TITLE

SUB TOPIC

AUTHOR

Time Frame:	Standards:
3 – 55 min. class periods	6.S.1.3.1 Analyze changes that occur in and among systems. (618.03.b) 6.S.2.1.1 Compare and contrast the differences among elements, compounds and mixtures. (620.01.a) 8-9.PS.2.4.1 Describe the properties, function, and location of protons, neutrons, and electrons. (650.01a)

Objectives:

Following the lessons on nuclear fission and the production of electricity using uranium the middle level students will understand the basics of how uranium is used to produce electric energy, concepts of nuclear fission, nuclear power plants, steam generation, turbines and generators, and heat transfer will be covered and they will demonstrate their knowledge by completing the drawing to 100%.

Background Information:

There are many nuclear power plants in America. The students may not know this. If you want there is a lot of background at www.NEED.org on this and other energy topics. There are other countries in the world that make more of their electricity from nuclear than we do but we do more than most people realize.

The use of Uranium to make electricity began at the end of WWII in the 1940's. The Uranium has some unique characteristics as compared other elements. These properties make it ideal to use to heat water turning it to steam. The steam then can be pumped through a turbine to spin it and turn a generator to make electricity. This the same process that a coal fired power plant goes through to make electricity, it just uses coal instead of uranium to make steam.

Nuclear fission is the splitting apart of an atoms' nucleus. Most atoms when split give off heat energy in some form. Usually it takes more energy to split the nucleus than you get back at splitting. But uranium does not require a lot of energy to split, so it gives back much more than it uses to split, plus it sends out other particles which then split still more atoms and so on. It is called a chain reaction the continual splitting of the remaining atoms, in fact the reaction speeds up splitting more atoms faster and faster. Good graphic at how stuff works web site to show splitting of nuclei.

Nuclear power plants are highlighted at howstuffworks.com

Materials:

Light bulbs one CFL and one Incandescent

A copy of the Need Curriculum Guide (Secondary level)

Internet access: howstuffworks.com

Procedure:

Lesson Plan Outline:
Day One
Starter Activity: Two different light bulbs. (10 min.)
Direct Instruction History of Electricity from Need Curriculum page 62 (20 min.)
(if you would like make a lecture notes page for students to follow for lecture.)
You may want to go deeper in to measuring electricity from the Need Curriculum.
Activity on Sources of electricity (20 min.) This is modified from Need curriculum guide
Day Two:
Activity How much Do I Use? From the Needs curriculum guide Do consumption sheet at home for an energy audit, as homework. Prepare for the homework (20 min.)
Activity Facts of Light from the Needs Curriculum page 63. (20 min.)
Day three:
Direct instruction: Go over individual house audits (25 min.)
Go through the power plant picture and production cycle. (15 min.)
Students recreate schematic of power plant cycle (20 min.)
Take quiz (15 min.)
howstuffworks.com nuclear power plant pictures show the students what it looks like.
Wrap up entire unit. There is a test question bank provided if you want to test the students.

Starter Activity: Hold up two different light bulbs. An incandescent and a CFL (a compact fluorescent light) and ask what are these? Why are they so different? Who uses which one? Is one bad and one good? Why should we use one and not the other? Are there places where we should use both? (Any other question you feel is relevant and helpful.)

Most of the activities for this unit are from the Need project curriculum guide.

How is nuclear energy used to make electricity?

The enrichment of uranium. (have the students follow a long on the picture of the power plant).
Step one: In the earths' crust is uranium it is mostly found as the atom U 238 meaning it's atomic number is 238 (the number of protons and neutrons equals 238) a small amount of it is U 235. To make the uranium useful in a nuclear power plant it needs to be of the U 235 type, this means it has to have fewer neutrons than U 238. So the uranium of the world needs to have the 238 removed, so that the amount of 235 is very high. This is called enrichment. The U 235 is then made into little pellet structures (most look like a big Tylenol capsule) to be placed in a long rod about ½ inch in diameter.
Step two: Reactor design and function

Then this rod is placed in the reactor to use as a fuel source to heat the water. Between the fuel rod assembles are also some other rods that are control rods. They look very similar to the fuel rods but are made of graphite (hard carbon). The control rods help us control the fissioning of the uranium. As it heats the water to steam. Without the control rods the atoms of uranium would break (fission) a part faster than we want and a lot of the energy would be lost.

Step three: Heating the water and creating steam

The reactor is full of water as the rods are placed inside. As the control rods are with drawn from between the fuel rods the fission reaction begins. We control how fast we want the reaction to go by how far we take the control rods out. They are never with drawn all the way. This would make the reaction hard to control. As the uranium breaks a part it releases heat energy to the water. As the water heats up it actually turn to steam. This is very, very hot water.

Step Four: Steam pumped into the turbine electricity is made.

The very hot water (steam) is pumped under pressure into a turbine. As it enters the turbine it causes the turbine to spin. The spinning turbine also spins a generator which makes electricity. As the steam is spinning the turbine it cools off and needs to be reheated. So it is put back into the reactor and reheated to come back out and spin the turbine again. This is the same in a power dam where the water spins the turbine or in a wind mill where the wind spins the turbine. In each of these cases the turbine spins a generator and electricity is produced. One advantage of nuclear power is that the uranium fuel has lots of heat to give up as if fissions. So we can make a lot of electricity from the small amount of fuel placed in the reactor. It is not renewable like the wind and water in the other two types of electricity production mentioned here.

Assessment:

Additional Content:

Test question bank approx. 40 questions if you want to quiz or test at anytime.

References: