell me about how it is growing? The whole group will do these several more times using non-numeric patterns (TT2.2a). Then teacher will create numeric patterns (TT2.2b,c) on the overhead for students to make predictions for the next 4 terms. The group will do this several times, but this time using numeric patterns.

Student Application – In the Super Duper Challenge (SR2) students will create a 4 term growing pattern, switch with a partner and explain how it is growing. Answer key may be found on TR2.

Embedded Assessment – Check the answers for the Super- Duper Challenge.

Re-teaching – Distribute snap cubes. Have students create a growing pattern. Ask students to explain their pattern, ask students, "Can you extend your pattern?" and "Does your pattern grow?" and "Is this pattern be increasing or decreasing?" Next give them a number pattern to extend and discuss.

Extension – Extra! Extra! Figure it out! (EL2) Create numeric growing patterns and make a rule for it. (EL2) or Build Your Pattern (EL2.1) Students will build a pattern when given a rule.

Lesson 3 Define and Create Function Tables

Example

In	Out
1	2
2	4
3	6
4	8

Preassessment - Introduce the two vocabulary words on the overhead "Input"(in) and "Output"(out). Display a function chart with an input column that increases by 1 each term and an output column that increases by two each term . Ask students to find a pattern. They should find that each number will increase by 2 from top to bottom.

Launch – Read transparency to class (TT3.1). Give students the opportunity to solve the problem. Give students a new T-chart using different labels for the two columns: "Number of Players" and "Number of Baseballs" (TR3.4). The Pattern for players is 1,2,3,4,5 etc. The Pattern for Balls is 4, 8, 12, 16, 20 etc. Then ask students to determine the rule for the function table by looking at the relationship between each row and column. Students should answer n x 4 = out.

Teacher Facilitation – Teacher will explain that a function table shows relationships between numbers. Look back at our baseball problem. What is the relationship between players and balls? (For every player there are four more balls). Lets look at some other function tables and try to identify the patterns and relationships between the input and output (TT3.2) This transparency can also be copied as a worksheet for the students. Identify if output pattern is increasing or decreasing. Verbalize what is happening. Have students identify 10th term, 15th term, and 100th term.

Student Application – Distribute "Missing In Action" (SR3.1). Students will identify the pattern and write rules. Answers may be found on TR3.2.

Embedded Assessment SR3.2 Students will answer brief constructed response questions.

Re-teaching—Students will look at basic growing patterns and extend them. Next they will fill look at a function table and relate it to the growing pattern. Students will also verbalize how it grows (RT3a-c)

Extension Students will use the rules they have learned about growing patterns and function tables to try and stump the teacher and their classmates. (EL3)

Summative Assessment:

Teachers will use (SA1) and (TSA1) to determine students understanding of the lesson. SA1 is a combination of selected response and brief constructed response questions.

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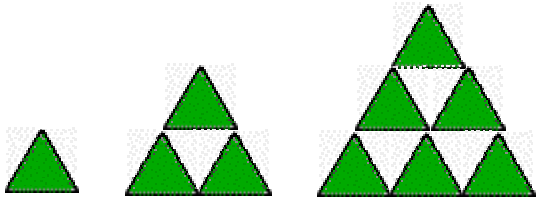
Teacher Transparency 1

1.)



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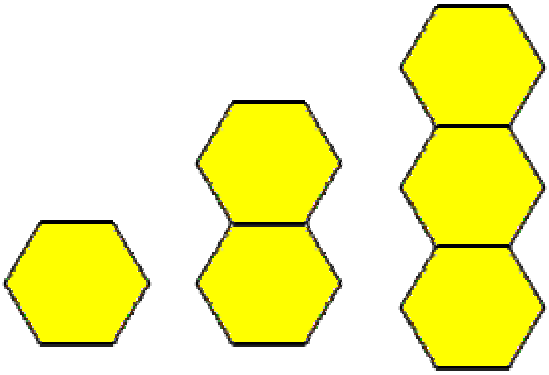
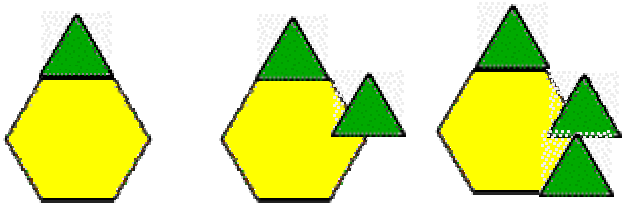
2.)



_____ _____

3.)



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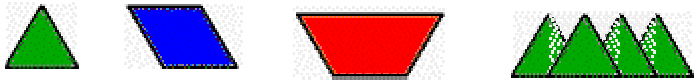
4.)



_____ _____

Teacher Resource 1.1

Vocabulary Terms

Lesson 1

Pattern: A pattern is a sequence of objects, numbers color, etc. that repeats or grows. *We will be focusing on growing patterns.*

Sequence: a set of objects or numbers arranged in a special order or pattern.

Term: A term is each place or position in the sequence.

Lesson 3

Function: A set of ordered pairs such that for any first number (the input), there is only one possible second number (the output).

Term (Input)	✔ (output)
1	2
2	3
3	4
4	5

✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔ ✔

Teacher Resource 1.2

Student	Create Pattern	Extend Pattern	Group work	Total / 9
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.				

Key

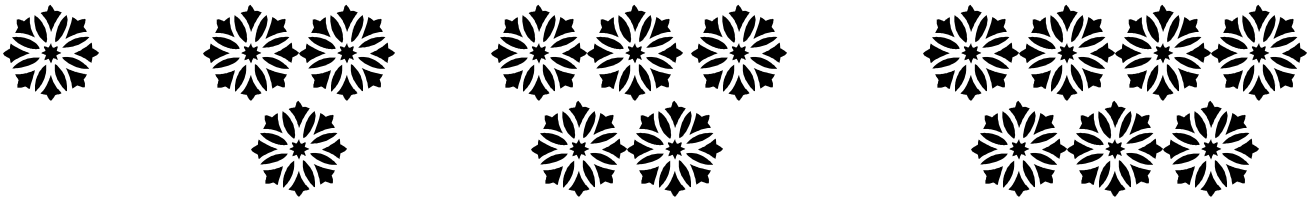
3/3 Student has mastered the concept
2/3 Student has partially mastered the concept
1/3 Student needs more help

Student Resource 1

Name: _____

Brief Constructed Response

Look at the Pattern below.



