A Gender Responsive Unit for Green Energy

A middle school unit for grades 6-8 including concepts on; Alternative Energy, Global Warming, Community Awareness, Green Careers, and more!

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Energy Education and Environmental Education are units that are sometimes left out of the curriculum. They are used frequently as "fill-in" lessons, if at all, and are often placed at the end of the school year. This is a troubling thought considering the Earth's atmospheric properties, the Earth system, and Energy are the basis for our existence. The topic of Green Energy is necessary in the curriculum now more than ever as our world faces rapid and drastic climate change, the push for renewable energy usage, and the recent pressure towards "green" careers and businesses. The goal of this unit is to engage students of both genders in the popular, but crucial area of Green Energy.

This unit is written with an inquiry based approach to learning. The lessons are thought provoking; use higher-order thinking skills, are real world based, and application oriented. Gender stereotypes and biases are not present in this lesson. The concepts addressed are based on the Iowa Core Curriculum along with guidance from the National Science Content Standards.

Why a female responsive unit on Green Energy?

Girls face many challenges in Science, Technology, Engineering, and Mathematics (STEM) classes and careers. Many of these issues begin in the classroom and often go unnoticed by teachers. The stereotypes, misconceptions, and attitudes toward these subject areas often persist in college and effect future career choices. It is the responsibility of the teacher to eliminate stereotypes and biases toward the STEM fields. Due to the fact that STEM fields do not have much of a "gendered" history, this unit is imperative. The unit is essential in order to make students of both genders competent in the sciences. The Green Energy unit is vital as our world has a science-based future and will require more careers in the sciences, specifically those in Green Energy fields.

Tips on teaching in a gender responsive manner:

- Activities/lessons that have a direct link to practical application and "helping" others are best.
- Allow students to work in pairs with same-sex partners so girls feel comfortable participating and asking and answering questions. This also creates a safe space which increases risk-taking and decreases girls' ability to pass on duties to boy classmates.
- It is also a good idea to balance the curriculum by developing units that alternate between STEM disciplines preferred by boys and those preferred by girls.
- Research shows that bringing in role models from the STEM areas are influential to girls, specifically those that are women.

- Continue to use a variety of examples throughout the lesson and be aware of differential knowledge and experiential bases of your students.
- Make direct connections between the concepts being taught/ learned and their practical application. This is especially important if the concepts are humanitarian.
- When asking questions in class, keep in mind that girls will often take longer to answer the question as they are processing the question and preparing the answer. Research shows that the teacher must wait an additional 3-5 seconds to allow for increased processing time. Most importantly, if the answer is wrong or if the teacher does not get a response, help the student process step by step to generate the correct answer so they do not end up feeling like they have failed.
- Set up situations where the outcome is to come up with creative solutions to a posed problem rather than a competition with a winner and a loser.
- The teacher must be flexible and open to new ideas and strategies, which engage both genders. This will allow for optimal success of any unit.

This unit will not only influence Science Education in the State of Iowa, but more importantly, it will influence the students within the State of Iowa. Green Energy will have a larger impact on the lives of girls and women both today and in the future as a result of this unit. Take special note of the green light bulb along the margins throughout the unit and supplemental materials table. The green light bulb represents areas for gender responsive teaching and resources for gender based programs and research.

Acknowledgements:

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Green Energy Unit [Grades 6-8]

Content Overview

1. Introduction to Alternative Energy
2. Alternative Energy sources
3. Understanding the concept of "Going Green"
4. Solution to and understanding the process of Global Warming/ Climate Change
5. Decreasing Greenhouse Gas emissions
6. Wind Energy
7. Debating current energy issues
8. Solution/Plan of Action-Designing a "Green Community"
9. "Green Careers", community awareness, and real world people in the STEM areas

