Title: Exploring Repetitive and Growing Patterns

Brief Overview:

The students will be able to recognize a core in a repeating pattern and extend it for several terms. Students will also be able to create a symbolic version of a repeating pattern using letters. Lastly, students will extend a growing pattern and record terms that may follow using concrete and abstract examples.

NCTM Content Standard/National Science Education Standard:

Algebra: Understand patterns, relations, and functions: describe, extend, and make generalizations about geometric and numeric patterns; represent and analyze patterns and functions, using words, tables, an graphs.

Grade/Level:

Grade 3-4

Duration/Length:

Lesson is estimated to be 60 minutes in length for 3 days.

Student Outcomes:

The students will be able to

- Identify, describe, extend, and create numeric patterns and functions.
- Complete a function table using an even addition or subtraction rule.
- Identify, describe, extend and create non-numeric patterns.
- Represent and analyze growing patterns using symbols, shapes, designs, or pictures.

Materials and Resources:

- Index cards (approximately 50)
- Pattern shapes
- Markers, colored pencils, or crayons
- Sentence strips or construction paper at similar lengths
- Chart paper
- Overhead transparencies
- Student copies (SR #1) (SR#3 – four class set copies) (SR#4) (SR#5) Summative Assessment TR #2 and #3 Overhead Transparency
- Multiple copies of SR #2 Copied on cardstock laminated if possible and cut individually
- Basket or container is suggested for SR#2 once cut

- Blank overhead transparencies
- "Barrel of Monkeys" game or paperclips to create a paper clip chain
- Teacher Resource #7 – with student names
- Teacher Resource #8 can be made into a poster on chart paper for students to use

Development/Procedures:

Lesson 1

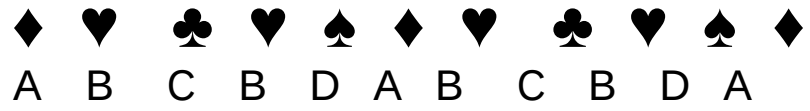
Preassessment –begin the lesson assessing students' understanding of patterns. The lesson will require students to be placed in groups of 4. Once students are within groups, the teacher must provide each group with enough index cards, and approximately 40 pattern pieces per student. Students are given the task of creating an example of a pattern. They may use the tangram pieces, draw a pattern on the index cards, or create a pattern by snapping, clapping or stomping. Once all students have created a pattern, have students discuss the different patterns created by all students. (Teacher note: If students create a growing pattern question students as to the type of pattern that they have created, whether it repeats, or changes over time). Once a consensus is made on a pattern definition, create a parking lot on chart paper for math vocabulary words that will be introduced in this unit. Place the word, "pattern" up on the chart and encourage students to place other words that they deem important as we progress through the unit. Inform students that there may be more than one definition for the patterns concept.

Launch - Students will be able to choose the vehicle in which to display their version of a pattern. They will also be able to share this pattern with the class and explain their reasoning as to why their creation is a pattern.

Teacher Facilitation – Upon completion of the pre-assessment, have students create a repeating pattern using three different pattern shapes. Hint to students that the pattern must have a clear beginning and ending. Identify this concept as the CORE of the pattern. Write this word on the chart. Tell students that each item within the core will be identified as a term. (Place this word on the word parking lot). Explain that a term holds the place for an item within a pattern. Once all students have completed their patterns, have students rotate to another student's desk in a clockwise pattern, so that each student is now located at another desk. Have the students then continue his/her neighbor's pattern by one core. Once the students have completed this, have them rotate one more time and repeat. Students will then return to his/her original desk to check if other students correctly extended the patterns. Introduce and engage in a class discussion how letters can represent a pattern. Remind students that

if an item repeats itself within a core, a new letter is not assigned, rather repeated within the core.

Example:



Students will then use the sentence strips to create a new pattern independently. The pattern must have at least three different shapes. Encourage students to use different kinds of shapes. There can be as many items in a core as desired, and items can repeat. Students must also label with letter symbols below to show the pattern created. Distribute SR#1 for a homework assignment. Answers can be found on TR#1.

Student Application – Students will use three different shapes and create a pattern independently. Using a sentence strip, students will draw a repeating pattern using shapes and symbols along with letter symbols.

Embedded Assessment – Determine each student's progress toward understanding of the concept. Build this assessment into each part of the lesson. Use TR#7 to keep an informal assessment to see if students meet objectives with each lesson. Part of today's lesson should be to have students read and extend repeating patterns.

