Feature Lesson: Half-lives, Radioactive Decay, and Nuclear Power

Block I - General Information

Class: 4th Period  
Subject: Honors Chemistry  
Lesson Title: Half-lives, Radioactive Decay, and Nuclear Power  
Grade Level: 10th and 11th Grades  
Lesson Length: 3-4 days (90 minutes each day)

Block II - Purpose

The purpose of this lesson is to develop students understanding of half-lives and radioactive decay. In addition, students will rid themselves of common misconceptions about half-lives and radioactive decay, and learn how these concepts relate to other scientific topics including generating electricity at a nuclear power plant.

Block III – Objectives

**Content Objectives**
Given this assignment, all students will be able to explain the concept of half-life, successfully solve all the variations of basic half-life problems and explain the process of alpha and beta decay using models, and be able to solve radioactive decay and half-life problems. In addition, students will be able to synthesize information into a coherent presentation to demonstrate their understanding of nuclear reactors.

1. ELLs will become familiar with the definition of radioactivity and half-life:  
2. ELLs will discuss how to solve basic half-life problems:  
3. ELLs will create marshmallow models of atomic nuclei that can be used to explain alpha decay, beta decay and fission.

**Language Objectives**
All students will be able to verbally explain half-life and radioactive decay as it pertains to the M&M and marshmallow activities, and give a brief oral explanation of how radioactivity relates to other areas of study:

1. ELLs will read reference texts concerning half-life and radioactivity and listen to native language CD’s when available on these topics.  
2. ELLs will discuss nuclear power plants and nuclear weapons as they relate to radioactivity:  
3. ELLs will rewrite the key vocabulary words that relate to radioactivity, half-life and nuclear power:

**Culture Objectives**
1. ELLs will pair with a native English speaking student go through the half-life exercise with M&M's, the radioactive decay exercise with marshmallows, the web quest research project, and the half-life and radioactive decay calculations.

**Block IV – State Standards**

**North Carolina Standard Course of Study for Chemistry**
Competency Goal 4: The learner will build an understanding of energy changes in chemistry.

**4.04 Analyze nuclear energy.**

- Radioactivity: characteristics of alpha, beta and gamma radiation.
- Decay equations for alpha and beta emission.
- Half-life.
- Fission and fusion.

**Block V – Teacher Materials**

**Teacher Materials:**
Laptop Computer with Internet Access
PowerPoint Program
Projector and SMART Board
Graph Paper and Regular Paper
Pens and Pencils
M&M's and Marshmallows
Student Computers with Internet Access

**Block VI – Content, Procedures, and Instructional Strategy – Include an explanation of all ELL accommodations that will be used for each activity within the lesson.**

**Activity 1** – Through the use of a PowerPoint Presentation I will introduce the concepts of half-life and radioactivity, including a brief history of radioactivity and the scientists involved in the discovery and further research of radioactivity. I will continue the PowerPoint presentation to define half-life and go over some basic uses of half-life including dating of fossils. I will ask students what happens to the matter that is undergoing radioactivity, and what will happen after the passing of one half-life to a bottle full of radioactive material. I will assess responses and correct misconceptions about matter decaying into nothing over the course of several half-lives, and then introduce M&M half-life activity and marshmallow
radioactive decay activity.

Activity 2 – Students will be paired and then pairs of students will be paired again to make a group of four which will participate in a learning together activity as developed by David and Roger Johnson (Brophy, 2004). One pair of students will perform a half-life activity with M&M's while the other pair builds atomic models with marshmallows to simulate alpha and beta decay. The students as a whole group will graph the data from the M&M half-life activity and write a brief lab report detailing what they learned about the decay of atoms. The pair of students that completes the marshmallow decay activity will explain the radioactive decay process to the other pair of students in the group while I listen to the explanation. Together these students will write a brief description of what is happening in this activity. For thoroughness, ELL students will be paired with a native English speaking student. Informal assessments will be made throughout this activity and formal assessment made of the lab report.

Activity 3 – I will divide the class into groups of four where each group will be given the task of researching nuclear reactors (including how they work and the pros and cons of these reactors). Each student within a group will have a different role, with one student being a scientist, one being an historian, one an economist, and one an environmental expert. This is a variation of the Jigsaw Method as outlined by Elliot Aronson and his colleagues (Brophy, 2004). The students will research nuclear reactors and present their findings in a PowerPoint presentation to the county commissioners explaining why a nuclear power plant should or should not be rebuilt in Long Island, New York. In addition, each student will prepare a 2-3 page written paper detailing his or her individual findings. ELL students will be paired with native English speaking students. This web quest was developed by Anthony Forti (n.d.) and details, including the rubric used to grade the final project can be found at the following web site: http://www.geocities.com/acjforti/index.html.

