Activity 1.1.1 Thinking Globally

Introduction

Imagine a world:
- where there is abundant, healthful food for everyone
- where there is a clean, bountiful water supply
- where the environment is resilient and flourishing
- where there is sustainable, clean energy
- where good health is the norm

Each of these goals is a daunting challenge. Furthermore, none can be attained independently of the others—we want to grow more food without using more energy or harming natural environments, and we want new sources of energy that do not contribute to global warming or have adverse health effects. (National Research Council. A New Biology for the 21st Century. Washington, DC: The National Academies Press, 2009.)

Engineering is at the heart of advancing civilization. In the past century, engineering was responsible for revolutionizing and vastly improving human life. From electrification to the Internet, all the way to decoding the human genome, engineering has changed the world dramatically and improved the human condition. For all of engineering’s greatest achievements of the last century, the century ahead poses many formidable worldwide problems. As the world’s population grows and its needs and desires expand, engineers and scientists face a whole new set of unique challenges to sustain our way of life, sustain our natural resources, and better civilization.

In this activity you will examine some of the most pressing challenges to our world right now and begin to appreciate the important role that engineering and science play in addressing these challenges. Throughout this course, your work will revolve around providing environmentally friendly and sustainable solutions to produce affordable, renewable energy; clean, safe drinking water; and nutritious food that is sufficient for a growing world population.

Equipment

- Engineering notebook
- Pencil
- Computer with Internet access
- Activity 1.1.1 Student Resource Sheet

Procedure

1. Think about your daily life and the lives of those around you. Brainstorm and record your ideas to the following questions in your engineering notebook.
   - What do you consider to be the biggest challenges to your life?
Biggest challenges: garbage, smoking, and pollution
- Think about your country. What do you consider to be the biggest challenges facing the people in this country as a whole?

Biggest challenges: wasting food, pollution, and over consumption
- Think about the people living on other continents, such as people living in Africa and Asia. What do you think are the biggest challenges facing the people on those continents?

Biggest challenges: Clean water, food, pollution, and deforestation, and over population.

2. Discuss your ideas with a partner.

- Make solar energy economical
- Provide energy from fusion
- Develop carbon sequestration methods
- Manage the nitrogen cycle
- Provide access to clean water
- Restore and improve urban infrastructure
- Advance health informatics
- Engineer better medicines
- Reverse-engineer the brain
- Prevent nuclear terror
- Secure cyberspace
- Enhance virtual reality
- Advance personalized learning
- Engineer the tools of scientific discovery

4. View the National Academy of Engineering’s video introducing the Grand Challenges for engineering on the Internet.

5. Discuss and take notes on your thoughts regarding the Grand Challenges for engineering with your partner. Revisit the questions in #1 above. Are your answers the same? Did this video give you insight into additional challenges? Write a paragraph in your engineering notebook about your reaction to the 14 Grand Challenges for Engineering – do you agree or disagree with them and why? Which of these challenges/solutions will have the most positive affect on you? Which of these challenges/solutions will have the most positive affect on the United States? Which of these challenges/solutions will have the most positive affect on our global society? Why?

6. In 2008, the National Research Council, upon the request of the National Institutes of Health, the National Science Foundation, and the U.S. Department of Energy, released a report with recommendations on how the United States can best capitalize on the significant advances recently made in biology and to accelerate new breakthroughs that could solve some of society’s most pressing problems. The report, *A New Biology for the 21st Century*, describes an approach to research where physicists, chemists, computer scientists, engineers, mathematicians, and other scientists are integrated into the field of biology to create the type of research community that can tackle society's big problems.
The committee focuses on four broad challenges in the report: food, environment, energy, and health. Review the challenges listed below.

- Generate food plants to adapt and grow sustainably in changing environments.
  - Potential Impact: Developing solutions that become critical contributions toward making it possible to feed people around the world with abundant, healthful food, adapted to grow efficiently in many different and ever-changing local environments.
- Understand and sustain ecosystem function and biodiversity in the face of rapid change.
  - Potential Impact: Generating breakthroughs in our ability to monitor ecosystem function, identify ecosystems at risk, and develop effective interventions to protect and restore ecosystem function.
- Expand sustainable alternatives to fossil fuels.
  - Potential Impact: Advancing fundamental knowledge, tools, and technology needed to optimize the production of biofuels.
- Understand individual health.
  - Potential Impact: Making it possible to monitor each individual’s health and treat any malfunction in a manner that is tailored to that individual and that will lead to individualized predictive medicine.

7. Research online, discuss, and take notes on your thoughts regarding the challenges outlined for the New Biology for the 21st Century with your partner. Answer the following questions in your engineering notebook:

- Describe the similarities and differences between the Grand Challenges for Engineering and the New Biology for the 21st Century.
- Which of the four challenges identified in the New Biology for the 21st Century report do you think is the most critical to solve? Why?
- Describe an idea that you have that would help to solve any of these global challenges.

8. Work with your partner to review your brainstormed ideas and those ideas gathered from the National Academies of Engineering and Science. With your partner, create a list of what you feel are the Top 5 global problems of this century and defend your reasoning. Rank these challenges in the order you feel they should be addressed by engineers and scientists.

9. Share your ideas and defend your reasoning with the class.

10. Read through the three stories presented in the Student Resource Sheet and answer the questions.

11. Answer the conclusion questions in your engineering notebook.

**Conclusion**

1. What do you personally feel are the top five global problems of this century? Defend your reasoning.
   - Global Warming- making the weather messed up and melting the ice.
ii) World Hunger - many people around the world are dying from starvation.
iii) Overconsumption - We are consuming too much, thus more materials are being wasted and sooner or later we will run out. (oil, food, water, etc.)
iv) Overpopulation - This is leading to overconsumption, and it's just this earth has a limited amount of space. To create more space we have to cut down more trees and harm the environment, which is just bad.
v) Pollution - We isn’t as horrible as we used to be with pollution, but I feel like it’s still not enough. The weather is changing drastically and this just leading to global warming.

2. How might the human condition be improved by engineering?
   With engineering we can improve many aspects of the human condition. We can make better medicine and create better and more efficient methods of growing food, thus healthier humans. We can also create technology that can help humans stay healthy.

3. Why is it important for scientists and engineers to work together to solve problems?
   Scientists know all the science about the problem and what is causing it. Engineers will then be able to figure out how to solve that or how they can do it more efficiently. So basically the scientists give feedback on the engineer’s work, just like how a teacher would give to a student.

4. After reading Amara, Jovany, and Daryl’s stories, why do you feel that food insecurity, a lack of clean water, and the need for renewable energy sources are problems worth solving?
   These are problems worth solving because these are basically the basic needs of all human beings and if we don’t do something about this then it will probably be harmful for everyone. For this world to be a better place, we need better things.