Reteaching/–

- Students having difficulty will be provided with index cards that have letter patterns placed on them. They can choose an index card and using the pattern shapes replicate the pattern and extend the pattern for three more terms.

Extension –

- Students can choose from more complex letter patterns that are created by the teacher on index cards. Students can then draw symbols to represent these patterns on sentence strips and share with one another.

Lesson 2

Preassessment – Students will be given an example of a growing pattern and asked to explain what observations they can make regarding the pattern and the differences noted from the previous patterns studied. For example, a growing pattern using triangles that increases by two for each term.

Launch – Students will be able to use manipulatives of fun beach pictures to replicate and extend growing patterns illustrated on the overhead. (Suggestion for teacher) Manipulatives can be placed inside any container and placed on tables for students to use during class.

Teacher Facilitation – Copy Student Resource #2 onto cardstock and laminate (if possible) to be cut individually. Teacher Resource #2 and #3 must be made into an overhead transparency for this lesson. Students should have approximately 75-100 shells per student. Present examples of growing patterns on the overhead only exposing one example at a time. Question students as to their observations of this pattern; being sure to point out the differences between the previous day's patterns. Ask students what they notice happening and if they can determine what the next three terms would look like in the pattern. Clarify the difference between a term in a repeating pattern and a term in a growing pattern. Emphasis should be noted on the idea that the pattern is growing. Direct students to note the amount that the pattern increases from term to term. Record numbers below each term so students can visualize a numerical increase taking place. Display the next example on the overhead and have the students use the manipulatives to extend the pattern by 3 terms. Once time is provided for students to complete this task, guide a student discussion by sharing their responses. Unveil answer and record the number for each term. Discuss the value each term increases by for this second example. Repeat the same activity a third time. Next, use the third example on the overhead. Suggest drawing a chart to present another method of viewing the pattern with numbers. Draw a T-chart on the board labeling the left column with the word TERM and the right with the number of seashells. Continue numbering each term and record the number of seashells that accompany that term. Using the chart for discussion, have students look for patterns that may be present in both the TERM and number of seashell columns. See example table.

Term	# of shells
1	2
2	4
3	6
4	8
5	10
6	12

Patterns: – down term column – increase by one
Down right hand column – increase by two
Rule – multiply the term # by 2 = the number of shells

Lastly, repeat this activity for a fourth time. After students have extended the pattern, provide each student with a teacher created T-chart (SR#3). Students are to fill in chart with the appropriate values. Once this is done discuss any

patterns observed within each column. Distribute SR#4 for homework. Answers may be found on TR#4.

Student Application - Students will use manipulatives to extend four growing patterns presented on the overhead. Through discussion students will also learn or discover how to apply a numerical value to each term. They will also transfer the numerical value of the pattern into a T-Chart (SR#3)

Embedded Assessment - Students will extend several growing patterns and create a T-Chart as a symbolic representation of the growing pattern. An informal assessment will also be made during classroom discussions. Use TR#7 to record students' ability to meet objectives. Teacher should be looking for students' abilities to recognize a growing pattern and extend it. Students should also be able to transfer appropriate information onto a T chart.

Reteaching/Extension -Students can access the following websites:
http://www.library.thinkquest.org
http://www.harcourtschoolcom (Click on the learning site, go into search by word and type "pattern activities". Direct students to the pattern builders or other activities.)

Lesson 3

Preassessment – A growing pattern will be created on the chalkboard using monkeys from a barrel of monkeys. Term 1 will contain 5 monkeys, term 2 has 10 monkeys, and term 3 will have 15 monkeys. Students will have to determine the number of monkeys contained in terms 4, 5, and 6 and illustrate this understanding on a teacher created T-chart (SR#3 can be used for this).

Launch – A few students will have an opportunity to add monkeys to the growing pattern created on the board. All students will independently complete a chart representing the growing pattern and the examples for terms 4, 5, and 6.

Teacher Facilitation – ** Provide students with at least two copies of (SR#3). Using the growing pattern example of monkeys on the board, ask students to complete the T-chart identifying the term and number of monkeys in each. Have the students determine the amount of monkeys that would be contained in terms 4, 5, and 6. Once students have placed their predictions on their paper, lead a discussion highlighting their results. Place a T-chart on the board like students have on their paper. Complete the chart and follow-up focusing on patterns students observed vertically and horizontally. Question students to determine

if a rule can be made that will predict future results for terms not listed. Suggest trying to predict the number of monkeys that would exist for term 50. Next, divide the students into groups of 4 students. For this activity specific job tasks can be assigned. Provide each group with a different set of manipulatives to use in creating its own growing pattern. Direct students to make their own growing pattern containing at least six terms within a core. Once all groups have finished, have them record their results on the overhead T- Chart and share with the class. Discuss numerical pattern characteristics that may occur vertically or horizontally. (Use professional judgment as to whether a rule is clearly present.) Some rules may be clear and some may not for the growing patterns students made. Later recopy examples students made on chart paper to show the different examples of growing patterns and any rules that were found. Distribute SR#5 and have students complete the problems. Answers can be found on TR#5.

