<u>REPEATING PATTERNS</u>: Grid Patterns

Directions: The teacher will give you centimeter grid paper. On the paper you can mark off grids that are the width that you want to use: 3, 4, 5, or 6 squares wide.

1. Record an A-B-B-C pattern on a 3-square wide grid. You can use crayons and make colored dots or circles to record the patterns. Discuss what you see after recording five or six rows in the grid.

   _____

   _____

   _____

2. Record the same pattern on a 4-square grid. What do you notice?

   _____

   _____

   _____

3. What would happen with an A-B-C pattern on a 4-square grid? What would you notice?

   _____

   _____

   _____

Directions: Explore the following patterns on the grid paper in any way that you wish. For each pattern, write about what you have discovered.

4. A-B-B-B-C

   _____

   _____

   _____

5. A-A-B-B-C-C

   _____

   _____

   _____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 292-293)

6.   A-B-C-D-D-B

_____

_____

_____

Directions: Answers all of the following questions for an A-A-B-C pattern.

7.   What grid size will result in columns of colors?

_____

_____

_____

8.   In a 3-grid, what rows will be the same as the first row? How did you decide?

_____

_____

_____

9.   In a 5-grid, what rows will be the same as the first row? How did you decide?

_____

_____

_____

10.   On what size grids will the B color make a diagonal from left to right? Right to left?

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 292-293)

11. What will be in the fifteenth row of a 3-grid? What will be in the fifteenth row of a 5-grid? The hundredth row?

_____

_____

_____

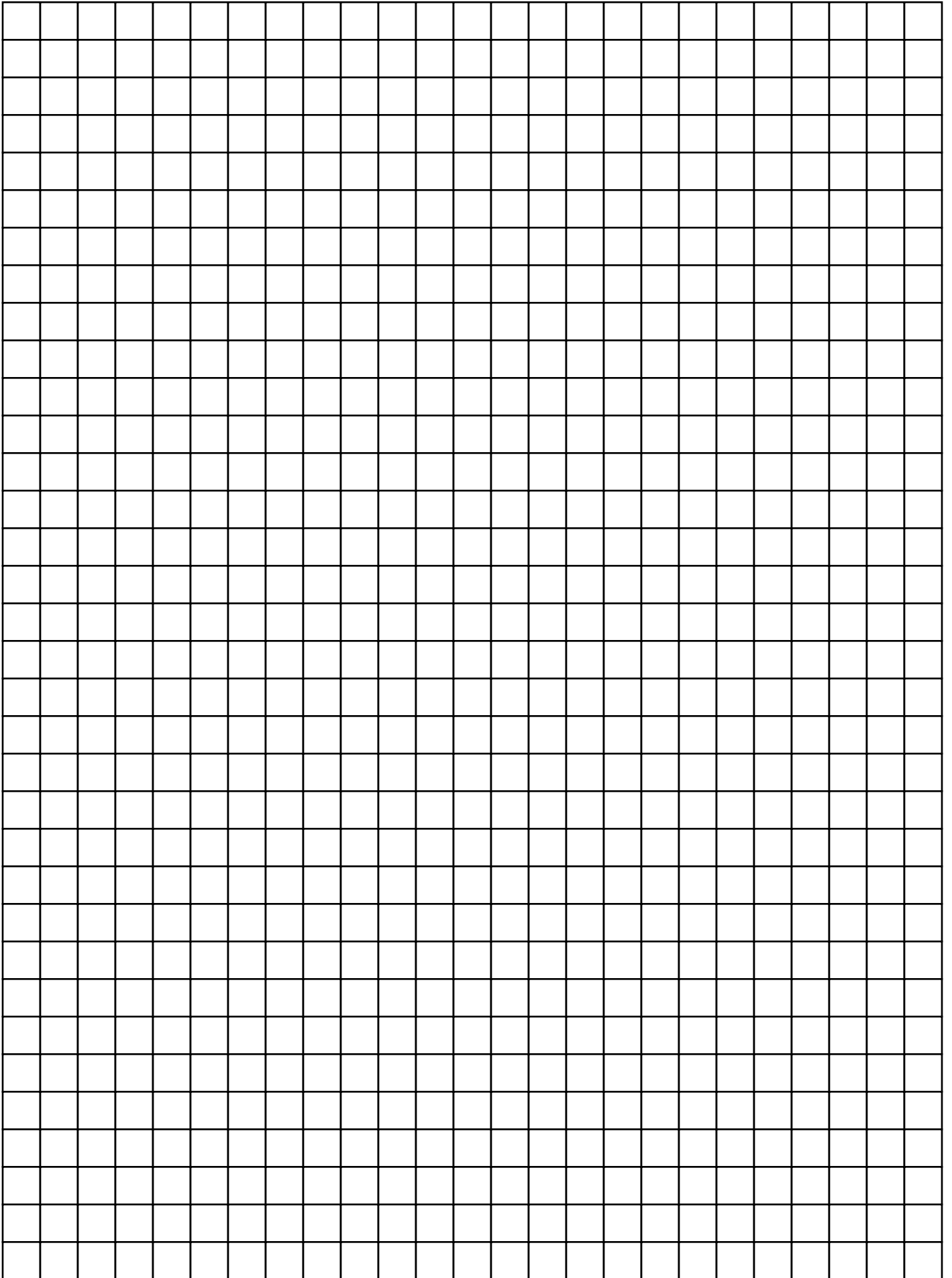**12.** What patterns happen in the columns? How will the column patterns change if you change the grid size?

