



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21-century GLOBAL SKILLS

Springfield Public Schools
Springfield, New Jersey 07081

Algebra II Honors

Curriculum Guide

2024

This curriculum may be modified through varying materials, techniques, and strategies as per an individual student's IEP.

*Springfield Board of Education
Approved August 26, 2024*



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21-century GLOBAL SKILLS

Springfield Public Schools Springfield, New Jersey

**Dr. Rachel Goldberg
Superintendent of Schools**

**Erica Scudero
Asst. Superintendent of Curriculum and Instruction**

Curriculum Developed By:

Dr. Norman Francis ~ Principal of Jonathan Dayton High School

Gregory Salmon ~ Math and Science Supervisor

Wendy Garrod ~ Math Teacher



Unit Overview Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Equations, Inequalities & Functions

Unit Summary: This unit will deal with equations and inequalities and their importance to the foundation of mathematical understanding. Students will work with linear equations and functions, and understand their importance in representing and interpreting data.

Primary Interdisciplinary Connections: *Science and Engineering*

21-century Themes ☐ Creativity and Innovation ☒ Critical Thinking and problem-solving ☐ ICT Literacy
☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: The ability to model and solve numeric and algebraic expressions and to solve equations or inequalities is essential to a further understanding of Algebra. The ability to create and visually represent linear functions is also important in presenting and understanding data trends and results.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Learning Targets

Standards: A.CED; A.REI; F.IF; F.BF

Content Statements: Create equations that describe numbers or relationships; Understand solving equations as a process of reasoning and explain the reasoning; Solve equations and inequalities in one variable; Understand the concept of a function and use function notation; Interpret functions that arise in applications in terms of the context; Analyze functions using different representations; Interpret the structure of expressions; Build new functions from existing functions



CPI#:	Cumulative Progress Indicator (CPI):
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.
A.CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
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.
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 $V = IR$ to highlight resistance R .
A.REI.A.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
A.REI.A.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
A.REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
A.SSE.A.2	Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.
F.IF.A.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.
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.
F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
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.
F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step



	functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. (+) Graph exponential and logarithmic functions, showing intercepts and end behavior.
F.IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
F.BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
F.BF.B.4a	Find inverse functions. a. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Unit Essential Questions:

- What is the best problem-solving approach to take?
- When is simplification helpful? When is simplification not helpful?
- What can we understand by reading a graph?
- How can a correlation be determined?

Unit Enduring Understandings:

- Algebra allows the expression and communication of ideas.
- The rules of Algebra ensure a common basis for understanding mathematics.

Unit Learning Targets:

Students will....

- Students will be able to analyze and evaluate a variety of simple algebraic expressions.
- Students will be able to model real life applications using algebraic expressions.
- Students will be able to analyze and evaluate a variety of simple algebraic expressions.
- Students will be able to model real life applications using algebraic expressions.
- Climate Change Example: Students may create equations and/or inequalities to represent the economic impact of climate change.



- 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.
- 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.
- 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.
- 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).



Evidence of Learning

Summative Assessment: Tests

Equipment Needed: Calculator, chapter quizzes & tests

Teacher Resources: Textbook

Formative Assessments:

- Entrance/Exit tickets
- Guided Practice Exercises
- Khan Academy activities
- Homework checks
- Notebook checks



Lesson Plans

Lesson	Time Frame
Lesson 1 Linear Equations	1 day
Lesson 2 Quick Graphs of Linear Equations	1 day
Lesson 3 Graphing Piecewise Functions	1 day

Teacher Notes:

Frequently break students into small groups to work on problem solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Linear Equations Time Frame: 1 day

Lesson Components

21-century Themes

- ☐ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Write, solve, and graph linear equations. • Model real life situations using linear equations . • Use technology to investigate graphs.	Lesson Sequence • Homework review/check. • Mini-lesson opener and daily quiz. • Work through examples of linear graphs. • Closure activity on linear graphs.	• Homework check • Khan Academy Activity • Lesson opener or daily quiz • Guided practice exercises • Closure activity
Differentiation: Guided practice: different levels of difficulty when graphing and solving equations		
Resources Provided: • Graphing Calculator		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Quick Graphs of Linear Functions Time Frame: 1 day

Lesson Components

21-century Themes

- ☐ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Use the slope-intercept form of a linear equation to graph an equation. • Use the standard form of a linear equation to graph an equation.	Lesson Sequence • Homework review/check • Lesson opener and daily quiz. • Discuss the different ways to graph linear equations based on the form of the given equation. • Guided practice. • Closure activity.	• Homework check • Lesson opener or daily quiz • Khan Academy activity • Guided practice exercises • Closure activity
Differentiation: Check answers on graphing calculator and/or Desmos		
Resources Provided: Graphing Calculator		



Lesson Plan 3 Template

Content Area: Math Lesson Title: Graphing Piecewise Functions Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Represent piecewise functions. - Use piecewise functions to model real life quantities, such as the amount you earn at a summer job.	Lesson Sequence - Homework review/check - Lesson opener: graph the set of data. What do you notice about the graph? - Define a piecewise graph using a function with domain restrictions. - Guided practice. - Closure activity.	- Guided practice - Closure activity - Khan Academy activity
Differentiation: Difficulty of functions: step functions; piecewise with 3 pieces vs 2 pieces		
Resources Provided: Graphing Calculator		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher order thinking and problem-solving skills	☐	☒	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21-century skills	☐	☒	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☒	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☐	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Equations, Inequalities & Functions
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math	Grade Level: 9-11	Unit Title: Linear Equations and Functions
Unit Summary: This unit will have students analyze systems of equations and inequalities, and their importance in modeling and understanding real applications of mathematics.		
Primary Interdisciplinary Connections: <i>Science and Engineering</i>		
21-century Themes ☑ Creativity and Innovation ☑ Critical Thinking and problem-solving ☑ ICT Literacy ☑ Information Literacy ☑ Life and Career Skills ☐ Communication and Collaboration ☑ Media Literacy		
Unit Rationale: The ability to create and visually represent linear functions are important in presenting and understanding data trends and results.		
Career Readiness (Standard 9): 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills. 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas. 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8). 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1). 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice. 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6). 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).		

Learning Targets

Standards: F.IF; N.Q; A.REI	
Content Statements: Understand the concept of a function and use function notation; Interpret functions that arise in applications in terms of the context; Analyze functions using different representations; Reason quantitatively and use units to solve problems; Solve systems of equations.	
CPI#:	Cumulative Progress Indicator (CPI):
N.Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
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.



F.IF.A.1	Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.
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.
F.IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.
F.IF.B.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.
F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Unit Essential Questions: • What can we understand by reading a graph? • How can a correlation be determined?	
Unit Enduring Understandings: • Algebra allows the expression and communication of ideas. • The rules of algebra ensure a common basis for understanding mathematics.	



Unit Learning Targets:

- Students will be able to analyze and evaluate a variety of simple algebraic expressions.
- Students will be able to model real life applications using algebraic expressions.
- 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.
- 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.



Evidence of Learning

Summative Assessment: Chapter Test (with differentiated levels)

Equipment Needed: Graphing calculator

Teacher Resources: Textbook

Formative Assessments:

- Homework check
- Lesson opener or daily quiz
- Khan Academy Activities
- Guided practice exercises
- Closure activity



Lesson Plans

Lesson	Time Frame
Lesson 1 Graph and Solve Linear Equations in Two Variables	1 day
Lesson 2 Algebraic Methods and Linear Systems	1 day
Lesson 3 Graphing and Using Systems of Linear Inequalities	1 day

Teacher Notes:

Frequently break students into small groups to work on problem-solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Graph and Solve Linear Equations in Two Variable

Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Graph equations in two variables. - Solve equations in two variables.	Lesson Sequence - Homework check/review. - Lesson opener or daily quiz. - Define input and output variables (independent and dependent). - Decide what form of a line to rewrite equations in. - Have students describe the shape of the graph prior to drawing the graph. - Guided practice exercises - Closure activity	- Homework review - Lesson opener or daily quiz - Khan Academy activity - Guided practice exercises - Closure activity
Differentiation: Audio and visual instruction		
Resources Provided: - Problem Set - Demo using emulation software		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Algebraic Methods and Linear Systems Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Use algebraic methods to solve linear systems. • Use linear systems to model real-life situations.	Lesson Sequence • Homework check/review. • Lesson opener or daily quiz. • Take a linear system of equations and work through the different solution types: 1 solution, no solution, and infinite solutions. • Take two linear equations and lead a discussion on transferring them into a matrix. • Guided practice exercises. • Closure activity.	• Homework review • Lesson opener or daily quiz • Khan Academy activity • Guided practice exercises • Closure activity
Differentiation: Slope triangle, real life rates of change		
Resources Provided: • Textbook • Graph paper		



Lesson Plan 3 Template

Content Area: Math Lesson Title: Graphing and Using Systems of Linear Inequalities
Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Graph a system of linear inequalities to find a solution to the system - Use a system of linear inequalities to model real-life situations	Lesson Sequence - Homework check/review - Lesson opener or daily quiz - Take a linear system of inequalities and work through the different solution types. Draw each solution type on a graph. - Guided practice exercises. - Closure activity.	- Homework review - Lesson opener or daily quiz - Guided practice exercises - Closure activity - Khan Academy activity
Differentiation: Audio and visual instruction		
Resources Provided: - Graphing calculators - Problem Set		

Lesson Reflection



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Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher-order thinking and problem-solving skills	☐	☒	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21st-century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity, and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with the teacher acting as a facilitator and co-learner during the teaching and learning process	☐	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☐	☒	☐
Provide opportunities for student reflection and self-assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Linear Equations and Functions

Created: 2024

Board Approved on:



Unit Overview Template

Content Area: Math	Grade Level: 9-11	Unit Title: Matrices and Determinants
Unit Summary: This unit will focus on matrices and determinants, and their importance in gathering and analyzing data.		
Primary Interdisciplinary Connections: <i>Science and Engineering</i>		
21-century Themes ☒ Creativity and Innovation ☒ Critical Thinking and problem-solving ☒ ICT Literacy ☒ Information Literacy ☒ Life and Career Skills ☐ Communication and Collaboration ☒ Media Literacy		
Unit Rationale: The ability to create and visually represent data in tabular form has applications in science and engineering.		
Career Readiness (Standard 9): 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills. 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas. 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8). 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1). 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice. 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6). 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).		

