Earth Science Name:

A MODEL OF RADIOACTIVITY

INTRODUCTION

Some **isotopes** (varieties of an atoms) of certain elements are **radioactive**. This means that they are **unstable**—they can break apart into atoms of different elements and **emit** (“**radiate**”) energy. The **daughter radioisotopes** created are smaller and more stable than the original **parent atom**.

Scientists and engineers use this property of radioactivity is many important ways. Geologists can sometimes determine how old a fossil or rock is by measuring the radioactive atoms in it. In this way, we can “date” (find the approximate age of) the sample.

Another important way in which radioactivity is used involves energy production. Heat energy radiated from the radioactive atoms can be used to produce electricity in a **nuclear power plant**. Much of the electricity produced in New Jersey, New York, and elsewhere is generated in nuclear power plants. Radioisotopes are also used in **medical diagnoses** and **treatments**, and many **industrial processes.**

In this investigation, you will find out more about radioactivity using a **scientific model**. We often use models to study changes that may be too fast, too slow, too large, too slow, or too dangerous to study the real things.

We will use the results from our experimental model to mathematical analyses and create **“decay curves”** that show how fast the parent isotopes change into daughter atoms**.** Finally, you will learn why radioactive materials are dangerous to people, and why they pose an important environmental problem, as well as having many useful applications

Procedure

1. Count 100 pennies and place them “heads-up” in the box.

2. Cover the container and shake for about ten seconds, holding it tightly to avoid them flying out.

3. Remove all the pennies which are now “tails-up.” Count these and put them in piles of 10 on the table.

4. On your data sheet, record the number of “heads-up” and “tails-up” pennies after the first shake.

5. Repeat this until all the pennies turn “tails-up.”

6. When you have all your results, put the pennies back into their original container.

7. Write your group results on the board with results from other groups, so you can find the “class” results.
8. Then, construct tables and graphs and answer the questions.

What To Include In Your Chart and Graph

Your data chart should include six columns showing: Turn, # ('number') of heads-up pennies, # of tails-up pennies, total # of tails-up pennies, class average # of heads-up pennies, and class average# of total tails-up pennies.

Your graph should include four curves: # of heads-up pennies, total # of tails-up pennies, class average # of heads-up pennies, and class average # of tails-up pennies.

You will plot these with "Turns" on the **x-axis** ("independent" variable) and "Number" on the **y-axis** ("dependent" or "manipulated" variable.)

We will try to make the chart and graphs using **Microsoft Excel**. Pay attention to the directions to work with this very useful software program.

Questions -- Write your answers on another paper which you staple to this.

1. Explain what each of the following parts of this scientific model represents: heads-up pennies, tails-up pennies, box, period of shaking.
2. What is meant by "unstable isotopes"? "stable isotopes"? "half-life"?
3. Briefly explain how radioactivity creates energy.
4. Select any three radioactive isotopes. Give their 'daughter isotope,' half-life, and how they are used by scientists, physicians, or engineers.
5. Name three ways in which radioactivity is used beneficially and three ways in which it is harmful.

Additional questions based on the NYS Earth Science Reference Tables

1. If you had 10 g samples of ^{12}C, ^{40}K, ^{87}Rb, and ^{238}U, which would completely decay the fastest and which the slowest? Explain your reasons.
2. Which of those isotopes would be best for finding the age of a Late Pleistocene campfire? Why?
3. Which of these isotopes has a half-life that is close to the estimated age of Earth?
4. What would be the approximate age of a sample of granite if a lab finds that it contains 75% of its original amount of ^{40}K? Explain your answer.
5. What might be the age of a Mastodon bone if it contains only 1/8th of its original ^{12}C? Explain your calculation.

“A Model of Radioactivity” Date ______________________

Group Members ____

Turn (Half-life)	Pennies heads-up (“parent”/ unstable)	Pennies tails-up (“daughter”/ stable)	Total tails-up pennies	“Class average” of heads-up pennies	“Class average” of tails-up pennies
0 (start)					
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Notes: