



SPRINGFIELD PUBLIC SCHOOLS
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Springfield Public Schools Springfield, New Jersey 07081

Calculus

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 on August 26, 2024



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Unit Overview Template

Content Area: Math **Grade Level(s) :** 11-12 **Unit Title:** Limits

Unit Summary: Students will find the limit of a function using a variety of methods. Students will understand the meaning of the limit as it applies to different mathematical models. Students will solve the different types of limits, explore cases where limits do not exist, and set a framework for understanding how to interpret infinite limits.

Primary Interdisciplinary Connections: *Physics, Engineering*

21st-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 concept of a limit leads to the formation of the derivative.

Career Readiness (Standard 9):

9.4.12.CI.1 - Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CT.2 - Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).

9.4.5.CT.3 - Describe how digital tools and technology may be used to solve problems.

9.4.12.TL.1 - Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).

9.4.12.TL.3 - Analyze the effectiveness of the process and quality of collaborative environments.

9.4.2.TL.6 - Illustrate and communicate ideas and stories using multiple digital tools (e.g., SL.2.5.).

Learning Targets

Standards: A.SSE; A.APR; A.CED; A.REI; F.IF; F.LE

Content Statements: Write expressions in equivalent forms to solve problems; Understand the relationship between zeros and factors of polynomials; Rewrite rational expressions; Create equations that describe numbers or relationships; Solve equations and inequalities in one variable; Interpret functions that arise in applications in terms of the context; Analyze functions using different representations; Interpret expressions for functions in terms of the situation they model.

CPI#:	Cumulative Progress Indicator (CPI):
A.SSE.B.3	Choose and produce an equivalent form of an expression to reveal and explain the 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 $(1.151/12)^{12t} \approx 1.01^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.
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



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	factor of $p(x)$.
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.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.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.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
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.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. f. (+) Graph trigonometric functions, showing period, midline, and amplitude.
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.



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SEL.PK-12.5.2	Utilize positive communication and social skills to interact effectively with others.
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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.
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Unit Essential Questions:

- What is the meaning of a limit?
- How do you compute a one-sided limit?
- How do you compute a two-sided limit?
- How do you compute a limit using a table?
- How do you compute a limit using a graph?
- How do you compute a limit algebraically?
- When does a limit not exist?
- What does it mean for a function to be continuous?
- How do we force a function to become continuous?

Unit Enduring Understandings:

- The graphical meaning of a limit.
- What it means for the limit to not exist.
- The meaning of an infinite limit.
- The difference between the different types of discontinuities.

Unit Learning Targets:

Students will develop methods to take the limit of different types of functions.

Climate Change Example: Students may create equations and/or inequalities to represent the economic impact of climate change.

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.



Evidence of Learning

Summative Assessment: Exam on Limits

Equipment Needed: Whiteboard, projector, graphing software

Teacher Resources: Textbook, handouts

Formative Assessments:

- Classwork
- Homework
- Quizzes
- Exam
- Class discussions



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Lesson Plans

Lesson	Time Frame
Lesson 1 Evaluating Limits Graphically	3 days
Lesson 2 Evaluating Limits Algebraically	3 days
Lesson 3 Continuity of Functions	3 days

Teacher Notes: Emphasize the idea of evaluating the limit from what x is approaching.

Curriculum Development Resources/Technology Resources:

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

www.kutasoftware.com

www.youtube.com/user/TheIntegralCalc

tutorial.math.lamar.edu

<https://www.calc-medic.com/>

desmos.com

[geogebra.org](https://www.geogebra.org)



Lesson Plan 1 Template

Content Area: Math Lesson Title: Evaluating Limits Graphically Time Frame: 3 days

Lesson Components

21st-century Themes

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

21st-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:

Physics, engineering

Integration of Technology:

Use of graphing software from Desmos

Equipment Needed:

Computer with a projector and Desmos

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Graph functions - Understand what the meaning of a limit is - Be able to look at a graph of a function and evaluate a limit - Understand the graphical meaning of jump, point, and infinite discontinuity - Understand what a function with no limit at a certain value looks like	Lesson Sequence - Start with the graph of a line - Define the limit as the y-value the function gets close to as we get closer to the given x value. - Follow on the graph from the left and right of the x-value to show what y-value it approaches. - Next, repeat the process for a parabola. - Next, repeat the process for a graph with a jump discontinuity. Use $y = x /x$. Discuss the limit from the left and right of $x = 0$. Notice they are different. - Repeat the process for a graph with a point discontinuity. Use $y =$	- Classwork - Class discussion - Homework - Exam



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$(x^2-4)/(x+2)$ and look at $x = -2$.

