Unit 4: Polynomials (5 Weeks)

Content Area: **Template**
Course(s):
Time Period: **Full Year**
Length: **9 Weeks**
Status: **Published**

Unit Rationale

A unit on polynomials in Algebra 1 is essential for developing a deep understanding of algebraic structures and operations, serving as a foundation for more advanced mathematical topics. Here's a rationale for including a polynomials unit in Algebra 1:

1. Foundational Algebraic Concepts

- **Understanding Algebraic Expressions:** Polynomials introduce students to a broader class of algebraic expressions, extending their knowledge beyond linear and quadratic equations. Mastery of polynomials is crucial for understanding more complex algebraic operations and relationships.
- **Operations with Polynomials:** Students learn to perform operations such as addition, subtraction, multiplication, and division with polynomials, reinforcing their skills with arithmetic operations while extending these skills to more complex expressions.

2. Critical Problem-Solving Skills

- **Factoring Techniques:** Learning to factor polynomials is a key skill in algebra, which aids in solving equations and simplifying expressions. Factoring also helps students recognize patterns and develop strategic approaches to problem-solving.
- **Connection to Previous Knowledge:** Working with polynomials requires students to apply their knowledge of exponents, distributive properties, and basic arithmetic, thereby reinforcing and expanding on concepts learned earlier in their mathematical education.

3. Real-World Applications

- **Modeling Complex Situations:** Polynomials are used to model a wide range of real-world situations, from physics and engineering problems to economics and statistics. Understanding polynomials allows students to develop mathematical models of real-world phenomena.
- **Understanding Growth Patterns:** Polynomials, particularly those of higher degrees, can describe complex growth patterns and trends. This is particularly useful in fields like biology, finance, and social sciences, where such patterns are common.

4. Preparation for Higher-Level Math

- **Foundation for Advanced Topics:** A solid understanding of polynomials is essential for success in more advanced math courses such as Algebra 2, Pre-Calculus, and Calculus. Topics like polynomial functions, roots, and the behavior of graphs build directly on the concepts learned in Algebra 1.
- **Introduction to Algebraic Structures:** Working with polynomials introduces students to more abstract algebraic structures, such as polynomial rings and fields, which are foundational concepts in higher mathematics.

5. Enhancing Mathematical Reasoning

- **Pattern Recognition:** Polynomials help students develop the ability to recognize and work with patterns, such as in the coefficients and degrees of terms. This enhances their overall mathematical reasoning and problem-solving abilities.
- **Connection Between Algebra and Geometry:** Understanding polynomials and their graphs helps students see the connection between algebraic equations and geometric shapes, such as the graphs of polynomial functions. This dual representation deepens their conceptual understanding of mathematics.

6. Engaging and Versatile Content

- **Variety of Problem Types:** Polynomials offer a rich variety of problem types, from simple operations to complex word problems and graphing exercises. This keeps students engaged and challenged, catering to different learning styles and abilities.
- **Visual Learning Opportunities:** Graphing polynomial functions provides visual learners with an opportunity to engage with abstract concepts in a concrete way, making the material more accessible and interesting.

7. Development of Abstract Thinking

- **Transition to Higher Abstractions:** Polynomials help students transition from concrete arithmetic to more abstract algebraic thinking. This is an essential step in their mathematical development, preparing them for more theoretical concepts in advanced mathematics.
- **Logical Reasoning:** Working with polynomials requires careful logical reasoning, especially when simplifying expressions, factoring, or solving polynomial equations. This skill is valuable not only in mathematics but in any field that requires analytical thinking.

8. Preparation for Standardized Testing

- **Common Topic in Exams:** Polynomials are frequently tested on standardized exams like the SAT, ACT, and state assessments. Mastery of this topic is crucial for students to perform well on these tests, as it often forms the basis of several types of questions.

By including a unit on polynomials in Algebra 1, educators equip students with essential algebraic tools that are critical for success in higher-level mathematics, real-world problem-solving, and standardized testing. This unit helps students develop a deeper understanding of algebraic structures, enhancing their overall mathematical literacy and reasoning abilities.

