Name: Date:

Chapter 5 Project

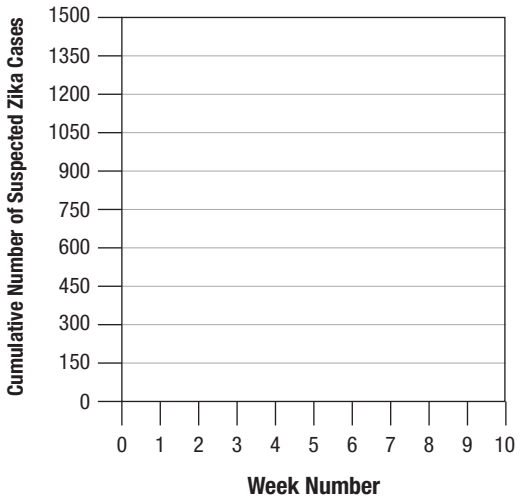
Those Pesky Mosquitos

According to the Center for Disease Control and Prevention, the Zika virus is a disease "spread to people primarily through the bite of an infected *Aedes* species mosquito." Although the virus was first discovered in 1947, the first human case wasn't documented until 1952. Since then, outbreaks have been reported in Africa, Southeast Asia, and the Pacific Islands. One of the latest epidemics of the Zika virus occurred between 2013 and early 2014, on a cluster of islands in the South Pacific called French Polynesia. Let's have a look at how fast it spread.

1. Based on what you've heard or know about viruses and your knowledge about functions, what type of growth do you think usually describes epidemics – exponential, polynomial, logarithmic, or linear? Explain your reasons for your choice.

2. Below is data of the weekly number of suspected Zika cases in French Polynesia in 2013. Plot the data on the graph below.

Week #	New Cases	Cumulative Cases
1	49	49
2	191	240
3	369	609
4	331	940
5	333	1273



3. Here are five different functional models that might represent the growth of the number of Zika cases, where x represents the week number, and y represents the number of cumulative cases.

1. Linear $y = 258.74x$
2. Logarithmic $y = 937.37\ln(x) - 202.03$
3. Quadratic $y = 31.357x^2 + 134.93x - 122$
4. Power $y = 55.278x^{2.0101}$
5. Exponential $y = 47.399e^{(0.6737x)}$

For each function model listed, create a graph for $1 \le x \le 5$, along with the Zika case data from Step 2. Be sure your graphs clearly label the function and the actual data.

We recommend the use of Excel, or a similar application, to draw the graphs. Otherwise, use graph paper with each graph on a separate sheet. (If creating the function models by hand, be sure to keep room for x-values up through 20.)

4. Which of the graphs in Step 3 do you think best models the Zika data? Why?

5. On the graphs from Step 3, extend the graphs by plotting the functions for $6 \le x \le 10$.

6. Which of these functions do you think will best model the growth of the number of Zika cases over weeks 6–10? Is it the same function as you choose in Step 4? If not, what caused you to change your decision?

7. Below is the actual data for the spread of the Zika virus during weeks 6–10 of the epidemic.

Week #	New Cases	Cumulative Cases
1	49	49
2	191	240
3	369	609
4	331	940
5	333	1273
6	571	1844
7	742	2586
8	955	3541
9	1029	4570
10	883	5453

Plot the actual data for weeks 6–10 on each of the function graphs. Is the function you chose in Step 6 still the best model for growth over weeks 1–10? Why or why not?

8. Below is the data for weeks 11–20. Plot the entire Zika data on each of the function graphs. Discuss when each function ceases to be a good model for the data and why that might be.

Week #	New Cases	Cumulative Cases	Week #	New Cases	Cumulative Cases
1	49	49	11	682	6135
2	191	240	12	512	6647
3	369	609	13	412	7059
4	331	940	14	381	7440
5	333	1273	15	343	7783
6	571	1844	16	256	8039
7	742	2586	17	247	8286
8	955	3541	18	142	8428
9	1029	4570	19	82	8510
10	883	5453	20	71	8581

Ioos S, Mallet HP, Leparc Goffart I, Gauthier V, Cardoso T, Herida M. "Current Zika virus epidemiology and recent epidemics." *Med Mal Infect* (July 2014): 44(7):302-7 doi: 10.1016/j.medmal.2014.04.008. Epub 2014 Jul 4.

9. The population of French Polynesia at the time of the outbreak was about 270,000. The population of the United States in 2016 is approximately 322,762,000. How could you modify your function to model a potential spread of the Zika virus over the United States?

10. Discuss if it is reasonable to use your modified Zika function model for French Polynesia as a model for the United States.

