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Instructional Design

EDTL 7100

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**Statement of Purpose**

Each year it seems that students find it difficult to apply past knowledge with present learning. They see each mathematical standard that is taught as an independent concept that seems to have very little relevance to any topic that they have learned in past math classes. Students tend to have a difficult time with exponential growth and decay because they are expected to bring their past knowledge to the table as well as continue to build upon that knowledge. To them, the Algebra of the past seems nothing like the Algebra they are expected to learn in my class. They feel that the problems are more difficult and require more steps to arrive at the answer. They see that one misplaced negative sign could completely ruin a half page of work. They are now expected to show their work and to explain why they arrived at the answer.

Gone are the days of math simply being right or wrong. I want to know who worked on the problem. I want to know what issues they had when they solved for the answer. I want to know where they looked for help when they were struggling. I want to know when they realized that they truly understood the concept. I want to know why they got the answer they did in a detailed explanation. And I want to know how they plan to relate their new found knowledge to the real world.

I chose to explore the exponential functions subunit, because it forces students to access a vast amount of mathematical foundation knowledge in order to fully grasp the idea of exponential growth and decay. Students must be able to define new vocabulary and successfully apply order of operations to equations. They must understand how to convert percentages to decimals and recall the tips they learned when rounding to the nearest tenth or hundredth. They need to access their problem solving skills in order to pull the most important facts from a story problem and properly insert them into a formula. They need to be familiar with entering a series of computations into the calculator and decide whether or not the answer they received is logically the correct one. And most important, they need to be able to relate the skills they are learning in math class to real world problems and decide whether or not the answers they are finding would suffice if they were to encounter the problem outside of math class.

Most often, I use the Basic Lesson Plan Model in my classroom, just for the sake of ease. I am forced to turn in written lesson plans, complete with standards. However, most of my lesson plans are inside my head. I think through a lesson or idea. I visualize it. I research the internet for a supplemental that I would like to use. For the most part, I write little down, and if I do, it is probably only understood by me.

However, after reading the text and learning about the different models, I believe that the 5-E Learning Cycle Model is best suited for my class. While many classes today seem to be a dictatorship, mine is definitely a democracy. I speak to all of my students every day. They solve problems on the smartboard and explain steps to the other students in the class. They have board races to spark their competitive side. They come to my computer for completion grades and at that time ask me questions, if they have any. At the beginning of class, they work in groups to answer warm-up questions as I wander about the classroom, stopping to clarify any issues that might result. They vote when they would like to have tests. They decide if they have had sufficient time to complete their projects. My students, if they choose to be, are constantly engaged and involved in almost every activity that takes place in my room.

The author of the text states that the 5-E model “has become an integral part of science and math methodology courses only recently, due to its strong linkage to constructivist theories of teaching and learning” (Chiarelott, p. 90, 2006). To me, the basic lesson plan model places me in charge from beginning to end. The 5-E model allows my students to be in charge of their own learning. It calls for my students to play the key role in learning instead of the teacher. The students are expected to be engaged in learning activities, explore information presented to them, explain what they learned, extend their understanding to real world issues, and evaluate how well they have learned the material. I also feel that this model is best suited for the exponential functions subunit, because growth and decay is ever present in the world around us. This concept can be found in many careers such as banking, science, medicine, the auto industry, and many more.

**References**

Chiarelott, L. (2006). Curriculum in Context: Designing Curriculum for Teaching and Learning in Context. Wadsworth: Belmont, CA.

Larson, R., *et al* (2004). Algebra 1. Evanston, Illinois: McDougal Littell.

