TOWNSHIP OF UNION PUBLIC SCHOOLS

General Math 3

Adopted August 12, 2015

Updated December 18, 2018

Mission Statement

The Township of Union Board of Education believes that every child is entitled to an education designed to meet his or her individual needs in an environment that is conducive to learning. State standards, federal and state mandates, and local goals and objectives, along with community input, must be reviewed and evaluated on a regular basis to ensure that an atmosphere of learning is both encouraged and implemented. Furthermore, any disruption to or interference with a healthy and safe educational environment must be addressed, corrected, or when necessary, removed in order for the district to maintain the appropriate educational setting.

Philosophy Statement

The Township of Union Public School District, as a societal agency, reflects democratic ideals and concepts through its educational practices. It is the belief of the Board of Education that a primary function of the Township of Union Public School System is to formulate a learning climate conducive to the needs of all students in general, providing therein for individual differences. The school operates as a partner with the home and community.

Course Description

General Math 3 is intended for students who have completed Algebra I and Geometry but who are not yet ready for Algebra II. This program helps solidify students understanding by providing a different kind of learning experience. Students model real-world applications with a functions approach netting a deeper grasp of the important concepts necessary for success in Algebra II.

Recommended Textbook:

Modeling with Mathematic: A Bridge to Algebra II (2nd Edition)

Curriculum Units

Unit 1: Numerical Operations

Unit 2: Linear Equations and Inequalities

Unit 3: Geometry, Symmetry, and Transformations

Unit 4: Data Analysis and Probability

Unit 5: Functions

Pacing Guide

Content	Number of Days
Unit 1: Numerical Operations	**23**
Unit 2: Linear Equations and Inequalities	**67**
Unit 3: Geometry, Symmetry, and Transformations	**28**
Unit 4: Data Analysis and Probability	**30**
Unit 5: Functions	**32**

Unit 1: Numerical Operations

Essential Questions	NJSLS/Instructional Outcomes	Activities	Assessments
• When should fractions, decimals, and percent be used? • What is the correct order of operations when evaluating an expression? • What is the importance of understanding decimal places and rounding correctly? •	• Evaluate expressions properly using the order of operations. (N-RN 1-3) • Convert values between forms (fractions, decimals, and percent). (NQ 1-3) • Find the percent of change when given an original amount and a new amount. (N-RN 1-3) • Understand the naming of decimal places and properly round decimals. (N-RN 1-3) • Convert between standard form and scientific notation. (N-RN 1-2) • Solve basic percent problems. (A-REI 5-6) ; (N-RN 1-3)	• Calculate the amount of a discount on Internet sales. **(Interdisciplinary Connection)** • Let students create a proportional measure of a statue of themselves.	• List the following values in order from least to greatest: 0.2 ; 21% ; ½ ; 3/8 • What is 45% of 520? • The price of Lay's Potato Chips was originally priced at $0.25. Now, the same bag of chips is priced at $0.45. What is the percent of change? Is it a percent of increase or decrease? • The earth is approximately 92,960,000 miles away from the sun. Convert the distance to scientific notation. • Using the order of operations, evaluate the following expression: (9+1) +3(2 +1) – 4/2

Suggested Differentiation for Unit 1

- **Tier 1 Learners:**
  - Have guided notes filled out at different levels according to ability.
  - Give assignments that contain tasks of varying difficulty. Each task should focus on essential learning that all students should master, but the tasks will vary in difficulty.
  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
  - Group students so that each group contains all level learners. The tier 3 learners can serve as peer helpers.
  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
  - Allow students to choose a method for completing a project: video, PowerPoint, paper, or presentation.
- **Tier 2 Learners:**
  - Utilize foldables creating tangible products to help students digest information while incorporating several of the multiple intelligences.
- **Tier 3 Learners:**
  - Have problems posted around the room. Have students loop to specific questions based on difficulty.

