SITES-M Mathematics Challenge

Everyday Patterns

Level: Kindergarten

Standard: Algebra

Learning Target: Focus on Patterns

Checks for Understanding

0006.3.2	Name, copy, and extend patterns.
0006.3.3	Translate simple patterns into rules.
0006.3.4	Sort, order, and classify objects by attribute and identify objects that do not belong in a particular group.

SITES-M Mathematics Challenge

Grade K–Focus on Patterns
Everyday Patterns

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. Each Challenge includes a set of tasks that require higher-order thinking skills. Because these types of tasks may be new for students and they will have varying levels of understanding, the student responses will vary. The Challenges and guiding questions were designed to help teachers plan their implementation and elicit, analyze, and act on evidence of student understanding.

You will be able to choose which Mathematics Challenge Packet to implement each month, according to the learning needs of your students and your teaching context. Each packet contains all the materials necessary to implement the Mathematics Challenge including a grade-appropriate Challenge, the Mathematics Challenge Meeting Protocol, and the Guiding Questions for Analyzing Student Responses to Mathematics Challenges.

For each Challenge, you will complete a six step process of planning, implementation, and analysis and reflection.

The Mathematics Challenge Process

Stage	Step	Task
Planning	Step 1.	Review the Mathematics Challenge Meeting Protocol
	Step 2.	Review and solve the Mathematics Challenge prior to your Professional Learning Community (PLC) meeting. Think about your responses to the guiding questions on the Meeting Protocol
	Step 3.	Hold your PLC meeting and discuss your responses to the Guiding Questions on the Meeting Protocol
Implementation	Step 4.	Implement the Mathematics Challenge with your class
Analysis and Reflection	Step 5.	For your own planning and documentation, respond to the Guiding Questions on the Analyzing Student Responses Protocol
	Step 6.	To help us improve the Challenges and to provide recommendations for teachers implementing them in future years, complete the Mathematics Challenge Feedback Log and provide copies of all student work to the Assessment Coordinator

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns
Everyday Patterns

Mathematics Challenge Meeting Protocol

Each month, your Professional Learning Community will meet to discuss the implementation of one Mathematics Challenge. In preparation for your monthly meeting, please print and review this month's Mathematics Challenge, solve all tasks within the Challenge, and think about the guiding questions below. These questions will be used to facilitate a group discussion regarding the implementation of the upcoming Mathematics Challenge.

Guiding Questions for Implementing the Mathematics Challenges

1. What is the title of the Challenge that you will use this month?
2. What skills or standards is this Challenge measuring?
3. Where does this Challenge fit within your curriculum? Within which unit?
4. At what point during the unit will you administer this Challenge (e.g., At the beginning of a unit to determine what students do or do not know, at the end of a unit to assess what students have or have not learned, in the middle of a unit to determine where to go next instructionally)?
5. How will your students complete this Challenge (e.g., individually, one-on-one, in small groups, as a class)? Why?
6. Are there any prerequisite skills, common misunderstandings, or vocabulary needs that you will have to address? What are they?
7. What difficulties do you anticipate your students will have with the Challenge? How will you address them?
8. Are these skills and difficulties different for special needs students, ELL students, etc.? How? Will you do anything different for these students? What?
9. How will you evaluate student responses (e.g., grade responses with the provided rubric, scan responses to identify common mistakes/misconceptions, have students evaluate one another's responses, have students evaluate their own response)?
10. What will student responses to this Challenge tell you about student understanding?
11. How might you use this evidence of student understanding to adapt your teaching and learning?
12. What other materials, resources, or support might you need? Where can you get them?
13. How can your colleagues assist you in the analysis of student understanding?
14. What other questions or concerns do you have about this Mathematics Challenge?

After you have implemented the challenge with your class, be sure to respond to the Guiding Questions on the Analyzing Student Responses Protocol.

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns

Everyday Patterns

Standard: Algebra

Learning Target: Focus on Patterns

Claims:
Students should understand and be able to explain or demonstrate how to:

- ✓ Sort, order, and classify objects by attribute and identify objects that do not belong in a particular group;
- ✓ Name, copy, and extend patterns;
- ✓ Translate simple patterns into rules.

Task Preparation:

Each student will need a copy of the Student Response Sheet and a pencil.

Stimulus Cards (Drawing or Word Description):

None

Manipulatives/Supplies:

Pencils

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns

Cues/Directions:

Distribute student response sheets. If a student is unable to respond in writing, a scribe may be appointed or verbal answers may be accepted, but these responses will need to be documented for scoring. Students should be directed to look carefully at each figure. Allow students time to answer.