_____

_____

_____

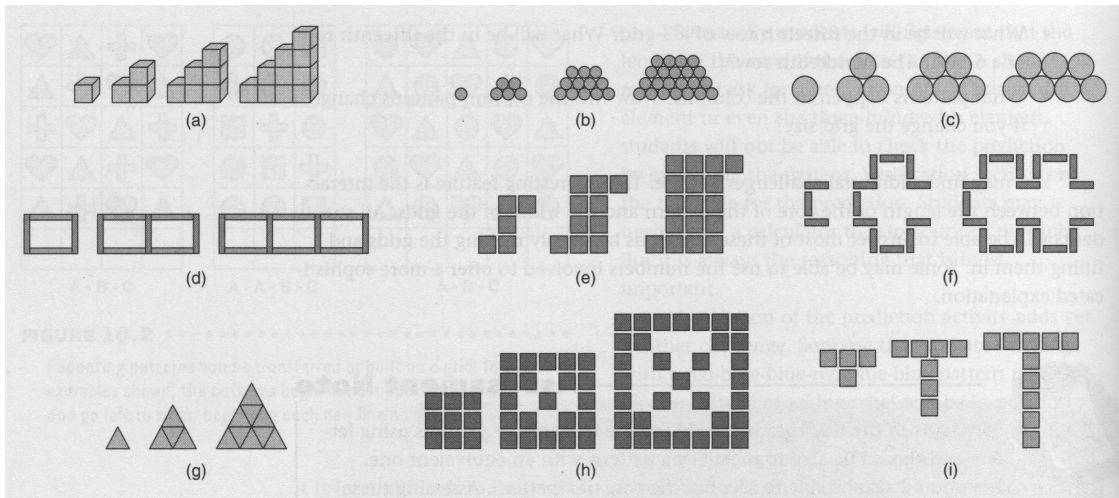Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 292-293)

<u>GROWING PATTERNS</u>: Extend and Explain

Directions: Using pencil and graph paper, extend the patterns. On the graph paper, record each step. On this paper, explain why your extension follows the pattern.

a. Why does your extension follow the pattern?

_____

_____

_____

b. Why does your extension follow the pattern?

_____

_____

_____

c. Why does your extension follow the pattern?

_____

_____

_____

d. Why does your extension follow the pattern?

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 294)

e. Why does your extension follow the pattern?

_____

_____

_____

f. Why does your extension follow the pattern?

_____

_____

_____

g. Why does your extension follow the pattern?

_____

_____

_____

h. Why does your extension follow the pattern?

