

Title: Patterns Your Way

Brief Overview:

Our unit includes various tasks which take the students through the hierarchy of patterns. Included are several teacher resource charts on problem solving, ways to increase students' use of math language, and the hierarchy of patterns. Students will recognize and describe patterns as well as utilize function tables to identify relationships and patterns in numbers. This unit was designed so that the tasks are sequential, thus allowing the teacher to utilize tasks appropriate to their students' needs and knowledge of patterns.

Links to NCTM Standards:

- **Mathematics as Problem Solving**

Students will demonstrate their ability to solve problems in mathematics using their knowledge of patterns. The problem solving will emphasize use of manipulatives, cooperative learning, and recognition of patterns in real-life situations (vignettes).

- **Mathematics as Communication**

Students will demonstrate their ability to communicate mathematically. In this unit the students will communicate by reading, using manipulatives, algebraic methods, symbols, oral and written language.

- **Mathematics as Reasoning**

The students will demonstrate their ability to reason mathematically. In this unit, students will identify, describe, and create patterns. Emphasis will be placed on their reasonable explanation of patterns. Students will be given opportunities to utilize different strategies to solve problems.

- **Mathematical Connections**

The students will demonstrate their ability to connect mathematical topics with calendar, holiday, electricity, social situations, geography, and Revolutionary War activities.

- **Patterns and Relationships**

The students will demonstrate their ability to perform algebraic operations by modeling algebraic concepts through the application of concrete materials and function tables.

Grade/Level:

4-5

Duration:

This series of lessons will take 6 one-hour class periods, which need not be consecutive.

Prerequisite Knowledge:

Students should have working knowledge of the following skills:

- Basic operations (+, -, x, ÷)
- Geometric names and shapes of pattern blocks

Objectives:

Students will:

- identify the core and terms of a pattern so they can copy, continue, and describe various patterns.
- build a pattern when given a description.
- use pattern vocabulary and descriptive language so they can describe an original pattern.
- make predictions about the pattern.
- organize information in a function table so they can identify regularity in the data.
- recognize the pattern in a given code so they can create and decipher their own secret message.

Materials/Resources/Printed Materials:

- Pattern blocks for each group of students
- Overhead pattern blocks (optional)
- Teacher Resource Sheets # 1-4
- Student Resource Sheets # 1-9
- Sets of cooperative pattern cards, one per group (4 cards per set)
- Colored paper cut in fourths, sets of four
- Teacher charts:
 - Chart A--Hierarchy of Patterns
 - Chart B--Math Talk
 - Chart C--Problem Solving Strategies
 - Chart D--Criteria for Writing

Development/Procedures:

Task 1 (Copy, continue, and describe patterns)

- Introduce patterns by asking students what they think of when they hear the word pattern. Where do you find patterns in everyday life? See? Hear?
- Show and discuss various examples of patterns such as striped shirts, tile floor, clapping games.
- Create a pattern on the overhead with pattern blocks (Red, Green, Blue, Red, Green, Blue). Ask students what they notice about the patterns. List their ideas. Show them the **terms** and the **core** of the pattern and share the definitions.

Core-The part of the pattern that repeats (red, green, blue)

Term- The individual units that make up the pattern. (Example: red)

- Ask students to copy a pattern you create using pattern blocks. (Example: trapezoid, triangle, square, trapezoid, triangle, square, trapezoid...)
 - What is the core? (trapezoid, triangle, square)
 - What is the first term? (trapezoid) second term (triangle)
 - Continue the pattern for 5 more terms. Teacher will circulate to observe student work.
- Referring to the above pattern, assign each term in the core a letter. Trapezoid (A), triangle (B), square (C), and repeat. Ask students what they notice.
- Create another pattern with pattern blocks. (Example: hexagon, hexagon, triangle, square, square, hexagon, hexagon, triangle, square, square,...)
 - How many terms are in the core? (5)
 - Continue the pattern for 7 more terms.

Show the students how the pattern is A, A, B, C, C.