Instruct students to follow along as you read aloud and say: **Patterns can be used in different ways at the grocery store. Let's look at some of those ways.**

1. Say: **The group of things below are found in the same place at the grocery store. (TEACHER NOTE:** Have students look at the group of fruits.**) Circle each thing below that is also a part of that group. (TEACHER NOTE:** Students should circle the correct things.**) How are all things in the group alike? (TEACHER NOTE:** Students should write their explanations in the box.**)**

2. **Look at the things below. Circle 3 things that could go together in one group. (TEACHER NOTE:** Students should circle 3 things.**) Look at the things you circled. How are they alike? (TEACHER NOTE:** Students should write their explanations in the box.**) Now look at the things you did NOT circle. How are they alike? (TEACHER NOTE:** Students should write their explanations in the box.**)**

3. **Look below at the pattern of fruit. (TEACHER NOTE:** Have students look at the pattern of fruit.**) Circle the fruit that goes on the line above to complete the pattern. (TEACHER NOTE:** Students should circle the correct fruit.**) Circle the rule that describes the pattern of the fruit. (TEACHER NOTE:** Students should circle the correct pattern.**)**

4. **Look below at the pattern of shapes. (TEACHER NOTE:** Have students look at the pattern of shapes.**) Draw the shape on the line above that completes the pattern. (TEACHER NOTE:** Students should draw the correct shape on the line above.**) Circle the rule that describes the pattern of shapes. (TEACHER NOTE:** Students should circle the correct pattern.**)**

5. **Each pencil costs 2 cents. Complete the table below. (TEACHER NOTE:** Students should fill in the blanks in the table.**) How much do 8 pencils cost? Show how you get your answer. (TEACHER NOTE:** Students should show their work or explain their answer in the box, and write the amount that 8 pencils cost in the blank at the bottom of the page.**)**

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6. **(TEACHER NOTE:** This task may be a stretch for some students. If you feel it is beyond the scope of your class, you may omit it, use it as enrichment, or use it as a whole-class or small-group activity.**)**

   Look below at the pattern of big and small rectangles. (TEACHER NOTE: Have students look at the pattern of rectangles.**) Ben says there will be more small rectangles in Row 5 than big rectangles. Is Ben correct? Check one of the boxes. (TEACHER NOTE:** Students should check the correct box.**) How do you know? (TEACHER NOTE:** Students should write their explanations in the box.**)**

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns

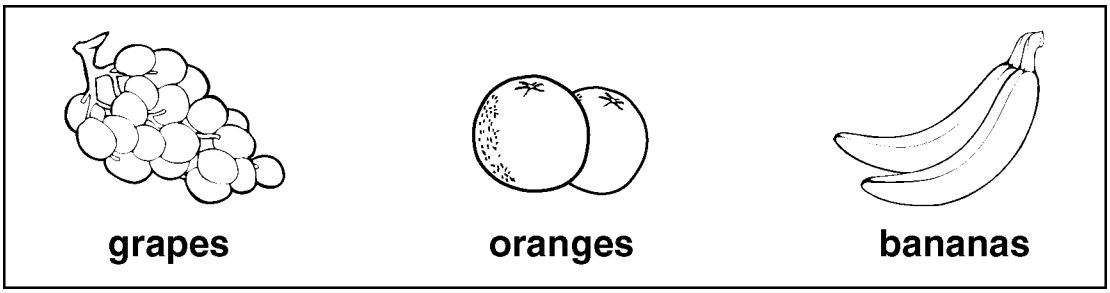
Student Response Sheet

Everyday Patterns

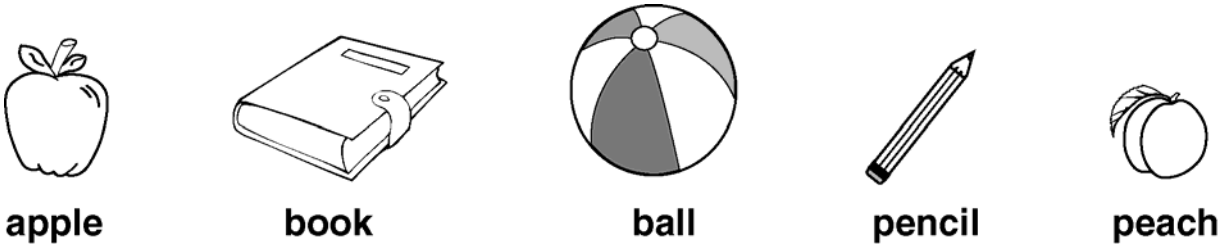
Name: _____ **Date:** _____

Patterns can be used in different ways at the grocery store. Let's look at some of those ways.

1. **The group of things below are found in the same place at the grocery store.**



Circle each thing below that is also a part of that group.



How are all things in the group alike?