Learning Targets

Standards: N.VM	
Content Statements: Perform operations on matrices and use matrices in applications.	
CPI#:	Cumulative Progress Indicator (CPI):
N.VM.C.6	Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
N.VM.C.7	Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.
N.VM.C.8	Add, subtract, and multiply matrices of appropriate dimensions.
N.VM.C.9	Understand that, unlike multiplication of numbers, matrix multiplication for



	square matrices is not a commutative operation but still satisfies the associative and distributive properties.
N.VM.C.10	Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
N.VM.C.11	Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.
N.VM.C.12	Work with 2×2 matrices as a transformation of the plane, and interpret the absolute value of the determinant in terms of area.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Unit Essential Questions: • How are matrices used in real life? • How can Algebra be used to find solve problems using matrices?	
Unit Enduring Understandings: • Algebra allows the expression and communication of ideas. • The rules of algebra ensure a common basis for understanding mathematics.	
Unit Learning Targets: • Students will be able to analyze and evaluate a variety of simple algebraic expressions. • Students will be able to model real life applications using algebraic expressions.	



Evidence of Learning

Summative Assessment: Chapter Test (with differentiated levels)

Equipment Needed: Graphing calculator

Teacher Resources: Textbook

Formative Assessments:

- Homework check
- Lesson opener or daily quiz
- Khan Academy Activities
- Guided practice exercises
- Closure activity



Lesson Plans

Lesson	Time Frame
Lesson 1 Matrix Operations	1 day
Lesson 2 Matrix Multiplication	1 day
Lesson 3 Determinants and Cramer's Rule	1 day

Teacher Notes:

Frequently break students into small groups to work on problem solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Matrix Operations Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Add and subtract matrices • Multiply a matrix by a scalar • Solve matrix equations • Use matrices in real life situations	Lesson Sequence • Addition and subtraction of matrices • Scalar multiplication of matrices • Use matrices to create models of real-life situations, and solve problems using matrix operations	• Homework review • Lesson opener or daily quiz • Guided practice exercises • Closure activity • Khan Academy
Differentiation: Audio and visual instruction		
Resources Provided: • Problem Set • Demo using emulation software		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Matrix Multiplication Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Multiply two matrices • Use matrix multiplication to solve real life situations	Lesson Sequence • Homework check / review • Lesson opener or daily quiz • Multiply a matrix using a scalar. • Show how to multiply two matrices properly. • Discuss the meaning of when matrices are multiplied (e.g. scaling on computer screens). • Guided practice exercises. • Closure activity.	• Homework review • Lesson opener or daily quiz • Guided practice exercises • Khan Academy activity • Closure activity
Differentiation: Audio and visual instruction		
Resources Provided: Graphing calculators and the problem set		



Lesson Plan 3 Template		
Content Area: Math	Lesson Title: Determinants and Cramer's Rule	Time Frame: 1 day
Lesson Components		
<u>21-century Themes</u>		
☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy ☐ Civic Literacy ☐ Health Literacy		
<u>21-century Skills</u>		
☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy		
Interdisciplinary Connections: Science and Engineering		
Integration of Technology: Graphing calculators, Desmos, Khan Academy		
Equipment Needed: Graphing calculators, Mimio Software		

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Find determinants • Use determinants • Use Cramer's Rule	Lesson Sequence • Homework check/review • Lesson opener or daily quiz • Discuss how to determine if a matrix has a determinant. • Find the determinant of different matrices. • Discuss the applications of the determinant (e.g. eigenvalues). • Guided practice exercises. • Closure activity.	• Homework review • Lesson opener or daily quiz • Guided practice exercises • Khan Academy activity • Closure activity
Differentiation: Audio and visual instruction		
Resources Provided: • Graphing calculators		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher order thinking and problem-solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21-century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Matrices and Determinants
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Polynomials and Polynomial Functions

Unit Summary: Students will use properties of exponents and scientific notation to simplify algebraic expressions and to model real-life problems. They will use synthetic substitution to evaluate polynomial expressions and to model real-life problems. They will also graph polynomial functions and investigate their end behavior. They will add, subtract, multiply and divide polynomial functions and will use factoring, synthetic division, and the rational zero theorem to find zeros of polynomial functions. Students will see how the Fundamental Theorem of Algebra can be used to determine the number of solutions of a polynomial equation and will use graphing calculators to approximate the real zeros of a polynomial function. They will use zeros to write polynomial functions and they will use x-intercepts and turning points to graph polynomial functions. Finally, students will use finite differences to determine the degree of a polynomial that will fit a set of data. Throughout the unit, students will apply the skills they have learned to solve real-life problems.

Primary Interdisciplinary Connections: *Science and Engineering*

21-century Themes ☐ Creativity and Innovation ☒ Critical Thinking and problem-solving ☐ ICT Literacy
☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Polynomials are fundamental in applying to science and engineering.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Learning Targets

Standards: A.SSE; A.APR; A.REI; F.IF; F.BF

Content Statements: Write expressions in equivalent forms to solve problems; Perform arithmetic operations on polynomials; Understand the relationship between zeros and factors of polynomials;



Use polynomial identities to solve problems; Solve equations and inequalities in one variable; Analyze functions using different representations; Build new functions from existing functions.

CPI#:	Cumulative Progress Indicator (CPI):
A.SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. c. Use the properties of exponents to transform expressions for exponential functions. For example the expression $1.15t$ can be rewritten as $(1.151/12)12t \approx 1.01212t$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.
A.APR.A.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
A.APR.B.2	Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
A.APR.B.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
A.APR.C.4	(+) Prove polynomial identities and use them to describe numerical relationships. For example, the difference of two squares; the sum and difference of two cubes; the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.
A.APR.C.5	Know and apply the Binomial Theorem for the expansion of $(x + y)^n$ in powers of x and y for a positive integer n , where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.
A.REI.B.4	Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b .
F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.



	d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
F.IF.C.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.
F.BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
Unit Essential Questions: • How can we perform operations on polynomials and solve polynomial equations? • How can we evaluate, graph, and find zeros of polynomial functions?	
Unit Enduring Understandings: • Perform operations, add, subtract, multiply, and divide, on polynomial equations • Evaluate, graph and find zeros of polynomial functions	
Unit Learning Targets: <i>Students will....</i> • Use properties of exponents to evaluate and simplify expressions involving powers. • Use exponents and scientific notation to solve real-life problems. • Evaluate a polynomial function. • Graph a polynomial function. • Add, subtract and multiply polynomials. • Use polynomial operations and functions in real life problems. • Factor polynomial expressions. • Use factoring to solve polynomial equations. • Divide polynomials and relate the result to the Remainder Theorem and the Factor Theorem. • Find the rational zeros of a polynomial function.	