***Subunit Learner Outcomes***

***Subunit 3: Exponential Functions***

1. Students will be able to define exponential growth, exponential decay, percent of increase, percent of decrease, decay factor, growth factor, and initial amount. *Knowledge*
2. Students will be able to identify the differences between the exponential growth and the exponential decay formulas. *Comprehension*
3. Students will be able to sketch the graphs of exponential models on coordinate plane graph paper*. Synthesis*
4. Students will be able to input exponential functions into a graphing calculator as well as appropriately adjust the windows to see the graph in its entirety. *Application*
5. Students will be able to write and use exponential growth models. *Synthesis*
6. Students will be able to write and use exponential decay models. *Synthesis*
7. Students will be able to write and solve real world, multi-step problems involving money, animal populations, depreciation of vehicles, and science phenomena. *Synthesis*
8. Students will be able to use technology such as graphing calculators and power point to create visual representations that can be used to teach others what they have learned about exponents. *Analysis, Synthesis, Evaluation*

**Pre-Assessment ALGEBRA 1B NAME**

**Exponents Unit \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Write the expression in exponential form and then evaluate.**

**1.** One fourth squared **2.** Negative eight cubed

**3.** 3x \* 3x \* 3x **4.** Four to the fourth power

**Evaluate the expression.**

**5.** 3a5 when a = -1 **6.** M (-m3) when m = 4

**7. \_\_**40\_ when x = -2 **8.** 22p4  when p = \_\_1\_\_

2x3 3

**Use your calculator to evaluate the expression.**

**9.** 1/3 (8 \* 3) + 18 **10.** 8 (7-4)2 + 4

**11.** [ 11 + (53 \* 2)] ÷ 3 **12.** 4 (2.7 ÷ .3) – 5

**Covert the given percentage to a decimal and round to the nearest hundredth.**

**13.** 13.625% **14.** 25.3%

**15.** 6.5% **16.** 105.89%

**Plug the given numbers into the formula and label your answer appropriately. Round to the nearest tenth if the answer is in decimal form.**

**17.** Find the area of a trapezoid with a height of 24 inches, a top base of 13 inches, and a bottom base of 11 inches.

**18.** Find the area of a circle with a diameter of 3 feet.

**19.** Find the area of a triangle with a height of 12 cm. and a base of 4 cm.

**20.** You travel 800 miles at a speed of 25 miles per hour. How long should it take you to reach your destination?

**Graph the equation.**

**21.** 2x + 3y = 12 **22.** Y = 1/3x – 4

**23.** You buy a pair of jeans that costs $25.00 and a sweater that costs $20. There is a 15% coupon in the paper and the tax is 6.5% in Lima. How much do you pay for your clothes at the register? Round your answer to the nearest hundredth.

***Lesson Plans***

1. *Concept to be Learned*

Exponential Functions (Day 1)

1. *Lesson Objectives*
2. Students will be able to sketch the graphs of exponential models on coordinate plane graph paper.
3. Students will be able to input exponential functions into a graphing calculator as well as appropriately adjust the windows to see the graph in its entirety.
4. *Procedure*

**Engagement:**

*Question: How are linear models and exponential growth models different?*

5 minutes- Have this question written on the board when the students arrive. Ask them to define linear functions and provide an example of a linear equation in their notebooks.

5 minutes- Discuss their answers as a class. Develop a class definition of linear and write two or three examples of linear equations.

**Exploration:**

20 minutes- Break the students up into pairs. Tell them to open their books to page 476 of their Algebra textbook and complete the activity on that page. Also, point out the question that is written on the board and explain that the activity will guide them to the answer.

Hand out graph paper and explain to them that they need to graph the answers for questions two and four. The rest of the answers should be on notebook paper.

As the students work on the activity, I will roam around the room to answer questions.

**Explanation:**

30 minutes- Once the groups complete the activity, we will have a class discussion. There are 14 pairs of students and there are 14 questions. Therefore, each group is required to come up to the board, present their answer, and explain to the class how they arrived at the answer. The students will lead the discussion and I will fill in with the information that the students may have excluded.

**Extension:**

15 minutes- Once all of the correct answers have been discussed from the opening activity, I will use the graphing calculator function on the smartboard to show the students how to enter the function, how to adjust the windows to show the entire graph, as well as explain the differences between the linear graphs and the exponential graphs.

