Global Sustainability: An Authentic Context for Energy Education

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Facing the Future is an independent program of Western Washington University.

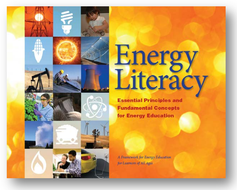
Introduction

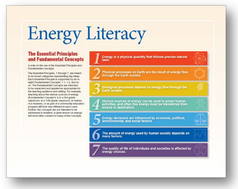
As a member of the NARA Education team, Facing the Future (FTF) was tasked with creating K-12 curricula and teacher workshops that promote the bioenergy literacy of students and teachers. While others may approach this task from the lens of one discipline such as science or social studies, our approach was to use a learning context that inspires educators and students to delve deeply and methodically into the social, economic, and environmental interconnections of energy issues—in other words, to learn about energy within the context of global sustainability.

For twenty years, FTF has developed global sustainability resources for educators around the world that equip and motivate students to develop critical thinking skills, build global awareness, and engage in positive solutions for a sustainable future. Global sustainability education (GSE) describes the concurrent and intentional use of both ***global issues*** — issues that are transboundary, interconnected, and persist over time — and ***sustainability*** to frame and design curriculum.

At FTF, sustainability is defined as the principle of meeting current needs without limiting the ability of future generations to meet their needs. Sustainability recognizes that the social, economic, and environmental concerns of a particular issue are interdependent and that there is an intergenerational responsibility to balance these 3 components today and in the future.

FTF's curriculum is used in all 50 US states and over 140 countries by teachers and students in grades K-12, in undergraduate and graduate classes, and across multiple subject areas. Our experience working with educators around the nation and across the globe suggests that **the context for education matters**. Recent research and publications on energy literacy also suggest that the context for energy education matters.





Background

The desired outcome of many energy education programs is not necessarily to produce energy experts, but to foster energy literate citizens who are able to understand and make informed decisions about personal, local, and global energy issues. While developing an energy literacy survey tool, DeWaters, Powers, and Graham found that:[1]

> "*Literacy* implies not only the understanding of a particular, relevant body of knowledge and set of relationships, but moreover, the ability and willingness to *use* that knowledge in a functional manner - to read and write, to communicate, to participate in society."

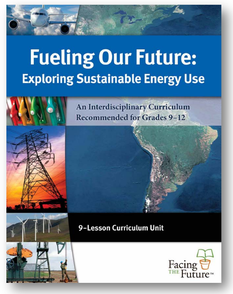
If our desired outcome for energy education is energy literacy, then content knowledge is not enough. Affect and behavior also must be addressed in order to promote energy literacy.[2] This concept is supported by the experts who created *Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education*. According to this framework, an energy literate citizen will understand "the nature and role of energy in the universe and in our lives" and will be able to "apply this understanding to answer questions and solve problems."[3] This framework clearly states that fostering energy literacy requires an interdisciplinary approach to energy education and the principles and concepts included in this framework explicitly address the social, environmental, and economic components of human energy use.[4]

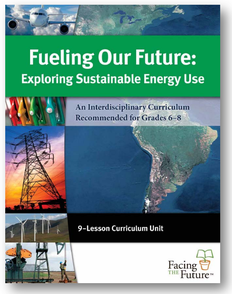
Effective energy education programs are in clear alignment with the goals and approach of global sustainability education. Lessons and curricula designed using global sustainability as a context are interdisciplinary and examine real-world issues from social, environmental, and economic perspectives. With GSE's student-centered approach, students learn much more than energy facts; they are empowered with the knowledge, skills, and dispositions necessary to be active, global citizens.

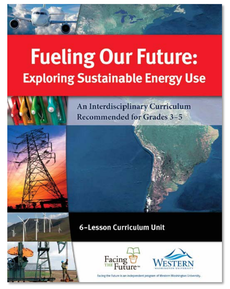
Methods

Global sustainability was used as a guiding framework to select content, create context for lessons, and to choose appropriate pedagogical methods for the elementary, middle, and high school versions of *Fueling Our Future: Exploring Sustainable Energy Use.* This curricula is interdisciplinary; the lessons seamlessly integrate core math, science, and social studies skills and create an authentically interdisciplinary opportunity for students to study energy. The lessons also help students broaden and deepen their global perspective through the inclusion of diverse cultural perspectives, world data, and case studies from around the globe.