Part A.

1. Show what the next 2 terms would be in the above pattern.

_____ _____

Part B.

2. Using what you know about patterns tell how you know your answer is correct.

_____

_____

_____

_____

_____

•Extra! Extra!

Figure it out!

Are you ready for a hard task ahead? Your challenge will require thinking and hard work! Can you do it?

Your job is to stump the students! Create a rule and complete a function based on your rule. Your function table should have 5 terms.

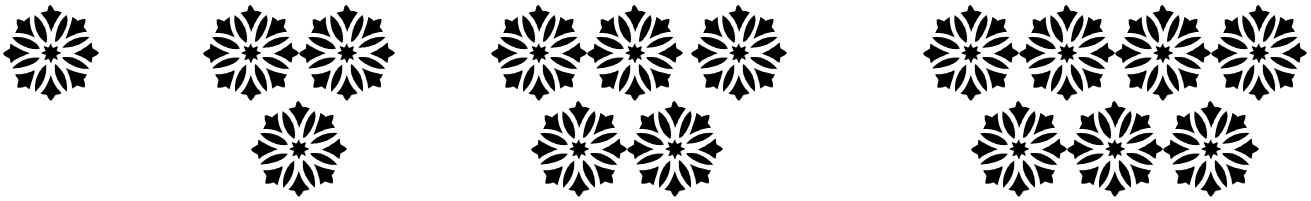
On a separate sheet of paper write the output pattern from your function table. Then exchange with another student. Their job is to figure out the rule.

Teacher Resource 1.3

Name: _____

Brief Constructed Responce

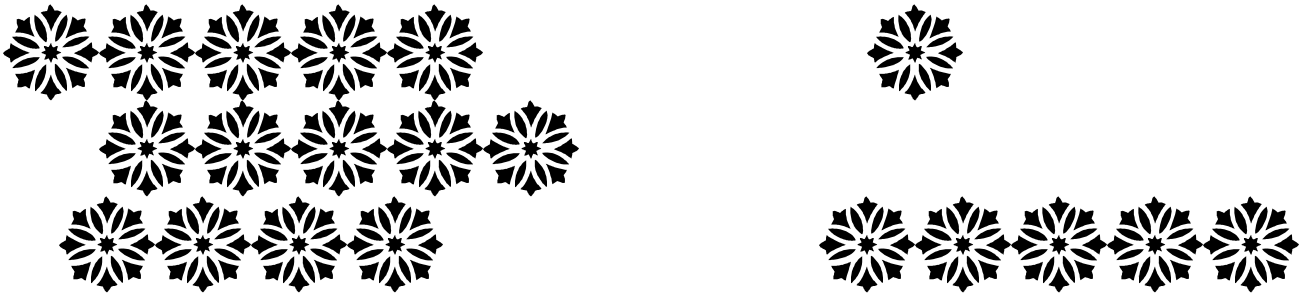
Look at the pattern below.



Part A.

3. Show what the next 2 steps would be in the above pattern.

Step 5 should have five on the top and 4 on the bottom. Step six should have six on the top and five on the bottom.

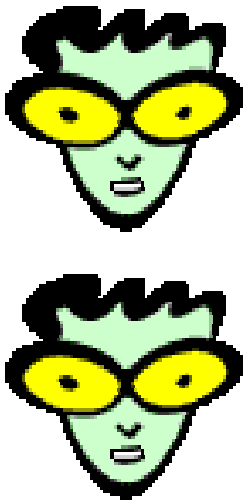


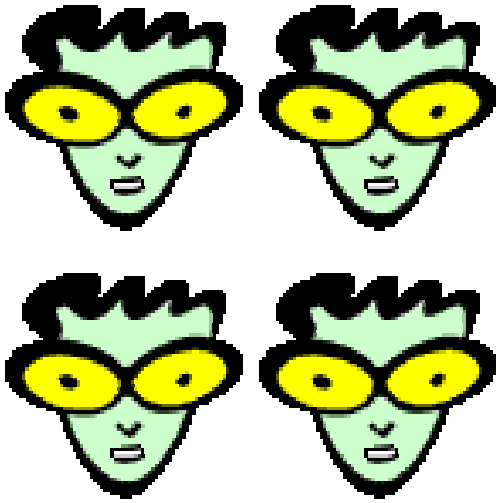
Part B.

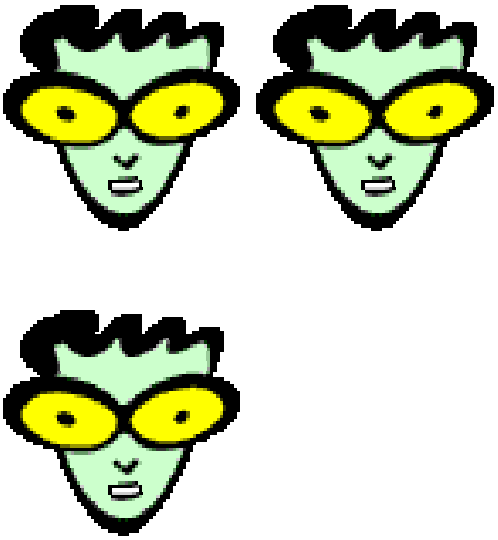
2. Using what you know about patterns tell how you know your answer is correct.

