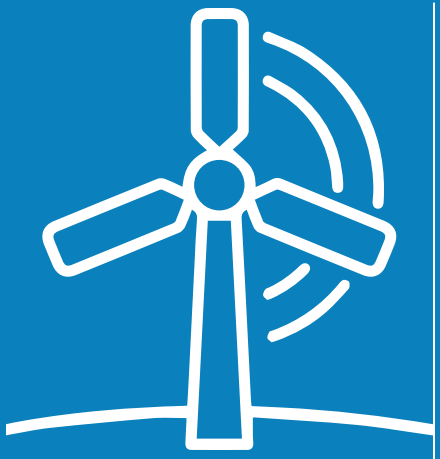

Wind Energy Extended

Contents:

- Twelve, 45-minute lessons
- Vocabulary
- List of Standards addressed

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Afterschool Curriculum:

The Wind Energy curriculum has twelve 45-minute lessons. Each lesson incorporates several vocabulary words. It would be a good practice to refer to these words throughout the lesson progression. These lessons would be appropriate for grades 3-8.

Format: Each lesson attempts to solve a question or problem. Each one starts with a "setting the stage" question for whole group input followed by a short (4 minute) video that further sets the stage. Each lesson asks kids to predict, measure, and chart. Having computer paper and pencils handy is a good practice.

Then, kids will work in groups or alone to complete a project related to the topic at hand. Reflections follow each project. Those can be oral, written, or podcasty or some combination of all the above. Many topics listed on the next page, have enrichment activities.

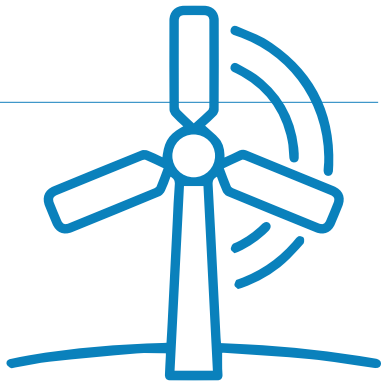
Beyond School Bells is very grateful to NextEra Energy Resources and the students and faculty at Wayne State College for developing this material which will be freely shared with afterschool programs across Nebraska.

Topics:

Day 1: What on Earth is a Wind turbine?
Day 2: Welcome to the Wind!
Day 3: Exploring the Wind! Blown Away! (3.1 and 3.2)
Day 4: Exploring the Wind! Entrance to Energy! (4.1-4.2 and 4.3)
Day 5: Air Pollution Baseball! Air Pollution Jeopardy! (5.1 and 5.2)
Day 6: Race the Wind! (6.1 and 6.2)
Day 7: Community Connections
Day 8: Anemometer and Fun!
Day 9: Sailboats, History, and Wind Energy
Day 10: Building a Human Grid Modeling Electrical Flow
Days 11 & 12: Wind Turbine Building Challenge

Wind Energy Vocabulary

Extended Curriculum



Vocabulary:

Wind turbine: a turbine having a large vaned wheel rotated by the wind to generate electricity.

Blades: the most critical piece of a wind turbine; they harness the wind energy.

Generator: a machine for converting mechanical energy into electricity.

Hub: what the blades of the wind turbine are connected to

Tower: the tubular portion of the wind turbine that holds the nacelle.

Nacelle: (na-cell) housing at the top of the tower that holds the electricity generating components.

Energy: the ability to do work. (Or, "power derived from the use of physical or chemical resources. For example, to provide light and heat or to work machines.")

Energy source: a source that energy is taken from.

Kinetic energy: energy something has by being in motion.

Wind energy: the energy of air in motion.

Renewable energy: energy that is replaced naturally or controlled carefully and can therefore be used without the risk of running out

Nonrenewable energy: energy that cannot be replaced after use.

Pressure: continuous physical force pushing on an object by something in contact with it.

Electricity: a form of energy resulting from the existence of charged particles (such as electrons or protons), either statically as an accumulation of charge or dynamically as a current.

Pollution: the introduction into the environment or presence of something that has harmful or poisonous effects.

Environment: the setting or conditions in which a particular activity is carried on.

Anemometer: an instrument used to measure wind speed.

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Definitions derived from Oxford dictionary, or created by curriculum developers.

L1 What on Earth is a Wind Turbine?

Lesson 1 of 12

Hi Pals, it's your new friend Watt! And I am a wind turbine!
ASK - Have you seen a wind turbine in action? What is one thing that you thought about when you saw it? (Solicit up to 10 responses). WRITE - Responses on the board.

Big Question: What is the purpose of a wind turbine? What are its parts?

