Title: ***Nuclear Energy Transformed***
Grades: 9-12

Subject Area(s): Science and Reading

Sunshine State Standard(s) and benchmarks:

Sunshine State Standards and Benchmarks	
SC.A. 2.4.3	The student knows that a number of elements have heavier, unstable nuclei that decay, spontaneously giving off smaller particles and waves that result in a small loss of mass and release a large amount of energy.
SC.A.2.4.4	The student knows that nuclear energy is released when small, light atoms are fused into heavier ones.
LA.A.1.4.1	The student selects and uses prereading strategies that are appropriate to the text, such as discussion, making predictions, brainstorming, generating questions, and previewing, to anticipate content, purpose, and organization of a reading selection.

Unit Title: Nuclear Changes

Purpose of the Unit:
Students will gain an understanding of **nuclear fission and fusion** and how they may be used to generate electricity.

Purpose of the Lesson:
To increase students' knowledge of **nuclear fission and fusion;** how they are alike, how they differ and how they may be used in generating electricity

Essential Question(s):
What are nuclear fission and fusion?
How are they alike and how are they different?
How is the fission process used in a nuclear reactor?

Objectives:
Upon the completion of the discussion, activities, and reading assignments, students will:
1. Define nuclear energy, nuclear fission, nuclear fusion and nuclear chain reaction.
2. Describe the process of nuclear fission and nuclear fusion and evaluate how the processes are alike and how they are different.
3 Explain how nuclear reactors are used to produce electrical energy.
4. Develop a timeline for the advancement of nuclear energy.

Materials:
Graphic Organizers: KWL, Venn diagram
These may be accessed at: http://www.eduplace.com/graphicorganizer/
Computer and internet access for word processing, PowerPoint application, and accessing resource materials
Visuals: Fusion reaction, fission reaction, nuclear reactor
Writing Journals/notebooks, Reflection sheets
Articles: "Nuclear Fission" and "Nuclear Fusion" which may be accessed at:
http://www.howstuffworks.com/nuclear-power1.htm
http://science.howstuffworks.com/fusion-reactor1.htm
Websites:
Nuclear Power Plant Demonstration
http://www.ida.liu.se/~her/npp/demo.html
How Nuclear Power Works
http://www.howstuffworks.com/nuclear-power2.htm
Nuclear Fission
http://www.howstuffworks.com/nuclear-power1.htm
Nuclear Fusion Animation
http://web.jjay.cuny.edu/~acarpi/NSC-2/NuclearFusion.html

Safety procedures:
Not Applicable

Lesson Procedures:

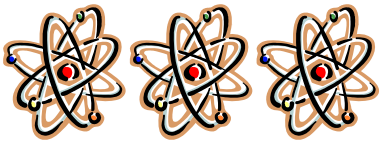
1. Introduce the lesson - Using a KWL chart, ask for student responses for "*What I Know*" about Nuclear Fission and Fusion.
2. Group students into cooperative groups to share their responses to "*What I Know*." Complete another KWL to capture each group's knowledge. Each group will share any responses, not already listed on the board.
   NOTE: Any student misconceptions may be noted as "*What I Need to Know*."
3. Give students a copy of the "Fission - Fusion Anticipation Guide" to complete, based upon the groups' responses on the KWL. The guide is composed of selected questions from the articles, to be completed as a **before-reading** activity.
   Students will record responses on the left-hand side of the anticipation guide.
4. Provide articles and instruct students to complete the right side of the anticipation guide as they read the article. This is a **during-reading** activity.
5. After students have read the article, ask students to read selected questions from the anticipation guide, determine whether the statement is true or false, and discuss the rationale for their response.
6. REVIEW Nuclear Fission using the information available at the following Web site:
   http://www.howstuffworks.com/nuclear-power1.htm
7. REVIEW Nuclear Fusion using the information available at the following Web site:
   http://web.jjay.cuny.edu/~acarpi/NSC-2/NuclearFusion.html
8. As a formative assessment, ask students to complete a Venn diagram, comparing and contrasting nuclear fission and nuclear fusion.

9. Allow students to use computers to interact with an animated nuclear energy reactor to gain understanding of reactor structure and the working process. If students do not have classroom access to computers, the teacher may use the Websites listed below with a computer and LCD projector.
   The nuclear power plant demonstration and a graphic of the design may be accessed at the following URL addresses:
   http://www.howstuffworks.com/nuclear-power2.htm
   http://www.nrc.gov/reading-rm/basic-ref/students/reactors.html
10. Ask students to write a summary of their observations and develop questions relating to the animation and information.
11. Share the questions with classmates and discuss to ensure understanding.
12. Ask students to use texts and other resources to develop a time line for the advancement of nuclear energy.

Assessments:
Venn diagram, Lesson reflections/summaries, and time line

Modification(s):
The following modifications may be made to accommodate ESE and LEP students:

- **Graphic organizers**- Pair students prior to instruction for brainstorming about main idea and vocabulary
- **Cooperative grouping**- Grouping may provide additional peer assistance with vocabulary, as will having students write a sentence or draw a picture for each word. Remedial strategies include journaling and writing reflections/summaries of activities
- **Visual Interpretations-** Use pictures, animations, diagram and graphs.
- **Spanish-English dictionaries and materials -** There are also Websites where terms may be translated
- **Accommodations as listed on IEPs**



Fission - Fusion Anticipation Guide

Instructions: Respond to each statement twice: once before the lesson and again after reading it.

- Circle **True** if you **agree** with the statement.
- Circle **False** if you **do not** agree with the statement.

Before Reading	Fission - Fusion	During Reading
True False	As soon as the nucleus captures the neutron, it splits into two lighter atoms and "throws off" two or three new neutrons.	**True False**
True False	Nuclear fusion is the joining (or fusing) of the nuclei of two atoms to form a single heavier atom.	**True False**
True False	For fusion to occur, the electrostatic repulsion between the atoms must be overcome.	**True False**
True False	The energy released by a single fission comes from the fact that the fission products and the neutrons, together, weigh less than the original U-235 atom.	**True False**
True False	The process of capturing the neutron and splitting of an atom happens very quickly, on the order of picoseconds ($2x10^{-12}$ seconds).	**True False**
True False	The two atoms that result from the fission later release alpha and gamma radiation of their own, as well.	**True False**
True False	Three-percent Uranium enrichment is sufficient for use in a civilian nuclear reactor, used for power generation.	**True False**
True False	The uranium bundle acts as an extremely high-energy source of heat. It heats the water and turns it to steam.	**True False**
True False	Weapons-grade uranium is composed of 90-percent or more U-235.	**True False**
True False	The probability of a U-235 atom capturing a neutron as it passes by is fairly low.	**True False**