NAME Melissa Bechtold **DATE:** February 20, 2014

SINGLE SUBJECT DAILY LESSON DESIGN FORMAT

TITLE OF LESSON	CURRICULUM AREA & GRADE LEVEL	DATE OF LESSON
Introducing Exponential Functions	Algebra II: High School 9-12	Day 2 of 5 in Olympics integrated Thematic Unit

CA CONTENT STANDARD(S) (Common Core)

- *HSF – IF.C.7 Analyze functions using different representations:* Graph exponential and logarithmic functions, showing intercepts.

CA ELD STANDARD(S)

- English Language Development grades 9-10: Supporting opinions and persuading others
  - Emerging: Negotiate or persuade others in conversations.
  - Expanding; Negotiate or persuade others using a growing number of learner phrases
  - Bridging: Negotiate or persuade others using a variety of learned phrases.

BIG IDEA ADDRESSED/ENDURING UNDERSTANDING: Why this material is important to teach; how it fits in with the unit or theme

This will be the introductory lesson into exponential equations in which the students will discover the graph and basic equation for such through cooperative learning. Then, students will be able to build on this in upcoming lessons where they will represent the competitive bracket for the Olympic hockey team through graphing and creating an equation.

ESSENTIAL QUESTIONS

How do we represent an exponential function using an equation and a graph? What situations are these applicable to in life?

OBJECTIVE

- Cognitive & Language: After hearing about a hypothetical situation, students will be able to model the situation graphically and by using a formula by working cooperatively with their peers to support opinions and negotiate others in order to create representations.

ASSESSMENT(S)

- Formative, progress-monitoring: The teacher will *informally* observe and facilitate student learning by watching their progress through the lesson and listening for the negotiating and persuading others in conversations.
- Formative: Students will model the vampire exponential function graphically and by using a formula. The teacher will be collect class work for a participation grade.
  - By collecting the work the teacher ensures that all members are participating but in order to be more reliable, the teacher is also informally observing the activity to make sure all students are contributing ideas.
  - The assessment is effective because we want students to be able to graph and come up with a formula through discovery.
  - A rubric is included if the teacher would like to grade students more formally. (see end of lesson)

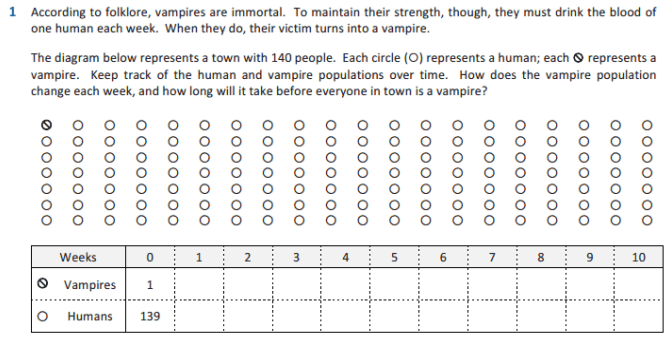
PREDICTION OF LIKELY DIFFICULTIES STUDENTS MAY ENCOUNTER WITH THIS MATERIAL

Process: Some students will be frustrated that the teacher is not simply delivering the material and that the students are asked to try to find the information on their own. This is a new type of learning for the students and will take some time to create an environment where the students accept that it is okay to make mistakes and share their answers, even if they are incorrect. We are working toward creating a positive environment where students are more accustomed to inquiry-based learning.

Content: Also, it will take some creative thinking to produce the formula $y=2^x$ and only some students will be able to truly discover the formula without the aid of the teacher. The teacher is responsible for teaching this information to the students who cannot reach the answer in the class period or the peers will share their knowledge with each other.

