PLTW : EE Science Frameworks

PLTW Course : Energy and the Environment

Science Strand: 2. The Practice of Engineering

Science Substrand : 1. Engineering is a way of addressing human needs by applying science concepts and mathematical techniques to develop new products, tools, processes and systems.

Science Standard being addressed: 9.1.2.1.2

Overview:

Science Standard :9.1.2.1.2

Benchmarks : when taught at the junior high school level, Recognize that risk analysis is used to determine the potential positive and negative consequences of using a new technology or design, including the evaluation of causes and effects of failures.

Correlation to AAAS Atlas: Technology usually affects society more directly than science because it solves practical problems and serves human needs (and may create new problems and needs). In contrast, science affects society mainly by stimulating and satisfying people's curiosity and occasionally by enlarging or challenging their views of what the world is like. (AAAS, 1993)

Essential Understandings/Big Ideas:
1. What is risk analysis and how is it used to determine positiv an negative impacts?
2. How do power plants make electricity?
3. Which type of renewable energy is currently most relied on in the United States?
4. What is the difference between alternative energy sources and renewable energy sources?
5. What factors are challenging governments to meet energy needs in the future?
6. What is a smart grid and how will it affect our lives in the future?

What should students know and be able to do [at a mastery level] related to these benchmarks?

Students should understand and be able to explain:
1. That there are events, risks and issues that challenge us to use energy wisely and to develop alternate forms of energy, including economic and population growth, natural disasters, and conflicts with countries that provide the United States with oil.
2. How energy sources can be used to produce electricity and hydrogen and that energy carriers provide the greatest diversity and lowest impact on the environment.
3. Decisions regarding the implementation of alternative energy sources involve the weighing of trade-offs between predicted positive and negative effects on the environment and financial burdens.

Misconceptions:

Student Misconceptions:

* fossil fuels are not plentiful, there is not an unlimited supply worldwide
* fossil fuels take many years to make, it is not a quick process
* using fossil fuels wisely now will preserve them for future populations
* fossil fuels have an economic impact on our daily life - no matter where we live
* how our environment reacts to the extraction of fossil fuels
* alternative energies are not a "quick" fix to the problems
* sometimes a risk is worth the outcome
* investing in the future without a specific deadline for a return

Teacher Resources:

Teacher Notes: This fits into the Project Lead the Way, Energy and The Environment Course, Sustainable Energy
The teacher needs to be able to get the student to see the worldwide impact fossil fuels make on our lives The alternative energies available for development are currently being studied and tried but we are years behind in developing an economically feasible, implemented energy source to take over for fossil fuel use by the worldwide population.
One of the most powerful ways to show the students as an introduction to this problem is to show them "The Next Frontier" DVD
This DVD is very well done and is at a level that students in the middle school/junior high school years can understand and relate to.
It is also "free to educators".
Another way to help the students understand the issues is to investigate and research various alternative energies. Teams can do this as a classroom activity and interact with each others group as well.
Outside speakers from the community/ utilities are a valuable, underused resource.

New Vocabulary :

Alternative Fuels	Fuels to eventually replace dwindling supplies of fossil fuels, such as biodiesel and hydrogen.
Electrolysis	Process of splitting water into hydrogen and oxygen by means of an electric current.
Emissions	Substances discharged into the air (as by a smokestack or an automobile engine)
Energy Carrier	Moves energy in a usable form from one place to another, like electricity or hydrogen.

Energy Conservation	Conserving resources through efficient and prudent use.
Fuel Cell	Device that combines hydrogen, or other fuels, and oxygen and produces electricity in the process.
Generator	A device used to convert mechanical energy into electrical energy
Natural Resources	Naturally occurring materials found within the Earth or its atmosphere.
Passive Solar System	A solar energy collection system that does not require electrical or mechanical components; can directly heat water or buildings or reduce solar heat gain or provide lighting.
Power Grid	A system of high-tension cables by which electrical power is distributed throughout a region.
Power Plant	Any unit that converts some form of energy into electrical energy, such as a hydroelectric or steam-generating station, a diesel-electric engine in a vehicle, or a nuclear power plant.
Smart Grid	An electrical power distribution network that can transmit electricity, including two-way, digital communications between producers and consumers. A smart grid includes an intelligent monitoring system that keeps track of all electricity flowing in the system. It also incorporates the use of superconductive transmission lines for less power loss, as well as the capability of integrating alternative sources of electricity such as solar and wind.
Steam Reforming	Process in which high-temperature steam separates hydrogen from carbon atoms in methane (CH_4).
Sustainable Engineering	Engineering that focuses on the development of a sustainable future through renewable energy, wise use of natural resources, recycling, and assessment of environmental impact.
Transformer	A device used to increase or decrease voltage supplied to a circuit.
Turbine	A machine for producing power in which a wheel or rotor is made to revolve by a fast-moving flow of water, steam, gas, or air.

