Patterns and Sequences

A **SEQUENCE** is a set of numbers that follow a pattern.
Each number in the sequence is a **TERM** of the sequence.

Today we're going to look at **TWO KINDS OF SEQUENCES:**
1. **ARITHMETIC SEQUENCES**
2. **GEOMETRIC SEQUENCES**

You find a term of an **ARITHMETIC SEQUENCE** by **ADDING** a fixed number to the previous term. This fixed number is called the **COMMON DIFFERENCE.**

1 - Finding the Common Difference

Example - What is the common difference in each sequence?

a. 8, 13, 18, 23,...

b. 12, 9, 6, 3,...

You find a term of a **GEOMETRIC SEQUENCE** by **MULTIPLYING** the previous term by a fixed number called the **COMMON RATIO**.

2 - Finding the Common Ratio

Example - Find the common ratio and next three terms of each sequence. Then write a rule to describe the sequence.

a. 4, 12, 36, 108,...

b. 4, 2, 1, 0.5,...

Not every sequence is arithmetic or geometric. You can determine whether any sequence of number is arithmetic or geometric by looking for a common difference or a common ratio. For other sequences, you can look for patterns.

Tell whether each sequence is arithmetic, geometric, or neither. Then find the next three terms of each sequence.

a. 4, 6, 8, 10,...

b. 4, 6, 9, 13.5, ...

c. 4, 6, 9, 13, ...

Graphing Nonlinear Functions

In this lesson, we will learn about TWO TYPES OF NONLINEAR FUNCTIONS:

1. QUADRATIC FUNCTIONS
2. ABSOLUTE VALUE FUNCTIONS

In a QUADRATIC FUNCTION, the input variable (x) is squared. The graph of a quadratic function is a U-shaped curve called a PARABOLA. The curve may open downward or upward.

1 - Graphing a Quadratic Function

Example - For the function $y = 2x^2$, make a table with integer values of x from -2 to 2. Then graph the function.

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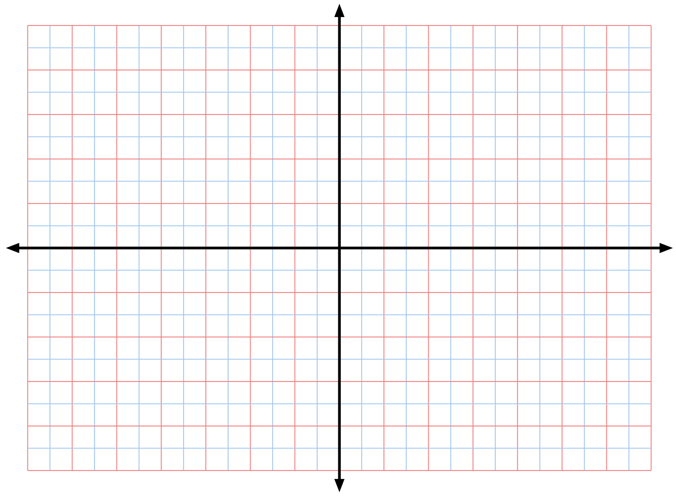

Do you remember what absolute value means?

2 - Graphing an Absolute Value Function

The equation $y = | x |$ is an ABSOLUTE VALUE FUNCTION.

Try it! Use a table to graph the function $y = | x |$.

You might have noticed the graph of $y = | x |$ is V-shaped. Why is that?

Exponential Growth & Decay

A function like $y = 2^x$ has input, or domain, values that are exponents. It models EXPONENTIAL GROWTH. Its graph curves upward as input values increase.

A function like $y = (1/2)^x$ models EXPONENTIAL DECAY. Its graph slopes downward as input values increase.

You graph exponential growth and decay functions in the same way that you graph quadratics and absolute value functions--make an x - y table.

Let's see exponential growth and decay in action--yippee! (Um, and also, that's one HUGE rabbit!!)

Polynomials

(Poly-nOme-ials, not polynolimals, polynonias, plolinolimams!)

We have already studied expressions like $x + 3$ or $17y - 2$. Some of these expressions are MONOMIALS. A MONOMIAL is a real number, a variable, or a product of real numbers and variables with whole-number exponents. In other words, MONOMIALS only have one TERM.

