Experiment 22
Introduction to Radioactivity

Fig. 22-1

Experiment 22
INTRODUCTION TO RADIOACTIVITY

EQUIPMENT

1 Radioactivity decay model consisting of:	*Radioactive source*
Set of plastic markers	*Alcohol*
Shaker	*Styrofoam plate*
Plastic cloud chamber	*Flashlight*
Dry ice	

INTRODUCTION

The isotopes of some elements are radioactive and spontaneously emit radiation. The original, or parent atom disintegrates into another, different atom called its daughter. The probability for the disintegration of radioactive atoms in a given time period depends on the isotope but does not depend on the past history of the atom. The time for one half of a group of atoms to decay is called the half-life of the isotope. When radioactive elements decay, they emit 3 types of radioactive particles: alpha (the nucleus of the helium atom, which consists of 2 neutrons and 2 protons), beta (an electron or positron), and a gamma ray (a high frequency electromagnetic radiation).
Since the probability of decay is statistical, or depends on chance, we can use a model system to produce the characteristics of radioactive decay.

PROCEDURE 1

A. Radioactive Decay

1. Assemble the shaker if necessary.

2. Place entire set (200) markers in the shaker. Place hand over the open end and mix the contents.

3. Carefully toss or spill the entire contents on a flat surface in front of you.

4. Move to one side all the markers that are white. Assume that these have "decayed". Count the number of white markers and record this number in Table 1.

5. Place only the black markers in the shaker and repeat the procedure until all the markers have "decayed." Record the number removed each time.

6. Plot the number of remaining black markers against the number of tosses (the time unit) in Graph 1.

B. Carbon Dating

7. Use Fig. 20-2 to represent 100% of the carbon found in all living matter. The square represents a sample of Carbon 14 (C^{14}). Divide the square in half with a vertical line and write "5700 yrs" on the left side to represent the amount of C^{14} decayed after its half-life of 5700 years. Now divide the right side in half with a horizontal line, and write "11,400 yrs" to represent the amount of C^{14} decayed after an additional half-life. Continue to divide the remaining sample to show the amount of carbon 14 decayed after 17,100 years, 22,800 years and 28,500 years.

8. Plot time against the fraction of carbon 14 remaining in an organic substance, on Graph 2.

C. THE CLOUD CHAMBER

Your instructor should have a *cloud chamber* demonstration ready for you to observe. The cloud chamber is a small dish with absorbent paper around the interior. The paper is soaked with methyl alcohol, and cooled with dry ice so that a *super saturated vapor* forms.

A supersaturated vapor is a gas that is cooled below its condensation point. Any impurity in the vapor will cause it to condense and become a liquid.

When a radioactive source is placed in the chamber, the radioactive particles serve to create sites on which neighboring gas molecules can condense. You will see this condensation as a small white cloud forming behind the particle as it streaks from the source. The process is very similar to the con trail left behind a jet plane when it reaches a certain height in the atmosphere.

The needle in the chamber will have the radioactive element Lead 210, and the particle emitted will be a beta particle. Observe the cloud chamber, and record your observations in QUESTION 9.

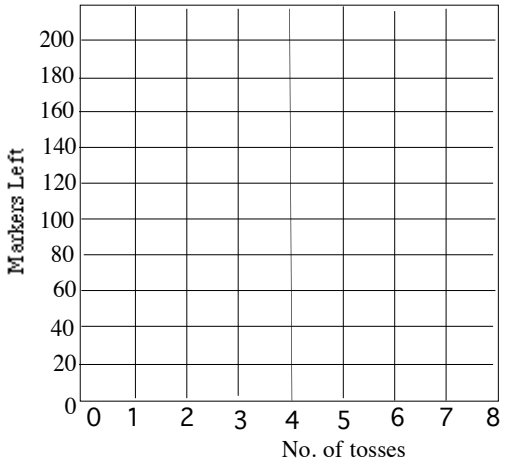
Experiment 23
INTRODUCTION TO RADIOACTIVITY

