

Wild about Wind

Grade Level: 4th-5th

Duration: 45-minute class session

Lesson Overview:

This lesson uses a hands on approach to teach about renewable energy with a case study in wind turbines. This lesson also uses engineering design to help situate renewable energy within a practical human society.

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Disciplinary Area:

**Earth
Sciences**

Key Concepts:

- What energy is
- How energy works
- How humans impact the planet
- Renewable energy

Key Lesson Information for Lesson One

Lesson Development Acknowledgement

This lesson was developed in collaboration with the [Gonzaga Science in Action!](#) program. The Science in Action! Program helped test the kits included in these lessons and helped guide Gonzaga undergraduates in developing the accompanying lessons. We thank Gonzaga SIA! for their collaboration and support!

Materials List

- Wind turbine kit
- Rechargeable batteries
- Document camera
- Printed diagrams of wind turbines
- Multimeter

NGSS Performance Standards Addressed

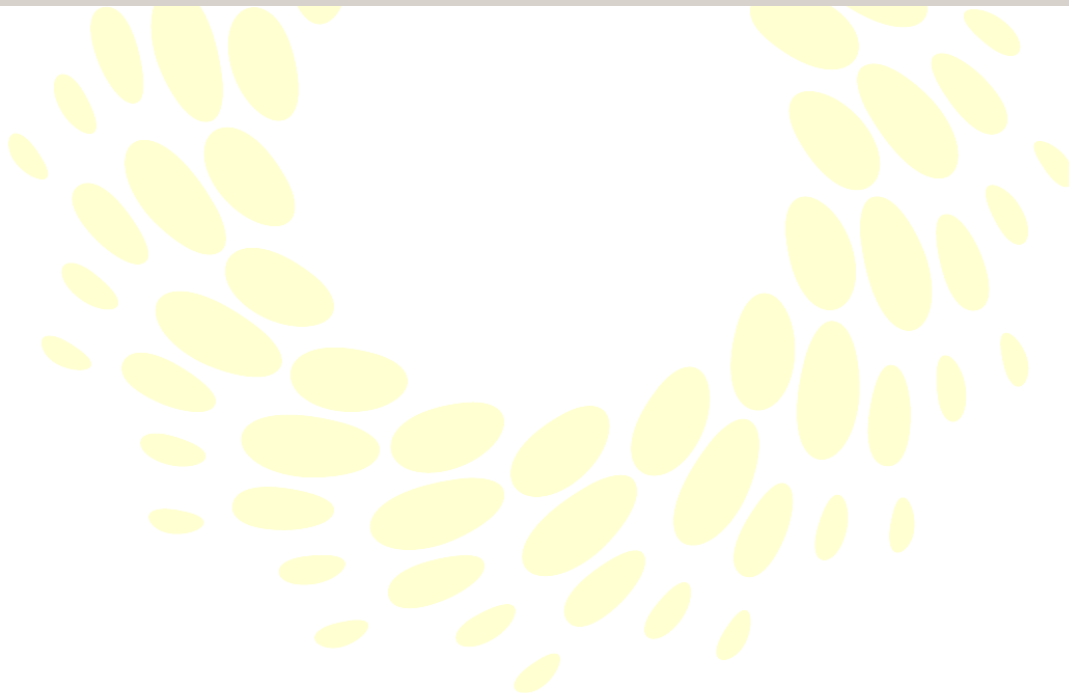
NGSS Disciplinary Core Idea	4-PS3-4 Energy
Disciplinary Core Ideas	Energy can be transformed between objects, solutions are limited by resources.
Performance Expectations	Applying scientific knowledge to solve problems.
NGSS Disciplinary Core Idea	4-ESS3.1
Disciplinary Core Ideas	Combine information on energy and fuel that we can get from nature (fossil fuels) and how that impacts the planet. Our lesson: briefly touches on what fossil fuels are, but not the focus
NGSS Disciplinary Core Idea	4-ESS3.2
Disciplinary Core Ideas	Generate and compare multiple solutions to reduce the impact of natural Earth processes on humans. Solution our lesson provides: what renewable energy sources are and how we can use them (also touches on ETS1.B)

Big Question:

What different types of power sources exist and how do we power our cities?