INSTRUCTIONAL STRATEGIES

1. Preparation: The class tables should be arranged into groups of 4. We are allowing the students to sit wherever they would like since Algebra II is a higher level math course. We are trying to allow the students as much freedom as possible but, of course, the teacher can step in to adjust the groups if necessary.
2. The daily warm-up will be on the board when students come into the classroom. The students will start working on the warm-up while the teacher works their way through the room to monitor their progress and assist those who need help. (6 minutes) The problems will include:
    a. Evaluate each expression for the given value of *x*:
        i. 2^x for $x=3$
        ii. $(1/2)^x$ for $x = 0$
        iii. 3^x3^{x-2} for $x = 2$
        iv. 2^x *for* $x = -2$
3. The teacher will go over the warm-up with the class on the board. (4 minutes)
4. Show the class the short Geico commercial about a vampire at a blood bank to open up our lesson: http://youtu.be/7bYr_PoVpcY (1 minute)
5. The teacher will *hook* the students by asking, "Are vampires real? There has been a lot of movies and t.v. focus on them lately. I want your opinion," and will wait for responses. (2 minutes)
6. The teacher will ask if anybody knows what happens when a vampire bites a human and will wait for somebody to say, "the human will then turn into a vampire." (1 minute)
7. Teacher continues, "I have been doing some research and found some varying opinions on how often vampires need to suck a humans blood and found that the most popular or widely received answer was once a week. Let's suppose there is a small town with 140 people, but one of the 'people' in that town is a vampire so there are 139 humans and 1 vampire (shows presentation slide on the overhead).



1 According to folklore, vampires are immortal. To maintain their strength, though, they must drink the blood of one human each week. When they do, their victim turns into a vampire.

The diagram below represents a town with 140 people. Each circle (○) represents a human; each ⊘ represents a vampire. Keep track of the human and vampire populations over time. How does the vampire population change each week, and how long will it take before everyone in town is a vampire?

Weeks	0	1	2	3	4	5	6	7	8	9	10
⊘ Vampires	1										
○ Humans	139										

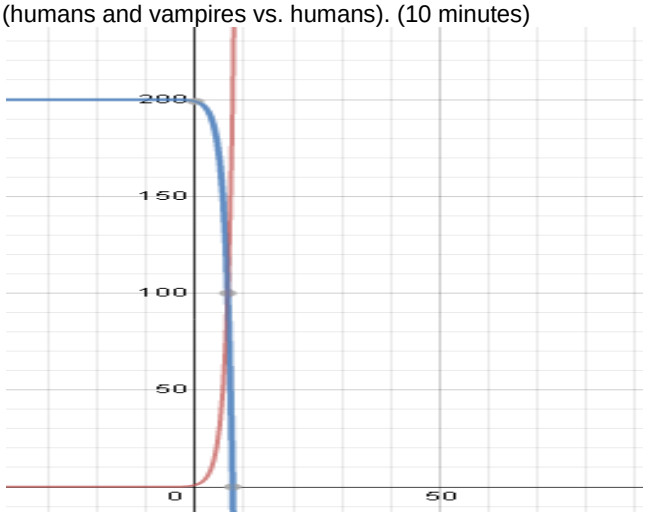
My question is, 'how many weeks will it take for the whole town to turn into vampires?' So, let's start this off together, at week 0 we have 139 humans and 1 vampire. Week 1 we would have 2 vampires and 138 humans because that vampire turned a human into another vampire (show slide). How many vampires would we have on week 2? (waits for class response) Yes, we would have 4 vampires and 136 humans. Now, copy this chart down on your own paper and work with your group to find out how many weeks it will take for this town to turn into vampires by completing this table." (5 minutes) *Remember*, the teacher is the facilitator. At this point, they should be waiting for the majority of the class to find out how many weeks it would take. Then, the teacher will demonstrate that sometime between week 7 and week 8, the town of 140 has now been completely overtaken by vampires.

8. The teacher will invite the students to make a graph, *any*

STUDENT ACTIVITIES:

1. Preparation: Students should already be familiar with using exponents and creating some types of graphs.
2. Students will come into the class and start their warm-up activity as they regularly do. (6 minutes)
3. The class will go over the warm-up together so that students may self-check their answers. (4 minutes)
4. Students will watch the Geico commercial *and hopefully laugh.* (1 minute)
5. Students can respond to the teachers question of "Are vampires real?" with their personal opinions. (2 minutes)
6. Students can respond to the teachers question of "What happens when a vampire bites a human?" some people think that the human dies but the answer we are looking for is that the human turns into a vampire. (1 minute)
7. Students will listen to some additional information about vampires: vampires need to drink blood once a week and the prompt of *how many weeks will it take for a town with 139 humans and 1 vampire to all turn into vampires?* Students are allowed and encouraged to work with the people around them. One of the nice things about this question is that some students will find quite quickly that the answer is sometime between week 7 and week 8. Those students will either try to narrow down when exactly in the week this happens or help their classmates arrive at the answer on their own. (5 minutes)
8. The students will make a graph representing the