Students should demonstrate an understanding of growth patterns. They should mention that each pattern grows by two snowflakes. They should also mention that the pattern starts out with one snowflake and gets bigger by having two lines with one more snowflakes added to each line.

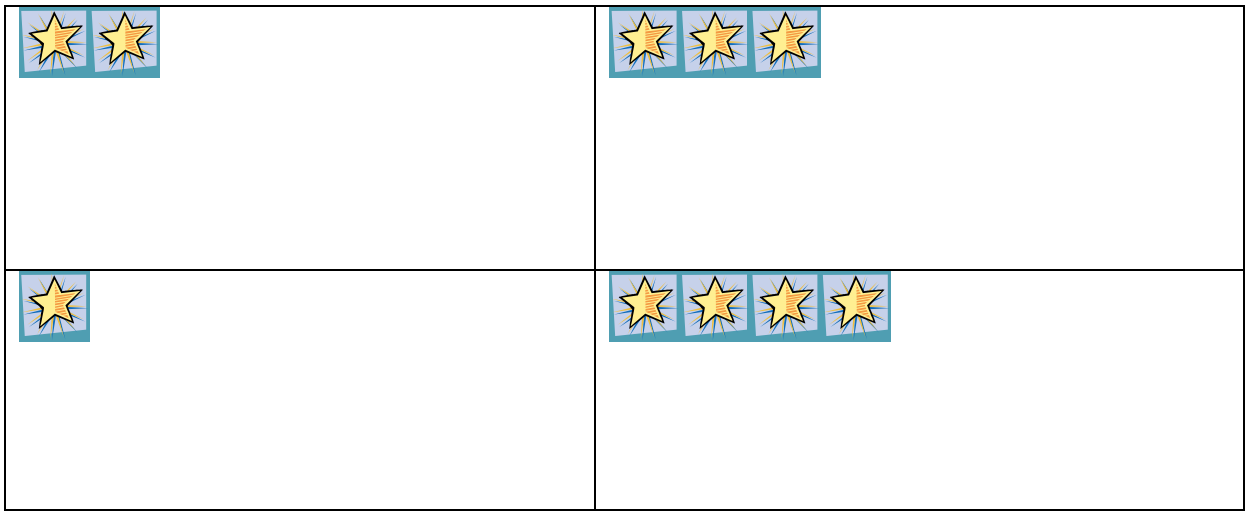
Reteach Lesson 1.a

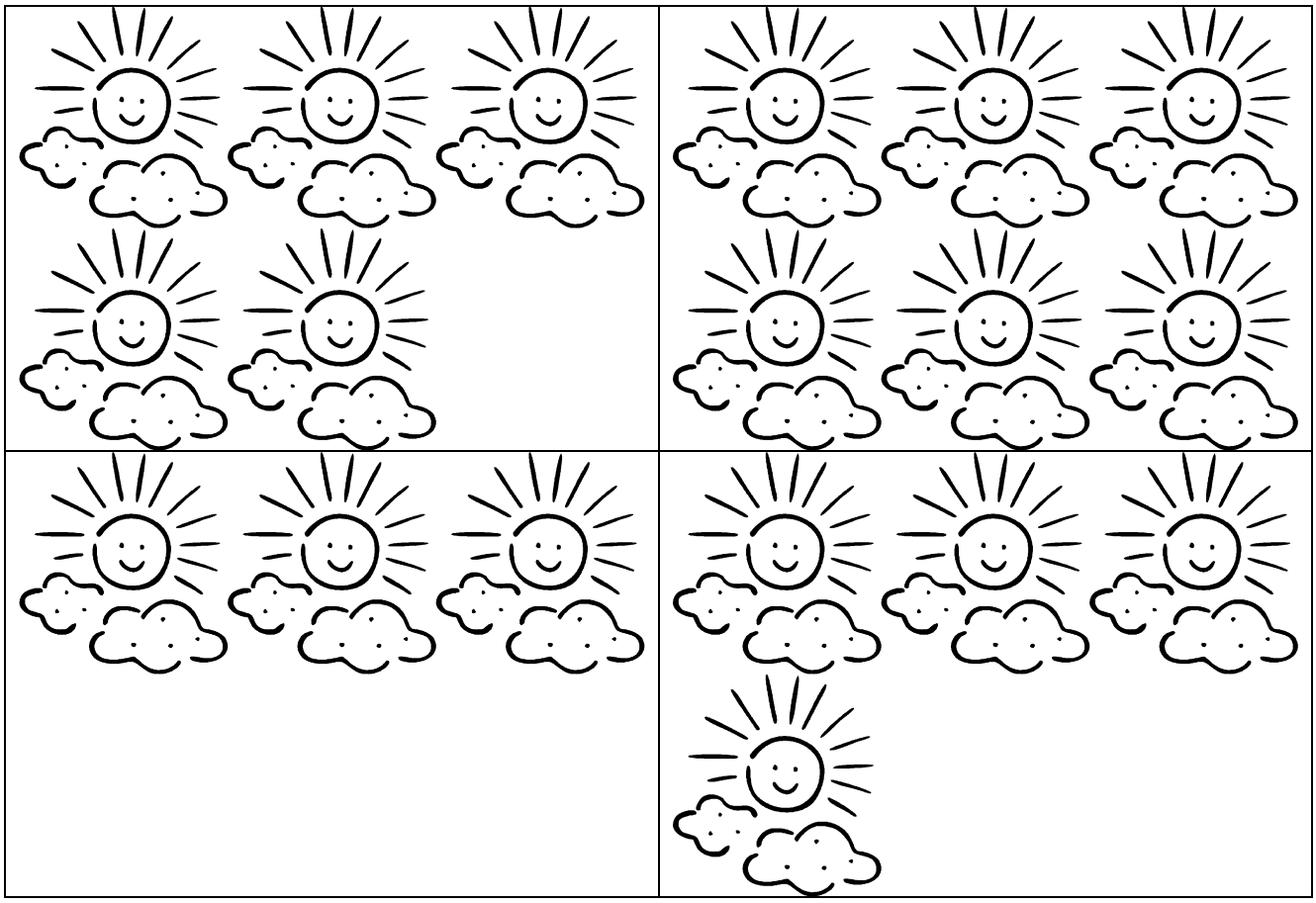






Reteach Lesson 1.b





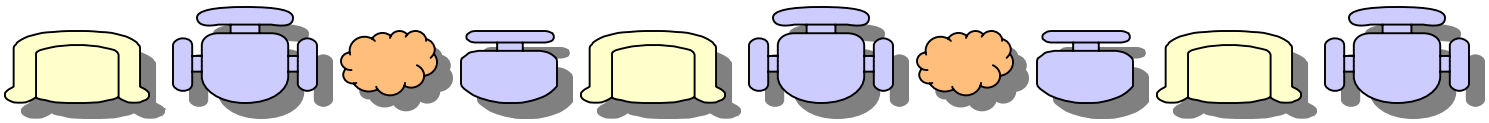
