



Calculating the Half-Life of Twizzlers and M&Mium

This lesson plan includes two labs designed to teach the concept of half-life. The Twizzler lab is designed to introduce the topic and is best if used before the M&Mium lab.

Primary Learning Outcomes

Students will learn the concept of half-life and how it relates to radioactive material. Students will determine, with a hands-on experiment, the half-life of Twizzlers and a “radioactive” element, M&Mium. Students will create and be able to recognize a graph representing the half-life of an element. Students will be able to determine how different factors modify the shape of the half-life graph.

Assessed Georgia Performance Standards

SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.

SPS1. Students will investigate our current understanding of the atom.

SPS3. Students will distinguish the characteristics and components of radioactivity.

Procedures/Activities (Designed to complete both labs in a 90 minute class period)

Step 1: Duration 15-20 minutes

Prior to class, the instructor should create partitions with 50 M&Ms each.

Step: 2 Duration: 20-30 minutes

Students will learn the concept of half-life in the first lab to determine and the half-life of a Twizzler. Students will determine the half-life of a Twizzler in terms of number of “half-bites” and in terms of time. Students will graph the amount of Twizzler left after each “half-bite” in order to learn the shape of a half-life curve. Follow procedure outlined in lab handout.

Step 3: Duration 50-60 minutes

Students will determine the half-life of a “radioactive” element, M&Mium. The half-life is the number of shakes that it takes for half of the M&Mium atoms to decay. Students will plot the data and determine the half-life of M&Mium. Follow procedure outlined in lab handout.

Materials and Equipment

Per student/group: 2 individually wrapped Twizzlers, 50 M&Ms, plastic cup, white paper, graph paper

Total Duration

Teacher prep: 15-20 minutes

In class: 80-90 minutes

Assessment

Students will be assessed on their understanding of half-life via post lab questions and graphs.

Half-life: Determining and Graphing the Half-life of a Twizzler

Background: You should know the term “half-life” and know how it is related to radioactive elements. The half-life of a radioactive element is the time it takes for half of its atoms to decay into something else. For example, iodine-125 (I-125) has a half-life of about 60 days; therefore, in 60 days, 1g of I-125 will turn into half a gram of iodine-125 and half a gram of something else (the radioactive decay products of radium). After another 60 days have elapsed, only a $\frac{1}{4}$ of the original 1g of I-125 will remain.

Purpose: To determine the half-life of a Twizzler and graph the results.

Materials:

- 2 Twizzlers (1 for Part I and 1 for Part II)
- pencil/pen
- 2 sheets of graph paper

Procedure: Part I: Amount of Twizzler vs. Bites

1. Hold original Twizzler vertically against the 'y' axis with one end at the origin. Mark the "length". This represents the beginning amount.
2. Wait for further instructions to “Take a $\frac{1}{2}$ bite!” You must eat HALF (and *only* half) the length of the Twizzler.
3. Repeat step 1, holding the Twizzler a unit from the origin. Mark the new length (this is your y coordinate).
4. Repeat steps 2 and 3 with the class until the instructor tells you to stop.
5. Draw a smooth “Best-Fit” line on your graph.

Procedure: Part II: Amount of Twizzler vs. Time

1. This time the procedure in Part I will be repeated except the instructor will tell you to take a bite every 45 seconds and record your data!

Conclusions and Analysis:

1. Did the Twizzler ever completely disappear? Explain.
2. What was the half-life of the Twizzler in Part II?
3. If you had started with a GIANT Twizzler (2X the normal size) how would this have affected the shape of the graph? Explain.

Describe the effect on the graph if you took a bite every 90 seconds.

Half-life: Determining and Graphing the Half-life of M&Mium

Background: You should know the term “half-life” and know how it is related to radioactive elements. The half-life of a radioactive element is the time it takes for half of its atoms to decay into something else. For example, iodine-125 (I-125) has a half-life of about 60 days; therefore, in 60 days, 1g of I-125 will turn into half a gram of iodine-125 and half a gram of something else (the radioactive decay products of radium). After another 60 days have elapsed, only a $\frac{1}{4}$ of the original 1g of I-125 will remain.

Purpose: To determine the half-life of the element M&Mium.

Materials:

Bag of M&Mium Isotopes

****Radioactive members of this isotope family are easily distinguished via a bold **m** on the front surface of the atom.****

1 plastic cup

pencil/pen

white piece of paper

1 sheet of graph paper

Procedure:

1. Count the number of M&Mium atoms as you place them in the cup. Record the total number of radioactive atoms you start with in your data table (on the back of your graph paper).
2. Cover and shake/rattle the cup.
3. Carefully pour your atoms onto your white paper. You will see that several of the previously radioactive atoms in the group have decayed, and the **m** is no longer visible. This means that they are now considered "safe" and, since they are no longer radioactive, may actually be eaten without fear of any harm to you! Please do so, and **as you remove the edible atoms, count them so you may determine the number of atoms that have decayed in that particular shake. (NOTE: You should not eat any of the decayed M&Mium atoms until you are on your 3rd trial)**
4. Now you need to continue this pattern until no more radioactive members remain. Remember to record the number of decayed atoms after each shake!

Analysis:

Using the graph paper provided, construct a graph of N (Number of decayed atoms) as a function of the number of shakes. Use the average of the 3 trials to construct this graph. (*Remember to label your x-axis, y-axis, and indicate a title for your graph.*)

Conclusions:

1. Calculate the half-life of M&Mium? (i.e., What number of shakes are necessary to reduce the radioactive members to one-half?)

