Algebra 1 Resource

Information Regarding This Resource The following resource will help to unify the concepts of Expressions, Functions, Inequalities and Interpreting Data by allowing students the opportunity to analyze data in a real-world scenario. Students will also collaborate, create and reflect on their learning.

The Format of This Resource This resource is organized into flexible components that can be utilized by educators, parents or students in its entirety or can be fragmented based on desired knowledge. Each text box contains the process skills students will use in the lesson to explore the mathematical content within the Algebra 1 Curriculum. The focus of each lesson is highlighted for easy reference. The lessons have been designed to allow multiple entry points to accommodate for different levels of understanding.

Throughout this resource, students are asked to justify or explain their answers, thought process or understanding. The intent is for students to reflect on their mathematical thoughts. Students should keep in mind that justifications or explanations can take multiple forms, including, but not limited to, diagrams, graphs, text, or pictures. These are not meant to be right or wrong, rather a means of making learning visible.

Connection of Standards:

Process Standard(s): Students will show their understanding of **rewriting radical form expressions in rational exponent form** by making sense of problems, persevering, reasoning and making sense of relationships, and using critical thinking skills to justify their mathematical reasoning.

Content Standards(s):

A1.NRNS.2* Use the definition of the meaning of rational exponents to translate between rational exponent and radical forms.

Analyze the two equations below.

$$x^{\frac{p}{t}} = \sqrt[t]{(x)^p} \qquad z^{\frac{2}{7}} = \sqrt[7]{(z)^2}$$

a. **Use your analysis to write a rule, in your own words, explaining the relationship between rational exponents and radicals.**
b. **Using your written rule, solve the following equation.** $(x-2)^{\frac{3}{5}} = \sqrt[5]{(2x+1)^3}$
c. **Validate your solution by checking your answer algebraically.**

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Connection of Standards:

Process Standard(s): Students will show their understanding of **interpreting information given exponential models** by making sense of problems, persevering, reasoning and making sense of relationships, using critical thinking skills to justify their mathematical reasoning, and connecting ideas to real world situations through modeling.

Content Standard(s):

A1.ACE.1* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.

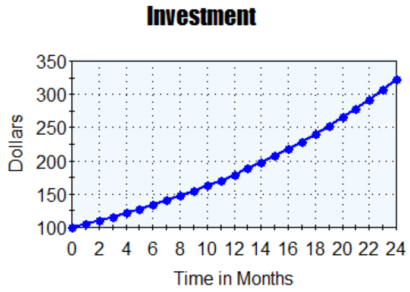
A1.AREI.10* Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.

A1.FIF.1* Extend previous knowledge of a function to apply to general behavior and features of a function.

A1.FIF.2* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation.

The below graph shows an investment that draws 5% interest per month.

a. **What information can you give about this investment by analyzing the graph?**
b. **Is this a legitimate investment? Why or Why not?**
c. **What is the Growth Factor for this investment?**
d. **How are the Growth Rate and Growth Factor different?**



Think of a real world example that might represent exponential *decay* instead of growth. Write an equation for the scenario identifying the initial value, decay rate and decay factor. Draw a visual representation of this example. Label both axes with units and labels. After you have drawn the graph, create 3 questions relating to the graph and answer the questions.

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Connection of Standards:

Process Standard(s): Students will show their understanding of **interpreting information given a quadratic function and modeling quadratic functions** by making sense of problems, persevering, reasoning and making sense of relationships, using critical thinking skills to justify their mathematical reasoning, and connecting ideas to real world situations through modeling.

Content Standard(s):

A1.ACE.1* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.

A1.AREI.4* Solve mathematical and real-world problems involving quadratic equations in one variable.

A1.AREI.10* Explain that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.

A1.FIF.1* Extend previous knowledge of a function to apply to general behavior and features of a function.

A1.FIF.2* Evaluate functions and interpret the meaning of expressions involving function notation from a mathematical perspective and in terms of the context when the function describes a real-world situation.

A ball is thrown into the air. The equation $f(t) = -16t^2 + 48t + 6$ represents the ball's path, where t presents the time in seconds and $f(t)$ the distance in feet.

a. **If this equation were graphed to model the ball's path, what does the negative coefficient tell you about the appearance of the graph?**
b. **Why does this negative coefficient make sense in terms of the ball's path?**
c. **If the leading coefficient were changed to -32, how would this effect the shape of the graph?**
d. **In terms of the ball's path, what does the constant represent in the equation?**
e. **How do you know this mathematically? Justify your answer.**
f. **Without the use of technology, what key features would assist in sketching the graph of a quadratic equation?**
g. **Sketch the graph of the ball's path. Label both axes.**
h. **Approximate after how many seconds the ball will hit the ground.**
i. **Show or explain how you determined this answer.**
j. **Either mathematically or graphically, find the maximum height the ball reaches.**
k. **The maximum height is what key feature of the quadratic model?**
l. **How did you determine this value?**
m. **What other key features might be of importance when evaluating this situation?**

Identify an experience that represents a quadratic function.

n. **Graph the quadratic function that represents this experience**
o. **Write an equation that you feel best fits the graph.**
p. **What information or technology might have made this task easier to accomplish?**

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Connection of Standards:

Process Standard(s): Students will show their understanding of **multiple representations of polynomial equations** by making sense of problems, persevering, reasoning and making sense of relationships, and using critical thinking skills to justify their mathematical reasoning.