Vignette:

Introduction of the unit: general vocabulary that will be used, goals, expectations, essential questions to be answered, etc.
Teacher will direct a discussion over the following topics:
"risk analysis", "cause and effect ,of successes as well as failures", positive and negative consequences of an action.
Historical development - old versus today - today versus the future- of our use of fossil fuels
What are alternative solutions under development today?
Students will view the DVD " The Next Frontier".
Teacher/ student discussion of the "The Next Frontier"
Teacher explains energy carriers (as in fuel cells ,solar panels , etc.)
Students will research the six alternative energies under development, display their findings and present those findings to the class for information and discussions.
One student from each of the six groups will now form a new expert group and debate the aspects of the alternative energies studied and present new findings to the class as a whole.
Teams will develop a model / prototype for using alternative energy sources.

Additional Instructional Resources : There are so many up to date, reliable resources on the web for students to use in their research, that I have not specifically listed them. Before the teacher begins this unit, a thorough search should be done to check for he current information and active status of a website so students could be guided to "your school" acceptable websites.

Assessments:

- Students will identify renewable energy sources and the advantages and disadvantages of each.
- Students will interpret data to accurately create graphs that represent energy consumption, imports, and production.
- Students will research and recommend an alternative energy source solution for a specific global problem.
- Students will participate in an energy expo that displays alternative energy sources.
- Students will build a model or prototype of a product that uses an alternative energy source.
- Students will summarize why a global energy crisis exists.

Differentiation:

Gifted and Talented:
This standard could be expanded from the classroom to the local community. Students could explore, within their local area , the alternative energy sources being used/developed/under construction. They could come back to the classroom and present their findings in various mediums. I have found the "City" offices, specifically the "Office of Economic Development" to be the most helpful with guiding students to specific areas.

Differentiation continued:

Special Education:
The Special Education student , depending upon their level of cognition, may be able to develop a model that shows their understanding of one of the alternative energies (hydropower - a waterway/dam example , possibly a Lego construction project). Depending upon the ability, a student might present the model and explain how it works to the class.

English Language Learners:
The English Language Learner will have a problem with the vocabulary because many of our ELL students did not grow up within the same environment ,with the commonalities we see and take for granted everyday. The power lines with the transformer boxes, the substations, etc. will have to be shown to them by some means, photographs possibly ,or a field trip nearby that could show a myriad of possible visuals. These would also have to be reinforced through the help of the ELL teachers .

Parents and Administration:

Administrative/Peer Classroom Observation:

Students Are:	**Teachers Are:**
Investigating	Facilitating
Testing	Guiding
Researching	Advising
Building models	Questioning
Discussing the topic	Monitoring
Collaborative teaming	Moving throughout groups/activities
Weighing options, risks, consequences	Listening
Determining constraints and specifications	Reinforcing concepts
Determining action plans	Leading discussions
Using problem solving techniques	Redirecting

Professional Learning Communities:
I am a PLTW teacher and we do not have a PLC group for PLTW. Our PLC groups meet as cross discipline team. I can individually work with new pilots, check out new resources, investigate areas of further study, and generally try to find new and exciting ways to present relevant information.

Parent Resources:

These are a few ways a parent might reinforce the teaching within the classroom as they spend time with their student:

* Draw attention to the various forms of alternative energy sources as you drive with students, turbines are popping up all over, solar panels are evident on houses, buildings, docks on lakes, etc. See how many you can find!
*Your local utilities have calculators and various simulations online. Work through the simulations with your child and maybe they will see the value of turning off a light or running errands in a specific pattern.
*If you are comfortable going over an electric bill, show your student where the money goes to provide the services your home has within it.
*Make a scale model of a wind turbine.
Parent Resources continued:
*Investigate how a solar panel could power a battery.
*Go to the local home improvement stores - talk with someone there about solar panel options available.

References:

Project Lead the Way , Gateway To Technology, Energy and the Environment course curriculum
Minnesota Science Academic Standards
American Association for the Advancement of Science, Project 2061, 1993.
plus years of experience and further education as an Industrial Arts/Technology/Pre-Engineering teacher!