I will graph y = 5x +20. *Is this linear or exponential? How do you know by looking at the equation? How do you know by looking at the graph?*

I will graph y = 5x. *Is this linear or exponential? How do you know by looking at the equation? How do you know by looking at the graph?*

**Evaluation:**

5 minutes- The students must get out their journals and provide an individual answer to the question that was posted on the board when they arrived. The notebooks will be handed in before they leave the class. I will read and comment on their responses before the next class.

**30 minutes- HOMEWORK-**

Students will take a sheet of 8 equations to graph. Their table of values for each function must be written on the back of the homework sheet and their graphs must be on graph paper. They will be given graph paper that has 4 blank coordinate planes on each side.

1. *Materials and Resources*

Algebra 1 Textbook

Calculators

Coordinate Plane Graph Paper

Smartboard

Worksheet

Journals

Exponential Functions Unit Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Linear and Exponential Functions Worksheet**

***The following equations need to be graphed on coordinate plane graph paper.***

***Please identify the type of function (linear or exponential) next to the equation.***

***Place the table of values on the back of this worksheet.***

***Use x= -2, -1, 0, 1, and 2 in your table.***

***Then graph each function on the graph paper that was provided.***

1. y = x + 5
2. y = 3x
3. y = 10 – 2x
4. y = 5 + 2x
5. y = 2(3x-1)
6. y = 1 + 2-x
7. y = 10(1.2)x
8. y = 3(.75)x

**Lesson Plans**

1. *Concept to be Learned*

Exponential Functions (Day 2)

1. *Lesson Objectives*
2. Students will be able to identify the differences between the exponential growth and the exponential decay formulas. *Comprehension*
3. Students will be able to input exponential functions into a graphing calculator as well as appropriately adjust the windows to see the graph in its entirety. *Application*
4. Students will be able to write and use exponential growth models. *Synthesis*
5. Students will be able to write and use exponential decay models. *Synthesis*
6. Students will be able to use technology such as graphing calculators and power point to create visual representations that can be used to teach others what they have learned about exponents. *Analysis, Synthesis, Evaluation*
7. *Procedure*

**Engagement:**

5 minutes- Look at the homework from the night before. Assign a completion grade to each student after looking at their graphs. (8 points)

35 minutes- Choose eight students and have each one place their table as well as their graph on the chalkboard. After all of the graphs are on the board, as a class, discuss whether the graphs are correct or incorrect. Also decide whether they are linear or exponential.

As we discuss number 7, I expand on the problem. *This graph is getting larger. Is it exponential growth or decay?*

*I do the same with number 8. This graph is getting smaller. Is it exponential growth or decay?*

This leads me into the discussion of exponential growth and decay.I present the two formulas: y = C (1 + r)t and y = C (1 – r)t.

*In formulas, what does r usually represent? What does t usually represent?*

I then explain that C is the initial amount, and I also explain that r needs to be changed from a percent into a decimal just as it does when finding the discount on an item in a store.

I present them with two examples, example 1 from page 477 of their text as well as example 2 from page 485 of their text. I will solve these problems step by step as they copy them into their notebook.

I also introduce the new vocabulary for the section and provide them with a sheet of the definitions.

**Exploration:**

35 minutes- Break the students up into pairs. Hand out the three presentation problems as well as the laptops. Have the students login, access the internet, and find the site [www.coolmath.com/graphit](http://www.coolmath.com/graphit). (This site has a graphing calculator function on it that will allow students who don’t have a graphing calculator to access one at home. It also allows the students the chance to get a hands-on approach to the graphing I completed yesterday.)

Students will solve these problems on the worksheet and arrive at the correct answers. They will then take the exponential models and plug them into graphing calculator application on the website. They will adjust the windows to display the entire graph. They will save the graphs to their drive and label each one using example 1, 2, and 3. These examples will be printed and handed in to me along with their completed worksheet.

As the students are working on their problems, I will roam around the room and assist with any issues that may arise. I will remind them about using *t* in their models, to adjust their windows if they cannot see the graph, and to use order of operations when looking for the answer when time was given.

**Explanation:**

5 minutes- I will wrap up the lesson by reviewing the differences between the exponential growth and decay formulas.

