



Patterns and Functions

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A World of Patterns

1

Overview

Mathematical Focus

- Describe, extend and create repeating patterns
- Repeating cores in patterns
- Recognize regularities in shapes, designs, events and numbers

In this activity, students use manipulatives to extend and create repeating patterns. They analyze repeating patterns to identify a core and to describe how that core repeats. At the same time they try to identify which pieces are missing from incomplete patterns. Students make their own patterns by creating a core and then repeating it. As students recognize, compare, and analyze patterns in their surroundings, they are beginning to think algebraically.

Patterns and Materials

Before the session, gather the following materials:

- Student Page 1
- Music source (optional)

Throughout this activity, and other activities in this unit, shape pieces are used. Student Page 1 contains shape pieces, which can be cut out of heavy paper and colored ahead of time. Alternatively, other manipulatives, such as toothpicks, popsicle sticks, buttons, and pennies could be used as a replacement for one of the types of shape pieces. Save manipulatives for use in future activities.

Part 1: Movement and Rhythmic Patterns

1. Introduce repeating patterns using movement and rhythm.

Slowly demonstrate a movement/rhythmic-repeating pattern to students.
Examples:

- ♦ Clap, clap, wave, clap, clap, wave, clap, clap, wave, . . .
- ♦ Touch your toes, touch your nose, touch your toes, touch your nose, . . .
- ♦ Spin, jump, jump, spin, jump, jump, spin, jump, jump, . . .

Have students say what you are doing as you make each movement or sound. When students think they know the pattern, they can join you in making it.

2. Continue a pattern and identify the core.

Start a new pattern, and this time stop somewhere in the middle of the pattern. For example, if you chose the pattern “spin, jump, jump, . . .” then repeat this core several times, but in the last repetition stop after “spin, jump.” Challenge students to continue the pattern of movements. Ask: *What is the group of movements or sounds that is repeated in this pattern?* Explain that the group of movements or sounds that is repeated is often referred to as the *core*. Have students identify the core in several more movement or rhythmic patterns that you make up.

3. Create your own rhythmic/movement pattern.

Guide students in making up their own repeating patterns:

- ♦ *What are some sounds or movements you could use to make a pattern?*
- ♦ *Pick two or three of those sounds or movements to be part of your repeating pattern.*
- ♦ *Make a core of sounds or movements that will be repeated in the pattern. What will you do first? What will you do second? Third?*
- ♦ *Show me your pattern!*

Play Pattern Courses

To play:

- ♦ One person is the pattern maker and the other is the actor. There can be more than one actor if three or more people are involved in the game. The actor starts at a designated spot in the room.
- ♦ The pattern maker decides and shows where the destination point will be. He or she then thinks of a core pattern of movements that the actor must use repeatedly in order to move to the destination point. For example, the pattern maker could say that the actor must *jump, jump, spin* repeatedly to get to the destination point. The pattern maker should demonstrate the core of movements to be repeated by the actor.
- ♦ Once the actor reaches the destination point, the pattern maker and the actor switch roles.

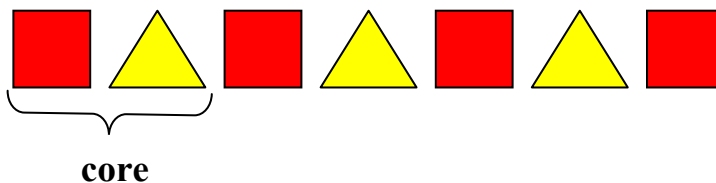
Teaching
Tip

You can adapt this game to be a paper and pencil game: The pattern maker dictates patterns of moving the pencil on a piece of paper. The actor must use these patterns to move the pencil from point to point on the piece of paper.

Part 2: Patterns of Objects

1. Use shapes to create repeating patterns.

Arrange shape pieces from Student Page 1 as pictured below:



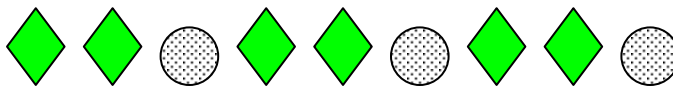
Ask students to describe the pattern. Have them say the names of the shapes in the pattern aloud: *square, triangle, square, triangle, ...*

Ask: *What shape should I put down next continue the pattern?*

What is the core of this pattern? Remind students that the core is the part of the pattern that is repeated.

2. Make additional shape patterns.

Arrange the following shape pattern in front of students:



Have students describe the pattern and then say it aloud. Ask:

- ♦ *What are the pieces of the pattern?* [diamonds and circles]
- ♦ *What part of this pattern is repeated?* [diamond, diamond, circle]
- ♦ *Use shape pieces to show me what the core of this pattern looks like.*
- ♦ *What shape comes next in the pattern? How do you know?*

Use shape pieces to create the following pattern:



Ask:

- ♦ *What are the pieces of the pattern?* [triangles, circles and squares]
- ♦ *What part of this pattern is repeated?* [triangle, circle, square]
- ♦ *Use shape pieces to show me what the core of this pattern looks like.*
- ♦ Use additional shape pieces to extend the pattern.

Teaching Tip

Younger children may only be able to continue the pattern, while older students should be able to identify the core and repeat it.

3. Play What's Missing.

To Play:

- ♦ One person is the pattern maker and the other is the detective.
- ♦ The pattern maker's job is to make a repeating pattern out of shape pieces or other manipulatives, give the detective time to look at the repeating pattern, and then take a piece or multiple pieces out of the repeating pattern while the detective has his or her eyes closed.
- ♦ The detective's job is to examine the pattern that the pattern maker forms, close his or her eyes, then open them and

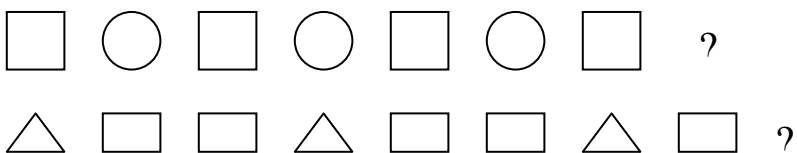
determine what piece or pieces are now missing from the pattern.

For the first few rounds, you should be the pattern maker and the students should be detectives. Explore the different types of patterns shown below. Keep in mind that if you remove too many pieces from a pattern, it is impossible to figure out what the pattern is. Once students have the hang of the game, you can give them the chance to be the pattern makers while you play the part of the detective.

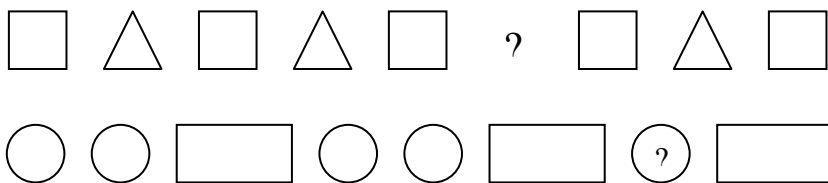
Teaching Tip

If the detective has trouble identifying the missing pieces, suggest that he or she say aloud the pieces of the repeating pattern, look for what group of shapes is repeated in the pattern, and place shape pieces in the empty space to see how they fit.

Type 1: Continuing patterns



Type 2: Patterns missing one piece late in the pattern



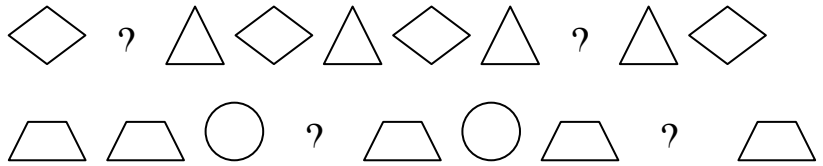
Teaching Tip

Types 3 and 4 may be too difficult for younger children. If so, continue with Types 1 and 2.

Type 3: Patterns missing one piece near the beginning of the pattern



Type 4: Patterns missing several pieces.



Type 5: Patterns missing pieces at the beginning of the pattern.



Extension

Listen to a song if you have a tape player available, or sing a song together. Ask students to try to identify the repeating patterns they can hear in the words of the song or in the beat of the song. Songs like “Old McDonald” and “Row, Row, Row Your Boat” are examples of songs with repeating patterns.

Make patterns with four or more elements in the core. Have students try to extend the patterns, identify missing pieces of the pattern that you take away, and create their own patterns with longer cores.

Pattern Families

Overview

Mathematical Focus

- ▶ Recognize, describe and extend repeating patterns
- ▶ Represent patterns in a variety of ways and translate from one representation to the other

Students continue to explore repetition in patterns. They classify repeating patterns into pattern families – patterns made of different elements that have the same rule of repetition. As they recognize and create different representations of the same repeating pattern, they use alphabetic notation to compare patterns and decide if two patterns belong to the same pattern family.

Preparation and Materials

Before the session, gather the following materials:

- ▶ Student Page 1
- ▶ Student Page 2
- ▶ Student Page 3
- ▶ Student Page 4

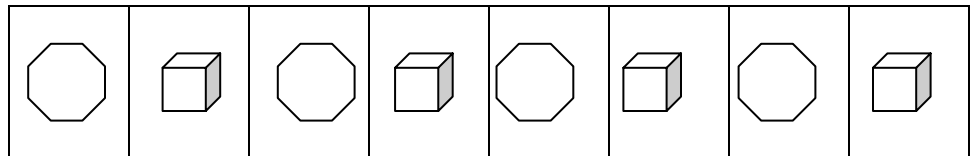
Cut out the following items ahead of time: shape pieces from Student Page 1; pattern strips from Student Pages 2 and 4; and letter cards from Student Page 3.

Activity

Part 1: Find Pattern Similarities

1. Introduce pattern strips.

Show students the first pattern strip from Student Page 2.