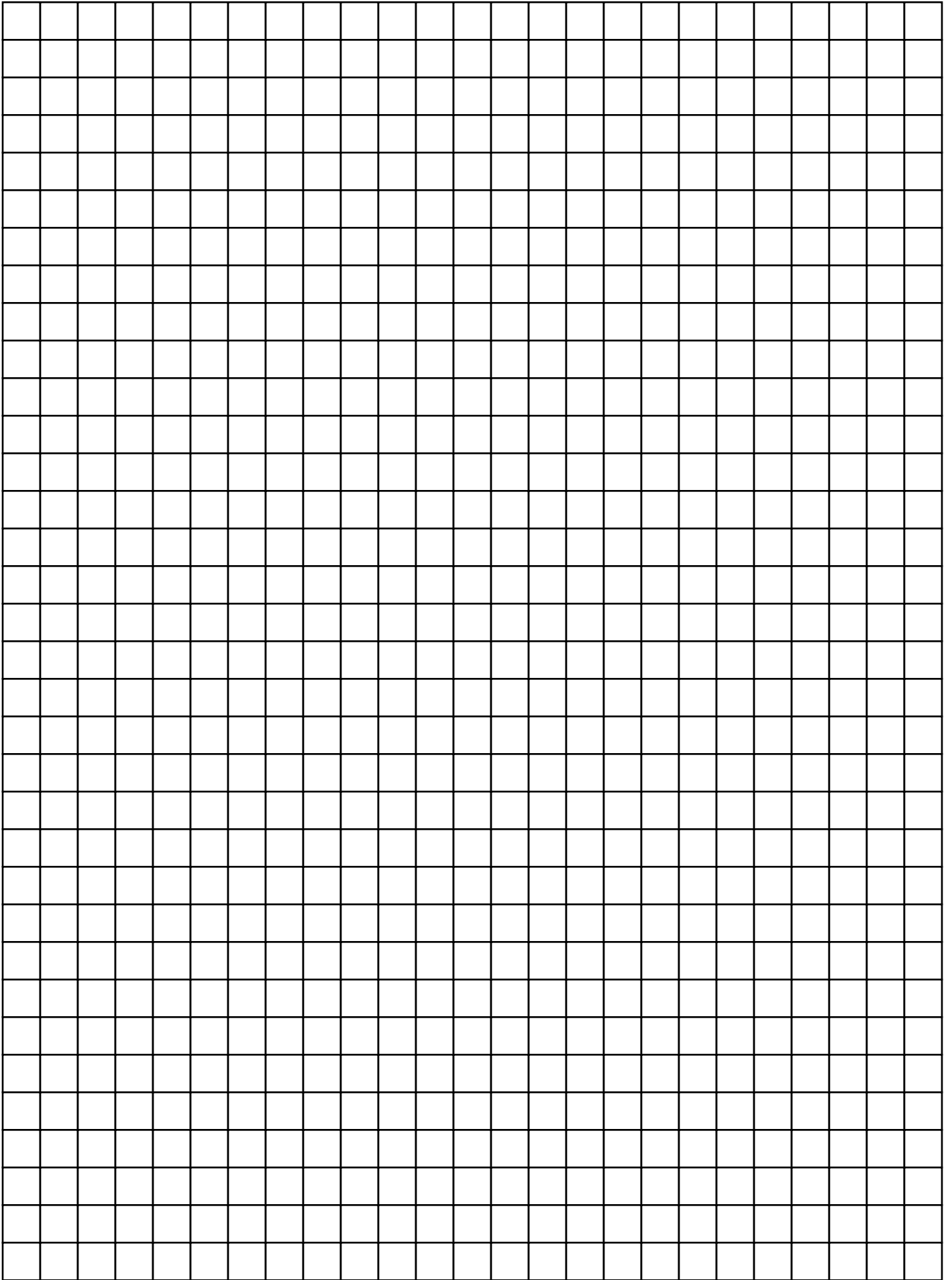_____

_____

_____

**i.** Why does your extension follow the pattern?

_____

_____

_____

199

GROWING PATTERNS: Predict How Many

Directions: Begin to extend each growing pattern.
- Predict the number of manipulatives for each table's 15th step. See if there is a way to do this without filling in the first 14 entries of the table. Predictions should also be accompanied by an explanation.
- Fill in the table showing how many items are needed to make each step of the pattern.
- See if your prediction was correct. If the prediction is incorrect, examine your reasoning and try to figure out why the prediction was off.
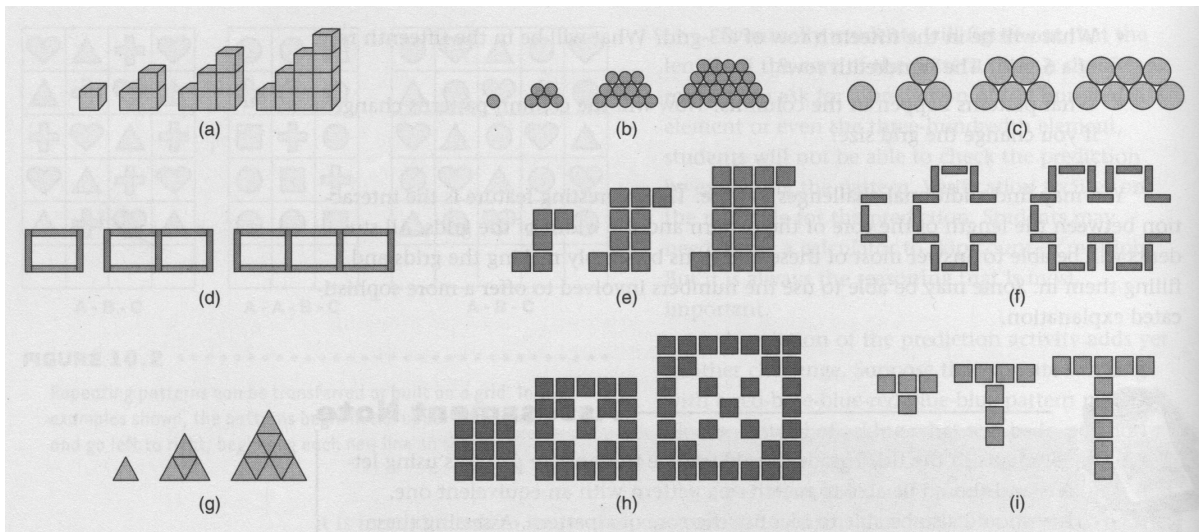
a.

Step															15
Number of manipulatives															

_____

_____

_____

b.

Step															15
Number of manipulatives															

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 294-295)

c.

Step														15
Number of manipulatives														

_____

_____

_____

d.

Step														15
Number of manipulatives														

_____

_____

_____

e.

Step														15
Number of manipulatives														

_____

_____

_____

f.

Step														15
Number of manipulatives														

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 294-295)

g.

Step													15
Number of manipulatives													

_____

_____

_____

h.

Step													15
Number of manipulatives													

_____

_____

_____

i.

Step													15
Number of manipulatives													

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 294-295)

SEARCHING FOR RELATIONSHIPS: Find the Function in the Pattern