**Extension:**

Students will be assigned homework problems, from their textbook, that pertain to real world problems. The assignment will be from page 496, numbers 43-46.

**Evaluation:**

Students will be assessed on the group activity that they handed in. They will be given 5 points per problem, 2 points for the model, 1 point for the answer, 1 point for the work, and 1 point for the graph.

1. *Materials and Resources*

Algebra 1 Textbook

Laptops

Smartboard

Notebooks

Definition Worksheet

Presentation Problems Worksheet

***Definitions for Exponential Functions***

1. **Exponential growth-** A quantity that is increasing by the same percent in each unit of time. Formula- y = C(1 + r)t
2. **Growth factor-** The expression 1 + r in the exponential growth model where r is the growth rate. The growth factor will be larger than one in an exponential growth model.
3. **Percent of increase-** In an exponential growth model, it is the percent more than one.
4. **Initial amount-** The variable C in the exponential growth and decay models. It is the amount with which you start.
5. **Exponential Decay-** A quantity that is decreasing by the same percent in each unit of time. Formula- y = C (1 – r)t
6. **Decay factor-** The expression 1 – r in the exponential decay model where r is the decay rate. The decay factor will be greater than zero but less than one in an exponential decay model.
7. **Percent of decrease-** In an exponential decay model, it is the percent less than one.

***Presentation Problems***

*Show all models and work on this worksheet. Be sure to label your answers!!*

**Problem 1**

In 1998, the population of a city was 2,000 people. Then, each year, for the next five years, the population increased by 4.5%. Write an exponential model to represent the situation. What will the population be in 2002? Write a model and solve the problem using the given time.

**Problem 2**

You buy a used truck for $14,000. It depreciates at a rate of 17% per year for six years. You bought the truck in 2003. Write an exponential model to represent the situation. How much will the truck be worth in 2008?

**Problem 3**

A population of 50 pheasants is released in a wildlife preserve. The population triples each year for three years. Write a model to represent the situation. What will the population be at the end of the third year?

**Lesson Plans**

1. *Concept to be Learned*

Exponential Functions (Day 3)

1. *Lesson Objective*
2. Students will be able to define exponential growth, exponential decay, percent of increase, percent of decrease, decay factor, growth factor, and initial amount. *Knowledge*
3. Students will be able to write and use exponential growth models. *Synthesis*
4. Students will be able to write and use exponential decay models. *Synthesis*
5. Students will be able to write and solve real world, multi-step problems involving money, animal populations, depreciation of vehicles, and science phenomena. *Synthesis*
6. *Procedure*

**Engagement:**

10 minutes- On the board place four words: *inflation, appreciation, depreciation,* and *deflation.* Ask the students to give a definition of each of these words. Write the responses under the words on the board and debate the issue until the class reaches a satisfactory definition for all four words.

**Exploration:**

5 minutes- Once the definitions are written, split the class into groups. Have the students create two lists. One list should contain items that appreciate and the other list should be of items that depreciate. Make it into a game. The group that lists the most items in the time allotted will receive a piece of candy.

10 minutes- Once the lists are generated, create a class list on the board and discuss why the items are valid.

**Explanation:**

25 minutes- Have the students get out their homework. Take a 5 point completion grade.

I will work through the answers on the smartboard. I will start with number 43 and 44. Read the problem. *Is this an example of appreciation or depreciation? So, is it exponential growth or decay? What formula do you use? What is the value for C? t? r? Do I leave r as a percent? What do I do to change it to a decimal? How do I enter this formula into the calculator? If I round to the nearest tenth, what is the final answer? How should it be labeled?* I will call on individual students to answer each of these questions.

With numbers 45 and 46, I will ask similar questions as I work to get the answer. *Is this exponential growth or decay? What is the formula? What is the growth or decay factor? How do you know by looking at this equation that it is growth or decay?*

I will ask if there are any more questions concerning the differences between growth and decay.

