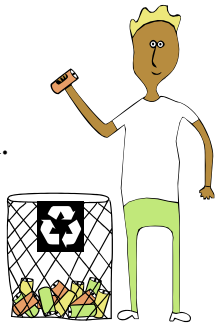


Scaffolding Task: Earth Day Project

In this activity, students consider a real-world situation involving a set of data. Using the data, students determine the pattern formed by the numbers in the data set. Then they extend the pattern and use the pattern to make predictions.

STANDARDS FOR MATHEMATICAL CONTENT

Generate and analyze patterns.

MCC4.OA.5 Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.
Analyze patterns and relationships.

MCC5.OA.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.
Graph points on the coordinate plane to solve real-world and mathematical problems.

MCC5.G.1 Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., *x*-axis and *x*-coordinate, *y*-axis and *y*-coordinate).

MCC5.G.2 Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

STANDARDS FOR MATHEMATICAL PRACTICE

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

BACKGROUND KNOWLEDGE

Students should have had prior experiences working with and extending patterns.

Also, students should be able to graph points easily. After points are graphed, ask students if it is appropriate to connect the points. (In this situation, it is not appropriate because students collect cans just once a day and they do not (typically) collect a fraction of a can. However, students may want to line up the points along the edge of a ruler or sheet of paper to make predictions using the graph.

For Teacher information only:

Teachers should give some thought to this pattern before presenting this problem to their students. Start by looking at the relationship of the numbers in the two columns. Teachers should try to express this relationship in words. See the examples below.
Some students may think about the pattern in this way:

Day 1 shows a column of 4 and 1 more.
Day 2 shows 2 columns of 4 and 1 more.
Day 3 shows 3 columns of 4 and 1 more
Day 4 will show 4 columns of 4 and 1 more.

Therefore the pattern is generated by $4\times \square + 1$, where $\square$ represents the number of the day. While it is not expected that students will be able to generalize this pattern to an expression (except possibly as an extension for some students), asking students to talk about what they see changing/growing in the pattern is important to help them develop an awareness of the structure of a pattern.

Keep in mind some students may see the pattern differently. For example, it is possible for students to describe it as follows:

Day 1 shows a 2×4 rectangle with 3 missing.
Day 2 shows a 3×4 rectangle with 3 missing.
Day 3 shows a 4×4 rectangle with 3 missing.
Day 4 will show a 5×4 rectangle with 3 missing.

Of course, this can be written as $(\square + 1) \times 4 - 3$, with the $\square$ representing the number of the day. Using the distributive property gives you $4 \times \square + 4 - 3$, which is the same as $4 \times \square + 1$. Asking students about their thinking is a good way to understand how students see the relationship of the numbers in the two columns.

ESSENTIAL QUESTIONS

- How does the coordinate system work?
- How do coordinate grids help you organize information?
- How can we represent numerical patterns on a coordinate grid?
- How can we determine the relationships between numbers?
- How can we use patterns to solve problems?
- How can we describe a pattern?

MATERIALS

- "Earth Day Project" student recording sheet, 3 pages
- Blocks to use to build the pattern (for those students who wish to use them)

GROUPING

Individual/Partner/Small group task

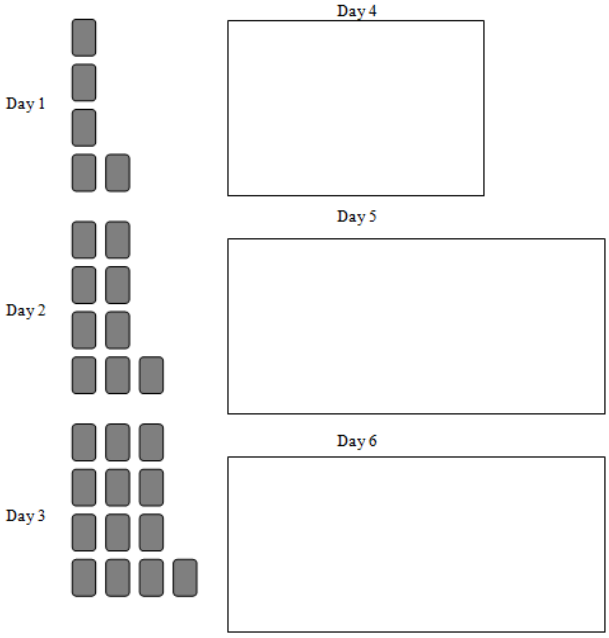
TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Comments: In this task, students are generating one numerical pattern. Although this concept is one that is developed in the fourth grade, students may benefit from reviewing one pattern before moving to two patterns.

Task Directions

Students will follow the directions below from the "Earth Day Project" student recording sheet.

Fifth graders in Ms. Smith's class have decided to start a recycling project for Earth Day. They put a bin in the cafeteria to collect used aluminum cans. At the end of each school day, they take the bin back to their classroom and count the cans collected for the day. Ms. Smith's class is keeping notes about how many cans are being collected. It seems that the number of cans collected each day follows a pattern. If the pattern continues, sketch the number of cans collected on days 4-6 in the boxes below.