7. Repeat the process for a graph with an infinite discontinuity. Use $y = 1/(x-2)$ around $x=2$.
8. Discuss other examples of graphs

Differentiation:

Give students time in class to work on problems with a variety of resources: the book, notes, with graphing software. Give scaffolded graphing examples.

Resources Provided:

- Graphing calculators
- Desmos activity
- Textbook



Lesson Plan 2 Template

Content Area: Math Lesson Title: Evaluating Limits Algebraically Time Frame: 3 days

Lesson Components

21st-century Themes

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

21st-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:

Engineering, physics

Integration of Technology:

Graphing software from Desmos, graphing calculator

Equipment Needed:

Whiteboard, laptop with projector, Desmos

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Evaluate limits without a graph. - Evaluate a limit by substitution - Evaluate a limit by using a table - Evaluate a limit by rewriting a function - Evaluate a sided limit without a graph	Lesson Sequence - Discuss the limit of a linear function. Notice the value is always on the graph. - Evaluate limits by substituting x-values into function. - Sometimes we cannot substitute a number in. Evaluate a function with a point discontinuity by using a table of values. - Evaluate a limit by rewriting simple rational functions that can be factored and reduced. - Evaluate a limit by multiplying by the conjugate of the numerator of a function. - Evaluate the limit in a piecewise function from	- Classwork - Class discussion - Homework



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the left and right of the chosen x -value. Discuss the discontinuity or continuity of each.

Differentiation:

Set up the Desmos activity with a variety of additional examples, supports, and explanations.

Resources Provided:

- Textbook
- Graphing calculators
- Desmos activity



Lesson Plan 3 Template

Content Area: Math Lesson Title: Continuity of Functions Time Frame: 3 days

Lesson Components

21st-century Themes

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

21st-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:

Physics, engineering

Integration of Technology:

Graphing software from Desmos, graphing calculators

Equipment Needed:

Whiteboard, computer with projector, graphing calculators

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Review continuity using a graph. - Discuss point discontinuity analytically. - Discuss infinite discontinuity analytically. - Discuss jump discontinuity analytically.	Lesson Sequence - Graph three functions with the three different discontinuities (point, jump, and infinite). - Discuss why these are discontinuous. - Using the equations for these graphs, analytically take the left and right limits, then compare to the function evaluated at the x-value in question. - Review analytically when you get a point, jump, or infinite limit, and use this to discuss the continuity.	- Class discussion - Homework - Exam - Class work
Differentiation: Ask students to use graphing software to explore and verify the type of discontinuity using a scaffolded problem set.		
Resources Provided: - Textbook - Desmos activity - Graphing calculator		



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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 Strongly 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: 11-12	Unit Title: Limits
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math **Grade Level(s) :** 11-12 **Unit Title:** Derivatives and Applications

Unit Summary: Students will develop a conceptual understanding of the meaning of the derivative based on the limit definition, which they will develop. Students will analyze different equations to determine basic rules of differentiation and apply knowledge of rates of change. Students will take the derivative of a variety of types of functions, interpret the result, and apply it to different situations. Students will apply the derivative to tangent line equations and approximations, absolute minimums and maximums, relative minimums and maximums, and optimization. Students will analyze implicit functions and calculate their derivatives.

Primary Interdisciplinary Connections: *Physics, Engineering*

21st-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 derivative is a basic operation in Calculus, and has many physical applications in a variety of disciplines.