Pre-Assessment

- HMH- Math Language Routines Library
- "Are you ready"- at the beginning of all modules.
- Before you begin- interactive lessons

Module 15: Polynomial Multiplication

Instructional Plan

Lesson 1: Multiply Monomials

Lesson 2: Multiply Monomials, Binomials, and Trinomials

Lesson 3: Special Products of Binomials

*All resources are listed in HMH.

https://www.hmhco.com/ui/#/discover/IM_NL20_A1

Module 16: Polynomial Addition and Subtraction

Instructional Plan

Lesson 1: Add and Subtract Polynomials

Lesson 2: Model with Polynomials

*All resources are listed in HMH.

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Standards

New Jersey Student Learning Standards: Content Area

MATH.K-12.1	Make sense of problems and persevere in solving them
MATH.K-12.2	Reason abstractly and quantitatively
MATH.K-12.3	Construct viable arguments and critique the reasoning of others
MATH.K-12.4	Model with mathematics

MATH.K-12.5	Use appropriate tools strategically
MATH.K-12.6	Attend to precision
MATH.K-12.7	Look for and make use of structure
MATH.K-12.8	Look for and express regularity in repeated reasoning
MATH.9-12.A.CED.A.1	Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
MATH.9-12.A.REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
MATH.9-12.A.REI.C.6	Solve systems of linear equations algebraically (include using the elimination method) and graphically, focusing on pairs of linear equations in two variables.
MATH.9-12.A.REI.C.8	Represent a system of linear equations as a single matrix equation in a vector variable.
MATH.9-12.A.REI.D	Represent and solve equations and inequalities graphically
MATH.9-12.A.REI.D.12	Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Integration of Computer Science and Design Thinking

CS.9-10.3A-AP-14	Use lists to simplify solutions, generalizing computational problems instead of repeatedly using simple variables.

Interdisciplinary Connections: NJSLS for ELA, Social Studies, Science and/or Math

SOC.K-12.1	Developing Questions and Planning Inquiry
MATH.9-12.S.IC	Making Inferences and Justifying Conclusions
LA.L.9-10	Language

Integration of Career Readiness. Life Literacies and Key Skills

TECH.9.4.2.CI	Creativity and Innovation
TECH.9.4.2.CT	Critical Thinking and Problem-solving
	A variety of diverse sources, contexts, disciplines, and cultures provide valuable and necessary information that can be used for different purposes.
	Digital tools can be used to display data in various ways.

21st Century Life and Career

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.

CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.

Integration of Diversity, Equity and Inclusion; Climate Change; Informational and Media Literacy

Diversity, Equity, and Inclusion

NCTM: Access and Equity in Mathematics Education

A Pathway to Equitable Math Instruction

Provide students with opportunities to give feedback to teachers about the classroom and instruction.

• Verbal Example: Fist to five, How well do you understand what we talked about today? Fist to five, How well did I teach this today?

• Classroom Activity: Exit tickets or surveys that ask students to identify how well teachers taught, what helped them learn, what got in the way of their learning, etc.

Treat mathematics as a language that everyone is learning while authentically centering students home languages.

• Classroom Strategies: Color-coding ideas, learning vocabulary in student languages, visual and kinesthetic learning, representations of learning without words.

• Classroom Activity: Multilingual Frayer Models for definitions or concepts

Incorporate true culturally relevant pedagogy, practice, and curriculum.

• Verbal Example: What are some of your family traditions that you are proud of? Would you be okay if we brought some of those into the classroom?

• Classroom Activity: Use Ankara fabric to teach mathematical concepts such as tessellations, fractions, area, percentages, etc.

Incorporate the history of mathematics into lessons.
• Verbal Example: Why do you think we call it Pythagorean's theorem, when it was used before he was even born? What should we call it instead?
• Classroom Activity: Learn about different bases and numerical ideas: Base 2, binary and connections to computer programming, how the Yoruba of Nigeria used base 20, and how the Mayans conceptualized the number 0 before the first recording of it

Solicit student ways of thinking and processing.
• Verbal Example: How might you all go about this? What do you notice?
• Classroom Activity: Incorporate explorations, where students interact with mathematics in a way that allows them to "discover" or experience mathematics.