Extension Lesson 1.a

Extra! Extra! Figure it out!

Okay—You think you've mastered the art of patterns! Let's see!

Your job is to look at these 3 patterns and decide if they are growing patterns. You should explain your answer in the space provided. This could be tricky! You have to think hard and work harder!

1.



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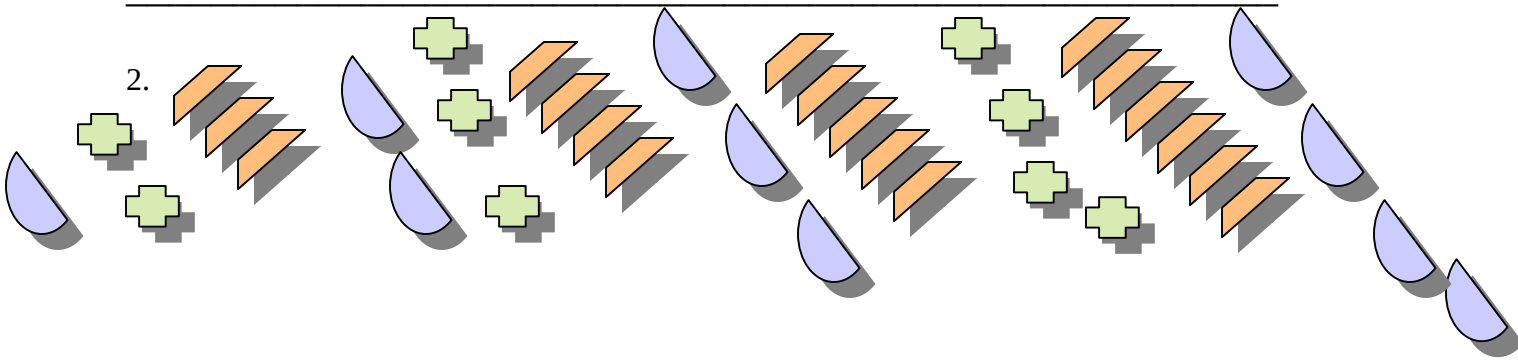
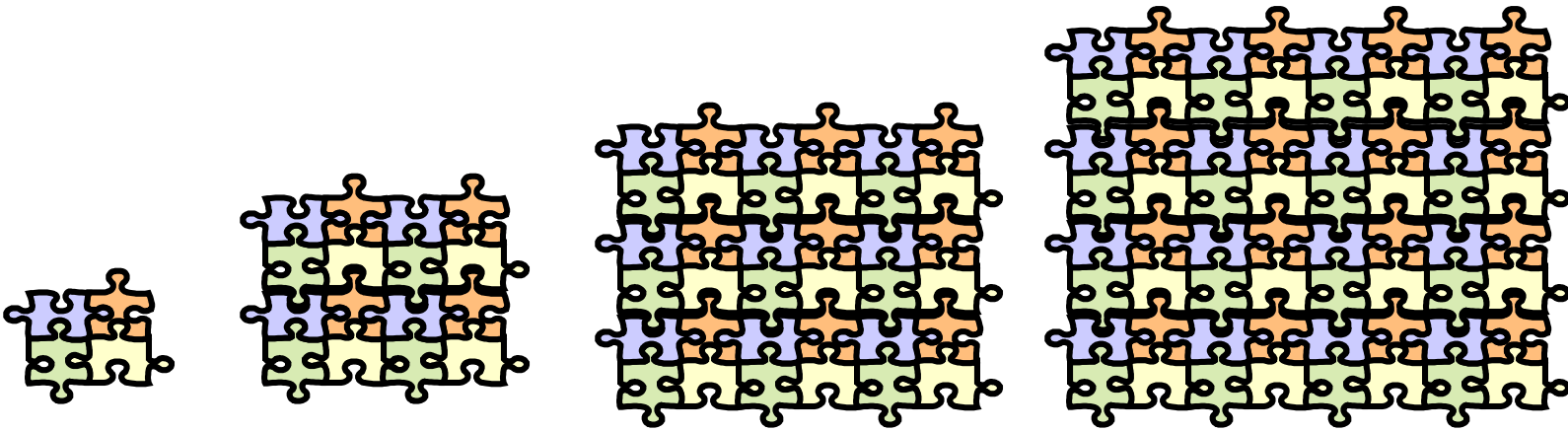