Career Readiness (Standard 9):

- 9.4.12.CI.1 - Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CT.2 - Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.5.CT.3 - Describe how digital tools and technology may be used to solve problems.
- 9.4.12.TL.1 - Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
- 9.4.12.TL.3 - Analyze the effectiveness of the process and quality of collaborative environments.
- 9.4.2.TL.6 - Illustrate and communicate ideas and stories using multiple digital tools (e.g., SL.2.5.).

Learning Targets

Standards: A.SSE; A.APR; A.CED; A.REI; F.IF; F.LE

Content Statements: Write expressions in equivalent forms to solve problems; Understand the relationship between zeros and factors of polynomials; Rewrite rational expressions; Create equations that describe numbers or relationships; Solve equations and inequalities in one variable; Interpret functions that arise in applications in terms of the context; Analyze functions using different representations; Interpret expressions for functions in terms of the situation they model.

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 $(1.15^{1/12})^{12t} \approx 1.01^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual



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	rate is 15%.
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.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.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.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.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
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.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.
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.



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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 meaning of a derivative?
- How do you compute a derivative using the limit definition?
- How do you compute the derivative of a constant?
- How do you compute the derivative of a polynomial?
- How do you compute the derivative of the basic trigonometric functions?
- How do you interpret the derivative of a function at a given location?
- How do you write the equation of a tangent line using a derivative?
- How do you apply the power, quotient, and chain rules?
- How do you apply the chain rule to solve related rates problems?
- How do you apply the derivative to solve optimization problems?
- What does the derivative tell you about the shape of a graph?
- How can you use the derivative to find the maximum and minimum values of a function?
- What is the meaning of higher derivatives, such as the second or third derivatives?

Unit Enduring Understandings:

- The meaning of the derivative.
- How to take the derivative of different types of functions.
- How to maximize or minimize a function.
- How to apply the maximum or minimum of a function to an optimization problem.

Unit Learning Targets:

Students will develop methods to take the derivatives of different types of functions.

Climate Change Example: Students may create equations and/or inequalities to represent the economic impact of climate change.

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.



Evidence of Learning

Summative Assessment: Exams on applications of the derivative, midterm exam

Equipment Needed: Whiteboard, projector, graphing software

Teacher Resources: Textbook, handouts, Desmos activities

Formative Assessments:

- Classwork
- Homework
- Quizzes
- Exam
- Class discussions

Lesson Plans

Lesson	Time Frame
Lesson 1 Taking the derivative of polynomials	3 days
Lesson 2 Implicit Differentiation	3 days
Lesson 3 Optimization	3 days

Teacher Notes: Stress the idea that the derivative represents the slope of the tangent line of a function.

Curriculum Development Resources/Technology Resources:

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

www.kutasoftware.com

tutorial.math.lamar.edu

<https://www.calc-medic.com/>

desmos.com

[geogebra.org](https://www.geogebra.org)



Lesson Plan 1 Template

Content Area: Math Lesson Title: Taking the derivative of a polynomial Time Frame: 3 days

Lesson Components

21st-century Themes

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

21st-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:

Physics, engineering

Integration of Technology:

Desmos

Equipment Needed:

Computer with a projector, graphing calculators

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Use the slope equation to define the slope of the secant line connecting two points on a graph. • Use the limit definition of a derivative to take the derivative of functions. • Use the power rule to take the derivative of polynomial functions. • Find the equation of the tangent line to a polynomial at a given location. • Interpret the meaning of the derivative of a function.	Lesson Sequence 1. Graph a polynomial function. 2. Choose two points on the curve, and find the slope of the secant line between them. 3. What if we moved these two points closer and closer? This is the limit as their distances approach zero. 4. Write the limit of the slope function, and evaluate the limit by rewriting the function. This is the definition of a derivative. 5. Use the definition of the derivative to find the derivatives of constant functions, linear	• Classwork • Class discussion • Homework



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functions, and
quadratics.

6. Work out the derivative of one cubic polynomial.
7. Compare the derivatives of these polynomial functions to the original function, and have students write the Power Rule.
8. Use the derivative to find the equation of the tangent line to a point on a curve.
9. Use Desmos to check a variety of lines with the same slope as the calculated tangent line.

