**Subject area/course**: Mathematics/Algebra 2

**Grade level/band**: 11-12

**Task source**: Educational Policy Improvement Center (EPIC)

**Spreads Like (Exponential) Wildfire**

**TEACHER'S GUIDE**

1. **Task overview**:

For this task, students will create and solve a problem that addresses a situation involving exponential growth or decay. Students imagine that the school's math department is conducting a math competition. The problems that they create are intended for that competition. The topic must be able to be modeled by an exponential function. (Examples include rumors, infections, wildfires, and so on.) Their final solutions should include graphs, charts, and other mathematical work supporting the solution.

1. **Aligned standards:**
2. **Primary Common Core State Standards**

[CCSS.Math.Content.HSF-LE.A.1](http://www.corestandards.org/Math/Content/HSF/LE/A/1/) Distinguish between situations that can be modeled with linear functions and with exponential functions.

[CCSS.Math.Content.HSF-LE.A.2](http://www.corestandards.org/Math/Content/HSF/LE/A/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).

[CCSS.ELA-Literacy.W.11-12.3](http://www.corestandards.org/ELA-Literacy/W/11-12/3/) Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

[CCSS.ELA-Literacy.WHST.11-12.4](http://www.corestandards.org/ELA-Literacy/WHST/11-12/4/) Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

1. **Secondary Common Core State Standards**

[CCSS.Math.Content.HSF-LE.B.5](http://www.corestandards.org/Math/Content/HSF/LE/B/5) Interpret the parameters in a linear or exponential function in terms of a context.

[CCSS.ELA-Literacy.W.11-12.7](http://www.corestandards.org/ELA-Literacy/W/11-12/7/) Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

1. **Critical abilities**

Research: Conduct sustained research projects to answer a question (including a self-generated question) or solve a problem, narrow or broaden the inquiry when appropriate, and demonstrate understanding of the subject under investigation. Gather relevant information from multiple authoritative print and digital sources, use advanced searches effectively, and assess the strengths and limitations of each source in terms of the specific task, purpose, and audience.

Analysis of Information: Integrate and synthesize multiple sources of information (e.g., texts, experiments, simulations) presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to address a question, make informed decisions, understand a process, phenomenon, or concept, and solve problems while evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

Communication in Many Forms: Use oral and written communication skills to learn, evaluate, and express ideas for a range of tasks, purposes, and audiences. Develop and strengthen writing as needed by planning, revising, editing, and rewriting while considering the audience.

1. **Time/schedule requirements:**

The task requires approximately three 50-minute class periods. This does not include time in class for students to work on their final product. They will likely require 1-2 additional hours outside of class. Some students may not have access to the Internet in order to conduct research; so additional class periods may be necessary to take students to a lab or to use a mobile lab.

1. **Materials/resources:**

* Copies of the rubric, one per student
* Graph paper
* Graphing calculators
* Reserve the computer lab for printing of final projects or conducting research if needed

1. **Prior knowledge:**

Students should be able to:

* Understand the concept of a simulation
* Organize data
* Interpret attributes of exponential functions
* Formulate exponential functions from data by identifying the initial population and calculating growth factors or rates or by using technology

1. **Connection to curriculum:**

Students often will be expected to formulate a problem and collect either data or information with the ultimate goal of communicating their findings to an audience. For this task, students will use skills they have learned in previous classes to connect the attributes of a function to the attributes of a situation.

1. **Teacher instructions:**

After an initial brainstorming session, students should work independently on the task.

Day 1:

* Introduce the lesson by asking students if they have ever read a rumor or false story on Twitter or Facebook. Try to keep the conversation generic or in the public domain—no personal stories.
  + What happened?
  + What were some of the consequences?
  + Why did the rumors spread so quickly?
  + Are there times when the quick spread of a story has a positive effect?
* Note: Research examples of the spread of information on social media and the consequences. Some examples from recent news that highlight some of the negative and positive consequences of information shared on social media are:
  + Stock market tumbles after Twitter hack
  + Rumors of a celebrity’s death spread online
  + Donations given to families in the wake of the Sandy Hook tragedy
* Since this task requires students to research a novel real-life situation that involves exponential growth or decay, you should only briefly discuss a few examples that may have come up in previous class sessions or assignments (examples may include infections, population growth or decline, and so on).
* Tell students that they will be writing their problem for a fictional math competition. Tell students they will be working to model an exponential situation that can have a positive or negative consequence. Hand out the project rubric. A fully realized project should be visually attractive, accurate, and should employ high standards of written and visual communication. It will include a summary of the real or simulated data represented in a table or scatterplot, the exponential function, and its associated graph. The write-up should include:
  + A clear description of the situation
  + All assumptions that are made concerning the initial population and growth rate, and other elements of the situation if necessary
  + Use written and visual information to tell a compelling story
  + A detailed solution to the problem
* Students may brainstorm ideas in small groups and/or do research on the Internet to find examples of real-world situations that could be modeled with an exponential function. As an exit ticket, you may have students write a paragraph describing the situation they want to model. Their paragraph should describe how they will simulate the situation. They should turn it in for pre-approval. Provide feedback, if possible.

Day 2:

* Return students’ proposals to them. Answer any student questions. Give students time to do more research and collect data regarding their situation. Meet with students who did not describe a simulation in their proposal, and help them get started.
* Be aware that examples of problems that use exponential functions are available on the Internet. Caution students about plagiarism and advise them about how they can make problems and solutions their own.
* Students should complete their data collection and interpretation by the end of the period. You may wish to collect this work for review.
* Note: Consider that students may want to use their Facebook, Twitter, or other social media accounts to simulate the spread of information. Although this is more “real,” collecting data may be problematic. Also, remind students that the spread of false information—even in a simulation—runs counter to digital citizenship and responsibility.

Day 3:

* Students should complete their projects in class or as a homework assignment. If students need access to computers to print their final papers, reserve a computer lab.

1. **Student support:**

The following suggestions are examples of scaffolding that can be used to meet diverse student needs within the classroom.

* When introducing this task, you may wish to remind students of the mathematics involved in solving some of the examples that you have already discussed in class.
* Students may need help in differentiating between exponential and non-exponential situations. Remind them that a key attribute is multiplicative growth (which can be modeled with repeated multiplication for positive integer inputs).
* Students may need help designing a real-life simulation of exponential situation. A simulation may be as simple as a tree diagram or a hands-on activity involving random process (e.g. start with 100 coins in a flat box and simulate exponential decay by shaking the box and removing all “heads”. Repeat.).
* Students may need help making assumptions about their situation. Ask questions to help them think through the problem. *How many people are you assuming at the beginning of the scenario (preliminary infection, number of people who start a rumor)? What is a reasonable growth rate?*
* Be explicit about expectations for student performance from the beginning of the lesson.
* Provide materials in students’ first language.
* Break down tasks into smaller pieces.

1. **Extensions or variations:**

Ask students to watch the news or read a major newspaper for three consecutive days and make a log of real-worldexponential problems. In groups, have them share these problems and brainstorm the types of data and functions that could be attributed to the situation.

1. **Scoring:**

Student work can be scored using the SCALE Math Performance Assessment Rubric (Grades 9-12).