Half-life Activity

**Purpose:** To determine the half-lives of different situations as an analogy to radioactive decay.

**Procedure:** You should be starting with 100 dice. Pour them into your tray.

1. Shake them around, MAKING SURE NONE SPILL OUT. This creates the randomness of radioactive isotopes.
2. Pick out all of the dice that show a 1, 2 or 3.
3. Record the number of dice remaining after the shake.
4. Shake the tray again, randomizing the dice, and pick out the new dice that are showing a 1, 2 or 3. Record this number. Repeat for 10 shakes.
5. Place all the dice back in and now remove dice showing a 5 or 6 only.
6. Place all dice back in the tray. Now repeat the process but take out the peas that show only a 1.

**Data:**

50/50 chance 1/3 chance 1/6 chance

|  |  |
| --- | --- |
| Shakes | Dice remaining |
| 0 | 100 |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

|  |  |
| --- | --- |
| Shakes | Dice remaining |
| 0 | 100 |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

|  |  |
| --- | --- |
| Shakes | Dice remaining |
| 0 | 100 |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |
| 7 |  |
| 8 |  |
| 9 |  |
| 10 |  |

**Prediction:** What do you think the half-life will be for each test? Explain your reasoning.

**Analysis:** Open up Desmos and input the three sets of data. The type of equation that governs radioactive decay is $N\left(t\right)=N\_{o}e^{-λt}$ where λ is the decay constant, which relates to the radioactivity of the material, as well as the half-life of the material with the equations: $λ=\frac{decay rate}{N}=\frac{ln⁡(2)}{T\_{^{1}/\_{2}}}$ Create a trend line for each data set with the above equation and determine the half-life for each test. Print and staple the graph to this page.

What are the half lives of the 3 different trials?

Post Activity Questions:

1. Shown at the right are samples of two radioactive elements. For each sample we are told how much of the radioactive element is initially present and the half-life of each element. After **12 hours** will the mass of element A that remains be *larger*, *smaller* or the *same* as the mass of element B?

**M = 124 g**

**T1/2 = 3 hours**

**M = 96 g**

**T1/2 = 4 hours**

**A**

**B**

Explain your reasoning.

1. A radioactive substance has a half-life of 20 minutes. How long would it take to lose 95% of the parent isotope?
2. From experimentation, it has been found that the ratio of 14C to 12C in CO2 in the atmosphere is held constant at 1.3\*10-12. When a living organism dies on Earth, it no longer consumes carbon into its body and so the 14C starts to go through β- decay. The 1/2life of 14C is 5,730 years. Let’s say an ancient wood club is found that contains 290 g of carbon and has an activity of 8.0 decays/sec. How old is the club? (18,230 yrs)
3. The half-life of 216Po is 1/7 s. What is the probability that any particular 216Po atom will decay within one second? (99%)
4. Radon gas has a half-life of 3.83 days. If 3 g of radon gas is present at time t = 0, what mass of radon will remain after 36 hours? (**2.29 g**)
5. A building has become accidently contaminated with radioactivity. The longest lived material in the building is strontium 90. (atomic mass of $$ is 89.9077 u and ½life of 2.88 hours ) If the building initially contained 5.0 kg of $$ and the safe level of radioactivity is 10 decays/min, how long will the building be unsafe? (**8 day and 20 hours**)