Name:_________________

Radioactive Decay: A sweet simulation of half-life

Introduction:

Testing of radioactive minerals in rocks best determines the **absolute age of the rock**.

In radiometric dating, different isotopes of elements are used depending on the predicted age of the igneous rocks. Potassium/Argon dating is good for rocks 100,000 years old since Potassium 40 has a half-life of 1.3 billion years! Uranium/Lead dating is used for the most ancient rocks, .since U-238 has a half-life of 4.47 billion years.

By comparing the percentage of an original element (parent atom) to the percentage of the decay element (daughter atom), the age of a rock can be calculated. The ratio of the two atom types is a direct function of its age because when the rock was formed, it had all parent atoms and no daughter atoms

Some isotopes are radioactive and "decay", changing their chemical identity as they shed subatomic particles and emit high-energy radiation. Such *radioisotopes* decay into lighter and lighter radioisotopes until they become stable isotopes (isotopes that are not radioactive.) The ongoing radioactive decay of elements such as uranium, potassium, and thorium deep within Earth emits heat that travels slowly upward toward Earth's surface, heating rock and water along the way, eventually being released to the atmosphere. Each radioisotope decays at a rate determined by that isotope's *half-life,* the amount of time it takes for one-half the atoms to give off radiation and decay. Different radioisotopes have very different half-lives, ranging from fractions of a second to billions of years. The radioactive isotope uranium-235 (^{235}U) is our society's source of energy for commercial nuclear power.

Procedure:

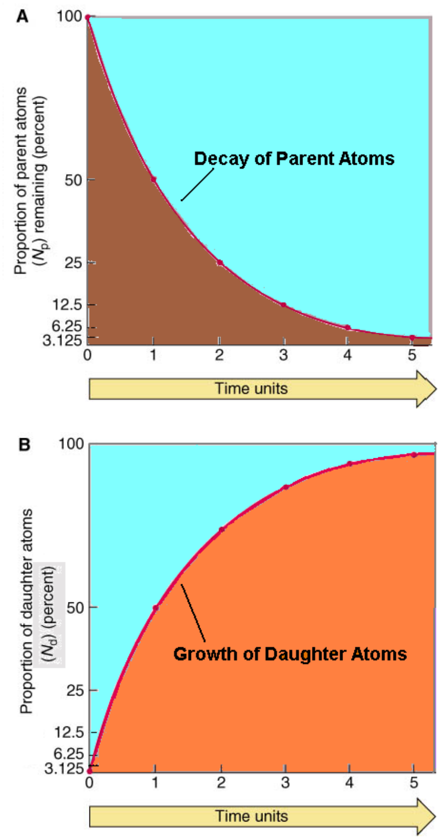
1. Count your nuclei (candy). Write that number in the data table under the heading "Number of Radioactive Nuclei. Radioactive nuclei are represented by M side up, decayed nuclei are represented by M side down.

2. Place your "nuclei" in a cup, cover and 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 each category in the data table.

3. Return only the radioactive "nuclei" to your paper cup. **Atoms are never lost they just decay from the radioactive atoms (M&Ms) to more stable ones (flipped over M&Ms).**

4. Continue this process until there are no radioactive "nuclei" left. Add more rows to your data table, if needed.

Time (Toss)	Number of radioactive nuclei (M side up, Parent Atom)	Number of decayed nuclei (M side down, Daughter Atoms)
1		



Analysis and Conclusions:

Using the pooled data, prepare a graph by plotting the number of radioactive "nuclei" on the y-axis and the number of tosses, which we will call half-lives, on the x-axis. Be sure to include the following when constructing your graph.

- Labeled axes
- Appropriate scale

1. What do we mean by half-life?

2. How much of a radioactive element becomes stable in a half-life? (Not based on lab results)

3. What is the half-life of the M&M's? (i.e., what number of shakes is necessary to reduce the radioactive members to one-half?) **EXPLAIN YOUR ANSWER**

4. Try multiplying 1/2 X1/2 over and over to determine if you ever get to zero.
1/2 x 1/2 x 1/2 x 1/2 x 1/2 x 1/2 x 1/2 x 1/2 x etc. Will a small amount of the "parent" radioactive element always remain? Explain.

5. Suppose an M&M was shaped like a cube and only one side was marked with the M&M logo. Would it take more or less or the same amount of time trials (shakes) to remove half of the M&Ms? Explain your reasoning.

6. If you started with a sample of 600 radioactive nuclei, how many would remain undecayed after three half-lives? **(SHOW WORK** FOR CREDIT)

7. Explain how the end of the lab is different from real life radioactive decay.