

VIRTUAL FIELD TRIP TEACHER'S GUIDE

Powering the Planet: Renewable Energy

Grades: 3-8

Subjects: Science

Purpose: This guide contains information on teacher preparation for the event, technical information, as well as a variety of student materials, which can be used before, after, or during the virtual field trip. It also contains links to Nature Works Everywhere resources and other resources ranging from lessons, activities, demonstrations, experiments, real-time data, and multimedia presentations.



Alex Wegmann
Palmyra Program Director
The Nature Conservancy

Description of Virtual Field Trip: We use energy to power our lives every day—to boot up our computers, fuel our cars, charge our cell phones, flick on a light switch, and in a myriad of other ways. Join scientist Alex Wegmann as we embark on a Virtual Field Trip to explore a compelling question: How can we get the energy we need without harming nature? By harnessing renewable sources of energy, such as sunlight and wind, scientists are finding ways to do just that.

On this journey, we'll visit the Palmyra Atoll, a wildly remote cluster of islands atop coral reefs and teeming with animal life. Scientists there have developed ways to power the entire island almost exclusively through renewable energy sources. We'll also journey to the scorching Mojave Desert, home to rattlesnakes, tortoises, bats, and coyotes, to check out massive solar panel installations that are working to power large cities. We'll learn about innovative methods for capturing energy that are safe, sustainable, and can change the destiny of life on our planet.

Materials:

Elementary School

- Nature Spy Handout**
https://www.natureworkseverywhere.org/asset/resources/TNC-Nature-Spy-Worksheet_Renewable_Energy_V2.pdf
 This handout includes images of animals and other items that students will see during the field trip. Print it off and have students check off the images as they see them.
- Renewable Energy Virtual Field Trip Log**
https://natureworkseverywhere.org/asset/Powering_the_Planet_Virtual_Field_Trip_Log.docx
 This one page handout can be printed and used before, during, and after the field trip for students to think about what they hope to see, what they learned, what they want to know more about.
- Renewable Energy Vocabulary Graphic Organizer**
https://natureworkseverywhere.org/asset/Powering_the_Planet_Vocabulary_Graphic_Organizer.docx
 This handout includes vocabulary words used during the virtual field trip and provides a structure for students to define and use them in a sentence.

Middle School

- **Renewable Energy Virtual Field Trip Discussion Questions**

https://natureworkseverywhere.org/asset/Renewable_Energy_VFT_Discussion_Questions.docx

This fourteen question handout can be used during and after the virtual field trip. You can modify the questions as needed or use them as discussion prompts after the trip. The answer key is located at the end of this teacher's guide.

Standards: A more detailed, grade-based map to the standards can be found here:

https://natureworkseverywhere.org/asset/Standards_for_Renewable_Energy_VFT.pdf

Next Generation Science Standards Disciplinary Core Ideas

- ESS3.A Natural Resources
- ESS3.C Human Impacts on Earth Systems
- ESS3.D Global Climate Change
- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- LS4.D Biodiversity and Humans

Related Nature Works Everywhere Resources: The following lesson plan and video can be used to supplement the virtual field trip.



Renewable Energy

Grade Levels: 6-8

<https://www.natureworkseverywhere.org/resources/renewable-energy/>

In this lesson, students explore solar and wind power—two important renewable energy sources. Unlike the nonrenewable energy sources that humans currently use (fossil fuels, coal and natural gas), solar and wind power can quickly replenish themselves and are usually available in a never-ending supply. Acting as residents of different regions, students weigh the pros and cons of each renewable energy option for a region, and make a recommendation based on their evaluation.

Teacher Preparation and Tech Considerations Before the Event:

- Check to see if YouTube is blocked at your location. If so, you may be able to request that your district or school's IT person unblock the link to the virtual field trip. Refer to the link you received in your registration email. Be sure to do this several days in advance of the event.
- If your school site is not able to unblock YouTube, register for the field trip anyway and you will be added to a mailing list about the event. You will receive a newsletter when we edit the live recording and place the video on Vimeo (approximately 2-3 weeks after the live event) and you can try viewing it there. If you don't have school access to Vimeo, you can download the video at your home or other location and bring it to school on a USB drive.
- Note that anytime during the live recording, you can press "pause" and come back to the event. It will no longer be live, but your students can pick up where they left off in the event of recess, a fire drill, or any other interruption.
- **Also note that you can use the same link that was emailed in your registration to view the virtual field trip anytime.** Once the live event has concluded, you can watch it from the beginning. This is helpful if you are showing it to multiple periods or if the time of the live event doesn't work for you.
- Because there will be opportunities for Q and A as well as a "quiz" during the event, you may wish to select a student who can type in answers, questions, or comments before the event. **If you would like to participate in the Q and A, you will need to have a Google + account.** This feature of Google Hangouts, which can be accessed through YouTube, is only available to Google + users.

If you would like to participate in the Q and A feature, click on the "Be a Part of the Conversation" in the lower left hand corner of the screen, which will open the presentation in the "Google Hangouts" window.

If would like to enlarge the screen while watching, click on the "full screen" icon in the lower right hand corner of the screen.

