### SD Common Core State Standards Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain: The Real Number System</th>
<th>Cluster: Extend the properties of exponents to rational exponents</th>
<th>Grade level: 9-12</th>
</tr>
</thead>
</table>

#### Correlating Standard in Previous Year

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.EE.1 Work with radicals and integer exponents</td>
<td>9-12.N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define 5^(1/3) to be the cube root of 5 because we want [5^(1/3)]^3 = 5^[(1/3) x 3] to hold, so [5^(1/3)]^3 must equal 5.</td>
<td>9-12.N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.</td>
</tr>
</tbody>
</table>

#### Student Friendly Language:

I can apply (use) properties of exponents to simplify algebraic expressions with fractional exponents.

#### Key Vocabulary:

- rational
- index
- radical
- radicand
- simplify expressions
- integer
- exponents

#### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

- Using interest rates (i.e. Savings accounts and loans)
- Applying scientific notation in real world applications
- Exponential Growth and Decay including half-life
SD Common Core State Standards Disaggregated Math Template

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<thead>
<tr>
<th>Domain:</th>
<th>The Real Number System</th>
<th>Cluster:</th>
<th>Extend the properties of exponents to rational exponents</th>
<th>Grade level:</th>
<th>9-12</th>
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</table>

**Correlating Standard in Previous Year**

9-12.N.RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{1/3}$ to hold, so $5^{1/3}$ must equal 5.

**Number Sequence & Standard**

9-12.N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

**Correlating Standard in Following Year**

9-12.N.RN.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.

**Student Friendly Language:**

I can convert from radical form to rational exponent form and vice versa.

I can use (apply) properties of exponents to simplify rational and radical expressions.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual) The students will understand that:</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>radical form</td>
<td>Radical expressions can be written in exponential form.</td>
<td>Rewrite exponential expression in radical form.</td>
</tr>
<tr>
<td>properties of exponents</td>
<td>Exponential expressions can be written in radical form.</td>
<td>Rewrite radical expressions in exponential form.</td>
</tr>
<tr>
<td>rational exponents</td>
<td>The Order of Operations must be followed when using the Properties of Exponents.</td>
<td>Apply the order of operations and properties of exponents when simplifying expressions with radicals and/or exponents and recognize when an expression is fully simplified.</td>
</tr>
<tr>
<td>simplified expression</td>
<td>It is easier to simplify or solve certain problems using either exponential or radical form.</td>
<td>Describe what the parts of the rational exponent represent when rewriting in radical form.</td>
</tr>
<tr>
<td>order of operations</td>
<td>Radical symbols are a form of grouping symbols.</td>
<td>Use the most appropriate notation in various situations (i.e. exponential or radical form).</td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

Exponential form  Radical form  Rational exponent

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Use it in the financial world, for example, interest rates, inflation, or depreciation

Calculating the distance using points in a coordinate plane or in space (i.e. Distance Formula)

To see how exponential growth or decay affects populations.
Domain: The Real Number System
Cluster: Use properties of rational and irrational numbers
Grade level: 9-12

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<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.NS.1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.</td>
<td>9-12.N.RN.3 Explain why the sum or product of 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.</td>
<td></td>
</tr>
</tbody>
</table>

Student Friendly Language:
I can add and multiply rational numbers which results in a rational number and explain the results.
I can add a rational and irrational number which results in an irrational number and explain the results.
I can multiply a nonzero rational and irrational number which results in an irrational number and explain the results.

Know (Factual)
- Definition of a rational number
- Definition of an irrational number
- Order of operations
- Product of rational and irrational numbers
- Sum of rational and irrational numbers

Understand (Conceptual)
The students will understand that:
- Rational numbers are fractions (numerator and denominator are rational numbers), repeating decimals, and terminating decimals.
- Irrational numbers (could be fractions with an irrational numerator or denominator) are non-terminating, non-repeating decimals. For example, pi, e, square roots of not perfect squares.
- The sum and product of a rational number results in a rational number.
- The sum of a rational number and an irrational number is an irrational number.
- The product of an irrational number and a nonzero rational number is irrational.

Do (Procedural, Application, Extended Thinking)
- Explain why the sum or product of rational numbers is rational.
- Explain why the sum of a rational number and an irrational number is irrational.
- Explain why the product of a nonzero rational number and an irrational number is irrational.

Key Vocabulary:

Rational numbers            Irrational numbers               sum                product

Relevance and Applications: How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

When baking, you must add rational numbers. (Ex. 1/2 c. + 2/3 c.)

When carpeting a room, you must find the area by multiplying the side lengths of the room.

Finding the volume of a grain elevator (cylindrical container). (Ex. \(\pi r^2 h\), leave answer in terms of \(\pi\).)
**SD Common Core State Standards Disaggregated Math Template**

**Domain:** Number and Quantity  
**Cluster:** Reason quantitatively and use units to solve problems  
**Grade level:** 9-12

<table>
<thead>
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<tbody>
<tr>
<td>7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.</td>
<td>9-12.N.Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.*</td>
<td>9-12.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.*</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can use correct units when problem solving.

I can use units to help solve problems.

I can choose the correct scale for graphs and data displays.

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<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
</table>
| • Units for length, area, and volume  
• How to combine units for acceleration and other derived units  
• Identify independent and dependent variable to place them correctly on a graph | The use of units is important in solving word problems.  
It is important to convert to a single common unit of measure before solving the problem.  
Units of measure can help you determine what a quantity in a word problem represents.  
It is important to use proper units of measure in context of the problem. | Choose appropriate units of measurement when solving problems.  
Use quantities to solve word problems.  
Use quantities to choose an appropriate graph scale.  
Set the correct scale on a graph (Set the correct window on a graphing calculator). |

**Key Vocabulary:**

scale  
units of measure  
origin

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Read and interpret graphs in newspapers and magazines.

Look for bias in graphs based on choice in scale.

Calculate quantities such as gas mileage, areas, volume, surface area, area per gallon paint, etc in a word problem using appropriate units of measure.
**SD Common Core State Standards Disaggregated Math Template**

| Domain: | Number and Quantity | Cluster: | Reason quantitatively and use units to solve problems | Grade level: | 9-12 |

<table>
<thead>
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<tbody>
<tr>
<td>8.NS.1 Understand informally that every number has a decimal expansion; the rational numbers are those with decimal expansions that terminate in 0s or eventually repeat. Know that other numbers are called irrational.</td>
<td>9-12.N.Q.2 Define appropriate quantities for the purpose of descriptive modeling.*</td>
<td>9-12.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can round my number appropriately.

I can round my numbers at appropriate times knowing that the sooner I round, the less accurate my answer will be.

I can use the correct form of a number.

I can label my work correctly throughout the problem.

I can justify my answer and determine whether or not it could be an appropriate model for an alternative scenario.

I can determine whether or not my answer makes sense in the context of the problem.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>I want students to understand that:</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
</table>
| ● Information can be modeled in many different ways (graph, equation, etc)  
● Different representations of numbers | Selection of appropriate quantities when modeling real world situations is important.  
It is important to know when to round a number and how to round it appropriately based on the situation.  
It is important to be consistent with the numeric representation of a number throughout the problem. | Determine the appropriate numeric representation of the quantities in a word problem.  
Round all quantities appropriately in a word problem based on the context of the situation.  
Be consistent in labeling all quantities throughout the process of solving a problem.  
Examine the results and determine if it makes sense in the context of the problem. |

**Key Vocabulary:**

quantities   rounding   numeric representations   modeling   units of measure

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Students are at an age where they could have a paying job. The student needs to be able to determine if their paycheck has been calculated correctly. They will need to interpret a model which encompasses wage, time worked, overtime, and deductions. They will also need to use numbers rounded to hundredths place to correctly model a monetary situation.

An appropriate model can be utilized repeatedly every pay period.
Domain: Number and Quantity
Cluster: Reason quantitatively and use units to solve problems
Grade level: 9-12

Correlating Standard in Previous Year

4.MD.1 Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two column table. For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...

Number Sequence & Standard

9-12.N.Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Correlating Standard in Following Year

Student Friendly Language:

I can compare units of measurement for precision in my answers.

I can understand that not all measurements are exact; there are human errors in every measurement.

Know (Factual)

Understand (Conceptual)
I want students to understand that:

Do (Procedural, Application, Extended Thinking)

- How to convert units of measurement
- How to use significant digits

Unit and scale can be used as a tool to effectively model context and solve problems.

Precision is limited to the instrument used to make a particular measurement.

Precision and accuracy are not synonymous terms.

Choose values based on their limitations in the context of the situation.

Explain the accuracy of the results in the context of the situation.

Key Vocabulary:

unit conversions significant digits accuracy precision measurement tools

Relevance and Applications: How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question "why do I have to learn this"?

Measurement is seen in all areas of science. Chemists are limited to the precision of their instruments. In the same nature, carpenters are limited to the precision of their tape measure or rulers.

Examples of instrument limitation:

- The scales read “1 kg” when there is nothing on them
- You always measure your height wearing shoes with thick soles.
- A stopwatch that takes half a second to stop when clicked
# SD Common Core State Standards Disaggregated Math Template

<table>
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<tr>
<th>Domain: Seeing Structure in Expressions</th>
<th>Cluster: Interpret the structure of expressions</th>
<th>Grade level: 9-12</th>
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</thead>
</table>

## Correlating Standard in Previous Year | Number Sequence & Standard | Correlating Standard in Following Year
---|---|---
8.F.2 - Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a linear function represented by a table of values and a linear function represented by an algebraic expression, determine which function has the greater rate of change. | 9-12.A.SSE.1 - Interpret expressions that represent a quantity in terms of its context* A.SSE.1a - Interpret parts of an expression, such as terms, factors, and coefficients. A.SSE.1b - 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 \( P \). | 9-12.A.SSE.9-12.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments. |

## Student Friendly Language:

I can interpret what the terms, factors, and/or coefficients are in expressions and formulas.

## Know (Factual) | Understand (Conceptual) | Do (Procedural, Application, Extended Thinking)
---|---|---
- how to identify factors, terms, coefficients
- what effect a factor, term, or coefficient can have on an expression | Components of expressions and equations have meaning within a function and its real-world context. Expressions and equations can be used to represent physical quantities and relationships. | Recognize and utilize mathematical relationships to explain, interpret, and model. |

## Key Vocabulary:

- coefficient
- term
- factor
- expression

## Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question "why do I have to learn this"?

The student could understand how the component parts of the interest formula, for example initial amount, APR, and time, all affect their investing.