Extension Lesson 1.b

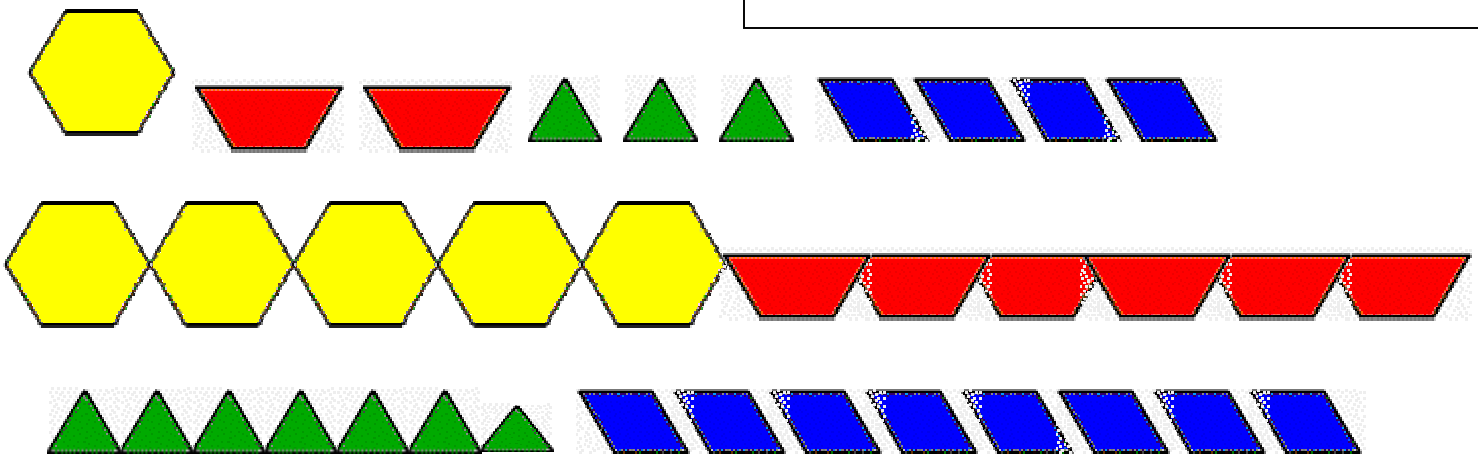
3.



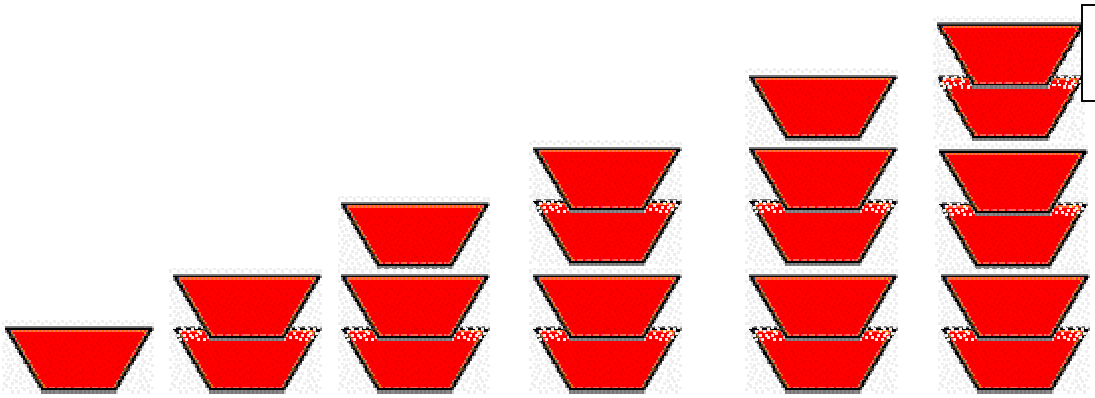
4.

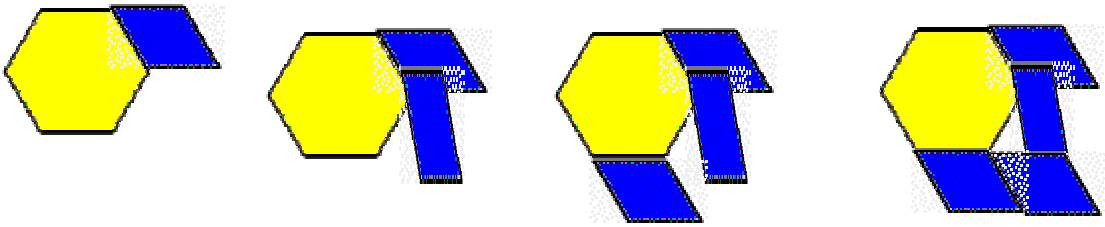
3 8 13 18 23 28 33 38 43 48

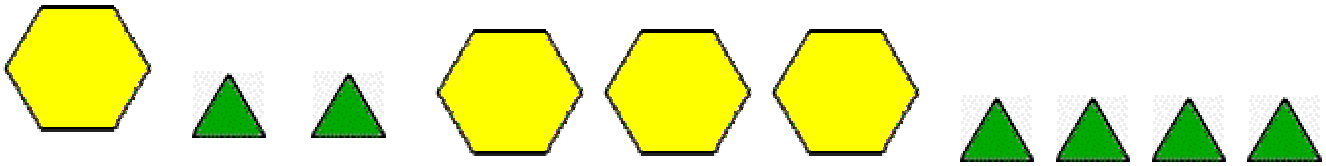
Teacher Transparency 2.1



Teacher Transparency 2a







Teacher
Transparency 2.b

1, 2, 3,4,5,6

22, 20, 18, 16

3,6,9,12,15

Teacher
Transparency 2.c

400, 375, 350, 325,

1,7,13,19,25

81, 72, 63, 54

Student Resource 2

Super-Duper Challenge

Your assignment will be a two step project!

1. Creating a 4 term growing pattern. Draw your pattern on construction paper. Then switch with a partner and explain how your pattern is growing.

2. Make an answer key on notebook paper for your pattern. On your answer key you will have to include:
   a. The original pattern
   b. Three more terms of the pattern
   c. Explanation of how your pattern is growing. (Be sure to include the correct geometric terms for your patterns and an explanation of how it grows or changes.)

