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Math LESSONS Student Edition

USA TODAY NO. 1 IN THE USA

DATA ANALYSIS:

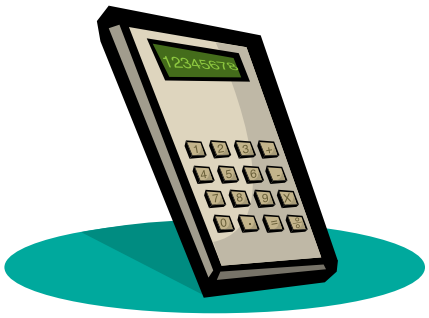
Earthquake!

Introduction

Have you ever been in an earthquake? An earthquake can be a deadly natural disaster. It occurs when two tectonic plates split or slip. If an earthquake occurs in the ocean, a tsunami can result. These high waves can be extremely dangerous to people living in seaside locations. In this lesson, you will examine a scale used to measure the magnitude of any earthquake. Read the article below to learn about a recent earthquake in the United States.

Materials Needed

- Spreadsheet software with graphing capability (or a graphing calculator)



Preparation

Follow the directions below to prepare for an analysis of any relationships that may exist between the Richter number, increase in magnitude, and energy released for an earthquake.

The Richter scale measures an earthquake's magnitude. Column 2 shows the increase in magnitude from one number to another. For example, the earthquake in the newspaper article with magnitude 5.1 is about 10 times greater than an earthquake with magnitude 4. Column 3 shows the approximate amount of energy released in an equivalent amount of TNT.

In Columns 1, 2, and 3 of your spreadsheet or calculator data list, enter the data given in the table on the next page.

Richter Number	Increase in Magnitude	Approximate Energy Released
1	1	0.00017 metric ton
2	10	0.006 metric ton
3	100	0.179 metric ton
4	1,000	5 metric tons
5	10,000	170 metric tons
6	100,000	5,643 metric tons
7	1,000,000	179,100 metric tons
8	10,000,000	5,643,000 metric tons

Source: The New York Public Library Science Desk Reference, page 391

ANALYSIS

Here are some questions to help you analyze the data.

1. Make the following scatterplots. Be sure to label your scatterplots so that you know which variables have been used in each.

a. Richter number as the independent variable, increase in magnitude as the dependent variable

b. Richter number as the independent variable, energy released as the dependent variable

c. increase in magnitude as the independent variable, energy released as the dependent variable

2. Find several regression equations to model the data for each scatterplot. Be sure to record how well each equation fits the data. Consider the following types of equations:

- linear equation ($y = ax + b$)
- quadratic equation ($y = ax^2 + bx + c$)
- exponential equation ($y = a \cdot b^x$)
- power equation ($y = a \cdot x^b$)
- logarithmic equation ($y = a + b \ln x$)

QUESTIONS

Here are some questions to help you clarify your thinking about any relationships you found between sets of data.

1. Do any of the scatterplots you made in **Question 1** of the Analysis section represent functions? If so, which ones? Explain why these graphs represent functions.

2. Which type of equation best fits the data in scatterplot **a**? What is the regression equation that you chose to model this data?

3. Which type of equation best fits the data in scatterplot **b**? What is the regression equation that you chose to model this data?

4. Which type of equation best fits the data in scatterplot **c**? What is the regression equation that you chose to model this data?

5. Use a calculator or spreadsheet to find the natural logarithm ($\ln x$) of the values in Column 2 (Increase in Magnitude). (Recall that $\log_e x = \ln x$.) Make a scatterplot where the independent variable is the Richter number and the dependent variable is the natural logarithm of each value for increase in magnitude.

6. Which type of regression equation best fits the data? What is the regression equation that you chose to model this data.

CONCLUSION

- Write several paragraphs describing what you discovered in this activity about any relationships between Richter number, increase in magnitude of an earthquake, energy released by an earthquake, and the natural logarithm of the increase in magnitude. Use your graphs to help you illustrate what you discovered.

EXTENSIONS

- Research how the epicenter of an earthquake is located. Make a poster showing the mathematics that is used for this process.
- Research the number of earthquakes and the magnitude of those earthquakes for a particular region. Make an appropriate display of the data.
- Research the cause of earthquakes and what is being done to help detect earthquakes before they strike. Write a one–page paper about what you learned.
- Research the most powerful and/or well–known earthquakes in the world. Present the data in a creative way.
- Analyze this data about earthquakes. The table shows categories of earthquakes by Richter number. Present your findings in some type of graph or other display.

Earthquake Occurrences per Year		
Richter Magnitude	**Category**	**Number Expected**
1.0 to 3.9	1	about 949,000
4.0 to 4.9	2	about 6200
5.0 to 5.9	3	about 800
6.0 to 6.9	4	about 226
7.0 to 7.9	5	about 18
8.0 to 8.9	6	about 2 or less

Source: Glencoe Earth Science, p. 255

NEWS - MONDAY - April 22, 2002 – 7A

5.1 quake an unsubtle reminder the East also trembles

By Martha T. Moore
USA TODAY

NEW YORK — With a rumbling sound like a freight train, a weekend earthquake reminded the Northeast that seismic events aren't just for California.

The quake, which struck Upstate New York at 6:50 a.m. Saturday, sent tremors from Maine to Maryland. It had a magnitude of 5.1, according to the National Earthquake Information Center of the U.S. Geological Survey.

At the epicenter of the quake, in the Adirondack hamlet of Au Sable Forks, near Plattsburgh, N.Y., chimneys were toppled, water mains broken and mobile homes damaged. More than 3,000 homes were without power for the day.

No injuries or deaths were reported. But the quake was a startling reminder that the region is at risk for earthquakes, though they are usually small ones.

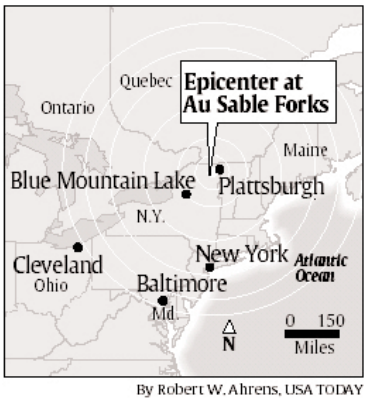
"It was like a freight train coming through," says Larry Lafaive, an emergency services dispatcher in Plattsburgh who had reported to work right before the quake struck. "It kept getting louder and louder and louder, and the whole building started shaking. We didn't know what it was, and then someone said, 'Hey, we're having an earthquake.' "

The quake was the strongest in the Adirondack region since 1983, when a 5.1 quake shook Blue Mountain Lake.

It hit in the Northern New York-Western Quebec seismic zone, an active earthquake area for smaller quakes measuring a magnitude less than 4. Smaller earthquakes hit New York state this February and in October 2001, and a mild quake hit the Plattsburgh area region two years ago to the day. The record for the region is a 5.8 quake in 1944 that hit near the U.S.-Canadian border about 72 miles west of Saturday's epicenter.

The quake woke Kelly Donoghue, assistant director of emergency services for Clinton County. At first he thought his wife had tripped over their new puppy and fallen downstairs. When she rushed in to tell him she thought the pipes were bursting, he realized it was an earthquake. "It sounded like a train rumbling."

In Ticonderoga, 65 miles from the epicenter, Ray Thatcher, Essex County emergency services director, was up and shaving when it hit. He says the house shook for 30 seconds as objects crashed from shelves and off dressers. "I've been preaching earthquake for a long time," Thatcher says. After all, he says, "We are in a fault area."



By Robert W. Ahrens, USA TODAY