The student could understand that y-intercept represents monthly service charge and slope represents charge per text message on a cell phone/data plan.
### SD Common Core State Standards Disaggregated Math Template

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<th>Seeing Structure in Expressions</th>
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<tbody>
<tr>
<td>8.F.3 Interpret the equation ( y = mx + b ) as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function ( A = s^2 ) giving the area of a square as a function of its side length is not linear because its graph contains the points ((1,1),(2,4)) and ((3,9)), which are not on a straight line.</td>
<td>A.SSE.2 Use the structure of an expression to identify ways to rewrite it. For example, see ( x^4 - y^4 ) as ((x^2)^2 - (y^2)^2), thus recognizing it as a difference of squares that can be factored as ((x^2 - y^2)(x^2 + y^2)).</td>
<td>A.SSE.3 - Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. A.SSE.3a- Factor a quadratic expression to reveal the zeros of the function it defines. A.SSE.3b- Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. A.SSE.3c- Use the properties of exponents to transform expressions for exponential functions. For example the expression (1.15^t) can be rewritten as ([1.15^{(1/12)}]^{(12t)} = 1.012^{(12t)}) to reveal the approximate equivalent monthly interest rate if the annual rate is 15%</td>
</tr>
</tbody>
</table>

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### Student Friendly Language:

I can rewrite an expression in many different forms by using algebraic properties without changing its value.

<table>
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<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
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</thead>
</table>
| ● algebraic properties  
● factoring methods  
● equivalent forms of expressions | There are many algebraic properties that can be used to write equivalent forms of an expression. | Apply different algebraic properties to an expression to produce an equivalent form. |

### Key Vocabulary:

- coefficient
- term
- factor
- expression
- equivalent
- commutative
- associative
- distributive
- substitution

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question "why do I have to learn this?"

The student could rewrite a formula in order to isolate certain quantities such as the initial amount in an interest problem.

The student could rewrite several expressions in order to put them into the same form. This would enable them to compare similar quantities such as baseball batting averages.
# SD Common Core State Standards Disaggregated Math Template

## Domain: Seeing Structure in Expressions

### Cluster: Write expressions in equivalent forms to solve problems

**Grade level:** 9-12

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<tbody>
<tr>
<td>8.EE.7 Solve linear equations in one variable.</td>
<td>9-12.A.SSE.3 - Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression 9-12.A.SSE.3a- Factor a quadratic expression to reveal the zeros of the function it defines. 9-12.A.SSE.3b- Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines 9-12.A.SSE.3c- Use the properties of exponents to transform expressions for exponential functions. For example the expression $1.15^t$ can be rewritten as $[1.15^{(1/12)}]^{12t} \approx 1.012^{(12t)}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%</td>
<td>9-12.A.SSE.9-12.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. For example, calculate mortgage payments.</td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can change the form of a quadratic function in order to discover certain properties of that function.

I can factor a quadratic function to find the zeros and interpret those zeros.

I can write an exponential function in multiple equivalent forms.

### Know (Factual)

- factoring techniques
- exponential properties
- zeros of a quadratic expression
- properties of a parabola

### Understand (Conceptual)

The students will understand that:

- Quadratics can be written in different forms.
- The maximum or minimum point of a quadratic is the vertex.
- Exponential functions can be written in different forms.
- The zeros of a quadratic function are important and have meaning.

### Do (Procedural, Application, Extended Thinking)

- Transform quadratic expressions from one form to another.
- Apply the terms of maximum and minimum to real life situations (projectile motion).
- Apply the properties of exponents to exponential functions to produce an equivalent form.
- Calculate the zeros of a quadratic function.

### Key Vocabulary:

- coefficient
- term
- factor
- exponent
- expression
- quadratic
- maximum
- minimum
- zero
- root
- completing the square

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

The student could use quadratics to model the fuel efficiency of a vehicle at different speeds or the height of a ball as it is thrown into the air.

The student could manipulate exponential functions to model the growth of an investment.

The student could transform an exponential function to calculate a monthly interest rate.
**SD Common Core State Standards Disaggregated Math Template**

**Domain:** Arithmetic with Polynomials and Rational Expressions  
**Cluster:** Perform arithmetic operations on polynomials  
**Grade level:** 9-12

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</thead>
<tbody>
<tr>
<td>7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.</td>
<td>9-12.A.APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.</td>
<td>9-12.A.APR.4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2+y^2)^2=(x^2-y^2)^2+(2xy)^2$</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can relate adding, subtracting, and multiplying polynomials to the same operations on integers.

I can add, subtract, and multiply polynomials.

<table>
<thead>
<tr>
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<th>Understand (Conceptual) I want students to understand that.</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
</table>
| ● Polynomial definition  
● Descending order  
● Ascending order  
● Degree of polynomial  
● Analogous  
● FOIL method | Descending order is useful when completing mathematical operations on polynomials.  
The order of operations applies to polynomials in the same manner it does to integers.  
Like terms are necessary to simplify polynomials that have been added and subtracted. | Produce a polynomial of a given degree.  
Simplify polynomials using order of operations.  
Determine the need for the commutative, associative, and distributive properties and apply them appropriately.  
Identify procedural errors in polynomial computation. |

**Key Vocabulary:**

<table>
<thead>
<tr>
<th>order of operations</th>
<th>Commutative property</th>
<th>Associative property</th>
<th>Distributive property</th>
<th>Like terms</th>
</tr>
</thead>
</table>

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

determine unknown related lengths, perimeters, areas, and volumes of geometric shapes. For example, if the length of a rectangle is 4 meters longer than its width, represent its perimeter. This allows for generalizations used in spreadsheet formulas.

Example: Given a cylindrical shape for a footing, how much concrete is needed to fill the footing?
### SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain: Creating Equations</th>
<th>Cluster: Create equations that describe numbers or relationship</th>
<th>Grade level: 9-12</th>
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</table>

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<tbody>
<tr>
<td><strong>8.EE.7</strong> Solve linear equations in one variable.</td>
<td><strong>9-12.A.CED.1</strong> 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.</td>
<td><strong>9-12.F.BF.1</strong> Write a function that describes a relationship between two quantities. b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.</td>
</tr>
<tr>
<td><strong>8.EE.7a</strong> Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form ( x = a, a = a, ) or ( a = b ) results (where ( a ) and ( b ) are different numbers).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>8.EE.7b</strong> Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can build a one variable equation and find the solution.

I can build a one variable inequality and find the solution set.

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<th><strong>Do (Procedural, Application, Extended Thinking)</strong></th>
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</thead>
<tbody>
<tr>
<td>algebraic properties of equality</td>
<td>Functions have related equations or inequalities that can be solved.</td>
<td>Create an equation and use it to find a solution.</td>
</tr>
<tr>
<td>special rules for solving inequalities</td>
<td>Real world situations can be represented by an equation or and inequality.</td>
<td>Create an inequality and use it to find a solution.</td>
</tr>
<tr>
<td>linear, quadratic, exponential, and simple rational functions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

<table>
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<tr>
<th>equation</th>
<th>inequality</th>
<th>linear</th>
<th>quadratic</th>
<th>rational</th>
</tr>
</thead>
<tbody>
<tr>
<td>exponential</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

The student can write an equation representing the time an object (football) is in the air after being launched and then solve to find various quantities.

The student can create an equation or inequality that represents the amount of money made in a t-shirt fundraiser and determine their break even point.
**SD Common Core State Standards  Disaggregated Math Template**

**Domain:** Creating Equations  
**Cluster:** Create equations that describe numbers or relationship  
**Grade level:** 9-12

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>7EE.4 a &amp; b Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. 8EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.</td>
<td>A.CED.2 Create equations in two or three variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.*</td>
<td>N.CN.4 (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can write equations in two or three variables to represent situations.

I can graph equations on a coordinate plane with appropriate labels and scales.

**Know (Factual)**

- graphs and equations of linear functions, quadratic functions, rational functions, and exponential functions
- methods of graphing equations
- 3-variable equations and xyz coordinate plane

**Understand (Conceptual)**

The students will understand that:

- Relations between two or more variables can be identified to create an appropriate mathematical equation.
- Equations can be represented graphically on a coordinate plane.
- Scale and labeling are important when interpreting graphs.
- The shapes of graphs are related to their equations.

**Do (Procedural, Application, Extended Thinking)**

- Analyze given information and choose the appropriate mathematical relationship.
- Create an appropriate equation with two or three variables that represent relationships between quantities.
- Graph equations in two or three variables on a coordinate plane using appropriate labels and scales on paper/pencil and/or graphing technologies.

**Key Vocabulary:**

function rational exponential linear quadratic coordinate plane labels scales

For advanced work: half-plane, xyz, three variables, vectors, three dimensions

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

The student could calculate the amount of money accumulated through investment or to be paid back in loan repayment as it relates to interest rate.  
\[ A(t) = Ao(1+r)^t \]

The student could compare two cell phones plans each with different monthly charges and usage rates.

The student could determine the height of a projectile based on initial velocity and starting height.  
\[ h(t) = -4.9t^2 + v,t + h_0 \]
## SD Common Core State Standards Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain</th>
<th>Algebra: Creating Equations</th>
<th>Cluster: Create equations that describe numbers or relationship</th>
<th>Grade level: 9-12</th>
</tr>
</thead>
</table>

### Correlating Standard in Previous Year

- CC.8.EE.8 Analyze and solve pairs of simultaneous linear equations.
- 8.EE.8a - Understand that solutions to a system of two linear equations in two variables correspond to points of intersection of their graphs, because points of intersection satisfy both equations simultaneously.
- 8.EE.8b - Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For example, $3x + 2y = 5$ and $3x + 2y = 6$ have no solution because $3x + 2y$ cannot simultaneously be 5 and 6.
- 8.EE.8c - Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.

### Number Sequence & Standard

- 9-12.A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

### Correlating Standard in Following Year

- 9-12.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

### Student Friendly Language:

- I can write a system of equations/inequalities based on the constraints that are presented in a given problem.
- I can find a solution to a system of equations or solution set to a system of inequalities.
- I can explain what a solution means in the context of a problem and determine if that solution is realistic or not.

### Know (Factual)

- methods of solving systems of equations/inequalities
- graphical representation given by constraints
- meaning of the intersection of viable solutions

### Understand (Conceptual)

- The students will understand that:
- In real world situations there are often limiting factors called constraints that need to be taken into consideration.
- The point(s) or region of intersection represents viable solutions for the problem given.

### Do (Procedural, Application, Extended Thinking)

- Create equations/inequalities modelling the constraints presented in the model.
- Find the point(s) or region of intersection representing viable solutions and explain what those solutions mean in the context of the situation.

### Key Vocabulary:

- constraints
- viable region
- system of equations/inequalities
- linear programming

### Relevance and Applications:

**How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

- The student could model a manufacturing situation where they have a limited amount of resources.
- The student could build a formula to model time allocation for school work, outside jobs and/or sports participation.
- The student could utilize linear programming to find viable solutions to real world applications such as manufacturing scenarios.
## SD Common Core State Standards Disaggregated Math Template

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</tr>
</thead>
</table>

### Correlating Standard in Previous Year

8.EE.7.b Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

### Number Sequence & Standard

9-12.A.CED.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 \( R \).