Content Principals addressed, according to the Iowa Core Curriculum

1. Earth & Space
   - Understand and apply knowledge of the earth's atmospheric properties and how they influence weather and climate.
   - Understand and apply knowledge of the structure and processes of the earth system and the processes that change the earth and its surface.
2. Life Science
   - Interdependency of organisms, changes in environmental conditions, and survival of humans and all living species. The cycling of matter and energy in ecosystems.
   - Understand and demonstrate knowledge of the social and personal implications of environmental issues.
3. Physical Science
   - Understand and apply knowledge of forms of energy and energy transfer.
4. Science as Inquiry
   - Identify and generate questions that can be answered through scientific investigations.
   - Select and use appropriate tools and techniques to gather, analyze and interpret data.
   - Use evidence to develop descriptions, explanations, predictions, and models.

- Think critically and logically to make the relationships between evidence and explanations.

Learning Outcomes

1. Students will successfully brainstorm and visualize the task at hand through concept mapping.
2. Students will understand the concept of Alternative Energy through the Renew-A-Bean activity.
3. Students will understand Alternative Energy sources by writing a promotional ad for an Alternative Energy source.
4. Students will better understand the concept of Global Warming through the Global Warming activity.
5. Students will comprehend the area of Greenhouse Gas Emissions through the Greenhouse Gas Emissions Activity.
6. Students will better understand how to decrease energy consumption through the Energy Conservation Activity.
7. Students will create and design a Green Neighborhood.
8. Students will have first-hand experience with a person in a STEM career through a guess speaker session and will then have the opportunity to elaborate on this area by the Guest Speaker Reflection.

Daily Lessons Outline

Introduction to Alternative Energy [three 45 minute class periods, (variable depending on the amount of background knowledge students have on energy and the environment)]

Concept mapping allows girls to visualize the task at hand

I. Bellringer: Have students brainstorm a list of items we use oil and coal for.

II. Concept Mapping: Students will develop a concept map in pairs brainstorming ways energy is used every day.

III. Discussion:

   A. Students will present the concept map to the class and provide reasoning if necessary.

   B. Teacher will then introduce the topic of Alternative Energy.

      1. Have students discuss what they think Alternative Energy means and allow for students to share their ideas.
      2. Alternative Energy: energy from sources that do not use up natural resources or harm the environment. Natural resources include- air, water, wood, ethanol, solar energy, and wind energy.

3. After discussing the definition of alternative energy ask students to raise their hands if they have heard the definition before. Inform students that Alternative Energy sources are being used in Iowa (Students may already know some uses, so ask students if they know of any).
4. This unit will precede a basic unit on Earth's properties and the Earth system, but if necessary, remind students of these ideas.

C. Peak Oil Theory
   1. Discuss with students the meaning of the Peak Oil Theory.
      a. It is used to describe the point at which the earth's supply of oil will no longer meet our energy needs (www.peak-oil-news.info/global/theory).
      b. Remind students of the importance of using renewable/ alternative sources of energy.

D. Renew-A-Bean Activity
   1. The purpose of this lesson is for students to increase their understanding of the eventual depletion of nonrenewable resources, how changing the amount of usage will affect the future, the role of conservation and the need to develop renewable resources.
   2. Students will also understand the importance of renewable resources and with conservation and the development of renewable resources; we can extend the availability of nonrenewables.
   3. Materials
      a. 1 container of beans for every 2 students.
         i. 92% of one color, 8% of another color. Be sure to maintain the 92:8 ratio to represent the ratio of nonrenewable to renewable energy consumption in the U.S.
   4. Refer to Appendix A at the end of the unit item number 2 for activity. Specifically, Activity 2 is located on page 19-25 in the article. Original activity was obtained from National Renewable Energy Laboratory- Education Programs in Colorado.

E. Discussion/Introduction of Alternative Energy sources.
    1. Biomass (Ethanol)
    2. Wind
    3. Solar
    4. Geothermal
    5. Hydroelectric
    6. Refer to Appendix A item number 2 for descriptions and talking points on renewable energy. Description is on page 7 of the article. Original activity was obtained from National Renewable Energy Laboratory- Education Programs in Colorado.

