Can You Help Save the World?

Subject Area(s) Chemistry

Associated Unit Thermochemistry

Lesson Title Can You Help Save the World?

Header

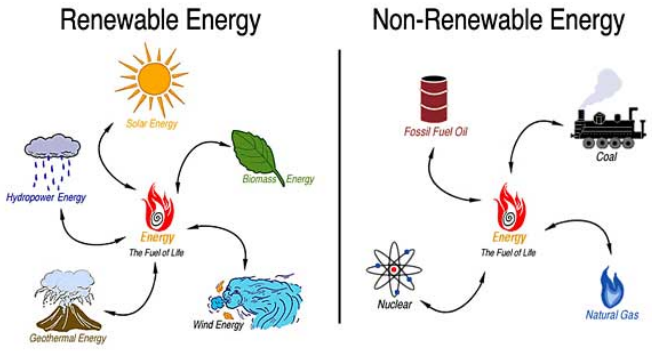

Image 1

ADA Description: The following image shows the examples of renewable and non-renewable energy. Some example of renewable energy include the sun, rain, biomass (leaves), geothermal, and wind. Examples of non-renewable energy includes oil, coal, nautral gas, and nuclear power.

Source/Rights: Copyright © http://multidict.net/clilstore/page.php?id=2823

Caption: Examples of renewable and non-renewable energy.

Grade Level 10, 11, 12

Time Required 200 minutes (Four 50 minute periods)

Summary

This lesson will allow students to be more aware of the benefits and drawbacks of renewable and non-renewable resources through discussion, a group activity, and research. When discussing renewable energy, they will learn ways in which engineers contribute to the innovation of a more energy efficient world. Through a lab, students will act as energy engineers and investigate different blade designs to test the amount of energy output. Students will have a better appreciation of the use of renewable resources and how energy affects our environment.

Engineering Connection

Energy engineers, who include industrial, mechanical, electrical, and materials engineers, understand how to make the best use of renewable resources in order to generate electricity. They are committed to improving our environment and our health by reducing our use of non-renewable resources and developing new ways to conserve energy through alternate sources found naturally. Students will explore how different engineers help save the environment by designing products to harness renewable resources to make energy. Students will also design their own wind turbine to create the maximum amount of energy possible while understanding the engineering design.

Engineering Category =

Choose the category that best describes this lesson's amount/depth of engineering content:
Engineering design process

Keywords

Energy, energy efficiency, renewable energy sources, non-renewable energy sources, wind power, energy conservation

Educational Standards (List 2-4)

State STEM Standard (required)

CPALMS, 2008, SC.912.L.17.11, grades 9-12, Evaluate the costs and benefits of renewable and nonrenewable resources, such as water, energy, fossil fuels, wildlife, and forests.

CPALMS, 2008, SC.912.L.17.19, grades 9-12, Describe how different natural resources are produced and how their rates of use and renewal limit availability.

ITEEA Standard (required)

Standard 16 (Grades K-12): Students will develop an understanding of and be able to select and use energy and power technologies.

Learning Objectives

After this lesson, students should be able to:

- Distinguish between non-renewable and renewable resources.
- Discuss the pros and cons of non-renewable and renewable resources.
- Explain the importance of transforming our energy sources to renewable resources.
- Explain how engineers contribute to developing energy that has the least impact on the earth.
- Understand how to conserve energy personally and as a community.
- Understand the designing process of wind turbines.

Introduction / Motivation (5E – Engage)

Day 1: Introduce renewable and non-renewable resources with a short video:

https://www.youtube.com/watch?v=KEeH4EniM3E

After the video, a class discussion will begin based on the following questions:

- How do human activities affect non-renewable resources? Renewable resources?
- What will happen to the human population when non-renewable resources are used up?
- What are some things we can do to get our energy without destroying our earth?
- Think about the last 24 hours. Were the activities you did powered by renewable or non-renewable energy? Did you try to conserve energy, if so, how?