### Correlating Standard in Following Year

9-12.F.LE.4 For exponential models, express as a logarithm the solution to \( ab^c = d \) where \( a \), \( c \), and \( d \) are numbers and the base \( b \) is 2, 10, or \( e \); evaluate the logarithm using technology.

### Student Friendly Language:

I can solve an equation for any variable.

I can isolate any variable in a formula.

### Know (Factual)

- algebraic properties
- order of operations
- inverse operations

### Understand (Conceptual)

The students will understand that:

- Equations in different forms still represent the same equation.
- Answers may be easier to find once an equation is solved for a certain variable.

### Do (Procedural, Application, Extended Thinking)

Manipulate a formula using algebraic properties in order to isolate a targeted variable.

### Key Vocabulary:

<table>
<thead>
<tr>
<th>variable</th>
<th>isolate</th>
<th>inverse</th>
<th>equation</th>
<th>formula</th>
</tr>
</thead>
</table>

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

- The student can create equation for use in an Excel spreadsheet.
- The student can convert units through the use of appropriate formulas.
- The student can use formulas in science and physics to represent relationships between real world quantities and they must be able to use those formulas in a variety of ways.
- The student can determine consumer costs through the use of appropriate formulas.
## SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Reasoning with Equations and Inequalities</th>
<th>Cluster:</th>
<th>Solve equations and inequalities in one variable</th>
<th>Grade level:</th>
<th>9-12</th>
</tr>
</thead>
</table>

### Correlating Standard in Previous Year | Number Sequence & Standard | Correlating Standard in Following Year

8.EE.7 Solve linear equations in one variable.

- a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form \( x = a \), \( a = b \), or \( a = b \) results (where \( a \) and \( b \) are different numbers).
- b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

9-12.A.REI.1 Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

9-12.A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

### Student Friendly Language:

- I can demonstrate that solving an equation means that the equation remains balanced during each step
- I can recall the properties of equality
- I can explain why, when solving equations, it is assumed that the original equation is equal
- I can determine if an equation has a solution
- I can choose an appropriate method for solving the equation
- I can justify solution(s) to equations by explaining each step in solving a simple equation using the properties of equality, beginning with the assumption that the original equation is equal
- I can construct a mathematically viable argument justifying a given, or self-generated, solution method

### Know (Factual) | Understand (Conceptual) | Do (Procedural, Application, Extended Thinking)

<table>
<thead>
<tr>
<th>The students will understand that:</th>
<th>Operations on both sides of an equation keep it balanced.</th>
<th>Prove solutions to equations by explaining each step. Communicate understanding properties of equality by justifying each step.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order of operations</td>
<td>Operations on both sides of an equation keep it</td>
<td></td>
</tr>
<tr>
<td>Properties of equality</td>
<td>balanced.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiple solution strategies are possible.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construct a viable argument to justify solution method.</td>
<td></td>
</tr>
</tbody>
</table>

### Key Vocabulary:

- Justify
- Properties of Equality
- Prove
- Viable argument

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Text messaging and data plans for cell phones (if your data plan is $5 per month plus 10 cents per megabyte, how many megabytes did you use if your bill is ten dollars?)
## Correlating Standard in Previous Year

8.EE.7 Solve linear equations in one variable.
- a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form $x = a$, $a = a$, or $a = b$ results (where $a$ and $b$ are different numbers).
- b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive property and collecting like terms.

## Number Sequence & Standard

9-12.A.REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

## Correlating Standard in Following Year


## Student Friendly Language:

I can recall properties of equality

I can solve multi-step equations in one variable

I can solve multi-step inequalities in one variable

I can determine the effect that rational coefficients have on the inequality symbol and use this to find the solution set

I can solve equations and inequalities with coefficients represented by letters

## Know (Factual)

<table>
<thead>
<tr>
<th>Understand (Conceptual) The students will understand that: Properties of equality and inequality are used to solve equations and inequalities in one variable.</th>
<th>Do (Procedural, Application, Extended Thinking) Solve equations and inequalities in one-variable using the properties of algebra.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properties of equality</td>
<td>Properties of equality</td>
</tr>
<tr>
<td>Order of operations</td>
<td>Order of operations</td>
</tr>
<tr>
<td>Properties on inequality</td>
<td>Properties on inequality</td>
</tr>
</tbody>
</table>

## Key Vocabulary:

Properties of equality | Properties on inequality | Opposite operations | Inequality

## Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Example: You make $8 per hour with a $100 signing bonus, how many hours would you have to work to make a $1000 dollars?

Example: You want to go on a school trip to Washington DC, and it will cost you at least $1200. If you make $8 per hour with a $100 signing bonus, how many hours would you have to work in order to afford the trip?
<table>
<thead>
<tr>
<th>Domain: Reasoning with Equations and Inequalities</th>
<th>Cluster: Solve equations and inequalities in one variable</th>
<th>Grade level: 9-12</th>
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<tbody>
<tr>
<td>Correlating Standard in Previous Year</td>
<td>Number Sequence &amp; Standard</td>
<td>Correlating Standard in Following Year</td>
</tr>
<tr>
<td>8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form ( x^2 = p ) and ( x^3 = p ), where ( p ) is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that ( \sqrt{2} ) is irrational.</td>
<td>9-12.A.REI.4 - Solve quadratic equations in one variable. 9-12.A.REI.4a - 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. 9-12.A.REI.4b - 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 ).</td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can solve quadratic equations by using multiple methods including taking square roots, factoring, completing the square, and the quadratic formula.

I can derive the quadratic formula by completing the square on a quadratic equation in \( x \).

I can use the discriminant to classify the number and types of solutions (one real, two real, two complex).

I can determine appropriate strategies to solve problems involving quadratic equations, as appropriate to the initial form of the equation.

### Know (Factual)

- How to solve quadratic equations
- Factoring
- Square roots
- Completing the square
- Quadratic formula
- Complex solutions
- Real number solutions
- Imaginary number
- Radicals
- Method of inspection
- Quadratic Formula
- Completing the Square

### Understand (Conceptual)

The students will understand that:

- The quadratic formula can be derived by using the completing the square process. Recognize the appropriate method to solve a quadratic equation. For example: \( x^2 = 36, (x-2)(x-3)=0 \).
- Knowledge gained from the discriminants tells how many solutions and what type (one real, two real, two complex solutions). Complex solutions come in conjugate pairs.

### Do (Procedural, Application, Extended Thinking)

- Derive quadratic formula.
- Solve a quadratic equation using an appropriate method (factoring, square root, etc).
- Identify type of answer based on discriminant.
- Apply the quadratic formula from the initial form of the equation.

### Key Vocabulary:

- Quadratic equation
- Completing the square
- Quadratic formula
- Factoring
- Complex solutions
- Conjugates
- Discriminants
- Square roots
- Transform
- Derive
- Initial form
- Real numbers
- Imaginary numbers
- Radicals
- Standard form
- Vertex form

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Use quadratic equation to model free fall motion.

For example: A ball is thrown from ground level at 30 feet per second, ignoring air resistance, when will the ball hit the ground?

Area maximum problems.

For example: A farmer wishes to build a rectangular pen adjacent to a river and has 30 meters of fencing materials. What is the largest area of the pen that can be created?
# SD Common Core State Standards Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Reasoning with Equations and Inequalities</th>
<th>Cluster:</th>
<th>Solve systems of equations.</th>
<th>Grade level:</th>
<th>9-12</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.EE.8 Analyze and solve pairs of simultaneous linear equations.</td>
<td>9-12.A.REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.</td>
<td></td>
</tr>
</tbody>
</table>

## Student Friendly Language:

I can solve a linear system of equations by using the elimination process.

I can substitute the answer into both equations to verify it is a solution.

I can interpret the solution as to whether it is: exactly one, infinitely many or no solution.

## Know (Factual) / Understand (Conceptual) / Do (Procedural, Application, Extended Thinking)

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>The students will understand that:</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
</table>
| ● Addition Property of Equality  
● Multiplication Property of Equality  
● Distributive Property  
● Additive Inverse  
● Substitution Property  
● Equivalent Equations  
● Coefficients  
● Least Common Multiple  
● Elimination Method | | The solution of the system is an ordered pair that must satisfy BOTH equations of the system.  
To eliminate one of the variables, the coefficients of the variables must be additive inverses.  
After finding the first value, the second value can be found by substitution.  
The system could result in exactly one solution, infinite solutions, or no solution. | Multiply one(or both) equations by a number(s) to obtain equivalent equations having opposite coefficients of one variable.  
Combine the two equations using addition, eliminating at least one of the variables.  
Determine the nature of the solutions(infinite, exactly one, or none).  
Solve for the remaining variable(if possible).  
Substitute solution into one of the equations to solve for other variable.  
Check by substituting both solutions into both equations. |

## Key Vocabulary:

- variables  
- additive inverses  
- substitution  
- linear systems  
- elimination  
- ordered pair  
- properties of real numbers  
- coefficients  
- systems of equations  
- unique solutions  
- infinite solutions  
- parallel lines  
- intersecting lines

## Relevance and Applications:

Find: Find unknowns. Compare two phone plans. Plan A charges $35.00 per month and $0.10 per text. Plan B charges $25.00 per month and $0.40 per text. Which plan should Sally use if she averages 200 texts per month.
SD Common Core State Standards  Disaggregated Math Template

**Domain:** Reasoning with Equations and Inequalities  
**Cluster:** Solve systems of equations  
**Grade level:** 9-12

<table>
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<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
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</tr>
</thead>
<tbody>
<tr>
<td>8.EE.8 Analyze and solve pairs of simultaneous linear equations.</td>
<td>9-12.A.REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.</td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can recognize and solve a system of linear equations using multiple methods.

I can justify the method used to solve systems of linear equations exactly and approximately.

I can interpret my solution--two lines may intersect and have exactly one solution, two lines may be parallel and have no solution, two lines may be the same line and have infinitely many solutions.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
</table>
| Characteristics of linear equations  
Graph of a linear equation  
Slope-intercept form of a linear equation  
Standard form of a linear equation  
Slopes of parallel lines  
Intersection of lines may be a unique point.  
Least common multiple | If the slopes of the lines in the system are the same, there are two possible scenarios. The lines could be parallel or they could be the same line.  
If there is a solution to the system it is an ordered pair, it has both an x-value and a y-value.  
There are multiple methods of solving a linear system--graphing, substitution, and elimination.  
A linear system could be an appropriate method for solving a real world problem.  
An answer on their graphing calculator (or other technology) may be an approximate solution rather than an exact solution. | Solve the linear system by the graphing method, both by hand and using technology.  
Solve the linear system by the substitution method.  
Solve the linear system by the elimination method.  
Solve a real life problem using a system of linear equations.  
Interpret and explain the solution of a real world application  
Create a real life problem involving a system of linear equations. |

**Key Vocabulary:**

<table>
<thead>
<tr>
<th>slope</th>
<th>linear equation</th>
<th>parallel</th>
<th>intersection</th>
<th>ordered pair</th>
<th>graphing</th>
<th>additive inverse</th>
</tr>
</thead>
</table>

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Cost comparison analysis: Your family is planning a 7 day trip to Florida. You estimate that it will cost $275 per day in Tampa and $400 per day in Orlando. Your total budget for the 7 days is $2300. How many days should you spend in each location?