Curriculum Development Resources

- Course textbook - Modeling with Mathematic: A Bridge to Algebra II
- Graphing calculator
- Kuta software

Unit Proficiencies

Students will be able to:

- Define, give examples of, distinguish between, use the numbers of, and use the properties of number systems within the set of

real numbers

- Apply the laws of exponents to numerical and algebraic expressions
- Convert between fractions, decimals and percents.
- Use proportions.

Unit 2: Linear Equations and Inequalities

Essential Questions	NJSLS/Instructional Outcomes	Activities	Assessments
• How can you use mathematical models to describe change or change over time? • How can expressions of real world situations be used so that the powers of mathematics apply? • How can models be used to help explain real-life situations? • How can patterns be used as a tool to support and explain real-life situations?	• Write equations that model real life situations. (A-CED 1-4) ; (A-REI 5-6) • Identify direct variation. (A-REI 1) • Solve linear equations. (A-REI 1-2) ; (A-REI 5-6) • Solve inequalities in one variable. (A-REI 3) • Graph inequalities, including compound inequalities, in one variable. (A-REI 3-4) ; (A-REI 10) • Solve absolute value equations and inequalities (A-REI 3-4) • Graph absolute value equations and inequalities. (A-REI 10)	• Create small groups with students. Give each group a chart that describes the growth of a plant over a 10-week period. Have students create an equation representing the plants growth and predict how tall the plant will be by week 16. **(Interdisciplinary)** • Place students in group for the following activity: A family going on a one-week vacation is given four rent-a-car plans. Choose the best plan by using the following options: 1. Make a table 2. Make a graph 3. Analyze the graph 4. Write the functions • Ordered-Pair Speed Dating- Give each student an index card with an ordered pair written on it. Set the	• Write the equation of the line that passes through the following points. (2,3) and (5,7) • Convert the following equation into slope intercept form. $2x + 3y = 12$ • Solve the following inequality and graph your solution on a number line: $2x < 4x + 3$ • Solve the following absolute value equation: $\|3x+1\| = 12$ • Find the slope of the line that is perpendicular to the following line and passes through the following point. $2x + 5y = 10$; (4,3)

	• Describe, analyze and use key characteristics of linear systems and their graphs. (A-REI 10) • Determine the algebraic difference between parallel and perpendicular lines. (A-REI 10) • Distinguish the difference between intersection and union. (A-REI 10)	classroom up in pairs. Have students' pair up with other students finding the slope and y-intercept of the line that passes through the two of their points. Have student switch every 2 to 3 minutes, like speed dating. • Use a protractor to draw parallel and perpendicular lines on graph paper. Prove the algebraic relationship between parallel and perpendicular lines.	

Suggested Differentiation for Unit 2

- **Tier 1 Learners:**
  - Have guided notes filled out at different levels according to ability.
  - Give assignments that contain tasks of varying difficulty. Each task should focus on essential learning that all students should master, but the tasks will vary in difficulty.
  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
  - Group students so that each group contains all level learners. The tier 3 learners can serve as peer helpers.
  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
  - Allow students to choose a method for completing a project: video, PowerPoint, paper, or presentation.

- **Tier 2 Learners:**
  - Utilize foldables creating tangible products to help students digest information while incorporating several of the multiple intelligences.
- **Tier 3 Learners:**
  - Have problems posted around the room. Have students loop to specific questions based on difficulty.

Curriculum Development Resources

- Course textbook - Modeling with Mathematic: A Bridge to Algebra II
- Graphing calculator
- Kuta software

Unit Proficiencies

Students will be able to:

- Solve single-variable linear equations and inequalities with rational coefficients
- Solve absolute value equations
- Graph and analyze the graph of two variable linear equations and inequalities
- Solve systems of linear equations algebraically and graphically
- Recognize, describe, and represent linear relationships using words, tables, numerical patterns, graphs, and equations
- Determine parallel and perpendicular lines given their slopes.
- Identify slope and intercept of a linear equation and find such given 2 points on a line.