Content Standard(s):

A1.ASE.2* Analyze the structure of binomials, trinomials, and other polynomials in order to rewrite equivalent expressions.

A1.ASE.3* Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

a. **Write an equivalent form of the equation $y = (x + 1)^2(x - 2)$.**
b. **How could you mathematically test to confirm these expressions are equivalent**?
c. **Classify the polynomial in terms of its degree and number of terms**.
d. **Can you classify it by degrees and number of terms in both of the equivalent forms**?
e. **Explain your reasoning**.
f. **Sketch a graph of the function and list all key features to include, but not limited to, intervals of increase and decrease, end behavior, extrema (maxima and minima), intercepts (x and/or y), domain and range**.
g. **Compare and contrast the key features between the original above function and $y = -(x + 1)^2(x - 2)$. (Which features or characteristics are the same and which are different**?)
h. **Why would some of the key features remain the same when the equation has changed? Explain your reasoning in words, mathematically or graphically.**

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Connection of Standards:

Process Standard(s): Students will show their understanding of **operations with polynomial expressions** by making sense of problems, persevering, reasoning and making sense of relationships, and using critical thinking skills to justify their mathematical reasoning.

Content Standard(s):

A1.AAPR.1* Add, subtract, and multiply polynomials and understand that polynomials are closed under these operations.

The following statements may be true or false. Determine the validity of each statement and then justify your conclusion mathematically.

a. The sum of two quadratic polynomials is always quadratic.
b. The product of two quadratic polynomials is always quadratic.
c. The difference of a quadratic polynomial and a linear polynomial is linear.

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Connection of Standards:

Process Standard(s):

Students will show their understanding of **writing and solving linear systems** by making sense of problems, persevering, reasoning and making sense of relationships, using critical thinking skills to justify their mathematical reasoning, and connecting ideas to real world situations through modeling.

Content Standard(s):

A1.AREI.5 Justify that the solution to a system of linear equations is not changed when one of the equations is replaced by a linear combination of the other equation.

A1.AREI.6* Solve systems of linear equations algebraically and graphically focusing on pairs of linear equations in two variables.

We often use a system of equations to determine when desired outcomes are more beneficial than others or when the outcomes might be the same.

Example: I am going to rent a car. Rental Company A offers a deal of $100 per day and $5/mile and Rental Company B offers a deal of $75 per day and $8/mile. It is beneficial for me to determine the better value for the number of miles I plan to drive and the number of days I need the car.

Think of a meaningful experience that might require you to determine when one value might be more beneficial than another. Write two equations to represent the two separate situations and then answer the following questions.

a. **At what point are the two equations equivalent?**
b. **What does this equivalence mean in terms of this scenario?**
c. **Justify your answer.**
d. **Find values where one of the scenarios is better than the other.**

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Connection of Standards:

Process Standard(s):

Students will show their understanding of **finding key features of quadratic models and writing equations from transformations** by making sense of problems and persevering to solve them, reasoning and making sense of relationships, and using critical thinking skills to justify mathematical reasoning.

Content Standard(s):

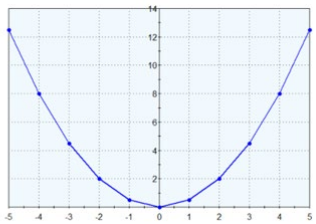
A1.FBF.3* Describe the effect of the transformations (x), $(x)+k$, $f(x+k)$, and combinations of such transformations on the graph of $y = f(x)$ for any real number k. Find the value of k given the graphs and write the equation of a transformed parent function given its graph.

A1.FIF.1* Extend previous knowledge of a function to apply to general behavior and features of a function.

A1.FIF.4* Interpret key features of a function that models the relationship between two quantities when given in graphical or tabular form. Sketch the graph of a function from a verbal description showing key features. Key features include intercepts; intervals where the function is increasing, decreasing, constant, positive, or negative; relative maximums and minimums; symmetries; end behavior and periodicity.

a. List as many key features for the below graph as you can. Include, but do not limit yourself to, intervals of increase and decrease, intercepts, end behavior, extrema (maxima and minima), domain and range.