graph, representing the data they just found. Some students will graph vampires vs. humans, some will make pie charts, some will make bar graphs, etc. but there will be likely be at least one person to graph vampires vs. weeks and humans vs. weeks. (The scale of the graph below could be better to represent a stretch horizontally but gives you the idea, nonetheless.) The teacher should ask several students to go up to the board and to explain why they made their graph the way they did. The teacher should then explain that while all the graphs are correct since we did not put any limitations on how to graph the information, we are going to take particular interest in this graph (humans and vampires vs. humans). (10 minutes)



9. The teacher should have a discussion with the class as to why they think weeks should be represented on the x-axis? (1 minute)
10. The teacher asks what words the students would use to describe the shapes of these curves and explains the new vocabulary "growth" and "decay." (1 minute)
11. Then the teacher asks the class to create an equation representing one of the lines on our graph. This is the most difficult part of the lesson for most people since students have not covered exponential graphs, yet. Most will experiment with some linear types of equations using $2x$ and some may find x^2 and the goal is to have students explain their answers and to discover on their own why these equations do not work. Hopefully, some students come up with Vampires = $2^{\#\text{ of weeks}}$ and can explain their findings. The teacher can offer hints as necessary like pointing out patterns on our chart from earlier. (8 minutes)
12. The teacher poses the question of, "how many weeks would it take for the whole world to turn into vampires? How many people are in the world?" and asks for some guesses. We can then show students how they can plug this equation into a graphing calculator and scan the table of values (its not very long, about 33 weeks). The teacher may also let the class know that we will learn how to solve this problem in this unit. (2 minutes)
13. Teacher asks, "So, are vampires real?" The class will conclude that they are not real. The teacher can discuss that, "No, vampires are probably not real, then. However, something that is very real is contagious diseases which can spread much like our vampire pandemic here," and shows students a 3 minute video on Ebola in Africa and how strictly the Center for Disease Control handles the situation to prevent a worldwide catastrophe. (5 minutes)
14. To emphasize the real world nature of this problem the teacher may emphasize, "Some of you want to go into medicine, do humanitarian work, etc. so this problem is very applicable to your future." The teacher may also stress that this activity felt different today because the students

information we just filled out on the chart. Some students may ask for more information like, "what type of graph do you want me to make?" but the teacher should not tell them. It is likely that there will be at least four different types of graphs made in the class. Some students will be selected to draw their graphs up on the board and to explain why they thought of drawing it the way they did. (10 minutes)

9. The students should discuss why having time on the x-axis is appropriate? (1 minute)

10. Students will describe the shape of the lines on the graph. Some answers may include curved, increasing, decreasing, etc. and listen to the teacher explain that we are going to call them *growth* and *decay*. (1 minute)

11. Students will try to come up with an equation for the lines on the graph. If students are able to come up with the equation for one of the lines, they can start working on discovering the equation for the other line. Then, the students can present their ideas to the class. (8 minutes)

12. Students will guess how many weeks it would take for the whole world (approximately 7.8 billion people) to turn into vampires and watch as the teacher displays her graphing calculator's data showing that it would not take as long as many would presume. (2 minutes)