Directions: Look back at your work from "Predict How Many." For each pattern (a through i):
   a. Find and describe in writing as many patterns as possible, both from the table and from the physical pattern. For each pattern found in the table, you should see how that idea can be found in the physical pattern. The most important pattern to look for is the one from steps to number elements, the functional relationship.
   b. Write the functional relationship as a formula in terms of the step number. Show how the formula works for each part of the table already constructed. Use the formula to predict the next entry in the table, and check this with an actual construction of the pattern, if possible. Use the formula to predict the twentieth entry in the table.

Pattern a

   a. _____

   _____

   _____

   b. _____

   _____

   _____

Pattern b

   a. _____

   _____

   _____

   b. _____

   _____

   _____

Pattern c

    a. _____

_____

_____

    b. _____

_____

_____

Pattern d

    a. _____

_____

_____

    b. _____

_____

_____

Pattern e

    a. _____

_____

_____

    b. _____

_____

_____

Pattern f

    a. _____

_____

_____

    b. _____

_____

_____

Pattern g

    a. _____

_____

_____

    b. _____

_____

_____

Pattern h

    a. _____

_____

_____

    b. _____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 297)

Pattern i

   a. _____

_____

_____

   b. _____

_____

_____

Extension: Choose one of the patterns. Use its (1) table and (2) functional relationship in order to create a line graph of its data. The graph should extend the pattern beyond what is represented in the table.

