Future Fuels From Forests Art & Science Unit
By Kristine Halonen

Target Grade: 9-12
Subject: Art at Houghton High School

Lesson Overview:
This unit will present the subjects of environmental sustainability and future energy choices to my art students. Students will learn about the possibility of using fuels from forests in the future. As a final project, students will create an art work that will be displayed in our school and used as an educational tool for its viewers.

Objectives:
At the end of the unit, students will be able to:
1. Describe ways in which alternative fuel use can benefit the environment.
2. Define biomass and the environmental benefits of its use.
3. Define renewable resources.
4. Define nonrenewable resources.
5. Define biofuels and describe and discuss their pros and cons.
6. Describe the positive effects that the use of alternative sources of energy can have on our planet.
7. Define bioenergy and its sources.
8. Define sustainability.
9. Create an art work that educates its viewers about the positive effects of using alternate sources of energy and sustaining our environment.

Michigan Benchmarks:

Earth Science

E1.1A
Generate new questions that can be investigated in the laboratory or field.

E1.2A
Critique whether or not specific questions can be answered through scientific investigations.

E1.2B
Identify and critique arguments about personal or societal issues based on scientific evidence.

E1.2C
Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.

E1.2D
Evaluate scientific explanations in a peer review process or discussion format.

E1.2f
Critique solutions to problems, given criteria and scientific constraints.
E2.2B
Identify differences in the origin and use of renewable (e.g., solar, wind, water, biomass) and nonrenewable (e.g., fossil fuels, nuclear) sources of energy.

E2.4A
Describe renewable and nonrenewable resources of energy for human consumption (electricity, fuels), compare their effects on the environment, and include overall costs and benefits.

Art

C.2
Develop an idea, question, or problem that is guided by the personal, historical, contemporary, cultural, environmental, and/or economic contexts of the visual, performing, or applied arts discipline.

P.1
Apply the techniques, elements, principles, intellectual methods, concepts and functions of the visual, performing, or applied arts discipline to communicate ideas, emotions, experiences, address opportunities to improve daily life, and solve problems with insight, reason, and competence.

P.3
Describe and consider relationships among the intent of the student/artist, the results of the artistic/creative process, and a variety of potential audiences or users.

P.4
Perform, present, exhibit, publish, or demonstrate the results of the artistic/creative process for an audience.

R.2
Identify, describe, and analyze connections across the visual, performing, and applied arts disciplines, and other academic disciplines.

R.3
Describe, analyze, and understand the visual, performing, or applied arts in historical, contemporary, social, cultural, environmental, and /or economic contexts.

R.4
Experience, analyze, and reflect on the variety of meanings that can be derived from the results of the artistic/creative process.

Resources:

*Paradise Lost? by: University of Wisconsin-Madison: Center for Biology Education, Department of Forest Ecology and Management, Center for Limnology, Trout Lake Field Station, Center for Continuing Studies and the Arts and by the North Lakeland Discovery Center, Manitowish Waters

*Should the US continue to invest in biofuels to offset our CO2 emissions? by Dr. Kate Bradley
DAY 1

Students will see the words Paradise Lost? written on the board when they walk into the class room. As a class, we will discuss the book and look at it together. We will view the work of the artists’ in the book and discuss their pieces. Students will discuss how living in the North has made them who they are. A discussion will be held on what makes where we live special and what the specific attributes of this area are. Students will be asked to take a few moments to brainstorm ideas for a project of their own that depicts our life here in the U.P. and the importance of what we have in our surroundings. I will then have the students close their eyes. I will ask them to imagine life here without any trees. What would be lost besides the trees if all the trees were gone? (Wild life, jobs, etc.) We will then discuss briefly the topic of Global Climate Change. We will talk about greenhouse gasses and how they effect our planet. (Makes it warmer) We will talk about different fuel sources that create green house gasses. The students will then be asked if they are aware of alternate sources of energy that decrease greenhouse gasses. I will list alternate sources of energy on the board as the students name them. If students do not bring up wood/biomass as a fuel source, I will bring it up and write it down on the board. We will then discuss how trees are important to our community and way of life not only for their beauty and aesthetics, but for their ability to remove CO2 from the atmosphere, their economic influence on our community (jobs they are affiliated with), and their use as a natural renewable resource that can be used to create fuel called biofuel. Any remaining time left of the class period will be used for more brainstorming and discussion for project ideas. Students may incorporate informative text into their art work or create a separate write up that informs the viewer about the artwork that will be displayed with the piece.

DAY 2

The word Biofuel will be written on the board when students enter the room. Conversation from yesterday on biofuels will be continued. Students will be asked if they know the definition of biofuel. Students will discuss their prior knowledge of biofuels. Students will then all receive a copy of the hand out, Should the US continue to invest in biofuels to offset our CO2 emissions? by Dr. Kate Bradley. We will read the hand out together and have a group discussion. Students will later be quizzed on the pros and cons of biofuels.

