Name: ___________________________

# Extension: Half-Life of Candium: Radioactive Dating

## Determining Absolute Age

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

**Procedure**: You will be given a sample of a radioactive element known as Candium (M&M's), 50 candies. Radioactive Candium stabilizes into a more stable element Greenium (split peas). **Read the procedure before you start the lab**

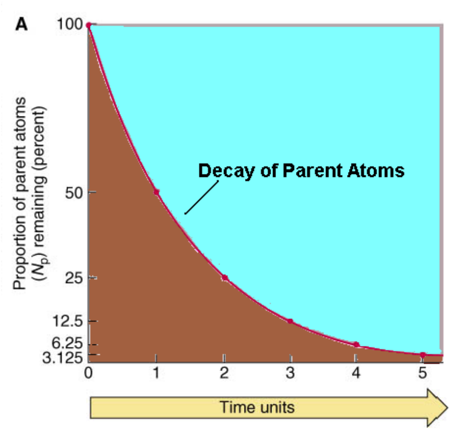
1. Place the 50 candies in the bag. The Candium with the "M" side up are the number radioactive **unstable** "undecayed" Candium atoms (the parent atoms) in your igneous rock when it was formed
2. Shake the bag- not too vigorously! Shake the bag for about 7.13 seconds (this represents 713 million years passing). This represents time to decay or one half-life.
3. Carefully pour the Candium atoms onto a paper towel. Remove all the **stable** Candium atoms-those with the "M" side down. Stable Candium atoms are really a new element: Greenium atoms. Replace in the bag these removed stable Candium atoms (parent atoms) with same number of greenium atoms (daughter atoms).

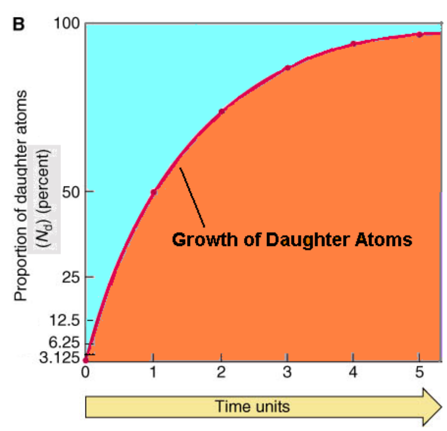
**The total number of M&M's and peas in your bag must be the same as the number of M&M's you started with (50).** Atoms are never lost they just decay from the radioactive atoms (M&Ms) to more stable ones (flipped over M&Ms or peas).

4. Count and record the number of radioactive "undecayed" Candium atoms ('M' side up) remaining. Record in the data table
5. Repeat steps 2, 3 and 4 until all the candies "decayed" (flipped 'M' side down) or 10 shakes of the bag-which ever happens first.

**Data Table**

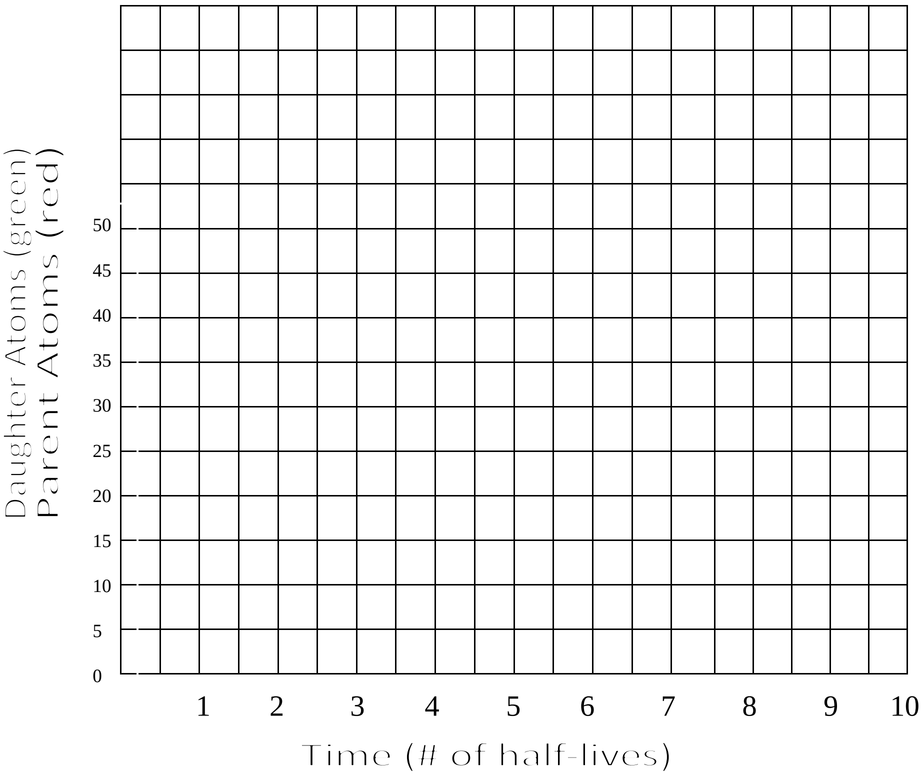
| Time (# of shakes) **Half Lives** | Number of "undecayed" radioactive Candium atoms remaining with the "M" side up. "Parent" atoms. | Number of Greenium atoms. The stable "daughter" atoms. |
|---|---|---|
| 0 | 50 | 0 |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |



**Data Analysis**

Please use the graph below plot your data of parent and daughter atoms over time passed (millions of years).




**Questions**

1. The M&M's represent the ________________________.

2. The split peas represent the _________________________.

3. How much of a radioactive element becomes stable in a half-life?

4. What is the half-life of Candium? (hint: The time you shook the bag is the half-life of candium.)

5. If you started with 100 M&M's, would the half-life change? Please explain.

6. Suppose you had 20 radioactive (parent) M & M’s. Using your graph determine how many half-lives had passed.

7. After 3 half-lives had passed how many radioactive (parent) M & M’s would be left? Number of decayed (daughter) M&M’s left?

8. Looking at the table of elements used in radioactive dating, identify which element the radioactive M & M’s represent. (Hint: you shook your m&m’s for 7.13 seconds to represent 713 million years).

| Elements used in radioactive dating | | |
|---|---|---|
| **Radioactive element** | **Half-life (years)** | **Dating range (years)** |
| carbon-14 | 5,730 | 500-50,000 |
| potassium-40 | 1.3 billion | 50,000-4.6 billion |
| rubidium-87 | 47 billion | 10 million-4.6 billion |
| thorium-232 | 14.1 billion | 10 million-4.6 billion |
| uranium-235 | 713 million | 10 million-4.6 billion |
| uranium-238 | 4.5 billion | 10 million-4.6 billion |

9. Can this radioactive element be used to determine the age of humanoid fossils? Why or why not? (Remember humanoids first appeared 5 million years ago).

10. 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?

Answers

1. Parent Atoms
2. Daughter Atoms
3. 50%, Each candy piece has two sides, therefore the chances of either side landing face up is 50%
4. The half-life of candium in this activity was 10 seconds

5. The half-life will not change. One can start with "any given amount".

6.

7. 2000/713=2.8 HL Look on graph.

8. U-235

9. No would need to use C-14

10. Yes, a small amount of the parent Atom will remain. This concept is successive halves. No matter how far you multiply, a fraction of the whole will remain. In the case of C-14, eventually only a single atom will remain.