Set the Stage: Energy 101: Wind Power Video

Activity:

Procedure: After the intro video – Engage
After the video, we are going to learn about the purpose and parts of a wind turbine using first-hand knowledge. This model will help support what is coming in days 2-12. We are going to build one ourselves!
Distribute materials.

Building Steps:

1. Glue two popsicle/craft sticks together in the middle, so the sticks make a cross.
2. Use hot glue (instructors might need to perform this step) to attach the popsicle sticks to either end of the unsharpened pencil. Hold pencil still until the glue is dry.
3. After the glue is dry enough to hold a pencil up by itself, tape two craft sticks to the plastic cup.
4. Then, tape a crafting stick flat on top of the two sticks, making a platform.
5. Next, tape two or three crafting sticks together, like a picket fence, and attach them to the platform to make a triangle or square-shaped tunnel for the pencil to go through (see images for clarity).
6. Now, cut the dixie cup in half, remove the bottom parts, and then cut the two halves in half to make fourths as the picture shows.
7. Put masking tape on one long end of each dixie cup section and attach them to the crafting stick blades. (Be sure all blades point the same direction as in the picture provided.)
8. Finally, insert the pencil in the tunnel and spin the blades. They should spin easily.

Materials:

- 1 paper or plastic dixie cup per student
- 1 plastic, 18 oz. party cup per student
- 7 or 8 large crafting sticks per student
- 1 round, unsharpened pencil per student
- 1 roll of masking tape per every few students
- 1 pair of scissors per student
- Glue gun

Note to teacher:

- this activity could be completed in pairs.

For the Teacher:

Students will be instructed on the different parts of a wind turbine: blades, generator (inside the nacelle), hub (what the blades attach to), tower (standing part), and the nacelle (on top of the tower and holds the generator). There will also be a brief explanation of what wind turbines are used for. For example, wind turbines are used to take energy from the wind and turn that energy into electricity that we can use.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards: SC.1.6.2.B, SC.2.3.1.A, SC.3.1.1.A, SC.4.4.2.C, SC.4.4.2.D., SC.4.4.2.E, SC.4.4.2.F, SC.6.4.1.B, and SC.6.4.1.D

L2 Welcome to the Wind!

Lesson 2 of 12

Introduction: To get the students excited and ready for the day, set up fans around the room. Blow up balloons of various sizes and place them in a large trash bag. When students are settled and, in their seats,, empty the large trash bag of balloons in front of the fan. The fan will act as a source of wind by blowing the balloons around the room. Ask the students what caused the balloons to fly around the room; use guiding questions to lead them to the answer of wind!

Big Question: What is wind? What causes wind?

Set the Stage: Energy 101: Wind Power Video

Activity:

Procedure: After the intro video – Engage
After the videos, say, today, we are going to learn about how pressure relates to wind!

Building Steps:

1. Place the deflated balloon over the rim of a water bottle.
2. Set out your two bowls one with ice-cold water and one with boiling or very hot water. Fill the bowls so that when the water bottle is placed in that bowl, the bottle is 1/3 to 1/2 submerged. The bottle may need to be held down, but that will not alter the result.
   Note: This experiment can be done with only one bowl. After the balloon has inflated, pour out the hot water and replace with ice.
3. Place bottle with the balloon in cold water and notice how the balloon does not inflate.
4. Take the bottle and place it in hot water watching as the air inside the bottle expands, due to the heat, and fills the balloon.
5. Remove the bottle from hot water and set on the table and observe how balloon stays inflated.
6. Move bottle to cold water and watch the balloon deflate as the air cools and becomes more dense.

Materials:

- 1 electric fan or more
- 2 packages of balloons
- 2 trash bags
- 2 bowls deep enough to cover ⅓ to ½ of a water bottle for each group of students
- 1 bowl of hot water and 1 bowl of ice-cold water for each group of students
- 1 empty water bottle for each group of students

For the Teacher:

Allow students to take turns moving the bottle from the hot to cold water.
Ask them observation questions:

- What is happening to the balloon in the cold-water vs. the hot water?
- What is moving inside the bottle that causes the balloon to inflate?
- Work toward making the conclusion that warm air rises and causes a movement in the air.

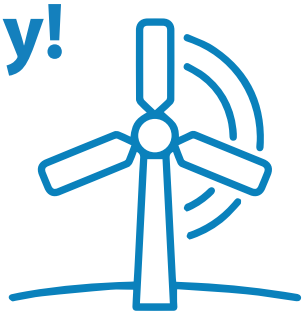
Then relate this to the wind moving outside that when it is windy outside way up high in the sky, the air has to me changing temperature or pressure and causing a current of air to move known as wind.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.4.4.2.B, SC.4.4.2.C, SC.4.4.2.F, SC.6.4.1.C and SC.6.4.1.D

L3.1 Exploring Wind! Blown Away!