Graph $f(x)$



b. Write the quadratic equation for this graph. How did you derive this equation?

c. Is this graph vertically stretched or compressed from the parent function $y = x^2$?

d. Write the new equation for this graph if it is translated down 5 units.

e. Write the new equation for this graph if it is translated right 1 unit.

f. Write the new equation for this graph if it is reflected over the x-axis, translated down 5 units and translated right 1 unit.

g. Give the new domain and range for the transformed graph in f.

h. State the average rate of change for the new transformed graph over the interval [-1,4].

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Connection of Standards:

Process Standard(s):

Students will show their understanding of **comparing linear, quadratic and exponential functions** by making sense of problems, persevering, reasoning and making sense of relationships, using critical thinking skills to justify their mathematical reasoning, and connecting ideas to real world situations through modeling.

Content Standard(s):

A1.FIF.9* Compare properties of two functions given in different representations such as algebraic, graphical, tabular, or verbal.

A1.FIF.6* Given a function in graphical, symbolic, or tabular form, determine the average rate of change of the function over a specified interval. Interpret the meaning of the average rate of change in a given context.

a. **Write the equation for one Quadratic, Linear and Exponential function below.**

$f(x) =$ _____	g(x) = _____	h(x) = _____
Quadratic	**Linear**	**Exponential**

b. **Can you predict which of the above functions will have a greater rate of change over the interval [-2,3]?**
c. **Without the parameters of a given domain, which of the three graphs do you predict would increase most rapidly as the domain moves towards infinity?**
d. **Justify your answer for c. numerically.**
e. **Mathematically calculate the rate of change over the interval [-2,3]? Was your prediction correct?**
f. **Can you identify a real-world example to model each of the three equations? Explain each example.**

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Connection of Standards:

Process Standard(s):

Students will show their understanding of **writing linear inequalities from real-world problems** by making sense of problems, persevering, using critical thinking skills to justify their mathematical reasoning, and connecting ideas to real world situations through modeling.

Content Standard(s):

A1.ACE.1* Create and solve equations and inequalities in one variable that model real-world problems involving linear, quadratic, simple rational, and exponential relationships. Interpret the solutions and determine whether they are reasonable.

Tony is preparing for a marathon. He predicts he will need at least 635 ounces of water for the marathon. A small water bottle holds 16 ounces of water and a large bottle holds 20 ounces of water. Martha is preparing for the same marathon. She predicts she will need at least 585 ounces of water for the marathon because she is much smaller that Tony.

a. **Write an inequality to represent each of the above constraints.**
b. **If Martha and Tony both want to carry the same number of small and large water bottles, what is one possible combination of the number of small and large water bottles each will carry?**

Identify a relatable experience you have had that would require an inequality in two variables.

a. **What makes this experience an inequality?**
b. **What are the two variables within the inequality?**
c. **Write an inequality to represent this experience.**
d. **Why is it important for you to solve the system to determine the values of the two variables?**

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Connection of Standards:

Process Standard(s): Students will show their understanding of **writing equations for arithmetic and geometric sequences** by making sense of problems, persevering, and using critical thinking skills to justify their mathematical reasoning.

Content Standard(s):

A1.FLQE.2* Create symbolic representations of linear and exponential functions, including arithmetic and geometric sequences, given graphs, verbal descriptions, and tables.

The following sets of numbers are both sequences.

A. -1, 3, 7, 11, … **B. -1, -4, -16, -64, …**

a. **Compare and contrast these sequences.**

Think of the sequences in terms of a table of values, where the x-value is the number of the term and the sequence number is the corresponding y-value.

Example of A:

x	1	2	3	4
y	-1	3	7	11

b. **Graph the table of values that corresponds with sequence A. What type of line does it create?**
c. **Graph the table of values that corresponds with sequence B. What type of line does it create?**
d. **An arithmetic sequence creates a linear graph and a geometric sequence creates an exponential graph. Knowing this, label each of the above sequences as arithmetic or geometric.**
e. **Explain in your own words without a visual model of the graph how you can determine if a sequence is arithmetic or geometric.**
f. **Attempt to write an equation for both sequences.**
g. **Create your own arithmetic sequence. Write an equation for this sequence.**
h. **Create your own geometric sequence. Write an equation for this sequence.**

Reflection:

a. **Collaborate with someone in your family, a friend, or a neighbor. Ask them to look over your mathematical reasoning and ask you at least 5 guiding questions. Document the 5 questions they asked.**
b. **Document the answers you gave to the 5 questions.**
c. **Reflect on your work. Where did you struggle? Where did you triumph? What do you still wonder?**
d. **Look over the content you covered, the processes that guided you through your discoveries, and think about your collaboration. Write down your thoughts and allow your reflection to move you forward in your mathematical thinking.**