Key Terms:

1. **Renewable:** Something we will never run out of and can use as much as we want of, like wind, or sunshine.
2. **Non-renewable:** Something we will run out of. There is only a certain amount of this thing and once it is all used up, we can't get it back-- like fossil fuels.
3. **Climate change:** Changes over a long period of time in the temperature and weather patterns around the earth
4. **Wind Energy/Power:** Light from the sun that is then turned into energy that can be used to heat, light and power our homes and businesses.



5E model part 1: Engage (5 minutes)

Introduction and Background: 6-8 minutes

In this lesson we will focus on the aspects of physics and energy and less on energy in an electric sense—the conversion of energy to electricity will be covered in the second lesson in this unit.

So, what *is* wind?

To start, let us talk about energy! What is energy and how do we use it?

We need energy for everything in our life. Energy is what fuels us-- like when we have a snack after playing basketball. It creates electricity which powers our lights, charges our phones, and fuels our cars.

Some of you may have heard of the difference between two different energy sources, renewable and *non*-renewable. Do not worry if that word is new, we are going to learn all about it. Energy comes from many different places including ones we can use over and over again, and some we can only use once. We are going to watch a video that helps explain this.

<https://www.youtube.com/watch?v=jGds7edakbk> (1:15)

Let us summarize some of the things we just saw in the video. I am going to ask a few questions and you will pause this video and talk about them as a class!

- Question 1: What does renewable and non-renewable mean?
- Question 2: What are greenhouse gases?
- Question 3: What is climate change?

Key Terms:

1. **Renewable:** something that can be used again and again. When we use it, other people can still use it because there is enough. When we go outside in the sun to warm up, other people can also go in the sun-- just because we use it doesn't mean other people can't
2. **Non-renewable:** there is not enough of this to use forever. If we use it, someone else cannot. Like on Halloween when we get candy-- eventually if we keep eating it, we will run out. Every candy bar we eat is a candy bar someone else can't eat
3. **Climate change:** long term changes in weather patterns. These changes over time have included rising temperatures around the world, more natural disasters (like fire), and changes in what the seasons look like
4. **Greenhouse gases:** A gas that traps heat close to the earth causing it to warm up

This video brought up greenhouse gases and, while these can seem alarming, we need them to keep our planet warm enough to survive— as scientists' it is important to look at all perspectives and the data. One way that greenhouse gases are released is when we burn non-renewable energy sources. Without *any* greenhouse gases our planet would be freezing, and nothing could survive on it. The right amount of these gases is like putting on a jacket when it is cold out.

Question: What would happen if we released *too many* of these gases if greenhouse gases are like a jacket?

Answer: When we release too many of these gases, our planet gets overheated just like putting on a jacket on a hot day.

Many of these non-renewable resources have been storing excess greenhouse gases so the planet does not overheat. As we burn them, we release the stuff stored inside, adding more to the planet, and warming it up. This is what causes *climate change*.

Climate change is long term changes in weather patterns. These changes over time, like overall hotter temperatures, rising sea levels, and more natural disasters (think of fire season).

While greenhouse gases are not always bad, one way we can avoid producing more of them is by using *renewable* energy. Now that we know the basics of what energy is, we are going to discuss one type of renewable energy and how we can use that energy to our advantage by building a wind turbine.

5E model part 2: Explore (25 minutes)

Wind energy: 4 minutes

Some of you may have seen wind turbines driving to the other side of Washington or have seen pictures of them. Let us watch a quick video walking us through what a wind turbine is and how it works

<https://www.youtube.com/watch?v=8lWTQdHEazg> (2:30, start at 30 sec)

Question: What are the types of renewable energy that the video mentioned?

- Wind
- Solar
- Water

Awesome summary team! It is finally time for us to **build our own wind turbines!** We will walk through the steps together!

