Science Technology Engineering Mathematics (STEM) through a WIND TURBINE

A K-12 Curriculum using a Wind Turbine

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Main Question:

How are Communities Impacted by Renewable Energy Produced by WIND TURBINES?

"Wind for Schools (WfS) Wind Application Center (WAC) Operation Plan"
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BACKGROUND

The Department of Energy (DOE)/National Renewable Energy Laboratory (NREL) launched a wind for schools (WfS) pilot project in Fiscal Year (FY) 2005 in Colorado which resulted in one (1) school small turbine project and many lessons learned. Eventually eleven (11) states (CO, KS, NE, AZ, PA, MT, SD, VA, NC, AK and ID) were funded under the WfS program. In 2013, Illinois (IL) joined the network and moved the total number of participating states to twelve (12). The WfS program's first long term objective was to develop in-state technical assistance capacity through the development of Wind Application Centers (WAC) located at a college or university in each state, in order to educate engineers in wind applications analysis and developing knowledge/skill sets that would make them more valuable to a growing wind workforce. The second objective of the WfS program was to educate students in wind energy and inspire them to pursue renewable energy areas of learning/careers past high school. Lastly, each of the one hundred and thirty-four (134) participating schools introduced a "community" to wind energy, providing opportunities for wind discussions with audiences beyond the classroom.

Implementing a school wind project is complex and involves many stakeholders. Based on experience, the WfS program originally determined that it was prudent to engage an in-state person to act as a State Facilitator and interact with the variety of stakeholders that become involved in a school wind project. The key stakeholders are the schools' administrations, the schools' science teachers, the associated communities, the state energy offices, local power suppliers, and in-state sponsorships. Over time, the WAC leadership has taken over this vital role in many of the states, becoming the main facilitator for WfS and community wind development within those states.

Although activities initially focused on schools typically in rural areas, the expectation is that through the development of WfS activities, individuals, businesses and utilities within the extended community will become interested in wind energy as a supply option for their homes, farms, and businesses, in both rural and suburban communities. The WAC, through direct activities and the education of students who enter the workforce, will then be able to address these other markets. The expectation was also that WAC leadership would become centers of wind expertise that supported local governments, state regulators and other state officials as needed to appropriately address the deployment of wind energy in the state.

Initially, a primary activity for each WAC and state facilitator was to train undergraduate students in wind energy development, using the classroom instruction and the installation of small wind turbines at K-12 host schools. Over one hundred and thirty (130) small turbines were installed across the twelve (12) states. A second focus was to engage students, educators, and the local communities around host schools, providing K-12 teacher training

and engagement opportunities between students of different ages, increasing interest in science, technology, engineering and math (STEM) disciples. Since the launch of the activity some state programs have adjusted activities away from "new" turbine installations, refocusing their efforts on education programming, data collection improvements, and supporting the maintenance of the existing fleet of turbines within their state. A new networking tool has been developed on OpenEI (i.e. Wind for Schools Portal) that is the platform used by all of the WACs and schools as a central database for each turbine's performance data. Basic data analysis tools are also available on the WfS website as well as a curricula database and other educational resources.

Jolene Willis facilitated the development of a K-12 STEM based science curriculum using a WIND TURBINE using funds from the project's background described above.

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Top 7 Useful Things to Know About the STEM Through a Wind Turbine K-12 Curriculum

OR

Top 7 Reasons Why You Might Want to Use Lessons from the STEM Through a Wind Turbine Curriculum in Your Classroom

1. **Storyline** - This curriculum is based on one **main question**: *How are Communities Impacted by Renewable Energy Produced by Wind Turbines?* Each of the 12 lessons* in this curriculum, in turn, is based on a grade-level appropriate question:

	K-2	3-5	6-8	9-12
12 Lesson Titles/ Unit Questions	1. Do I use a resource? 2. Do the resources I use run out? 3. What is wind? 4. What is a wind turbine?	5. Is it important to use renewable resources? 6. How can you use a renewable resource like wind to make energy with a wind turbine? 7. How can more energy be obtained from two designs of wind turbines?	8. How can a better design of a wind turbine blade be investigated? 9. How can human impact on the environment be reduced by using a wind turbine? 10. How does it compare when energy is produced by wind turbine or with burning coal?	11. How can I design better wind turbine blades for increased energy production? 12. How can state/national wind turbine data be used to provide evidence to address the use of a natural resource for energy production?