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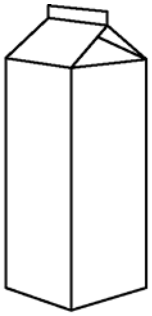
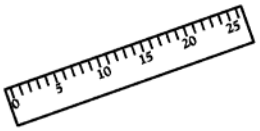
2. Look at the things below. Circle 3 things that could go together in one group.



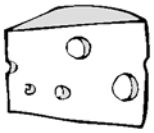
milk

pencil

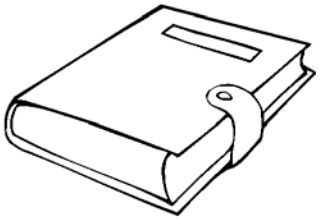


ruler

eggs



cheese



book

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Look at the things you circled. How are they alike?

Now look at the things you did NOT circle. How are they alike?

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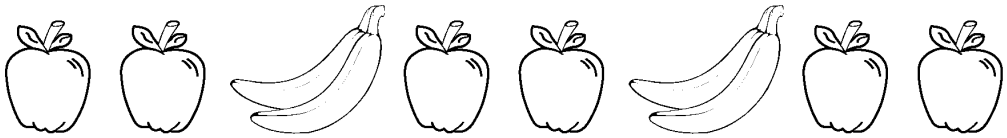
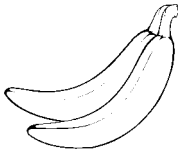
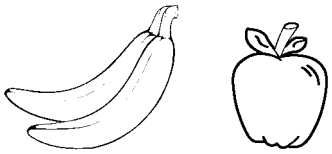
3. Look below at the pattern of fruit.

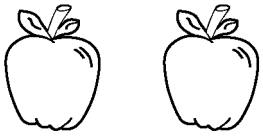
 _____

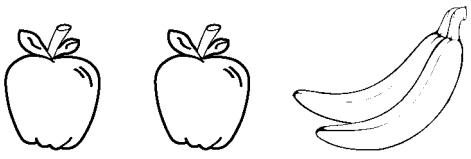
Circle the fruit that goes on the line above to complete the pattern.

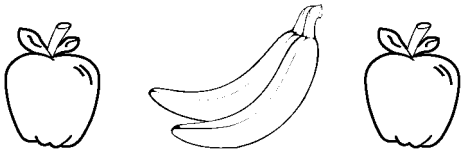
Circle one: 

Circle the rule that describes the pattern of the fruit.

a. 

b. 

c. 

d. 

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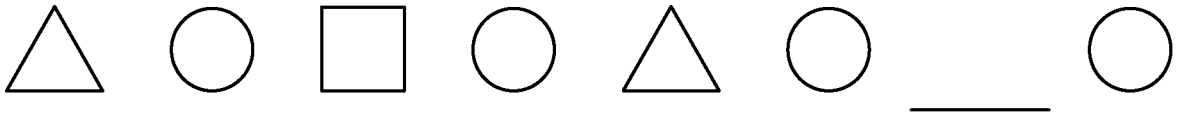
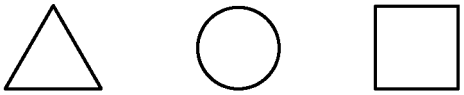
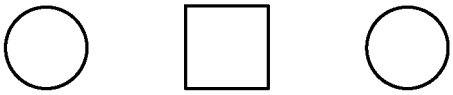
4. Look below at the pattern of shapes.

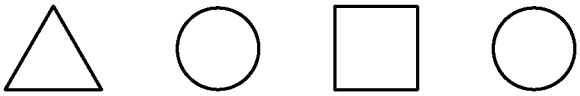


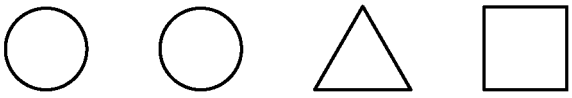
Draw the shape on the line above that completes the pattern.

Circle the rule that describes the pattern of shapes.

a. 

b. 

c. 

d. 

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5. Each pencil costs 2 cents. Complete the table below.

Number of Pencils	Cost
	2 cents
	4 cents
	6 cents
	_____ cents
	_____ cents

How much do 8 pencils cost?

Show how you get your answer.

8 pencils cost _____ cents.