Student Application – Students will begin class completing a T- Chart identifying the term and number of monkeys shown on the board. Using the information given, students will then figure out the number of monkeys that would exist for terms 4, 5, and 6. Students will work in groups and develop both a concrete and abstract representation of a growing pattern. Once completed, the students will share their results on the overhead and engage in a meaningful class discussion.

Embedded Assessment – The activity requiring students to create a growing pattern using both manipulatives and a T-chart will allow the teacher to assess for understanding visually. Questioning may also be used to determine students' level of understanding of repeating patterns. The informal checklist TR#7 can be used to see if students are able to complete a table and recognize patterns on a chart. The summative assessment will also be used to check for understanding of objectives.

Reteaching – Students having difficulty with the concept of growing patterns will be paired with students proficient with these patterns. Working together students will develop simpler growing patterns using several sets of manipulatives. Once skilled with manipulatives students having difficulty will transfer a growing pattern they make using manipulatives onto a T-Chart labeled with the appropriate terms and number of manipulatives. The teacher will then check for understandings having the students create a growing pattern and matching T - chart.

Extension - As an extension activity, students may decide on a rule to use in creating a growing pattern. Next, they can use manipulatives to demonstrate their rule affecting a growing pattern as well as numerically on a T-chart.

Summative Assessment:

Summative Assessment will be given at the end of day 3 (SR#6). Answers can be found on TR#6, 8, and 9.

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Student Resource #1

Name _____

Circle the correct answer.

1.) Which of the following would be the correct symbol for the next term?

A.) 

B.) 

C.) 

D.) 

2.) How many symbols are in the core of the repeating pattern?

A.) 1 B.) 2 C.) 3 D.) 4

3.) What is the correct symbolic example for the pattern above?

A.) a b c d B.) a b b c C.) a b c d D.) a a b b

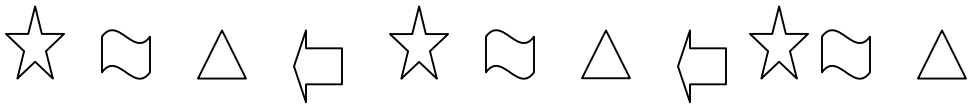
Student Resource #1

Extend the pattern for three more terms.

Using number, words, and or pictures to explain how you know your answer is correct.

Teacher Resource #1

Name _____



Circle the correct answer.

1.) Which of the following would be the correct symbol for the next term?

A.) 

B.) 

C.) 

D.) 

2.) How many symbols are in the core of the repeating pattern?

A.) 1 B.) 2 C.) 3 ***D.) 4***

3.) What is the correct symbolic example for the pattern above?

A.) a b c d B.) a b b c C.) a b c d D.) a a b b

Teacher Resource #1

Extend the pattern for three more terms.