Name: _____

Table: _____ Section: _____

No. of Toss	No. of markers removed	No. of markers remaining
1		
2		
3		
4		
5		
6		
7		
8		

Table 1



Graph 1

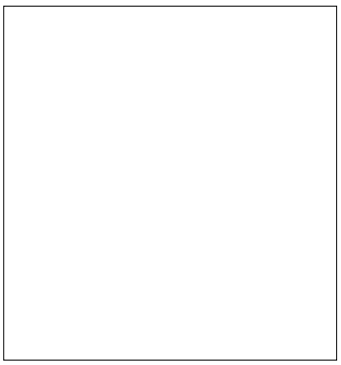
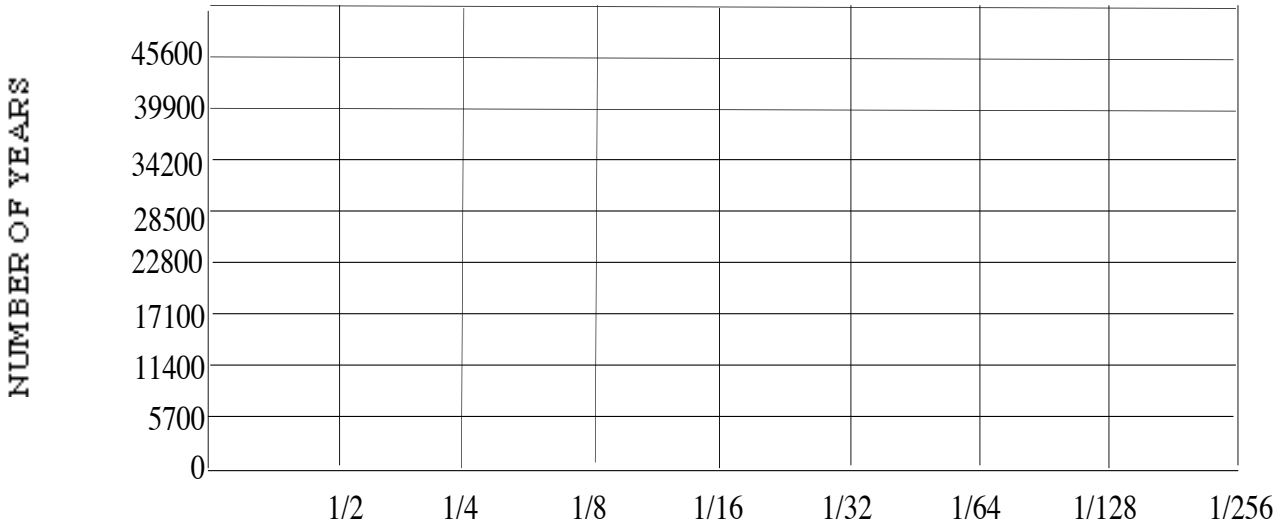


Fig. 23-2



Graph 2

QUESTIONS
(Refer to Fig. 23-2 and Graph 2 to answer questions 1 through 3.)

1) What fraction of carbon 14 still remains in charcoal burned in a primitive man's campfire approximately 28,000 years ago? _____ (Use the graph to find the answer. Check your answer with the divided square.)

2) What fraction of carbon 14 still remains in an animal frozen in a glacier 18,000 years ago? _____ Use your graph to find the answer. Check your answer with the square.

3) Estimate the age of pollen found in pear swamps left by a glacier from your graph. Assume that only 1/8 of the original carbon 14 remains in the pollen _____ Check your answer with the square.

4) Define the half-life of an isotope.

5) How many throws in this experiment equaled one half-life?

6) If each throw represented 500 years, what would be the half-life of the radioactive element represented by the markers?

7) Precambrian time is older than 600,000,000 years. Can carbon 14 be used in dating organic material from that era? Explain.

8) Radioactive elements emit 3 distinct types of radioactive particles. Name and describe each particle.

9) What did you see when you looked in the cloud chamber? If you saw nothing, consult your instructor. Describe the cause of the vapor trails.