- Ask students to create a pattern that follows the same rule. Teacher will circulate and offer assistance and repeated directions.
- Organize students into pairs. Each student should create a pattern. First, each partner will describe their pattern to the other partner. Next, switch partners and ask the new partner to identify the core and terms of your pattern and vice versa. Share ideas for describing.
- Display another pattern using pattern blocks. (yellow, yellow, green, blue, blue, yellow, yellow, green, blue, blue...) Using the cooperative learning strategy, Think-Pair-Share, ask students to describe the pattern. Remind students that they want to be as specific as possible, using appropriate math language. After students have paired, ask for volunteers to share responses, teacher should record all responses on chart or chalkboard. As a class, write a description of the displayed pattern using all of the generated responses. Focus on the math language used.
- Model paragraph: First, I created the pattern with pattern blocks. I noticed the pattern started to repeat after the blue blocks. This meant that the core was made up of 5 terms. It follows an A A B C C pattern.
- Either display another pattern or have all the students create a pattern or have one student share their pattern for the student, to describe in writing. Share ideas when complete.

Task 2 (Building patterns when given a description and creating a pattern)

Part I

- Arrange students in cooperative groups of four. (If you do not have even groups, create groups of three, not five.)
- Supply each group with pattern blocks and a set of cooperative pattern cards Teacher Resource Sheets #1-4.
- Directions for students: Each student takes a card. Each student reads their clue aloud to the group (Do not pass the cards). Using all the clues, create the described pattern. (Students may read the clues several times until the pattern is made.)
- After the group creates the pattern, ask, “How do you know your pattern is correct?” If the group can justify their pattern, give them another set of cards to work on.

Answers to Cooperative Pattern Cards

Teacher Resource #1	ORROY
Teacher Resource #2	ROTTBOR
Teacher Resource #3	YGGTRGT
Teacher Resource #4	BBTB

Part II

- Tell each group to create a linear pattern. (No tessellations, please.)
- Give each group a blank set of colored cards (paper cut in fourths). Explain to the students that they must now write four descriptive clues for their pattern.
- After the clues have been written, give the pattern clues to another table to read and use to build the pattern.
- Have the authors of the set of clues check the accuracy of their patterns.
- Summary/Conclusion
- Ask students to respond to the following writing prompt:
How did you prove the pattern you built was the pattern described on the cards?

• **Task 3 (See patterns and make predictions)**

- Part I
- Using 10 students in the room, create a pattern. The pattern is as follows: sitting, kneeling, standing.
- Ask students, “If I add 5 more students one at a time, what will the fifth student added be doing?” After students have had time to think and solve, share strategies for solving. Prove the answer by adding 5 more students. Discuss the findings.
- Finally ask students to solve the following problem: If we add 11 more people, use what you know to find out what the position of the last person added will be.
- Brainstorm ideas on how to describe the pattern and strategies for solving. Record student ideas on a graphic organizer. Be sure that all important math vocabulary and strategies are discussed. Write a one paragraph response together as a class. Here is an example of a paragraph explaining the pattern and a strategy to solve the problem. Remember the students should always refer to the Criteria for Writing (Teacher Resource Chart B)
- Model paragraph: To solve the problem I drew a picture. When we created the pattern with a model of it together as a class, we saw how the pattern repeats. By looking at the picture, I noticed that the core of the pattern is sitting, kneeling, standing. The first term is sitting. The second term is kneeling. The third term is standing. Drawing a picture was a helpful strategy for solving this problem.

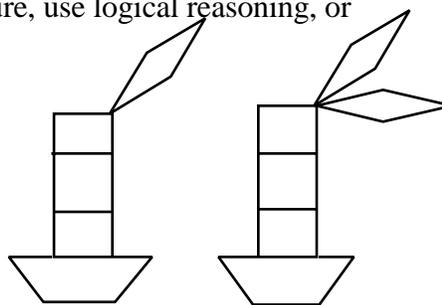
Part II

- The following problem will give the students an opportunity to work more independently. The cafeteria is beginning a new program where they will serve lunches on a four day rotation. The rotation will be as follows: chicken, meat, pasta, pizza. The rotation will continue throughout the year. What will be served on October 20, if pasta is served on October 1?
- See the Student Resource Sheet #1 where the students should solve the problem. It is important give the students opportunities to write to explain how they solved the problem after you have modeled several times. Remind the students to include math language and be as specific as possible in their description of their strategies.