Differentiation:

Use the Desmos activity to scaffold the graphing assignment, e.g. have a set of lines with equal slopes to the tangent line on the same graph.

Resources Provided:

- Graphing calculators
- Desmos
- Textbook



Lesson Plan 2 Template

Content Area: Math Lesson Title: Implicit Differentiation Time Frame: 3 days

Lesson Components

21st-century Themes

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

21st-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:

Engineering, physics

Integration of Technology:

Graphing software, graphing calculator, Desmos

Equipment Needed:

Laptop with projector, graphing software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Take the derivative of a variable with respect to another variable by applying the Chain Rule. - Use proper notation for the derivative with respect to another variable, i.e. dy/dx or y'. - Take the derivative of an implicit function and solve for the dy/dx term. - Interpret the meaning of dy/dx. - Apply Implicit Differentiation	Lesson Sequence - Begin with an equation in the form $y=...$. Use the dy/dx notation when taking the derivative of the left side. - Discuss how y is a function of x, so taking its derivative is an extension of the Chain Rule. - Write an equation for a circle with radius 1. Take the derivative, and - Evaluate a limit by rewriting simple rational functions that can be factored and reduced. - Evaluate a limit by multiplying by the conjugate of the numerator of a function. - Evaluate the limit in a piecewise function from	- Class work - Class discussion - Homework



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the left and right of the chosen x-value. Discuss the discontinuity or continuity of each.

Differentiation:

Provide the students with a list of area and volume equations. Have students determine what kind of units imply which formula, and add these to the list of equations.

Resources Provided:

- Textbook
- Graphing calculators
- Desmos activity



Lesson Plan 3 Template

Content Area: Math Lesson Title: Optimization Time Frame: 3 days

Lesson Components

21st-century Themes

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

21st-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:

Physics, engineering

Integration of Technology:

Graphing software, graphing calculators, Desmos

Equipment Needed:

Whiteboard, computer with projector, graphing calculators

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Review different area and volume equations. - Write algebraic expressions to represent lengths of sides of figures. - Write algebraic expressions and equations to represent word problems. - Use properties of derivatives to solve problems. - Apply the concept of maximizing and minimizing to solve problems. - Combine equations to represent restrictions in a problem (e.g. you are given a certain length of fence to maximize an area).	Lesson Sequence - Review area and volume formulas. - Maximize the area of a fenced in field with a given amount of fencing. - Maximize the area of a fenced in field that is two rectangles with a given amount of fencing. - Minimize the amount of paper used when designing a poster with given margins and a given printed area. - Minimize the surface area of a soup can with a given volume. - Minimize the cost of a box with a given volume (i.e. minimize the surface area).	- Class discussion - Homework - Exam - Class work



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Differentiation:

Give students the opportunity to work in class with different levels of support. Assign a Desmos scaffolded activity that includes more worked out samples of different solids.

Resources Provided:

- Textbook
- Graphing software
- Graphing calculator
- Desmos



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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 Strongly 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: 11-12	Unit Title: Derivatives and Applications
Created: 2024	Board Approved on:	



Unit Overview Template

Content Area: Math **Grade Level(s) :** 11-12 **Unit Title:** Antiderivatives and Applications

Unit Summary: Students will interpret the meaning of the antiderivative. Students will apply their knowledge of sums of areas to estimate regions under a curve. Students will derive the rules for antiderivatives based on the rules for differentiation. Students will take the antiderivative of a variety of types of functions, interpret the result, and apply to different situations. Students will apply antiderivatives to evaluate volumes of revolution.

Primary Interdisciplinary Connections: *Physics, Engineering*

21st-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 antiderivative is a basic operation in Calculus, and has many physical applications in a variety of disciplines.

Career Readiness (Standard 9):

- 9.4.12.CI.1 - Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).
- 9.4.12.CT.2 - Explain the potential benefits of collaborating to enhance critical thinking and problem solving (e.g., 1.3E.12profCR3.a).
- 9.4.5.CT.3 - Describe how digital tools and technology may be used to solve problems.
- 9.4.12.TL.1 - Assess digital tools based on features such as accessibility options, capacities, and utility for accomplishing a specified task (e.g., W.11-12.6.).
- 9.4.12.TL.3 - Analyze the effectiveness of the process and quality of collaborative environments.
- 9.4.2.TL.6 - Illustrate and communicate ideas and stories using multiple digital tools (e.g., SL.2.5.).