Lesson 3 of 12 (Option 1)



Introduction (Option 1): Teachers will have three objects, a notecard, a pencil, and a cup. The teacher will place these objects in front of a fan and see what object blows the farthest. Students will be asked questions throughout the process: Which object do you think will move the furthest? Why?

Big Question: How do different shapes and densities affect how far objects can travel in wind?

Set the Stage: Introduction Above

Activity:

Procedure: After the introduction activity, say – Today, we are going to have balloon races!

Steps:

1. Split students into groups of four.
2. Each group needs one 10ft long piece of string, four balloons, and four straws
3. Have two students (one on each end) hold the string
4. Have one student blow up his or her balloon and pinch the end shut
5. Have the fourth student grab a piece of tape and attach the straw to the side of the balloon
6. Thread the string through the straw with the opening of the balloon facing the starting end of the string, still making sure the balloon is pinched closed.
7. Once the string is threaded through the straw, pull the string tight and let go of the balloon watching the balloon slide across the string.
8. Have students rotate so each student can race his or her balloon.
9. If time allows, pair groups up and have them race the balloons. Have the groups move next to each other and see which group's balloon travels faster.
10. If there is more time, you can tie the strings together (using the knot of your choice) to form a longer string.

Materials:

- 10 feet of string per group of four (to race balloons on)
- A roll of tape
- 1 balloon and 1 straw per student
- 1 notecard
- 1 fan
- 1 cup
- 1 pencil

For the Teacher: Enrichment

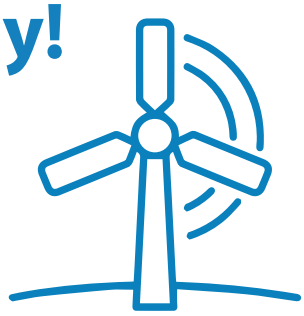
Tape another balloon on the other side of the straw. Blow both balloons up and let go. ASK - Do the balloons travel faster when there are two on the straw instead of only one? ASK - Why do you think that is?

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.4.4.2.B, SC.4.4.2.C, SC.4.4.2.F, SC.6.4.1.C and SC.6.4.1.D

L3.2 Exploring Wind! Blown Away!

Lesson 3 of 12 (Option 2)



Introduction (Option 2): Teachers will have three objects, a notecard, a pencil, and a cup. The teacher will place these objects in front of a fan and see what object blows the farthest. Students will be asked questions throughout the process: Which object do you think will move the furthest? Why?

Big Question: How do different shapes and densities affect how far objects can travel in wind?

Set the Stage: Introduction Above

Activity:

Procedure: After the introduction activity, say – Today, we are going to make and fly homemade kites!

Steps:

1. Fold construction paper in half (hamburger style).
2. Write a mark 2 ½ inches from the edge of the fold.
3. Make an additional mark 2 ½ inches from the first mark.
4. Fold the corners on one side of the construction paper to the first mark and staple.
5. Punch a hole along the fold on the second mark.
6. Lace string through the hole and secure it tightly with a knot.
7. FLY!

What it's all about: This shows how the movement of air (the air coming out of the balloon or air flying the kite) can force objects to move; just as the wind causes the blades of a wind turbine to move.

What does this have to do with wind energy? This lesson shows the wind's capability to move objects. This lesson also demonstrates that what an object is made out of can alter how easy or difficult it is for the wind to move it. Students will be able to relate this idea to the blades of wind turbines spinning and generating electricity

Materials:

- Construction paper per student
- Hole puncher per every few students
- String per student
- Stapler per group
- Ruler per student

*optional - markers for designing

For the Teacher: Enrichment

If you did both experiments, balloons and kites, ASK - Which experiment did you like best? ASK - Why?

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards: SC.4.4.2.B, SC.4.4.2.C, SC.4.4.2.F, SC.6.4.1.C and SC.6.4.1.D

L4.1- 4.2 Entrance to Energy!

Lesson 4, of 12 (Stations 1 and 2)

Introduction: This lesson is all about energy. Energy plays a huge role in wind turbines.
ASK - What do you know about energy? Can you see examples of energy happening around you?
WRITE - Examples on the board for later verification.

Big Question: What is energy? Energy is the ability to do work!