Discussion Questions: You can use or adapt these questions for a follow-up discussion with your students after viewing the virtual field trip. Older students may be able to follow along and answer the questions while viewing.

1. List at least two ways we get energy to power our lives.

Answer: Burning coal, gas, burning wood, biodiesel, algae/biofuel, wind, sun, water, geothermal, etc.

2. In the virtual field trip, Dr. Alex Wegmann talked about the importance of the bird guano to the ecosystem. Describe the role that guano plays on Palmyra Atoll.

Answer: The birds eat fish and other organisms from the marine environment and when they defecate, the nutrients from the marine environment are essentially transferred to the terrestrial environment. The guano (feces) acts as a fertilizer for the plants. The plants in turn support life on the islands (geckos, insects, etc.). The island's heavy rainfall pushes nutrients from decomposing plants or dead organisms back out to the ocean where they came from originally. Everything is connected.

3. Why is Palmyra a perfect place to study how a marine ecosystem responds to climate change?

Answer: Palmyra is a perfect place to study how a marine ecosystem responds to climate change because it has little human influence from things like pollution or overfishing. It is as close to a pristine environment that you can get and therefore, the changes observed are less likely to be caused by other variables related to human influence.

4. What is the difference between renewable and nonrenewable resources? Provide examples of each.

Answer: Renewable resources include the sun and wind and are things that can be "replenished" or are not used up. Nonrenewable resources include fossil fuels like coal and oil that took a long time to form and are not as easily replenished. For example, coal and oil are more likely to be used up before more can form because the process takes so long.

5. What is the reason for the special design of Palmyra's wind turbine (shown below)?



Credit: Cindy Coker

Answer: The wind turbine has a much different design than regular turbines because of the importance of the atoll as a nesting ground for thousands of birds. Regular wind turbines can harm birds and it was important to prevent this happening on the islands to limit human impact while harnessing wind power.

6. Why was it necessary to install solar panels and a wind turbine on the atoll?

Answer: The wind turbine is intended for use as a back-up energy source in the event of bad weather, heavy cloud cover, or nightfall that could limit solar power production. Using renewable energy on Palmyra also helps keep costs down while protecting the environment.

7. What is the relationship between fossil fuels and carbon dioxide?

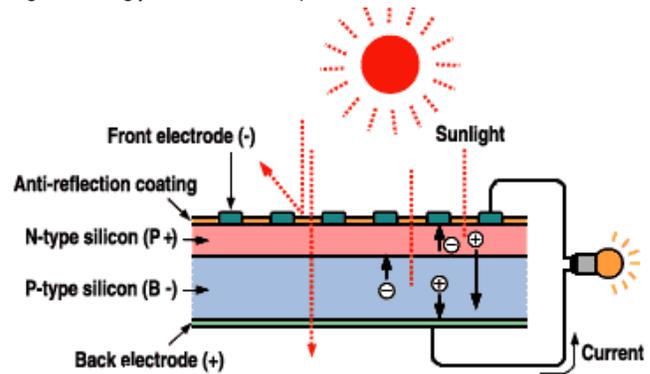
Answer: When fossil fuels are burned or combusted they release carbon dioxide into the atmosphere.

8. What is an important chemical component of solar cell (also known as a photovoltaic cell)?

Answer: Silicon

9. Describe what happens when a photon (a packet of light energy from the sun) hits a solar cell.

Answer: When photons hit a semiconductor on a solar panel, their energy frees some electrons in the semiconductor material. The electrons create an electric current, which is harnessed by wires connected to the positive and negative sides of the cell. The amount of electricity that can be produced depends on the number of cells in each solar panel and the number of panels in a whole facility.



Credit: Bureau of Labor Statistics

10. How does concentrating solar power (CSP) differ from photovoltaic cells?

Answer: Concentrating solar power involves a series of mirrors that reflect sunlight onto a solar power tower. Water contained in the tower gets heated up by the reflected sunlight. When the water is heated, it produces steam, which turns a turbine and generates electricity.

11. How do fossil fuels contribute to climate change?

Answer: When fossil fuels are burned, they release greenhouse gases like carbon dioxide into the atmosphere. Greenhouse gases contribute to climate change because they create a layer of gas in the atmosphere that can trap heat. Normally some of the sun's energy gets reflected back out into space, but when there is a layer of greenhouse gases, heat can be trapped, causing warming.

12. How do engineers and scientists decide where to locate solar facilities?

Answer: The first consideration when locating a solar facility is the amount of solar radiation a site receives. This makes the desert Southwest a prime location for siting solar facilities. Other considerations include how much the land will be disturbed. For example, solar facilities can destroy animal habitat, so it's important to choose locations that will have less impact on animals and plants and/or choose sites that have already been disturbed like abandoned fields. Additionally it's important to note where major migration routes exist so as not to block the movement of animals.

13. In the United States (in 2015) how much electric power was generated from renewable resources?

Answer: Only 13%

14. What are some ways the students and other people can help to make a difference when it comes to energy use?

Answer: You can turn off lights when you leave a room. While reducing energy use is a good start, it's not always practical. Switching out old incandescent light bulbs for newer, more energy efficient bulbs like LED bulbs or compact fluorescent bulbs can save a lot of energy when the lights are on.