FANtastic
Using Wind Energy

Instructional Time:
50 minutes

Introduction

In this lesson, students will apply the first four stages of the design thinking process through discovering environmental issues related to fossil fuels and the benefits of renewable energy. There will be a strong focus on wind energy and maximizing its utility.

The *Wind Energy Organizer* student resource is available in print and digital versions. Students will need the use of computers or laptops to complete the digital student resource as well as a *Wind Energy Virtual Lab.* Students may work individually or as partners in completing the virtual lab.

The final two slides in the presentation are designed for a lesson extension and can be skipped if you choose not to include the extension.

Design Thinking. This lesson explores the highlighted stages in the design thinking process.

Empathize – **Define** – **Ideate** – **Prototype** – Test

Standards and Practices

Common Core State Standards:

- CCSS.ELA-Literacy.W3-5.8: Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories.
- CCSS.MATH.PRACTICE.MP5: Use appropriate tools strategically.

International Society for Technology in Education Standards:

- ISTE 3: Knowledge Constructor. Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others.

Next Generation Science Standards:

- NGSS.4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

Lesson Objectives

Students will:

- Investigate renewable and nonrenewable energies, while distinguishing between and citing advantages of both types of energy.
- Understand the concept of wind energy and how it can improve the quality of life for people in their community.

Teacher Preparation:

- Review the *FANtastic: Using Wind Energy* Presentation.
- Prepare digital or print copies of *Wind Energy Organizer.*
- Share the link to the *Wind Energy Virtual Lab* with students.

Materials/Resources:

(Please see the AVID STEM Connections matrix for links to the resources mentioned here in a variety of formats.)

Hands-on:

- *FANtastic: Using Wind Energy* Presentation
- *Wind Energy Organizer* (digital and print versions)
- Linked resources:
  - *Nat Geo: Renewable Energy 101* Video
  - *Energy 101: Wind Power* Video
  - *Wind Energy Virtual Lab*
- Student computers (1 per student or 1 per pair)

Minds-on:

- Critical thinking
- Empathy
- Ideate
- Social-emotional learning
- Growth mindset

Essential Question: *How can renewable energy improve the quality of life for those around me?*

ENGAGE (10 minutes)

Electricity in Your Day:

Introduce the lesson by telling students that the class will be discussing electricity, how it is made, and how this process can impact our environment.

Distribute the *Wind Energy Organizer* to students or provide a link to the digital version.

Display *Electricity in Your Day* (Slide 2). Allow students to brainstorm ideas for 1 minute on how they use electricity each day. Remind students that they are adding their ideas to the *Wind Energy Organizer* for question 1. Select 3–5 student volunteers to share one idea with the entire class.

Display *Electricity in Your Day* (Slide 3) and refer to the examples given on the slide, and any others you may want to include.

Direct students to brainstorm where electricity comes from for question 2 on their *Wind Energy Organizer*. Allow students to think-pair-share for 2 minutes.

Use *Where Does Electricity Come From, Anyway?* (Slides 4 and 5) to have students identify common electrical items in a single room of a house or have students estimate how many different electrical items are pictured.

Resources:

FANtastic: Using Wind Energy Presentation

Wind Energy Organizer (print or digital)

Remote Learning Modifications:

Distribute digital copies of the Wind Energy Organizer to students via LMS. After students brainstorm, they can share their ideas in the video conference group chat. Teachers can point out responses that are repeated the most or unique.

Using a digital whiteboard or Jamboard shared with the class, students can add sticky notes to the whiteboard with their brainstorm ideas. Students can think-pair-share in breakout rooms.

Students can share their responses to Slides 4 and 5 in the group chat.

EXPLORE (12 minutes)

Where Does Electricity Come From?

Display *Where Does Electricity Come From, Anyway?* (Slide 6) and explain to what fossil fuels are. Display Slide 7, review possible consequences of fossil fuel use, and discuss with students the first two questions on the slide. Have students answer question 3 on their *Wind Energy Organizer.*

Resources:

Nat Geo: Renewable Energy 101 Video

Remote Learning Modifications:

Explain how fossil fuels produce energy and possible byproducts while displaying *Where Does Electricity Come From, Anyway?* (Slides 8–11).

Discuss the benefits of clean air and allow students to respond aloud to question 4 via a preferred selection method. Allow students time to record their response on their *Wind Energy Organizer* page after the discussion.

> **Teacher Tip:** You can select students to respond aloud based on initials, ask for volunteers, or use the Numbered Heads Together strategy, in which where students first share ideas with their group. Each group member is assigned a number, usually 1–4. Ideally student groups should all be the same size for numbered heads together. Once the groups have brainstormed within their group, you can ask all number 3s (or another number) to share out an idea their group had discussed.
>
> You can find directions for Numbered Heads Together and other collaborative strategies on the AVID STEM Connections LMS *>> Educator Resources >> Collaborative Instructional Strategies*.

Display *Where Does Electricity Come From, Anyway?* (Slide 12) and read (or have a student read) the information.

Direct students to preview questions 5 and 6 on their *Wind Energy Organizer* as you read them aloud.

- *List two types of renewable resources that are mentioned in the video.*
- *Name one benefit or one downside of using renewable energy.*

Show the linked National Geographic introductory video, then ask students to answer questions 5 and 6 on their *Wind Energy Organizer.*

Students may view these slides and videos independently, organizing their responses via FlipGrid or Jamboard.

EXPLAIN (10 minutes)

Wind Energy:

Display *Wind Energy* (Slide 13) and read the information. Define wind energy and explain some of its benefits over using fossil fuels.

Display *Wind Energy* (Slide 14) and ask students the question on the slide: "How exactly does wind energy work? Let's find out!"