Topics of discussion (from Dr Kate Bradley’s handout):

#1 The Basics of Ethanol based Biofuels
#2 Biofuels are Easy to Use, but Not Always Easy to Find
#3 Are there Enough Farms and Crops to Support a Switch to Biofuels?
#4 Does Producing Biofuels Use More Energy than They Can Generate?
#5 Advantages of Biofuels
#6 Disadvantages of Biofuels
#7 US,EU asked to reconsider biofuel goals as food prices rise
#8 Do ethanol based biofuels reduce carbon dioxide emissions?
**Pros & Cons of Biofuels** (listed below - information from handout by Dr. Kate Bradley).

**PROS**

Renewable- Ethanol is a renewable fuel that comes from agricultural crops. It takes only six months to grow and harvest a crop such as corn which can be converted to ethanol.

No special vehicle needed- Ethanol can be used by all gasoline vehicles in the United States in concentrations up to about 10%. With slight alterations, former gasoline vehicles can be run on ethanol blends as high as 85%. Ethanol provides lower vehicle emissions with out the need to purchase a hybrid vehicle.

Reduces fossil fuel imports-The use of ethanol can reduce the use of gasoline. A reduction in the use of gasoline reduces some of the dependence on foreign powers for fossil fuels.

Reduces air pollution- Ethanol reduces the amount of carbon monoxide and other ground-level toxic air pollutants as compared to conventional unleaded gasoline.

Domestic- Crops such as corn can be grown and produced into ethanol in the US.

Cost-effective production- Ethanol is relatively inexpensive to process.

Boosts effectiveness of gasoline- Ethanol and help prevent engine knocking, and it increases gasoline’s lubricity.

Supports rural economies- Ethanol production increases jobs due to plant construction, operations, and maintenance. Most ethanol plants are in rural communities.

**CONS**

Price- ethanol can be more expensive than conventional gasoline on the West Coast and East Coast.

Energy level- Ethanol contains less energy than gasoline. A car won’t go as far on a gallon of ethanol as it would on a gallon of conventional gasoline. The actual miles per gallon performance may vary depending on the vehicle.

Availability- Ethanol does not have nationwide distribution. E85 is widely available only in the Midwest, with limited availability in other areas of the United States.

Energy-intensive production- Corn farming and corn-based ethanol production can use nearly as much energy to produce as it supplies. New technologies are being introduced and are improving the efficiency of production.

*A quiz will be given tomorrow on biofuels, renewable resources, and nonrenewable resources. Students will be advised to study information learned today in class.

*Students will then present their rough sketches and ideas to the class of their project plans. Any remaining time will be used to work further on art projects.
DAY 3

*Information regarding Bionenergy from Maria Janowiak*

I will write the word bioenergy on the board and ask the students if they know what bioenergy is. I will then write the definition of bioenergy on the overhead. *Students will be expected to take notes. Information will be on the quiz this week. Bioenergy definition: the creation of energy- electricity, heat, and fuel- from plant or animal materials. Bioenergy is an alternative to fossil fuels because biomass comes from renewable sources that are produced and replaced more quickly than fossil fuels, such as agricultural and forest residues, pulp and paper mill wastes, urban wood waste, energy crops, landfill methane, and animal waste.

I will then continue with information on bioenergy (written on the overhead)
Bioenergy from wood sources is often described as “carbon neutral” because the carbon dioxide (CO2) emitted when wood based products are used for bioenergy will be reabsorbed by new tree growth in a relatively short period of time. The overall net input of CO2 into the atmosphere is near zero as long as forest growth is sustained after harvest. A continually increasing demand for energy a well as concern about climate change, demonstrate the need for greater production of bioenergy from wood. The US Department of Energy and Agriculture have determined that the US could produce enough biomass from forest lands to supply 10% of the nation’s current petroleum consumption.

Forest Bioenergy comes from 3 sources.
1. Waste wood- from pallets, landfills paper and pulp mills
2. Forest residues- of wood remaining in the forest after a harvest
3. Wood energy crops- trees that are grown specifically to be used for energy production

*Science Express Report*
The use of croplands for biofuels increases greenhouse gases through emissions from land use change

Studies have found that substituting biofuels for gasoline will reduce greenhouse gases because biofuels sequester carbon through the growth of the feedstock.
These analysis have failed to count the carbon emissions that occur as framers worldwide respond to higher prices and convert forest and grassland to new cropland to replace the grain or cropland diverted to biofuels. It was found that corn-based ethanol, instead of producing 20% savings nearly doubles greenhouse emissions over 30 years and increases greenhouse gasses for 167 years.
Most life-cycle studies have found that replacing gasoline with ethanol modestly reduces greenhouse gases if made from corn and substantially if made from cellulose or sugarcane.