2. This curriculum implements standards from **NGSS** (Next Generation Science Standards) and **CCSSM** (Common Core State Standards for Math).

3. Lessons use everyday **materials that are readily available**. For example: straws, rubber bands, paper cups, string, and cardboard.

4. **STEM** (Science, Technology, Engineering, Mathematics) are interwoven in each lesson. While integration of STEM concepts can be challenging, using a wind turbine makes the integration natural. There is a progression from awareness of concepts in elementary grades to qualitative understanding in middle school to quantitative understanding and evidence-building in high school.

5. Each lesson uses the **5E Teaching Model** (a research-based best practice). **Engagement**: Stories or Videos used to create interest; **Exploration**: Student activity; **Explanation**: Students explain concepts; **Extension**: Options for deeper learning; **Evaluation**: Assessment options.

6. **Teacher Edition** (background information and objectives) and **Student Edition** (which can be used as a handout) provided for each lesson. The progression (1, 2, 3, 4, 5) on the Student Edition handouts correspond to the 5E Teaching Model. While the curriculum is provided in large PDF file, teachers can jump ahead to lessons in their grade-level band.

7. *Lessons are **flexible** and **adaptable** and each is **independent**. For example, Lesson 6 (from table above) could be used in grades 3, 4, or 5. It does not assume students have done any of the previous lessons in the curriculum. The lesson can be adapted to various student differentiation levels and interests and classroom settings.

Curriculum is a free download at http://faculty.wiu.edu/jR-Olsen/wiu/tea/Wind/Wind-NGSS.html

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K-12 STEM curriculum USING A WIND TURBINE
Progressions within *Disciplinary Core Idea*

A. Earth Space Science Progression

	K-2	3-5	6-8	9-12
ESS3.A Natural Resources **Standard:** ***K-ESS3-1 Earth and Human Activity***	DCI Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do. P.E. Use a model to represent the relationship between the needs of plants and animals (including humans) and the places they live.	Energy and fuels that humans use are derived from natural sources and their use affects the environment. Some resources are renewable over time, others are not.	Humans depend on Earth's land, ocean, atmosphere, and biosphere for different resources, many of which are limited or not renewable. Resources are distributed unevenly around the planet as a result of past geologic processes.	Resource availability has guided the development of human society and use of natural resources has associated costs, risks, and benefits.

B. Physical Science Progression

	K-2	3-5	6-8	9-12
PS3.B Conservation of energy and energy transfer	Sunlight warms Earth's surface.	Moving objects contain energy. The faster the object moves, the more energy it has. Energy can be moved from place to place by moving objects, or through sound, light, or electrical currents. Energy can be converted from one form to another form.	Kinetic energy can be distinguished from the various forms of potential energy. Energy changes to and from each type can be tracked through physical or chemical interactions. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter.	The total energy within a system is conserved. Energy transfer within and between systems can be described and predicted in terms of energy associated with the motion or configuration of particles (objects).

C. Progression with Science and Engineering Practices

K-2	3-5	6-8	9-12
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested. -Ask questions based on observations to find more information about the natural and/or designed world(s). - Ask and/or identify questions that can be answered by an investigation. -Define a simple problem that can be solved through the development of a new or improved object or tool.	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. - Ask questions about what would happen if a variable is changed. -Identify scientific (testable) and non-scientific (non-testable) questions. -Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. -Use prior knowledge to describe problems that can be solved. -Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.	Asking questions and defining problems in 6–8 builds on K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models. -Ask questions - that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. -to identify and/or clarify evidence and/or the premise(s) of an argument. -to determine relationships between independent and dependent variables and relationships in models. -to clarify and/or refine a model, an explanation, or an engineering problem. -that require sufficient and appropriate empirical evidence to answer. -that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a	Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Ask questions - that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. -that arise from examining models or a theory, to clarify and/or seek additional information and relationships. -to determine relationships, including quantitative relationships, between independent and dependent variables. -to clarify and refine a model, an explanation, or an engineering problem. Evaluate a question to determine if it is testable and relevant. -Ask questions that can be investigated within the scope of the school laboratory, research facilities, or field (e.g., outdoor environment)