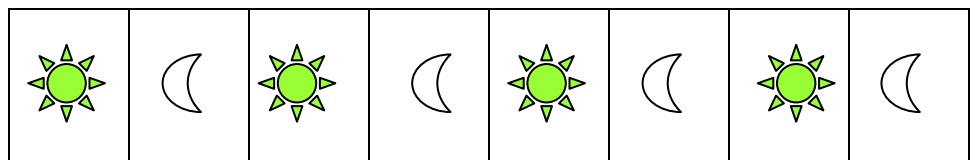


Ask:

- ♦ *Can you name the shapes on the pattern strip?*
- ♦ *Are there shapes that repeat on the pattern strip? Students may recall that the group of repeated shapes is called the *core* of the pattern.*

2. Compare Pattern Strip 1 with Pattern Strip 2.

Show students the second pattern strip from Student Page 2. Have them say aloud the pictures on the strip.



Ask:

- ♦ *How is this pattern similar to the last pattern?*
- ♦ *How is it different?*
- ♦ *Line up the pattern strips with one placed above the other. What do you notice?*
- ♦ *Can you describe a “rule” for making this type of pattern?*

3. Create a third pattern strip that follows the same rule.

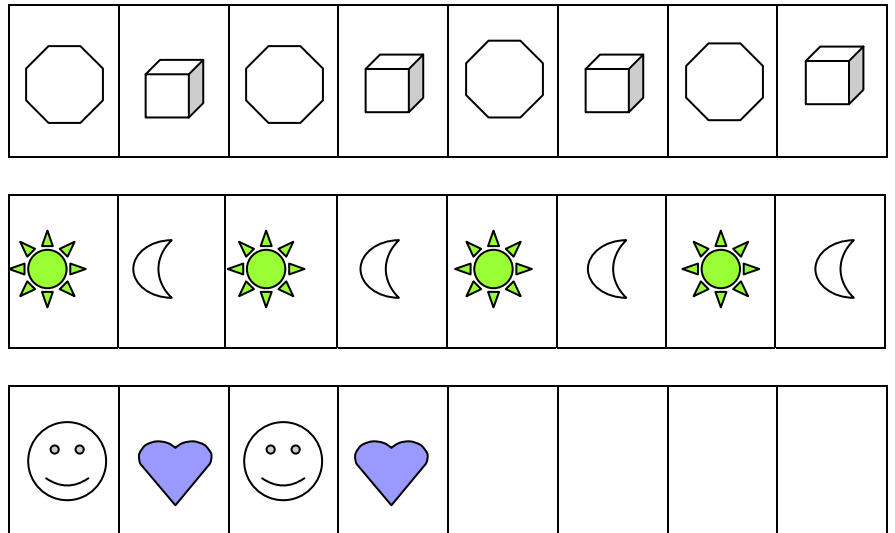
Give students a blank pattern strip. Challenge them to create a third pattern strip that follows the same pattern rule as strips 1 and 2. Suggest that students use a different combination of shapes for the core.

Teaching
Tip

Patterns are in the same pattern family if their elements repeat by the same rule. So square, triangle, square, triangle, . . . would be in the same pattern family as circle, hexagon, circle, hexagon, . . . because each has two elements and the elements repeat in an AB pattern.

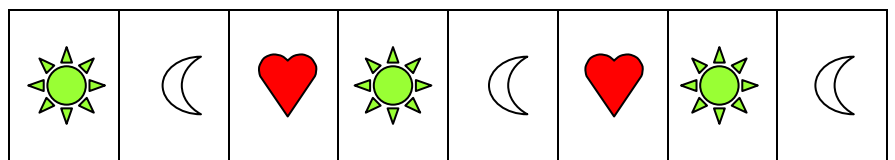
4. Form a “family” of patterns.

Ask students to line up the three pattern strips. These three pattern strips are from the same *pattern family*. Explain that a pattern family contains patterns that repeat in the same way.



5. Make additional pattern strips that do belong to the same pattern family and pattern strips that do not belong to this pattern family.

Ask students to make additional pattern strips that belong to the same family. Also challenge them to make pattern strips that *do not* belong to this pattern family. Have them explain their thinking. Example strip that does not fit:



6. Decide which rhythm/movement patterns belong in the family.

Present a few rhythm/movement patterns and ask students to decide which ones belong in the family of pattern strips they just created and which do not. Encourage students to explain their thinking. For each new pattern presented, have students identify the core.

Examples:

- ♦ Clap, wiggle, clap, wiggle, clap, wiggle, ... (belongs in the pattern family above)
Core = *clap, wiggle*
- ♦ Jump, clap, clap, jump, clap, clap, (does not belong in the pattern family)
Core = jump, clap, clap

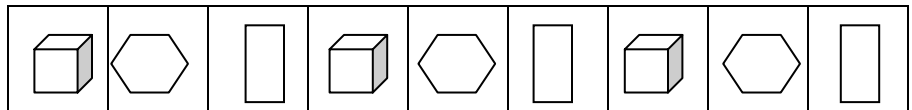
7. Make your own pattern family.

Ask students to make their own pattern family. Give them shape pieces cut out from Student Page 1 or other manipulatives. Encourage students to build patterns by choosing groups of shapes to repeat. When they have completed one pattern, they can take different set of shape pieces and try to make another repeating pattern that repeats by the same rule. When students are done constructing patterns, ask them to describe their patterns aloud, and identify the core group of shapes that is repeated in each pattern.

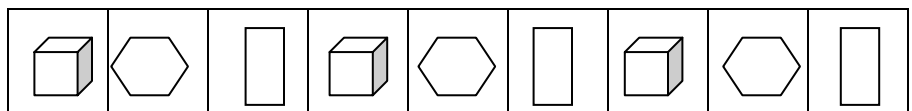
Part 2: Use Letter to Represent Patterns

1. Use alphabetic notation to label pattern strips.

Show students Student Page 3: Patterns and Alphabetic Notation. Have students examine the first pattern and say the pattern aloud. Ask student to circle the core of the pattern:



Give students letter cards cut out from Student Page 3. Ask them to place an A below each cube, place a B below each hexagon, and then a C below each rectangle. Ask: *What is the same about the way the shapes and the letters repeat?*



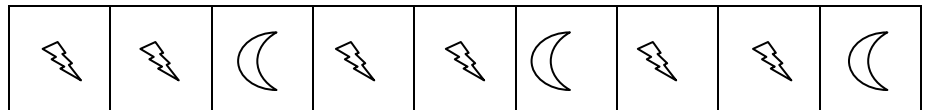
A B C A B C A B C

Remove the pattern strip, but leave the letters that were labeling the pattern strip, and ask:

- ♦ *What is the core of letters that is repeated in the pattern of letters? [A, B, C]*
- ♦ *Would this pattern of letters be in the same pattern family as the pattern strip you were just looking at? How do you know?*

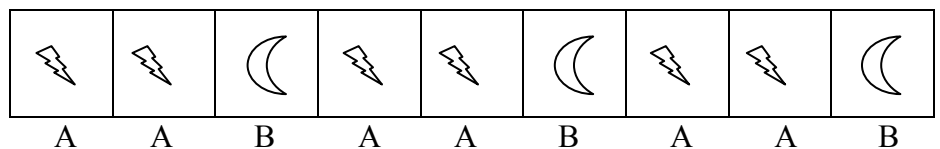
2. Label a second pattern strip with letters.

Have students look at the second pattern strip from Student Page 3 and say the pattern aloud. Ask them to identify the different shapes used to create the pattern and then circle the core.



Challenge students to label the pattern strip with letter cards. Remove the pattern strip and ask students to compare the letters that labeled this strip with those that labeled the first pattern strip. Ask:

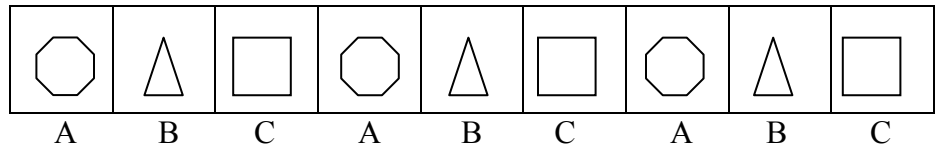
- ♦ *In what ways are the patterns different?*
- ♦ *Does this pattern belong to the same family as Pattern 1? Explain your thinking.*



3. Label a third pattern strip.

Have students label the third pattern strip. Ask questions such as the following:

- ♦ *What is the core of this pattern?*
- ♦ *What letters represent the core?*
- ♦ *Does this pattern belong to the same family as Pattern 1 or Pattern 2? Explain your thinking.*



Part 3: Pattern Concentration

1. Play “Pattern Concentration”

To Play:

Turn all of the pattern strips from Student Page 4: Pattern Concentration face down on a flat surface and spread them out. Players alternate turns. During a turn, a player picks up two of the pattern strips, flips them over, and decides if they are in the same pattern family. If they are, the player keeps the two strips. If not, the player places the strips face down. The player should explain why or why not the patterns are in the same family. The game ends when all of the pattern strips are used.

Grid Patterns

3

Overview

Mathematical Focus

- ▶ Recognize, describe and extend patterns in two dimensions

Students extend their work with patterns into two dimensions. They explore how patterns repeat in a plane by looking for missing pieces, extending patterns, and creating patterns.