Activity One: Building the wind turbines

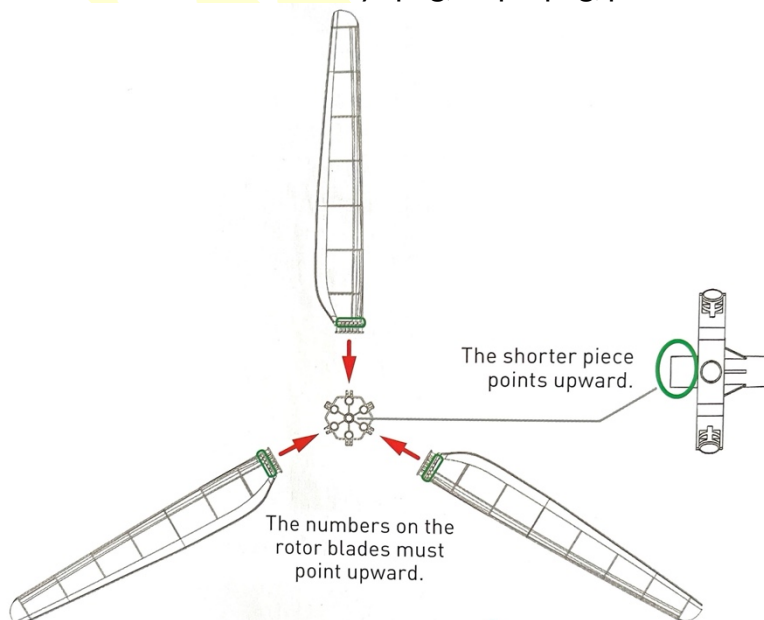
Acting as engineers, students will be using the wind turbine kit in partners to construct a turbine and charge a battery.

Essential Concepts

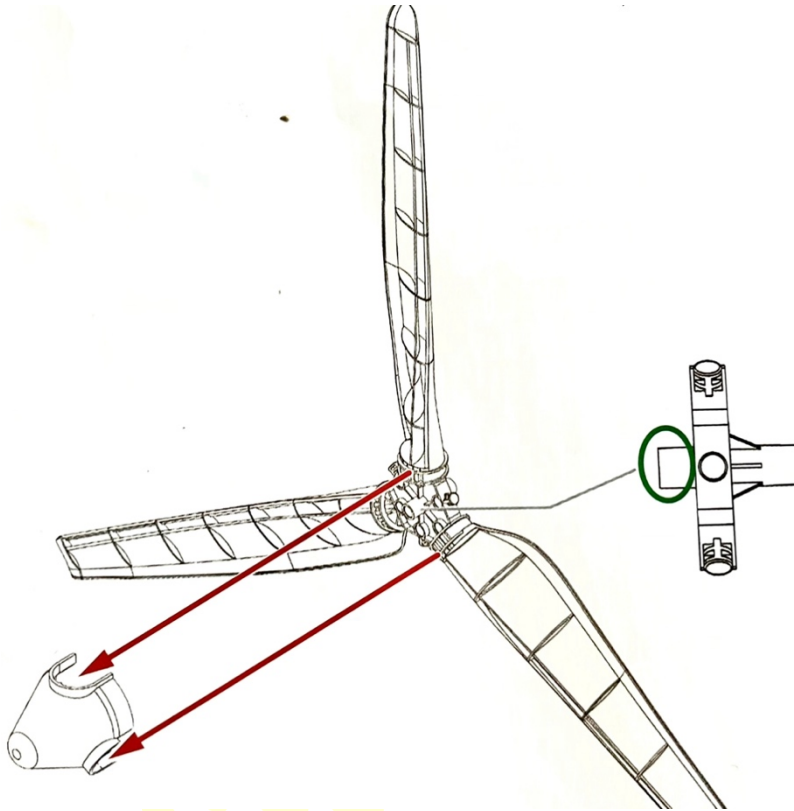
This is the first step in connecting the dots between wind energy and electricity generation/storage

Activity One Procedure: 15-20 minutes (not including charging)

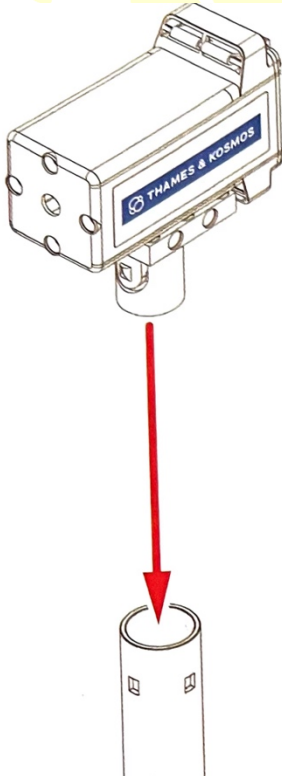
1. Teacher will use document cam at front of class to work through building the turbine in pairs as a whole class
2. Before beginning the building process, tell the students that there is a battery in the nacelle (A nacelle is the battery and gear compartment where the wind energy is converted into usable energy and stored by the batteries in this turbine.) and that it is rechargeable. So, as the blades turn, they are creating energy that is going into the battery and being stored.
3. Taking the center cog piece, students will attach the three blades. Place the first blade on the sideways peg, skip a peg, put on the next, and repeat for the third.



