

## BANK OF COLUMBIA Teaching Guidelines

**Subject:** Mathematics

**Topics:** Algebra—Linear Equations

**Grades:** 6 - 9

**Knowledge and Skills:**

- Can translate a real-world problem into a one-variable linear equation

**Materials:** None

Procedure: This project should be done by students working in teams of two.

Distribute copies of the letter to students. Essentially this is a very sophisticated word problem. Students will need to focus on a) what values are they being asked to find and then b) what data is relevant.

As a first step, students should scan the letter and make a list of words and terms whose meaning they are not certain of. You may wish to make a master list of these terms on the blackboard and, as a class activity, have students get them defined and understood with dictionaries and discussion.

For their next step students should consider just the first question: How long would it take to pay back an initial loan of \$8 million? You may wish to work this problem through with the class. How much money will the plant make each year? 25,000,000 kilowatt-hours at 10 cents per kilowatt-hour gives \$2.5 million per year. In  $y$  years, this is  $\$2.5*y$  million dollars. Over that same period, the costs will be  $\$1.5*y$  million. The amount left over to pay off the loan, then, is

$$2.5y - 1.5y,$$

and the equation to solve becomes

$$8 = 2.5y - 1.5y$$

Students should work out the other three parts of the problem on their own. Algebraic techniques may be used but are not required.

Be sure that students notice that they must attach a copy of their calculations, and that these should be clear enough that the reader (“Mr. Morgan”) can follow them.

Though the mathematics involved in solving this problem is not advanced, students can find the problem itself quite difficult. Help them to meet this challenge by making sure they understand the words, by breaking the problem down for them, by letting them struggle up to the point of frustration before giving them suggestions as to how to proceed.

A good strategy for solving the problem in which the rates change is the use of a chart to represent what happens each year. (If it is feasible, have students use a spreadsheet program to create this table; they will get more practice with algebraic formulas.)

	Year 1	2	3	4	5	6	7	8	etc.
Cost of electricity per kwh	\$.10	\$.10	\$.10	\$.10	\$.10	\$.15	\$.15	\$.15	etc.
Income	2.5 million (25,000,000 kwh x \$.10)	\$2.5 mil.	\$2.5 mil.	\$2.5 mil.	\$2.5 mil.	\$3.75 mil.	\$3.75 mil.	\$3.75 mil.	etc.
Operating costs	1.5 million	\$1.5 mil	\$1.5 mil	\$1.5 mil	\$1.5 mil	\$1.5 mil	\$1.5 mil	\$1.5 mil	etc.
Money left over to repay loan	\$1 mil	\$1 mil	\$1 mil	\$1 mil	\$1 mil	\$2.25 mil	\$2.25 mil	\$2.25 mil	etc.
Amount of loan which has been repaid	\$1 mil	\$2 mil	\$3 mil	\$4 mil	\$5 mil	\$7.25 mil	\$9.5 mil	\$11.75 mil	etc.

**Mr. Charles Morgan, Director  
Bank of Columbia, Western Regional Division  
4802 Wilshire Blvd.  
Los Angeles, CA 90010**

Please fill in the missing numbers for me and attach your calculations. Need this done by 3 pm to get in today's mail.--J.T.

**Dear Mr. Morgan:**

**I appreciate your time on the telephone yesterday and your interest in our project. Let me outline here the basics of the financial side of our plan; attached you will find the calculations behind these figures.**

**We estimate that the construction of a wind power generation facility which is capable of generating up to 10 megawatts (an estimated 25,000,000 kilowatt-hours of energy per year) will cost \$8 million dollars. Operating costs will be \$1.5 million per year, and the lifetime of this plant will be 25 years.**

**We can sell the electricity we produce at the current rate of 10 cents per kilowatt-hour. At that rate, assuming the plant always delivers at full capacity of 10 megawatts, we would be able to pay back the initial loan of \$8 million in \_\_\_\_ years. We could pay it back with an additional 25% interest in \_\_\_\_ years.**

**However, we know that, as the cost of oil and coal goes up, electrical rates will also rise, and the stricter emissions requirements that will be imposed on fossil fuel power generation plants will also act to raise power costs. Estimating this quite conservatively, industry experts say that 5 years from now electricity will be selling for 15 cents per kilowatt hour, and 10 years from now it will go up to 20 cents per kilowatt hour. If we match those prices, then the initial loan of \$8 million, with 25% interest, could be paid back in \_\_\_\_ years.**

To look at this another way, paying back the original loan plus 25% interest within a period of 30 years would require an average selling price of electricity of only \_\_\_\_ cents per kilowatt hour.

All of these figures are in current dollars, and since inflation will act on all of them in the same way we can ignore it for these rough calculations.

I think you will agree that this project is not only financially attractive, but will have a strong appeal to those of your investors who have an interest in environmentally responsible development.

I will look forward to your response.

Sincerely,

John Thrasher  
President  
Windbeaters, Inc.