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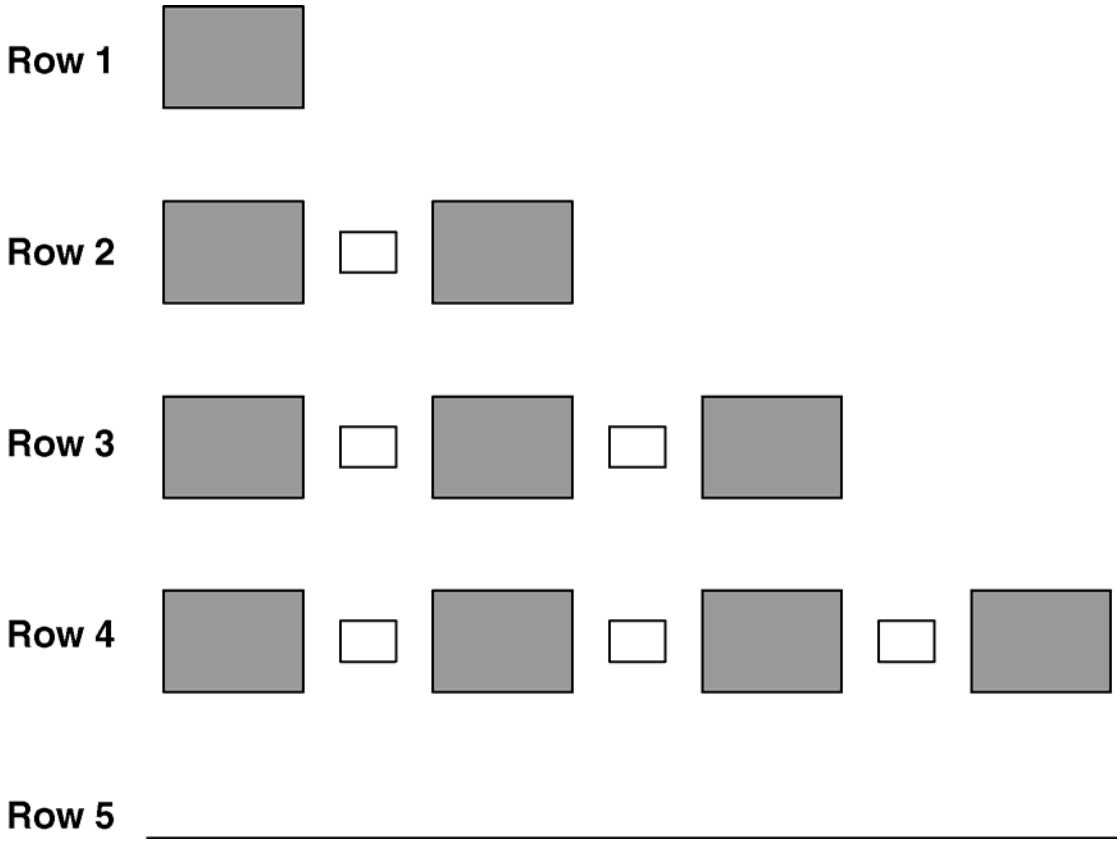
6. Look below at the pattern of big and small rectangles.



Ben says there will be more small rectangles in Row 5 than big rectangles. Is Ben correct?

Check one: ☐ **Yes** ☐ **No**

How do you know?

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Learning and Teaching Considerations

Task 1:

A) Be sure that students are able to identify "apple" and "peach" as belonging with the other fruits or things that you eat.

B) If a student says or writes, "I just know," prompt him or her by saying something like "I'm glad you know, but it's important in math to be able to explain your answers so other people can understand what you're thinking."

C) If a student says or writes, "I don't know," say something positive like "Let's start with what you do know about this problem." Students often know more than they think or say, and encouraging them to vocalize or write about that knowledge is all they may need.

Task 2:

A) Be sure that students are able to group the items you eat with those you don't.

B) Students may also recognize the items you eat as items you cook with and may recognize the items you don't eat as items you use in school. Be open to other explanations, such as things in the refrigerator or backpack, for example.

Task 3:

A) Be sure that students understand the concept of a repeating pattern and how a pattern is extended or continued.

B) Be sure that students understand that the core of the repeating pattern is the shortest string of elements that repeats. The teacher could use actual fruit or manipulatives such as pattern blocks or colored tiles to create a pattern, show two iterations of the pattern, and then ask students to use the fruit or pattern blocks, for example, to show how to continue the pattern and explain their thinking.

C) Students may have the misconception that the core of the repeating pattern is shorter or longer than the shortest string of elements that repeats. If this happens, ask them to convince you and the class that their pattern will always work

D) Students may have the misconception that the pattern does not continue after one or two iterations. Be sure students understand that patterns are continuous and go on infinitely.

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Task 4:

A) Students may have the misconception that the core of the repeating pattern is shorter or longer than the shortest string of elements that repeat. If this happens, ask them to convince you and the class that their pattern will always work

B) Students may have the misconception that the pattern does not continue after one or two iterations. Be sure students understand that patterns are continuous and go on infinitely.

Task 5:

A) Be sure that students understand that the number patterns found in number sequences are based on a particular rule.