Evidence of Learning

Summative Assessment: Unit Test

Equipment Needed: Textbook, Graphing Tools, Graphing Calculators

Teacher Resources: Textbook

Formative Assessments:

- Entrance/Exit tickets
- Math Journals
- Khan Academy Activities
- Homework checks
- Notebook quiz



Lesson Plans

Lesson	Time Frame
Lesson 1 Graph a Polynomial Function	1 day
Lesson 2 Factor Polynomial Expressions	1 day
Lesson 3 Divide Polynomials	1 day

Teacher Notes:

Frequently break students into small groups to work on problem solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Graph a Polynomial Function Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Solve quadratic equations. - Manipulate complex numbers.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Discuss the shapes of quadratic equations. - Find zeros to graph. - Discuss what an imaginary zero does to the shape of a graph. - Guided practice. - Closure activity.	- Homework check - Lesson opener or daily quiz - Khan Academy activity - Guided practice exercises - Closure activity
Differentiation: Polynomials with several factors vs polynomials with less factors.		
Resources Provided: - Textbook - Graph paper		



Lesson Plan 2 Template		
Content Area: Math	Lesson Title: Factor Polynomial Expressions	Time Frame: 1 day
Lesson Components		
<u>21-century Themes</u>		
☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy ☐ Civic Literacy ☐ Health Literacy		
<u>21-century Skills</u>		
☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy		
Interdisciplinary Connections: Science and Engineering		
Integration of Technology: Graphing calculators, Desmos, Khan Academy		
Equipment Needed: Graphing calculators, Mimio Software		

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Factor polynomial expressions. - Discuss how the graph of the function compares to the factored form.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz - Factor simple polynomials. - Extend to more complicated polynomials. - Discuss patterns and look for generalizations. - Guided practice. - Closure activity.	- Homework check - Lesson Opener or daily quiz - Khan Academy activity - Guided practice exercises - Closure activity
Differentiation: Longer expression vs shorter expressions.		
Resources Provided: Textbook		



Lesson Plan 3 Template

Content Area: Math Lesson Title: Divide Polynomials Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Divide polynomials.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Factor a polynomial to warm up. - Use the factorization to set up a polynomial division. - Simultaneously solve a long division of integers and polynomials to illustrate the steps. - Guided practice. - Closure activity.	- Homework check - Lesson opener or daily quiz - Khan academy activity - Guided practice - Closure activity
Differentiation: Dividends that are missing terms vs ones whose exponents decrease consecutively		
Resources Provided: Textbook		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher-order thinking and problem-solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21-century skills	☐	☒	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☐	☒	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☐	☒	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☐	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self-assessment	☐	☒	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Polynomials and Polynomial Functions
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Powers, Roots, and Radicals

Unit Summary: Students will learn how to evaluate n th roots of real numbers using both radical and exponential notation. They will use properties of rational exponents to evaluate and simplify expressions, and they will evaluate power functions and perform arithmetic operations with functions as well as composition of functions. They will find inverses of functions, and they will graph square root and cube root functions. Students will solve equations that have radicals or rational exponents. They will use roots, rational exponents, power functions, function operations, and radical equations to solve real-life problems. Students will also learn to use measures of central tendency and dispersion to describe a data set and will use box-and-whisker plots and histograms to represent data.

Primary Interdisciplinary Connections: *Science and Engineering*

21-century Themes ☐ Creativity and Innovation ☒ Critical Thinking and problem-solving ☒ ICT Literacy
☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Powers, roots, and radicals are fundamental in science and engineering.

Career Readiness (Standard 9):

9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.

9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Learning Targets

Standards: N.RN; N.CN; F.IF; F.BF; S.ID

Content Statements: Extend the properties of exponents to rational exponents; Perform arithmetic operations with complex numbers; Represent complex numbers and their operations on the complex plane; Analyze functions using different representations; Build new functions from existing functions; Summarize, represent, and interpret data on a single count or measurement variable; Use complex numbers in polynomial identities and equations.



CPI#:	Cumulative Progress Indicator (CPI):
N.RN.A.1	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.
N.RN.A.2	Rewrite expressions involving radicals and rational exponents using the properties of exponents.
N.CN.A.1	Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
N.CN.A.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
N.CN.A.3	(+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.
N.CN.B.4	(+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.
N.CN.B.5	(+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, $(-1 + \sqrt{3}i)^3 = 8$ because $(-1 + \sqrt{3}i)$ has modulus 2 and argument 120° .
N.CN.C.7	Solve quadratic equations with real coefficients that have complex solutions.
F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
F.BF.B.4	Find inverse functions. a. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$. b. (+) Verify by composition that one function is the inverse of another. c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. d. (+) Produce an invertible function from a non-invertible function by restricting the domain.
F.BF.B.5	(+) Use the inverse relationship between exponents and logarithms to solve problems involving logarithms and exponents.
S.ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).



SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Unit Essential Questions:

- How can we use rational exponents and n th roots of numbers?
- How can we perform operations with and find inverses of functions?
- How can we graph radical functions and solve radical equations?

Unit Enduring Understandings:

- Rational exponents can be written as n th roots
- N th roots can be written as rational exponents
- There is a relationship between the graph a function and its inverse

Unit Learning Targets:

Students will....

- Evaluate n th roots of real numbers using both radical notation and rational exponential notation.
- Use n th roots to solve real-life problems.
- Use properties of rational exponents to evaluate and simplify expressions.
- Use properties of rational exponents to solve real-life problems.
- Perform operations with functions including power functions.
- Use power functions and function operations to solve real-life problems.
- Find inverse of linear functions.
- Find inverse of nonlinear functions.
- Graph square root and cube root functions
- Use square root and cube root functions to find real-life quantities
- Solve equations that contain radicals or rational exponents
- Use radical equations to solve real-life problems
- Use measures of central tendency and measures of dispersion to describe data sets
- Use box and whisker plots and histograms to represent data graphically
- Climate Change Example: Students may represent geoscience data, with plots on the real number line, as they analyze results from global climate models.



Evidence of Learning

Summative Assessment: Test

Equipment Needed: Textbook, Graphing Tools, Graphing Calculators

Teacher Resources: Textbook

Formative Assessments:

- Quizzes
- Chapter Test
- Khan Academy Activities
- Project



Lesson Plans

Lesson	Time Frame
Lesson 1 Inverse of Linear Functions	1 day
Lesson 2 Graph Square Root and Cube Root Functions	1 day
Lesson 3 Use Box and Whisker Plots and Histograms to Represent Data Graphically	1 day

Teacher Notes:

Frequently break students into small groups to work on problem solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

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www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Inverse of Linear Functions Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Find inverse of linear functions. - Investigate graphs of inverses. - Manipulate complex numbers.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Discuss the meaning of an inverse function. - Solve a function for its inverse. - Check to make sure the inverse function is actually an inverse function. - Guided practice. - Closure activity	- Homework check - Lesson opener or daily quiz - Khan Academy activity - Guided practice exercises - Closure activity
Differentiation: Equations with several operations vs equations with minimal operations		
Resources Provided: - Textbook and graph paper - Practice problem set		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Graph Square Root and Cube Root Functions Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Graph square root functions. - Graph cube root functions.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Discuss how the square root and square operations are inverses. - Graph the square root and a parabola to compare. - Graph a third-degree polynomial and a cube root to compare. - Guided practice. - Closure activity.	- Homework check - Lesson opener or daily quiz - Khan Academy activity - guided practice exercises - Closure activity
Differentiation: Graphing by hand and graphing using Graphing Calculator technology and/or Desmos		
Resources Provided: - Textbook - Graph paper		



Lesson Plan 3 Template		
Content Area: Math	Lesson Title: Box and Whisker Plots	Time Frame: 1 day
Lesson Components		
<u>21-century Themes</u> ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy ☐ Civic Literacy ☐ Health Literacy		
<u>21-century Skills</u> ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy		
Interdisciplinary Connections: Science and Engineering		
Integration of Technology: Graphing calculators, Desmos, Khan Academy		
Equipment Needed: Graphing calculators, Mimio Software		

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Create box and whisker plots. • Read box and whisker plots.	Lesson Sequence • Homework review/check. • Lesson opener or daily quiz. • Create box and whisker plots based on a data set. • Give a sample box and whisker plots to analyze. • Guided practice. • Closure activity.	• Homework check • Lesson opener or daily quiz • Khan Academy activity • Guided practice • Closure activity
Differentiation: Different sets of data. Some with more numbers, some with larger numbers, some with more difficult values, i.e. decimals.		
Resources Provided: • Textbook		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher-order thinking and problem-solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st-century skills	☐	☒	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☐	☒	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☐	☒	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☐	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self-assessment	☐	☒	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Powers, Roots, and Radicals
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Exponential and Logarithmic Functions

Unit Summary: Students will graph general exponential functions; identify and graph exponential growth and exponential decay functions; and use them to model real life situations such as compounding interest and depreciating the value of goods. Students will be introduced to the natural base e , and will simplify and evaluate expressions involving e . They will graph natural base functions, including those that model real-life situations. Students will learn the definition of logarithm to the base b , which they will use to evaluate logarithmic expressions and functions, including those involving common logarithms and natural logarithms. They will examine the inverse relationship between logarithmic and exponential functions, and will graph logarithmic functions, which they will use to solve problems. Students will use the change of base formula and properties of logarithms to expand and condense logarithmic functions. They will solve exponential and logarithmic equations. Students will write exponential and power functions, using exponential and power regression to model real-life problems. Finally, students will evaluate and graph logistic functions, solve logistic equations, and use logistic growth functions to model real-life problems.

Primary Interdisciplinary Connections: *Science and Engineering*

21-century Themes ☒ Creativity and Innovation ☒ Critical Thinking and problem-solving ☐ ICT Literacy
☐ Information Literacy ☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Exponential and logarithmic functions are fundamental in science and engineering.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Learning Targets

Standards: F.LE



Content Statements: Construct and compare linear and exponential models and solve problems; Interpret expressions for functions in terms of the situation they model.