F. Real-world connection.
    1. There are many real-world connections you may provide for students.

Girls have a natural interest in real world activities

IV. Elaboration: Students will write a promotional ad for one of the alternative energy sources discussed. This will require students to do research on the energy source and provide reasons why it is the best choice and why it should be used over the others. Refer to worksheet and rubric at the end of the unit.

What does Going Green really mean?! [one class period]

Giving girls an opportunity to use their surroundings in order to problem solve is effective

I. Bellringer: Have students look around the room and list everything that is green (most students will list everything that is the color green and will not be thinking about energy sources that are “green”).

II. Start-up discussion

A. Ask students if they have heard the term, “going green” (make a list if the discussion seems to be going well).

B. Explain that the term “going green” has been used as an advertising technique to describe ways that individuals can help decrease harmful effects on the environment through habits, behaviors, and lifestyles.
    1. A good way to think of this is, making small changes over time to improve your life as well as the earth as a whole.

C. Explain the reason for “going green”
    1. Ask students, “Why do we need to “go green” anyway?”
        a. Students may have some ideas in mind, but allow for open discussion and thought processing.

i. Begin explaining the process of Climate Change/ Global Warming and remind students about the earth's atmospheric properties along with the structure and processes of the earth system.

b. Climate change has been occurring for a very long time, in fact, it is estimated that the climate has increased in temperature about 1 degree each year for the last 100 years. (http://epa.gov/climatechange/kids/cc.html).

c. Explain to students that lots of research has been done on the topic and that many scientists believe that humans are making the Earth warmer. (Offer examples of how this is occurring).

d. Teacher may wish to add additional instruction on "going green".

Global Warming Introduction [three class periods]

I. Global Warming/ Climate Change discussion

A. Students will begin to wonder what types of things are making the planet warmer, examples include: lights, TV's, computers, and appliances. Explain to students that these items are powered by electricity. To make electricity, power companies must burn fossil fuels. Explain to students that fossil fuels are mostly coal, oil, and natural gas that are made from plants and animals that lived almost 300 million years ago.

B. Refer to Appendix A item number 1 for the Power Point and Teacher Guide. Use the information below (items 1-3) if more explanation or discussion is needed. Original lesson was obtained from the National Wildlife Federation in 2007.

1. Ask students: "What fossil fuel is burned every time we drive our cars?" Answer: Oil, oil companies drill oil out of the ground and then turn it into gasoline or diesel.
2. Explain to students that it is great to have modern technology, electricity, etc, but the problem arises when people all around the world are using these items and since they require fossil fuels to work, too much fossil fuels are being burned. Too much fossil

fuel becomes a problem because when it burns it gives off a gas called carbon dioxide. (CO_2)

3. This carbon dioxide ends up in the atmosphere, as does oxygen (O_2) and other gases. Remind students that the atmosphere is like a blanket over the Earth. The atmosphere holds in some of the sun's heat, which keeps the Earth warm. But, burning fossil fuels is leading to too much carbon dioxide being emitted into the atmosphere making the Earth much warmer.

II. Ways to decrease global warming

A. Ask students if they can think of any ways to decrease global warming. Students should come up with some ideas from the alternative energy activity.

Research shows that girls work better in pairs with same-sex partners rather than in small groups

1. In pairs, have students generate a list of items that could be leading to global warming, at school, at home, etc. Students will then list alternative actions to these problems. Have students share their ideas in front of the class if they wish and compile the lists to make a large list to be posted in the classroom.
2. Refer to Appendix A item number 8 for a short list of ideas, if needed. List comes from U.S. Environmental Protection Agency in 2006.