Self Evaluation

5/5 I really knew my stuff. I was able to create a growing pattern, extend my partners pattern, and create an answer key.

4/5 I knew my stuff. I had some small problems with _____ but I knew what I was doing.

3/5 I had some problems with _____ _____ _____. I tried my best. I need help

2/5 My partner asked me to correct my paper. When he brought it over and told me I could see the mistakes and I knew how to fix it. I need help.

1/5 My partner asked me to correct my paper, but I did not know how. I need help.

Teacher Resource 2

Super-Duper Challenge

Your assignment will be a two step project!

1. Creating a 4 term growing pattern. Draw your pattern on construction paper. Then switch with a partner and explain how your pattern is growing

2. Make an answer key on notebook paper for your pattern. On your answer key you will have to include:
   a. The original pattern
   b. Three more terms of the pattern
   c. Explanation of how your pattern is growing. (Be sure to include the correct geometric terms for your patterns and an explanation of how it grows or changes.)

Rubric

5/5 Student shows great understanding of growing Patterns
4/5 Student has strong understanding of growing patterns
3/5 Student has some understanding of growing patterns.
2/5 Student is confused by growing patterns.
1/5 Student does not understand growing patterns

_____/5

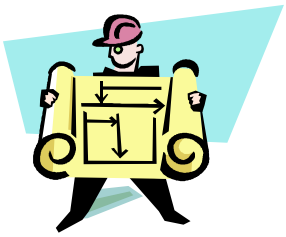
Extension Lesson 2

Extra! Extra! Figure it out!

CAN YOU DO THIS?

Create a numeric growing pattern and make a rule for it. Good luck!

Work Space



Extension Lesson 2.1

Build your Pattern!

1. Build a pattern that grows and changes by **+1** each time.

2. Build a pattern that grows and changes by **+2** each time.

3. Build a pattern that grows and changes by **+5** each time.

Teaching Transparency 3.1

At the start of the new baseball season Cal Ripken has to order baseballs for his baseball players. Each player recieves 4 baseballs at the begin of the new season. If Cal has 20 baseball players how many baseballs should he order?

At the start of the new baseball season Cal Ripken has to order baseballs for his baseball players. Each player recieves 4 baseballs at the begin of the new season. If Cal has 20 baseball players how many baseballs should he order?

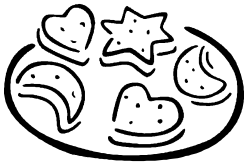
In	Out
1	4
2	8
3	12
4	16
5	20
10	40
20	80
Rule n x 4	

Teacher Transparency TT3.2

Our school earns five dollars for every soup can label that is collected. How much money will be earned if every student brings in one label?

Input Number of Labels	Output Amount of Money

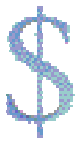
The fifth grade is having a bake sale to raise money for their next field trip. The fifth grade will make fifty cents for every cookie sold. How many cookies do they need to sell to make twenty dollars?



INPUT Number of Cookies	OUTPUT Money Earned

Teacher Resource 3.3

Answer Key



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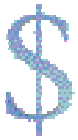
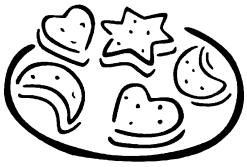


Input Number of Labels	Output Amount of Money
1	5
2	10
3	15
4	20
5	25
10	50
Input x 5	Output

The fifth grade is having a bake sale to raise money for their next field trip. The fifth grade will make fifty cents for every cookie sold. How many cookies do they need to sell to make twenty dollars?



INPUT Number of Cookies	OUTPUT Money Earned
1	$ .50
2	$ 1
3	$ 1.50
4	$ 2
5	$ 2.50
10	$ 5
20	$ 10
Input x .50	Output
40	$ 20

Missing in Action

Find the patterns. Then write how the pattern is growing for A and B then write the rule.

A	B
1	3
2	6
3	9
4	12
5	15

+ 1 Pattern A

+3 Pattern B

n x 3 Rule

A	B
1	5
2	10
3	15
4	20
5	25

Pattern A

Pattern B

Rule

A	B
10	20
20	40
30	60
40	80
n x __	

Pattern A

Pattern B

Rule

A	B
25	5
20	4
15	3
10	2
5	1

Pattern A

Pattern B

Rule

A	B
1	2
2	4
3	6
4	8
5	10

Pattern A

Pattern B

Rule

A	B
9	3
6	2
3	1

Pattern A

Pattern B

Rule

Teacher Resource 3.1

Missing in Action

Find the patterns. Then write how the pattern is growing for A and B then write the rule.

A	B
1	3
2	6
3	9
4	12
5	15

+ 1	Pattern A
+3	Pattern B
n x 3	Rule

A	B
1	5
2	10
3	15
4	20
5	25

+1	Pattern A
+5	Pattern B
n x5	Rule

A	B
10	20
20	40
30	60
40	80
n x __	

+10	Pattern A
+20	Pattern B
n x 2	Rule

A	B
25	5
20	4
15	3
10	2
5	1

-5	Pattern A
-1	Pattern B
n/5	Rule

A	B
1	2
2	4
3	6
4	8
5	10

+1	Pattern A
+2	Pattern B
n x 2	Rule

A	B
9	3
6	2
3	1

-3	Pattern A
-1	Pattern B
n/3	Rule

Student Resource 3.2

Thomas is a fifth grader at Lake Arbor Elementary School. Thomas is participating in a fundraiser that has a point system. For every box of candy sold, Thomas will earn 100 reward points. Each student must earn 1000 reward points in order for the school to get one computer.

Input Boxes Sold	Output Points Earned

Part A: How many boxes does he need to sell to earn 1000 reward points?

_____

Part B: Use what you know about function tables to explain how you know your answer is correct.

_____

_____

_____

_____

_____

Teacher Resource 3.2

Thomas is a fifth grader at Lake Arbor Elementary School. Thomas is participating in a fundraiser that has a point system. For every box of candy sold, Thomas will earn 100 reward points. Each student must earn 1000 reward points in order for the school to get one computer.