were asked to find the information on their own – we did not give them the formula and ask, "Which standards of mathematical practice from the new Common Core standards (we have written on posters in our classroom) did we use today?" Wrap up the class by praising their ability to work collaboratively and to share their hypothesis with us. Collect classwork for participation grade. (3 minutes) *Total time: 49 minutes*	13. Students will conclude that vampires cannot be real based on what we just found out but will listen to an explanation on the similarity this vampire pandemic has to contagious diseases. Students will watch a video on Ebola in Africa. (5 minutes) 14. Students may be able to relate today's lesson to their anticipated careers. Students will explain which of the standards for mathematical practice the believe we covered through today's lesson such as use appropriate tools strategically, make arguments and justify others, etc. (3 minutes)
INFO ABOUT ENGLISH LANGUAGE LEARNERS*: Wilson* • Readiness level: CELDT 2: Beginner intermediate • Learning profile: strengths and challenges: Wilson has enough vocabulary to get his message across in conversation but lacks a lot of subject specific vocabulary necessary in an Algebra II class, in other words he needs improvement with his academic language. His reading skills are fair but has more difficulty with writing. Granted, in math less writing is required. • Prior successful differentiation strategies: If the teacher can translate some information in advance, that is great for Wilson so that he does not have to spend time translating on his own, especially if there are extensive amounts of reading or listening. Wilson loves working with other people. • Interests— Wilson likes to be funny and the center of attention. He likes to watch movies and hang out with friends.	INFO ABOUT STUDENTS W/ SPECIAL NEEDS: Pamela • Readiness level: Auditory processing difficulties, attention focusing • Learning profile: strengths and challenges: Pamela has her good days and bad days. On the whole, she is strong in math skills but lacks the ability to focus for longer periods of time. Writing is more difficult for Pamela and she usually receives lower grades in English class. She asks for help from the teacher, aid, or peers most of the time and other days she quietly pretends to understand. For this reason, it is important to watch to make sure she is actually making progress and attempting the work instead of zoning out. • Prior successful differentiation strategies: Keep lecturing to a maximum of 15 minutes for maximum effectiveness. Giving directions in stages is more effective than chunking all directions together at one time. • Interests—academic and/or personal: Math is one of Pamela's stronger subjects. She is on the school basketball team.
DIFFERENTIATION FOR ENGLISH LANGUAGE LEARNERS *choose area(s) as necessary based on information above* • Content - ***what*** *material - including key vocabulary - is learned:* Wilson will need the new math vocabulary of *growth, decay, and exponential* explained to him or he may use his translator. He may also struggle to understand what a vampire is but should be able to figure it out from the context of the commercial but is encouraged to use his translator whenever he needs it. • Assessment: While the assessment is informal, Wilson will be aiming for the bridging English language standard. o If Wilson is able to participate in the lesson by collaborating with his peers, making a graph, and at least hypothesizing about the function, then I will know that the differentiation strategy is effective. If not, then I may need to offer further assistance by guiding Wilson individually through some of the vocabulary and ideas.	DIFFERENTIATION FOR STUDENTS WITH SPECIAL NEEDS • Process - ***how*** *the material is learned:* This should be a good activity for Pamela because she gets to work with classmates, talk, and the attention span required is short due to the frequently changing focus of the questions. o If Pamela is collaborating with her peers, writing down guesses, and focusing on the task at hand then I will know that the differentiation is effective. If not, then I may have to talk to her to remind her to focus. I may also need to have her explain to me what she is supposed to be doing and what she thinks about the problem in a more one-on-one scenario.
RESOURCES: *Attach materials needed to implement the lesson - e.g., power point presentation, text, graphic organize* This lesson was adapted from a lesson on mathalicious.*com* called Pandemic: http://www.mathalicious.com/lessons/pandemic Graphing calculator Projector that can show videos	REFLECTION: I really enjoyed this lesson and my impression is that the students did too. I heard that several students went home and told their families about their day in math and I will use that to officially say they enjoyed it and it kept them thinking until they got home. The downside to this lesson is that it takes up significantly more class time to have the students discover this information on their own than direct lecture would but I argue that the students will understand the exponential graph more deeply because they taught it to themselves and are not being forced to mimic the teachers actions, thereby memorizing the formula. Some students were not able to produce the equation on their own but at least they were able to hear different viewpoints from their peers and hopefully they will learn to fully understand the topic as we progress through teaching the unit. I felt that most students were engaged and the one or two in each class that were silent, I just asked their opinions which got them back on track

	with their group.

