Mini-Project 1

This assignment should be completed in **the same teams** in which you do your worksheets. "Mini-project" is another name for "group homework". Please list all names at the top of the paper, and note which team member was the "scribe" who wrote down the solutions. In the course of the semester, you should take turns being the scribe. In particular, each person on the team must be the scribe at least once, and nobody should be the scribe twice in a row.

The Lower Mississippi River meanders over its flat valley, forming broad loops called oxbows. In a flood, the river can jump its banks and cut off one of these loops, getting shorter in the process. In his book *Life on the Mississippi* (1884), Mark Twain suggests, with tongue in cheek, that some day the river might even vanish! Here is a passage that shows us some of the pitfalls in using rates to predict the future and the past.

In the space of one hundred and seventy six years the Lower Mississippi has shortened itself two hundred and forty-two miles. That is an average of a trifle over a mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Oolitic Silurian Period, just a million years ago next November, the Lower Mississippi was upwards of one million three hundred thousand miles long, and stuck out over the Gulf of Mexico like a fishing-pole. And by the same token any person can see that seven hundred and forty-two years from now the Lower Mississippi will be only a mile and three-quarters long, and Cairo [Illinois] and New Orleans will have joined their streets together and be plodding comfortably along under a single mayor and a mutual board of aldermen. There is something fascinating about science. One gets such wholesome returns of conjecture out of such a trifling investment of fact.

Let L be the length of the Lower Mississippi River. Then L is a variable quantity we shall analyze.

Problems:

8. According to Twain's data, what is the exact **rate** at which L is changing, in miles per year? What approximation does he use for this rate? Is this a reasonable approximation? Is this rate *positive* or *negative*? Explain. In what follows, use Twain's approximation.

9. Twain wrote his book in 1884. Suppose the Mississippi that Twain wrote about had been 1100 miles long; how long would it have become in 1990?

10. Twain does not tell us how long the Lower Mississippi was in 1884 when he wrote the book, but he does say that 742 years later it will be only $1\frac{3}{4}$ miles long. How long must the river have been when he wrote the book?

11. Suppose t is the number of years since 1884. Write a formula that describes how much L has changed in t years. Your formula should complete the equation:

$$\text{the change in } L \text{ in } t \text{ years} = \ldots$$

12. From your answer to question 10, you know how long the river was in 1884. From question 11, you know how much the length has changed t years after 1884. Now write a formula that describes how long the river is t years later.

13. Use your formula to find what L was a million years ago. Does your answer confirm Twain's assertion that the river was "upwards of 1,300,000 miles long" then?

14. Was the river ever 1,300,000 miles long; will it ever be $1\frac{3}{4}$ miles long? (This is called a **reality check**.) What, if anything, is wrong with the "trifling investment of fact" which led to such "wholesale returns of conjecture" that Twain has given us?