Day 4: Introduce how wind power works with a short video:

https://youtu.be/EYYHfMCw-FI

Lesson Background & Concepts for Teachers (5E – Explain)

Energy comes from sources such as power plants, the sun, food, windmills, dams, etc. However, not all energy that we use comes from a source that will be available forever. Non-renewable resources are used to create energy, but are not able to be replenished after they are completely used up. These resources are commonly called fossil fuels, which include natural gas, oil, coal, and nuclear energy. Although these resources are readily available and generates about 80% of the United States' energy, they negatively

impact our environment. When fossil fuels are burned to create energy the particles released pollute the air, water, and land. The pollution from fossil fuels has contributed to global warming by releasing carbon dioxide into the air which traps heat.

In order to slow and eventually halt our pollution and still get the same amount of energy needed, renewable resources can be used instead. Renewable resources are energy sources that are able to replenish themselves over time. The sun, wind, water, and biomass are examples of renewable energy. Designing cleaner and more efficient ways to produce energy is a job for many engineers. Civil, electrical, mechanical, and environmental engineers work together to create technology such as solar panels, wind turbines, and dams.

Wind is a great energy source to take advantage of. Engineers have figured out how to harness wind power in order to generate a substantial amount of electricity. A combination of many wind turbines are placed in locations that have high winds such as a flat, treeless area or offshore to make a wind farm. These locations are known to have plenty of wind for the turbines to transform the wind into energy. In order to generate energy from a wind farm, air must make the blades spin, which turns a generator within the turbine to create electricity.

Engineers have designed wind turbines to maximize the amount of energy that is obtained. The number of blades has shown to change to optimization of energy output. A turbine with 3 blades is more efficient than one with 2 blades, but 4 blades does not show much difference. The angle at which the blade is aligned is also important, as there are different velocities at which the wind hits the root of the blade and the tip of the blade. Length of the blades cannot be too long or they may bend and hit the tower, decreasing the efficiency. Although the blade of the wind turbine is important in design, so is the tower itself. Engineers must determine at what altitude the wind in the particular location has the highest velocity. Wind turbine towers are typically as high as they can structurally go given road transportation parameters.

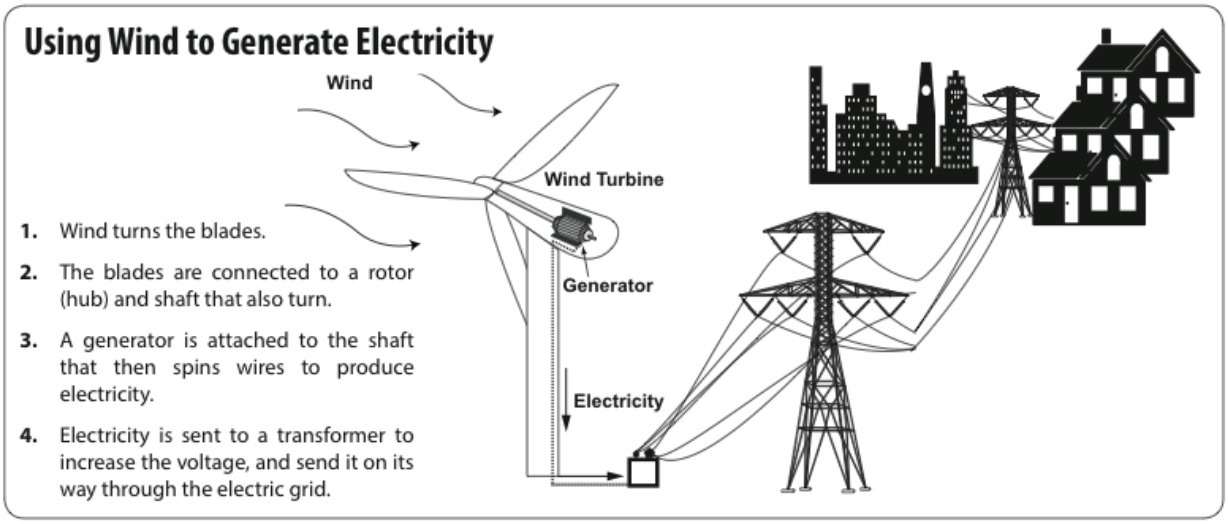

Image 2

ADA Description: Diagram showing the process in which wind can be used to generate electricity.