Learning Targets

Standards: A.SSE; A.APR; A.CED; A.REI; F.IF; F.LE

Content Statements: Write expressions in equivalent forms to solve problems; Understand the relationship between zeros and factors of polynomials; Rewrite rational expressions; Create equations that describe numbers or relationships; Solve equations and inequalities in one variable; Interpret functions that arise in applications in terms of the context; Analyze functions using different representations; Interpret expressions for functions in terms of the situation they model.

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 $(1.15^{1/12})^{12t} \approx 1.01^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.
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



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	factor of $p(x)$.
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.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.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.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
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.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.
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.



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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 meaning of an antiderivative (also known as the integral)?
- How do you approximate the area using a Riemann Sum?
- How do you compute an antiderivative using the limit definition with a Riemann Sum?
- What is the difference between an indefinite integral and a definite integral?
- How do you compute the antiderivative of a constant?
- How do you compute the antiderivative of a polynomial?
- How do you compute the antiderivative of the basic trigonometric functions?
- How do you interpret the antiderivative of a function in a given boundary?
- How do you solve for the constant in the indefinite integral?
- How do you apply u-substitution to an integral?
- How do you apply integration by parts to solve an integral?
- How do you apply the antiderivative to solve volume problems?
- What does the antiderivative tell you about acceleration, velocity, and position?

Unit Enduring Understandings:

- The meaning of the antiderivative.
- How to take the antiderivative of different types of functions.
- How to apply the antiderivative to find area or volume.

Unit Learning Targets:

Students will develop methods to take the antiderivatives of different types of functions.

Climate Change Example: Students may create equations and/or inequalities to represent the economic impact of climate change.

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.



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Evidence of Learning

Summative Assessment: Exams on applications of the anti-derivative, Final exam

Equipment Needed: Whiteboard, graphing software, graphing calculators, laptops

Teacher Resources: Textbook, handouts

Formative Assessments:

- Classwork
- Homework
- Quizzes
- Exam
- Class discussions



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Lesson Plans

Lesson	Time Frame
Lesson 1 Taking the Antiderivative of Polynomials	3 days
Lesson 2 Exact Area Using the Definite Integral	4 days
Lesson 3 Volumes of Revolution	4 days

Teacher Notes: Stress the idea that the antiderivative represents the area between the function and the x-axis.

Curriculum Development Resources/Technology Resources:

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

www.kutasoftware.com

tutorial.math.lamar.edu

<https://www.calc-medic.com/>

desmos.com

[geogebra.org](https://www.geogebra.org)



Lesson Plan 1 Template

Content Area: Math Lesson Title: Taking the Antiderivative of Polynomials Time Frame: 3 days

Lesson Components

21st-century Themes

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

21st-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:

Physics, engineering

Integration of Technology:

Use of graphing software, Desmos, graphing calculators

Equipment Needed:

Computer with a projector and graphing software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: • Use their knowledge of the derivative to guess the antiderivative of polynomials. • Take antiderivatives of constants and check by taking the derivative. • Understand why the general or indefinite antiderivative has a constant. • Solve for the value of the constant given certain initial conditions. • Solve initial value problems in physics.	Lesson Sequence 1. Give an equation like $g'(x)=2x$. Solve for $g(x)$. 2. Give a variety of simple polynomial equations to find the antiderivative of. 3. Discuss other answers to the same problem. This means each will have a $+c$ at the end to represent all the possible functions with the same antiderivative. 4. Work out a variety of integrals of polynomials. 5. Discuss the notation for the integral. Describe the integral symbol as telling you what operation to complete and the dx term as telling you what variable you will use.	• Class work • Class discussion • Homework



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- | | | |
|--|--|--|
| | 6. Work out functions with fractional exponential powers. Note these are not polynomials, but they use the same exact rules. | |
|--|--|--|

Differentiation:

Provide students with a scaffolded Desmos activity, e.g. an investigation of different basic antiderivatives such as zero, a constant, and linear.