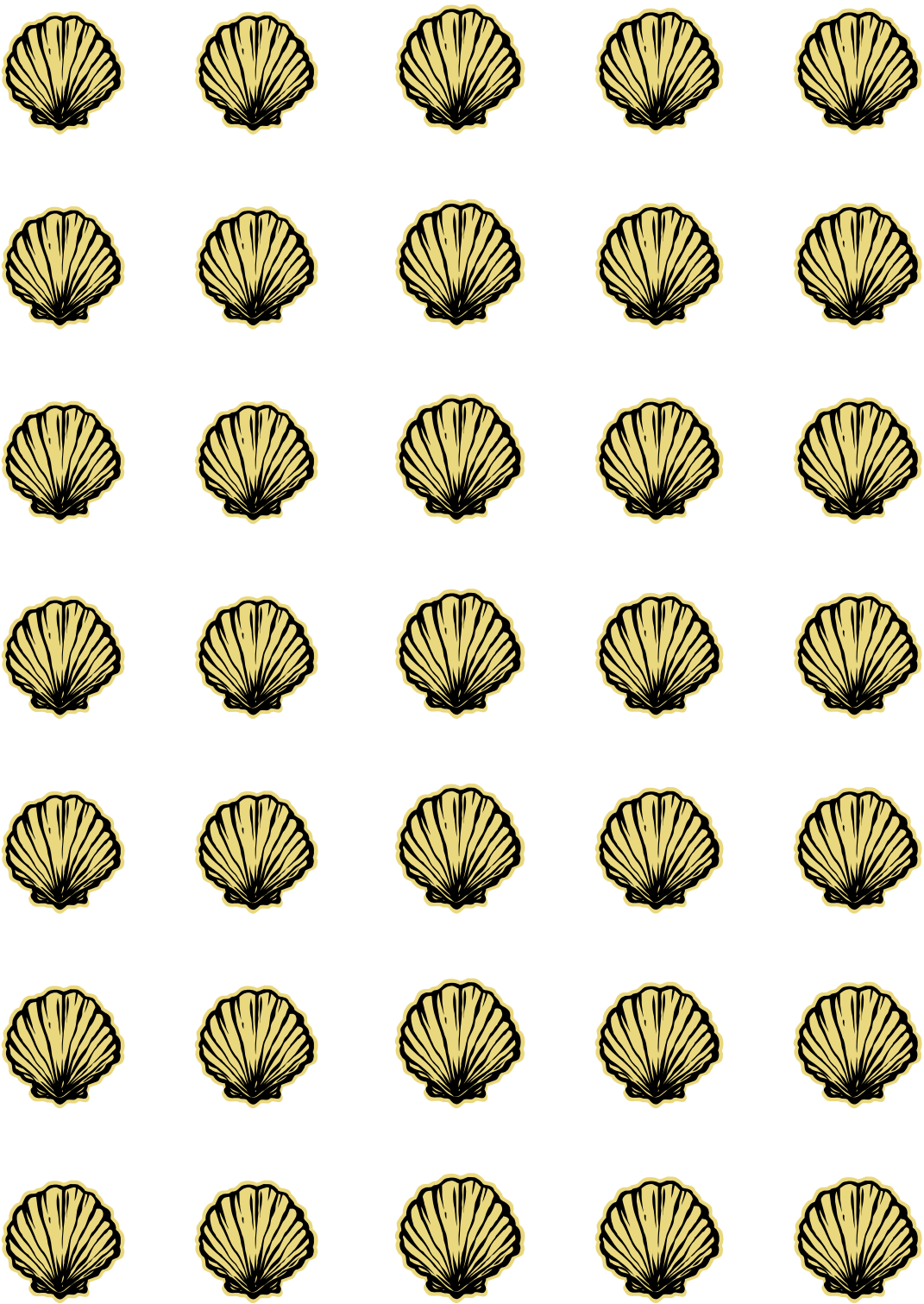
▲ ■ ∞ ♪ ♪ ▲ ■ ∞ ♪ ♪ ▲ ■

Drawing should include the next three terms in the pattern.
(Figure eight on its side, followed by two music notes)

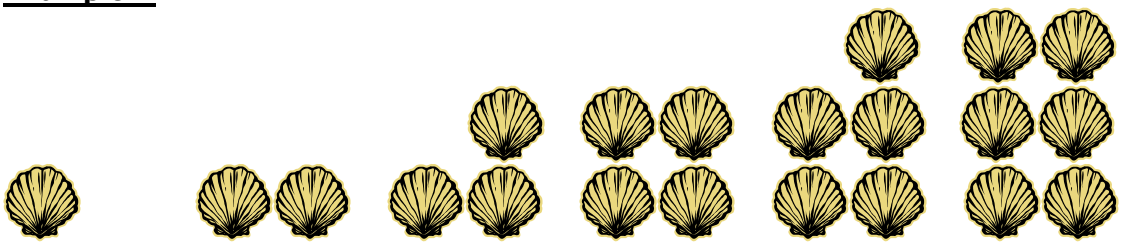
Using number, words, and or pictures to explain how you know your answer is correct.

Answers will vary. Use rubric to score. Answers should include that the students recognized where the core of the pattern started and ended. The students may also describe which terms repeated and did not need to be included in the repeated sequence.

