Name:
Teacher/Section:

RADIOACTIVE DATING METHODS AND "DECAY CURVES"

INTRODUCTION

Some atoms of certain elements are ***radioactive***. This means that they are ***unstable***—they can break apart into atoms of different elements and give of ("radiate") energy. The ***daughter*** atoms left behind are smaller and more ***stable*** than the original ***parent*** atom.

Scientists and engineers use this property of radioactivity is two important ways. Scientist 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.

The other important way in which radioactivity is used involves *energy production*. The heat energy radiated from the radioactive **isotopes** (varieties of an element) can be collected and used to produce electricity in a *nuclear power plant.* Much of the electricity produced in New York State comes from such power plants, including the Indian Point facilities on the Hudson River near Peekskill.

In this investigation, you will find out more about radioactivity using a **scientific model**. We will then use the results from our experiment to make **decay curves**. You will also learn how scientists can determine the "absolute age" of a fossil or rock, as compared with its "relative age." Finally, we will examine 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 plastic box with a lid.

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

3. Next, remove all the pennies which are now "tails-up." Count these and put them aside. On your data sheet, record the number of "heads-up" and "Tails-up" pennies after the first shake.

4. Repeat this until all the pennies turn "tails-up."

5. When you have all your results, put the pennies back into their original container and place them next to the covered.

6. Begin to answer the questions on the next page and construct graphs.

Questions

1. Explain what each of the following parts of this scientific model represents in reality: heads-up pennies, tails-up pennies, box, period of shaking.

2. What is meant by "half-life"? "unstable isotopes"? "stable isotopes"?

3. Make a table showing three radioactive isotopes, their half-lives, and ways in which they are commonly used by scientists, physicians, and engineers.

4. Briefly explain how radioactivity creates energy.

5. Name three ways in which radioactivity is used beneficially and three ways in which it is harmful.

6. A lab possess 10 g samples of C^{14}, K^{40}, Rb^{87},and U^{238}. After a certain number of years, which has decayed the least and which has decayed the most? Explain why.

7. Which radioisotope would probably be most useful for determining the approximate age of a late Pleistocene campfire? Explain why.

8. Which radioisotope would probably be most useful for determining the approximate age of Precambrian rocks here in the Manhattan Prong? Explain why.

9. How much C^{14} would remain after 5 half-lives. How old would such a sample be? Explain your answers.

10. A rock containing potassium minerals is analyzed. The sample shows that only 75% of the original K^{40} is still present. How old is the sample? Explain your reasoning.

<u>What to Include in Your Table, Graph, and Discussion</u>

Your data table should include six columns showing: Turn, # 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.

You should include on your graph the # of heads-up pennies, total # of tails-up pennies, class average of heads-up pennies, and class average of tails-up pennies.

In your Discussion, you should explain why there may be differences between your group's results and the class results. Tell which is more likely to be closer to what happens in reality. Also discuss the difference between "absolute age" and "relative age." Include anything else you think should be in a discussion of radioactivity.

[Historical note: This activity was first widely used as part of the Earth Science Curriculum Project, a program created in the 1960s by the American Geological Institute and part of the basis for the New York State Regents Earth Science curriculum in 1970.]