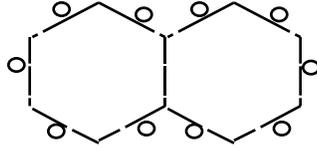
Task 4 (Organize information and find regularity in the data)

- Warm-up activity: By using overhead pattern blocks or drawing on the chalkboard, create a palm tree using 1 red trapezoid as the pot, 3 orange squares as the trunk, and 1 tan rhombus as a palm. Lead the students with the following questions:
 - How many total blocks would you need to create a palm tree with 1 palm? (5)
 - How many total blocks would you need to create a palm tree with 2 palms? (6)
 - How many total blocks would you need to create a palm tree with 7 palms? (11)
- Ask students to share their strategies to solve the palm tree problem. Record all of their ideas. If a table was not shared, be prepared to present the function table strategy to the class. (Most students will make a model, draw a picture, use logical reasoning, or brainstorm.)

palms	total blocks
1	5
2	6
3	7
4	8
5	9
6	10
7	11



- Ask students if they see any relationships between the number of palms and the total blocks used in the design. By asking questions, lead students to identify the rule which is +4 (palms + 4 = total blocks). From the rule you can develop an algebraic equation ($p + 4 = b$). You would also introduce the word variable at this point.
- For this task students will independently read the directions from Student Resource Sheet #2 Be sure that all students can identify the hexagon shape and understand that in constructing the table 2 sides must be joined.



- Have the students solve the problem. Record their strategies on the board. Make sure a table is included as one strategy for solving the problem. Identify the rule, variable, and algebraic equation. Answers to Student Resource Sheet Problems:
Thanksgiving Day Feast--You will need 6 tables. Rule: $(4 \times t) + 2 = s$
- There are two additional vignettes (tasks) to reinforce the skill of function tables.
Student Resource Sheet #3 Rollerblading Recess--There will be 90 wheels. Rule: $s \times 6 = w$
Student Resource Sheet #4 Circuit City--There will be 23 objects. Rule: $w + 2 = t$ (total objects) The circuit will consist of 21 connected wires, one battery, and one light bulb.

Task 5 (Cryptography)

Part I

- As an introduction, read the directions for Student Resource Sheet # 5 aloud as a class, stopping to define vocabulary.

Cipher text- An encoded message

Plain text- An encoded readable message

Decipher- To interpret or translate by using a key

- Students read and complete independently Student Resource Sheet # 5
Ask the students to decipher the message and identify the pattern the cryptographer used to develop his secret code.
- Discuss the message and code pattern with class. Message: Cryptography is the science of writing and reading codes. Mathematicians can use patterns to decipher these codes.
Pattern used in cipher text: the alphabet is shifted by three letters to the right.

Part II--Secret Soldier

- The students will read and complete Activity 1 from Student Resource Sheet # 6 by developing a cipher text with a partner.
- After developing the cipher text, the students will write a cipher text note to General Washington (Activity 2) independently. After Activity 2 is completed, students will exchange their notes written in cipher text. Then they will decode the cipher text using the key from Activity 2, Student Resource Sheet # 6. Then, the students will write the translated plain text in Activity 3, Student Resource Sheet # 7.
- The students will write a letter to the teacher stating whether Activity 4 should be used next year on Student Resource Sheet # 7. It also can be used as homework or an extension activity.

Performance Assessment:

Throughout the various tasks, there are opportunities for students to justify and explain their thinking and answers. It is up to the teacher's discretion as to whether the students' responses are formally assessed by using the Criteria for Writing (Teacher Resource Chart D). In addition, two performance tasks were written to assess the students' knowledge and application of skills and strategies as related to patterns.

Suggestion: For the Rumors Assessment, it is suggested that you provide a 3 month calendar of August, September, and October that indicates when the school year starts, as well as the days the school is closed.

