**Half Life Introduction Lab:**

**Name: Date: Period:**

**Background Activities:**

In relative dating, we are simply trying to determine whether one rock layer is older than another or gathering an idea of the geological history of a certain area. In these cases, we are using observations and clues to determine a relative age. However, sometimes it is necessary to be more accurate and determine actual years or an absolute age.

One of the way scientists determine absolute age is through radioactive dating, which uses the half-life of radioactive materials to figure out an approximate age. Rocks generally have small amounts of radioactive material that can be used to figure out the age of a substance. Remember to earlier in the year when we discussed how atoms of the same element, which have different number of neutrons are called isotopes. These radioactive isotopes will emit particles and energy, while in the process breaking down into stable elements. Each of these radioactive isotopes will decay at a constant rate which can be used to calculate the age of the rocks. The time it takes for half of a sample of a radioactive isotope (parent isotope) to break down into more stable isotopes (daughter isotopes) is called a half-life. Thus after one half-life, one half of the parent isotope has broken down into the daughter isotope. After two half-lives, half of the remaining one half of the parent isotope breaks down into the daughter isotope, leaving only ¼ of the original amount of the parent isotope.

To better understand the concept, imagine you have a million dollars and you have to spend ½ of what you have everyday. How many days do you think it would take to get to zero?

Give it a try below and graph your results:



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| Days | Remaining |
|  0 | 1,000,000 |
| 1 | 500,000 |
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Another way to look at it, is you have a sample that was initially comprised 100% of the radioactive parent isotope Carbon 14. Carbon 14 has a half life of 5,730 years, which means, that after 5,730 years, ½ of the Carbon 14 has decayed into its daughter isotope of Nitrogen 14. Use the models below to fill in the chart below:

    

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ½ Life | 0 |  |  |  |  |  |  |  |  |
| Carbon 14 | 16 |  |  |  |  |  |  |  |  |
| Nitrogen 14 | 0 |  |  |  |  |  |  |  |  |
| Years Passed | 0 |  |  |  |  |  |  |  |  |

 **Lab Activity:**

1. Count your nuclei (candy). Write that number in the data table under the heading "Number of Radioactive Nuclei, Toss 0." In the column marked "Prediction for Next Toss" write the number of radioactive nuclei you think you will have with your next toss. (Radioactive nuclei will be those candies with the marked side down, while stable nuclei will have an “S” side up.)
2. Place your "nuclei" in a paper cup, cover and gently shake the cup. Pour the "nuclei" onto your paper towel. Separate the "nuclei" into two piles, one with the marked side up and the other with the marked side down. Count the number of "nuclei" in each pile. On your data table, record the number of "radioactive nuclei" candies with the marked side down. Predict how many radioactive "nuclei" you will have after the next toss.
3. Return only the radioactive "nuclei" to your paper cup. Keep the “decayed nuclei” in a separate pile. Only after you have completed the activity, copied your data to the overhead and you get my permission can you consume your nuclei.
4. Continue this process until there are no radioactive "nuclei" left. Add more rows to your data table, if needed. Put your data on the table on the document camera and copy other groups.

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| Toss | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| # of Radioactive |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Prediction of next toss |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Class data: Number of Radioactive Nuclei

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Toss | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Group 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Group 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Group 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Group 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Group 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Group 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Group 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Class Totals |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Graph:**

*Using* ***the pooled data,*** prepare a graph by plotting the number of radioactive "nuclei" and the number of tosses, which we will call half-lives. Be sure your axes are labeled, have units and that you have an appropriate title. Be sure to use an appropriate scale for your graph so that you use most of the graph paper. Connect your points with a smooth curve.



**Analysis:**

**Please answer all in complete sentences!**

1. How good is our assumption that half of our radioactive "nuclei" decay in each half-life? Explain.

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1. If you started with a sample of 600 radioactive nuclei, how many should remain undecayed after three half-lives?
2. If 175 undecayed nuclei remained from a sample of 2800 nuclei, how many half-lives have passed?
3. Why did we pool the class data?

5. Is there any way to predict when a specific piece of candy will land marked side up or "decayed?" If you could follow the fate of an individual atom in a sample of radioactive material, could you predict when it would decay? Explain.

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6. Strontium-90 has a half-life of 28.8 years. If you start with a 10-gram sample of strontium-90, how much will be left after 115.2 years? Show your work.

\*Bonus Challenge (show your work): Selenium-83 has a half-life of 25 minutes. How many minutes would it take for a 10mg sample to decay and only have 1.25mg of it remain?