Input Boxes Sold	Output Points Earned
1	100
2	200
3	300
4	400
5	500
6	600
7	700
8	800
9	900
10	1000

Part A: How many boxes does he need to sell to earn 1000 reward points?

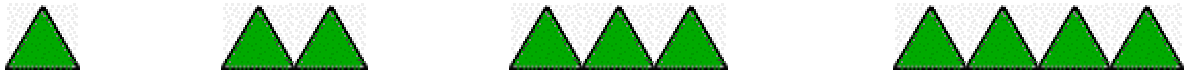
_____

Part B: Use what you know about function tables to explain how you know you answer is correct.

Answer: Student should respond with 10 boxes needs to be sold by Thomas. The table shows that when the reward points reaches 1000, the table stops at 10. This table must be completed by the student. The rule is N x 100. The number missing in action is 100. 100 is multiplied by the numbers in the column labeled "Box of Candies" in order to get the Reward points which is the product.

Reference : Follow MSA Rubric for grading criteria

Reteach Lesson 3.a



Extend this pattern three terms.

_____ _____ _____

IN	OUT
1	1
2	2
3	3
4	4
5	
6	

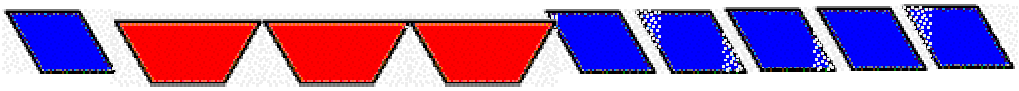
What is the rule for this pattern? _____

Explain how you know that this rule is correct.

_____

_____

_____



Extend this pattern out two terms.

Reteach Lesson 3.b

_____ _____

In	Out
1	1
2	3
3	5
4	
5	

What is the rule for this problem? _____

Discribe this growing pattern and explain how you know that this pattern is correct.

_____
_____
_____

Create a growing pattern with 5 terms.

Reteach Lesson 3.c

Fill in the Function Table for your growing pattern.

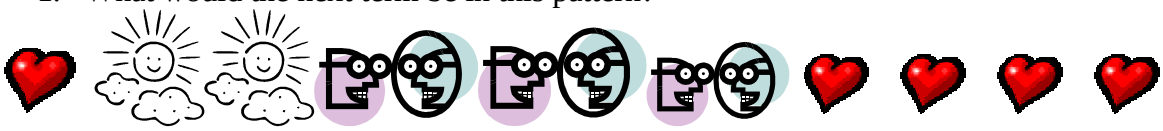
IN	OUT

What is the rule for your growing pattern?

_____

Summative Assessment-1

1. What would the next term be in this pattern?

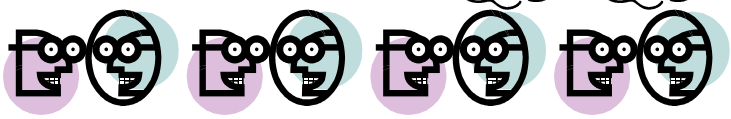


A.

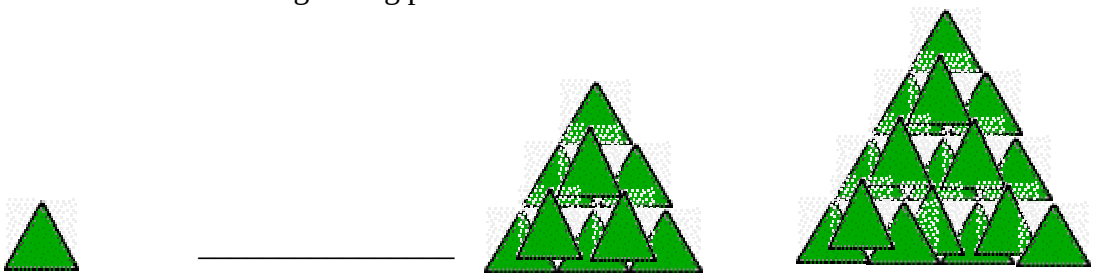
B.

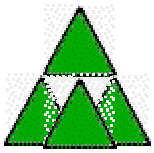
C.

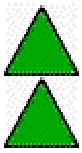
D.

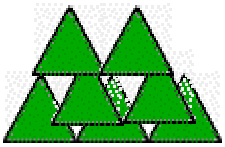
E. 

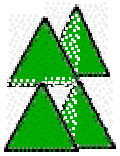
2. Which 2nd term will make this growing pattern true?

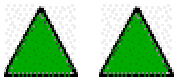


A. 

B. 

C. 

D. 

E. 

Summative Assessment-2

3. What is term five on this chart?

IN	OUT
1	3
2	6
3	9
4	12
5	???

A. 21 B. 25 C. 7 D. 27 E. 15

4. Which numerical pattern set is not a growing pattern?

A. 1, 3, 5, 7, 9

B. 25, 20, 15, 10, 5

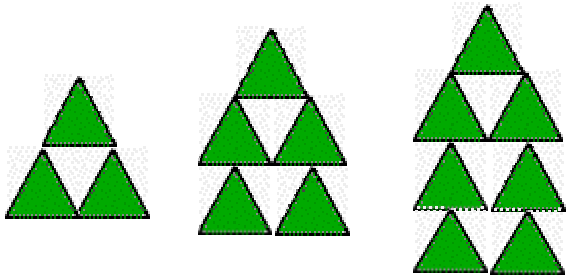
C. 9, 18, 27, 36, 45

D. 5, 10, 6, 11, 7

E. 10, 25, 40, 55, 70

Mr. Periwinkle taught one student how to find the rules of patterns. That student taught two students the rules. If each student after teaches one more person, how many people will know the rules after the 5th student has taught it?