Mixture problems: If I have 30% mixture and a 5% mixture, how many Liters of each do I need if I want to make 5 Liters of a 10% mixture?
## Domain:
Reasoning with Equations and Inequalities

## Cluster:
Solve systems of equations

## Grade level:
9-12

### Correlating Standard in Previous Year
8.EE.8.b Solve systems of two linear equations in two variables algebraically, and estimate solutions by graphing the equations. Solve simple cases by inspection. For Example, 3x + 2y =5 and 3x + 2y = 6 have no solution because 3x + 2y cannot simultaneously be 5 and 6.

### Number Sequence & Standard
9-12.A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = –3x and the circle x^2 + y^2 = 3.

### Correlating Standard in Following Year

### Student Friendly Language:
I can solve a system consisting of a linear equation and a quadratic equation algebraically and graphically. I can use a graphing tool to find the intersection point(s) of a system of equations involving a linear equation and a quadratic equation.

### Key Vocabulary:
- Solution
- Intersection
- System of Equations
- Solve
- Linear Equation
- Quadratic
- Substitution
- Algebraic
- Quadratic Formula
- Factoring Quadratic Expressions

### Relevance and Applications:
How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

An air traffic control tower radar reaches a circle of 25 mile radius from the tower. Plane is traveling along a linear path given by a linear equation and will fly past the tower. Find the points at which the airplane is first visible on radar as it approaches the tower and at which it is no longer visible on radar as it is flying away from the tower. Could also ask for how many miles is the plane within detection of the radar.


The price $C$, in dollars per share, of a high-tech stock has fluctuated over a twelve-year period according to the equation $C = 14 +12x - x^2$, where $x$ is in years. The price $C$, in dollars per share, of a second high-tech stock has shown a steady increase during the same time period according to the relationship $C = 2x + 30$

- For what values are the two stock prices the same? (Only an algebraic solution will be accepted.)
- Determine the values of $x$ for which the quadratic stock price is greater than the linear stock price.
- State your answer as an inequality. (Hint: You should be able to answer this almost immediately based upon your analysis in the first part above.)

### Reasoning
Which value below for $b$ would result in the linear-quadratic system $y = x^2 + 3x + 1$ having only one intersection point? Justify your answer algebraically, graphically or with a table.

(a) 1  (b) 2  (c) 3  (d) 4

<table>
<thead>
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<tbody>
<tr>
<td>8.EE.5 Understand the connections between proportional relationships, lines, and linear equations. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. For example, compare a distance-time graph to a distance-time equation to determine which of two moving objects has greater speed.</td>
<td>9-12.A.REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (hich could be a line).</td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can plot points to represent an equation on a coordinate plane.

I can explain why each point on a curve is a solution to its equation.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
</table>
| ● Graphing equations and plotting ordered pairs  
● Substitution and order of operations | There are an infinite number of solutions to an equation.  
The graph of the line or curve is a picture of the solutions of the equation. | Plot ordered pairs that satisfy the equation  
Create a real life problem that is represented by the graph and equation  
Solve a real life problem |

**Key Vocabulary:**

<table>
<thead>
<tr>
<th>Equation</th>
<th>variables</th>
<th>coordinate plane</th>
<th>ordered pair</th>
<th>curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>slope</td>
<td>graphing</td>
<td>plotting</td>
<td>line</td>
<td>intercept</td>
</tr>
<tr>
<td>solution</td>
<td>range</td>
<td>linear</td>
<td>dependent variable</td>
<td>independent</td>
</tr>
<tr>
<td>quadratic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>domain</td>
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<tr>
<td>variable</td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Path of a ball in a Quadratic equation

Number of hours worked and gross pay, salary and commission; example Determine your total pay, given: salary is $1000 per month plus a 25% commission on total sales. Interpret this information in terms of slope and y-intercept and determine various total pay based on various amounts of sales.
SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain: Reasoning with Equations and Inequalities</th>
<th>Cluster: Represent and solve equations and inequalities graphically</th>
<th>Grade level: 9-12</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.EE.8 Analyze and solve pairs of simultaneous linear equations.</td>
<td>A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations ( y = f(x) ) and ( y = g(x) ) intersect are the solutions of the equation ( f(x) = g(x) ); find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where ( f(x) ) and/or ( g(x) ) are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.*</td>
<td>9-12.A.REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can approximate or find the solutions to a system.

I can explain what it means when the graphs of two functions intersect at a point(s).

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking) (Action)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Graphs of Functions</strong></td>
<td>Two functions have equal solutions where their graphs intersect.</td>
<td>Explain why x-coordinate of the intersections of the graphs of two functions is a solution to both functions.</td>
</tr>
<tr>
<td><strong>Systems of Equations</strong></td>
<td>Two functions have common solutions where their table of values have an equal ordered pair.</td>
<td>Use paper/pencil and technology to produce a table of values explain what x-coordinate of a common ordered pair represents in the context of the problem.</td>
</tr>
<tr>
<td><strong>Function Notation</strong></td>
<td><strong>Solutions of an equation/function</strong></td>
<td><strong>Table of Values</strong></td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

equivalent  function (linear, exponential, absolute value, polynomial, rational, logarithmic solutions
ordered pair  intercepts  line  coordinate plane  x-axis  y-axis  intercept form
intersection  input  output

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question "why do I have to learn this"?

Given two job offers, evaluate and compare the salary options and decide which is better short/long term.

What is the break even point for use of E85 as opposed to E10 gasoline, based on cost per mile and mileage of your car?

If you have two moving objects, traveling at different speeds, at what point in time will they be in the same location?
### SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Reasoning with Equations and Inequalities</th>
<th>Cluster:</th>
<th>Represent and solve equations and inequalities graphically</th>
<th>Grade level:</th>
<th>9-12</th>
</tr>
</thead>
</table>

**Correlating Standard in Previous Year** | **Number Sequence & Standard** | **Correlating Standard in Following Year**
---|---|---
8.EE.8 Analyze and solve pairs of simultaneous linear equations. | 9-12.A.REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. |

**Student Friendly Language:**

I can find points to determine the boundary line and decide whether the line is solid (included) or dashed (excluded).

I can choose a test point to determine which half-plane should be shaded.

I can graph more than one inequality on the same coordinate plane and determine the region of their intersecting shaded half-planes.

### Know (Factual)
- Boundary line and inequality symbols
- Test point
- System of inequalities
- Feasible region

**Understand (Conceptual)**

The students will understand that:

- A line divides the coordinate plane into two half-planes.
- On a solid line ($\leq$ or $\geq$), all points on the line will be solutions to the inequality.
- On a dashed line ($<$ or $>$), all points on the line will not be solutions to the inequality.
- If the test point is a solution to the inequality, then the half-plane that includes the test point should be shaded.
- When in slope-intercept form, a less than inequality will be shaded below the line and a greater than inequality will be shaded above the line. If boundary line is vertical, less than is shaded to the left and greater than is shaded to the right.
- All points in the feasible (shaded) region of a system of inequalities, will be solutions to the system.
- Linear programming is a method to solve real world problems using a system of linear inequalities.

**Do (Procedural, Application, Extended Thinking)**

- Determine and explain why the boundary line should be solid or dashed.
- Choose a test point and determine if the point is a solution of the inequality.
- Shade the solution half-plane. If the test point is not a solution, then shade the other half-plane.
- Graph multiple inequalities on the same coordinate plane and determine their solution region.
- Use linear programming to maximize profit or minimize cost.

### Key Vocabulary:

- inequality
- test point
- boundary
- half-plane
- solid line
- dashed line
- intersection
- solution, shaded
- system of inequalities
- feasibility region
- linear programming
- test point

### Relevance and Applications:

**How might the grade level expectation be applied at home, on the job or in a real-world, relevant context?**

Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Using linear programming to maximize profit or minimize cost in a small business.

Example: The director of the Dance Studio must plan for operate many different classes, 7 days a week, at all hours of the day. Each Saturday class fills up quickly. To plan the Saturday schedule, the director has to consider the following facts.

- It is difficult to find enough good teachers, so the studio can offer at most 8 tap classes and at most 5 jazz classes.
- Limited classroom space means the studio can offer at most 10 classes for the day.
- The studio makes profit of $150 from each tap cla and $250 from each jazz class.

a) Write and graph the constraint inequalities.
b) Write the objective function for this situation.
c) What combination of classes would maximize profit.
d) The director of Backstage Dance Studio really wants to promote interest in dance, so she also wants to maximize the number of children who can take the classes. Each tap class can accommodate 10 students , and each jazz class can accommodate 15 students. Find the schedule that gives maximum student participation.
### Domain: Functions  
#### Cluster: Understand the concept of a function and use function notation

#### Grade level: 9-12

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.F.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.</td>
<td>9-12.F.IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If ( f ) is a function and ( x ) is an element of its domain, then ( f(x) ) denotes the output of ( f ) corresponding to the input ( x ). The graph of ( f ) is the graph of the equation ( y = f(x) ).</td>
<td>9-12.F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function ( h(n) ) gives the number of person-hours it takes to assemble ( n ) engines in a factory, then the positive integers would be an appropriate domain for the function.*</td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can identify the domain and range of a function.

I can determine if a relation is a function.

I can graph or plot a function from a table of values.

### Know (Factual)

- Domain and range can be used to determine whether or not a relation is a function.
- Models such as vertical line tests, input/output tables, and mapping diagrams can help to visualize functions and non-functions.
- Function notation, \( f(x) \), is the output of \( f \) corresponding to the input \( x \).

### Understand (Conceptual)

The students will understand that:

- There is a graphical and numerical approach to identify functions, domain, and range.
- The Vertical Line Test determines a relation as a function.
- In a function, that each input corresponds with exactly one output.

### Do (Procedural, Application, Extended Thinking)

- Identify a relation/set of data as function or not a function.
- Model functions and relations.
- Write equations in function form.

### Key Vocabulary:

<table>
<thead>
<tr>
<th>Domain</th>
<th>Range</th>
<th>Corresponding</th>
<th>One-to-One</th>
<th>Function</th>
<th>Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function notation</td>
<td>Vertical line test</td>
<td>Mapping diagrams</td>
<td>Input/output tables</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Functions are important to show how one circumstance is directly connected to a specific outcome. For example, if you work for 10 hours at $8.00/hour, you will be paid $80.00, not some random amount. If you begin with a certain number for population, after an amount of time, the population can be approximated.
### SD Common Core State Standards Disaggregated Math Template

**Domain:** Building Functions  
**Cluster:** Understand the concept of a function and use function notation  
**Grade level:** 9-12

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.F.1 Understand that a function is a rule that assigns to each input exactly one output.</td>
<td>9-12.F.IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.</td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can solve an equation in two variables and identify the dependent and independent variables.