Unit 3: Geometry, Symmetry, and Transformations

Essential Questions	NJSLS/Instructional Outcomes	Activities	Assessments
• When should the Pythagorean Theorem be used? • How are the formulas for volume derived from the formulas for area? • How can trigonometry functions be used to find unknowns in triangles?	• Find the sine, cosine, and tangent of an acute angle of a right triangle. (G-SRT 6-8) • Find the missing side of a triangle using the Pythagorean Theorem. (G-SRT 6-8) • Be able to give the most specific name to a quadrilateral with given characteristics. (G-SRT 1-3) • Find the sum of the interior angles of a polygon with 'n' number of sides. (G-SRT 1-3) • Find the area and volume of figures by breaking down figure into parts. (G-SRT 1-3)	• Students stack textbooks that are 3 feet from the edge of the table. Using a ruler they will measure the height and hypotenuse formed between the table and the books. Students will record the answers in a chart for different quantities of textbooks stacked together. • Students will be placed into groups to tape a piece of rope from the floor to the wall. Using a protractor and a ruler they will find the length of the sides of the right triangle formed along with the angles. Afterwards, students will contrast the results using trigonometry to verify the measurements taken.	• Find the length of a ladder leaning against a house when the high of the house is 8 ft away high and 6 feet away from the ladder. • The ramp on the back of a moving van is 3 ft high and rises at an angle of 25 . How long is the ramp? • Your friend is flying a kite. She lets out 105 ft of string and anchors it to the ground. She determines that the angle of elevation of the kite is 48°. Find the height the kite is from the ground. • A12ft ladder is propped against a vertical wall.Thetopendis11ft above the ground. What is the measure of the angle formed by the ladder with the ground? • The lengths of the sides of a triangle are given. a)

•	Find all angles formed by 2 parallel lines and a transversal given just one angle. (G-SRT 6-8)		Determine if they form a right triangle, then b) Determine if it is a Pythagorean Triple.

Suggested Differentiation for Unit 3

- **Tier 1 Learners:**
  - Have guided notes filled out at different levels according to ability.
  - Give assignments that contain tasks of varying difficulty. Each task should focus on essential learning that all students should master, but the tasks will vary in difficulty.
  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
  - Group students so that each group contains all level learners. The tier 3 learners can serve as peer helpers.
  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
  - Allow students to choose a method for completing a project: video, PowerPoint, paper, or presentation.
- **Tier 2 Learners:**
  - Utilize foldables creating tangible products to help students digest information while incorporating several of the multiple intelligences.
- **Tier 3 Learners:**
  - Have problems posted around the room. Have students loop to specific questions based on difficulty.

Curriculum Development Resources

- Course textbook - Modeling with Mathematic: A Bridge to Algebra II
- Graphing calculator
- Kuta software

Unit Proficiencies

Students will be able to:

- Develop and use the triangle-sum and angle-measure theorems for polygons, and the triangle Inequality theorem
- Identify and apply conditions that are sufficient to guarantee similarity of triangles.
- Show how similarity of right triangles allows the trigonometry functions sine, cosine and tangent to be properly defined as ratios of sides.
- Recognize and apply the definitions and properties of circles
- Determine the surface area and volume of solid figures, recognizing and using relationships among volumes of common solids

Unit 4: Data Analysis and Probability

Essential Questions	NJSLS/Instructional Outcomes	Activities	Assessments
• What do the intersection and union of two sets mean? • How is a line of best fit representative of its data? • When is each measure of central tendency appropriate to use? • How can experimental and theoretical probabilities be used to draw conclusions or make predictions? • How can probability be applied to real-life situations? • When does order matter? • How can the collection, organization, interpretation	• Apply probability concepts to determine the likelihood an event will occur in practical situations. (S-ID 1-4) • Use the ratio of a given area to the total area, which it is contained in to compute the geometrical probability. (S-CP 1-4)	• Investigate different types of lotteries and determine the total possible number of outcomes. **(Interdisciplinary)** • Analyze various carnival games by searching on the internet • Attach different premeasured weights to coiled pipe cleaners and plot stretched length per weight and then determine line of best fit. • Research the cost per year of attending the local community college, a state college, a private college, an Ivy league school and an out of state school. Analyze the mode, mean and median of the data in terms accurately predicting college cost.	• If a population of a town follows a linear growth trend describe the slope as a rate of change and set up the appropriate axes and labels to graph a five year representation. • If a student has scores 78, 82, 91, 84 and 67, what score must be achieved on the sixth test to raise the average to 82? • Compare the number of ways the letters in the word FROG and DEER can be arranged to form different 4-letter sequences.