Once outlines and lessons were drafted, many content experts, NARA members, and educators reviewed and piloted them, including the team at University of Idaho College of Natural Resources McCall Outdoor Science School (MOSS). Once lessons were finalized, *Fueling Our Future* was published in print, PDF, and SMART Board formats to meet the diverse needs of teachers. Content from this unit was then integrated into online and in-person professional development resources and presented to teachers at workshops in the Pacific Northwest and Wisconsin. ***Fueling Our Future* is now available on Facing the Future's website: www.facingthefuture.org**







Middle and High School Lessons

Lesson 1: Energy 101
Students classify forms of energy as potential or kinetic and explore the law of conservation of energy.

Lesson 2: Power to the People!
Students identify pros and cons of different nonrenewable and renewable energy sources used to generate electricity.

Lesson 3: Lighten Up: A Personal Energy Audit
Students calculate their daily electricity use and identify behaviors and technology that can reduce their energy use.

Lesson 4: Toil for Oil
Students simulate the extraction of oil and analyze graphs depicting global oil consumption and reserves. High school students then use an interactive timeline to examine the role of oil in U.S. history.

Lesson 5: Energizing the World
Students examine graphs and statistics to learn of the diverse energy needs of people around the world and propose sustainable energy solutions.

Lesson 6: Fueling the Future
Students use multiple perspectives to evaluate the sustainability of extracting or growing different transportation fuel feedstocks.

Lesson 7: The Sky's the Limit
Students critically assess information from different multimedia resources to identify the motivation to shift from petroleum-based aviation fuels to alternative fuels.

Lesson 8: The Life of a Fuel
Students research the steps required to produce different biofuels and consider possible environmental impacts on the region.

Lesson 9: Sustainable Flight: A Stakeholder Meeting
Students represent stakeholder interests to negotiate a sustainable aviation biofuel mix for the Pacific Northwest.

Elementary School Lessons

Lesson 1: Energy in Action
Students use observations of domino chains and Rube Goldberg machines to learn about different forms of energy, energy transfer and transformation, and energy flow through systems.

Lesson 2: Mystery Dinner – Energy in Ecosystems
The class uses an energy flow diagram to represent transfer of energy from the sun to food to people. Then small groups create dinner menus to represent energy flow through particular food chains and analyze the roles of the sun, producers, consumers, and decomposers in ecosystems.

Lesson 3: Mapping My Energy Use
After learning electrical safety tips and observing their energy use for 24 hours, students design an energy map to visually represent and categorize their personal energy use.

Lesson 4: Where does my energy come from?
Small groups read nonfiction text to learn about a natural resource used to provide people with energy. They classify their source as nonrenewable or renewable, present their research to the class, and design a trading card to represent the unique characteristics of their energy source.

Lesson 5: Oil Takes a Trip
Students move through the supply chain of gasoline from oil wells around the world to gas stations in the United States. Along the way, they track their mileage and summarize each step in the supply chain. In a follow-up activity, students reflect on this supply chain using systems thinking and economics.

Lesson 6: Energy for All
Students review what they have learned about energy and brainstorm reasons to use energy sustainably. Small groups then read and analyze case studies about youth around the world to learn 4 different strategies to conserve energy and nonrenewable resources.

Outcomes

Since publication,

- **388 copies** of *Fueling Our Future* have been purchased and distributed
- **271 free individual lessons** have been downloaded from FTF's website
- Over **19,770 students*** have been reached

*FTF conservatively estimates that 50% of teachers who order the resource use the resource, and each teacher serves 60 students.

Since 2013,

- **487 educators** have participated in FTF energy-related workshops or viewed FTF energy-related webinars.

Pre and post surveys were used with 32 teachers that participated in 3 different energy workshops facilitated by FTF in 2015. After these workshops,:

- **100%** of teachers agreed that they are **more likely to integrate energy** into their curriculum.
- **97 %** of teachers agreed that they are **more likely to integrate sustainability** into their curriculum.

Conclusion

As human energy use is complex and interdisciplinary in nature, so too should be our efforts in energy education. As shown in Facing the Future's curriculum, *Fueling Our Future: Exploring Sustainable Energy Use*, global sustainability is an authentic, interdisciplinary context for teaching students about the complexities of energy, addressing the social, economic, and environmental components of human energy use, and preparing students to be energy literate citizens. By presenting students with multiple perspectives on important energy issues and allowing them to grapple with real-world issues such as the development of sustainable aviation biofuels, students are able to formulate their own perspectives on energy issues and to develop the skills needed to positively respond.

Acknowledgements

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References

[1, 2] J.E. DeWaters, S.E. Powers, and M. Graham, "Developing an Energy Literacy Scale," In Proceedings of the 114th Annual ASEE Conference & Exposition, Honolulu, HI, June 2007, paper number AC 2007-1069, www.clarkson.edu/cses/research/pdf4.pdf.

[3,4] US Department of Energy, *Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education,* (Washington, DC: March 2012), http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education.

NARA
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