Show the *Energy 101: Wind Power* video and instruct students to listen for important terms in the video.

Point out to students that *where* you put the wind turbine can make a big difference in the amount of energy it can create.

> **Teacher Tip:** You may draw attention, depending on group needs, to the terms "Wind Farm," "Wind Turbine," and "Renewable Energy" during the clip. If you would like to have students begin thinking about extensions, take a brief minute and ask students if they can think of any locations that match what was described in the video.

Resources:

Energy 101: Wind Power Video

Remote Learning Modifications:

Students may utilize Flipgrid to explain Wind Energy in their own words, as well as why the location of the turbines is critical to maximum performance.

ELABORATE (13 minutes)

Wind Energy Virtual Lab:

Explain to students that they are now going to build their own wind turbines and see how many homes we can power!

Display *Wind Energy Virtual Lab* (Slide 15).

Distribute computers to students if they are not already in use and share the link for the *Wind Energy Virtual Lab*. (https://www.youngscientistlab.com/sites/default/files/interactives/wind-energy/)

Display *Wind Energy Virtual Lab* (Slide 16) and explain that students will need to use what they have already learned to decide where the best location would be to install new wind turbines in the simulator. Instruct students to answer question 7 on the *Wind Energy Organizer.*

Resources:

Wind Energy Virtual Lab Website

Remote Learning Modifications:

Students should follow these steps, but experiment with one changed variable over a few different steps. Via Jamboard, Flipgrid, or Google Forms, students should hypothesize which single variable makes the largest impact on performance before conducting a few calculations with one different variable each time and reporting the results.

Explain the use of variables for the turbine design.

- After students choose a location, they will need to choose variables for turbine design.
- Provide students with the following values the first time they use the simulator:
  - Blade length – 40
  - Pitch – 10
  - Twist – Yes
  - Tip Shape – Thin
  - Airfoil – Thin
  - Height – 120
- Tell students *not* to click the "Next" button after finding their turbine performance on the first experiment. The next section is not relevant to the lesson and may cause students to become lost or get off-track.

  Teacher Tip: Students may experiment with additional variables later if time allows ***from the same screen***. Providing this uniform design will ensure that all students understand turbine placement. Under this arrangement, the offshore option will power the most homes.

Display *Wind Energy Virtual Lab* (Slide 17) and ask students to answer question 8 in the *Wind Energy Organizer*. Upon completion of question 8, students will brainstorm with a table group. While monitoring students provide 8 minutes to test the various locations in the simulator and consider ideas of why turbines were more or less efficient in the simulation.

EVALUATE (5 minutes)

"Wind"ing Down:

Display *"Wind"-ing Down – Choose Two* (Slide 18) as an introduction to the exit ticket.

Ask students to respond to two of the provided questions. After allowing 2 minutes for the responses, initiate a pair-share to provide responses with a nearby partner, repeating the two-minute allowance. To wrap up remaining time, allow student volunteers to share a partner's response that helped them understand the lesson better.

Vocabulary

- **Byproduct:** A second material created as a result of a process; for example, smoke is a byproduct of burning wood burning for a fire
- **Finite:** Limited; something that will not last forever
- **Fossil Fuels:** Oil or natural gas found in the earth that creates environmental pollutants when burned for energy
- **Pollutants:** Any substance that makes the environment (air, land, or water) dirty or contaminated
- **Renewable Energy:** Energy generated by harnessing natural energy sources like wind, the sun's rays, or the movement of water
- **Wind Energy:** Electricity created by using the motion energy provided by the wind, captured through wind turbines
- **Wind Turbine:** A large motor with fan blades that is moved by the wind; the motor converts this spinning motion energy into electricity

Refer to the *Glossary* in the AVID STEM Connections LMS site.

Career Connections

- **Environmental Engineers** plan projects from water treatment to energy creation that will reduce pollution and improve quality of our air, land, and water.
- **Land Acquisition Specialists** design plans for acquiring land for wind farms.
- **Machinists** use tools designed for shaping materials precisely. These materials can be used for building wind turbines and other equipment used on wind farms.
- **Renewable Energy Engineers** work to create machines and devices that create energy efficiently. These engineers can analyze wind speeds and direction to determine turbine placement, test new turbine designs in wind tunnels, and work on teams that install turbines on wind farms.

Refer to the *Career Connections Educator Resource* in the AVID STEM Connections LMS site.

Please visit the link to the Occupational Handbook of the Bureau of Labor Statistics for specific career information. https://www.bls.gov/ooh/

Extensions and Modifications

Mild Extension:

- In the *Wind Energy Virtual Lab,* students can determine which of the six *blade variables* makes the largest difference in energy generation. Have them change one single variable, then click "test," document the response, and repeat with another variable *after changing the previous variable back to its original state*. Students can create a table to collect the data from their changes to provide evidence to support their claim as to which of the *blade variables* makes the largest difference.

Medium Extension:

- Utilize Slides 19 and 20 in the *FANtastic: Using Wind Energy* Presentation to guide students in using Google Earth to find locations within their local area that would be suitable for wind turbine placement. Students can identify three possible locations for the wind turbine and describe why these locations were chosen.

Spicy Extension:

- Have students make a single selection from the choices established in the medium extension. Have them write a paragraph explaining the characteristics of the area that would make it the best performer locally for a new wind turbine. You may utilize Slides 19 and 20 for this activity. You may consider adding the following question for this extension:
    - *Of the three locations, which one is the very best location? Explain why that location was chosen. Be sure to support your response with evidence!*

Teacher Tip: If Google Earth asks for permission to use your location, students must select "Allow" for the button to work. If you choose not to use this option, you will need to use the search box to find your location (school and city name, zip code, etc.).