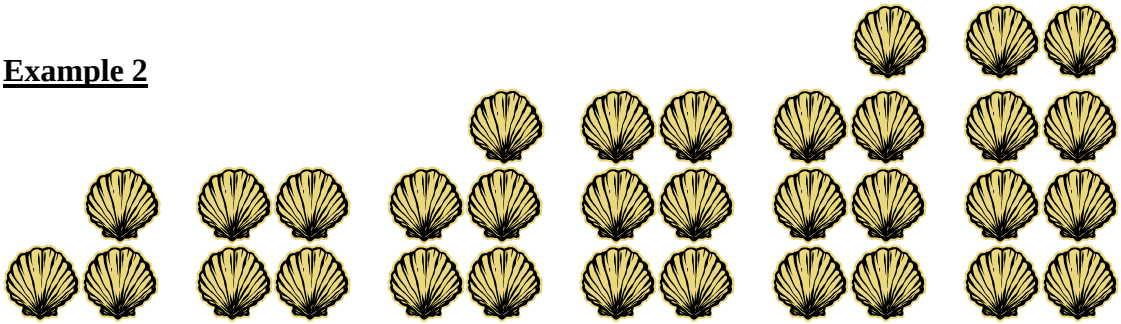
Student Resource #2



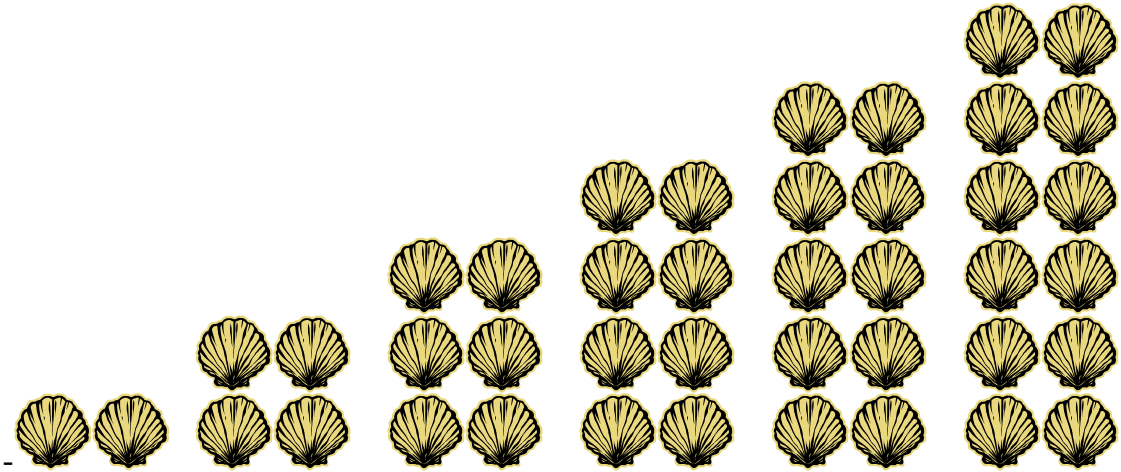
Example 1



Example 2

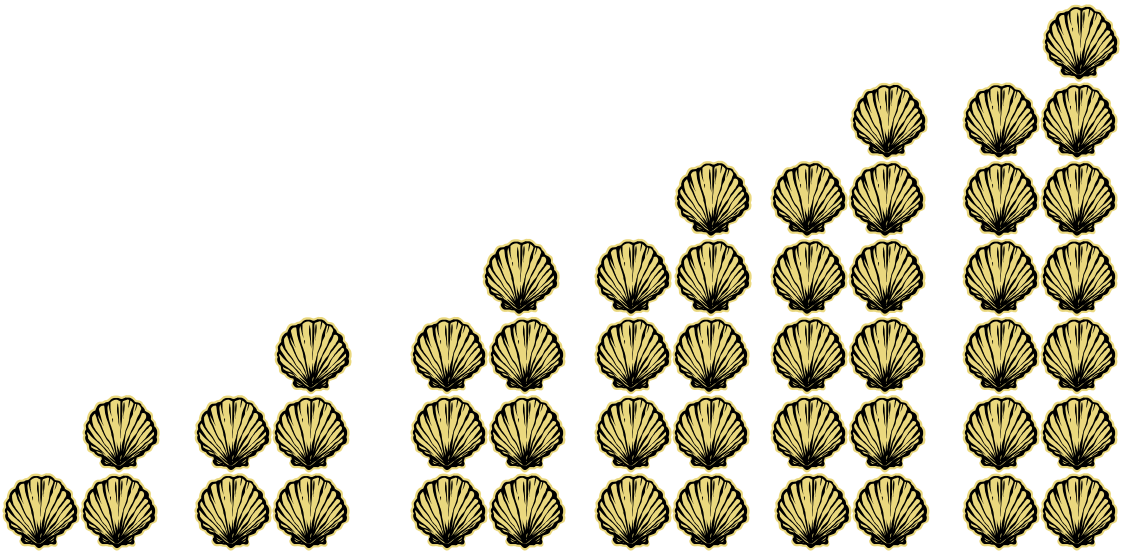


Example 3



Teacher Resource # 3

Example 4



TERMS	NUMBER OF

Student Resource #4

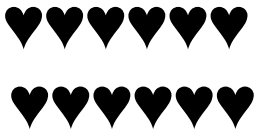
Name _____

Circle the correct answer.