Preparation and Materials

Before the session, gather the following materials:

- ▶ Student Page 5
- ▶ Student Page 6
- ▶ Student Page 7
- ▶ Student Page 8
- ▶ Pennies or counters
- ▶ Crayons or markers

Activity

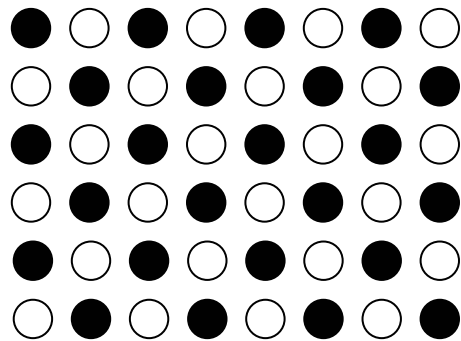
Part 1: Color Patterns on a Grid

1. Introduce grid patterns.

Give students a copy of Student Page 5, then ask:

- ♦ *In what ways does this repeat?*
- ♦ *Is there more than one way?*

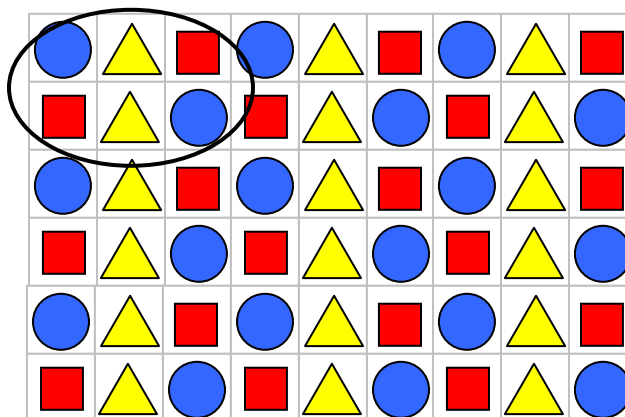
Give students a copy of Student Page 6 and ask them to duplicate Grid Pattern 1 on their own grid sheet. Encourage them to look for patterns in rows, in columns and on diagonals. Have them share their pattern discoveries.



2. Analyze a second, more complex grid pattern.

Show students Student Page 7. Ask questions such as:

- ♦ *What patterns do you notice?*
- ♦ *Can you identify a pattern made by the circles and squares?*
- ♦ *Can you find a core that could be used to build this grid pattern?*



Grid Pattern 2

3. What's Missing?

Once students are familiar with Grid Pattern 2, have them close their eyes and cover several cells of the grid with pennies. When students open their eyes, challenge them to figure out what shapes you have covered. Have them explain their strategies for deciding the shape covered. Ask: *What clues do you use when you are trying to figure out what the missing shape is?*

Teaching Tip

If this is difficult, let students cover a few cells and you close your eyes. As you make guesses, model your thinking process. For example, “If I look at another spot on the grid, I see that a triangle always has another triangle above it and below it. In this spot where there is a penny, there is a triangle above and a triangle below; there must be a triangle under the penny.”

4. Make your own grid pattern.

Give students a copy of Student Page 6. Have them create a grid pattern. Begin by making a core. Repeat the core both horizontally and vertically. As students are working, make a grid pattern of your own. When everyone is finished, trade designs and challenge the other person to find the core and describe how the pattern repeats.

Cover pieces of the new patterns and have students guess what is covered.

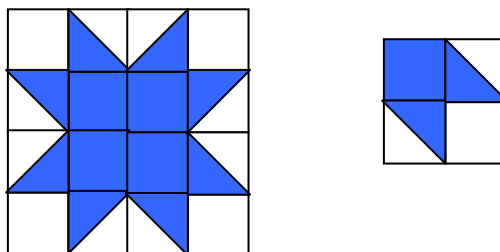
Part 2: Quilt Patterns on a Grid

1. Explore quilt patterns on a grid.

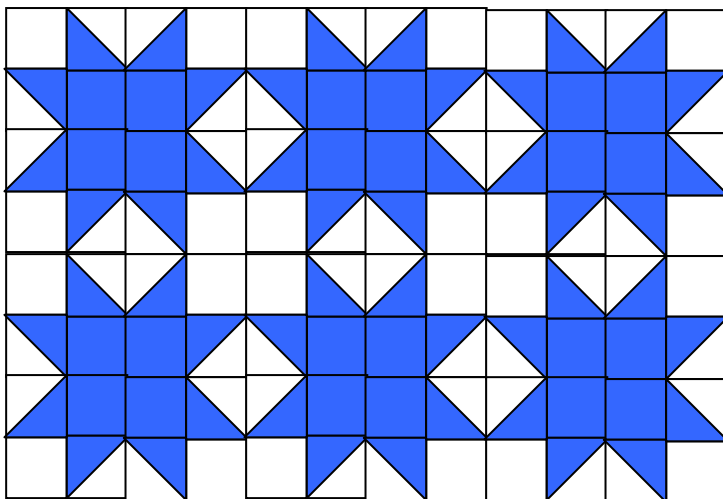
Give students a copy of Student Page 8. Ask:

- ♦ *What shapes are used in this grid pattern?*
- ♦ *What group of shapes repeats on the grid? Circle an example of the core.*
- ♦ *Are there other groups of shapes, bigger or smaller, that repeat?*

Here are two possible cores:



Quilt Pattern



2. Finish the quilt pattern.

Challenge students to continue the quilt pattern on the rest of the grid. Remind them to look at how the shapes are grouped in the completed part, and how that of the pattern repeats itself.

3. Design your own quilt pattern.

Give students a copy of Student Page 6 and ask them to design their own quilt pattern. They should decide how the shapes will be grouped and how they will repeat. For some patterns it might be helpful to cut out a copy of the core and then repeatedly trace it on a blank grid. Have students describe their quilt pattern and identify at least one core.

Extension

Help students look for repeating geometric patterns in their environment. For each repeating geometric pattern they find, ask them to:

- ♦ *Describe the repeating pattern.*
- ♦ *Tell what shapes are in the pattern.*
- ♦ *Identify a core element that is copied or repeated to create the overall design.*

Some examples of places where students might see geometric repeating patterns include:

- ♦ Brick walls
- ♦ Ceiling tiles
- ♦ Floor tiles
- ♦ Checkered shirt
- ♦ Mosaic
- ♦ Window
- ♦ Piece of graph paper
- ♦ Chain-link fence
- ♦ Cage
- ♦ Game board

Growing & Shrinking Patterns

Overview

Mathematical Focus

- ▶ Identify growing and shrinking patterns
- ▶ Analyze how growing and shrinking patterns are generated
- ▶ Extend growing and shrinking patterns.

In this activity, students explore growing and shrinking patterns: sequences of shapes or numbers in which each successive term increases or decreases in a regular way. In Part 1, students describe and analyze how patterns grow or shrink. They predict the next term in a pattern and then use manipulatives to extend the pattern and verify their prediction. In Part 2, students use manipulatives to create their own patterns. They look for similarities and differences in the patterns they have created and use their observations to write a description for each growing or shrinking pattern.

Preparation and Materials

Before the session, gather the following materials:

- ▶ Student Page 1

Cut out the shape pieces from Student Page 1 ahead of time

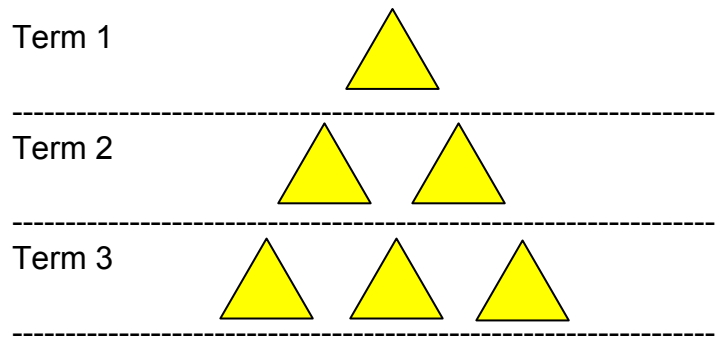
Activity

Part 1: How Does It Grow?

1. Introduce a growing pattern.

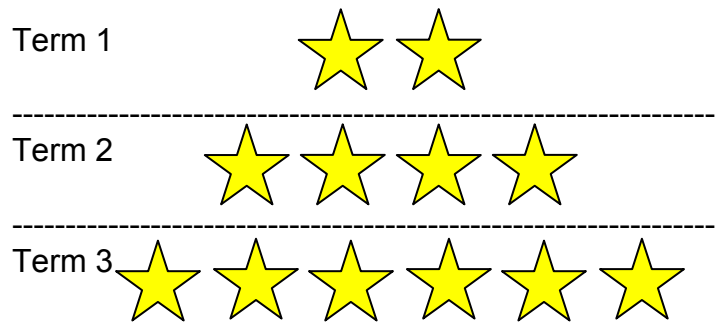
On a sheet of paper, draw and label the pattern below. Ask students:

- ♦ *Can you describe this pattern?*
- ♦ *Is the pattern growing (getting bigger), or shrinking (getting smaller)?*
- ♦ *Predict what the fourth term will look like. How many triangles will be in it? How do you know? Sketch the Term 4 of the pattern.*
- ♦ *What do you think the fifth term will look like? Can you predict how many triangles it will have?*

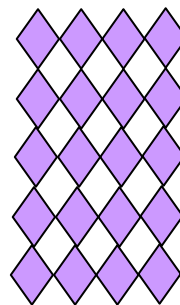


2. Explore different growing and shrinking patterns.

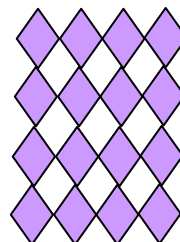
Draw a few more patterns for students to describe, analyze and extend. Be sure to include patterns that shrink as well as patterns that grow. Three sample patterns are presented below:



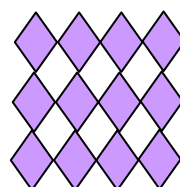
Term 1



Term 2



Term 3



Encourage students to compare the ways the patterns grow and shrink. Ask questions such as:

- ♦ *Which patterns are alike? How are they alike?*
- ♦ *Does each pattern grow or shrink by the same amount each time?*
- ♦ *Which patterns grow or shrink the fastest?*

Teaching Tip

Some children may be able to understand at how patterns grow numerically. For these children, discuss how the patterns above grow or shrink, and have them make numerical predictions.