*Bioenergy, Biomass and Biodiversity*
An expanding bioenergy economy in the US is likely to affect land use and habitat quality for forest and grassland species.
Currently 90% of biofuel in the US comes from corn. Corn based fuel is not renewable energy because it demands large inputs of fossil fuel, fertilizer, herbicides, pesticides, and water.
Cornfields provide habitat for few species and are associated with some of the highest soil erosion rates of any crop and high input rates of fossil fuels, herbicides, and pesticides.
Up to ¼ of current US energy needs could be met by using organic wastes and residues from agriculture and logging, such removals would almost certainly affect long-term soil fertility, increase erosion, and deplete soil organic carbon.

Calcium is critical to growth and disease resistance in plants, and its loss from ecosystems may have severe long-term effects on the structure and function of forest ecosystems. Low levels of soil calcium have been linked to over story tree die back, reduced seedling survival, and increased virulence of some exotic fungal diseases.

Effects of alterations to the nutrient cycle need to be considered when developing best management practices for bioenergy feed stock production.

As long as corn acres continue to expand and the expense of perennial grasslands such as CRP, this will have negative effects on almost all species of wildlife.

*We will hold a group discussion on bioenergy at the end of the note taking period. Any questions will be answered. Today’s information will be included on Friday’s quiz.

**DAY 4**

Information from Educator’s Guide to Program Development in Natural Resources

The word sustainability will be written on the board when the students enter the class room. Students will be asked what their prior knowledge of sustainability is and any information they relate will be written on the board. Students will be encouraged to take notes. I will then write the definition of sustainability on the overhead.

Sustainability: meeting the needs of the present without jeopardizing the ability of future generations to meet their own needs.

Northwest communities are exploring what sustainability means for them in specific, local terms. They have the goals of promoting economic vitality, protecting the environment, managing growth, building healthy communities, and enhancing the well-being of their residents.

Ecosystem Management is being adopted as a guiding philosophy for many natural resources based agencies, where changes toward more sustainable methods of managing fisheries, wildlife, forest, and agricultural lands are being implemented.

Ecosystem management emphasizes goals designed to:
- maintain existing biodiversity at genetic, species and ecosystem levels
- maintain evolutionary and ecological processes within ecosystems
- maintain or enhance long-term productivity of ecosystems
- manage over temporal and spatial scales that are appropriate for the ecosystem
- accommodate human uses within these constraints

*After students take notes, the remainder of the hour will be used for class discussion pertaining to sustainability and ecosystem management. Questions will be answered and the class will review for tomorrow’s quiz.
DAY 5

Students will be allowed five minutes to review their notes and ask questions before the quiz. Quiz is below and answer key are below.

*After the quiz, students will use the remainder of the hour to work on their art projects. Projects will be due in seven days and will be critiqued in front of our class and then displayed around the school.

DAYS 6-10

Students will use the next five days in class and at home to work on their artworks related to the use of alternate sources of energy and sustaining our environment. Students must either include informative text within their artwork or a separate explanatory statement.

On day 10 students will present their projects to the class and the projects will then be displayed throughout the school.

RUBRIC for PROJECT

Project pertains to the use of alternate fuel sources/environmental sustainability_______ (30 points)

Quality of work_______ (30 points)

Originality of idea_______(10 points)

Work time spent wisely_______(15 points)

Project incorporated informative text or a separate explanatory statement was included_______(15 points)
Biofuels, bioenergy, nonrenewable resources, and renewable resources, sustainability, and ecosystem management

QUIZ

Name_____________________

1. Circle the renewable resources in the list below.
   -coal
   -fuel oil  -propane
   -solar power  -biofuels
   -natural gas  -wind power

2. Please write the definition of a nonrenewable resource? Name two.

   Definition________________________________________________________________________
   1.
   2.

3. Define biofuel.

4. Name 3 pros and 3 cons of using biofuels.

   Pros
   1.
   2.
   3.

   Cons
   1.
   2.
   3.

5. Name 3 things that would be lost if our trees were lost.
   1.
   2.
   3.

6. True or False. Corn based ethanol is a win-win solution for replacing fossil fuels. It is easy to create, cheap, CO2 emission friendly, and wildlife friendly.

7. Define sustainability.

8. True or False. Ecosystem Management is about using the ecosystem in every way that we can to benefit humans alone.
QUIZ Answer Key for Biofuel, bioenergy, renewable and nonrenewable resources

1. Solar power, biofuels, and wind power.

2. A resource that can not be reproduced.
   -coal
   -natural gas
   -fuel oil/petroleum, gasoline

3. Fuel that is created from renewable resources.

4.
   Pros
   -They are renewable
   -No special vehicle is needed to use them
   -They reduce fossil fuel imports
   -They reduce air pollution
   -They can be produced domestically
   -Production is cost-effective
   -They boost the effectiveness of gasoline
   -They support rural economies

   Cons
   -Price
   -Biofuels contain less energy than gasoline
   -Biofuels are not readily available in all parts of the U.S
   -Energy-intensive production

5. Wild life, jobs, natural CO2 reducer, source of biofuel.

6. false

9. Sustainability: meeting the needs of the present without jeopardizing the ability of future generations to meet their own needs.

8. False.