1. Look at the pattern above. Which of the following is the next term in the pattern?

a. 

b. 

c. 

Using numbers, pictures and/or words, explain how you know your answer is correct.

_____

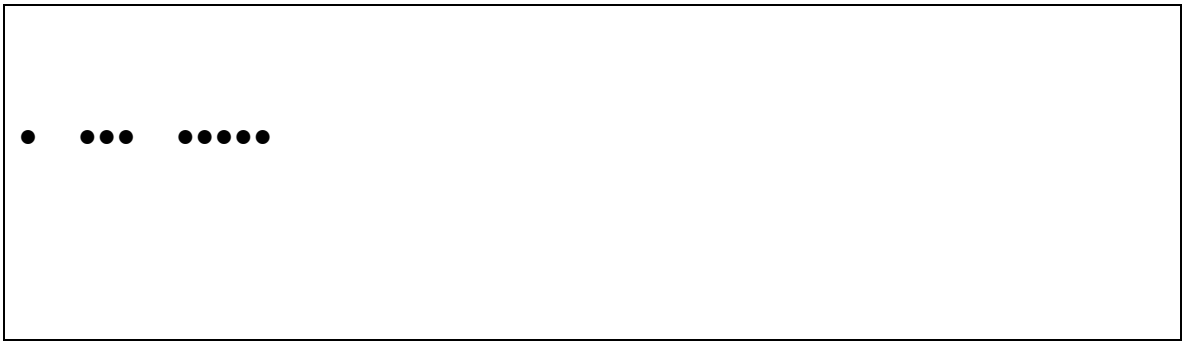
_____

_____

_____

_____

2a. Extend the following pattern by three terms.



2b. How many items will be in the fifth term?

a. five
b. nine
c. seven
d. two

Explain using numbers, words or pictures the difference between a repeating pattern and a growing pattern.

Teacher Resource #4

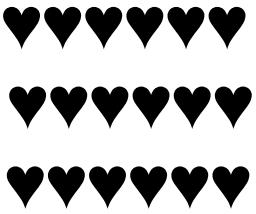
Name _____

Circle the correct answer.

1. Look at the pattern above. Which of the following is the next term in the pattern?

a. 

b. 

c. 

Using numbers, pictures and/or words, explain how you know your answer is correct.

Answers will vary. Use rubric to score. Answers should include that the students recognized a growing pattern in multiples of four.

2a. Extend the following pattern by three terms.

(answer should extend the pattern as seen below)

2b. How many items will be in the fifth term?

a. four
b. nine
c. seven
d. two

Explain using numbers, words or pictures the difference between a repeating pattern and a growing pattern.

Answers will vary. Use rubric to score. Answers should include a reasonable explanation comparing repeating patterns that have a core of items that repeat themselves and a growing pattern that changes over time.

Student Resource # 5

Name _____

1.) Use the growing pattern below to fill in the term and number of shapes on the T-Chart.

TERMS	Number of ☺

2.) Record the total number of smile faces the next two terms would have in the growing pattern.

3.) Describe any pattern you see between each term and the number of ☺ .

_____

4.) Predict how many ☺ would be found in TERM 10? _____

Teacher Resource # 5

Name _____

1.) Use the growing pattern below to fill in the term and number of shapes on the T-Chart.

TERMS	Number of ☺
1	3
2	6
3	9
4	12
5	***15***
6	***18***

2.) Record the total number of smile faces the next two terms would have in the growing pattern.

(Answers listed on the T-Chart for Terms 5 and 6.)

3.) Describe any pattern you see between each term and the number of ☺ .

The shapes are increasing by multiples of 3 from term to term.

4.) Predict how many ☺ would be found in TERM 10? ***30*** ☺

Summative Assessment

1. Take a look at the pattern below.

What are the next three shapes in this pattern?