B) Be sure that students understand that a rule is something that will always work. For example, the student might notice a recursive pattern in which the previous number is operated on to get the next number.

C) Students may have the misconception that the core of the repeating pattern is shorter or longer than the shortest string of elements that repeat.

D) Students may answer in words, symbols (such as the addition symbol), numbers, or by using manipulatives. They may also use number lines or charts. Be sure they understand that they can get the correct answer using any of these strategies. The teacher can also encourage them to link these strategies and/or representations to each other as a way to provide a convincing solution.

E) Students may describe even numbers.

F) Students may add 2 to the previous number each time to get the next number.

G) Be sure that students understand that the number pattern appears in that order and the numbers cannot be reversed or switched.

Task 6:

A) Students may add 1 small rectangle and 1 big rectangle to row 4.

B) Students may recognize that there are more small rectangles than big rectangles in each of the rows.

C) Students may answer that 2 new rectangles won't visually fit in row 5 and provide that reason.

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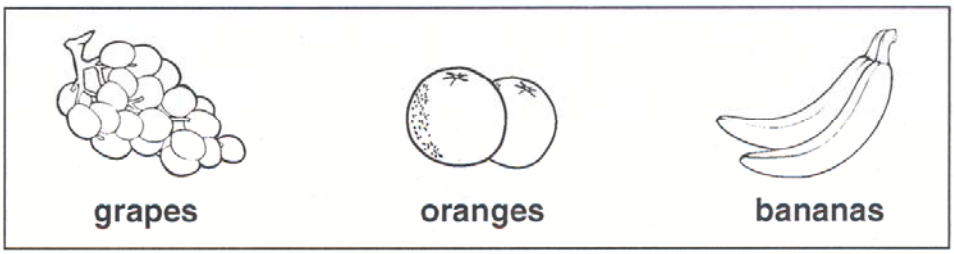
Name: ANSWER KEY Date: _____

Patterns can be used in different ways at the grocery store. Let's look at some of those ways.

1. **The group of things below are found in the same place at the grocery store.**



Circle each thing below that also is a part of that group.

How are all things in the group alike?

THEY ARE FRUITS, OR THINGS YOU EAT.

ANSWERS MAY VARY

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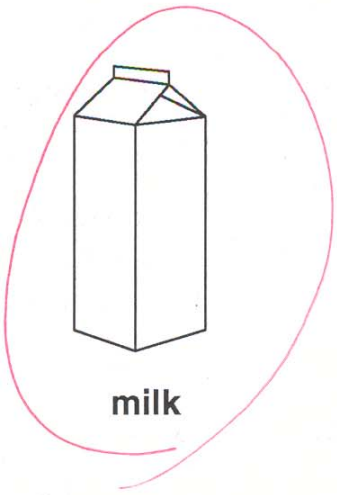
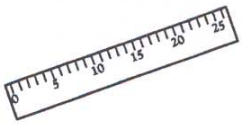
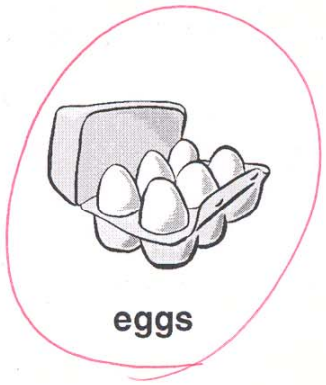
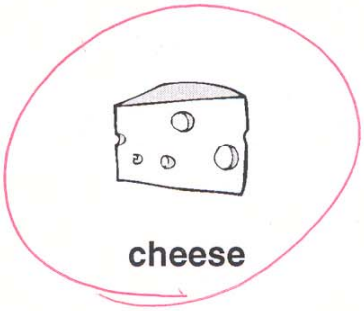
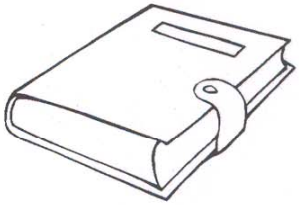
2. Look at the things below. Circle 3 things that could go together in one group.











NOTE: ANSWERS MAY VARY.

STUDENT MIGHT CIRCLE

PENCIL, RULER, BOOK

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Look at the things you circled. How are they alike?

MILK, EGGS, CHEESE & THINGS YOU EAT, OR DAIRY PRODUCTS

OR FOOD IN REFRIGERATOR

ANSWERS MAY VARY.

↕ MAY BE REVERSED DEPENDING ON WHAT WAS CIRCLED.

Now look at the things you did NOT circle. How are they alike?

PENCIL, RULER, BOOK & THINGS FOR SCHOOL

OR THINGS IN MY BACKPACK

OR THINGS YOU DON'T EAT

ANSWERS MAY VARY.