Resources Provided:

- Graphing calculators
- Graphing software
- Desmos activity
- Textbook



Lesson Plan 2 Template

Content Area: Math Lesson Title: Exact Area Using the Definite Integral Time Frame: 4 days

Lesson Components

21st-century Themes

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

21st-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:

Engineering, physics

Integration of Technology:

Graphing software, graphing calculator, Desmos

Equipment Needed:

Laptop with projector, graphing software

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Recall that using a Riemann Sum only approximates the area under a curve. - Understand that when taking the limit as the number of rectangles in a Riemann Sum approaches infinity translates to an infinite number of infinitely small rectangles filling the region under a curve completely, thus giving an exact area. - Relate the Riemann Sum notation to the integration notation. - Understand the definite integral means the exact area under a curve.	Lesson Sequence - Work through a Riemann Sum problem. - Recall this is the approximate area under a curve. Recall that having more rectangles means a more accurate answer. - Take the limit of the Riemann Sum, and define it as the definite integral. - Show students how to apply the boundary conditions. Graphically reason with a projection from Grapher. - Take the definite integral so that the answer is negative. Again, graphically reason about this.	- Classwork - Class discussion - Homework



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- Take the integral on a boundary and interpret the result.
- Sketch the region they are integrating under.
- Understand the meaning of a negative answer from a definite integral.

6. Carefully sketch each example out. Use polynomial functions and basic trigonometric functions.
7. Discuss how the integral could equal zero. Have students give specific examples.
8. Introduce proper definite integral notation and have students compute using this form.

Differentiation:

Prepare a Desmos activity for different levels of students containing additional examples, e.g. showing the link between the Riemann sum notation and the definite integral notation.

Resources Provided:

- Textbook
- Graphing calculators
- Desmos



Lesson Plan 3 Template

Content Area: Math Lesson Title: Volumes of Revolution Time Frame: 4 days

Lesson Components

21st-century Themes

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

21st-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:

Physics, engineering

Integration of Technology:

Graphing software, graphing calculators, Desmos

Equipment Needed:

Laptop with projector, graphing calculators

Goals/Objectives	Learning Activities/ Instructional Strategies	Formative Assessment Tasks
Students will: - Understand that rotating a 2-dimensional shape in space will result in a 3-dimensional shape. This means we can use the integral to find the surface area and the volume made by rotating that surface. - Draw 2-dimensional figures and understand how they are rotated to make a 3-dimensional figure. - Find intersections between two curves to determine the boundaries - Find the volumes of rotation of a variety of regions using either washer or disk method.	Lesson Sequence - Sketch regions in 2-dimensions. - Discuss what the regions they sweep out look like when rotated in 3-dimensions. - Start with a constant function. When rotated, this makes a cylinder. - Find the volume of the region under $y=x$ when rotated around the y axis, then around the x axis. - Discuss how to sketch graphs that are $y=$ and $x=$. - Rotate $y=x^2$ and then $x=y^2$ around the two axes in a given interval. - Give two curves, have students find their intersections either by	- Class discussion - Homework - Quiz - Class work



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hand or with the graphing calculator, then set up an integral for the volume of revolution about an axis.

8. Change the axis of rotation to $y=3$ instead of the x axis. How does this change the integral?
9. Discuss the difference between the washer and disk method.
10. Work through a mixed set of examples, varying between dx and dy , and with various sets of intersecting functions.

Differentiation:

Utilize videos to help illustrate volumes of revolution, e.g:

https://www.youtube.com/watch?v=QLHJl2_aM5Q

Work with small groups of students to ensure understanding of revolutions.

Resources Provided:

- Textbook
- Graphing software
- Desmos
- Graphing calculator



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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 Strongly 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:** 11-12 **Unit Title:** Antiderivatives and Applications

Created: 2024

Board Approved on:



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**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



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**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:



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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



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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



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**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



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**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



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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.