CPI#:	Cumulative Progress Indicator (CPI):
F.LE.A.1	Distinguish between situations that can be modeled with linear functions and with exponential functions. a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
F.LE.A.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
F.LE.A.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
F.LE.A.4	Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to $abct = d$ where a , c , and d are numbers and the base b is 2, 10, or e ; evaluate the logarithm using technology.
F.LE.B.5	Interpret the parameters in a linear or exponential function in terms of a context.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Unit Essential Questions:

- How can we graph and use exponential, logarithmic, and logistic growth?
- How can we use the number e , and the definition and properties of logarithms?
- How can we solve exponential and logarithmic equations?

Unit Enduring Understandings:

- Rewriting logarithms and exponents
- Graphing growth and decay models

Unit Learning Targets:

Students will....

- Graph exponential growth functions.
- Use exponential growth functions to model real-life situations.
- Graph exponential decay functions.



- Use exponential decay functions to model real-life situations.
- Use the number e as the base of exponential functions.
- Use the natural base e in real-life situations.
- Evaluate logarithmic functions.
- Graph logarithmic functions.
- Use properties of logarithms.
- Use properties of logarithms to solve real-life problems.
- Solve exponential equations.
- Solve logarithmic equations.
- Model data with exponential functions.
- Model data with power functions.
- Evaluate and graph logistic growth functions.
- Use logistic growth functions to model real-life quantities.



Evidence of Learning

Summative Assessment: Test

Equipment Needed: Textbook, Graphing Tools, Graphing Calculators

Teacher Resources: Textbook

Formative Assessments:

- Quizzes
- Chapter Test
- Khan Academy Activities
- Project



Lesson Plans

Lesson	Time Frame
Lesson 1 Graph Exponential growth functions	1 day
Lesson 2 Evaluate Logarithmic Functions	1 day
Lesson 3 Graph Exponential Equations	1 day

Teacher Notes:

Frequently break students into small groups to work on problem-solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Graph Exponential Growth Functions Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☐ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Recognize exponential growth functions. - Graph exponential growth functions.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Discuss the shape of the graph of exponential functions. - Use a data chart to identify if you have an exponential function. - Graph a variety of exponential functions. - Guided practice - Closure activity	- Homework check - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Equations with several operations vs equations with minimal operations.		
Resources Provided: - Textbook - Graph paper		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Evaluate Logarithmic Functions Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Evaluate logarithmic functions.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Relate the exponential function to the logarithmic function. - Work on solving problems, including problems that require exponentiating both sides of the equation. - Guided practice - Closure activity	- Homework check - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Use of the graphing calculator.		
Resources Provided: - Textbook - Google Slides		



Lesson Plan 3 Template		
Content Area: Math	Lesson Title: Graph Logarithmic Equations	Time Frame: 1 day
Lesson Components		
<u>21-century Themes</u>		
☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy ☐ Civic Literacy ☐ Health Literacy		
<u>21-century Skills</u>		
☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy ☐ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy		
Interdisciplinary Connections: Science and Engineering		
Integration of Technology: Graphing calculators, Desmos, Khan Academy		
Equipment Needed: Graphing calculators, Mimio Software		

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Graph logarithmic equations.	Lesson Sequence - Homework review/check - Lesson opener or daily quiz - Relate the exponential functions to logarithmic functions and how they are inverses. - Graph a logarithmic function and an exponential function on the same graph. - Guided practice - Closure activity	- Homework check - Lesson opener or daily quiz - Guided practice - Closure activity
Differentiation: Use of the graphing calculator.		
Resources Provided: - Textbook - Graph paper		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher order thinking and problem-solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21-century skills	☐	☒	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☐	☒	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☐	☒	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☐	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☐	☒	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☐	☒	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Exponential and Logarithmic Functions
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Rational Equations and Functions

Unit Summary: The goal of this unit includes writing and using inverse variation and joint variation models in real-life problems. Students will graph rational functions, simplify complex fractions and rational expressions, and solve equations that contain rational expressions. They will use rational expressions and equations in real-life problems. In the project, students will graph data from an experiment, fit a model to the data, and compare the model to other models they have learned so far.

Primary Interdisciplinary Connections: *Science and Engineering*

21-century Themes ☒ Creativity and Innovation ☒ Critical Thinking and problem-solving ☒ ICT Literacy
☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: The ability to create, solve, and visually represent data involving rational equations and functions.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12.prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Learning Targets

Standards: A.APR; A.CED; A.REI; F.IF; F.TF

Content Statements: Rewrite rational expressions; Create equations that describe numbers or relationships; Represent and solve equations and inequalities graphically; Analyze functions using different representations; Extend the domain of trigonometric functions using the unit circle; Model periodic phenomena with trigonometric functions; Prove and apply trigonometric identities.

CPI#:	Cumulative Progress Indicator (CPI):
A.APR.D.6	Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form



	$q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
A.APR.D.7	(+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
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.
A.REI.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
A.REI.D.11	Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
F.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
F.TF.A.1	(+) Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
F.TF.A.2	(+) Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
F.TF.B.5	(+) Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
F.TF.C.8	(+) Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.



HS-ETS1-2

Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Unit Essential Questions:

- How can we simplify and perform operations with rational expressions?
- How can we graph rational functions and solve rational equations?
- How can we use variation models and rational models in real-life situations?

Unit Enduring Understandings:

- We can simplify operations with rational expressions using properties of polynomials learned in previous chapters.
- We can graph rational functions and solve rational equations using the properties of graphs of rational functions.
- We will use variation models in real-life situations by connecting our findings to experiences that occur in the world on a daily basis.

Unit Learning Targets:

Students will....

- Write and use inverse and joint variation models
- Graph simple rational functions
- Use the graph of a rational function to solve real-life problems
- Graph general rational functions
- Multiply and divide rational expressions
- Add and subtract rational expressions
- Simplify complex fractions
- Solve rational equations
- Use rational equations to solve real-life problems
- Climate Change Example: Students may create equations and/or inequalities to represent the economic impact of climate change.



Evidence of Learning

Summative Assessment: Chapter Test (with differentiated levels)

Equipment Needed: Textbook, Projector, Graphing Tools, Graphing Calculators

Teacher Resources: Textbook

Formative Assessments:

- Quizzes
- Chapter test
- Project
- Homework Assignment
- Exit cards



Lesson Plans

Lesson	Time Frame
Lesson 1 Graphing General Rational Functions	1 day
Lesson 2 Multiplying and Dividing Rational Expressions	2 days
Lesson 3 Solving Rational Equations	2 days

Teacher Notes:

Frequently break students into small groups to work on problem solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Graphing Rational Functions Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Examine the characteristics of graphs of rational functions. - Graph different types of rational functions.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Investigate the shape of the rational function graph by plotting points from a chart. - Investigate different rational functions and make generalizations about different parts of the function (e.g. the denominator's zeros). - Guided practice. - Closure activity.	- Homework review - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Scaffolded guided practice.		
Resources Provided: Problem Set, Textbook		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Multiplying and Dividing Rational Expressions Time Frame: 2 days

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Multiple and divide rational expressions. - Use rational expressions to model real-life quantities, such as the heat generated by a runner.	Lesson Sequence - Homework check/review. - Lesson opener or daily quiz. - Review multiplying two fractions. Review dividing fractions. - Work out examples of multiplying and dividing rational expressions. Ensure students can reduce to the lowest terms by factoring. - Guided practice exercises. - Closure activity. - Repeat above for day 2.	- Homework review - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Long division vs synthetic division		
Resources Provided: - Textbook - Problem Set		



Lesson Plan 3 Template

Content Area: Math Lesson Title: Solving Rational Equations Time Frame: 2 days

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Solve rational equations. - Use rational equations to solve real-life problems, such as finding how to dilute an acid solution.	Lesson Sequence - Homework check/review. - Lesson opener or daily quiz. - Set up rational equations. - Discuss how to “remove” the denominators when solving. - Discuss extraneous and missed solutions. - Guided practice exercises - Closure activity - Day 2- Student pairs will present and solve an equation for the class	- Homework review - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Level of difficulty of equations can vary.		
Resources Provided: Problem Set		

Lesson Reflection



SPRINGFIELD PUBLIC SCHOOLS
ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21-century GLOBAL SKILLS

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher-order thinking and problem-solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☒	☐	☐
Integrate 21st-century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity, and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with the teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self-assessment	☒	☐	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Rational Equations and Functions

Created: 2024

Board Approved on:



Unit Overview Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Quadratic Relations and Conic Sections

Unit Summary: Students first make use of the distance and midpoint formulas for line segments. Then they learn to write equations and draw graphs for the four conic sections: parabolas, circles, ellipses, and hyperbolas. They explore these quadratic relations and their graphs, first with centers at the origin and then with centers translated to other points in the coordinate plane. Finally, students learn to solve quadratic systems by using the algebraic techniques they used for systems of linear equations.

Primary Interdisciplinary Connections: *Science and Engineering*

21-century Themes ☒ Creativity and Innovation ☒ Critical Thinking and problem-solving ☒ ICT Literacy
☒ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: The ability to write equations and draw graphs for conic sections and solve quadratic systems.

Career Readiness (Standard 9):

9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.

9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.

9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.

9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.

9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Learning Targets

Standards: A.APR, A.REI; G.GPE

Content Statements: Understand the relationship between zeros and factors of polynomials; Solve equations and inequalities in one variable; Solve systems of equations; Translate between the geometric description and the equation for a conic section; Use coordinates to prove simple geometric theorems algebraically.