Day	Cans
1	5
2	9
3	13
4	17
5	21
6	____
7	____
8	____
9	____
10	____
•	
•	
•	
20	____
•	
•	
•	
100	____

The students recorded the number of cans they collected each day in the t-table below. When they collect one hundred cans, the students can turn them in to the recycling center and earn money to be used for an upcoming field trip. If the pattern continues how many days will it take to collect at least 100 cans?

1. Use what you know about the cans collected in the first five days to make a prediction about how many days it will take to collect at least 100 cans. Show your work and explain in words why you predicted the number of days that you chose.
2. Continue the pattern in the t-table. Fill in the missing values.
3. Explain how you found the missing values in the t-table.
4. How many days will it take the class to collect enough cans for the field trip. Show all work and explain your thinking.
5. On the graph paper below, label the horizontal axis "Number of Days," label the vertical axis "Number of Cans." Label the horizontal axis 1-25 by 1s; label the vertical axis 1-100 by 5s. Make sure you start at zero. Plot the number of cans collected each day for days 1 - 5.
   If the pattern continues, use the graph to predict the number of cans the students will collect on the 25^{th} day.

FORMATIVE ASSESSMENT QUESTIONS

- What is the coordinate for the horizontal axis?
- What is the coordinate for the vertical axis?
- Why do you need to plot your point where two lines intersect?
- How do you graph a point on the coordinate plane?
- How do you use an ordered pair to identify a point on the coordinate plane?
- How did you determine how to number your x and y axis?
- What is changing each day in the pattern?
- How many cans will be collected on day 4? How do you know? How will the pattern look?
- How did you complete the chart? How do you know you are correct?
- What do you notice about the numbers in each column? What do you notice about how the numbers in each row are related?
- How did you find the number of cans collected on day 20? On day 100? How do you know your answers are correct?

DIFFERENTIATION

Extension

- Ask students to write in words what is happening in the pattern (i.e. each day the number of cans increases by 4; the number of cans each day can be found by multiplying the day number by 4 and adding 1 or the expression $4 \times \square + 1$ where $\square$

is the day number.). Also, ask students to make other predictions based on the graph and check their predictions using the expression $4 \times \square + 1$.

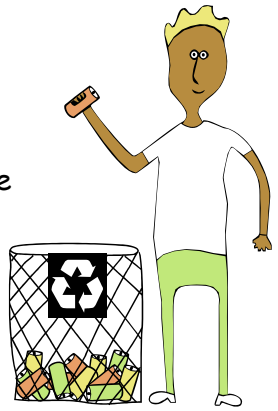
- If students are ready, they could generate another pattern from a competing fifth grade class/school. This could be graphed along with the original pattern to observe relationships.

Intervention

- Some students will benefit by using manipulatives to help them demonstrate the problem with concrete objects prior to drawing a model or attempting to extend the pattern.

Name_____ Date _____

Earth Day Project



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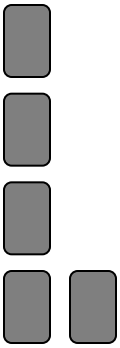
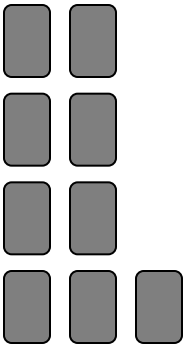
Look at the data for the number of cans collected on each of the first three days. What do you notice? If this continues, sketch the number of cans collected on days 4 through 6.

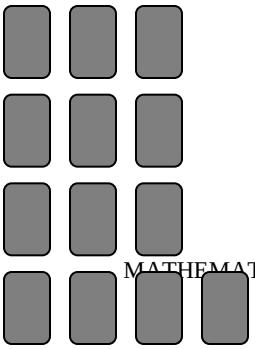
Day 1



Day 2



Day 3



Day 4

Day 5

Day 6

The students recorded the number of cans they collected each day in the t-table below. When they collect one hundred cans, the students can turn them in to the recycling center and earn money to be used for an upcoming field trip. If the pattern continues how many days will it take to collect at least 100 cans?

1. Use what you know about the cans collected in the first five days to make a prediction about how many days it will take to collect at least 100 cans. Show your work and explain in words why you predicted the number of days that you chose.

Day	Cans
1	5
2	9
3	13
4	____
5	____
6	____
7	____
8	____
9	____
10	____
• • •	
20	____
• • •	
100	____

2. Continue the pattern in the t-table. Fill in the missing values.
3. Explain how you found the missing values in the t-table.

4. How many days will it take the class to collect enough cans for the field trip? Show all work and explain your thinking.

5. On the graph paper below, label the horizontal axis "Number of Days," label the vertical axis "Number of Cans." Label the horizontal axis 1-25 by 1s; label the vertical axis 1-100 by 5s. Make sure you start at zero. Plot the number of cans collected each day for days 1 - 5.
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