Set the Stage: What is Energy? Video

Activity:

Procedure: After the intro video – Engage
Set up 3 stations (Dominoes/books, Marshmallow Shooter, and Ruler/ Marbles experiment) students rotate through practicing using different types of energy. Station 3 directions are on the page that follows.

Station1: Dominoes and the Transfer of Energy

1. Have students set up the dominoes in a line.
2. Once all the dominoes are set up, have one student push the first domino over.
3. Observe the effect of the dominoes (one-by-one knocking each other over).
4. The instructor(s) explain the transfer of energy. When energy is exerted on an object, that energy is stored in that object until it transfers to another object.

Station 2: Marshmallow Shooter

1. Give students the necessary materials (cup, balloon, marshmallow).
2. Remove the bottom of the cups and then stack the two cups.
3. Cut the tips of the balloons off (the tight band).
4. Covering the newly made holes, put the deflated balloon around the bottom of the cups.
5. Put the marshmallow in the cup.
6. Pull back on the balloon and release. When you release, the marshmallow should fly out of the cup.
7. Again, explain the process of transferring energy (see station one).

Materials:

- 1 set of dominoes,
- At least 5 books (can be used instead of dominoes)
- 1 red plastic solo cup per student
- 1 balloon per student
- 1 marshmallow per student
- (pompons can also be used)
- 3 rulers
- 12 marbles (4 per ruler)

For the Teacher:

Energy can be transferred between objects. Energy is everywhere and can take all sorts of forms [ex: heat, electricity, motion]) Wind turbines process energy by transforming wind energy (motion of air particles) into moving the blades, which is then used to generate electricity. Energy is transferred from motion to electricity by the generator.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.4.4.2.C, SC.4.4.2.B, and SC.4.4.2.C

L4.3 Entrance to Energy!

Lesson 4, of 12 (Station 3)

Introduction:

This lesson is all about energy. Energy plays a huge role in wind turbines. ASK - What do you know about energy? Can you see examples of energy happening around you? WRITE - Examples on the board for later verification.

Big Question: What is energy? Energy is the ability to do work!

Set the Stage: What is Energy? Video

Activity:

Procedure: After the intro video – Engage
Set up 3 stations (Dominoes/books, Marshmallow Shooter, and Ruler/ Marbles experiment) students rotate through practicing using different types of energy.

Station 3: Ruler & Marbles Experiment: (Newton's Cradle)
https://frugalfun4boys.com/transfer-of-energy-science-experiment/

1. Give each group of students two rulers (they should have a groove in the center for the marbles) and four marbles.
2. Set three marbles in the groove of each ruler.
3. Take the fourth marble, set it behind the three marbles, leaving a space between them.
4. Push the fourth marble towards the three marbles and watch as the marble on the opposite end moves outward.
5. Again, explain the process of transferring energy (see station one).

What does this have to do with wind energy? The transfer of energy is a vital concept in wind energy. For wind turbines to operate, there must be a transfer of energy to convert wind to electricity.

Reflection – Ask students what the book, cup, and marble experiments have in common. What do they not have in common?

Materials:

- 3 rulers
- 12 marbles (4 per ruler)

For the Teacher:

Energy can be transferred between objects. Energy is everywhere and can take all sorts of forms [ex: heat, electricity, motion]) Wind turbines process energy by transforming wind energy (motion of air particles) into moving the blades, which is then used to generate electricity. Energy is transferred from motion to electricity by the generator.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards: SC.4.4.2.C, SC.4.4.2.B, and SC.4.4.2.C

L5.1 Air Pollution Baseball

Lesson 5.1 of 12

Introduction: This lesson is all about air pollution. Air pollution affects all living things.
ASK - What do you know air pollution? Can you see examples of it happening around you?
WRITE - Examples on the board for later verification.

Big Question: What causes air pollution? What are renewable and nonrenewable energy sources?

Set the Stage: What is Air Pollution: Video

Activity:

Procedure: After the intro video – Engage

1. Split the group into grades K-2, 3-6. Each set of grades need two teams. Make sure to split the teams evenly having a fair amount of younger to older kids on each team.
2. Use the questions listed above that are sorted into single, double, or triple. The difficulty of the question correlates to the number of bases. Have one team sit down and the other create a batting order, note that the students must keep the same batting order.
3. Establish different points in the room that will serve as first, second, third, and home plate.
4. Send the first batter to home plate. The teacher will be the pitcher and ask the batter if he/she wants a single, double, triple. Then ask a question listed under the category the batter selected. If correct, the batter can move that many bases. If incorrect, do not read the correct answer as the question can be used again, this also serves as a strike.
5. Every time a batter gets a question right, all members of that team, that are on a base, move the number of bases that the batter is moving. Once a batter gets home, that team gets a point.
6. After three incorrect answers (strikes), the other team is up to bat.
7. The game can end when there are no more questions, or there is no more time available (questions can be repeated).