CPI#:

Cumulative Progress Indicator (CPI):



A.APR.B.2	Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
A.APR.B.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
A.REI.B.4	Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
A.REI.C.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.
G.GPE.A.1	(+)Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.
G.GPE.A.2	(+) Derive the equation of a parabola given a focus and directrix.
G.GPE.A.3	Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
G.GPE.B.6	(+) Find the point on a directed line segment between two given points that partitions the segment in a given ratio.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Unit Essential Questions:

- How do we use the distance and midpoint formula?
- When do we use the distance and midpoint formula?
- How do we graph and write equations of conics?
- How do we classify conics?
- How do we solve systems of quadratic equations?
- When will we use systems of quadratic equations in real life?

Unit Enduring Understandings:

- Using the distance formula
- Using the midpoint formula
- Graphing equations of conics
- Writing equations of conics
- Solving systems of quadratic equations

Unit Learning Targets:

Students will....

- Find the distance between two points.
- Find the midpoint of two points.



- Use the distance and midpoint formulas in real-life situations.
- Graph and write equations of parabolas.
- Use parabolas to solve real-life problems.
- Graph and write equations of circles.
- Use circles to solve real-life problems.
- Graph and write the equations of ellipses.
- Use ellipses in real-life situations.
- Graph and write equations of hyperbolas.
- Use hyperbolas to solve real-life problems.
- To write and graph an equation of a conic with its center or vertex at (h, k) .
- Classify conics using equations.
- Solve systems of quadratic equations.
- Use quadratic systems to solve real-life problems.



Evidence of Learning

Summative Assessment: Chapter Test (with differentiated levels)

Equipment Needed: Textbook, Projector, Graphing Tools, Graphing Calculators

Teacher Resources: Textbook

Formative Assessments:

- Quizzes
- Chapter test
- Project
- Khan Academy activity
- Guided practice
- Homework assignments
- Exit cards/closure activity



Lesson Plans

Lesson	Time Frame
Lesson 1 Graphing and Writing Equations of Parabolas	2 days
Lesson 2 Graph and Write Equations of Hyperbolas	2 days
Lesson 3 Graph and Write Equations of Ellipses	2 days

Teacher Notes:

Frequently break students into small groups to work on problem solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Graphing and Writing Equations of Parabolas
Time Frame: 2 days

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Graph parabolas. - Write equations of parabolas. - Use parabolas to solve real world problems.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Starting with $y=x^2$, graph a series of parabolas by shifting and dilating. - Solve for the zeros and vertex. - Guided practice. - Closure activity.	- Homework review - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Guided practice		
Resources Provided: - Graph paper - Textbook		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Graphing and Writing Hyperbolas Time Frame: 2 days

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☒ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Graph hyperbolas. - Write equations of hyperbolas. - Use hyperbolas in real-world problems.	Lesson Sequence - Homework check/review. - Lesson opener or daily quiz. - Write the equation of a hyperbola. Solve in standard forms. - Discuss the different parts to graph when graphing the hyperbola. - Ask the students to compare the equations of parabolas and circles. - Guided practice exercises. - Closure activity. - Repeat above for day 2.	- Homework review - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Checking work on Grapher vs calculator vs graph paper		
Resources Provided: - Textbook - Graph paper		



Lesson Plan 3 Template

Content Area: Math Lesson Title: Graphing and Writing Ellipses Time Frame: 2 days

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☒ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Graph ellipses. - Write equations of ellipses. - Use ellipses in real-world problems.	Lesson Sequence - Homework check/review. - Lesson opener or daily quiz. - Start with the equation of a circle. Have students graph it. - Discuss the equation of an ellipse and how it differs from the circle. - Graph the ellipse by plotting points, then have students make a conjecture about how the graph relates to the equation. - Guided practice exercises. - Closure activity.	- Homework review - Lesson opener or daily quiz - Guided practice exercises - Closure activity



- Day 2- Student pairs will present and solve an equation for the class.

Differentiation:

Graphing on calculators and on graph paper

Resources Provided:

- Textbook
- Graph paper



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher order thinking and problem-solving skills	☒	☐	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st-century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☐	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self-assessment	☒	☒	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Quadratic Relations and Conic Sections
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math	Grade Level: 9-11	Unit Title: Sequences & Series
Unit Summary: Students will use, write, and graph sequences. They will also learn summation notation and write rules for future terms. They will find the sum of an arithmetic and geometric series. They will also find common ratios and write repeating decimals as fractions. Students will use finite geometric series to model real life situations. They will finish the chapter by evaluating and writing recursive rules for arithmetic and geometric sequences and will use the rules to solve real life problems.		
Primary Interdisciplinary Connections: <i>Science and Engineering</i> 21-century Themes ☒ Creativity and Innovation ☒ Critical Thinking and problem-solving ☐ ICT Literacy ☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy		
Unit Rationale: Identifying and analyzing sequences is used everyday, not just in mathematics.		
Career Readiness (Standard 9): 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth. 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills. 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas. 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8). 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1). 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice. 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data. 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6). 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).		

Learning Targets

Standards: A.SSE; F.IF; F.BF; F.LE	
Content Statements: Write expressions in equivalent forms to solve problems; Understand the concept of a function and use function notation; Build a function that models a relationship between two quantities; Construct and compare linear and exponential models and solve problems.	
CPI#:	Cumulative Progress Indicator (CPI):
A.SSE.B.4	(+) Derive and/or explain the formula for the sum of a finite geometric series



	(when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.
F.IF.A.3	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.
F.BF.A.1	Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model. c. (+) Compose functions. For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.
F.BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
F.LE.A.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Unit Essential Questions:

- How do we recognize and write sequences?
- How do we find the sum of sequences?
- How do we evaluate sequences and series?

Unit Enduring Understandings:

- Sequences and Series can be discovered, written, and evaluated.
- Infinite series can be used to model real life problems.
- Sequences are used on a daily basis.

Unit Learning Targets:

- Students will be able to use and write sequences, and use summation notation to write series and find sums of series.
- Students will be able to write rules for arithmetic and geometric sequences, find sums of arithmetic and geometric sequences, and sums of infinite series.
- Students will be able to evaluate and write recursive rules for sequences.
- Students will be able to use sequences and series in real life problems.



Evidence of Learning

Summative Assessment: Test

Equipment Needed: Calculator; chapter quizzes & tests

Teacher Resources: Textbook

Formative Assessments:

- Homework check/review
- Khan Academy activities
- Guided practice exercises
- Homework checks
- Notebook checks



Lesson Plans

Lesson	Time Frame
Lesson 1 Arithmetic Sequences and Series	1 day
Lesson 2 Infinite Geometric Series	1 day
Lesson 3 Recursive Rules for Sequences	1 day

Teacher Notes:

Frequently break students into small groups to work on problem-solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: Arithmetic Sequences and Series Time Frame: 1 day

Lesson Components

21-century Themes

- ☐ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☒ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Write rules for arithmetic sequences and find sums of arithmetic series.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Write an arithmetic sequence. - Have students come up with rules for arithmetic sequences. - Discuss what an arithmetic series would be, and have students come up with the rule for a sum. - Guided practice. - Closure activity.	- Homework check - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Difficulty of problems: finding different parts of the formula; more complex common differences		
Resources Provided: Google Slides		



Lesson Plan 2 Template

Content Area: Math Lesson Title: Infinite Geometric Series Time Frame: 1 day

Lesson Components

21-century Themes

- ☐ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy, Vernier Graphical Analysis

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Find sums of infinite geometric series. - Use infinite geometric series to find patterns in a bouncing ball.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Discuss what the geometric series looks like. - Use the bouncing ball activity to show a geometric series. - Guided practice. - Closure activity.	- Homework check - Lesson opener or daily quiz - Guided practice exercises - Closure activity
Differentiation: Data recorded for the bouncing ball activity		
Resources Provided: Vernier Graphical Analysis software		



Lesson Plan 3 Template

Content Area: Math Lesson Title: Recursive Rules for Sequences Time Frame: 1 day

Lesson Components

21-century Themes

- ☐ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: Evaluate and write recursive rules for sequences.	Lesson Sequence - Homework review/check. - Lesson opener. - Ask students to define what a recursive rule is. Have students give examples. - Give the students a sequence to write a recursive rule for. - Guided practice. - Closure activity.	- Guided practice - Khan Academy activity - Closure activity
Differentiation: Modify difficulty of sequence		
Resources Provided: Graphing Calculator		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly*, *Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher-order thinking and problem-solving skills	☒	☒	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21-century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☒	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self- assessment	☒	☒	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Sequences & Series
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math **Grade Level:** 9-11 **Unit Title:** Probability and Statistics

Unit Summary: Start with counting techniques that will later help find probabilities. Fundamental counting principle, permutations and combinations are used. Students use what they learned about combinations to use the binomial theorem. Probability is introduced halfway through the chapter. Students find theoretical and experimental probabilities. Binomial and normal distributions are introduced and students construct and interpret binomial distributions and use them to test a hypothesis. Normal distributions are used to calculate probabilities and approximate binomial distributions.