Greenhouse Gas Emissions [four class periods]

I. Introduction to Greenhouse gases

A. Refer to Appendix A item number 7 for the lesson plan in its entirety.

1. Original lesson was obtained from NASA in the Astro Venture: Atmospheric Science Educator Guide.

B. Remind students that the less energy we use, the less pollutants we put in the environment.

C. If possible, take students on a tour of a LEED (Leadership in Energy and Environmental Design) building in your area.

1. Refer to Appendix A item number 14 for website information.

Real world application that girls can see first hand

Current Issues in Green Energy [2 days]

I. Clearing up misconceptions

A. Discussion of current issues.

1. Have students bring in at least 1 article from the newspaper or an online news source about energy issues.

Girls respond better when tasks are real world based and have a direct application to their lives

a. Have students share their articles in pairs and discuss the similarities and differences between their articles.
b. Have each pair share their list of similarities and differences and ask if any have conflicting information or facts.
c. Use this as an opportunity to discuss the importance of getting scientific information from credible sources and to pay attention to the scientific facts of the articles.
d. Students may have many questions so take the time to answer the questions and clear up any misconceptions that may be present.

2. Common ideas and/or areas that students may need clarification in are as follows. Allow students to ask more questions and make time to explain common misconceptions. Some of the misconceptions were obtained from Ezine Articles, which was posted in 2009. (www.ezinearticles.com)
    a. If global warming is real, is it really going to affect us here in Iowa?
        i. Ocean levels are on the rise, temperatures are rising, and hurricane strength is increasing. Our climate is changing right now and we must take action soon.
    b. We don't have to worry about global warming; it will take many years for the planet to get warmer.
        i. The truth is, the planet is getting warmer every year and climate change is happening at a rapid pace, more rapid than once thought.
    c. A single person can't slow the progression of global warming.
        i. One persons actions can and will cause others to follow, which will then influence more people, like a "multiplier effect".
3. Remind students that education on current issues on Green Energy is the most important and having adequate knowledge on the concept will allow us to take informative and effective action on the issue of Global Warming and also on Green Energy.

Solution/Plan of Action- Designing a Green Community (house, mall, daycare, school, etc) [eight plus class periods]

I. Energy Conservation Lesson Plan
A. Overview

Girls respond well to tasks that allow them to "make the world a better place"

1. The purpose of this lesson is for students to learn about conserving energy in the home through building materials and by using efficient appliances in the home.
2. Students will realize the importance of using proper insulation with a high R-value to reduce heat transfer. A materials R-value is the measure of its resistance to transfer heat. For example; the higher the R-value, the more material it insulates.
3. Students will conduct a simple experiment to test the differences in heat conduction among several materials.

B. Materials
1. Copy of the Reading Passage and Student Data Sheets (includes reading comprehension questions, vocabulary and Lab Activity) for each student (Refer to Appendix A item number 11 pages 6-14 of the article).
2. Copy of the assessment questions for each student (Refer to Appendix A item number 11 pages 6-15 of the article).
3. Graph paper.
4. 1 activity kit per group containing:
    a. 2 spoons (one plastic, one metal)
    b. 1 popsicle stick
    c. 1 glass stirring rod (about the same height as the spoons)
    d. 500 mL beaker
    e. 500 mL hot water, greater than 85 degrees Celsius
    f. Timer or stop watch
    g. 1 plastic knife
    h. 4 thumbtacks
    i. 4 ¼ inch square slices of saturated margarine or butter (in stick form), very cold or frozen (size can vary depending on size of thumbtacks used)
    j. Goggles
    k. 1 small piece of wax paper

C. Lab Activity
1. Refer to Appendix A item number 11 pages 1-15 of the article.
2. Lesson was originally designed from Renewable Energy- The Infinite Power of Texas (Texas State Energy Conservation Office).

II. Design a Green Neighborhood

A. Overview
1. The purpose of this lesson is for students to become aware of and understand the importance of Green communities/ neighborhoods.

Real world applications especially those that are humanitarian lead to optimal success for girls

2. The lesson allows students to obtain various roles in a community to advocate and design a Green neighborhood.
3. If possible, seek out an actual plot of land in your community that could serve as the Green neighborhood that will be designed.