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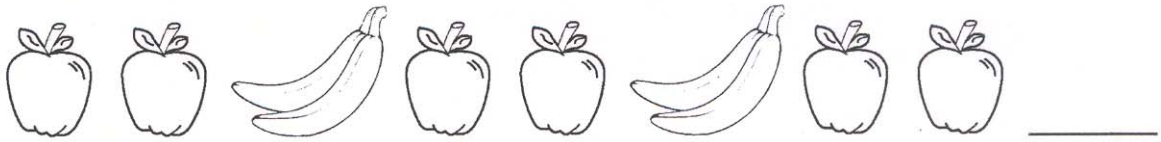
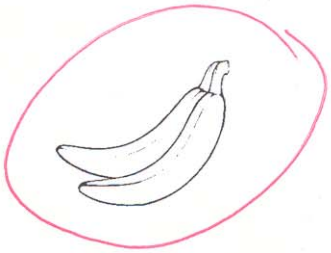
3. Look below at the pattern of fruit.



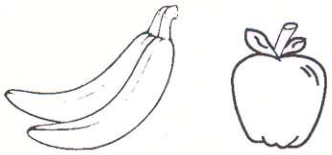
Circle the fruit that goes on the line above to complete the pattern.

Circle one:

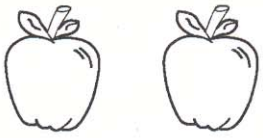


Circle the rule that describes the pattern of fruit.

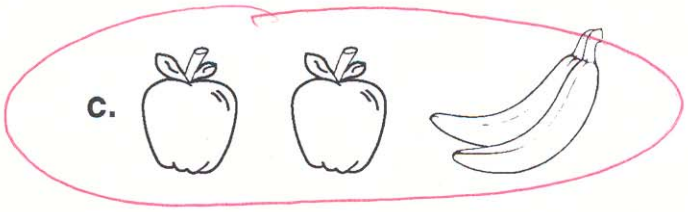
a.



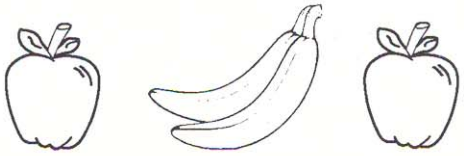
b.



c.



d.



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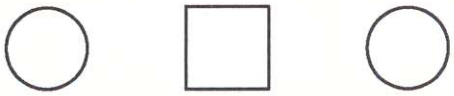
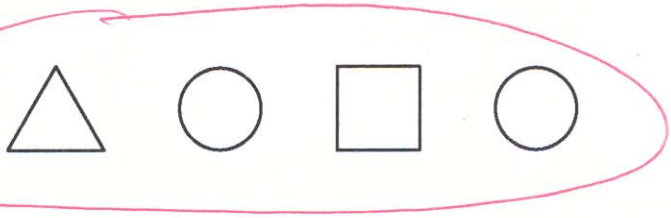
4. Look below at the pattern of shapes.

Draw the shape on the line above that completes the pattern.

Circle the rule that describes the pattern of shapes.

a.

b. 

c. 

d.

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5. Each pencil costs 2 cents. Complete the table below.

Number of Pencils	Cost
	2 cents
	4 cents
	6 cents
	8 cents
	10 cents

How much do 8 pencils cost?

Show how you get your answer.

1 2
2 4
3 6
4 8
5 10
6 12
7 14
8 16

COUNT BY 2's

OR

$2 \times 8 = 16$

8 pencils cost 16 **cents.**

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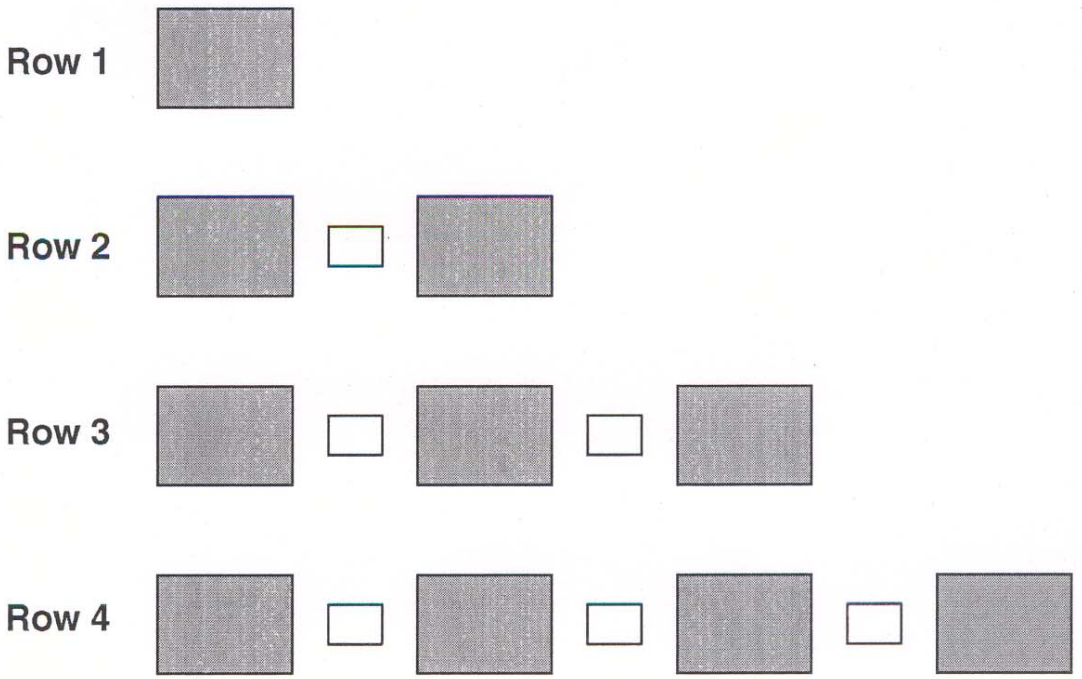
6. Look below at the pattern of big and small rectangles.