Activity 4 - Students will complete a series of worksheets detailing radioactive decay and half-life problems. These worksheets will include problems where students will have to fill in the correct particle in a nuclear decay equation as well as half-life problems that will ask for the length of the half-life, the amount of sample remaining, the amount of material in the original sample, and the number of half-lives undergone. Students will work individually for the most part, but ELL students will be paired with a native English speaking student.

Conclusion: One learning together group of students from the class will be chosen to explain the details of the M&M half-life experiment. This group will emphasize that matter does not disappear in the process of radioactive decay, but is rather transformed into another form. Another group of students will demonstrate, with their own set of marshmallows, what happens during: alpha decay, beta decay and fission. Students will present their findings of their nuclear reactor assignment to the class, with the rest of the class acting as county commissioners during their presentation. Applause from the students and encouraging remarks from the
The teacher will follow each explanation and presentation. Questions will be taken from the class, and then the class will engage in a final discussion of concepts that were learned and the knowledge that was acquired during these activities.

**Assessment:** Students will be informally assessed constantly while they are working on the different sections of this lesson. The teacher will guide students through the M&M activity and the Marshmallow decay activity as he circulates around the room to assess understanding among the different groups. Students will have access to the teacher throughout most of the web quest activity and the worksheet problems. A select few example problems will be done in class as well as a few problems from the worksheets. The half-life and radioactive decay worksheets will be formally graded as a homework assignment. The PowerPoint created, as well as the 2-3 page written paper will be graded based on the attached rubrics, which can also be found at the following link: [http://www.geocities.com/acjforti/index.html](http://www.geocities.com/acjforti/index.html). The rubrics can be found under the Evaluation and Conclusion tabs.

**Block VII – Instructional Technology Used for Teaching** – Please indicate the level and type of technology that will be incorporated into the lesson. The chart below will assist you in categorizing your use of technology on a 9 point continuum. During any lesson, you may elect to use technology at more than one point on this continuum. Give a rationale for your decisions. Remember that pedagogy should always determine your choice of technology integration.

<table>
<thead>
<tr>
<th>Purpose for Technology</th>
<th>Point</th>
<th>Use of Technology</th>
<th>Purpose of Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructional Technology for Teaching</td>
<td>1</td>
<td>Teacher-use Only (Electronic Equipment)</td>
<td>Technology as a Tool</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Teacher-use Only (Virtual Learning Environments)</td>
<td>Managing</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Teacher Helper (Presentation Tools)</td>
<td>Instructing</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Teacher-made Resources for Students (Exercise and webpage builders)</td>
<td></td>
</tr>
<tr>
<td>Instructional Technology for Learning</td>
<td>5</td>
<td>Student Use Only (Internet research)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Student Helper (Online quizzes, games,</td>
<td>Facilitating</td>
</tr>
<tr>
<td>Level</td>
<td>Tool Description</td>
<td>Function</td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------</td>
<td>------------</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Student Helper (Listening and writing tools)</td>
<td>Practicing</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Student Helper (Webpage building, portfolio building)</td>
<td>Generating</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Student-made Resources (Audio and video podcasting, blogging, moviemaking)</td>
<td>Creating</td>
<td></td>
</tr>
</tbody>
</table>

- I will utilize technology at levels 3, 5, and 7 in the activities outlined in the above lesson plan. I will utilize level three to deliver information to students that incorporates visual and verbal cues in the process of acquiring information. I will utilize this level most frequently, because it seems to me to be the most efficient use of time and best method for students to acquire that information.

- Students will use Internet (which qualifies as level five) in their web quest activity because this allows for greater interactivity for the students in a more independent setting. The links to specific websites provide enough guidance to keep them on track for the task at hand.

- I will utilize level seven in the second half of the web quest. This allows the students to use writing and presentation software to synthesize their knowledge into a succinct final product.

**Block VIII – Author Identification**

Lesson Author: Kevin Hamilton  
School: Davie High School  
Signature:  
Permission to Publish: X Yes No