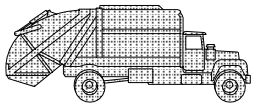
CLASS _____ NAME _____

CHAPTER FIVE
MODELING PROJECT 2



GARBAGE MODEL

Below is the numeric representation of the amount of garbage generated per person per day in the United States from 1960 to 2010. The goal of this project is to develop the symbolic representation of the function that describes the garbage generated per person per day. You may use any function studied to develop your symbolic representation. You should take advantage of your knowledge of the connection between the behavior of a function and the numbers (parameters) in the symbolic representation of the function. There are many different correct responses to several of the questions and there are many different acceptable mathematical models. Create interactive data by running the program WGARB129.

Year (t)	1960	1970	1980	1988	1993	1998	2004	2006	2010
Garbage (g) in pounds	2.7	3.2	3.6	4.0	4.1	4.2	4.3	4.4	4.6

1. What type function can be used as a general behavior model? That is, as you study the numeric representation or look at the graphical representation, what function does it most behave like?

_____

2. Should the domain of your model be restricted to numbers from 1960 to 2010? _____

   Explain your response. _____

_____

3. What is the average rate of change from each data pair to the next pair, for all data pairs?

_____

4. There are many ways of developing the symbolic representation of the function that models the data. Although you may use any method you think best, the intention is that you apply the mathematics as described next. You have studied the connection between the numbers (parameters) in the symbolic representation of a function and the behaviors caused by these parameters. For example, if the parameter d in the function $d|x+e|+f$ is changed from 2 to 3, the graphical representation will look skinnier. Or if the parameter f is changed from –2 to 3, the maximum or minimum will change from –2 to 3. Using these connections and educated guessing and checking, list below all of the attempts you make in creating a model of the data. List your attempts in the order in which you create them.

_____

_____ **Continued**

5. **Should** your model have a zero? Explain your response.

6. What is your final mathematical model for garbage generated per person per day in the United States?

7. Describe a situation under which your model of garbage generation will not apply.

8. What are the limitations to your model?

9. What do you think is the biggest reason for the increasing amount of garbage we are creating?

   Explain your thinking?

10. Using **your** mathematical model, how much garbage per person was generated in 1945?

    The EPA's model predicts 4.8 pounds per person per day in 2018. What does your model "predict"?

11. Is your answer above for 1945 realistic? Explain.

12. What rate of change did you use in your final model, if you used a linear function?

13. In terms of garbage creation, what is your interpretation of the mathematical behavior of increasing?

14. How much garbage is generated at a zero of your mathematical model?_____

15. Is your model of this data ever negative?_____ If so, when?_____ What is your interpretation of garbage creation when your model is negative?

_____

16. If the rate at which we generate garbage were greater than what it is, what function parameter in your model can you change to make it reflect this fact?_____

17. If there were 3.12×10^8 people in the U. S. in 2011, how many pounds of garbage were generated in the entire year?

_____

18. If one point on the graph of your model is (2012, 4.7), explain what these numbers mean._____

_____

19. Do you think anyone working at a professional job would need or could use your mathematical model to help solve a problem?_____ If yes, what kind of professional?_____

How would they use it?_____

_____

20. What page(s) of the text did you use as a reference for working this project?_____ Did you use any other reference work or resource person?_____ If yes, what and/or who?

_____

21. Give a detailed description of the thought process you used to develop your mathematical model.

_____

_____

_____

22. If you worked in a group, list the contributing group members.

_____

Teacher Notes:

Each chapter contains 2-3 modeling projects at the end, and they are used as summative assessments. This particular project is at the end of the linear function chapter. But students are taught about linear functions, and their behaviors beginning in Chapter Two. While you might think that since the project is at the end of the linear function chapter, it would suggest that the model is automatically linear. But in Chapters Two, Three, and Four, students have been introduced to a variety of functions. Base on years of experience, we know that most students use a linear model, but others use absolute value, quadratic, and even square root functions.

The modeling projects require exploration, conjecturing, conceptual understanding, tenacity, and a graphing calculator. They assume some knowledge of the connection between function behavior and function parameters and/or they require the use of geometric transformations (starting in Chapter Seven) to create the mathematical model of real-world data. A study of statistics is not assumed, and regression models are to be avoided. Students typically may require 2 to 10 hours to finish a modeling project.

The modeling projects provide you with an opportunity to ask your students to apply the mathematics that is in the text. Mathematics such as using the relationships between the parameters in a function and the behavior of the function, geometric transformations, arithmetic operations of functions and the resulting change in the domain, behavior near the zeros of functions, etc. Students must recognize the shapes of the basic elementary functions. They must know how arithmetic operations of functions change the geometry of the graphical representation of the functions. The main goal of the modeling projects is to find a symbolic representation of any function that models the data. Once the model is developed, students will be asked to use the model and describe behaviors of the model.

Just as an engineer, physicist, business person, or astronomer may solve a problem by following a prescribed procedure, your students are directed through this problem solving process by being asked a series of questions about the data. Once they have solved the main problem and have developed the symbolic representation of the function (mathematical model), they are asked to defend their solution by explaining the limitations of their model. This includes giving a situation when their model does not apply. They must explain their thinking on how they developed the model. Students are given the opportunity to use their model when asked questions about data not available in the given information. They are also asked to conjecture on what type of professional person might use their model. And finally, they must identify the references and resource person(s) used to help them in the problem solving process.

Class time may be used to work on the projects or they provide a good assignment outside of class. Depending on the level of mathematical sophistication of your students, the projects may take from one to four hours. Group work is encouraged. As you move away from evaluating your students by traditional testing methods, the modeling projects should provide a large percent of your assessment of student understanding of mathematics. The modeling projects provide another tool for assessment that measures still other traits of the math student.