and display of data be used to answer questions?		• Students bring in unwanted clothing and class determines all possible outfits that can be made. Use tree diagram to represent all the combinations and derive the counting principle. Donate clothing afterwards!	

Suggested Differentiation for Unit 4

- **Tier 1 Learners:**
  - Have guided notes filled out at different levels according to ability.
  - Give assignments that contain tasks of varying difficulty. Each task should focus on essential learning that all students should master, but the tasks will vary in difficulty.
  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
  - Group students so that each group contains all level learners. The tier 3 learners can serve as peer helpers.
  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
  - Allow students to choose a method for completing a project: video, PowerPoint, paper, or presentation.
- **Tier 2 Learners:**

- Utilize foldables creating tangible products to help students digest information while incorporating several of the multiple intelligences.

- **Tier 3 Learners:**
  - Have problems posted around the room. Have students loop to specific questions based on difficulty.

Curriculum Development Resources

- Course textbook - Modeling with Mathematic: A Bridge to Algebra II
- Graphing calculator
- Kuta software

Unit Proficiencies

Students will be able to:

- Calculate measures of central tendency
- Apply the multiplication rule of counting in complex situations, recognizing the difference between situations with replacement and without replacement, and recognize the difference between ordered and unordered counting situations.
- Recognize probability problems that can be represented by geometric diagrams, on the number line, or in the coordinate plane.
- Recognize and explain relationships involving combinations and Pascal's triangle, and apply those methods to situations involving probability.
- Draw line of best fit and state its correlation to data.

Unit 5: Functions

Essential Questions	NJSLS/Instructional Outcomes	Activities	Assessments
• How can quadratic equations be used to model real life situations? • How can exponential functions be used to model real life situations?	• Recognize exponential functions. (N-RN 1-2) • Use properties of exponents to simplify expressions (N-RN 1-2) • Define and use negative exponents and the zero exponent (N-RN 1-2) • Simplify monomials • Identify and model situations involving exponential growth and decay (F-LE 1) • Identify vertex, axis of symmetry, and other characteristics of a parabola (F-LE 1) • Solve quadratic equations by completing the square, factoring, and using the	• Write the quadratic equation created by The Gateway Arch in St. Louis, Missouri. **(Interdisciplinary)** • Students will form groups and create the equation that represents a students hair. • Use the Smart Board to illustrate changes to the vertical motion model in real-life problems. • Given the volume of various solids, students will rewrite the formulas in terms of height. • Use the graphing calculator to identify the zeroes of the quadratic equation.	• Solve the following quadratic equation using the quadratic formula, process of completing the square, and by factoring. x^2 +3x +2 = 0 • Determine the vertex of the function $F(x) = 4x^2 - 4x + 8$ • An owl is circling a field at a height of 70 feet and sees a mouse. The owl folds its wings and begins to dive with an initial speed of 6 feet per second. Estimate the time the mouse has to escape. The model for the height of the owl at time t is $h = -16t^2 - 6t + 70$

	quadratic formula. (N-CN 7) ; (A-REI 4a-4b)		

Suggested Differentiation for Unit 5

- **Tier 1 Learners:**
  - Have guided notes filled out at different levels according to ability.
  - Give assignments that contain tasks of varying difficulty. Each task should focus on essential learning that all students should master, but the tasks will vary in difficulty.
  - Group students by similar interest when working on application problems.
  - Use mini lessons to reteach to those having difficulty.
  - Group students so that each group contains all level learners. The tier 3 learners can serve as peer helpers.
  - Assign a basic homework assignment. Require students to spend a set amount of time to work (showing effort) on the assignment rather than completing the entire assignment.
  - Allow students to choose a method for completing a project: video, PowerPoint, paper, or presentation.
- **Tier 2 Learners:**
  - Utilize foldables creating tangible products to help students digest information while incorporating several of the multiple intelligences.
- **Tier 3 Learners:**
  - Have problems posted around the room. Have students loop to specific questions based on difficulty.