Materials:

- Question cards with air pollution and renewable and nonrenewable questions (See back of Lesson for questions.)
- Something to be used as bases

For the Teacher:

What does this have to do with wind energy? Learning what renewable and nonrenewable sources of energy are, helps the students to understand why wind energy matters.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.K.7.2.B, SC.K.7.2.D, SC.2.3.1.A, SC.4.4.2.F, and SC.5.1.3.4.C

L5.1 Air Pollution Baseball - Questions

Lesson 5.1

1. What is wind? (SINGLE)
    a. A current of air that moves across the Earth
2. Do you think there would be more air pollution in a big city or a small town? (SINGLE)
    a. Big city
3. Which type of resources on average is safer for the environment, renewable or nonrenewable? (SINGLE)
    a. Renewable
4. Give an example of a source of renewable energy (SINGLE)
    a. Water, wind, sun
5. Give an example of a nonrenewable resource (SINGLE)
    a. Coal, gas, oil
6. Can you see energy directly? (SINGLE)
    a. No
7. What different kinds of energy are there? (One base for each type named)
    a. Examples include but are not limited to: thermal, kinetic, potential, sonic, gravitational, wind, solar, nuclear, chemical.
8. Name the parts of a wind turbine (One base for each part named)
    a. Nacelle, hub, blades, tower, generator, anemometer.
9. Why is Nebraska an ideal place to have wind farms? (DOUBLE)
    a. It's flat and windy a lot of the time
10. What is pressure? (DOUBLE)
    a. How much one thing is pushing on something else
11. What is energy? (DOUBLE)
    a. The ability to do work
12. What is pollution? (DOUBLE)
    a. Harmful particles that are introduced to the environment
13. What kind of things cause air pollution? (multiple choice) (DOUBLE)
    a. Cars
    b. Factories
    c. Burning fossil fuels
    d. All of the above
14. What is a nonrenewable resource? (DOUBLE)
    a. Something that cannot be replaced
15. What are renewable resources? (DOUBLE)
    a. Something that doesn't run out faster than you use it
16. How can the world reduce air pollution? (DOUBLE)
    a. By using more renewable resources
17. How can air pollution affect plants (DOUBLE)
    a. Plants die quicker, they don't grow as well, they wilt
18. What needs energy? (DOUBLE)
    a. Our homes, humans, plants, animals, cars, planes, trains, electricity, phones
19. Why is air pollution bad? (TRIPLE)
    a. It can make people sick
20. What are ways you can reduce pollution at home? (TRIPLE)
    a. Recycle, ride a bike or walk instead of driving, shut lights off when not in use, plant trees and plants

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.K.7.2.B, SC.K.7.2.D, SC.2.3.1.A, SC.4.4.2.F, and SC.5.1.3.4.C

L5.2 Air Pollution Jeopardy

Lesson 5.2 of 12

Introduction: This lesson is all about air pollution. Air pollution affects all living things.
ASK - What do you know air pollution? Can you see examples of it happening around you?
WRITE - Examples on the board for later verification.

Big Question: What causes air pollution? What are renewable and nonrenewable energy sources?

Set the Stage: What is Air Pollution: Video

Activity:

Procedure: After the intro video – Engage

1. Split the group into grades K-2, 3-6. Each set of grades need two Split the group into K-2 and 3-6, then split each section into two or three teams.
2. Have each team create a group name. Then explain that they will be playing jeopardy.
3. For the older kids it is recommended that you have them answer the questions on their own but for the younger students have them work as a team to come up with an answer.
4. Feel free to create your own jeopardy rules… for example if the teacher knows the answer to the question without having to flip the card and the students seeing they can create a steal option if the first team get the question incorrect!
5. If a projector is unavailable write the categories and points on a whiteboard and have students erase the points as they choose that question. The teacher can then read the question orally to the student in this option the stealing points is fun to do and hell all students stay engaged and listening!

Materials:

- Computer with internet access, for large groups a projector or smart board for students can see questions
- Link: https://jeopardylabs.com/play/air-pollution-and-more

For the Teacher:

Pollution occurs when potentially harmful particles are introduced to an environment. Air pollution, in particular, is caused by vehicle exhaust, factories, and the burning of fossil fuels. The energy used to power cars, fuel factories, and light buildings is either renewable or nonrenewable. However, the majority are nonrenewable, which is a problem. Generally, nonrenewable energy is more harmful to the environment than renewable energy. (Except for nuclear energy, which is less harmful to the environment than almost any other energy source).