4. Once the blades are on have another student put the cone shaped cap over the cog.
5. Next, the blades will need to be aligned properly. There are small numbers on the edges of the blade. Line the number 3 up with the arrows on the cone cap.

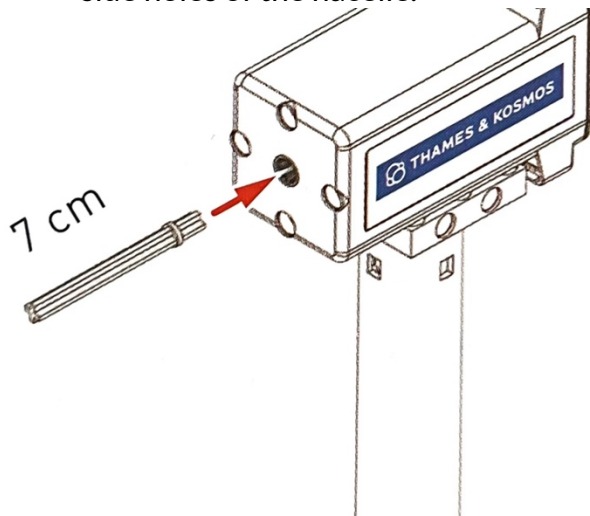


6. Now it is time to attach the *nacelle* to the base. To attach the nacelle, just line the nubs on the bottom up with the holes on the top.



7. Put the black rod in the hole on the nacelle.

8. Put the white bar with two red studs onto the gray rod, attaching the studs in the side holes of the nacelle.



9. Attach the fan unit.
10. Once the turbines are put together, they will need to be placed in front of fans to create energy.
 - a. In order to cut down on the number of fans needed, half of the teams will put their turbines up to charge. This will take a total of 10 minutes. Once the time is halfway passed switch the turbines with the other groups. While all of the fans are charging students will work on an alternate activity-- see activity 3 below to complete while the turbines charge.
11. Once the fans have charged, have students press the button on the back of the nacelle to the "in" position. This will use the charge from the batteries to start turning the blades on its own. Explain to the students that this is because the battery took and stored energy when the fan was "charging" that can now be used to power things (in this case, the fan).

Activity Three: Wind turbine diagram

While it is important to learn the general ideas of how a wind turbine works, it's also important to learn some of the specifics. This activity can be done while the wind turbines charge.

Essential Concepts

The more mechanical elements of the wind turbine, focusing on some of the more engineering/problem solving based NGSS standards.

Activity Two Procedure: this should take **10 minutes, 5 for each group to charge their fans**

1. Give students diagrams bellow to fill out.
2. Using the power point slide presentation, *describe* the parts of the turbine but do not show what it is. Have students guess what you are describing
3. Go through and fill out the worksheet in this manner. If it is too loud in the classroom because of the fans, you can print out the power point with notes and allow students to do this independently.

Note: ask students to think about these questions as they go through the worksheet

1. What do we need for the blades to turn?
2. How do we store the energy in the kit?
3. Is that how it works in real life?
4. Why is it so tall?
5. What can we use the energy it makes to power?
6. What do we need for the blades to turn? What are the blades turning?