I understand that the term domain means input (for f(x), x is the input).

I understand that the term range means the output (f(x)).

I understand that f is used to name the function.

I can interpret general formulas in function notation.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
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</table>
| ● Domain values can be put into a function to evaluate it.  
● Formulas can be written and evaluated in function notation.  
● Domain values will determine the range values. | F(x) means to evaluate the function at x.  
Linear, absolute-value, quadratic and exponential equation can be rewritten in function notation.  
Some relations can be written in function notation. | Evaluate a function given a specific domain value.  
Interpret formulas in terms of function notation, i.e., \( P(s) = 4s \).  
Apply appropriate use of domain when evaluating functions to obtain the range. |

**Key Vocabulary:**

function  
function notation  
evaluate  
domain  
range  
simplify  
input  
output  
relation

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

Utility bills are a function of energy used

Cell phone rates are a function of minutes available

The cost of a trip is a function of the price of gas

Conversion of temperature
**SD Common Core State Standards  Disaggregated Math Template**

<table>
<thead>
<tr>
<th>Domain:</th>
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</tr>
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<tbody>
<tr>
<td>Cluster:</td>
<td>Understand the concept of a function and use function notation</td>
</tr>
<tr>
<td>Grade level:</td>
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<tbody>
<tr>
<td>8.F.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.</td>
<td>9-12.F.IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by ( f(0) = f(1) = 1, f(n + 1) = f(n) + f(n - 1) ) for ( n ) greater than or equal to 1.</td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can tell the difference between arithmetic and geometric sequences.

I can write a function rule to model a sequence.

I can determine the domain of a sequence using integers.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual) I want students to understand that:</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● Types of sequences include arithmetic and geometric. ● A function can be written to represent a sequence. ● The domain of a sequence is subset of the set of integers.</td>
<td>There are different types of sequences. Sequences can be modeled with function rules which when evaluated, predict future terms. The domain of certain sequences may have restrictions. Some sequences may be written explicitly and recursively, and some can only be written recursively.</td>
<td>Identify the type of sequence. Write a function rule explicitly and/or recursively to represent a given sequence. Determine the domain of a sequence.</td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

<table>
<thead>
<tr>
<th>sequence</th>
<th>arithmetic sequence</th>
<th>geometric sequence</th>
<th>explicit formula</th>
<th>recursive formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>domain</td>
<td>function rule</td>
<td>function</td>
<td>function notation</td>
<td></td>
</tr>
</tbody>
</table>

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

To determine your total cost for repayment on a loan with interest included after a certain number of years.

To estimate the population after a certain number of years of growth or decline.

To determine the half-life of radioactive isotopes, carbon dating, and nuclear waste.
<table>
<thead>
<tr>
<th>Domain:</th>
<th>Functions</th>
<th>Cluster:</th>
<th>Interpret functions that arise in applications in terms of the context</th>
<th>Grade level: 9-12</th>
</tr>
</thead>
</table>

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<tr>
<th>Correlating Standard in Previous Year</th>
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<th>Correlating Standard in Following Year</th>
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<tbody>
<tr>
<td>8.F.4-5 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</td>
<td>9-12.F.IF.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.</td>
<td>Algebra I - linear, exponential, and quadratic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Algebra II - emphasize selection of appropriate models</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can sketch a graph.
I can correctly label a graph’s intercepts and intervals.
I can identify where the function is increasing, decreasing, positive, or negative.
I can identify relative maximums and minimums.
I can identify various symmetries, end behaviors, and periodicity.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The students will understand that:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● A rough graph of a function can be created if given key features.</td>
<td>Graphs are a visual representation of a function.</td>
<td>Sketch a graph.</td>
</tr>
<tr>
<td>● A graph’s intercepts are locations where it crosses the axes.</td>
<td>Intercepts are the points where functions cross the x &amp; y axes.</td>
<td>Label a graph’s intercepts and intervals.</td>
</tr>
<tr>
<td>● A function can have increasing/decreasing (positive/negative intervals)</td>
<td>A relative maximum may be the highest point of the graph.</td>
<td>Interpret where the function is increasing, decreasing, positive, or negative.</td>
</tr>
<tr>
<td>● Relative maxima and minima of a graph indicate the location of crests and troughs.</td>
<td>A relative minimum may be the lowest point of the graph.</td>
<td>Interpret relative maximums and minimums.</td>
</tr>
<tr>
<td>● Symmetries, end behaviors, and periodicity of a function can be interpreted.</td>
<td>There are multiple lines of symmetry and various end behaviors found in functions.</td>
<td>Interpret various symmetries, end behaviors, and periodicity.</td>
</tr>
<tr>
<td></td>
<td>Periodic functions repeat themselves. (cookie cutter functions)</td>
<td></td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

intercept x-intercept y-intercept relative maximum relative minimum interval increasing interval decreasing interval periodicity

**Relevance and Applications:**

How does car speed relate to gas mileage? Does an accelerating, idling, or a constant speed of a car create the best gas mileage.

Relationship between position, velocity, and acceleration

Using \( D = rt \) to plan a trip
# SD Common Core State Standards Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Functions</th>
<th>Cluster:</th>
<th>Interpret functions that arise in applications in terms of the context</th>
<th>Grade level:</th>
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<tr>
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<th>Number Sequence &amp; Standard</th>
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</table>
| 8.F.5  Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g. where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. | 9-12.F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function. | Algebra I - linear, exponential, and quadratic
Algebra II - emphasize selection of appropriate models |

## Student Friendly Language:

I can relate the domain of a function to its graph.
I can determine the appropriate domain for a real world situation.
I can relate the domain of a function to the relationship it describes.

## Key Vocabulary:

- domain
- function

## Relevance and Applications:

Smoke jumpers are in free fall from the time they jump out of the plane until they open their parachutes. The function $y = -16t^2 + 1600$ models a jumper’s height $y$ in feet at $t$ seconds for a jump from 1600 ft. How long is the jumper in free fall if the parachute opens at 1000 ft?

To be able to recognize that a function is just an equation and be able to apply the concepts used to solve equations to functions.

To become familiar with function notation used in higher level math classes.
## SD Common Core State Standards Disaggregated Math Template

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<tbody>
<tr>
<td>8.F.4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two ((x, y)) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</td>
<td>9-12.F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.</td>
<td>Algebra I - linear, exponential, and quadratic Algebra II - emphasize selection of appropriate models</td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can find the slope of a function which is also known as the rate of change, over a specified interval.

I can use the graph to interpret the rate of change of the function.

I can calculate the rate of change given a table of values over a specified interval.

I can define the slope of a line in terms of rate of change.

### Know (Factual)

- Rate of change can be calculated from a table of values.
- Rate of change can be estimated from a graph of a function.
- The rate of change can be interpreted from a problem.
- Rate of change can be calculated from a mapping.

### Understand (Conceptual)

The students will understand that:

- How to evaluate a function.
- Real-life situations can be modeled through functions and rate of change.
- The slope will affect how the function is graphed.
- Slope is the rate of change of a function over a specified interval.
- Rate of change can be calculated from a table, graph, mapping, or a function.

### Do (Procedural, Application, Extended Thinking)

- Calculate the rate of change given a table of values.
- Estimate the rate of change given a graph of a function.
- Interpret the meaning of the rate of change in the context of the problem.
- Calculate the rate of change using a mapping.

### Key Vocabulary:

- Slope
- Rate of Change

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

The “pitch” of a roof can be determined by slope. The pitch of a roof could vary from region to region.

Slope and a linear function can be used to predict future events.

Slope is relevant in construction of wheelchair ramps (meeting ADA requirements).
<table>
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<tr>
<td>8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</td>
<td>9-12.F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.</td>
<td>Algebra I - Linear, exponential, quadratic, absolute value, step, piecewise defined</td>
</tr>
<tr>
<td></td>
<td>9-12.F.IF.7a Graph linear and quadratic functions and show intercepts, maxima, and minima. (Algebra I)</td>
<td>Algebra II - Focus on using key features to guide selection of appropriate type of model function.</td>
</tr>
<tr>
<td></td>
<td>9-12.F.IF.7b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions (Algebra I and Algebra II)</td>
<td>4th course - Logarithmic and trigonometric functions.</td>
</tr>
<tr>
<td></td>
<td>9-12.F.IF.7c- Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. (Algebra II)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9-12.F.IF.7d (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. (4th course)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9-12.F.IF.7e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude (Algebra I and Algebra II)</td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can graph functions and identify the specific features (including zeros, maxima, minima, intercepts, and end behavior).

**Key Vocabulary:**

- maxima                minima            increasing                      decreasing
- linear function       quadratic function
- square root function  cube root function  piecewise function  step function  absolute value function
- zeros of functions    end behavior      rational functions  asymptotes  exponential function
- logarithmic functions trigonometric functions period midline amplitude

**Relevance and Applications:**

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

- Given a rate, such as cost per minute of a phone plan, graph the function.
- Given an interest free loan and constant payments, use a graph to find the amount of time needed to pay off the loan.
- Model projectile motion using quadratic functions; use key features of graphs to find maximum height and when the projectile reaches certain heights.
- Use functions to solve optimization problems (maximum area/volume, etc).
- Calculate compound interest. Apply it to loan or investment situations.
- Model tides with trigonometric functions.
### SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Functions</th>
<th>Cluster:</th>
<th>Analyze functions using different representations</th>
<th>Grade level:</th>
<th>9-12</th>
</tr>
</thead>
</table>

#### Correlating Standard in Previous Year

| 8.F.3 | Interpret the equation $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. $y = mx + b$ as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function $A = s^2$ giving the area of a square as a function of its side length is not linear because its graph contains the points $(1, 1), (2, 4)$ and $(3, 9)$, which are not on a straight line. 2 giving the area of a square as a function of its side length is not linear because its graph contains the points $(1, 1), (2, 4)$ and $(3, 9)$, which are not on a straight line. |
| 8.F.5 | Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally. |

#### Number Sequence & Standard

| 9-12.F.IF.8 | Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. |
| 9-12.F.IF.8a | Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. |
| 9-12.F.IF.8b | Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = 1.02^t$, $y = 0.97^t$, $y = 1.01^{12t}$, $y = 1.25^{t/10}$, and classify them as representing exponential growth and decay. |

#### Correlating Standard in Following Year

| Algebra I - Linear, exponential, quadratic, absolute value, step, piecewise defined. |
| Algebra II - Focus on using key features to guide selection of appropriate type of model function. |

### Student Friendly Language:

- I can change the form of the equation of a quadratic or exponential function.
- I can use the changed function to determine information that will help me graph the function.
- I can interpret the meaning of parts of the function.