Nonrenewable energy, simply put, cannot be renewed (in a short time). In other words, we have a limited supply of nonrenewable energy. Nonrenewable energy sources include coal and fossil fuels such as natural gas and petroleum (gas used to power most cars). Renewable energy is energy that can be renewed. These energy sources include wind, water, and solar. These types of energy are always going to be present and are "clean" sources, meaning they don't produce a lot of pollution.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.K.7.2.B, SC.K.7.2.D, SC.2.3.1.A, SC.4.4.2.F, and SC.5.1.3.4.C

L6.1 Race the Wind!

Lesson 6.1 of 12

Introduction: To introduce the lesson, students will be told they are competing in a big race. They will be shown a model of the wind car (the teacher builds a model prior to the lesson), and students will be able to ask questions after being told they will be assembling their own race car.

Big Question: How is wind energy harnessed?

Set the Stage: How to Make a Wind Car: Video

Activity:

Procedure: After the intro video – Engage

1. Teachers first cut out four circles from cardboard (preferably thick cardboard), of equal size, to be the wheels.
2. Using a small nail or tack, poke guide holes in the center of each wheel and on the tubes as well, wherever the tubes will be punctured by the skewer sticks.
3. While the teachers do step 1 and 2 (if they have not already done them before the lesson began), students may decorate and color on one side of their construction paper.
4. If doing the balloon option, students may decorate the cardboard roll itself or their balloons with markers, if given the balloons before-hand.
5. After the teachers have cut out the wheels and made the guide holes in the wheels and tubes (steps 1 and 2), each student will be given four wheels, a paper towel/toilet paper roll, three skewer sticks (one 10 inches long and two 5 inches long), a piece of construction paper, scissors, and some tape.
6. If doing the balloon option students do not need the 10-inch skewer stick or construction paper, but do need a balloon.
7. Students will carefully poke their 5-inch skewers through the paper towel/toilet paper roll, one towards the front and one towards the back.
8. Once the skewers fit through the roll, work them until the skewer can spin inside the holes

Materials:

- 1 paper toilet paper roll per student (paper towel rolls will work even better)
- Several rolls of masking tape for the group
- 3 skewer sticks (1-10-inch stick and 2-5-inch sticks) per student (instructors may cut 10-inch skewer sticks in half to make the smaller sticks)
- Cardboard for wheels (thick cardboard is better)
- 1 piece of construction paper per student
- Markers, Crayons
- Fan power

Note to teacher:

- You will need scissors to cut the wheels and a small nail or tack to make the guide holes before the lesson is started

For the Teacher:

See Lesson 6.2.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards: SC.4.4.2.C, SC.4.4.2.B, and SC.4.4.2.C

L6.2 Race the Wind!

Lesson 6.2 of 12

Introduction: To introduce the lesson, students will be told they are competing in a big race. They will be shown a model of the wind car (the teacher builds a model prior to the lesson), and students will be able to ask questions after being told they will be assembling their own race car.

Big Question: How is wind energy harnessed?

Set the Stage: How to Make a Wind Car: Video

Activity:

Procedure: After the intro video – Engage

1. Teachers first cut out four circles from cardboard (preferably thick cardboard), of equal size, to be the wheels.
2. Using a small nail or tack, poke guide holes in the center of each wheel and on the tubes as well, wherever the tubes will be punctured by the skewer sticks.
3. While the teachers do step 1 and 2 (if they have not already done them before the lesson began), students may decorate and color on one side of their construction paper.
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7. Students will carefully poke their 5-inch skewers through the paper towel/toilet paper roll, one towards the front and one towards the back.
8. Once the skewers fit through the roll, work them until the skewer can spin inside the holes

Materials:

- 1 paper toilet paper roll per student (paper towel rolls will work even better)
- Several rolls of masking tape for the group
- 3 skewer sticks (1-10-inch stick and 2-5-inch sticks) per student (instructors may cut 10-inch skewer sticks in half to make the smaller sticks)
- Cardboard for wheels (thick cardboard is better)
- 1 piece of construction paper per student
- Markers, Crayons
- Fan power

Note to teacher:

- You will need scissors to cut the wheels and a small nail or tack to make the guide holes before the lesson is started

For the Teacher:

See Lesson 6.2.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards: SC.4.4.2.C, SC.4.4.2.B, and SC.4.4.2.C

L7 Community Connections

Lesson 7 of 12

Introduction: This lesson is all learning from a community partner about how their business or service impacts their community, school and home. The teacher introduces the class, each student can share their name and grade.

Big Question: What does this company do and how does it impact the community as a whole?

Set the Stage: Have students use technology to look up some information about your guest.

Activity:

- Introduce the community member.
- Help with any activities that the community member may want to have the students do.
- Have students ask questions such as, "What does you company do? How does this impact our community, my school, and my home?"
- Provide an oral thank you to the guest.

After the visit concludes, have students write or draw something that relates to something that they learned about energy from the community partner today. Students may work in teams. Enclose a couple student words in the thank you note from the group.

Community Partner:

Career Ideas:

- Electricians
- County extension agents
- Power company managers
- High school science teachers
- Electrical, Mechanical, and Civil Engineers
- OSHA representatives
- Wind turbine technicians

For the Teacher:

What it's all about: After the member leaves, follow up with the students to make sure everything that was said was understood and bring the talk back to wind energy.

What does this have to do with wind energy? Having the students ask questions and getting them answered is an elaboration about a topic related to wind energy.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards: SC.K.7.2.B, SC.K.7.2.D, SC.2.3.1.A, SC.4.4.2.F, and SC.5.1.3.4.C

L8 Anemometer and Fun!

Lesson 8 of 12

Introduction: Students will be shown the model anemometer (created by the teacher(s) prior to the lesson). ASK – Do you know what this is? WRITE – Guesses on the board. Students will be shown how the model anemometer works.

Big Question: How is wind energy harnessed?

Set the Stage: How to make an anemometer (wind speed meter): Video

Activity:

Procedure: After the intro video – Engage
Split the students into the same number of groups as instructors. Instructors will each need to be in charge of one group and make this model step-by-step with the students to show the directions as they can be confusing for many kids. (Splitting the kids having a variety of ages in one group works best as older kids may be able to help the younger students.)

Materials:

- Paper puncher(s) (to share)
- Dixie cups (5 per student/group)
- Pencils with erasers (1 per student/group)
- Push pins (1 per student/group)
- Straws (1 per student/group)
- Model anemometer
- Electric fan

Building Steps:

1. Take one cup and punch four holes opposite of each other right below the rim (at the 12, 3, 6 and 9 o'clock positions.)
2. Then, push the two straws through the holes (they will form an X)
3. Use the hole puncher to make adjacent two holes in each of the remaining cups about an inch apart.
4. Put each of these remaining cups onto the ends of the straws through the center cup. Make sure all the cups face the same direction (all clockwise or counterclockwise).
5. Use the tip of a sharp pencil to poke a hole in the bottom of the center cup.
6. Press the pencil through the hole, eraser first, and wiggle it to widen the hole so the pencil can rotate easily.
7. Lightly push the pushpin through the two straws and into the eraser. (Be sure not to push it in too far, as this will create too much friction). Alternatively, you can use popsicle sticks to use as a holder if the pencil does not rotate properly.
8. Stand the anemometer up and test out the spinning. If it doesn't spin, try loosening the pushpin.
9. Take the anemometer outside, if it's windy, or use a fan.

For the Teacher:

The anemometer helps technicians keep track of wind speeds over time. This information is important in determining the best conditions for maximum energy production. Some areas on Earth have higher average wind speeds than others. Companies like NextEra Energy record and keep track of wind data before deciding where to build their wind turbines. Here is a Nebraska wind map from NREL (National Renewable Energy Laboratory) which shows the average wind speed at 80 meters above the ground in all areas of Nebraska

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.K.12.3.A, SC.3.1.1.B, SC.3.12.4.B, SC.4.4.2.F

L9 Sailboats, History, and Wind Energy

Lesson 9 of 12

Introduction:

ASK – Can we guess what makes the wind blow? WRITE – Guesses on the board.

Big Question: How has wind energy changed over the years?

Set the Stage: Energy 101: Wind Power Video

Activity:

Procedure: After the intro video – Engage

Steps:

1. Pass out materials to each student.
2. Cut the paper plate in half.
3. Stack the two halves of the paper plate on top of each other, aligning the straight edges together and the curved edges together. Trim off the plate's curved edges on the bottom.
4. Position the two halves so that the edges align creating the shape of a boat. Seal the edges with tape.
5. For the sail, cut approximately a 3-inch square out of construction paper. Make two little cuts - one in the bottom-middle and one in the top-middle of the square.
6. Place a straw through the two holes in the construction paper.
7. Take a toilet paper roll and cut a small hole just big enough for the straw in the middle. Then place the straw with the construction paper on it through the hole in the toilet paper roll.
8. Place the toilet paper roll in the boat, creating a sailboat.
9. Race boats.