Primary Interdisciplinary Connections: *Science and Engineering*

21-century Themes ☒ Creativity and Innovation ☒ Critical Thinking and problem-solving ☐ ICT Literacy
☐ Information Literacy ☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy

Unit Rationale: Statistics and probability are used in science and engineering.

Career Readiness (Standard 9):

- 9.2.12.CAP.3: Investigate how continuing education contributes to one's career and personal growth.
- 9.2.12.CAP.6: Identify transferable skills in career choices and design alternative career plans based on those skills.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CI.2: Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
- 9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.TL.2: Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
- 9.4.12.TL.4: Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem (e.g., 7.1.AL.IPERS.6).
- 9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S.ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).

Learning Targets

Standards: S.ID; S.IC; S.CP

Content Statements: Summarize, represent, and interpret data on a single count or measurement variable; Summarize, represent, and interpret data on two categorical and quantitative variables; Interpret linear models; Make inferences and justify conclusions from sample surveys, experiments, and observational studies; Understand independence and conditional probability and use them to interpret data; Use the rules of probability to compute probabilities of compound events in a uniform probability model.



CPI#:	Cumulative Progress Indicator (CPI):
S.ID.A.2	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
S.ID.A.3	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).
S.ID.A.4	Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.
S.ID.B.5	Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.
S.ID.B.6a	Represent data on two quantitative variables on a scatter plot and describe how the variables are related. a. 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.
S.ID.C.7	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.
S.IC.A.1	(+) Understand statistics as a process for making inferences about population parameters based on a random sample from that population.
S.IC.A.2	(+) Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?
S.IC.B.3	(+) Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
S.IC.B.4	(+) Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.
S.IC.B.5	(+) Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.
S.IC.B.6	(+) Evaluate reports based on data (e.g. interrogate study design, data sources, randomization, the way the data are analyzed and displayed, inferences drawn and methods used; identify and explain misleading uses of data; recognize when arguments based on data are flawed).
S.CP.A.1	(+) Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).
S.CP.A.2	(+) Understand that two events A and B are independent if the probability of A



	and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.
S.CP.A.3	(+) Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A, and the conditional probability of B given A is the same as the probability of B.
S.CP.A.4	(+) Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.
S.CP.A.5	(+) Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.
S.CP.B.6	(+) Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.
S.CP.B.7	(+) Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.
SEL.PK-12.2.2	Recognize the skills needed to establish and achieve personal and educational goals.
SEL.PK-12.4.1	Develop, implement and model effective problem-solving, and critical thinking skills.
SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

Unit Essential Questions:

- How can you count the number of ways an event can happen?
- How do you calculate and use probabilities?
- How do we use binomial and normal distributions?

Unit Enduring Understandings:

- Count the number of ways an event can happen.
- Calculate and use probabilities.
- Use binomial and normal distributions.

Unit Learning Targets:

- Students will be able to use the fundamental counting principle to count the number of ways an event can happen.
- Students will be able to use combinations to count the number of ways an event can happen.
- Students will be able to use the binomial theorem to expand a binomial.
- Students will be able to find theoretical and experimental probabilities.



- Students will be able to find geometric probabilities.
- Students will be able to find probabilities of unions, intersections, independent and dependent events.
- Students will be able to find binomial probabilities and analyze binomial distributions.
- Students will be able to calculate probabilities using normal distributions.
- 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.



Evidence of Learning

Summative Assessment: Test

Equipment Needed: Calculator; chapter quizzes & tests

Teacher Resources: Textbook

Formative Assessments:

- Homework check/review
- Khan Academy activity
- Guided practice exercises
- Homework checks
- Notebook checks



Lesson Plans

Lesson	Time Frame
Lesson 1 The Fundamental Counting Principle & Permutations	1 day
Lesson 2 An Introduction to Probability	1 day
Lesson 3 Probability of Compound Events	1 day

Teacher Notes:

Frequently break students into small groups to work on problem-solving. During this time, meet with groups for mini-lessons and formative assessments.

Curriculum Development Resources/Technology Resources:

Click the links below to access additional resources used to design this unit:

www.kutasoftware.com

<https://tasks.illustrativemathematics.org/content-standards>

<https://www.desmos.com/>

<https://nj.digitalitemlibrary.com/home>

<https://nj.mypearsonsupport.com/practice-tests/math/>

<https://resources.newmeridiancorp.org/released-items/>

www.khanacademy.com

www.desmos.com



Lesson Plan 1 Template

Content Area: Math Lesson Title: The Fundamental Counting Principle & Permutations
Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☒ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy, Google Sheets

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Use the fundamental counting principle to count the number of ways an event can happen. • Use permutations to count the number of ways an event can happen.	Lesson Sequence • Homework review/check. • Lesson opener or daily quiz. • Define the fundamental counting principle by showing a series of examples that illustrate it. • Have students determine how to use permutations to count the number of ways an event can happen. • Show the students to notation (p choose q). • Guided practice. • Closure activity.	• Homework check • Lesson opener or daily quiz • Khan Academy activity • Guided practice exercises • Closure activity
Differentiation: Tree Diagram for students who need to see all of the possibilities.		
Resources Provided: • Graphing Calculator		



Lesson Plan 2 Template

Content Area: Math Lesson Title: An Introduction to Probability Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy, Google Sheets

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Find theoretical and experimental probabilities. - Find geometric probabilities.	Lesson Sequence - Homework review/check. - Lesson opener or daily quiz. - Give the students a data set and have them determine the probabilities. - Discuss the formulaic method of calculating probabilities. - Have students come up with examples of probabilities they can calculate. - Guided practice. - Closure activity.	- Homework check - Lesson opener or daily quiz - Khan Academy activity - Guided practice exercises - Closure activity
Differentiation: Difficulty of geometric probability examples.		
Resources Provided: Graphing Calculator		



Lesson Plan 3 Template

Content Area: Math Lesson Title: Probability of Compound Events Time Frame: 1 day

Lesson Components

21-century Themes

- ☒ Global Awareness ☒ Financial, Economic, Business and Entrepreneurial Literacy
☐ Civic Literacy ☐ Health Literacy

21-century Skills

- ☒ Creativity and Innovation ☒ Critical Thinking and Problem Solving ☐ Information Literacy
☒ Life and Career Skills ☒ Communication and Collaboration ☐ Media Literacy ☐ ICT Literacy

Interdisciplinary Connections:

Science and Engineering

Integration of Technology:

Graphing calculators, Desmos, Khan Academy, Google Sheets

Equipment Needed:

Graphing calculators, Mimio Software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Find probabilities of unions and intersections of two events. - Use compliments to find the probability of an event.	Lesson Sequence - Homework review/check. - Lesson opener. - Have students discuss what the probability of rolling a 5 on a die and getting a heads on a coin flip is. - Next, have the students determine the probability of choosing a red ball from a bag of 10 red and 10 blue balls. Then have them determine the probability of it happening two times in a row. - Have students discuss the difference between these events.	- Guided practice - Closure activity - Khan Academy activity
Differentiation: Real life examples of compound events		
Resources Provided: Graphing Calculator		



Lesson Reflection

Reflect on the lesson you have developed and rate the degree to which the lesson *Strongly, Moderately* or *Weakly* meets the criteria below.

Lesson Activities	Strongly	Moderately	Weakly
Are challenging and require higher-order thinking and problem-solving skills	☐	☒	☐
Allow for student choice	☒	☐	☐
Provide scaffolding for acquiring targeted knowledge/skills	☒	☐	☐
Integrate global perspectives	☐	☒	☐
Integrate 21st-century skills	☒	☐	☐
Provide opportunities for interdisciplinary connection and transfer of knowledge and skills	☒	☐	☐
Foster student use of technology as a tool to develop critical thinking, creativity, and innovation skills	☒	☐	☐
Are varied to address different student learning styles and preferences	☒	☐	☐
Are differentiated based on student needs	☒	☐	☐
Are student-centered with the teacher acting as a facilitator and co-learner during the teaching and learning process	☒	☐	☐
Provide means for students to demonstrate knowledge and skills and progress in meeting learning goals and objectives	☒	☐	☐
Provide opportunities for student reflection and self-assessment	☐	☒	☐
Provide data to inform and adjust instruction to better meet the varying needs of learners	☒	☐	☐

Curriculum Design Template

Content Area: Math	Grade Level: 9-11	Unit Title: Probability and Statistics
Created: 2024	Board Approved on:	



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

IEP AND 504 ACCOMMODATIONS AND MODIFICATIONS FOR EARLY CHILDHOOD AND ELEMENTARY SCHOOL STUDENTS:

Large print textbooks
Textbooks for at-home use
Additional time for assignments
Review of directions
Use of mnemonics
Have student restate information
Concrete examples
Adaptive writing utensils
Support auditory presentations with visuals
Use of a study carrel
Assistance in maintaining uncluttered space
Weekly home-school communication tools (notebook, daily log, phone calls or email messages)
Space for movement or breaks
Study sheets and teacher outlines
Extra visual and verbal cues and prompts
Math sheets with highlighted instructions
Graph paper to assist in organizing or lining up math problems
Use of computers and calculators
Books on tape
Graphic organizers
Quiet corner or room to calm down and relax when anxious
Preferential seating
Alteration of the classroom arrangement
Reduction of distractions
Answers to be dictated
Hands-on activities
Use of manipulatives
No penalty for spelling errors or sloppy handwriting
Follow a routine/schedule
Alternate quiet and active time
Teach time management skills
Rest breaks
Verbal and visual cues regarding directions and staying on task
Agenda book and checklists
Adjusted assignment timelines
Visual daily schedule