Part 2: Build Your Own Patterns

1. Create your own growing and shrinking patterns.

Give students shape pieces from Student Page 1, or use other manipulatives. Ask students to use the materials to make a growing or shrinking pattern. Have them show at least four terms of the pattern. Have them glue the pattern onto a piece of paper. Have students build several patterns, including both growing and shrinking patterns.

2. Describe your patterns.

When students have finished, help them write a description of each pattern. Ask questions such as:

- ♦ *How would you describe your pattern?*
- ♦ *What shapes are in your pattern?*
- ♦ *Is your pattern a growing or shrinking pattern?*
- ♦ *How many shapes are added or removed from each term?*

Example pattern and student description:



I made my pattern with stars and hearts. The pattern keeps getting bigger so it is a growing pattern. Each time I make a new term, I add three stars or three hearts.

Patterns on a Hundreds Chart



Overview

Mathematical Focus

- ▶ Recognize, describe and extend simple numeric patterns.
- ▶ Analyze how numeric patterns are generated

In this activity students explore numerical patterns on a hundreds chart. They look for patterns that can be made by skip-counting or by following rule for choosing numbers.

Preparation and Materials

Before the session, gather the following materials:

- ▶ Student Page 9, several copies
- ▶ Small manipulatives (buttons, scraps of paper, pennies, blocks) to use as place markers on the hundreds chart
- ▶ Crayons or markers.

Determine what type of hundreds chart students use in their classrooms and use the one that is familiar.

Activity

Part 1: Skip Counting

1. Skip count by 2's on a Hundreds Chart.

Show students Student Page 9. Ask them to use the chart to count by two's aloud. Have them shade each number they say. Their shaded chart should look similar to the one below.

After students have shaded in the multiples of two for a few rows, stop them and ask:

- ♦ *What numbers have you shaded?*
- ♦ *Do the shaded numbers make a pattern? Describe it.*
- ♦ *Which number will you shade next?*

If you continue counting by two's and shading each number you say, what do you think the chart will look like when you finish?

0	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

2. Skip count by 3's on a Hundreds Chart.

Give students another copy of the Hundreds Chart. Ask them to count by three's this time. Have them shade each number as they say it aloud. After they have completed three or four rows, ask:

- ♦ *What pattern do the shaded numbers make?*
- ♦ *How could you decide whether to shade a square without looking at the number inside the square?*
- ♦ *Should the number 54 be shaded? How do you know?*

0	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

Part 2: Buzz Numbers

1. Play “Buzz 5.”

Give each student a copy of Student Page 9. At the top left corner of the chart, players take turns reading the numbers on the chart. If the number to be read has a 5 in it, then the player should say “buzz” instead of the number. For example: “One, two, three, four, buzz, six,” If the number to be read has two 5's in it (55) then the player says “buzz buzz” instead of the number. In addition to saying “buzz” instead of the number, players should place an “x” on any number with a 5 in it on the chart. If a player misses a buzz number, their turn ends and the next player begins reading where the first player left off.

0	1	2	3	4	X	6	7	8	9
10	11	12	13	14	X	16	17	18	19
20	21	22	23	24	X	26	27	28	29
30	31	32	33	34	X	36	37	38	39
40	41	42	43	44	X	46	47	48	49
X	X	X	X	X	X	X	X	X	X
60	61	62	63	64	X	66	67	68	69
70	71	72	73	74	X	76	77	78	79
80	81	82	83	84	X	86	87	88	89
90	91	92	93	94	X	96	97	98	99

When the number 99 has been reached, stop and ask some of the following questions:

- ♦ *Look at the buzz numbers that have an “x” on them, is there a pattern in their location on the chart?*
- ♦ *What do you notice about the buzz numbers going up and down? What about the buzz numbers going from left to right?*

2. Play “Buzz 2.”

Give students another copy of Student Page 9. This time, play “Buzz 2”. Players take turns reading numbers on the chart, this time replacing any numbers with the digit 2 in them with “buzz” or “buzz buzz” and marking the number with an “x.” When the game is finished, ask:

- ♦ *What do you notice about the column of “x’ed” numbers? What about the row of “x’ed” numbers?*
- ♦ *What is true about all of the numbers that do not have an “x” on them?*
- ♦ *In what ways is this pattern the same as the pattern that the 5’s made? How is it different?*
- ♦ *Can you predict what the pattern will look like if we play “Buzz 7?”*
- ♦ *What is the pattern that starts with 7 ends in 7?*

Part 3: Adding Digits

1. Add digits to make a target number of 6.

Give students a copy of the Hundreds Chart. Tell them that the target number for this activity is *six*. Have them identify every number on the Hundreds chart whose digits add up to 6, for example, in the number 51, the digits of 1 and 5 when added together equal 6. Have students put an “x” on each number whose digits add up to six. When they have found all of the numbers, ask:

- ♦ *Are there any rows or columns of numbers that cannot have digits that add to 6? Which ones? Explain your thinking.*
- ♦ *What kind of pattern do the numbers make?*

0	1	2	3	4	5	●	7	8	9
10	11	12	13	14	●	16	17	18	19
20	21	22	23	●	25	26	27	28	29
30	31	32	●	34	35	36	37	38	39
40	41	●	43	44	45	46	47	48	49
50	●	52	53	54	55	56	57	58	59
●	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

2. Add digits to make a target number of eight.

Have students find the numbers that add up to 8. Place an “x” on any numbers whose digits add up to 8. Ask:

- ♦ *What kind of pattern do these numbers make?*
- ♦ *Is the pattern similar to or different from the numbers whose digits added to six?*

Part 4: Guess My Rule

2. Mark numbers on a hundreds chart according to a “rule.”

Think of a rule that you will use to mark numbers on a hundreds chart. For example, all 2-digit numbers that begin with 3; all odd numbers; or all numbers that contain two of the same digit. Do not tell students your rule. Begin marking numbers on the chart according to your rule. Have students try to guess the rule.

Take turns being the rule maker and the rule guesser.

Calendar Patterns



Overview

Mathematical Focus

- ▶ Identify and describe patterns on a 7 number lattice

Students apply what they have learned about number patterns and patterns on grids to the concept of calendars. They explore the traditional calendar as a 7 lattice by investigating the relationships between spatial arrangements of numbers on a 7-lattice and their numerical relationships.

Preparation and Materials

Before the session, gather the following materials:

- ▶ Student Page 10
- ▶ Student Page 11

Date cards and blank squares from Student Page 17 should be cut out ahead of time.

Part 1: Exploring Calendars

1. Build a base-seven number lattice.

Give students a copy of Student Page 10. Some of the numbers are missing from the calendar. Have students fill in the missing numbers. Skip around on the calendar. Point to empty spaces and have students fill them in and ask: What is...

- ♦ *To the right of an existing number*
- ♦ *To the left of an existing number*
- ♦ *Three squares to the right of a number*
- ♦ *Above a number*
- ♦ *Below a number*

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1				5		
			11			
	16					21
				26		
		31				

2. Discuss problem-solving strategies.

For each question above, ask students to explain their problem-solving strategies. Students may say that each date is seven more than the date above it and seven less than the date below it. If they know one number in a column, they should be able to count on from seven to determine the next date in the column.

3. Compare the calendar with the hundreds chart.

Once all of the dates have been filled in on the calendar, challenge students to make comparisons between the calendar and the hundreds chart they have worked with in previous activities.

Save the completed calendar for use in Part 2: Date Matching.

Teaching Tip

A number lattice is an ordered table of numbers. Lattices are named by the number of columns, for example, a 10-lattice has ten columns of numbers, a 7-lattice has seven columns of numbers. The hundreds chart that students have been working with in previous activities is an example of a ten lattice. The calendar is an example of a seven number lattice. While it is not important that students learn the lattice terminology, exploring the relationship between spatial arrangements of numbers on a lattice and their numerical relationships help students develop number sense and an understanding of place value and arithmetic operations.

Part 2: Date Matching

1. Play “Date Matching”

Introduce students to the game of Date Matching. You will need the completed calendar made in Part 1 of this activity, blank squares, and date cards. Use a blank square to cover each date on the calendar. Shuffle the date cards and place the stack face down.

To play:

- ♦ Player 1 draws a date card from the stack and picks the square on the calendar game board where he or she thinks that date belongs.
- ♦ If the date on the calendar matches the date on Player 1’s date card, Player 1 keeps the card and the blank square is removed from the calendar.
- ♦ If the date on the calendar does not match the date on Player 1’s date card, player 1 returns the date card, face down, to the bottom of the date card pile and the blank square is put back in place on the calendar.
- ♦ Player 2 now repeats the process.
- ♦ Players continue to take turns until all the numbers on the calendar are face-up.
- ♦ The winner is the player who has the most date cards at the end of the game.

Shape Frames

Overview

Mathematical Focus

- Represent the idea of a variable as an unknown quantity using symbols.

Students explore addition and subtraction using shape frames. Shape frames, like letters in algebraic expressions, are used to represent numbers. (Whatever number is used to fill one type of shape within an expression must be used to fill all the other frames of the same shape in that expression.) Using shape frames to represent unknown quantities in an expression helps students develop the concept of variables. A particular shape represents a particular number: if there is more than one of the same shape in an equation or expression, it represents the same number.

Preparation and Materials

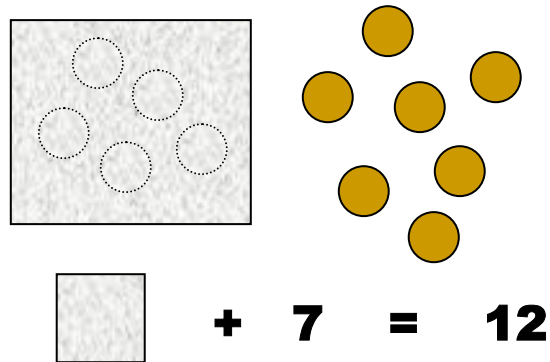
Before the session, gather the following materials:

- Student Page 12
- Student Page 13
- Counters (for example: pennies, buttons or small cubes)
- Squares of scrap paper.

