

Half-Life and M&Ms Activity:

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Teacher's Guide

Goals

- To understand the concept of half-life
- To have a useful analogy that helps students to actually “see” the decay process, a very abstract concept otherwise.

The Activity

M&Ms are used to simulate the decay of radioactive isotopes. Having two different sides, they represent the “radioactive” and the “decayed” elements. The decaying process is imitated by sequential discarding of the M&Ms, which fall “right side up” on the tabletop, until no M&Ms are left.

Materials for Each Group

- Lunch tray
- Styrofoam cup
- 100 M&Ms candies

Lecture Notes

In your cups, you should have 100 M&Ms. Make sure you have them all.

Make sure you have an M on one side, since it will affect your results.

If you need a replacement, come up, and take what you need.

About Half-Life

See the following sites:

<http://www.umich.edu/~radinfo/introduction/lesson/half.html>
A brief explanation of half-life.

http://www.sciencecourseware.com/VirtualDating/files/RC_2.html
An interactive on radiocarbon dating.

Half-life is the measure of the time it takes for a process (say, radioactive decay) to arrive at one half of its initial value. For example, the half-life of U238 is 4.5×10^9 years, and thus it still exists on earth in its radioactive form, whereas C11 is very short lived, relatively, since it has a half-life of only 20 minutes. Being an important isotope for medicine, it must be reformed every time it is used.

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The decay sequence of Uranium-238:

U-238 comprises 99.3% of all uranium ores

=> Alpha =>Thorium-234 (4,510 million years)

=> Beta =>Protactinium-234 (24.1 days)

=> Beta =>Uranium-234 (6.75 hours)

=> Alpha =>Thorium-230 (247,000 years)

=> Alpha =>Radium-226 (80,000 years)

=> Alpha =>Radon-222 (1,620 years)

=> Alpha =>Polonium-218 (3.823 days)

=> Beta =>Bismuth-214 (26.8 mins)

=> Beta =>Polonium-214 (19.7 mins)

Branch: 99.98% Polonium-214 =>Alpha => Lead-210 (0.000164 secs)

=> Beta =>Bismuth-210 (21 years)

Branch: 81% Bismuth-210 =>Beta => Polonium-210 (5.01 days)

=> Alpha =>Lead-206 (138.4 days)

Lead-206 is stable

Taken from <http://www.saveguard.co.nz/>.

Teaching Tips From Ms. Rottmann

We spend about two weeks on nuclear chemistry. Half-life is just one aspect of our entire unit. We talk about the different types of radiation, sources of radiation, how radiation affects us.

Half-life is a difficult concept to understand because it is so abstract.

We're talking about radioactive isotopes and how they decay. We don't see it. And so we use M&Ms because it is something that they can physically manipulate.

They know how to calculate the half-life from their graphs.

So far we just looked at models of half-life. The true understanding will come when we do more problems and actually bring the radioisotopes into how scientists use half-life. It seems that they get the picture of what it is.

References: Links

<http://www.lbl.gov/abc/> Extensive pages from Lawrence National Lab. Be sure to click on "Basic Nuclear Science" and "Experiments."

References: Readings

Hughes, E.A., and Zalts, A. (2000) "Radioactivity in the Classroom," *Journal of Chemical Education*, Vol. 77, No. 5, pp: 613-614.