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 297)

<u>NUMBER PATTERNS</u>: What's Next and Why?

Directions: (a) Extend the pattern for several numbers and (b) explain the rule for the pattern.

1. 1, 2, 2, 3, 3, 3, …

    a. _____

    b. _____

2. 2, 4, 6, 8, 10, …

    a. _____

    b. _____

3. 1, 2, 4, 8, 16, …

    a. _____

    b. _____

4. 2, 5, 11, 23, …

    a. _____

    b. _____

5. 1, 2, 4, 7, 11, 16, …

    a. _____

    b. _____

6. 1, 4, 9, 16, 25, …

    a. _____

    b. _____

7. 0, 1, 5, 14, 30, …

    a. _____

    b. _____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 299)

NUMBER PATTERNS: Start and Jump Numbers

Directions: Make a list of numbers beginning with 3 and skip count by 5. The 3 is called the "start number" and 5 is the "jump number". It is helpful to make the list in a vertical column.

Start with 3 Jump by 5s

The task is to examine the list of numbers and find as many patterns as possible. Ideas should be shared with others in the class. Students should be sure that all suggested patterns really exist.

1. Patterns: _____

_____

_____

_____

_____

When you have found patterns for this first list, change the start number and see how the patterns change. Different groups can explore different start numbers. Find as many patterns as possible, share your ideas with the class, and make sure all of your patterns really exist.

Start with ____ Jump by 5s

2. Patterns: _____

_____

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 299-300)
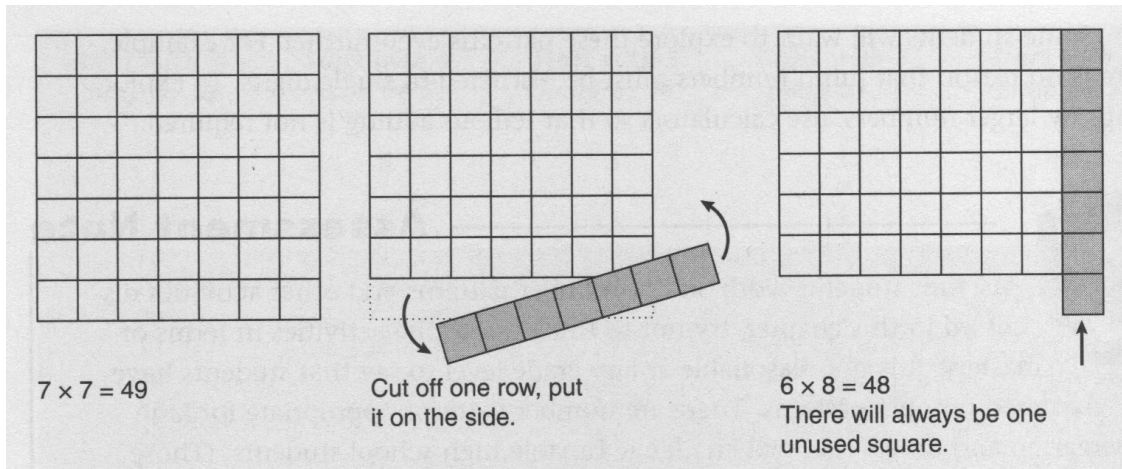
Next, make changes in the jump numbers. Different groups can explore different jump numbers. Find as many patterns as possible, share your ideas with the class, and make sure all of your patterns really exist.

3.   Patterns: _____

_____

_____

_____

_____

| Start with 3 Jump by ___s |
| --- |
| |
| |
| |
| |
| |
| |
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| |

PATTERNS WITH OPERATIONS: One Up and One Down – Multiplication

7 × 7 = 49

Cut off one row, put
it on the side.