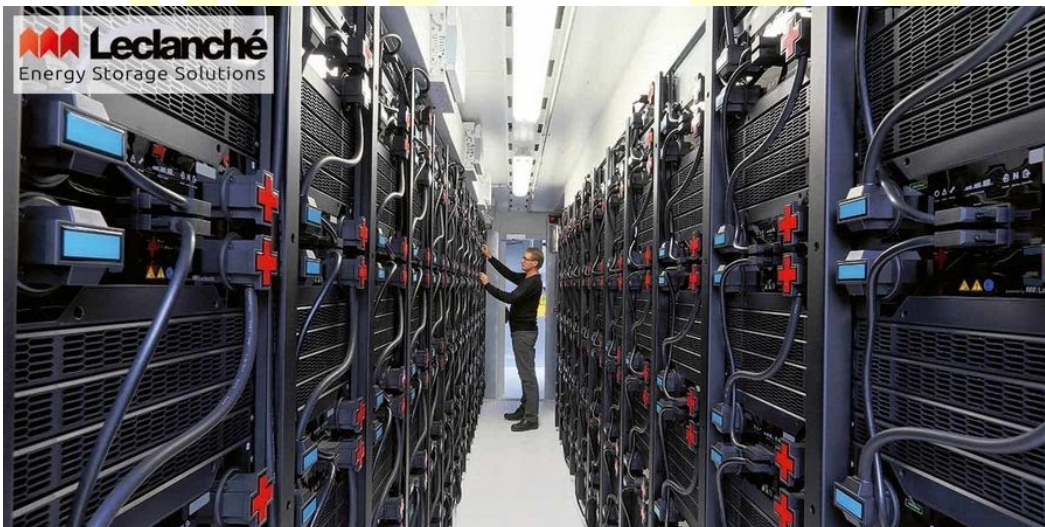
5E model parts 3 & 4: Explain/Elaborate

Discuss what the battery did: **5 minutes**

The reason this worked was because of batteries. We've all used batteries at some point, for a remote control or a toy. Batteries take energy and save it so we can use it later. One problem with renewable energy is trying to keep it so we can use it later once it has been created. By using a battery, we can store energy even when the wind is not blowing.

1. Asking questions
 - a. What happens to the turbines if they don't have wind to move them -> create energy?
 - b. What happens when the wind is blowing, and we don't use all the energy it makes?
2. Conclude with this video on why we need battery storage for wind power and a class discussion
 - a. <https://www.youtube.com/watch?v=4Ha5vSlpW2w&t=104s> (1:48 min)
 - b. Picture of batteries

We use energy for *so* many things in our daily lives. A great way to help the planet AND save tons of money is finding ways to reduce our energy consumption. Your teacher is going to hand you a sheet on something called bright action, a website that helps us in Spokane learn about our energy use!



5E model part 5: Evaluate (5 minutes)

Finish the lesson with the exit survey.

By the end of this Lesson

Concepts Learned:

- Nature interacts with things humans build and engineers can solve problems by working with nature.
- Most types of energy (renewable and nonrenewable) work the same way.
- Energy can be stored in a battery to be used later.

- Different types of energy can be used to power cities and the things we use every day.

Connections Made:

- **Renewable:** Something we will never run out of and can use as much as we want of, like wind, or sunshine.
- **Non-renewable:** Something we will run out of. There is only a certain amount of this thing and once it is all used up, we cannot get it back-- like fossil fuels.
- **Climate change:** Changes over a long period of time in the temperature and weather patterns around the earth
- **Wind Energy/Power:** Light from the sun that is then turned into energy that can be used to heat, light and power our homes and businesses.

Additional Resources:

If there is time, reference the following worksheets that cover renewable energy.

Is it Renewable?

Instructions: Next to the picture of the energy source circle YES if it is renewable and NO if it is not renewable. Then use your yes or no answer to spell a secret phrase.



Wild about Wind!



Center for **Climate, Society,**
and the **Environment**

What is energy?



Video!



Greenhouse Gasses

Why We Need It

- Keeps the planet warm

Question: What do you think releasing **too many** of these gasses would do to the planet, if greenhouse gases are like a jacket?