Part 1: What's hidden?

1. Use symbols as place frames for numbers.

Use some pennies or counters and ask students to count them. Record the total. Cover some of the pennies. Ask students how many counters are covered. How do they know? Have them describe their strategy. Record this number as well. Show students how to put the numbers together to write a math sentence that describes the penny situation. For example, if you start with 12 pennies and cover 5, 7 pennies will be uncovered:



Challenge students to figure out how many counters are covered. Ask them to explain their thinking.

2. Use symbols as placeholders in a variety of addition problems.

Repeat the process described above for numbers. For each example:

- ♦ Place a group of counters in front of students. Have them count and record the total number of pennies.
- ♦ Cover some of the pennies.
- ♦ Ask students to write a number sentence to describe the situation.

Then ask:

- ♦ *What number does the square in your number sentence represent.*
- ♦ *How do you know? Can you explain your problem solving strategies?*

3. Use symbols as place holders in subtraction problems.

Explore subtraction sentences. Use from 10 to 20 counters. Remove some counters. Write a number sentence to represent the situation, using a square as the placeholder. *For example, start with 10 pennies and remove seven. Record the following number sentence. Ask students what number the square represents.*

$$10 - \square = 3$$

Part 2: Shape Sentences

1. Introduce shape frames.

Write the following expression:

$$\square + \square = 4$$

Explain that whatever number is used to fill in a specific shape must be used to fill in that shape everywhere in that expression. Encourage students to try some numbers to see if they can make the sentence true. If students are unsure how to begin, model a strategy for trying numbers, for example:

- ♦ *Let's try 1. What happens when we put a 1 in each square? Is that too big or too small?*
- ♦ *What number should we try next?*

Students should see that a 2 can be placed in each of the squares to make the expression true. Ask: *Is there any other number that could be put in the square to make the expression true?* (no)

2. Combine frames of different shapes in the same expression.

Try another example with different shape frames.

$$\square + \triangle = 5$$

Again, model a strategy for trying different numbers. Ask questions such as:

- ♦ *What two numbers can be added together to make 5?*
- ♦ *Is it possible to have more than one solution to this problem?*

Note: If two frames have different shapes, it is legal to use the same number for each frame; however, if two frames have the same shape, the same number must be used to fill those frames. For example, in the sentence: triangle + triangle = 6, the same number must be used in both triangles (3); however in the sentence: triangle + square = 6, three could be used in both the triangle and the square, or different numbers such as two and four could be used in the triangle and the square.

Make up a variety of shape frame sentences for students to solve. Include problems that involve both addition and subtraction.

3. Match number sentences with shape frame sentences.

Give students a copy of Student Page 12 and ask them to match each number sentence on the left with a corresponding shape frame sentence on the right.

4. Solve Mystery Shape Puzzles.



Give students a copy of Student Page 13 and challenge them to solve each puzzle. As students are working, encourage them to describe the problem solving strategies they are using.


Extension


1. Play “Twenty Questions”


To play:


Choose a number range, (e.g. 1 – 50). The chooser picks a mystery number in that range, then draws a shape, to represent the number chosen. The guessers take turns asking questions to figure out what the number is until they can figure out the number. Each time a question is asked the guesser should be recorded it on a piece of paper. The number chooser should answer yes or no and then write down the answer on the paper. For example, the paper could look as follows at the end of a game.


Is the number under the  bigger than 5? yes


Is the number under the  6? no

Is the number under the  odd? Yes

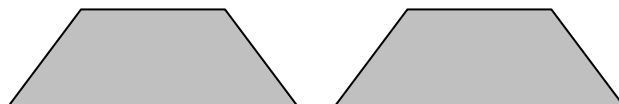
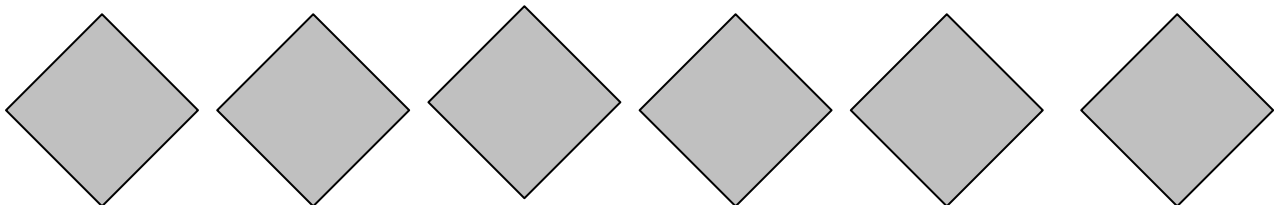
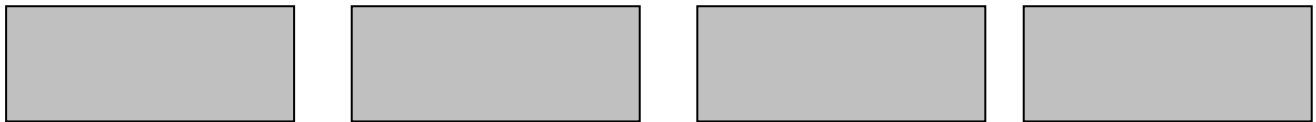
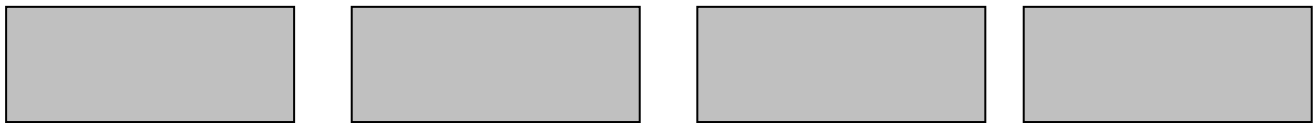
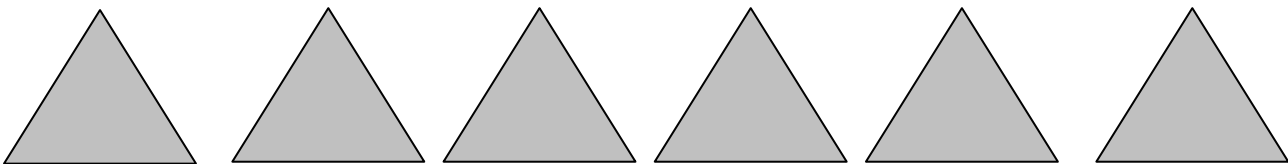
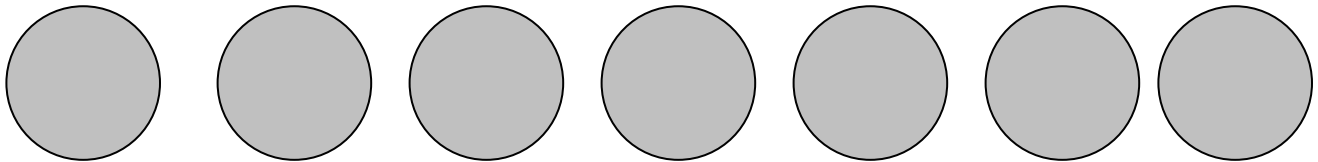
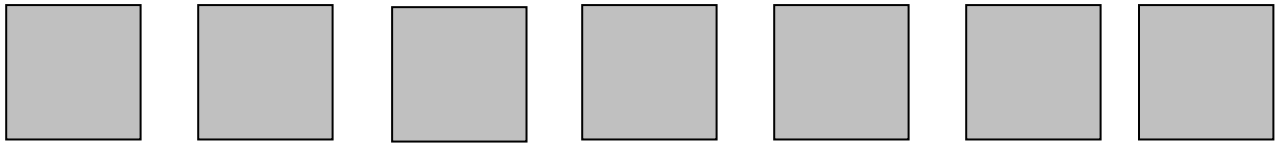
Is the number under the  9? no

Is the number under the  smaller than 10? yes

Is the number under the  7? yes

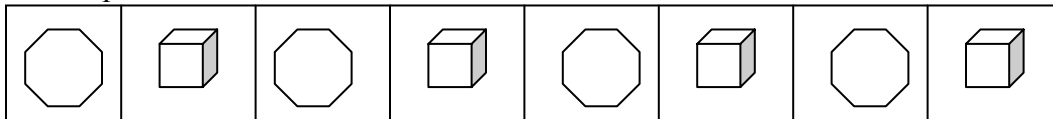
Shape Pieces

1

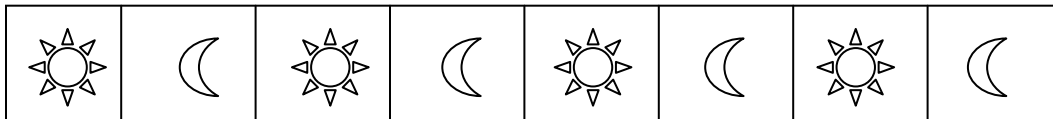


Pattern Strips

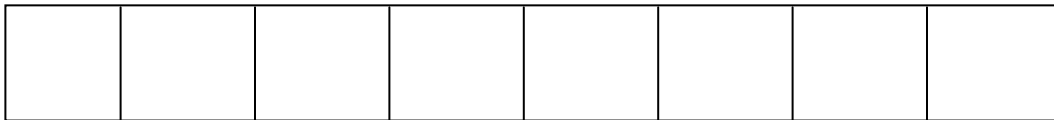
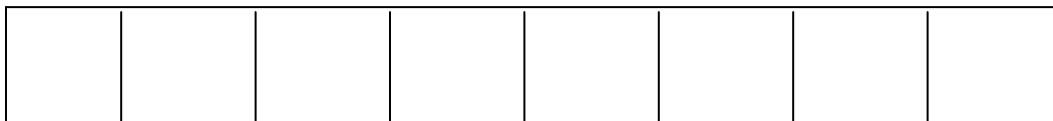
Pattern Strip 1