#### Know (Factual)

- A variety of methods can be used to find zeros of quadratic functions.
- Completing the square can be used to convert a quadratic function into vertex form.
- The vertex and zeros of a function have real-life meanings.
- There are key features in the graph of a quadratic function.
- Exponential functions can show growth or decay.
- Percent rate of change can be identified from exponential functions.

#### Understand (Conceptual)

- Completing the square gives a form of quadratic equation that identifies the vertex (maximum and minimum), and axis of symmetry. This form also identifies transformations of the graph of a quadratic equation. Different parts of the quadratic formula provides information about the number of real zeros, the $x$-value of the vertex, and the $x$-intercepts of the graph. The zeros of the quadratic function are the $x$-intercepts of its graph. The base of an exponential function is the percentage rate of change. The sign of the exponent in an exponential function indicates growth or decay. |

#### Do (Procedural, Application, Extended Thinking)

- Factor, complete the square or use the quadratic formula to find zeros of quadratic functions.
- Complete the square to write a quadratic function in vertex form to find extreme values and identify vertical and horizontal shifts, shrinks, and stretches. Explain the meanings of vertex and zeros in the context of a real-life application. Interpret the symbolic characteristics of a quadratic function as key elements in its graphical representation.
- Classify exponential functions as growth or decay. Identify percent rate of change in growth and decay functions.

### Key Vocabulary:

- factoring
- completing the square
- quadratic formula
- vertex form of a quadratic
- rate of change
- exponential functions
- maximum and minimum
- axis of symmetry
- growth model
- decay model

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

The path of a ball in sports can be modeled and analyzed by a quadratic function.

Exponential functions can be modeled by credit card interest rates, savings account interest rates, population, spread of disease, and chemical decay.

Students who are interested will be prepared for upper or advanced-level mathematics and science courses when asked to change the form of an equation into conic form and understand transformations of all functions.
SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Interpreting Functions</th>
<th>Cluster:</th>
<th>Analyze functions using different representations</th>
<th>Grade level:</th>
<th>9-12</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.C.8.F.2 Compare properties of two functions each represented in a different way.</td>
<td>C.C.9-12.F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions. For Example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum. Algebra I - Linear, exponential, quadratic, absolute value, step, piecewise defined. Algebra II - Focus on using key features to guide selection of appropriate type of model function.</td>
<td></td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

- I can graph an equation to model real-life situations.
- I can identify the slopes and x and/or y intercepts of the two functions represented as an equation and graph.
- I can identify, from a graph, the ordered pairs of a function.
- I can compare properties of two functions in any form.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● The slope and y-intercept can be determined from linear functions (that may be represented in different ways)</td>
<td>When graphing a linear equation that has been converted into slope-intercept form the y-intercept is graphed first, then the slope. All functions can be graphed in different ways. Slope is rise over run or change in y over change in x. A function can be presented as an equation, table, graph, mapping, or verbal form. Different representations of functions can be compared.</td>
<td>Identify the slope and x and/or y intercepts of linear equation. Identify domain and range of different functions. Describe the characteristics between linear, quadratic, square root, absolute value, and cubed functions. Compare properties of two functions represented in different forms.</td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

- slope-intercept form
- coordinate plane
- increase
- decrease
- quadratic equation
- linear equations
- tables
- function
- domain
- range
- minimum
- maximum
- properties
- mapping

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

A cell phone company charges $56.35 for their service each month plus $.20 per minute as part of their program package deal. A second cell phone company charges a total flat fee of $95.36 (graph is provided). How many minutes does a person using the first company need to use to pay the same bill for the first company as the second company.

You need to learn this because in everyday life you will be presented material in different forms and you will need to be able to interpret them in any form.
### SD Common Core State Standards Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain: Functions</th>
<th>Cluster:</th>
<th>Build a function that models a relationship between two quantities</th>
<th>Grade level: 9-12</th>
</tr>
</thead>
</table>

#### Correlating Standard in Previous Year

- Functions 8.F. Define, evaluate, and compare functions.
  1. Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output. Use functions to model relationships between quantities.
  4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two \((x, y)\) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.
  5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.

#### Number Sequence & Standard

- 9-12.F.BF.1 Write a function that describes a relationship between two quantities.
  - 9-12.F.BF.1 a. Determine an explicit expression, a recursive process, or steps for calculation from a context. (Algebra I)
  - 9-12.F.BF.1 b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model. (Algebra I and II)
  - 9-12.F.BF.1 c. (+) Compose functions. For example, if \(T(y)\) is the temperature in the atmosphere as a function of height, and \(h(t)\) is the height of a weather balloon as a function of time, then \(T(h(t))\) is the temperature at the location of the weather balloon as a function of time. (Fourth year course)

#### Correlating Standard in Following Year

- Algebra I - Linear, exponential, and quadratic.
- Algebra II - Include all types of functions studied.
- Fourth Course - F.BF.1.c only

### Student Friendly Language:

- I can create a function that relates two pieces of data.
- I can interpret a graph.
- I can determine the pattern in the data. (linear vs quadratics vs exponential)
- I can perform operations on two or more functions.

#### Know (Factual)

- A function can be created to relate two sets of data (often given in table form).
- This created function could be linear, quadratic or exponential.
- The function chosen to relate the data is chosen based on characteristics of the data.
- Operations and compositions can be carried out on two or more functions.

#### Understand (Conceptual)

- Equations can be created to reasonably model situations.
- Functions can be added, subtracted, multiplied, and divided.

#### Do (Procedural, Application, Extended Thinking)

- Interpret a table to write an appropriate function.
- Apply knowledge of linear, quadratic, and exponential functions to write the equation.
- Describe why they chose which type of function.
- Model a relationship between two functions.

### Key Vocabulary:

- explicit expression
- recursive process
- composition of functions

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context?

Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”? 

- Population growth/decline is modeled by exponential functions.
- Earned income is a linear function that relates time to rate of pay.
- Cell phone plans are functions of a base fee and number of minutes used.
## SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Functions</th>
<th>Cluster: Build a function that models a relationship between two quantities</th>
<th>Grade level: 9-12</th>
</tr>
</thead>
</table>

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<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</td>
<td>CC.9-12.F.BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.</td>
<td></td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can model a situation by writing the next term of a sequence from a previous set of terms.

I can model a situation by writing any term of a sequence in terms of the first term and the number of terms.

I can change recursive formulas into explicit formulas.

I can change explicit formulas into recursive formulas.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual) I want students to understand that:</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The common difference is the value added to each successive term in an arithmetic sequence.</td>
<td>That in an arithmetic sequence the difference between terms is constant.</td>
<td>Calculate the common difference in an arithmetic sequence.</td>
</tr>
<tr>
<td>• The common ratio is the value multiplied to each successive term in a geometric sequence.</td>
<td>That in a geometric sequence the ratio of any term to the previous term is constant.</td>
<td>Calculate the common ratio in a geometric sequence.</td>
</tr>
<tr>
<td>• Formulas can be used to determine indicated terms in arithmetic and geometric sequences.</td>
<td>That an explicit formula is a formula that allows direct computation of any term of a sequence.</td>
<td>Calculate an indicated term in an arithmetic or geometric sequence.</td>
</tr>
<tr>
<td>• In recursive formulas, each term is used to produce the next term.</td>
<td>That a recursive formula uses each term to define the next term.</td>
<td>Write an explicit formula of an arithmetic or geometric sequence that models a situation.</td>
</tr>
<tr>
<td>• An explicit formula is a formula that allows direct computation of any term for a sequence.</td>
<td>That linear functions are the explicit form of recursively defined arithmetic sequences.</td>
<td>Write a recursive formula of an arithmetic or geometric sequence that models a situation.</td>
</tr>
<tr>
<td>• Explicit formulas can be converted to explicit and vice versa.</td>
<td>That exponential functions are the explicit form of recursively defined geometric sequences.</td>
<td>Convert an explicit formula to its corresponding recursive formula.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Convert a recursive formula to its corresponding explicit formula, if possible.</td>
</tr>
</tbody>
</table>

### Key Vocabulary:

- arithmetic sequence
- common difference
- geometric sequence
- common ratio
- recursive formula
- explicit formula

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

Example: Write a recursive formula to represent a $10,000 debt, at 2.5% interest per month, with a $600 monthly payment.

Example: The bacteria *Staphylococcus aureus* has a generation or doubling time of half an hour. Also, every hour, 1000 bacteria are removed from the culture. If the initial population consisted of 1100 bacteria, what are the population sizes every hour for the next four half hours?

Example: The final enemy in Riley’s video game has 100 health points. During the final battle, the enemy regains 10% of its health points after every 10 seconds. If Riley can inflict damage to the enemy that takes away 10 health points every 10 seconds without getting hurt herself, will she ever kill the monster? If so, when?
## SD Common Core State Standards Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain: Functions</th>
<th>Cluster: Build new functions from existing functions</th>
<th>Grade level: 9-12</th>
</tr>
</thead>
</table>

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>8.F.4 &amp; 5 Use functions to model relationships between quantities. 4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. 5. Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.</td>
<td>CC.9-12.F.BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and (f + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. Algebra I - Linear, exponential, quadratic, and absolute value functions; emphasize common effect of each transformation across function types.</td>
<td></td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can describe what happens to the parent graph of f(x) when substituting values for k (constant), both positive and negative numbers (k can be added, subtracted, or multiplied to the parent function).

I can look at a graph and describe the transformation of a graph based on the k value.

I can try substituting in k values and make observations of what happens to the graph.

I can recognize an even or odd function based on what the graph and equation looks and behaves like.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>vertical stretch or compression</td>
<td>If k is positive, f(x) + k is a vertical translation up. If k is negative, f(x) + k is a vertical translation down.</td>
<td>Graph/identify vertical stretch and/or a compression.</td>
</tr>
<tr>
<td>horizontal stretch or compression</td>
<td>If k is positive, f(x + k) is a horizontal translation to the left since f(x+k) also can be written as f(x - k). If k is negative, f(x + k) is a horizontal translation to the right since f(x- k), also can be written as f(x - k).</td>
<td>Graph/identify a horizontal stretch and/or compression.</td>
</tr>
<tr>
<td>vertical and horizontal shifts</td>
<td>If abs(k) is between 0 and 1 f(kx) is a horizontal compression of the parent graph.</td>
<td>Graph/identify vertical and/or horizontal shifts.</td>
</tr>
<tr>
<td>vertical and horizontal reflections</td>
<td>If abs(k) is greater than 1 f(kx) is a horizontal stretch. If abs(k) is greater than 0 and 1, then k(f(x) vertical compression of the parent graph.</td>
<td>Graph/identify vertical and horizontal reflections.</td>
</tr>
<tr>
<td>even and odd functions</td>
<td>If abs(k) is greater than 1, then k(f(x) is a vertical stretch. If k is negative k(f(x) is a reflection over the x axis.</td>
<td>Identify/graph even and odd functions.</td>
</tr>
<tr>
<td>transformations</td>
<td>If k is negative k(f(x) is a reflection over the y axis.</td>
<td>Describe and explain the transformation of the parent function.</td>
</tr>
<tr>
<td>appropriate graphing technology</td>
<td>When given the graph of a function, we can write the function. If given the function, we can graph it.</td>
<td>Analyze and interpret the graphs of functions.</td>
</tr>
</tbody>
</table>

### Key Vocabulary:

- Transformations
- Vertical Translation
- Horizontal Translation
- Vertical Stretch
- Odd and Even Function
- Vertical Compression
- Horizontal Stretch
- Horizontal Compression
- Parent Function
- Shift

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”? 