Why We May Not Need It

- Too much warming changes the climate

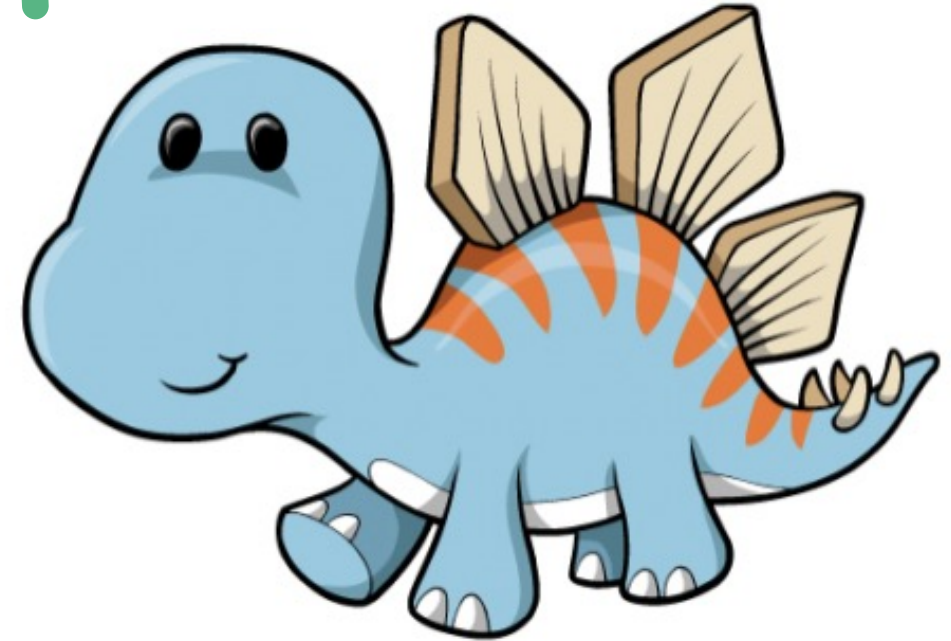
Answer: When we release too many of these gasses it's like putting on a jacket when it's a hot day, you get overheated.

A changing planet

- Non-renewables store extra gas
- Burning them releases that gas
- One reason the planet is changing