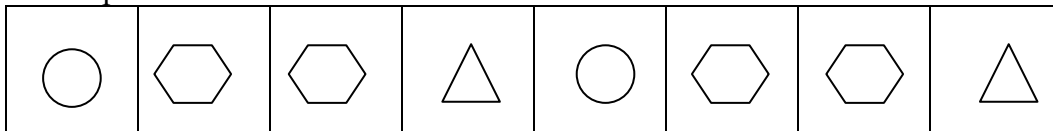
Pattern Strip 2



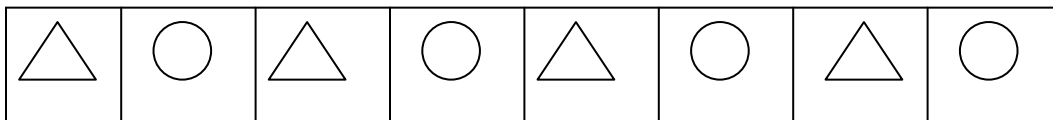
Blank Pattern Strips:



Pattern Strip 3



Pattern Strip 4

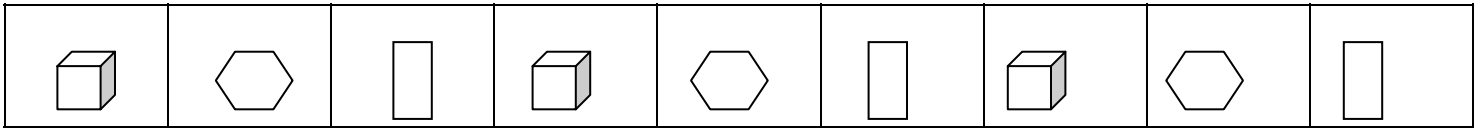


Patterns and Alphabetic

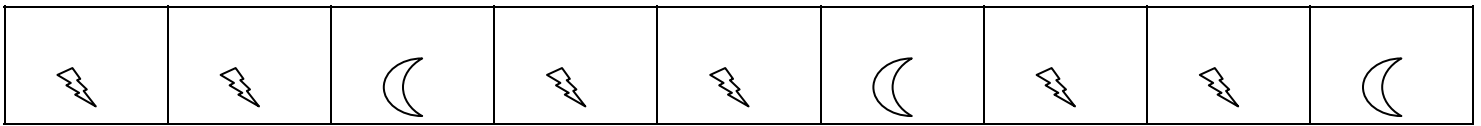
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Notation

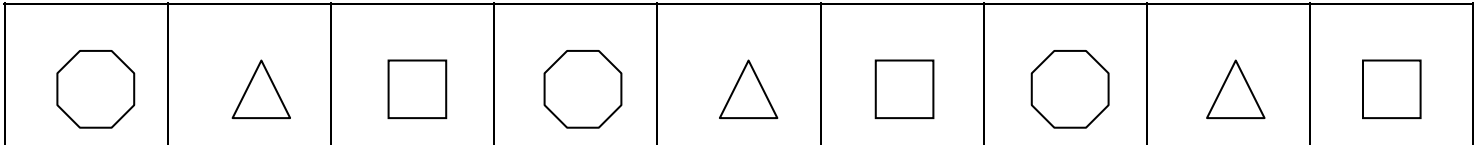
Pattern 1:



Pattern 2:



Pattern 3:

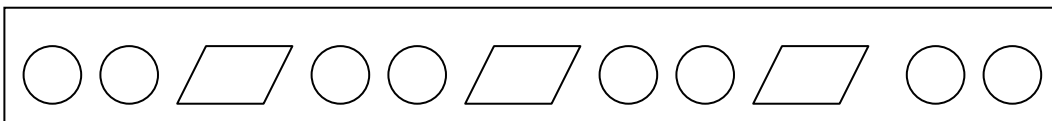
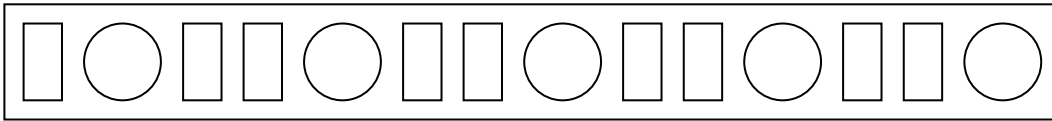
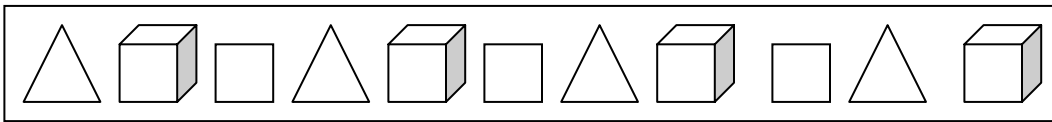
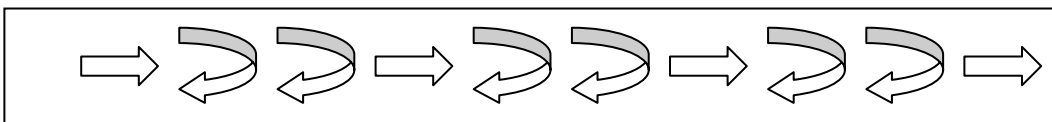
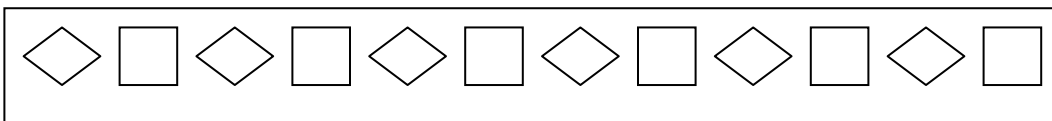
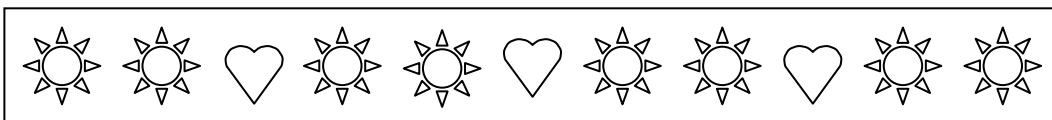
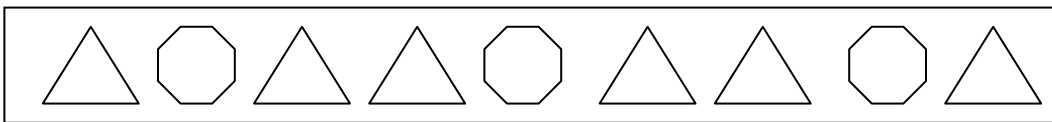
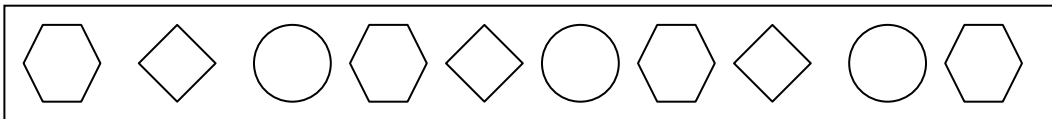
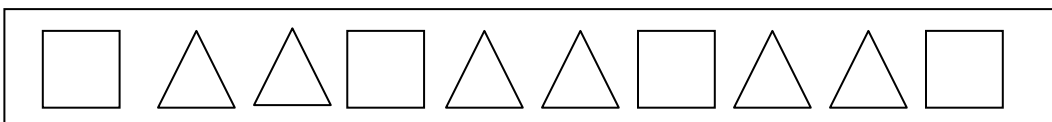
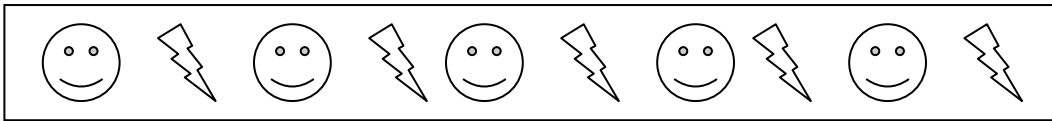


Letter Cards:

A	A	A	A	A	A	A	A
B	B	B	B	B	B	B	B
C	C	C	C	C	C	C	C

Pattern Concentration

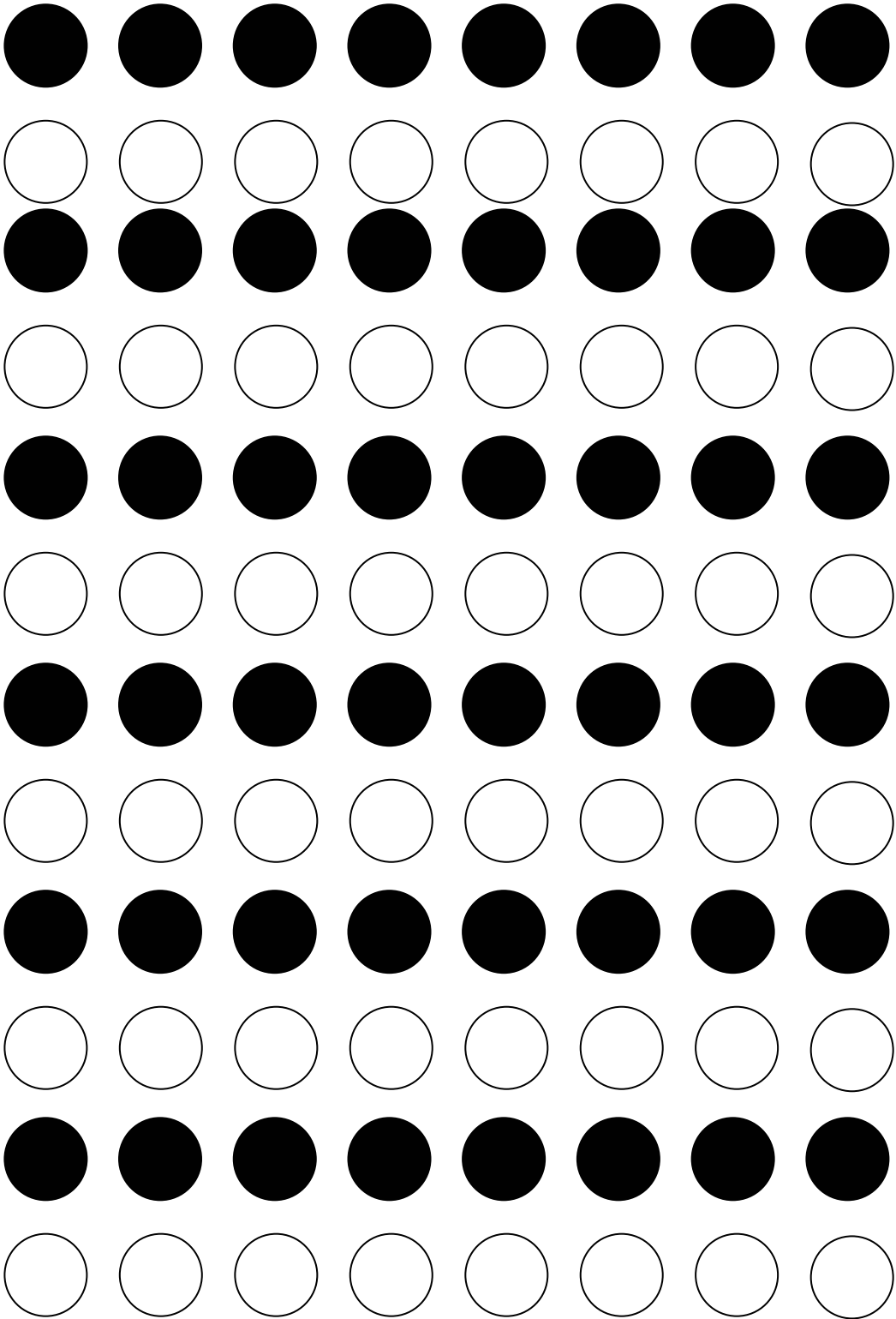
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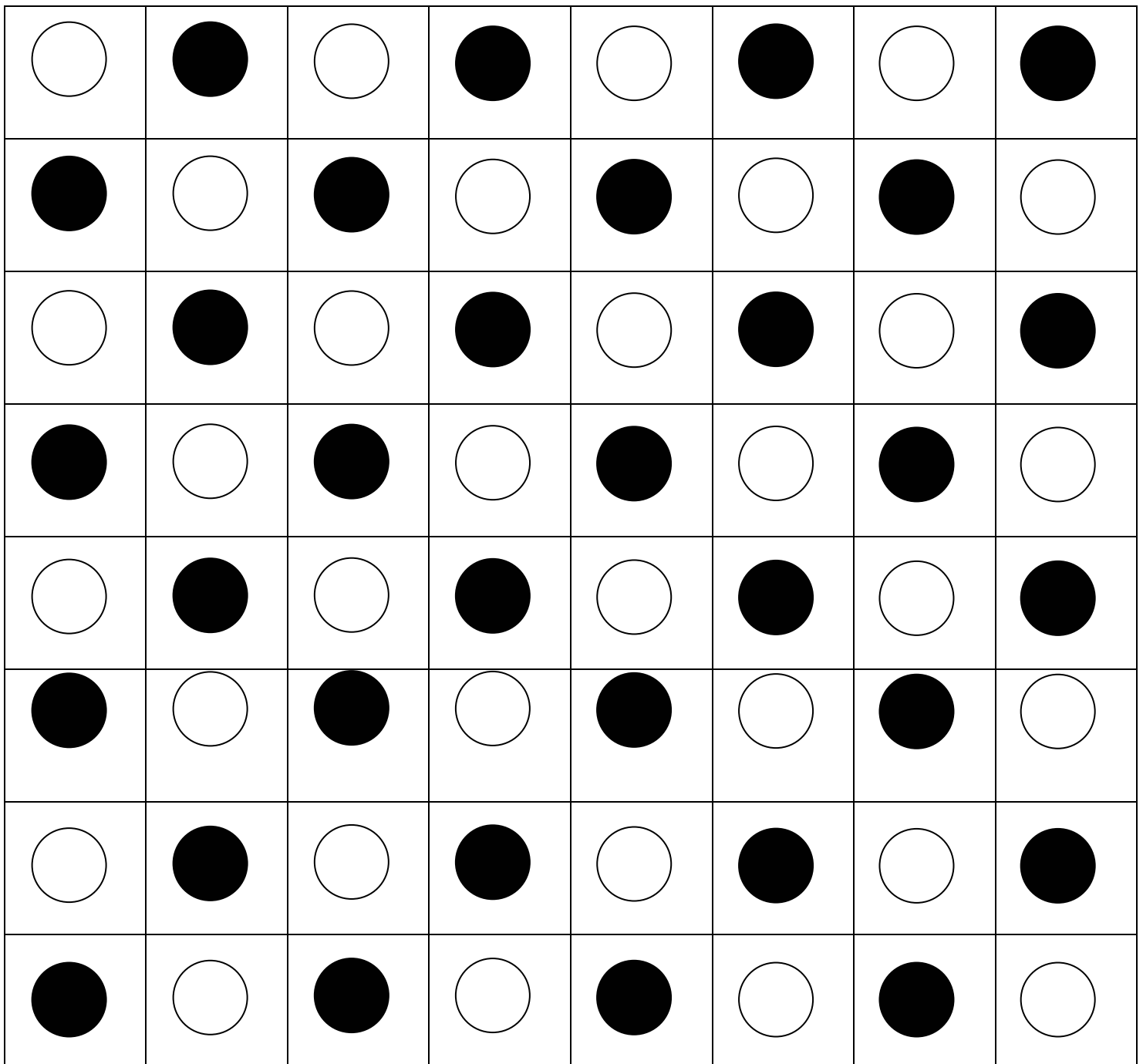
Grid Sheet



Tiles



Black and White Pattern



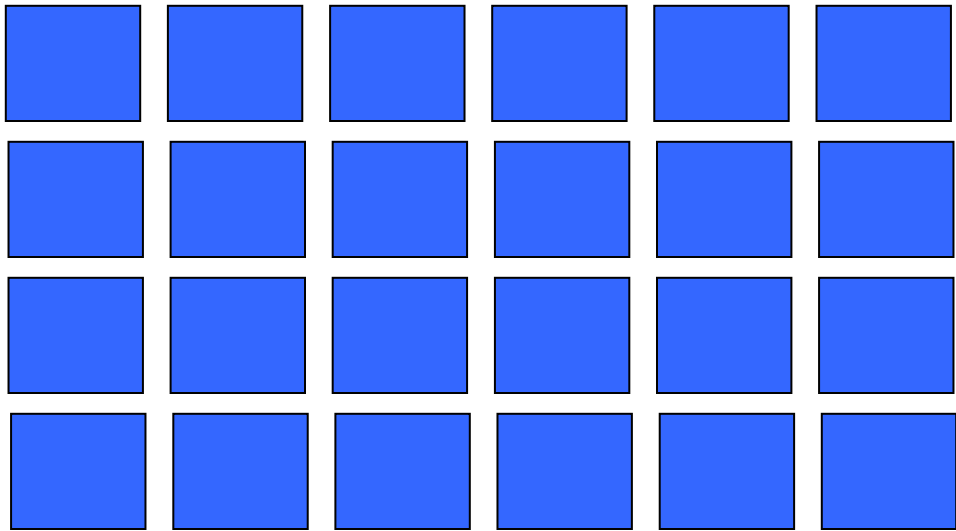
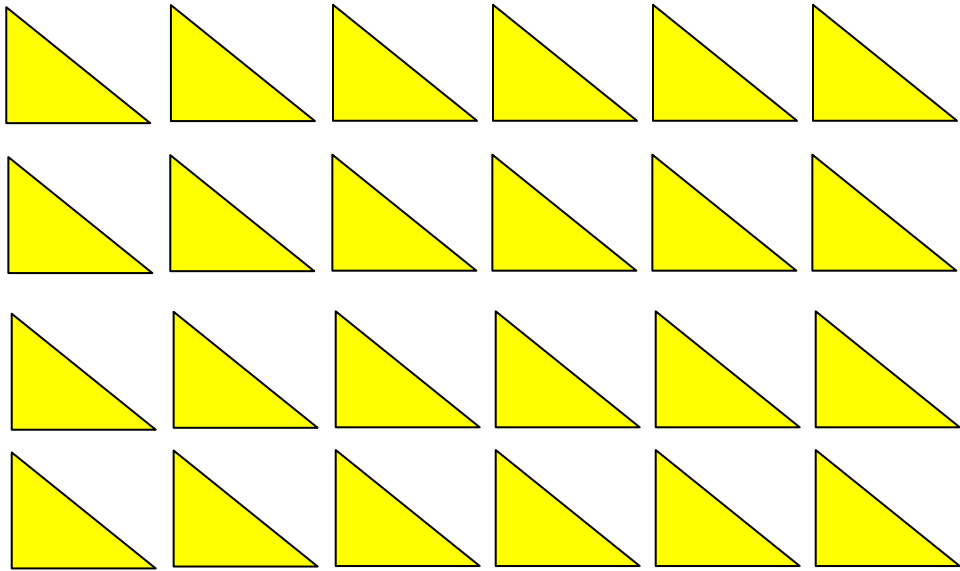