_____

2. Which of the following is the best choice to describe the next term in the pattern?

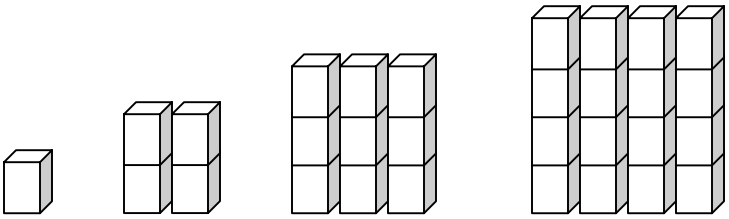
A B C D C A B C D C A

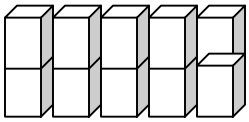
a. B
b. C
c. D
d. A

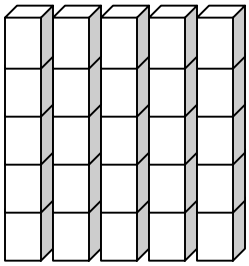
3. How many terms are in the above core of the repeating pattern?

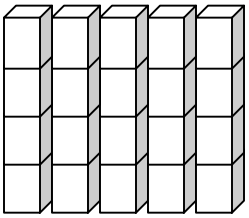
a. 6
b. 10
c. 12
d. 5

4. Which of the following would be the next term in the pattern?

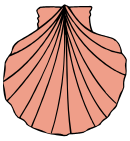


a. 

b. 

c. 

5. Look at the following pattern. Which of the following is the correct choice to represent the next term?

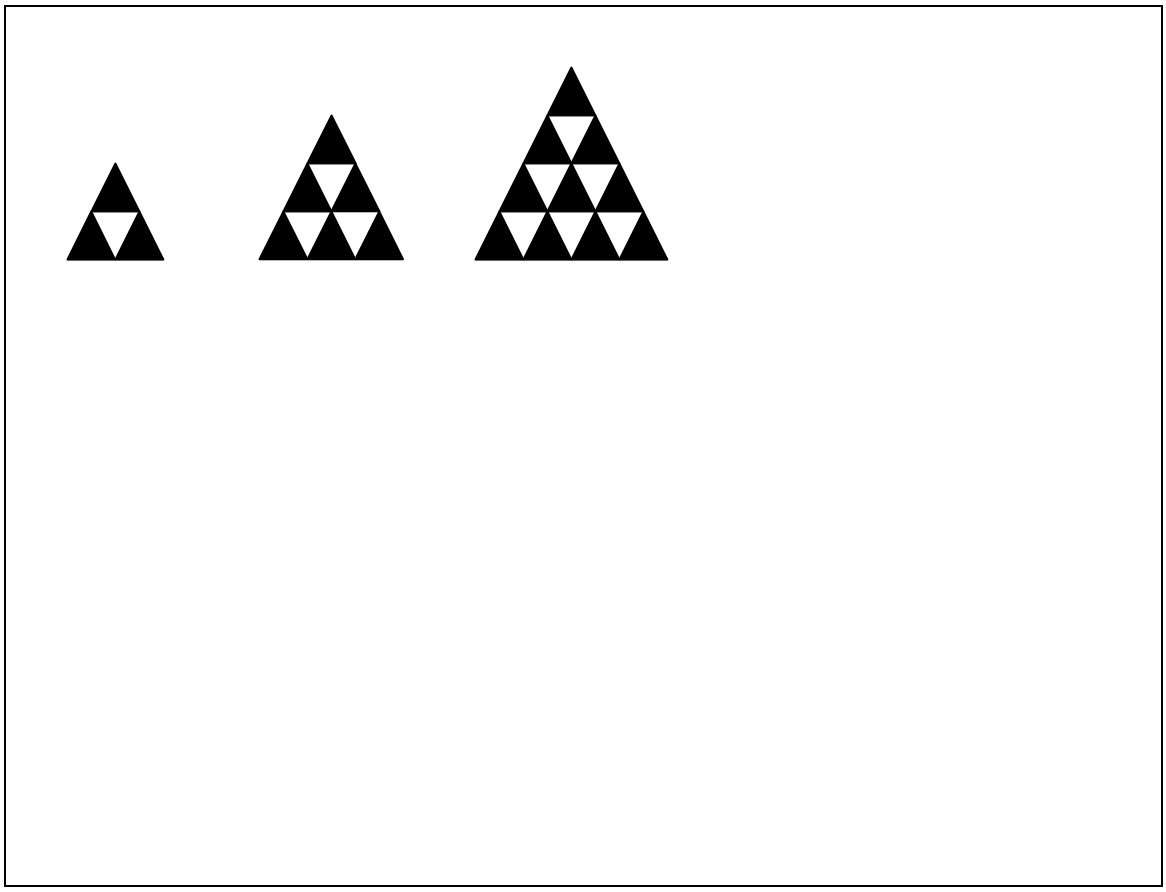
a. 

b. 

c. 

d. 