Materials:

- One paper plate per student*
- One straw per student
- One sheet of construction paper per student
- One toilet paper roll per student
- Scissors
- Masking tape
- Electric fan
-

Note to teacher:
*photos show Styrofoam plate but paper is preferred

For the Teacher:

For THOUSANDS of years, humanity has tried to find ways to harvest energy from the wind. As noted, wind energy is renewable. Therefore, finding ways to maximize the utilization of wind is crucial to the production of energy worldwide. Scientists, engineers, and technicians are continually trying to optimize wind turbines for the most efficient energy production. With all this in mind, teaching about the history and the future of wind energy is instrumental to understanding wind energy.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.4.4.2.D, SC.6.4.1.B

Beyond School Bells
nebraskachildren

L10 Building a Human Grid

Lesson 10 of 12

Introduction:

ASK – Have you ever participated in a wave at a sporting event? WRITE – What does it look like?

Big Questions: How does the motion of energy work? How does energy transfer relate to wind energy/wind turbines?

Set the Stage: Biggest Wave Ever!! Video

Activity:

Procedure: After the intro video – Engage

Building Steps:

1. Have students spread out, starting with a simple circle and changing patterns as the activity goes on.
2. Students will then have one end of a jump rope in each hand. This should form a long-interconnected chain.
3. Upon declaration, have one of the students on the end ripple his or her jump rope by moving his or her arm up and down in a quick motion.
4. The next student will ripple the subsequent jump rope (similar to performing the "wave").
5. Have each student ripple one-by-one until the last student finishes.
6. Students can realign in any way, shape, or form. The main idea is to illustrate how energy can be transferred.

Materials:

- 1 jump rope per student

For the Teacher:

What it's all about: This lesson illustrates the transfer of energy, one of the cornerstones of wind energy. In this case, students will be indicating the motion of energy from one point to another via jump ropes. Students can align in any way. The goal is to represent the transfer of energy from the origin to the end.

What does this have to do with wind energy? Electrical power generated in a wind turbine will travel in an underground line to a transformer (not like the transformers in the movie but a power station) which then sends the power to transmission lines, which are power lines meant to send electricity long distances. From there, the electricity goes to a local transformer which decreases the voltage before being sent to homes.

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.6.40SC.4.4.2.D

L11/12 Wind Turbine Building Challenge

Lesson 11 & 12 of 12

Introduction: To introduce the lesson, the teacher(s) will read the book When the Wind Blows by Stacy Clark. The book gives students a good look into wind turbines and what they entail.

Big Question: How much detail goes into building a wind turbine?

Set the Stage: When the Wind Blows by Stacy Clark: Goodreads Summary
In a poetic text and sweeping landscape paintings, this picture book explores the many facets of the wind.

While the blowing wind makes "porch doors sway" and "sea waves spray," it is responsible for much, much more. These same breezes send electron power traveling down windmills and circuits to ignite electricity. Electrons travel through power lines, and electricity charges the national grid so that lights may be turned on, cold homes may be warmed, and warm homes may be cooled. The guests can help make "Factories hum / Harbors light up / Smart cars run."

Activity/Design Challenge

Procedure: There is not a s pecific set of instructions for this activity since it is a design challenge. The idea is to encourage student creativity. Using the knowledge they have gained over the last 10 activity days, students are challenged to build a new and improved wind turbine (as compared to the initial wind turbine on day one). Just be sure, students are keeping in mind the different parts of a wind turbine and how turbines are assembled during the students' construction.

Materials:

Note to teacher:
You will need an abundance of all of materials including everything that you have used throughout the week and any other craft materials that your students would have fun building with or that would be of help.

Here are some ideas:

- Popsicle/craft sticks, pencils, pens, markers, crayons, colored pencils, skewers, dixie cups, solo cups, tape, scissors, glue, cardboard, paper towel/toilet paper rolls, and whatever else you can think of.

For the Teacher:

What it's all about: This lesson is all about wind turbines. Students will be reminded of the different parts of a wind turbine: blades, generator, hub, tower, and nacelle (holds the generator), while pointing at the pieces on the original model.
What are wind turbines used for? Turning renewable energy from the wind, into electricity that we can use.)

Standards:

Standards addressed by this activity - BSB – The Do Place: State Standards:
SC.K.12.3.E, SC1.6.2.B, SC.2.3.1.C, SC.4.4.2.D, SC.4.4.2.E, SC.4.4.2.F, SC.6.4.1.B, and SC.6.4.1.C