Examples: 3 m $5xy$ $0.35bc^3$ $\frac{w}{9}$ $\frac{1}{4}p^2q$

A POLYNOMIAL is a monomial or a sum or difference of monomials. We call the monomials that make up a polynomial its TERMS. Polynomials are named by the number of their terms.

Polynomial	Number of Terms	Examples
monomial	1	$4, 32, x, 2x^2$
binomial	2	$x - 3, 5x + 1, x^3 - x$
trinomial	3	$x^2 + x + 1, x^4 - 2x - 5$

In this section, we have two objectives:

1. Identify and name polynomials
2. Evaluate polynomials

IDENTIFYING AND NAMING POLYNOMIALS

Is the expression a monomial? Explain your answer.

$7x^2y$

$8+a$

$\frac{a}{7y}$

$\frac{5x}{4}$

Evaluating Polynomials

We've been evaluating all year. You probably (hopefully!) remember that to evaluate a problem means to replace the variables with a given value and solve. Evaluating polynomials works the same way!

Examples:

Evaluate each polynomial for $m = 8$ and $p = -3$.

a. $2mp$

b. $3m - 2p$

Evaluate each polynomial for $x = -2$ and $y = 5$.

a. $5xy$

b. $x + 3y$

c. $y^2 - 2y + x$

Adding and Subtracting Polynomials

Just like integers, polynomials can be added, subtracted, multiplied, and divided. In the next few lessons we will learn how to do that, but before we do, we need to review the concept of LIKE TERMS.

LIKE TERMS are terms with the EXACT same variable(s), raised to the EXACT same power(s). You can combine like terms by addition and subtraction, but you cannot combine unlike terms in this way. (Remember: you can always multiply and divide even if they are unlike. This rule is for adding and subtracting!)

Like Terms	Unlike Terms
$6x + -2x = 4x$	$6x + -2x^2 = 6x + -2x^2$
$11x^3y^2 - x^3y^2 = 10x^3y^2$	$-x^3y^2 + x^2y^2 = -x^3y^2 + x^2y^2$

Adding Polynomials

You add polynomials by combining their like terms. I like to add by stacking like this:

Example: Simplify $(7d^2 + 7d) + (2d^2 + 3d)$.

Now you try the following examples in your notes:

1. $(x^2 + 2x + 5) + (3x^2 + x + 12)$.
2. $(w^2 + 5w) + (2w - 6)$.

Subtracting Polynomials

Subtracting polynomials works in much the same way. You simply add the opposite of each term in the second polynomial:

Example: Simplify $(5x^2 + 10x) - (3x - 12)$.

Now try these in your notes:

1. $(3w^2 + 8 + v) - (5w^2 - 7v - 3)$
2. $(x^2 - 3x - 9) - (5x - 4 - 16x^3)$

Word Problem Applications

Write an expression for the sum of three consecutive integers. Let x be the first integer, then simplify the expression. What three consecutive integers have a sum of 108?

The perimeter of a triangle is 11y - 2. Two of the sides are represented by the expressions 3y - 1 and 3y + 1. Write an expression for the third side.

Multiplying a Polynomial by a Monomial

The trick to multiplying any size polynomial by another polynomial is making sure each term in the first polynomial is multiplied by each term in the second. In this section, we will practice with multiplying monomials and polynomials.

The steps for multiplying monomials and polynomials are simple:

1. MULTIPLY each term in the monomial with each term in the polynomial.

2. SIMPLIFY the product by combining like terms.

Here's an example:

$2a^2(2a^3 - 3a^2 + 3)$

Multiplying Binomials

Based on what we learned in the last class, how would you deal with the following problem?

$$(x + 4)(x - 3)$$

Lots of people remember the process of how to multiply two binomials by using an achronym called FOIL. FOIL stands for

First **O**uter **I**nner **L**ast

Now try some more practice problems...

$(a - 4)(a - 2)$

$(b + 1)^2$

$(2a + b)(4c - 2d)$

$(1/2x + 9)(4x + 8)$