Heart monitors and baby labor pain monitors both compare normal waves to irregular wave patterns. Tuning forks - sound waves, voice analysis are real world usage. All projectile motion like velocity.
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<tr>
<td>a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) = 2x^3 for x &gt; 0 or f(x) = (x+1)/(x-1) for x ≠ 1.</td>
<td>a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) = 2x^3 for x &gt; 0 or f(x) = (x+1)/(x-1) for x ≠ 1.</td>
<td>b. (+) Verify by composition that one function is the inverse of another.</td>
</tr>
<tr>
<td>Note: Looks like same standard as current but Algebra I focus is on linear only.</td>
<td>Algebra I - linear only Algebra II - Include simple radical, rational, and exponential functions</td>
<td>c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.</td>
</tr>
<tr>
<td>Note: Looks like same standard as previous year but now include simple radical, rational and exponential functions.</td>
<td>d. (+) Produce an invertible function from a non-invertible function by restricting the domain.</td>
<td></td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can find the inverse of a given function (linear, simple radical, rational and exponential),
- ex. replace f(x) with y, interchange x and y, solve for y, replace y with f^{-1}(x)

I can find the inverse of an exponential function using a logarithmic function
- ex. the inverse of f(x)=b^x is f^{-1}(x)=\log_b(x)

I can write the inverse as a function.

### Know (Factual)

- Property of Inverse Functions: If f and f^{-1} are inverse functions, then f(a)=b iff f^{-1}(b)=a
- The inverse of an exponential function can be written using a logarithm.

### Understand (Conceptual)

The students will understand that:

- The inverse of a function can be determined by using the Property of Inverse Functions.
- An inverse function can be written by using this process: replace f(x) with y, interchange x and y, solve for y, replace y with f^{-1}(x).
- When using the Property of Inverse Functions on an exponential function, logarithms must be used.

### Do (Procedural, Application, Extended Thinking)

- Use the Property of Inverse Functions to write the inverse function of a given function.
- Write the inverse of an exponential function.

### Key Vocabulary:

- inverse
- inverse relation
- inverse function
- domain
- range

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

Basic idea of inverse function: When someone calls you on the phone, he or she looks up your number in a phone book (a function from names to phone numbers). When Caller ID shows who is calling, it has performed the inverse function, finding the name corresponding to the number.

Inverse functions can be used to convert from one measurement unit to another.
- ex. If C(x)=5/9(x-32) can be used to convert from Fahrenheit to Celsius. C^{-1}(x) can be used to convert from Celsius to Fahrenheit.

Inverse functions can be used to model and solve real-life problems.
- ex. If a function gives the factory sales of digital cameras over a period of years an inverse function can be used to determine the year in which a certain dollar amount worth of digital cameras was sold.
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</table>
| 8.F Functions Use functions to model relationships between quantities.  
  8.F.4. Construct a function to model a linear relationship between two quantities  
  8.F.5. Describe quantitatively the functional relationship between two quantities by analyzing a graph. | 9-12.F.LE.1 Distinguish between situations that can be modeled with linear functions and with exponential functions.  
  9-12.F.LE.1a- Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.  
  9-12.F.LE.1b- Recognize situations in which one quantity changes at a constant rate per unit interval relative to another,  
  9-12.F.LE.1c- Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. | 9-12.F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). |

**Student Friendly Language:**

I can determine whether a function is linear or exponential by looking at a graph, table, or equation.

I can contrast characteristics of linear and exponential graphs.

I can determine when to use a linear model or an exponential model when given the data or situation.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
</table>
| Linear function characteristics (constant rate of change)  
Exponential function characteristics (percent rate of change) | Linear relationships have a constant rate of change.  
Exponential relationships have a proportional rate of change. | Determine whether data is linear or exponential by using a table or graph.  
Use graphing calculator regression models to determine whether linear or exponential models best fit the data.  
Determine whether a situation will produce a linear or exponential relationship in word applications. |

**Key Vocabulary:**

Slope  
exponential function  
equation  
exponential growth  
linear function  
rate-of-change  
constant  
graph  
table  
multiplier / base / factor

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

Linear  
- Distance - Miles per gallon  
- Income - Dollars per hour  
- Production

Exponential  
- Bacteria Growth  
- Population (animals & humans)  
- Drug levels in blood  
- Radioactive decay  
- Appreciation/Depreciation value (housing, machinery, etc.)  
- Interest
**Domain:** Linear and Exponential Models  
**Cluster:** Construct and compare linear, quadratic, and exponential models and solve problems  
**Grade level:** 9-12

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<tr>
<td>8.F.4 Construct a function to model linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.</td>
<td>9-12.F.LE.2 Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).*</td>
<td>9-12.F-LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can write equations for linear functions and for exponential functions.

I can write and apply formulas for arithmetic and geometric sequences.

I can identify the type of function given input-output pairs.

I can write a linear or exponential function given a graph

**Know (Factual)  
Understand (Conceptual)  
Do (Procedural, Application, Extended Thinking)**

- Linear Function  
- Exponential Function  
- Arithmetic Sequences  
- Geometric Sequences

- Linear functions are related to arithmetic sequences.  
- Exponential functions are related to geometric sequences.  
- Relationships between data can be represented multiple ways (graphs, tables, input-output pairs, mappings).  
- Real-world applications exist for linear and exponential functions.

- Construct linear functions given arithmetic sequences.  
- Construct exponential functions given geometric sequences.  
- Develop arithmetic and geometric sequences given multiple representation of data (table, graph, input-output pairs, or description).  
- Apply linear and exponential functions to real-world applications.  
- Apply arithmetic and geometric sequences to real-world applications.

**Key Vocabulary:**  
linear function  
exponential function  
arithmetic sequence  
geometric sequence  
relationship  
graph  
table  
input-output pair  
mapping

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Exponential:  
To find the compound interest of an investment or loan.  
To find depreciation of a car’s value over a certain amount of time.

Linear:  
To find miles per gallon of an automobile.  
To find wages in dollars per hour.
## SD Common Core State Standards Disaggregated Math Template

| Domain: | Functions | Cluster: | Construct and compare linear, quadratic, and exponential models and solve problems | Grade level: | 9-12 |

<table>
<thead>
<tr>
<th>Correlating Standard in Previous Year</th>
<th>Number Sequence &amp; Standard</th>
<th>Correlating Standard in Following Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>9-12 F.LE 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.</td>
<td>9-12.F.LE.3 Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.*</td>
<td>9-12.F.LE.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where $a$, $c$, and $d$ are numbers and the base $b$ is 2, 10, or e; evaluate the logarithm using technology.</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can interprete table and graph of exponential functions.

I can observe from a table or graph that an exponential graph eventually exceeds linear, quadratic or polynomial functions.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● rate of change</td>
<td>Linear, quadratic, higher-order polynomials and exponential functions increase at different rates. Exponential functions eventually exceed linear, quadratic, or polynomial functions..</td>
<td>Compare linear, quadratic, other higher-order polynomial functions, and exponential graphs. Compare linear, quadratic, other higher-order polynomial functions, and exponential tables. Analyze graphical representations of polynomial and exponential functions rate of change.</td>
</tr>
<tr>
<td>● linear functions (table &amp; graph)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● quadratic functions (table &amp; graph)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● other higher-order polynomial functions (table &amp; graph)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>● exponential functions (table &amp; graph)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

Linear function, quadratic function, polynomial function, exponential function, graph, table, rate of change

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Students need to understand how to read and interpret graphs and tables to make informed decisions about concepts of change. For example how money can grow when invested, population growth, and radioactive decay.
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</tr>
</thead>
<tbody>
<tr>
<td>9-12.F.LE.1b</td>
<td>9-12.F.LE.5 Interpret the parameters in a linear or exponential function in terms of a context.*</td>
<td>9-12.F.LE.4 For exponential models, express as a logarithm the solution to $ab^ct=d$ where $a$, $c$, and $d$ are numbers and the base $b$ is 2, 10, or $e$; evaluate the logarithm using technology.</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can interpret the parameters of linear and exponential functions in terms of context.

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<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
</thead>
<tbody>
<tr>
<td>● parameter</td>
<td>● Recognize the parameters that may exist in context with the problem.</td>
<td>● State and interpret the parameters of linear and exponential functions in terms of the context of a given situation.</td>
</tr>
<tr>
<td>● linear function</td>
<td>●</td>
<td>● Interpret linear and exponential functions.</td>
</tr>
<tr>
<td>● exponential function</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Key Vocabulary:**

function
linear functions
exponential function
parameter
expression
extraneous solutions

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Answers are not always appropriate or possible with the given “real-world” applications. They need to make sure that the answers given fall within the possible options and fit with the context of the problem.
### Domain: Statistics and Probability
### Cluster: Summarize, represent, and interpret data on a single count or measurement variable
### Grade level: 9-12

<table>
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</thead>
<tbody>
<tr>
<td>8.SP.1 Investigate patterns of association in bivariate data.</td>
<td>S.ID.1 Represent data with plots on the real number line (dot plots, histograms, and box plots).*</td>
<td>S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*</td>
</tr>
</tbody>
</table>

### Student Friendly Language:
I can create dot plots, histograms, and box plots on a real number line.

<table>
<thead>
<tr>
<th>Know (Factual)</th>
<th>Understand (Conceptual)</th>
<th>Do (Procedural, Application, Extended Thinking)</th>
</tr>
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<tbody>
<tr>
<td>*A histogram is a bar graph of a frequency table</td>
<td>Data can be represented in multiple ways.</td>
<td>Create a scale that will evenly distribute the data on graphs.</td>
</tr>
<tr>
<td>*Box plot plots the value of the 5 number summary</td>
<td>Different data will change the appearance of the graph.</td>
<td>Create dot plots, histograms, and box plots on a real number line.</td>
</tr>
<tr>
<td>*The 5 number summary is the min, Q1, median, Q3 and max values</td>
<td>The scale of the graph can display data accurately or skewed.</td>
<td>Compare graphs of different data sets of the same category.</td>
</tr>
</tbody>
</table>

### Key Vocabulary:

### Relevance and Applications: How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question "why do I have to learn this"?