Row 5 _____

Ben says there will be more small rectangles in Row 5 than big rectangles. Is Ben correct?

Check one: ☐ **Yes** ☒ **No**

How do you know?

EACH ROW HAS 1 MORE BIG AND 1 MORE SMALL THAN THE ROW BEFORE, SO ROW 5 HAS 5 BIG AND 4 SMALL RECTANGLES AND 4 IS LESS THAN 5.
OTHER REASONS COULD BE CORRECT.

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns
Rubric

CATEGORY	4	3	2	1
Mathematical concepts	**Response shows complete understanding of the mathematical concepts used to solve the problem(s).**	**Response shows substantial understanding of the mathematical concepts used to solve the problem(s).**	**Response shows some understanding of the mathematical concepts needed to solve the problem(s).**	**Response shows very limited understanding of the underlying concepts needed to solve the problem(s), OR the response is not written.**
	Response shows evidence in at least 5 of the following 6 tasks. **Task 1**. Student identifies apple and peach as belonging with the other fruits. **Task 2**. Student groups the items you eat with those you don't. **Task 3**. Student identifies the correct pattern of apple apple banana. **Task 4**. Student identifies the correct pattern of triangle circle square circle. **Task 5**. Student gives a correct reason why 8 pencils cost 16 cents. **Task 6**. Student shows evidence of understanding that row 5 will have 5 big and 4 small rectangles.	Response shows evidence in only 4 of the tasks described.	Response shows evidence in only 3 of the tasks described.	Response shows evidence in 2 or fewer of the tasks described.

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns
Rubric

CATEGORY	4	3	2	1
Strategy and procedures	**Student typically uses an efficient and effective strategy to solve the problem(s).**	**Student typically uses an effective strategy to solve the problem(s).**	**Student sometimes uses an effective strategy to solve the problem(s), but not consistently.**	**Student rarely uses an effective strategy to solve the problem(s).**
	Response shows evidence in ALL of the following tasks. **Task 3**. Student may show evidence of indicating the correct grouping in the original sequence by circling, counting, marking, etc. **Task 4**. Student may show evidence of indicating the correct grouping in the original sequence by circling, counting, marking, etc. **Task 5**. Student may extend the table to 8 pencils to continue the pattern; may show evidence of counting by 2s; may show evidence of repeated addition of 2. **Task 6**. Student may attempt to draw boxes in row 5; may show evidence of adding 1 to the large boxes and adding 1 to the small boxes.	Response shows evidence in only 3 of the tasks described in category 4.	Response shows evidence in only 2 of the tasks described in category 4.	Response shows evidence in only 1 of the tasks described in category 4 or the response shows no evidence of strategy.

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Grade K–Focus on Patterns
Rubric

CATEGORY	4	3	2	1
Explanation and communication	**Explanation is detailed and clear; uses appropriate terminology and/or notation.**	**Explanation is clear; uses some appropriate terminology and/or notation.**	**Explanation is a little difficult to understand, but includes critical components; shows little use of appropriate terminology and/or notation.**	**Explanation is difficult to understand, is missing several components, and does not use or include appropriate terminology and/or notation.**
	Response shows evidence in ALL of the following tasks. **Task 1**. Student explains that the things in the box are fruits or things you eat, and that an apple and a peach are also fruits or things you eat. **Task 2**. There may be different explanations that are acceptable, depending on what is and is not circled. The most obvious should be explaining that one group is things you eat (or dairy products, or things in the refrigerator), and the other group is things you don't eat (or school supplies, or stuff in the backpack). **Task 5**. Student may show counting by 2s, or by even numbers, or by repeated addition of 2s, or multiplication by 2. **Task 6**. Student explains that Ben is not correct because row 5 will have 5 big and 4 small rectangles, or because there is always 1 more big rectangle than small rectangle in each row.	Response shows evidence in only 3 of the tasks described.	Response shows evidence in only 1 or 2 explanations.	Response shows no explanations.