B. Materials
1. Student sheets.
2. Access to the World Wide Web.
3. Map of the area of the city to be developed.

C. Activity
1. Refer to Appendix A item number 12 pages 2-12 of the article.
2. Lesson was originally designed by Science West- Getting Around, A Driving Force for Change, in 2004.

Green Careers, community awareness, and real world people in the STEM areas [three class periods]

I. Green Careers

A. Introduction to and importance of Green Careers

Real world application and first hand experience gain girls' attention and interest

1. Climate change and recent legislation has made it imperative for careers to "go green". Green Careers are here to stay, which is why it is necessary to learn about these careers.
2. Inform students that according to Green Energy Career Guide, few industries are guaranteed such fast global growth as Green Energy.
3. Career databases are calling it the "Green Rush" and stating that these careers are in high demand and are here to stay, reinforce this with the students.
4. Refer to Appendix A item numbers 15 and 16 for a link to a complete listing of "Green Careers" including descriptions and locations of the job.

B. Real World Application

Real world application and first hand experience gain girls' attention and interest

1. Have students choose one of the Green Careers to do a small report on. Refer to the end of the unit to obtain report worksheet.
2. Students will share their research with a small group.
3. Encourage students to continue to do research on the Green Careers and to save the websites listed for future reference.
4. If time allows, have students write a letter to the company explaining their interest in the job listed and career in Green Energy. This may be an opportunity for extra credit as well. Continue to provide resources

for students who express interest in this area, even after the lesson is completed.

Research shows that girls respond better to female role models

II. Real World people in STEM

A. Guest Speakers

1. Students will form positive feelings and express more interest in the STEM fields if a role model from the community is available. This will also help to eliminate stereotypes and biases of the career if students are able to ask questions and interact with the speaker.
2. The amount of time spent along with the number of guest speakers will vary depending on the availability and access to such careers in your area. For a list of guest speakers refer to www.pwse.iastate.edu.
3. Have students reflect on the guest speakers by writing a short one page reflection. Refer to the end of the unit for the worksheet. Teacher may choose how many reflections to use if more than one guest speaker is present.

Promotional Ad Rubric
15 points

Category	1 Satisfactory	2 Good	3 Excellent
Content Covered	Information is not accurate or appropriate to the ad and areas are missing	Information is appropriate to the ad, but some areas are missing	Information is accurate and vital to the ad, all necessary information is present
Organization	Information on the ad is not organized and the ad is not clear	Information on the ad is mostly organized with minor errors	Information on the ad is very organized and clear
Design	Little to no use of font, color, or pictures that do not enhance the ad	Use of font, color, or pictures, but does not enhance the ad	Use of font, color, or pictures to enhance the ad is present
Demonstrates Content Knowledge	Lack of understanding of the content and incorrect statements are made on the ad	Some fuzzy areas in content knowledge is apparent	Clear, accurate, and detailed description that demonstrates mastery of the content
Grammar/ instructions followed	Ad has several spelling errors and grammatical errors, no first person usage and is minimal is length	Ad has minor spelling errors and grammatical errors, some use of first person and is less than five sentences long	Ad has no spelling errors or grammatical errors, use of first person present and is at least five sentences long

Comments: _____

_____

_____

Total: _____/15

Name_____

Promotional Ad for Alternative Energy

We have discussed various forms of alternative energy, now it is your turn to promote the use of one type of alternative energy source. You must assume the role of the energy source and use first person tenses when writing the ad. It is your job to market and advertise your chosen alternative energy source. For example: Want a clean, cheap energy source that is good for the Iowa economy? Use me, ethanol, as your source of renewable energy! The advertisement must be at least five sentences long. You may include drawings or pictures. Remember, you are selling and promoting the alternative energy source so do what you can to hook the reader! Use the space below or another sheet of paper for your advertisement.