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Untimed tests
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book tests
Read test and directions to student
Provide study outline prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator and/or number line for math tests
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS MODIFICATIONS:



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Breaks between tasks
Cue expected behavior
Daily feedback to student
Have contingency plans
Use de-escalating strategies
Use positive reinforcement
Use proximity/touch control
Use peer supports and mentoring
Model expected behavior by adults
Have parent sign homework
Have parent sign behavior chart
Set and post class rules
Chart progress and maintain data



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

IEP AND 504 ACCOMODATIONS AND MODIFICATIONS FOR MIDDLE AND HIGH SCHOOL STUDENTS:

- Large print textbooks
- Textbooks for at-home use
- Additional time for assignments
- A locker with adapted lock
- Review of directions
- Review sessions
- Use of mnemonics
- Have student restate information
- Provision of notes or outlines
- Concrete examples
- Adaptive writing utensils
- Support auditory presentations with visuals
- Weekly or bi-weekly home-school communication
- Space for movement or breaks
- Study sheets and teacher outlines
- Extra visual and verbal cues and prompts
- Lab and math sheets with highlighted instructions
- Graph paper to assist in organizing or lining up math problems
- Use of tape recorder for lectures
- Use of Interactive notebook
- Use of a scribe
- Use of computers and calculators
- Books on tape
- Graphic organizers
- Quiet corner or room to calm down and relax when anxious
- Preferential seating
- Alteration of the classroom arrangement
- Reduction of distractions
- Answers to be dictated
- Hands-on activities
- Ability to type all assignments
- Follow a routine/schedule
- Teach time management and organizational skills
- Rest breaks
- Verbal and visual cues regarding directions and staying on task
- Agenda book and checklists
- Daily check-in with case manager or special education teacher
- Adjusted assignment timelines
- Visual daily schedule



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Varied reinforcement procedures
Immediate feedback
Work-in-progress check
Personalized examples

TESTING AND ASSESSMENT ACCOMMODATIONS AND MODIFICATIONS:

Answers to be dictated
Frequent rest breaks
Additional time
Oral testing
Choice of test format (multiple-choice, essay, true-false)
Alternate ways to evaluate (projects or oral presentations instead of written tests)
Accept short answers
Open-book or open-note tests
Read test and directions to student
Provide study guides prior to tests
Highlight key directions
Test in alternative site
Use of calculator
Extra credit option
Pace long-term projects
Preview test procedures
Simplified test wording; rephrased test questions and/or directions

GENERAL ACCOMMODATIONS AND MODIFICATIONS:

Allow outlining, instead of writing for an essay or major project
Use of alternative books or materials on the topic being studied
Computerized spell-check support
Word bank of choices for answers to test questions
Provision of calculator for math tests
Film or video supplements in place of reading text
Reworded questions in simpler language
Projects instead of written reports
Highlighting important words or phrases in reading assignments
Modified workload or length of assignments/tests
Modified time demands



SPRINGFIELD PUBLIC SCHOOLS

**ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS**

Pass/no pass option
Modified grades based on IEP

BEHAVIOR ACCOMMODATIONS FOR STUDENTS:

- Breaks between tasks
- Cue expected behavior
- Daily feedback to student
- Have contingency plans
- Use de-escalating strategies
- Use positive reinforcement
- Use proximity/touch control
- Use peer supports and mentoring
- Model expected behavior by adults
- Have parent sign homework
- Set and post class rules
- Chart progress and maintain data



SPRINGFIELD PUBLIC SCHOOLS

ENGAGING STUDENTS • FOSTERING ACHIEVEMENT • CULTIVATING 21ST CENTURY
GLOBAL SKILLS

Accommodations and Modifications for ESL Students

- Give tests orally
- Give instructions/directions in writing and orally
- Assign a peer tutor, same language or English speaking
- Allow use of bilingual/translation dictionary
- Provide summaries of text or study guides of particular chapters
- Allow errors in speaking
- Allow errors in writing
- Accept writing in first language
- Highlight key vocabulary
- Reduce amount of work required
- Assess comprehension through demonstration or other alternative means (gestures, drawings)
- Rephrase questions, directions, and explanations
- Reduce multiple choices on assessments
- Provide study guides and/ or outlines
- Shorten reading assignments
- Allow extended time for test/project completion
- Use of audio books
- Use of graphic organizers
- Use reduced text, so that print is not dense
- Use visuals/pictures throughout lesson/unit/assignment
- Adapt homework to reflect language proficiency/home support
- Adapt homework to reflect home support
- Provide hands-on activities and explanations
- Allow extended time to answer questions, and permit drawing, as an explanation
- Use of translation dictionaries to locate words in the native language
- Use anecdotal records and portfolio of work as forms of assessment
- Use story retellings to assess comprehension

What Does the Gifted and Talented Experience Look Like? *Springfield Public Schools*

Mission Statement

The Gifted and Talented Program of the Springfield Public Schools aims to provide a meaningful and rigorous education that instills the value of lifelong learning and empowers all students to reach their full potential and become self-fulfilled creative leaders in accordance with the comprehensive standards of our state. We accomplish this by offering challenging, real-world experiences in a student-centered environment.

We recognize that students come from diverse socioeconomic, cultural, and ethnic backgrounds, and the mission of the gifted and talented program is to provide opportunities for students to explore their intellectual, creative, and artistic gifts and talents within the classroom and with beyond-the-classroom experiences. It is essential to provide diverse, appropriate, and ongoing learning experiences and environments that incorporate students' academic, psychological, and social needs. Our responsibility is to provide students with educational alternatives that teach, challenge, and expand their knowledge, while simultaneously stressing the development of independent and self-directed learners who continuously generate questions, analyze, synthesize, and evaluate information and ideas.

New Jersey Administrative Code 6A:8-3.1 defines students who are gifted and talented as those students who possess or demonstrate high levels of ability in one or more content areas when compared to their chronological peers in the local district and who require modification of their educational program if they are to achieve in accordance with their capabilities.

Goals:

To support our mission, we have established the following goals to guide our work:

- To infuse into the general education program a broad range of activities for high-level learning that will challenge all students to perform at advanced levels, and provide extended opportunities, resources, and support in particular areas where student interest or talent is demonstrated.
- To provide a continuum of gifted education services that will strengthen the total school program, offer enriching and challenging learning opportunities for all students, and provide specialized learning experiences
- To promote achievement of students' best potentials and increased ability.

Through a productive and collaborative relationship among the building principals, classroom teachers, and the Gifted and Talented teacher, our schools can create programming that will enhance the learning experience for every student and serve the unique and specialized needs of students currently demonstrating gifted behaviors.

Elements of the Schoolwide Enrichment Model, W.I.N (What I Need), differentiated instruction, advanced classes, or individual programs into a student's regular instruction program are integral to this overarching framework for gifted education in the Springfield School District.

Reference Board Policy and Regulation 2464 – Gifted and Talented Pupils (M)

Early Childhood Center **Edward V. Walton**

Schoolwide Virtual Enrichment

All first and second grade students have access to the [Gifted and Talented Virtual Classroom](#). This virtual classroom is a space for students to complete various challenges and enrichment opportunities at their own pace. Students can receive feedback and additional adaptable resources to meet their individual learning needs. The virtual classroom design expands accessibility to enrichment resources and allows students to choose learning activities according to their unique interests and abilities. The purpose of the activities is to encourage problem-solving, develop critical thinking

skills, and expand curiosity and imagination. Activities are aligned to the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

The Gifted and Talented teacher serves as a resource to all teachers within Edward V. Walton School. Teachers seeking resources for their high-ability learners will receive additional support from the Gifted and Talented teacher in various ways. This support may include additional units of study, challenging resources, and student projects.

Elementary Schools **James Caldwell** **Thelma L. Sandmeier**

The goal is to engage small groups of students in intensive learning experiences through standards-based, rigorous, and relevant units of study that supplement, not supplant, the grade-level curriculum and support students' unique learning needs.

Enrichment Experience Grade 3

Beginning in third grade, the G&T teacher will cycle through all classrooms to work on problem-solving and enrichment tasks with students. Driven by assessment data, academic performance, student interest, and teacher observation, small groups of students will meet with the G&T teacher during W.I.N. (What I Need) periods throughout the week that the teacher is assigned to their classroom teacher. Groupings will be flexible and monitored to best meet each student's needs throughout the school year. Activities will include brain teasers, puzzles, strategic thinking, problem-solving, and STEM challenges.