Source/Rights: Copyright © http://energy.gov/eere/education/teach-and-learn

Caption: Figure 1. Using wind to generate electricity.

Day 1:

- Engage students with a video on the various energy sources used in our daily lives.
- Propose questions based on the video about energy sources to start a class discussion.
- Put students into groups to complete bead activity to understand the difference between renewable and non-renewable energy (see attachment).
- Discuss engineering professions in energy conservation to lead into the next day's lesson and project.

Day 2:

- Students use class time to research an engineering profession they find interesting to present to their peers the next day. Presentation should include the job description, how the engineer contributes to energy conservation, and why it is interesting to you.

Day 3:

- Students present research to their peers.

Day 4:

- Show students video on how wind power works.
- Put students in groups to perform wind turbine lab (see attachment).

Vocabulary / Definitions

Word	Definition
Energy	The ability to do work.
Renewable Energy	Energy that comes from natural resources on Earth that can be replenished.
Non-renewable Energy	Energy that is created from fossil fuels, which will run out eventually.

Associated Activities (5E – Explore)

Day 1: Renew, Reuse, Deplete Bead Activity

Day 4: Wind Turbine Lab

Assessment (5E – Evaluate)

Pre-Lesson Assessment

Initial Discussion: Teacher will collect data based on discussion answers from students on Day 1.

Post-Introduction Assessment

Renew, Reuse, Deplete Bead Activity: Assessment of understanding the difference between renewable and non-renewable energy consumption rates (Day 1).

Lesson Summary Assessment

Use of Energy Report: Students will identify the pros and cons renewable and non-renewable resources in a page. They should be sure to include ways to help improve the way their community uses energy. Students should cite their resources.

Additional Multimedia Support

For more resources on energy basics and sources:
http://energy.gov/eere/education/teach-and-learn

For more videos on renewable and non-renewable resources:
https://www.youtube.com/watch?v=ycdke8MTSCI
https://www.youtube.com/watch?v=bn8R_XqjjI0
https://www.youtube.com/watch?v=T4xKThjcKaE

For more on how wind turbines work:
https://www.youtube.com/watch?v=niZ_cvu9Fts
http://energy.gov/eere/wind/how-do-wind-turbines-work

References

Durkee, D., & Lindley, D. (n.d.). What does an Energy Engineer do? Retrieved July 10, 2016, from http://www.wisegeek.com/what-does-an-energy-engineer-do.htm

Energy engineer job information | National Careers Service _tag.DCSext.LoggedIn=0;. (n.d.). Retrieved July 10, 2016, from https://nationalcareersservice.direct.gov.uk/advice/planning/jobprofiles/Pages/energyengineer.aspx

R., Powell. (n.d.). Going Green. Retrieved July 10, 2016, from http://www.cpalms.org/Public/PreviewResourceLesson/Preview/75983

Attachments

1) Renew, Reuse, Deplete Bead Activity
2) Wind Turbine Lab

Contributors

This lesson plan was written by Omari Baines.

Supporting Program

This lesson plan was made as part of the Summer 2016 Research Experience for Teachers (RET) at the Functional Material Research Institute at the University of South Florida.

Acknowledgements

Thank you to the FMRI RET program for this opportunity. I have gained so much experience over this summer.

Classroom Testing Information

N/A

ATTACHMENTS

Renew, Reuse, Deplete Bead Activity (Day 1)

Set up: Have 5 bowls with 200 green beads and 5 bowls with 200 purple beads set up around the room. Divide class into 9 groups. Each group will be assigned a community that uses a different ratio of renewable and nonrenewable energy sources. Pass out index cards to each group with their assigned community and percentage of energy source use. For example, Community A would use 90% energy from coal and 10% energy from wind power (90:10 ratio). Community B would use 80% energy from natural gas, 10% energy from solar power and 10% energy from nuclear power (80:20 ratio). Community C would use 70% coal and 30% hydroelectric. Community D would use 60% natural gas 30% solar 10% wind. Community E would use 50% coal 50% solar energy. Community F would use 40% natural gas and 60%solar energy. Community G would use 30%coal and 70% hydroelectric. Community H would use 20% natural gas and 80% wind. And Community I would use 10%coal and 40% solar 40%wind 10% nuclear. Be as creative as you wish with your resources. Some options include: coal, natural gas, solar, geo-thermal, hydroelectric, wind, biofuel.

Each group will need to select 100 beads that represent their energy resource usage. Purple beads represent non-renewable resources and green beads represent renewable. So Community A would need to select 90 purple beads and 10 green beads. Community B would need to select 80 purple beads and 20 green beads, etc.

The students will place the beads in the zip- type plastic bags. After everyone selects their beads, teacher will ask the class about their community's ratio and how many of each color bead they selected. This will ensure every group has the right ratio to start and also reinforce which energy sources are renewable and which are not.

The teacher will model the lab activity (explained below) with 2 volunteers and then the students will conduct the activity in their independent groups.

Activity: One student in each group will close their eyes and remove 10 beads, thus simulating annual consumption of energy. Another student will count how many green versus purple and record for trial 1 which represents one year of usage.

The student will replace the green beads back in the bag and repeat the trial for 20-30 years always leaving the purple beads out never replacing them. Each time a purple is picked out it cannot be replaced. The green beads are renewable so they can be placed back. Students should record their data for each trial (year). The teacher can walk around the room asking each group Guiding Questions.

Wind Turbine Lab (Day 4)

Blade Design Introduction

Observe how the wind turbine works with the standard blade designs. Record the results of your tests.

Question 1: What blade design will generate the most electricity (in volts)?

	Wind Source Speed				
	Low	**Medium**	**High**		**Average Voltage**
Blade Design 1					
Blade Design 2					
Blade Design 3					

Question 2: What can you conclude based on your data?

_____

_____

_____

_____

_____

Question 3: Think about the blade designs you tested. What changes could you make to the design that might get better results? On your own, make a list of changes you could make and draw some sketches of different blade designs.

_____

_____

_____

_____

_____

_____

_____

_____

Now share your ideas with everyone else in your group. What are some the same ideas you had? What are some of the different ideas? Why do you think one design would work better than another? Can you combine your ideas to make a better design?

Decide as a group which design you will use. Draw the design below and explain why you chose this design. Include the length and material of the design.

Write a hypothesis explaining why you think this blade design will do more work than the standard blades you tested initially.

I predict _____ (blade design) will do more work than the standard blade design because _____

_____

_____

_____

_____

Procedure:

1. **As a group, work together to construct the blades that you decided on.**
2. **Draw a diagram of your blades on the wind turbine. Label all of the parts.**
3. **Test your blades. Conduct three trials and then calculate the average of the three trials.**

   NOTE: You may have to wait for other groups to test their blades before it is your turn. Pay attention to their blade designs and the results they get. What blade designs are getting good results? What do those designs have in common?

Diagram

Data

	Voltage
Trial 1	
Trial 2	
Trial 3	
Average	

Conclusion: What did you learn from your investigation? Were your results better than the original blade designs? Did your blade design improve your results? Why or why not? (Reference the data from your investigations to support the statements in your conclusion.)

If you were a lead design engineer what would you recommend your company do to their turbine blades? Why?

What have you learned about wind and energy? Use the empty space to draw and label pictures and diagrams.

What new questions do you have about wind and energy? What are you wondering about now? How could you find the answers to your new questions?