Color Pattern

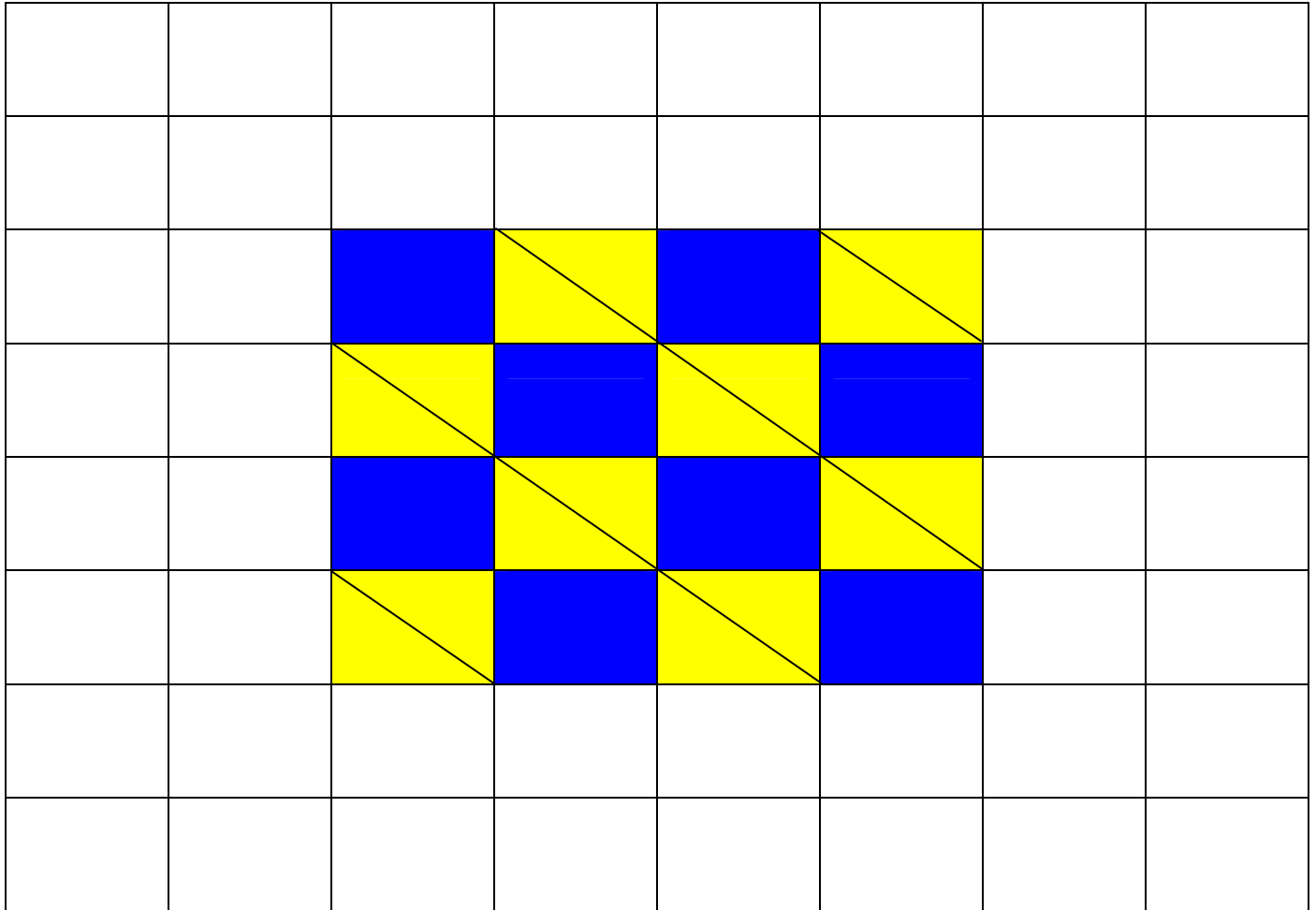
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●	○	○	●	●	○	○	●
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●	●	●	●	●	●	●	●
●	○	○	●	●	○	○	●
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●	●	●	●	●	●	●	●



Pattern Shapes



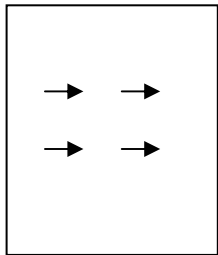
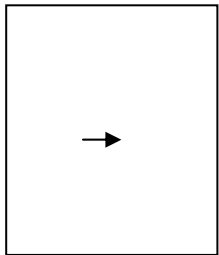
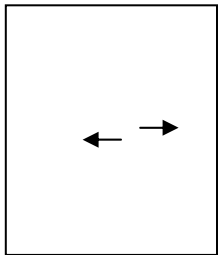
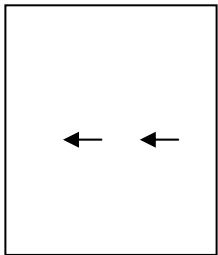
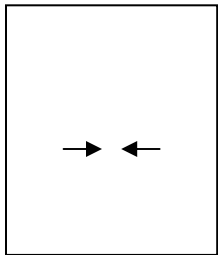
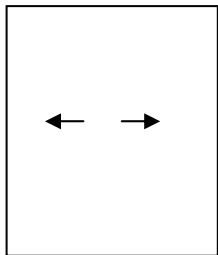
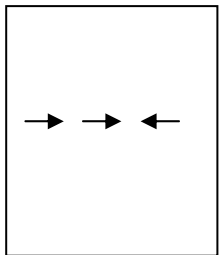
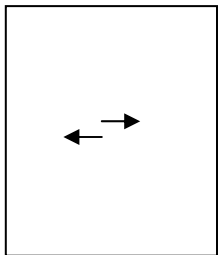
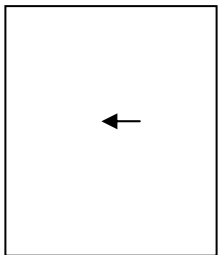
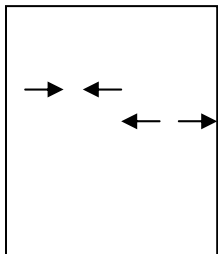
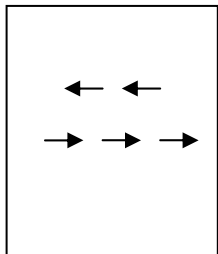
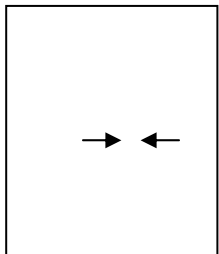
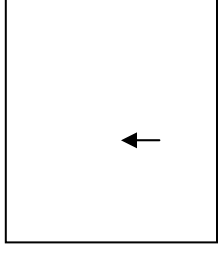
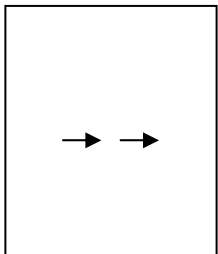
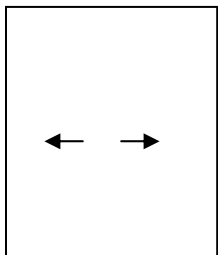
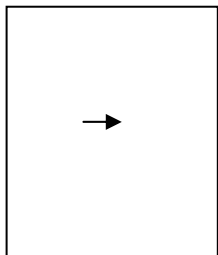
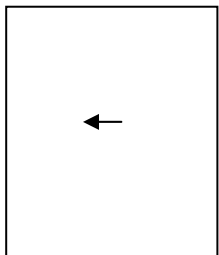
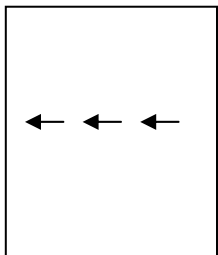
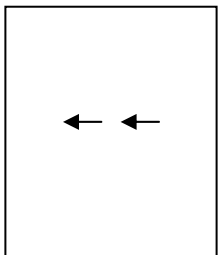
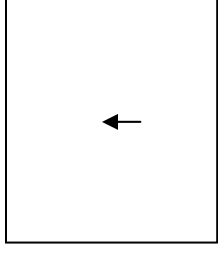

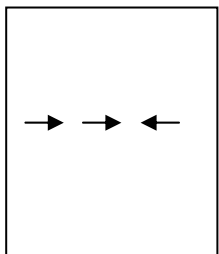
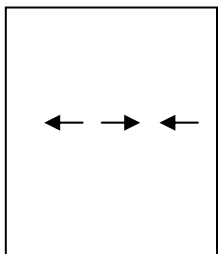
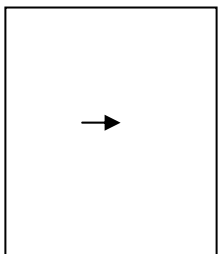
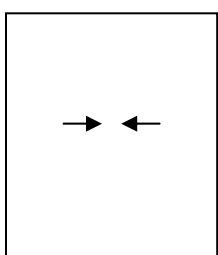
Quilt Pattern



0-99 Chart

0	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

Arrow Path Race Cards

Blank Month

13

Blank Month

Sunday	Monday	Tuesday	Wednesda y	Thursday	Friday	Saturday

January

January

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
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				

15

February

February

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			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	28			

March

16

March

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			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	

Dates

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				


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				


Mystery Shape


18

Frames

Mystery Shape Puzzle 1:


 Is bigger than 6


 Is an odd number

 + 3 is smaller than 13

$$10 - \text{diamond} = 1$$



Mystery Shape Puzzle 2:


 Has two digits

Both of the digits in  are the same

$$\text{square} + \text{square} = 22$$

Mystery Shape Puzzle 3:

 +  = a one-digit number

 is odd

$$5 + \text{circle} = 8$$