Targeted Gifted and Talented Programing Grades 4-5

Students may become identified as Gifted and Talented in fourth grade. Students that are identified may receive support from the G&T Teacher for up to five periods (200 minutes) a week during W.I.N. (What I Need) periods. Identified students will meet to explore grade-level content while incorporating depth and complexity in a student-centered, problem-based environment. The Gifted and Talented Program aims to provide students with various advanced and challenging learning experiences across content areas to promote independent thinking skills, refine critical thinking and communication skills, cultivate joy in learning, and expand student interests through problem-solving. The instruction that students receive incorporates 21st Century Skills and advanced content that is challenging, hands-on, and relevant to the real world.

Strategies and Practices that Support Gifted and Talented Students

- Adjusted Pace of Lessons
- Inquiry-Based Instruction
- Higher-Order Thinking Activities
- Interest-Based Content
- Real World Problem Solving/Problem Based Learning
- Independent Study/Passion Projects
- Units of Study with Like-Minded Peers

Schoolwide Virtual Enrichment

All JCS and TLS students have access to grade level-specific [Gifted and Talented Virtual Classrooms](#). These virtual classrooms are a space for students to complete various challenges and enrichment opportunities at their own pace. Students are able to receive feedback and additional opportunities based on their needs. The virtual classrooms have expanded the accessibility of enrichment resources directly to the students and allows for students to choose opportunities according to their interests and abilities. The purpose of the activities is to encourage problem solving, develop critical thinking skills, and expand curiosity and imagination in conjunction with the New Jersey Student Learning Standards.

Gifted and Talented Teacher as a Resource

In addition to classroom support, the Gifted and Talented teacher also serves as a resource to all teachers in the building. Teachers that are seeking resources for their high ability learners will receive additional support from the Gifted and Talented teacher in various ways. This may include additional units of study, challenging resources, student projects, and meeting with the G&T teacher as needed.

Additional Enrichment Opportunities

Across all grade levels 3-5, as recommended by the classroom teacher, students exhibiting a need for additional enrichment may have the opportunity to meet with the G&T teacher as the schedule allows. Groupings will be flexible and monitored to best meet the students' needs throughout the school year. Activities will include, brain teasers, puzzles, strategic thinking activities, problem-solving challenges, and STEM challenges. Students engage in an extended process of asking questions, using resources, and developing answers that lead to thinking about what and how they are learning. Students are held accountable for how they work and use their time by demonstrating their learning through products or presentations.

Students self-select to participate in individual and/or group projects based on interest and commitment. The classroom teacher and/or the enrichment teacher will help guide and monitor student exploration of chosen topics, facilitating their learning with resources and teaching of needed skills.

Secondary Schools
Florence M. Gaudineer Middle School
Jonathan Dayton High School

Grades 6-12: Access to specific content programs with higher levels of academic challenges (i.e. Pre-Algebra, Accelerated Communication Arts, and Advanced Placement Classes)

Dual Credit Courses provide students the opportunity to obtain high school credit, and college credit, simultaneously through partnerships with several institutions.

Project Lead the Way (PLTW) students become builders of technology by engaging in real world activities. Students are empowered as design thinkers collaborating on real world projects.

Gifted and Talented Identification Criteria

The Springfield Schools Gifted and Talented Program recognizes that students require differentiated learning experiences beyond the core curriculum being taught because of their advanced abilities in one or more content areas. These students may also have other cognitive qualities such as curiosity, creativity, motivation, leadership, and passion that require modifications to their academic experience.

Multiple Measures of Eligibility

Kindergarten through grade twelve identification process for gifted and talented students includes multiple measures. Multiple measures may include but are not limited to: achievement test scores; grades; student performance or products; intelligence testing; parent, student, and/or teacher recommendation; and other appropriate measures. The identification methodology is developmentally appropriate, non-discriminatory, and related to the programs and services offered by the Springfield School District. The identification procedures are reviewed annually.

According to N.J.A.C. 6A:8-3.1, all public school districts must have a board-approved gifted and talented identification process and provide services for identified students enrolled in the grades of that school district. The regulations require that identification and services be made available to students in grades K-12.

When students are recommended for the Gifted and Talented Program there are multiple measures that are considered to determine if services are necessary and appropriate. The assessments used are as follows:

- Cognitive Abilities Test (CogAT)
- Classroom Performance/Student Portfolios
- DRA2 Level
- iReady Diagnostic Scores
- Gifted Indicators Checklist
- Start Strong/NJSLA Assessment Data

The N.J.A.C. requires that students be compared to their chronological peers in the local school district. The New Jersey Department of Education has not established state-level criteria for identifying students who are gifted, such as mandated tests or assessments, grade point averages, or IQ scores. Local school districts must use multiple measures to identify students.

Procedures

<https://www.straussesmay.com/seportal/Public/DistrictPolicy.aspx?policyid=2464&id=b8a33a9f505e4998a6db3fb8e1de778b>

Gifted and Talented Program Identification Matrix

Minimum Score Required for Consideration: 14 Points

1 Point	2 Points	3 Points
Cogat Assessment Overall Stanine Score of a 7	Cogat Assessment Overall Stanine Score of an 8	Cogat Assessment Overall Stanine Score of a 9
iReady Math Assessment Just Below Current Grade Level	iReady Math Assessment On Grade Level	iReady Math Assessment ½ Year + Above Current Level
iReady ELA On Grade Level	iReady ELA ½ Year Above Current Level	iReady ELA One Full Grade Level + Above Current Level
NJSLA Math Approaching Expectations	NJSLA Math Met Expectations	NJSLA Math Exceed Expectations
NJSLA ELA Approaching Expectations	NJSLA ELA Met Expectations	NJSLA ELA Exceed Expectations
HOPE Teacher Rating Scale Raw Score: 11 - 29	HOPE Teacher Rating Scale Raw Score: 30 - 49	HOPE Teacher Rating Scale Raw Score: 50-66

Team meetings present the opportunity to review data and assess the educational needs of all students. Teacher provides examples of student work exhibiting above and beyond grade level expectations, creativity, leadership, critical and abstract thinking. Programs for gifted and talented students will be periodically evaluated for their continuing efficacy and adjusted accordingly. The parent of any student identified as gifted or talented shall be consulted regarding any program designed to address the student's particular needs.

Resource Links

https://riversideinsights.com/cognitive_abilities_test

<https://www.curriculumassociates.com/programs/i-ready-learning>

<https://www.nj.gov/education/assessment/resources/>

<https://www.routledge.com/HOPE-Teacher-Rating-Scale-Involving-Teachers-in-Equitable-Identification/Gentry-Pereira-Peters-McIntosh-Fugate/p/book/9781618214522#:~:text=The%20HOPE%20Teacher%20Rating%20Scale,making%20it%20easy%20to%20use.>

Gifted and talented student: The “*[Strengthening Gifted and Talented Education Act](#)*” defines a gifted and talented student as a “student who possesses or demonstrates a high level of ability in one or more content areas when compared to their chronological peers in the school district and who require modifications of their educational program if they are to achieve in accordance with their capabilities.”

Twice-exceptional (2E) students: A twice-exceptional (2E) student is defined as “a student who is both gifted and a student with a disability. These students may also be referred to as having dual exceptionalities or as being gifted with learning disabilities (GT/LD). This also applies to students who are gifted with ADHD or gifted with autism” (New Jersey Association for Gifted Children, www.nagc.org).

Instructional adaptation: An adjustment or modification to instruction enabling a student who is gifted and talented to participate in, benefit from, and demonstrate knowledge and application of the New Jersey Student Learning Standards in one or more content areas at the instructional level of the student, not just the student's grade level.

Identifying gifted and talented students: The focus of identification is to provide programming and services in which students' specific learning needs and potential are appropriately addressed and met. In every New Jersey school district, there are students who require modifications to the general education curriculum if they are to achieve in accordance with their abilities. By identifying a student's general intellectual ability, creativity, or specific academic area aptitudes, we are acknowledging that they need programming and services outside of the general education/grade level curriculum to advance their learning.

NJDOE Fast Facts

<https://www.nj.gov/education/standards/gifted/>

<https://www.nj.gov/education/standards/gifted/legislation.shtml>

Supplemental Resources/Programming for Gifted Students

Edward V. Walton

- PETS Program – Primary Education Thinking Skills
- Group Solutions/Group Solutions 2 – Cooperative Logic Activities
- Lollipop Logic
- Beginning Thinking Skills
- AIMS Education Programming

James Caldwell and Thelma L. Sandmeier

Math/ELA

- Project M3: Mentoring Mathematical Minds
- Junior Great Books
- AIMS Education Programming
- Borenson Hands on Equations
- BizWorld
- Perplexors
- Advanced Math Explorations grade 3-5
- Challenging Units for Gifted Learners (ELA and Math)
- Creative Curriculum Extenders
- Differentiated Lessons & Projects
- Challenge Math Grades 4+
- Differentiating Instruction with Menus (All Content Areas)
- Jacob's Ladder
- Genius Hour/Passion Project
- Spatial Reasoning
- Logic Puzzles, Brain Games, Analogies

STEM

- Engineering is Elementary
- Engineer Throughout the Year
- PBS Design Squad
- DefinedSTEM
- Project Lead the Way (PLTW)

Enrichment Events

Experience for all students to be enriched through events related to the curricular or extracurricular activities. Examples include after school clubs, PTA-sponsored events, leadership opportunities, visual and performing arts, and community service opportunities.