Marking Period: 4	Unit Title: Differential Equations	Recommended Instruction Days: 15-20

Standard-New Jersey Student Learning Standards: F-IF, F-BF, F-LE

Strand:

F-IF: Interpreting Functions

Understand the concept of a function and use function notation

2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers.

F-BF: Building Functions

Build a function that models a relationship between two quantities

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.
   c. Compose functions.
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: Linear and Exponential Models

Interpret expressions for functions in terms of the situation they model

5. Interpret the parameters in a linear or exponential function in terms of a context.

LGBT and Disabilities Law: *N.J.S.A. 18A:35-4.35*

NASA Employees

The mission is to ensure that every student is able to see themselves in our rich and diverse history.

Social and Emotional Learning: ***Competencies***	**Social and Emotional Learning:** ***Sub-Competencies***
Self-Awareness Social Awareness Self-Management Relationship Skills Responsible Decision-Making	• Recognizing the importance of self-confidence in handling daily tasks and challenges. • Demonstrate an awareness of the expectations for social interactions in a variety of ways. • Demonstrate an understanding of the need for mutual respect when viewpoints differ. • Recognize the skills needed to establish and achieve personal and educational goals. • Utilize positive communication and social skills to interact effectively with others. • Develop, implement, and model effective problem solving and critical thinking skills.

Recommended Activities, Investigations, Interdisciplinary Connections, and/or Student Experiences to Explore NJSLS-CLKS within Unit

Essential Questions	**Progress Indicators**	**Activity Description**
• How are differential equations used to describe rates of change? • What are differential equations and how do we solve them? • How does the Fundamental Theorem of Calculus	• Tests • Quizzes • Practice problems for homework • Worksheets • Leveled assessments • Projects	❖ Writing a Differential Equation ❖ Verifying Solutions ❖ Slope Fields ❖ Separation of Variables ❖ Example Tasks Below **Interdisciplinary Connections:** **Personal Financial Literacy Domain: Credit and Debt Management** The balance of a certain loan increases at a rate that is proportional at any time to the balance at that time. The loan balance is $1600 initially and it is $1920 after one year.

connect differential and integral calculus?		What is the balance of the loan after 90 days? **Answer:** Let $B(t)$ model the balance of the loan after t days. We are told that the rate of change of B is proportional to B: $$\frac{dB}{dt} = kB$$ This sort of differential equation describes an exponential model, and its solution is $$B(t) = C \cdot e^{kt}$$ Let's find the values for C and k. We are told that the balance was $\$1600$ initially. From this we can tell that $C = 1600$. We are also told that the balance of the loan was $\$1920$ after 365 days. From this we can tell that $k = \frac{\ln(1.2)}{365}$. We found that $B(t) = 1600e^{\frac{\ln(1.2)}{365}t}$. The balance of the loan after 90 days is $B(90)$: $$B(90) = 1600e^{\frac{\ln(1.2)}{365}90} \approx 1673.57$$ **In conclusion, the balance of the loan after 90 days is $\$1673.57$.**

		Task Which of the differential equations are separable? a) $xy' + y = 3$ b) $2x + 2y + 2y' - 1 = 0$ c) $y' = (x^2 + x)(y^2 + y)$ d) $x\frac{dy}{dx} + y\frac{dy}{dx} = x$ **Answer** a) and c) **Task** Each month the balance, B, of Harper's loan increases by 0.22% and decreases by $250. Write an equation that describes this relationship? **Answer** $\frac{dB}{dt} = 0.0022B - 250$

Mathematical Practices

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
7. **Look for and make use of structure.**
8. **Look for and express regularity in repeated reasoning.**

Assessments (Formative) ***To show evidence of meeting the standard/s, students will successfully engage within:***	**Assessments (Summative)** ***To show evidence of meeting the standard/s, students will successfully complete:***
Formative Assessment: ● Entry and Exit Slips ● Quizzes ● Self Assessments ● Focus Packets	**Benchmarks:** ● Chapter Tests ● Projects **Summative Assessments:** ● District assessments

Differentiated Student Access to Content: **Teaching and Learning *Resources/Materials***			
Core Resources	**Alternate Core Resources** ***IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core Resources**
online albert resource online achievethecore resource online learnzillion resource online khan academy resource online desmos resource online edulastic resource	Reteaching worksheets Skill building workbook Math manipulatives Leveled practice worksheets	Dictionary for native language Video tutorial in native language Success for English Learners worksheets Leveled Strategies for English Learners Linguistic Support	Enrichment worksheets Art of Problem Solving Leveled assessments
Supplemental Resources			

- Technology: Chromebooks, Graphing Calculators, Smartboards,
- Other: Zoom and Google Meets, Schoology, Google Classroom

Differentiated Student Access to Content: **Recommended *Strategies & Techniques***			
Core Resources	**Alternate Core Resources** ***IEP/504/At-Risk/ESL***	**ELL Core Resources**	**Gifted & Talented Core Resources**
Deliver instruction utilizing varied learning styles including audio, visual, and tactile/kinesthetic, provide individual instruction as needed, modify assessments and/or rubrics, repeat	Utilize a multi-sensory (VAKT) approach during instruction, provide alternate presentations of skills by varying the method (repetition, simple explanations, additional examples, modeling, etc.), modify test content and/or format, allow students to retake test for additional credit, provide additional times and preferential seating as needed, review, restate and repeat directions, provide study guides, and/or break assignments into segments of shorter tasks.	Extend time requirements, preferred seating, positive reinforcement, check often for understanding/review, oral/visual directions/prompts when necessary, supplemental materials including use of an online bilingual dictionary, and modified assessment and/or rubric.	Create an enhanced set of introductory activities, integrate active teaching/learning opportunities, incorporate authentic components, propose interest-based extension activities, and connect student to related