Fill in the next two terms of the growing pattern and the table.



_____ _____

IN	OUT
1	3
2	5
3	7
4	
5	

Summative Assessment-3

Describe the pattern in words.

_____

_____

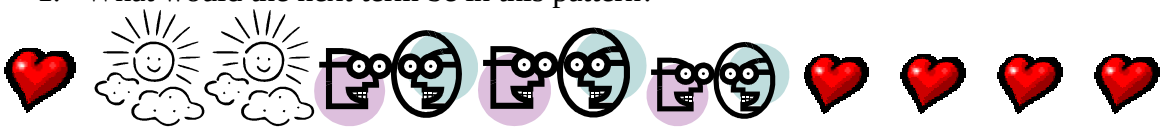
_____

_____

_____

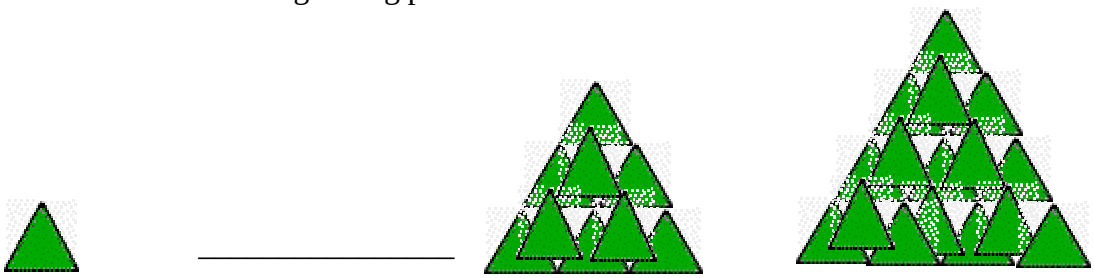
Summative Assessment-1

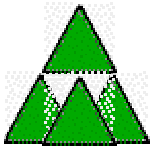
1. What would the next term be in this pattern?



B.

2. Which 2nd term will make this growing pattern true?



A. 

3. What is term five on this chart?

IN	OUT
1	3
2	6
3	9
4	12
5	???

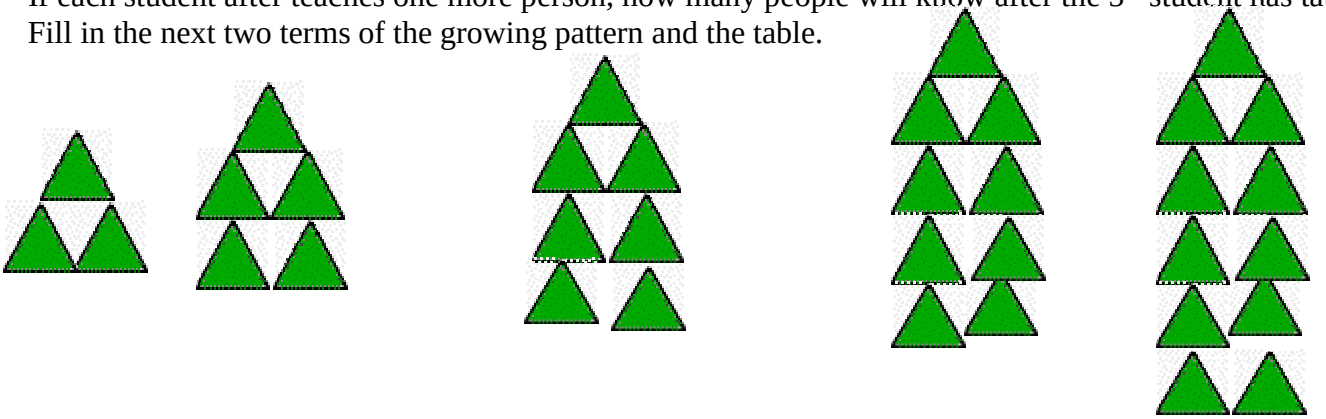
E. 15

Summative Assessment-2

4. Which numerical pattern set is not a growing pattern?

D. 5, 10, 6, 11, 7

Mr. Periwinkle taught one student how to find the rules of patterns. That student taught two students the rules. If each student after teaches one more person, how many people will know after the 5th student has taught it? Fill in the next two terms of the growing pattern and the table.



IN	OUT
1	3
2	5
3	7
4	9
5	11

Describe the pattern in words.

Students should be able to demonstraite an understanding of growing patterns, function tables. They should us the correct terminology when writing about the function table.

MSA Mathematics BCR Rubric
Grades 3 through 8

2 The response demonstrates a complete understanding and analysis of a problem.

- Application of a reasonable strategy in the context of the problem is indicated.
- Explanation[1] of and/or justification[2] for the mathematical process(es) used to solve a problem is clear, developed, and logical.
- Connections and/or extensions made within mathematics or outside of mathematics are clear.
- Supportive information and/or numbers are provided as appropriate. [3]

1 The response demonstrates a minimal understanding and analysis of a problem.

- Partial application of a strategy in the context of the problem is indicated.
- Explanation[1] of and/or justification[2] for the mathematical process(es) used to solve a problem is partially developed, logically flawed, or missing.
- Connections and/or extensions made within mathematics or outside of mathematics are partial or overly general, or flawed.
- Supportive information and/or numbers may or may not be provided as appropriate. [3]

0 The response is completely incorrect, irrelevant to the problem, or missing. [4]

Notes:

[1] **Explanation** refers to students' ability to communicate **how** they arrived at the solution for an item using the language of mathematics.

[2] **Justification** refers to students' ability to support the reasoning used to solve a problem, or to demonstrate **why** the solution is correct using mathematical concepts and principles.

[3] Students need to complete rubric criteria for ***explanation, justification, connections*** and/or ***explanation*** as cued for in a given problem.

[4] An exact copy or paraphrase of the problem that provides no new relevant information will receive a score of "0".