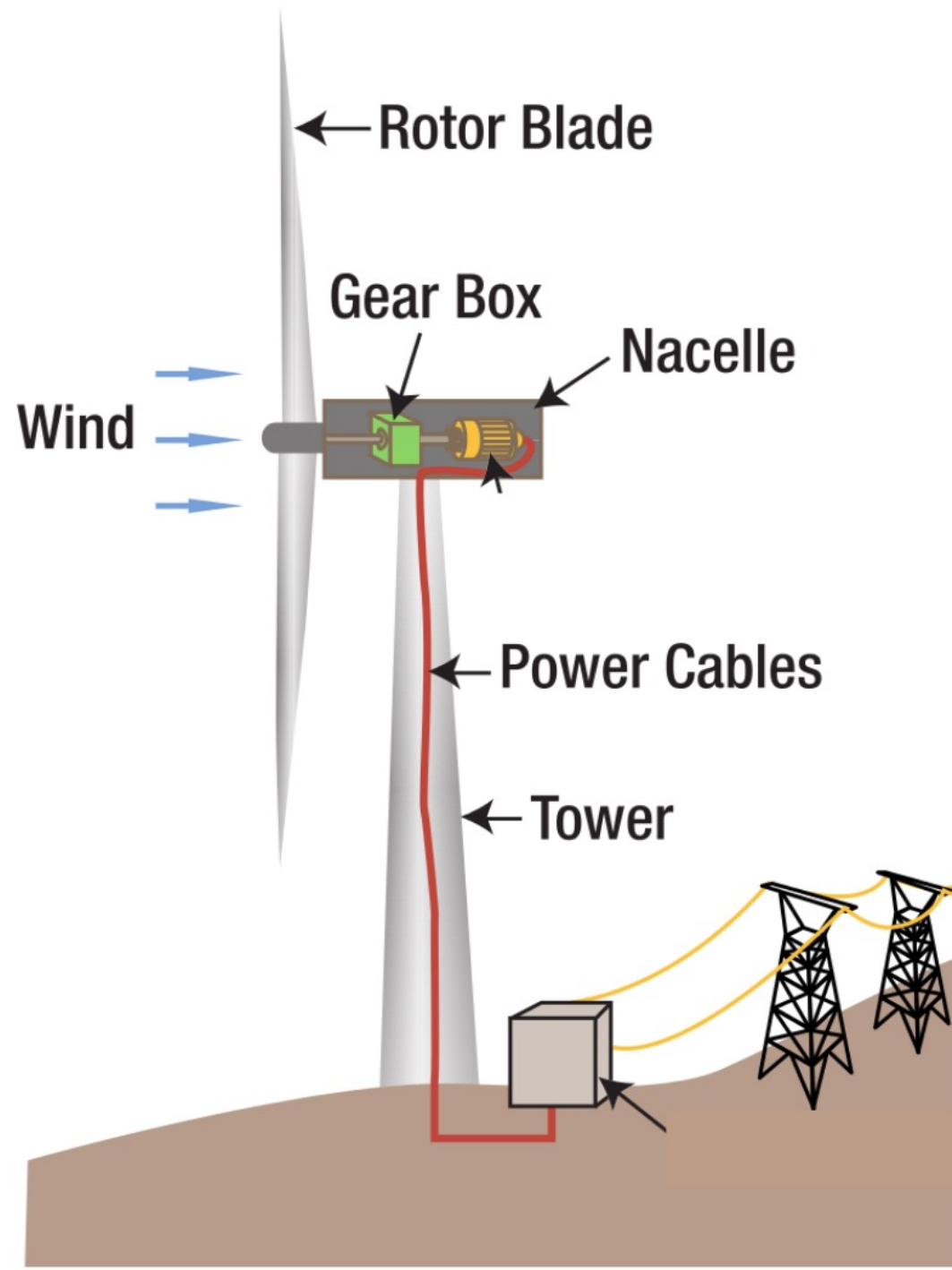
Changes

- Rising sea
- Hotter temperatures
- Fire seasons



Video:



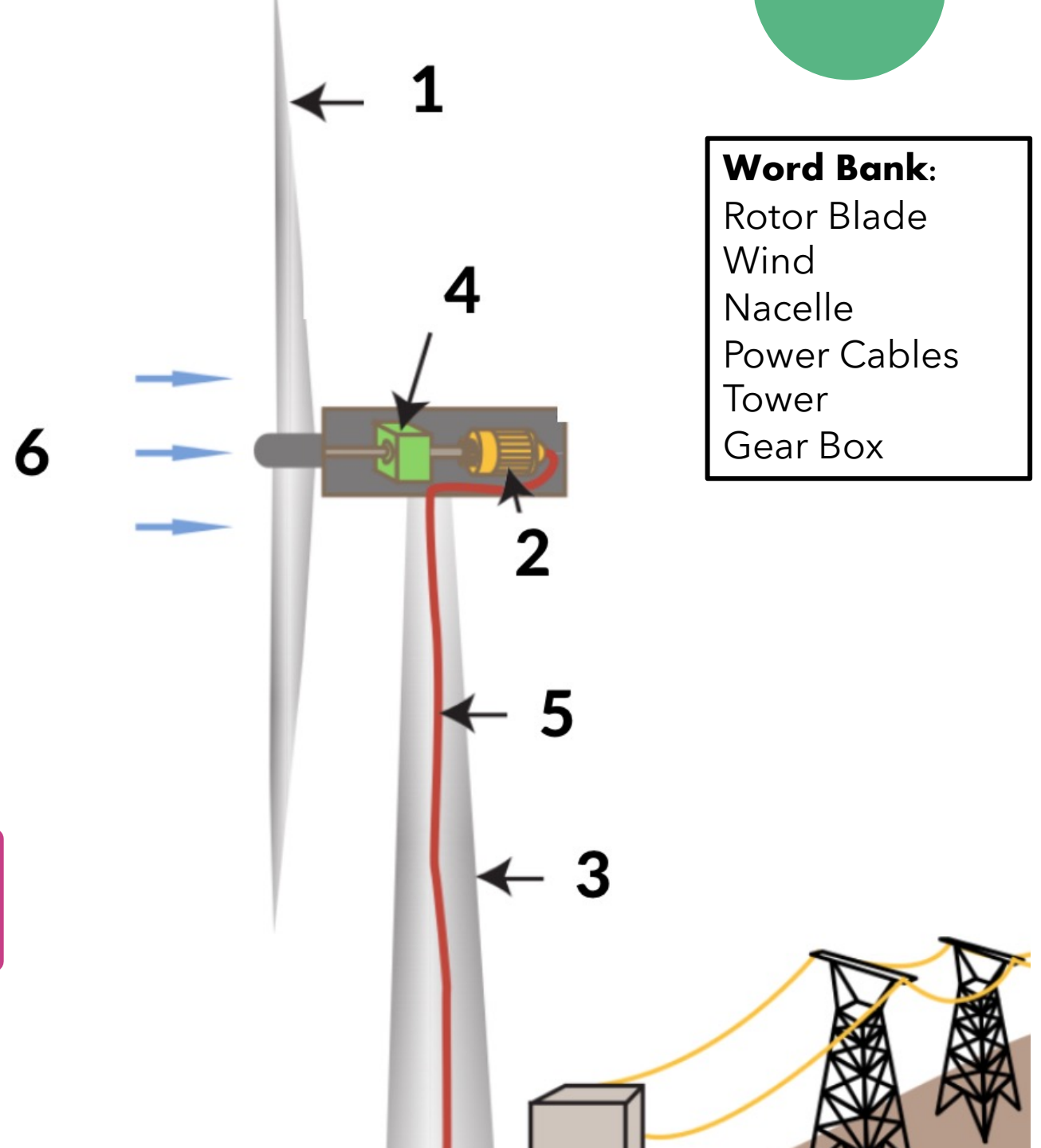


Engineering & Constuction Time!



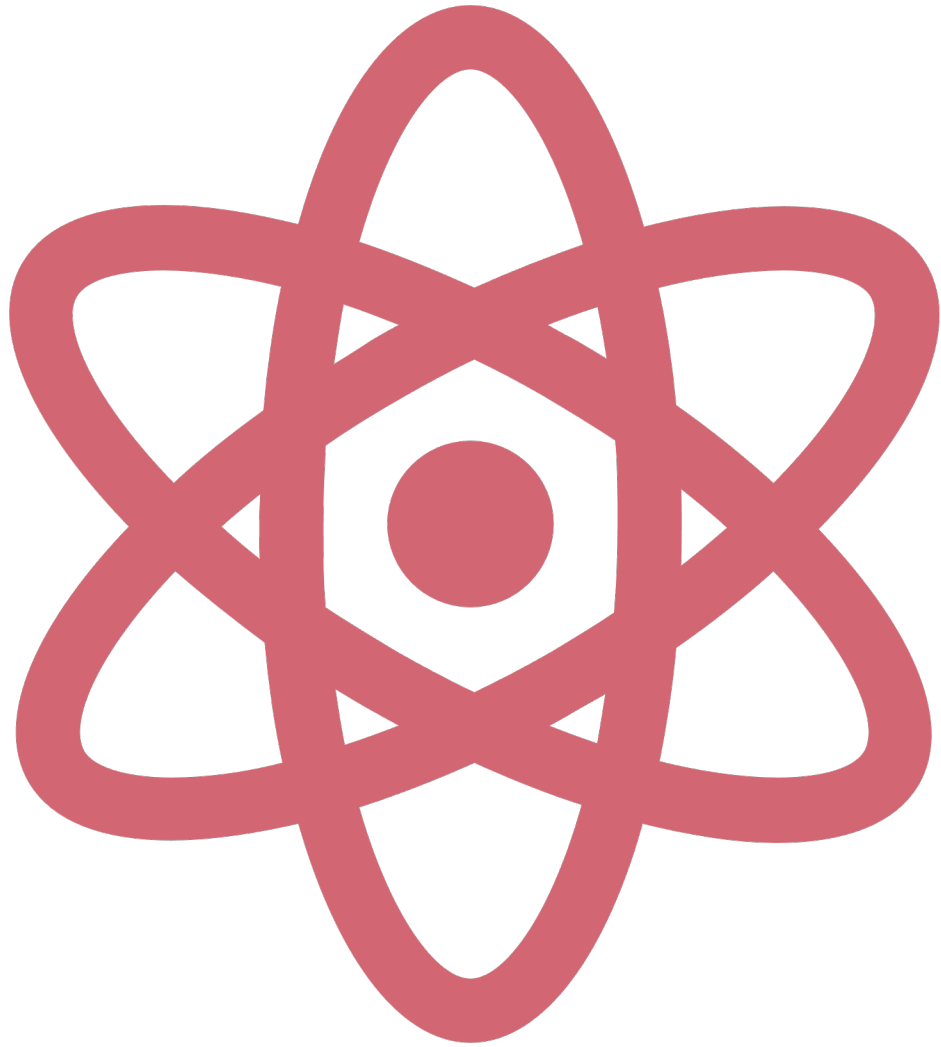
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Charging Break



Why Batteries are Important





**Thank You
Engineers
and
Scientists!**