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Hierarchy of Patterns

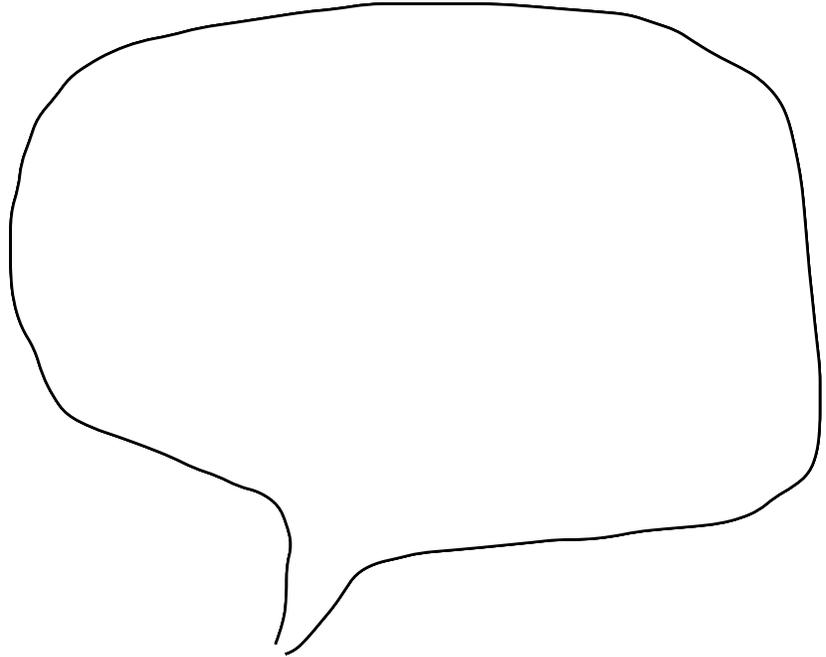
1. Copy
2. Continue
3. Describe
4. Build pattern when given a description
5. Create
6. See patterns and make predictions
7. Organize information and find regularity in the data

Math Talk

term

core

relationship



cryptography

cryptographer

decipher

* USE A BLANK CHART WITH EACH UNIT. ADD VOCABULARY WORDS AS THEY ARE HEARD OR EXPERIENCED. HANG CHART ON WALL WHEN THE UNIT HAS BEEN COMPLETED.

Problem Solving Strategies

- * Work Backwards
- * Make an Organized List
- * Guess and Check (Trial and Error)
 - * Look for Patterns
 - * Build a Model
- * Draw a Picture or Diagram
 - * Brainstorm
- * Work a Simpler Problem
- * Use Logical Reasoning
 - * Make a Table

* Start with just the title. When a new strategy is introduced or discovered, add it to the list. When students solve problems, make them identify the strategy.

Criteria for Writing (Rubric)

- 4 Uses all appropriate mathematical vocabulary
All details are in sequential order
Correct grammar is used
(capitalization, usage, punctuation, spelling)
Problem solving strategy is identified
- 3 Uses some appropriate mathematical vocabulary
Some details are in sequential order
Some grammatical errors
(capitalization, usage, punctuation, spelling)
Problem solving strategy is identified
- 2 Uses limited mathematical vocabulary
Some detail not sequential order
Some grammatical errors
(capitalization, usage, punctuation, spelling)
- 1 No mathematical vocabulary is used
Limited detail
Many grammatical errors
(capitalization, usage, punctuation, spelling)
- 0 No response
Off-topic
Illegible

Cooperative Pattern Cards

<p>The last term is a hexagon.</p>	<p>The first and fourth terms are orange.</p>
<p>There are three different colors, but there are five terms in the core.</p>	<p>When put together, the second and third term create the same shape as the last term.</p>

Cooperative Pattern Cards

<p>The pattern contains only four sided blocks. The pattern starts and ends with the same color.</p>	<p>Orange is the second term, it follows a red block.</p>
<p>There are eight terms in the core. Tan blocks are in-between blue blocks.</p>	<p>Orange must always be between red and blue blocks.</p>

Cooperative Pattern Cards

Four different colors must be used. Yellow is the first term and tan is the last term in the core.

$\frac{3}{7}$ of the core is green.
 $\frac{2}{3}$ of the green blocks follow the yellow.

The two tan blocks always come after green.

The red block follows a tan.

Cooperative Pattern Cards

<p>Create a linear pattern.</p>	<p>All four terms are shaped like a diamond.</p>
<p>The third term is thinner than the others.</p>	<p>$\frac{3}{4}$ of the pattern are the same color.</p>

Menu Mania

The cafeteria began a new program where the lunch menu follows a four day rotation. On the first day they will serve chicken. The rotation is as follows: chicken, meat, pasta, pizza. The lunch menu will rotate throughout the year.

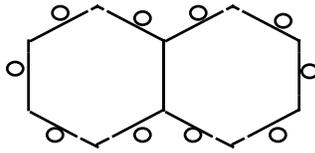
Using problem solving strategies and your knowledge of patterns, what will be served for lunch on October 20th, if pasta is served on October 1st?

October 1998

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				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

Thanksgiving Day Feast

The fifth grade will hold a Thanksgiving day feast on the Wednesday before Thanksgiving. Each class has a different assignment. Our class is in charge of the seating arrangements. Each hexagon shaped table can seat one student at each side. The tables will be joined together at the sides to form a straight line.