Rubric

CATEGORY	4	3	2	1
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning	Some evidence of mathematical reasoning.	Little evidence of mathematical reasoning.
Working with Others	Student was an engaged partner, listening to suggestions of others and working cooperatively throughout lesson.	Student was an engaged partner but had trouble listening to others and/or working cooperatively.	Student cooperated with others, but needed prompting to stay on-task.	Student did not work effectively with others.
Diagrams and Sketches	Diagrams and/or sketches are clear and greatly add to the reader\'s understanding of the procedure(s).	Diagrams and/or sketches are clear and easy to understand.	Diagrams and/or sketches are somewhat difficult to understand.	Diagrams and/or sketches are difficult to understand or are not used.

Single Subject Lesson Design Rubric

Name Melissa Bechtold Lesson Title Introduction to Exponents Date March 1st, 2014

See Lesson Design Resources Website for more details: https://sites.google.com/site/lessondesignresources/

Design Component & Criteria	Approaching	Meets (includes the criteria for Approaching)	Exceeds (includes the criteria for Approaching & Meets)	Evidence
Title, Curriculum Area & Grade Level 5%	Provides a title that is related to the lesson activity	& addresses the unit it belongs to and in what curriculum area and grade	& describes where it fits within a unit plan, i.e. Third lesson in a 4-week unit on Colonization.	Page 1, "Day 2 of 5…."
Rationale: Big Ideas & Essential Questions 10%	Describes the rationale for teaching this lesson (*big ideas, enduring understandings, essential questions*) …	& addresses how the instructional strategies and the student activities are suited to meet the standard and objective of the lesson…	& explains how the assessment is a valid (authentic) and reliable (consistent) way to assess student learning.	See, Big ideas, essential questions, and assessments.
Standards, Objectives & Assessments 25%	Both CA Content and ELD Standards are identified and each is addressed in an objective that contains a condition, verb, and criteria and is assessed	& each objective is labeled by the type (*cognitive, affective, psychomotor or language*), the number of the standard it addresses and the type of assessment is labeled (diagnostic, formative or summative)	& expectations are clearly communicated to students via rubric, model or sample student work.	I am looking for good participation and was going to either give students credit for participating or not. I have included a rubric though if I would like to implement that in the future.
Prediction of Likely Difficulties 5%	Possible misconceptions or assumptions are identified	& the misconception or assumptions are identified as being in the content, process or product of the lesson	& the instructional strategies, student activities &/or the differentiation strategies work to avoid these misconceptions or assumptions.	Labeled the type of misconceptions as process and content and how to accommodate those problems.
Instructional Strategies 15%	Provides an *into*, *through* and a *beyond* activity for lesson…	& describes in detail the steps the teacher will take to implement the lesson and instructional materials (i.e. graphic organizer, ppt, model, rubric)…	& provides a written script for teacher and times for each activity.	Times and detailed instructions are given.
Student Activities 10%	Describes what the students will do during the *into*, *through* and *beyond* activity of the lesson…	& each activity is student centered with multiple opportunities for the instructor to check for understanding…	& provides criteria for the student activities and times for each activity.	Detailed descriptions and times are given.
Student Information 10%	Identify the names of the students that need differentiation (both ELL & Students w/ Sp Ed needs)	& describe each of the students readiness level, learning profile and interests	& includes prior successful differentiation strategies for each student.	Yes, see "prior differentiation strategies."
Differentiation 10%	Describes the differentiation strategy for the ELL and the students with special education needs …	& labels the strategy (*content, process or product*) and the way it addresses the students identity and developmental needs (*readiness, interest or learning profile*)…	& provides how the strategy will be assessed for effectiveness and altered if needed.	I have given options in case the suggested differentiation strategies did not work.
Resources 5%	All instructional materials needed to implement the lesson are listed.	All instructional materials that are needed to implement the lesson are listed and described.	& all materials listed for the unit are listed and provided, such as power point, graphic organizer, sample student work, assignment rubric, quiz...	Yes, all resources are cited or included.
Reflection 5%	Reflection is provided on the strengths, limitations, assessment and differentiation plan.	The reflection addresses all prompts and identifies what would be done next based on this reflection.	Reflection is complete and a new lesson is provided to address the concerns in the reflection.	No new lesson was required.
Self-Evaluation (10% will be deducted if not included)	Provides a copy of the rubric with the lesson plan…	& highlights or circles the evaluated criteria for each lesson component…	& provides evidence for each criteria marked.	This paper is my evidence.