6. Complete the following pattern of the black triangles for the next three terms.



A. How many items were in the fifth term?

_____

B. How do you know your answer is correct? Use pictures, words and/or numbers to explain your answer.

C. Using the same pattern, complete the missing information on the table.

Term	# of Triangles
1	3
2	6
3	10
4	
5	
6	

Teacher Resource #6

Summative Assessment
Key

1. Take a look at the pattern below.

What are the next three shapes in this pattern?

(1pt.)

---

2. Which of the following is the best choice to describe the next term in the pattern?

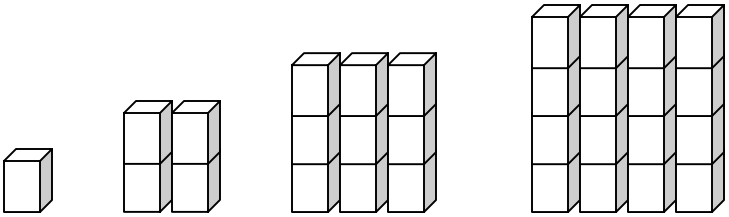
A B C D C A B C D C A

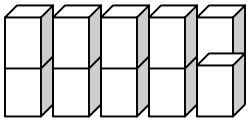
a. ***B***
b. C
c. D
d. A

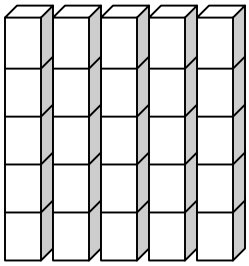
3. How many terms are in the core of the pattern?

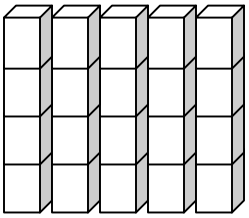
a. 6
b. 10
c. 12
d. 5

4. Which of the following would be the next term in the pattern?

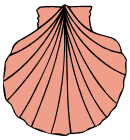


a. 

b. 

c. 

5. Look at the following pattern. Which of the following is the correct choice to represent the next term?

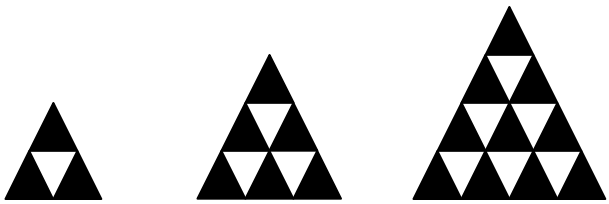
a. 

b. 

c. 

d. 

6. Complete the following pattern for the next three terms.



Pictures drawn should show the fourth term having 15 triangles, the fifth term having 21 triangles, and the sixth term having 28 triangles.

A. How many items were in the fifth term?

There are 21 triangles in the fifth term. (1pt.)

B. How do you know your answer is correct? Use pictures, words and/or numbers to explain your answer.

Answers will vary. Answer should include that the students new that the pattern was growing and that each new term that they added the number from the previous term and add one each time. (3+4+5+6+7+8)
(2pts.)

C. Using the same pattern, complete the missing information on the table.

Term	# of Triangles
1	3
2	6
3	10
4	***15*** **(1pt)**
5	***21*** **(1pt.)**
6	***28*** **(1pt.)**

Total points (out of twelve)

Teacher Checklist of Student Understanding for Content Taught in Pattern Unit. **Teacher Resource #7**

Student Name	Recognizes Repeating Pattern	Extends a Repeating Pattern.	Associates symbols to a repeating pattern.	Recognizes Growing Pattern	Extends a Growing Pattern	Completes a T-Chart and Recognizes Inherit Patterns

MSA Brief Constructed Response "Kid Speak" Mathematics Rubric
Grades 1 through 8

Score	
2	**My answer shows I completely understood the problem and how to solve it:** • **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.**
1	**My answer shows I understood most of the problem and how to solve it:** • **I used a strategy to find a solution that was partly correct.** • **I used some math vocabulary and most of my reasons were correct to explain how I solved the problem. My explanation needed to be more complete, well organized or logical.** • **I partly applied what I know about math to solve the problem.** • **I tried to use numbers, words, symbols or pictures (or a combination of them) to show how I got my answer, but these may not have been completely correct.**
0	**My answer shows I didn't understand the problem and how to solve it:** • **I wasn't able to 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.**

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 are 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]

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 ***extensions*** as cued for in a given problem.

[4] Merely an exact copy or paraphrase of the problem will receive a score of "0".