Reorganize your classroom teaching around concepts, and teach them more like a web rather than discrete sets of knowledge.
• Verbal Example: How does this connect to what you've learned in the past? How can you use that knowledge today?
• Classroom Activity: Learning webs that connect content

Start with more complex math problems and scaffold as necessary.
• Verbal Example: If we wanted to build a rocket, what are all the things we might need to know before we get started? Along the way, we decided that we want the rocket to reach the moon. What do we need to consider now?
• Classroom Activity: When solving equations, start with the most complex problem, generate ideas for how to solve it, and use the simpler equations as examples to support those ideas.

Offer a variety of ways to demonstrate thinking and knowledge.
• Verbal Example: Show your thinking with words, pictures, symbols.

Ask other questions that will demonstrate learning when it is not clear to you how students know the answer.
• Verbal Example: If you were working with a fellow mathematician who was absent this day, what might you tell them to help them learn it?

Learn about, engage with, and incorporate ethnomathematics.
• Verbal Example: Reflect on your day so far. What math have you already used today?
• Classroom Activity: Community walks to engage with slope.

Co-construct knowledge in the classroom.
• Verbal Example: Let's get into partners and do a think pair-share. We will incorporate everyone's ideas and try to synthesize them.
• Classroom Activity: Have students create mathematical definitions in their own words in groups, and bring the groups together to co-construct mathematical definitions as a class

Choose problems that have complex, competing, or multiple answers.
• Verbal Example: Come up with at least two answers that might solve this problem.

• Classroom Activity: Challenge standardized test questions by getting the “right” answer, but justify other answers by unpacking the assumptions that are made in the problem.
• Classroom Activity: Deconstructed Multiple Choice
- given a set of multiple choice answers, students discuss why these answers may have been included (can also be used to highlight common mistakes).

Identify what is right about the thinking, and highlight the mistake in what is factually or procedurally accepted.
• Verbal Example: You recognized that you had to combine the constants 27 and 9, could you explain your thinking?
• Classroom Activity: Error Analysis worksheets that highlight what is the right idea behind the mistake.

Using thoughtful questioning to solicit mathematical thoughts rather than telling.

• Verbal Example: What would a mathematician who is confused ask about this question?

• Classroom Activity: After students demonstrate knowledge of a topic, have them play a game where they have to explain their topic to a fellow mathematician and a skeptic. Develop their own reflective questioning/explaining in all three roles.

Create multiple ways of participating that honor myriad ways of thinking and being.
• Verbal Example: For this section, feel free to work alone, in pairs, trios, or quads (let them choose).
• Classroom Activity: Community circles or storytelling circles, incorporating dance, music, song, call and response, and other cultural ways of communicating.

Climate Change

Math Climate Change Companion Guide

• S.ID.B.6a Fit a function to the data (including with the use of technology); use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.
Climate Change Example: Students may use linear or exponential functions fitted to geoscience data to solve problems and analyze the results from global climate models to make an evidence-based forecast of the current rate of global climate change.

• F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
Climate Change Example: Students may use function notation to determine the amount of carbon dioxide produced by burning a given number of molecules of ethane (gasoline), m, where c(m) is the number of molecules of carbon dioxide.
• F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.
Climate Change Example: Students may relate the domain of a function c(m) representing the amount of

carbon dioxide produced by burning m molecules of ethane (gasoline), to its graph in order to determine the appropriate domain for c(m).
• F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
Climate Change Example: Students may calculate the average rate of change of a function c(m) presented symbolically or as a table, where c(m) represents the amount of carbon dioxide produced by burning a given number of molecules of ethane (gasoline).

• A.CED.A.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
Climate Change Example: Students may create equations and/or inequalities to represent the economic impact of climate change.
• A.CED.A.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.
Climate Change Example: Students may represent constraints describing the economic impact of climate change by equations, inequalities, and/or by systems of inequalities, and interpret solutions as viable or nonviable options.
• A.CED.A.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law to highlight resistance R.
Climate Change Example: Students may rearrange formulas related to the economic impact of climate change to highlight a quantity of interest, using the same reasoning as in solving equations.

• N.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
Climate Change Example: Students may use units to guide the solution of multi-step problems about how variations in the flow of energy into and out of the Earth’s systems result in climate change. Note: Changes in climate are limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.
• N.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling.
Climate Change Example: Students may define appropriate quantities for a descriptive model of how variations in the flow of energy into and out of Earth’s systems result in climate change. Note: changes in climate are limited to changes in surface temperatures, precipitation patterns, glacial ice volumes, sea levels, and biosphere distribution.