How many tables must be pushed together to seat a class of 25 students?
(Show all your work.)

Explain how you arrived at your answer.

Rollerblading Recess

Introduction:

As a reward for good behavior, Miss Stone allows her class to rollerblade on the court during recess every Friday afternoon. Unfortunately, not all of the students in her class earn this reward.

Task 1:

Each rollerblade has three wheels. How many wheels will be rolling on the court, if fifteen students earn recess? (Remember, each student wears two rollerblades - *one for each foot*!) Show all work in the space below.

Task 2:

Explain the relationship between the number of students and the number of wheels?

Task 2:

Explain the relationship between the number of wires and the number of objects in the circuit?

Cryptography

Directions: Use this key to decipher the coded message. Write the plain text over the ciphered message.

Cipher Text	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Plain Text	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

ZOVMQLDOXMEV FP QEB PZFBKZB LC TOFQFKD XKA OBXAFKD ZLABP.

JXQEBJXQFZFXKP ZXK RPB MXQQBOKP QL ABZFMEBO QEBPB ZLABP.

What pattern did the cryptographer use to develop the secret code?

Name _____ Date _____

Soldier's Secrets

Activity 1

Directions: Pretend you are a soldier in General Washington's army. As one of the few educated men in your unit, you are asked to work with a fellow soldier to develop a key for secret messages. You may use letters, shapes, or symbols for the cipher text of your code.

Cipher Text

Plain Text A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Activity 2

Directions: Since you did an excellent job creating a secret code, you have been selected by General Washington to spy on the British camp. After scouting the camp, you must write a note in your secret code to inform General Washington of how many soldiers are in the British camp, how many cannons they have and what would be the best way to attack the camp. Remember, you must write all numbers in word form. Write your message on lined paper.

Soldier's Secrets

Activity 3

Directions: Exchange your secret message from Activity 2 with a partner and decipher the message. If you can clearly understand the secret message, you and your partner are well on your way to becoming mathematicians specializing in Cryptography!

Activity 4

Directions: Write a letter to your teacher stating whether he or she should use the Soldier's Secret activity next year. Include what you liked most and what part of the activity should be changed to make it better.

A Soldier's Mission

Introduction:

You are a soldier in General Washington's army. In your unit there are soldiers from four different colonies: VA, MD, NY, PA. Your captain has called the troops to formation (line-up). He instructed the troops to line up according to the colony they are from. The soldiers hurry to formation which looks like this:

MD, VA, PA, NY, MD, VA, PA, NY, ...

Task 1:

General Washington chooses the 38th soldier for a secret mission. What colony is the 38th soldier from? (Show all work in the space below.)

Task 2:

Explain how you arrived at your answer in one complete paragraph, using all appropriate vocabulary. You determine your grade, so refer to the Criteria for Writing in order to write an exemplary response.

Task 3:

Pretend you, as the 38th soldier, are chosen for the mission. General Washington has given you the instruction to deliver a secret message to Captain Pierce in Boston, Massachusetts. It is 295 miles from Philadelphia to Boston. Throughout your mission you will stop to receive a new, rested, strong running horse. By switching horses you will be able to travel 70 miles a day. General Washington wants to know how many days it will take you to deliver the message to Captain Pierce. Use the space below to solve the problem.

Task 4:

Explain how you determined how many days it will take to deliver General Washington's message. Refer to the Criteria for Writing to ensure your best grade.

Rumors

Introduction:

At Powhatan Elementary School, a fifth grade student named Tyrone starts a rumor that Michael Jordan is going to visit the school on October 27th. He tells two students the rumor with the instructions not to tell anyone. (This will work, because Tyrone is the school bully.)

Task 1:

If Tyrone starts the rumor on the first day of school and tells two students every school day, how many students will know the rumor on the 20th day of school? Show all work in the space below.

Task 2:

Explain how you arrived at your answer in at least 1 paragraph. Be sure to include the strategy you used and describe the relationship between the number of school days and the number of students that heard the rumor.

Task 3:

It is now October 26th, how many students think Michael Jordan is visiting tomorrow? Show all work in the space below.

Task 4:

October 27th has arrived, but Michael Jordan has not. The principal conducted an investigation and found out that Tyrone started the rumor. What do you think should be the consequences for Tyrone's actions? Write a letter to the principal suggesting appropriate consequences for Tyrone. Be sure to use the correct friendly letter format.