Read and interpret statistical data found in newspapers, magazines, and on the Internet.

Create a box plot of prices on Ebay for each of two models of Ipods that you are interested in purchasing. This will help you determine if the current price for an item falls within the box plot range.
<table>
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</thead>
<tbody>
<tr>
<td>7.SP.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. <em>For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.</em></td>
<td>S.ID.2 Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.*</td>
<td>S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*</td>
</tr>
</tbody>
</table>

**Student Friendly Language:**

I can find median and mean.

I can find interquartile range and standard deviation.

I can compare the median, mean, interquartile range, and standard deviation of two or more different data sets.

I can choose the appropriate statistical measurement based on the data set.

**Know (Factual)**

- Center (mean, median)
- Spread (interquartile range, standard deviation)

**Understand (Conceptual)**

I want students to understand that:

- The median and mean indicate the center of the data set.
- The interquartile range and standard deviation indicate the spread of the data set.
- The shape of the data distribution determines which statistical measurement is appropriate for the specific data set.
- There are ways to visually display the data in a set such as a box and whisker plot.

**Do (Procedural, Application, Extended Thinking)**

- Compare center and spread of two data sets.
- Analyze the shapes of two or more data distributions to choose the appropriate statistical measurements to compare data sets.
- Explain the reasoning for choosing appropriate measurements.

**Key Vocabulary:**

- center
- mean (average)
- median
- spread
- interquartile range
- upper quartile
- lower quartile
- standard deviation
- outliers
- box and whisker plot

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question "why do I have to learn this"?

Sports Statistics - Individual player statistics can be analyzed and used to determine different coaching strategies.

- Using distributions to compare the statistics of two players a team may be interested in signing.
### SD Common Core State Standards Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Statistics and Probability</th>
<th>Cluster:</th>
<th>Summarize, represent, and interpret data on a single count or measurement variable</th>
<th>Grade level:</th>
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</thead>
<tbody>
<tr>
<td>8.SP.1. Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.</td>
<td>S.ID.3 Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).*</td>
<td>S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.</td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can find the mean, median, and mode.

I can find the range, variance, and standard deviation of a given set of data.

I can specify the shape of a data set.

I can explain how differences in the data can visually impact the shape.

I can explain how extreme data points can affect the graph.

### Key Vocabulary:

<table>
<thead>
<tr>
<th>central tendency</th>
<th>mean</th>
<th>interquartile range</th>
<th>median</th>
<th>mode</th>
<th>range</th>
<th>spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>standard deviation</td>
<td></td>
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</tr>
<tr>
<td>u-shaped</td>
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<td>right skewed</td>
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<tr>
<td></td>
<td></td>
<td>5-box plot summary outliers</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

How does hunting predators affect the population growth of livestock?

Example: A farmer has 400 sheep. There is a pack of 40 coyotes nearby. One sheep will feed 5 coyotes for 1 day. If the coyote population is reduced by 10% per week, how will this affect the herd?

Family income of students in the class: what happens to measures of central tendency if a millionaire’s child joins the class?

Many applications display data and may require you to interpret the data, example: news articles.
SD Common Core State Standards  Disaggregated Math Template

| Domain: | Statistics and Probability | Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables | Grade level: 9-12 |

<table>
<thead>
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</tr>
</thead>
</table>
| 8.SP.4 Understand that patterns of association can also be seen in bivariate categorical data by displaying frequencies and relative frequencies in a two-way table. Construct and interpret a two-way table summarizing data on two categorical variables collected from the same subjects. Use relative frequencies calculated for rows or columns to describe possible association between the two variables. | S.ID.5 Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.* | S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.  
● S.ID.6a- Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.  
● S.ID.6b- Informally assess the fit of a function by plotting and analyzing residuals.  
● S.ID.6c- Fit a linear function for a scatter plot that suggests a linear association |

**Student Friendly Language:**

I can recognize the difference between joint, marginal, and conditional relative frequencies.  
I can calculate relative frequencies including joint, marginal, and conditional relative frequencies.  
I can summarize categorical data for two categories in two-way frequency tables.  
I can interpret relative frequencies in the context of the data.  
I can recognize possible associations and trends in the data.

**Know (Factual)**

- joint frequency is represented by the body of the two-way frequency table  
- marginal frequency is represented by the totals of the rows and columns  
- conditional relative frequency shows the relative frequency for each row or column as a percentage.

**Understand (Conceptual)**

I want students to understand that:  
Two-way frequency tables can be used to analyze data and predict trends.

**Do (Procedural, Application, Extended Thinking)**

Calculate joint frequency.  
Calculate marginal frequency.  
Calculate conditional relative frequency.  
Interpret data within two-way frequency tables.  
Recognize associations and trends in two-way frequency data.

**Key Vocabulary:**

joint frequency  
marginal frequency  
conditional relative frequency  
two-way frequency table

**Relevance and Applications:** How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

An application would be to survey event attendees and determine relationships between subgroups based on sex and/or age and their concession stand preferences using a two-way frequency table and calculations of joint, marginal, and conditional relative frequencies.
### SD Common Core State Standards Disaggregated Math Template

<table>
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<tr>
<th>Domain:</th>
<th>Statistics and probability</th>
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<th>Summarize, represent, and interpret data on two categorical and quantitative variables</th>
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<th>Correlating Standard in Following Year</th>
</tr>
</thead>
</table>
| 8.SP.1 Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association. 8.SP.2 Know that straight lines are widely used to model relationships between two quantitative variables. For scatter plots that suggest a linear association, informally fit a straight line, and informally assess the model fit by judging the closeness of the data points to the line. | S.ID.6 Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.  
- S.ID.6a: Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.  
- S.ID.6b: Informally assess the fit of a function by plotting and analyzing residuals.  
- S.ID.6c: Fit a linear function for a scatter plot that suggests a linear association. | S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.* |

### Student Friendly Language:

I can plot data in a scatter plot.

I can find a function for the line of best fit.

I can use the function to predict an output for any given input.

I can use the scatter plot to estimate other values.

### Know (Factual)  
Understand (Conceptual)  
Do (Procedural, Application, Extended Thinking)

- Scatter plots can be used to see the general shape of a graph that may fit a set of data.  
- Not all data sets will fit to a linear or exponential function

A scatter plot represents two quantitative variables.  
Data on a scatter plot can have positive, negative, or no correlation.  
Data with a strong correlation can be fit to a function.

Read, interpret, and plot data using a scatter plot.  
Describe how data is related.  
Determine if a set of data can be represented by a linear or exponential function.  
Find either a linear or exponential function to fit the data.

### Key Vocabulary:

scatter plot linear function exponential function line of best fit

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Example: You work in a fish market. You are analyzing data from the years 2000-2010 and the amount of consumption of fish. Using the data estimate how many pounds of fish will be consumed in 2015.
### SD Common Core State Standards  Disaggregated Math Template

<table>
<thead>
<tr>
<th>Domain:</th>
<th>Statistics and Probability</th>
<th>Cluster:</th>
<th>Interpret linear models</th>
<th>Grade level:</th>
<th>9-12</th>
</tr>
</thead>
</table>

#### Correlating Standard in Previous Year | Number Sequence & Standard | Correlating Standard in Following Year
---|---|---
8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept | S.ID.7 Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.* | S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.*

### Student Friendly Language:

I can recognize that the y-intercept is the initial value/starting point.

I can describe the change and characteristics of the real world data using slope (rate of change).

I can make predictions based on current data.

### Key Vocabulary:

- Slope (Rate of Change)
- Negative Correlation
- Data Point (Ordered Pair)
- Slope-Intercept Form
- No Correlation
- Standard Form
- Intercepts
- Point-Slope Form
- Linear Model
- Positive Correlation
- Initial Value

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question "why do I have to learn this"?

Given the monthly charge and price per minute of two different cell phone plans, determine which is the most cost effective for a person who uses x minutes per month.
**SD Common Core State Standards  Disaggregated Math Template**

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<tbody>
<tr>
<td>8.SP.2 Investigate patterns of association in bivariate data</td>
<td>S.ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.*</td>
<td>S.ID.9 Distinguish between correlation and causation.*</td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can use a graphing calculator to find the correlation coefficient for linear data.

I can say what the correlation coefficient means in the context of the problem.

I can predict a value that was not in the given data by using the “line of best fit”.

### Know (Factual)

- Correlation coefficient—a number describing the relationship between variables
- Difference between strong/weak correlation
- Difference between +/− correlation
- How to find the ‘line of best fit’ on a graphing calculator

### Understand (Conceptual)

- The correlation coefficient tells us if there is a linear relationship between two sets of data.
- Given a strong correlation we can use the model to interpolate and sometimes extrapolate.

### Do (Procedural, Application, Extended Thinking)

- Compute the correlation coefficient using technology.
- Interpret the correlation coefficient in the given context.
- Justify your interpretation of the correlation coefficient.

### Key Vocabulary

correlation  correlation coefficient  line of best fit (regression line)  interpolate  extrapolate  linear data

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this”?

Example: Collect data on a sample of students on GPA and hours spent working to determine the correlation coefficient for the situation and then state what it means.

Example: Use ACT scores and time studied for students to determine a correlation coefficient and state what it means. Does more studying tend to result in a higher ACT score? Predict the ACT score for a student who studies x hours.
### SD Common Core State Standards Disaggregated Math Template

**Domain:** Statistics and Probability  
**Cluster:** Interpret linear models  
**Grade level:** 9-12

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<td>8.SP.1 Investigate patterns of association in bivariate data.</td>
<td>S.ID.9 Distinguish between correlation and causation.*</td>
<td></td>
</tr>
</tbody>
</table>

### Student Friendly Language:

I can understand that correlation means a relationship between two variables.

I can understand that although a relationship exists, correlation between two variables does not automatically imply that one causes the other.

I can compare events and determine their effects on the resulting outcomes.

### Know (Factual)  
Understand (Conceptual)  
Do (Procedural, Application, Extended Thinking)

- correlation determines the relationship between two variables.
- causation means that one event causes the outcome of another.

- If different events are correlated, it doesn’t mean that they are caused by one another.
- Correlation and causation may or may not be connected.
- Causation implies that one thing causes another.

- Be able to compare data and conclude what effects, if any, the events had on one another.
- Compare the independent variable and the dependent variable to determine if there is a correlation.

### Key Vocabulary:

- correlation  
- causation  
- event  
- outcome  
- independent variable  
- dependent variable  
- scatter plot  
- line of best fit

### Relevance and Applications:

How might the grade level expectation be applied at home, on the job or in a real-world, relevant context? Include at least one example stem for the conversation with students to answer the question “why do I have to learn this?”

- Determine the correlation between insurance premiums and age/sex of drivers.
- Have students do jumping jacks and measure heart rate leg length versus walking rate.
- There is a strong negative correlation between ice cream sales and patients with the flu. Neither one causes the other. They are both a function of temperature/seasons.