6 × 8 = 48
There will always be one
unused square.

Directions: When you begin with 7 x 7 = 49 and then raise one factor and lower the other, each by one, the product is one less than the original: 8 x 6 = 48.

Your task is to explore this for other numbers multiplied by themselves (squares). To help with your exploration, you can cut out a square array from grid paper. How can you change the square array into the new rectangle using scissors and tape?

Use words, pictures, and numbers to tell what you have found. Explore similar situations and see what patterns you can uncover.
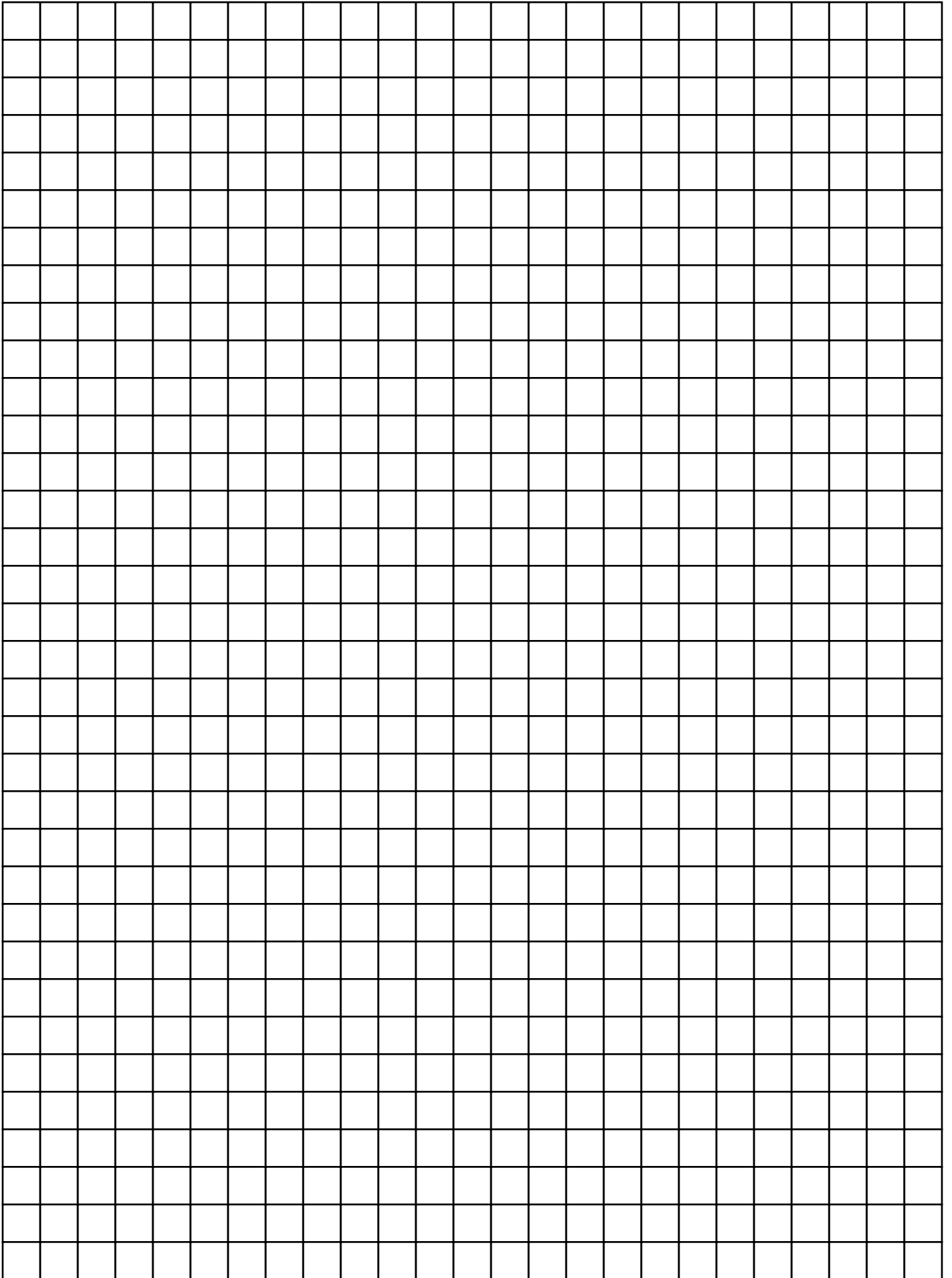
PATTERNS WITH OPERATIONS: Diagonal Sums

Directions: Select any four numbers in the hundreds chart that form a square. Add the two numbers on each diagonal.

