ACCHHHOOoooooo! Many of you have experienced, either directly or indirectly, the spread of influenza. The spread of a highly communicable disease through a confined area can be modeled by a mathematical function

**Class data collection:** In order to model this we are going to simulate the spreading of a disease throughout our class. Don't worry no injections will be given. This disease will be called the 'Sulu-Clacerp Plague'. (*Pronounced Soo-Loo-Clay-Serp*) Everyone is a resident in the room with an assigned number so that we can keep track of who is infected and who is not. Record the data in the table below.

YOUR ARE RESIDENT NUMBER: ____________________

| Day # | 0 | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| People Infected | 1 | | | | | | | | | | | | | |

Today is day zero, and one person is infected. BUT WHO! Let's keep track of who is healthy and who is infected.

*Healthy Resident Numbers…not for long* ☹

1 2 3 4 5 6 7 8 9 10

11 12 13 14 15 16 17 18 19 20

21 22 23 24 25 26 27 28 29 30

**The Sulu-Clacerp disease has spread throughout our classroom and all are infected ☹**

1.) Describe in words the rate at which the disease has spread. Offer an explanation as to why the disease spread in the manner in which it did.

2.) How will this impact the graph? Why does the curve behave as it does for the first half of the data collection? The second half? Think real life here…

3.) See how you did by considering a graph of the data. What do you notice about the graph? How is it similar to the concept of exponential growth discussed in class? How is it different?

4.) What are the equations of the asymptotes of the graph? What is the real life meaning behind these asymptotes?

5.) Over what interval is the spread of the disease increasing at an increasing rate? Over what interval is the spread of the disease increasing at a decreasing rate? How are these intervals represented in the graph?

6.) Approximate the instant when the spread of disease was the greatest. How is this represented in the graph? Why was the rate of the spread of disease greatest on that day?

7.) Approximate when the spread of the disease is the slowest. How is this represented in the graph? Why is the disease spreading at the lowest rate at the value you identified?

**PART II:** *Exponential growth is unrestricted. An exponential growth function increases at an ever increasing rate and is not bounded above. In many growth situations, there is a limit to the possible growth. A plant can only grow so tall. The number of goldfish in an aquarium is limited by the size of the aquarium. In such situations the growth often begins in an exponential manner, but the growth eventually slows and the graph levels out. The growth function is bounded both below and above by horizontal asymptotes. This type of growth is called* ***Logistic Growth Function.***

*Logistic Growth Functions:* $f(x) = \dfrac{c}{1+ab^x}$ *or* $f(x) = \dfrac{c}{1+ae^{kx}}$

How are $b$ and $e^k$ related in the two models?

1.) Consider only the exponential functions located in the denominator. For what values of $b$ or $k$ would the exponential models increase? Decrease?

*Increasing Exponential:* *Decrease Exponential:*

2.) Let's assume $ab^x$ and $ae^{kt}$ are increasing functions. As $x \to +\infty$, the functions $ab^x$ and $ae^{kt}$ approach ____ . So we can say the denominator of the logistics growth functions approach ____ . Therefore, as $x \to +\infty$, the entire function $f(x) \to$ ?

3.) Now let's assume $ab^x$ and $ae^{kt}$ are decreasing functions. As $x \to +\infty$, the functions $ab^x$ and $ae^{kt}$ approach ____ . So we can say the denominator of the logistics growth functions approach ____ . Therefore, as $x \to +\infty$, the entire function $f(x) \to$ ?

4.) What is true about the values of $b$, and $k$ for all increasing logistic growth functions? Decreasing logistic growth functions?

*Increasing Logistics:* *Decreasing Logistics:*

5.) How is the value of $c$ represented in the graph? What is the real life significance of the value of $c$?

6.) Attempt to fit the data from the Sulu-Clacerp portrayal using a logistics growth function.

7.) One person introduced the H1N1 virus to the student body at Penncrest High School that has roughly 1350 students. Given this information please determine the approximate value of $a$ in the logistics growth model.

Five days later 100 Penncrest students were infected. Good grief… Given this new information, determine the value of $b$, or $k$, for the logistics growth function.

Administration has decided to close Penncrest High School when 20% of the student body is sick. After how many days since the virus was introduced, should the administration close school?

8.) Ridley high school administration has heard of your analysis ability and has given you a graph of the opening days of the spread of the disease on their campus. They would like to administer the vaccine ASAP but won't get it until 20 days since the virus was initially introduced. They need to close school when 25% are infected. Will they have the vaccine in time?