Name_____

Global Warming Worksheet

Item	Location	Problem	Solution

Name_____

Green Careers

1. Name of company _____

2. Location of company _____

3. Job Title _____

4. Job Description _____ (you may use the space below as well)

5. List three duties the job entails

1. _____

2. _____

3. _____

6. List three reasons why you would go in to this career and apply for this job

1. _____

2. _____

3. _____

7. List one aspect of the job that you would not enjoy if you were hired

Name_____

Green Energy Guest Speaker Reflection

1. What did you find was most interesting during the guest speaker about Green Energy careers?

2. What did you find was the least interesting during the guest speaker about Green Energy careers?

3. What was the speaker's main point?

4. Would you consider working at a Green Energy job? Why or why not.

5. What questions do you wish you would have asked the guest speaker?

6. Where could you find more information about this career?

Supplemental Materials and Helpful Links for Teachers

Topic	Organization/ Source	Notes
1. Global Warming	National Wildlife Foundation - Climate Classroom	Teachers Guide
		Power Point Presentation
2. Renewable Energy	National Renewable Energy Laboratory -Educational Programs	PDF file
3. Wind Energy Activity	National Renewable Energy Laboratory -Educational Programs	Activity 6-page 49
4. Hydroelectricity Activity	National Renewable Energy Laboratory -Educational Programs	Activity 7-page 55
5. Real Scientists	PBS Kids-Dragon Fly TV	If your area does not have access to "Real Scientists" this is a great supplement
6. 10 Ways to Go Green and Save Green	Worldwatch Institute	
7. Greenhouse Gas Lesson	NASA	Some areas of the lesson may need to be omitted as the purpose of this lesson is for exploration and hands-on experience rather than an extension of another lab already completed
8. We Can Make a Difference	U.S. Environmental Protection Agency	A few ideas for decreasing greenhouse gas emissions
9. The Life Cycle of a Cell Phone	U.S. Environmental Protection Agency	Informative poster that is useful for discussion or printing and putting up in the classroom
10. Resource guide for Teachers Grades 6-8	U.S. Environmental Protection Agency	A resource guide for teaching Grades 6-8 about the environment. Includes helpful resources, lesson plans, and activities
11. Energy Conservation Lesson Plan	Renewable Energy-The Infinite Power of Texas	Lesson plan introducing how to conserve energy in the home and also how to build a environmentally friendly home
12. Design a Neighborhood	Science West	Lesson plan to design a neighborhood
13. Smart Energy Living: Hands-on Activities for the Middle Grades	Smart Energy Living Alliance	Teacher guide and student guide to activities involving green energy education
14. LEED Buildings- Iowa	U.S. Green Building Council	Listing of LEED buildings in Iowa along with other resources
15. Green Energy Career Guide	Green Energy Jobs	Listing of Green Energy careers by state along with various resources for other Green Energy career databases
16. Green Start Job Board	American Solar Energy Society	Listing of Green Energy careers by state along with various resources for other Green Energy career databases
17. STEM Equity Pipeline	STEM Equity Pipeline	Expanding options for Women and Girls in STEM

18. Iowa Commission on the Status of Women	Iowa Commission on the Status of Women	Champion the success and wellbeing of women and girls through responsive advocacy
19. Iowa Math and Science Education Partnership	Iowa Math and Science Education Partnership	A Regent Universities Collaborative to improve math and science performance, prepare more highly qualified math and science teachers, promote statewide collaboration and cooperation
20. Iowa Core Curriculum	Iowa Department of Education	Statewide academic expectations for students grades K-12
21. Program for Women in Science and Engineering	Iowa State University of Science and Technology	Program that works to increase the number of women in the STEM fields through a wide range of programs and partnerships
22. WISE	University of Iowa Women in Science and Engineering	Expanding and improving educational and professional opportunities for women in all fields of STEM
23. Girls Go Tech	Girl Scouts	
24. Society of Women Engineers - East Central Iowa Section	Society of Women Engineers	Provides a network for professional development and growth for all engineers and promotes engineering to students in the East and Central Iowa region.
25. WEPAN Knowledge Center	Women in Engineering ProActive Network	Comprehensive website

For more information, please contact:

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