**Extension:**

20 minutes- I will hand students back their journals and ask them to read the entry from two nights ago. I will then ask them to create their own exponential growth and decay problem. They will be asked to create two story problems, one growth and one decay. This will be on the front of the page. On the back, they will work out the answers to those problems. I will explain to them that their quiz the following day will contain consist of problems developed by them. I will choose 10 problems that were written by the students and create a quiz from them to assess the students’ understanding of growth and decay.

**Evaluation:**

10 minutes- To assess their understanding of the new vocabulary, the students will take an oral quiz.

1. *Materials and Resources*

Algebra 1 Textbook

Journals

Smartboard

Notebooks

Candy

Chalkboard

**Oral Quiz Questions (20 points)**

1. In the exponential growth formula, what does the C represent?
2. If the number inside the parentheses is 1.24, what is the percent of increase?
3. In the exponential decay model, what does the 1-r represent?
4. How do you tell the difference between a graph of a linear model and a graph of an exponential model?
5. If a car depreciates in value, which model would you use?
6. What must you do to the rate before you can enter the value into the formula?
7. If the number inside the parentheses is greater than one, is it growth or decay?
8. If I ask for an exponential model, which variable is not replaced with a value?
9. Can the value in the parentheses be zero? Why or why not?
10. Think about the exponential growth and decay formulas. What is the only difference between the two?

Exponential Functions Algebra 1B NAME

Assessment \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Place all multiple choice answers on the scantron. Place all short answer and extended response answers in the answer document. Be sure to show all work in order to receive partial credit.**

1. In the exponential growth model y = C (1 + r)t , the (1 + r) is the \_\_\_\_\_\_\_\_\_\_.
2. Time period
3. Growth factor
4. Initial amount
5. Growth rate
6. You start a new job at a pay rate of $6 per hour. You expect to receive a 4% raise each year. After six raises, how much will you be earning per hour?
7. $8.51
8. $7.02
9. $7.57
10. $7.59
11. Which of the models below are exponential decay models?
12. y = 1.19x
13. y = .12x
14. y = (5/3)x
15. y = (2/3)x
16. I and II B. II and III C. I and III D. II and IV
17. When x = 0, which quantity is greater?

A. y = (2/3)-x  B. y = (2/3)x C. They are the same. D. Not enough info.

1. You buy a used truck for $22,000. It depreciates at a rate of 10% per year. What is the value of the truck after four years?
2. $13,000
3. $14,434.20
4. $21,133.11
5. $21,912.13
6. You deposit $450 into a savings account that pays 6% interest compounded yearly. How much money is in the account after six years? Assume you make no more deposits or withdrawals.
7. $477.00
8. $602.20
9. $638.33
10. $639.33
11. When x = 3, which quantity is greater?
12. y = 3x B. y = 3x C. They are the same. D. Not enough information
13. Which one of the following is the graph of y = (1.2)4?
14. Exponential Growth
15. Exponential Decay
16. Quadratic
17. Linear
18. In order to arrive at the correct answer, the growth rate in an exponential growth model must be converted to a \_\_\_\_\_\_\_\_\_\_.
19. Fraction B. Whole number C. Percent D. Decimal
20. What is a possible equation of an exponential decay graph that passes through the coordinate (-1, 2)?
21. y = 2x
22. y = 3x
23. y = (1/2)x
24. y = (1/3)x
25. In 2004, the population of Circleville was 250,000. Then each year for the next six years, the population increased by 5.5%. Write an exponential growth model to represent this situation. What was the population in 2008? (5 points)
26. The model **y = 34 (0.23)t** is given. Classify as exponential growth or decay. Identify the growth or decay factor and the percent of increase or decrease. What does the 34 represent? If t = 5, then what is y? (5 points)
27. In 2005, you bought a car for $20,500. It depreciates at a rate of 15% per year for 6 years. How much will the car be worth next year? Write a model and solve. (5 points)
28. A population of 20 rabbits is released into a wild-life region. The population triples for the next five years. What is the percent of increase each year? What is the population after five years? (5 points)
29. Graph the function y = 4-x. Explain how you know this function is exponential instead of linear or quadratic. (5 points).