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns
Rubric

CATEGORY	4	3	2	1
Mathematical accuracy	**All or almost all of the steps and solutions have no mathematical errors.**	**Most of the steps and solutions have no mathematical errors.**	**Some of the steps and solutions have no mathematical errors.**	**Few of the steps and solutions have no mathematical errors.**
	Student provides correct answers for ALL of the following tasks. **Task 1**. Student circles apple and peach and nothing else. **Task 3**. Student circles the banana and chooses only choice c. **Task 4**. Student draws a square on the line and chooses only choice c. **Task 5**. Student completes table with 8 and 10 and answers 16 cents for 8 pencils. **Task 6**. Student answers no and nothing else.	Student provides correct answers for only 4 of the tasks described in category 4.	Student provides correct answers for only 2 or 3 of the tasks described in category 4.	Student provides a correct answer for only 1 task or none of the tasks described in category 4.

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns

Scoring Notes Checklist

Task	Check Yes	Category
Task 1		
Identifies apple and peach as belonging with the other fruits.		Concept
Explains that the things in the box are fruits or things you eat, and that an apple and a peach are also fruits or things you eat.		Explanation
Circles apple and peach and nothing else.		Accuracy
Task 2		
Groups the items you eat with those you don't.		Concept
There may be different explanations that are acceptable, depending on what is and is not circled. The most obvious should be explaining that one group is things you eat (or dairy products, or things in the refrigerator), and the other group is things you don't eat (or school supplies, or stuff in the backpack).		Explanation
Task 3		
Identifies the correct pattern of apple apple banana.		Concept
May show evidence of indicating the correct grouping in the original sequence by circling, counting, marking, etc.		Strategy
Circles the banana and chooses only choice c.		Accuracy
Task 4		
Identifies the correct pattern of triangle circle square circle.		Concept
May show evidence of indicating the correct grouping in the original sequence by circling, counting, marking, etc.		Strategy
Draws a square on the line and chooses only choice c.		Accuracy
Task 5		
Gives a correct reason why 8 pencils cost 16 cents.		Concept
May extend the table to 8 pencils to continue the pattern; may show evidence of counting by 2s; may show evidence of repeated addition of 2.		Strategy
May show counting by 2s, or even numbers, or repeated addition of 2s, or multiplication by 2.		Explanation
Completes table with 8 and 10 and answers 16 cents for 8 pencils.		Accuracy
Task 6		
Shows evidence of understanding that row 5 will have 5 big and 4 small rectangles.		Concept
May attempt to draw boxes in row 5; may show evidence of adding 1 to the large boxes and adding 1 to the small boxes.		Strategy
Explains that Ben is not correct because row 5 will have 5 big and 4 small rectangles, or because there is always 1 more big rectangle than small rectangle in each row.		Explanation
Answers no and nothing else.		Accuracy

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SITES-M Mathematics Challenge

Grade K–Focus on Patterns

Analyzing Student Responses Protocol

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. They include extended responses, open-ended tasks, and tasks that require higher-order thinking skills. Because these types of tasks may be novel for students and they will have varying levels of understanding, the student responses will vary.

The guiding questions below were designed to assist you in analyzing your class' response to the Challenge and determining appropriate next steps for your teaching and learning. Responses to these questions are for your reflection and documentation and will not be collected.

Guiding Questions for Analyzing Student Responses to the Mathematics Challenges

1. When completing the Challenge, what did your students do well? How do you know?

2. When completing the Challenge, what did your students struggle with? How do you know?

3. When your students completed the Challenge, did they implement multiple correct solutions strategies? What insightful approaches to problem solving did you observe?

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4. What, if any, patterns (e.g., common errors/misconceptions) did you observe across your student responses?

5. What questions or concerns did your students have when working through this Challenge or a particular task? Are these things you should address for the class as a whole?

6. What, if any, feedback did you provide to your class? How did you provide it?

7. What did you learn about your students' mathematical understanding based on their responses to this Challenge?

Reminders:

1) After you have completed the Challenge with your class and responded to these Guiding Questions for Analyzing Student Responses, please complete the Challenge Feedback Log. A link to this Log is e-mailed to you each month. Responses will be used to improve the Challenges and to provide recommendations for teachers implementing the Challenges in future years.

2) Please provide copies of all student work to the Assessment Coordinator.

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