Curriculum Development Resources

- Course textbook - Modeling with Mathematic: A Bridge to Algebra II
- Graphing calculator
- Kuta software

Unit Proficiencies

Students will be able to:

- Recognize, describe, represent, and analyze quadratic functions using words, tables, graphs, or equations
- Solve problems that can be modeled using a quadratic function
- Solve single-variable quadratic equations

Additional Suggested Modifications for Units

Below is an additional list of modifications and accommodations opportunities. This includes, but is not limited to,:

1. English Language Learners.
    a. Read written instructions.
    b. Model and provide examples
    c. Extended time on assessments when needed.
    d. Establish a non-verbal cue to redirect student when not on task.
    e. Students may use a bilingual dictionary.

English Language Development Standard 3: Language of Mathematics: English language learners communicate information, ideas and concepts necessary for academic success in the content area of mathematics.

2. Special Education/504 Students.
    a. Extended time on assessments when needed.
    b. Preferred seating to be determined by student and teacher.
    c. Provide modified assessments when necessary.
    d. Student may complete assessments in alternate setting when requested.
    e. Establish a non-verbal cue to redirect student when not on task.
    f. Maintain strong teacher / parent communication.
    g. Conversion chart

New Jersey Student Learning Standards - Technology

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations

B. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.

C. Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning.

E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

Students will be instructed on how to use TI-84 Plus graphing calculators, Microsoft Excel, and Fathom to generate graphs, compute statistics, and analyze data. Such technology will be required on homework, projects, and other assessments.

*See Activities for further Technology Integration.

Career Readiness Practices

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP4. Communicate clearly and effectively and with reason.
- CRP6. Demonstrate creativity and innovation.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP11. Use technology to enhance productivity.

NJSLS 9.2 - Career Awareness, Exploration, and Preparation

9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

New Jersey Student Learning Standards for Mathematics

Academic Area

Unit 1: Numerical Operations

N-RN

Extend the properties of exponents to rational exponents.

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 51/3 to be the cube root of 5 because we want (51/3)3 = 5(1/3)3 to hold, so (51/3)3 must equal 5.

2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. Use properties of rational and irrational numbers.

3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Unit 2: Linear Equations and Inequalities

A-SSE

Interpret the structure of expressions

1. Interpret expressions that represent a quantity in terms of its context.

    a. Interpret parts of an expression, such as terms, factors, and coefficients.
    b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

A-CED

Create equations that describe numbers or relationships

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.

2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

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.

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

Solve equations and inequalities in one variable

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

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 x2 = 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 ± bi for real numbers a and b.

Unit 3: Geometry, Symmetry, and Transformations

G-CO

Experiment with transformations in the plane

1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.

2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs.
Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).

3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.

4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.

5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.

G-SRT

Understand similarity in terms of similarity transformations

1. Verify experimentally the properties of dilations given by a center and a scale factor:
    a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.
    b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.

2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.

3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.

Unit 4: Data Analysis and Probability

S-CP

Understand independence and conditional probability and use them to interpret data

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").

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.

3. Understand the conditional probability of A given B as P(A 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-MD

Calculate expected values and use them to solve problems

1. (+) Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space; graph the corresponding probability distribution using the same graphical displays as for data distributions.

2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.

Unit 5: Functions

A-SSE

Write expressions in equivalent forms to solve problems

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.

F-LE

Construct and compare linear, quadratic, and exponential models and solve problems

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