Radioactive Decay – A Simulation
Chemistry

Name: _______________________
Lab Partners: _______________________

Introduction:
Radioactive materials are harmful to living tissues. Their half-lives are difficult to measure without taking safety precautions. To eliminate these problems, you will simulate the decay of unstable nuclei by using harmless materials that are easy to observe. In this experiment you will use dried split peas to represent the unstable nuclei of one element. Dried navy beans will represent the stable nuclei of another element. Your observations will allow you to make a mental model of how the nuclei of radioactive atoms decay.

Research Question or Hypothesis: (develop a question or hypothesis based on the above information)

Background: (use your notes and textbook to give background information on radioactive decay)

Materials:
- Dried split peas
- Dried navy beans
- 250 mL beaker
- Large tray
Procedure:
1. Count out 200 dried split peas and place them in a beaker.
2. Record the number of split peas in Table 1 as Observation 0.
3. Place the tray on a flat surface.
4. Hold the beaker over the tray and sprinkle the split peas onto the tray. Try to produce a single layer of split peas on the tray.
5. Remove all the split peas that have NOT landed on the flat side down. Count the split peas that you have removed and set aside. Replace the number of peas that you have removed from the tray with an equal number of lima beans. Count the number of peas and the number of lima beans on the tray. Record these values in Table 1 as Observation 1.
6. Scoop the peas and the beans from the tray and place them into the beaker.
7. Predict how many split peas you will remove if you repeat steps 4 and 5. Enter your predictions in the Data and Observations section.
8. Repeat steps 4 through 6, recording your data in the data table as Observation 2.
9. Predict how many observations you will have to make until there are not split peas remaining. Enter your prediction in the Data and Observations section.
10. Repeat steps 4 through 6 until there are no split peas remaining.

Data and Observations:

<table>
<thead>
<tr>
<th>Observations</th>
<th>Time (minutes)</th>
<th>Split Peas</th>
<th>Lima Beans</th>
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Prediction of number of split peas removed:

Prediction of number of observations until there are no split peas remaining:
**Analysis:** In this experiment each split pea represents the nucleus of an atom of radioactive element A. A split pea that has landed flat side down represents the nucleus of an atom of radioactive element A that has not yet decayed. Each split pea that has NOT landed flat side down represents the nucleus of element A that has decayed. Each navy bean represents the nucleus of an element B that was formed by the decay of the nucleus of an element A.

Assume that the time period between each observation was 5 minutes. Observation 1 will have been made at 5 minutes, observation 2 at 10 minutes, and so on. Complete the time column in Table 1.

1. Graph the results of your experiment. On the x-axis plot the time and on the y-axis plot the number of nuclei of element A atoms remaining after each observation.
2. Use this graph to construct another graph. Plot time on the x-axis and plot the number of nuclei of element B atoms remaining after each observation on the y-axis.
3. Determine the appropriate half-life of element A from your graph.

**Questions and Conclusions:**

1. What is the approximate half-life of element A?

2. Use your graph to determine the number of element A nuclei remaining after 2 half-lives, and after 3 half-lives.

3. Why did you replace split peas but not lima beans during this experiment?

4. That two graphs that you constructed look like mirror images. Explain why this is so.