INVESTIGATION 3

HOW MUCH RADIATION IS AROUND YOU?

INTRODUCTION

When most people hear the word radiation, they think of nuclear war, cancer, genetic mutations, and environmental destruction. They believe radiation is something to be feared, a classic example of technology out of control. It is unfortunate that important decisions in our society are based on these perceptions, rather than on knowledge and understanding of radiation. Radioactive materials have come to play an increasingly important role in our society. Research in physics depends heavily on the availability of nuclear reactors and particle accelerators. Radioactive isotopes are routinely used in many thousands of ways to improve the quality of our lives and to further scientific research. Important uses include areas of medical diagnosis and treatment, agriculture, geology, environmental science, and biochemistry, to name a few.

Graphs are an important tool to help see relationships between different variables (sets of numbers) or help you to make decisions or predictions. Graphs can help you better understand the role of radiation in your life. In this activity, you will construct different types of graphs to help you to learn more about radiation.

Pie Chart Graph

A pie chart graph is pictured as a pie. The area of each "slice" is proportional to the magnitude of the variable depicted in the "slice".

Bar Chart

A bar chart provides a simple graphing technique to aid in the interpretation of data. The height of each bar above or below the zero-line (origin) of the vertical (y) axis corresponds to the magnitude of the variable of interest.

OBJECTIVE

To evaluate your personal radiation dose, and to use graphing as a tool to aid in the interpretation of data.

PROCEDURE

1. Complete the “Personal Radiation Chart” to estimate your annual dose of radiation from natural and man-made sources.

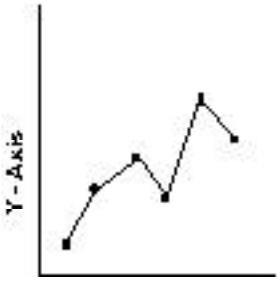
2. Construct a pie chart graph of the individual sources of radiation in your own personal exposure.

3. Compare your dose with those of your classmates.

4. Construct a bar graph that shows the distribution of the estimated total annual radiation doses from all sources for all of the students in your class.

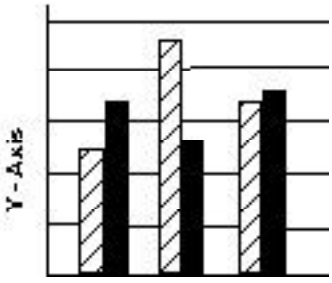
EXAMPLE GRAPHS

LINE GRAPH



PIE CHART GRAPH

BAR GRAPH



In a line graph, data points are plotted on the graph and then connected by a line. The line can either connect each point to the next or approximate the pattern displayed by the data points, as shown above. In a bar graph, the height of each bar corresponds to the values on the y-axis. Bar graphs and pie charts are good when you want to combine a lot of data points into different categories. Each category will then be displayed as one bar or one slice of the pie.

The following guidelines will help you to draw clear, easily-interpreted graphs:

1. Determine which set of numbers will be shown on which axis. If you think that one variable (set of numbers) might be causing the other variable to be affected, then it is best to put the variable suspected of causing the effect on the x-axis (horizontal) and the affected variable on the y-axis (vertical).

2. Choose scales for each axis. They don't have to be the same. They don't have to start at zero, and sometimes can include negative numbers. Choose scales that allow you to clearly show all of your data points without having a lot of empty space.

3. Number the major divisions along each axis, label each axis, and when possible show the units used.

ANALYSIS

5. What factors (individual radiation sources) are responsible for placing some students at the upper end of the distribution?

Hint: To answer this question, you will need to see which students were at the high end of the distribution of total radiation dose, and then see which individual sources of radiation caused them to be at the high end.

6. Which radiation source was the highest for most students in your class? Did this surprise you? Explain.

7. Which radiation sources were the lowest for most students in your class? Did this surprise you? Explain.

CONCLUSIONS

8. How important is indoor radon as a natural source of radiation in your life?

9. Why do you think people have a general fear of radiation? Is this fear justified?

Personal Radiation Chart (modified from Brookins 1990)

Source	Radiation Dose (mrem/yr)[1]
Cosmic radiation at sea level Add 1 mrem/yr for each 100 feet that you live above sea level in addition to the base figure of 28.	28 _____
Food and beverages	28
Medical x-rays Add 40 mrem/yr for each chest or body x-ray; add 14 mrem/yr for each dental x-ray received during the past year	_____
Building materials Add 100 mrem/yr if your home is brick or cement; add 5 mrem/yr if your home is wood	_____
Ground radiation	26
Nuclear weapons fallout	4
Airline travel Add 1 mrem/yr for each 1500 miles flown in a commercial jet during the past year	_____
Power Plant Add 0.3 mrem/yr if you live within 5 miles of a nuclear or coal power plant	_____
ColorTV Add 1-2 mrem/yr depending on how much you watch (approximately 0.1 mrem/yr for each hour of TV watched each week)	_____
Luminous watch dial Add 3 mrem/yr if you wear one	_____
Indoor radon Add 100 mrem/yr for each pCi/L of radon in your household air. If your home has not been measured, use the national average of 1.5 pCi/L.	_____
Your Total Annual Radiation Dose	_____

[1]Radiation dose can be measured in several ways. The unit called millirem per year (mrem/yr) is one commonly used unit of measurement.