

Lesson Title: Graphing Exponential Equations **Date:** _____

Subject: Algebra I or Algebra II Grade: 8 - 11	Topic: Exponential Functions Designer: Jessica Ulcickas
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Stage 1 – Desired Results

Lesson Overview: This activity teaches students about graphing exponential functions. Students are asked to graph various exponential growth and decay functions by connecting ordered pairs. By the end of the activity, students will be able to identify whether a function is a growth function or a decay function, and successfully graph the function by hand.

Standards Addressed:

CCSS.MATH.CONTENT.HSF.IF.C.7.E

Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

CCSS.MATH.CONTENT.HSF.IF.C.8.B

Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing exponential growth or decay.

CCSS.Math.Content.HSF-BF.B.3 Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ 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.

Enduring Understanding:

Exponential functions are typically either growth functions or decay functions. The base of the exponent determines whether or not the function will be a growth function or a decay function. All exponential functions retain the same basic shape and are subject to the same transformations as all other functions. Exponential functions all have an asymptote, which changes based on the vertical translation of the graph.

Essential Questions:

How does the equation of a function affect its graphical representation?

How does changing the equation of a function in more than one way affect its graphical representation?

How does changing the base of your exponential function change the shape of its graph?

<p>Students will need to know: Students will need to have basic knowledge of functions and what their graphical representations are. Students should also be familiar with function transformations and how the graphical representation of a function changes when the equation is changed.</p>	<p>Students will be able to:</p> <ul style="list-style-type: none"> • Identify whether an exponential function is a growth function or a decay function. • Graph an exponential function by connecting a sequence of ordered pairs that are part of the function.
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Stage 2 – Assessment Evidence

<p>Performance Tasks: In this activity:</p> <ul style="list-style-type: none"> • Asking students to identify whether a function is a growth function or a decay function. • Asking students to create a chart of ordered pairs in order to help graph exponential functions. • Asking students to graph exponential functions. • Asking students to identify transformations of exponential functions. 	<p>Other Evidence:</p> <ul style="list-style-type: none"> • To be decided by the teacher.
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Stage 3 – Learning Plan

<p>Lesson Procedure:</p> <p><u>Many Days Before:</u></p> <p>Students will be introduced to the topic of exponential functions and their graphs. How this introduction occurs and to what extent is at the discretion of the classroom teacher.</p> <p><u>Day Of:</u></p> <p>Students will go to the computer lab in order to complete this activity. For the duration of the activity, the teacher will monitor student progress to ensure that students complete the activity properly and do not simply click to complete. It is recommended that students take notes during the activity to help with their enduring understanding of the topic. The</p>	<p>Required Materials:</p> <ul style="list-style-type: none"> • Computers for each student. • Notebooks for each student.
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<p>activity will not take all class period, so the remainder of the class period will be at the discretion of the classroom teacher.</p>	
<p>Possible Discussion Questions for Students:</p> <ul style="list-style-type: none"> • What function transformation would change an exponential growth function into an exponential decay function? • What types of practical uses do you think exponential functions may have? • Are there any functions we have covered so far that also have asymptotes? What is the difference between those functions and exponential functions? 	<p>Sample Answers to Discussion Questions:</p> <ul style="list-style-type: none"> • A reflection over the y-axis, which is denoted by placing a negative sign in front of the x variable. • Answers may vary. Sample answers: Interest, population growth, radioactive decay, etc... • Sample answer: Yes, we have learned about rational functions. The biggest difference is that rational functions often have vertical asymptotes while exponential functions only have a one sided horizontal asymptote. Even though exponential functions often appear to have a vertical asymptote because of how fast y-values increase on an exponential function, there is no vertical asymptote in an exponential function.