64	65	66	67
74	75	76	77
84	85	86	87
94	95	96	97

1. What do you notice?

_____

_____

_____

_____

Explore other diagonal sums on the chart. Expand your search to diagonals on any rectangle. For example, the numbers 15, 19, 75, and 79 form four corners of a rectangle. The sums 15 + 79 and 19 + 75 are equal.
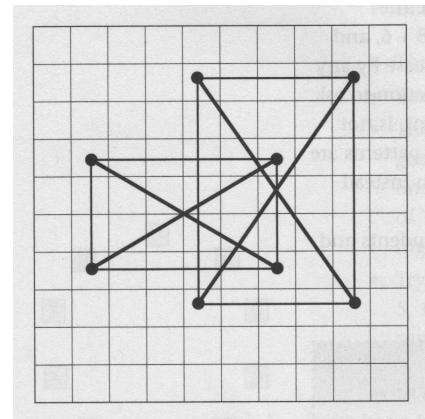
2. Challenge yourself to figure out why this is so.

_____

_____

_____

3. Repeat #2, but with subtraction instead of addition. What do you notice about the differences in diagonal corners? Why do you think this is so?

_____

_____

_____

4. Using only the top two numbers in the rectangle, how can you predict how much the diagonal differences will differ, regardless of the choice of the two bottom numbers?

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 302-303)

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

<u>VARIABLES</u>: Story Translations

Directions: Write an equation that means then same thing as the word problem. Then, solve for the variable.

1. Katrina is playing a game and she needs to earn 26 pickles total in order to win. She has 12 pickles. How many more does she need in order to win the game?

   _____

2. Al has 3 times as many baseball cards as Mark. If Mark has 75 cards, how many does Al have?

   _____

3. There are 3 full boxes of pencils and 5 extra pencils. There are 41 pencils in all. How many pencils are in each box?

   _____

4. Andrew is shopping for action figures and he would like to find 36 of them. He already has some, but now he needs 18 more. How many does he have?

   _____

Directions: Write a word problem that means then same thing as the equation. Then, solve for the variable.

5. $r - 12 = 21$

   _____

   _____

   _____

6. $w \div 12 = 14$

   _____

   _____

   _____

7. $9 \times k - 2 = 79$

   _____

   _____

   _____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 307)

Name _____   Date _____

VARIABLES: Number Tricks

1.
- Write down any number.
- Add to it the number that comes after it.
- Add 9.
- Divide by 2.
- Subtract the number that you began with.
- What is the number with which you ended up? See if you can find how the trick works.

_____

_____

_____

_____

2.
- Pick a number between 1 and 9.
- Multiply by 5.
- Add 3.
- Multiply by 2.
- Add another number between 1 and 9.
- Subtract 6.
- What do you see? See if you can find how the trick works.

_____

_____

_____

_____

3.
- Pick a number.
- Multiply by 6.
- Add 12.
- Take half of the result.
- Subtract 6.
- Divide by 3.
- What happens? See if you can find how the trick works.

_____

_____

_____

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (p. 308)

<u>VARIABLES</u>: What's True for All Numbers?

1. How do you know that $465 + 137 = 137 + 465$ without doing the computation?

_____

_____

_____

_____

2. How can this be written to show that it's a rule that is true for every number, even fractions and decimals?

_____

_____

_____

_____

3. Find other statements that are true for all numbers. Do your work below, and circle each statement that you find.

Adapted from *Teaching Student-Centered Mathematics: Grades 3-5* (pp. 308-309)