		hypothesis based on observations and scientific principles. -that challenge the premise(s) of an argument or the interpretation of a data set. -Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	with available resources and, when appropriate, frame a hypothesis based on a model or theory. -Ask and/or evaluate questions that challenge the premise(s) of an argument, the interpretation of a data set, or the suitability of a design. -Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical, and/or environmental considerations.

Please select from the Disciplinary Core idea of *Earth Space Science* and *Physical Science* **using** *Science and Engineering Practices* **from page 1-3 to create questions.**

Our Goal: Develop K-12 STEM curriculum that promotes understanding, application, analysis and synthesis of a wind turbine.

Main Question: How are communities impacted by renewable energy produced by wind turbines?

Performance Expectations (PE's)
Next Generation Science Standard (NGSS): Earth and Human Activity
Students who demonstrate understanding can: **(K-2) K-ESS3-3:** Communicate solutions that will reduce the impact of humans on land, water, air and/or other living things in the local environment. (Clarification Statement**:** Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles). *Specific DCI: Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.*
(3-5) 4- ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; nonrenewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels). *Specific DCI: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.*
(6-8) MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing human impact on the environment. (Clarification Statement: Examples of the design process include examining human impacts. This can include water usage such as the withdrawal of water from streams; land use, and pollution of air, water or land). *Specific DCI: Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.*
(9-12) HS- ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. (Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean)). *Specific DCI: Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.*

	K-2	3-5	6-8	9-12
Unit Questions	**1. Do I use a resource?** **2. Do the resources I use ever run out?** **3. What is wind?** **4. What is a wind turbine?**	**5. Is it important to use renewable resources?** **6. How can you use a renewable resource like wind to make energy with a wind turbine?** **7. How can more energy be obtained from two designs of wind turbines?**	**8. How can a better design of a wind turbine blade be investigated?** **9. How can human impact on the environment be reduced by using a wind turbine?** **10. How does it compare when energy is produced by wind turbine or with burning coal?**	**11. How can I design better wind turbine blades for increased energy production?** **12 How can state/national wind turbine data be used to provide evidence to address the use of a natural resource for energy production?**

Subject/Grade (DCI): Science/Earth Science/ /K-2 (Human Impacts on Earth Systems, **DCI**).

Big Idea Statement: What are some natural resources and its uses? (**CCC**)

Next Generation Science Standard: K-ESS3 Earth and Human Activity: Performance Expectation

Students who demonstrate understanding can:

K-ESS3-3: Communicate solutions that will reduce the impact of humans on land, water, air and/or other living things in the local environment. (Clarification Statement**:** Examples of human impact on the land could include cutting trees to produce paper and using resources to produce bottles. Examples of solutions could include reusing paper and recycling cans and bottles).

Specific Disciplinary Core Idea: **ESS3.C: Human Impacts on Earth Systems**

Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things. (K-ESS3-3)

Connections to other DCIs in kindergarten:
K.ETS1.A (K-ESS3-2),(K-ESS3-3)
Articulation of DCIs across grade-levels:
1.LS1.A (K-ESS3-1); 2.ESS1.C (K-ESS3-2); 2.ETS1.B (K-ESS3-3); 3.ESS3.B (K-ESS3-2); 4.ESS3.A (K-ESS3-3); 4.ESS3.B (K-ESS3-2); 5.LS2.A (K-ESS3-1); 5.ESS2.A (K-ESS3-1); 5.ESS3.C (K-ESS3-3)
Common Core State Standards Connections:
ELA/Literacy -
RI.K.1 With prompting and support, ask and answer questions about key details in a text. (K-ESS3-2)
W.K.2 Use a combination of drawing, dictating, and writing to compose informative/explanatory texts in which they name what they are writing about and supply some information about the topic. (K-ESS3-3)
SL.K.3 Ask and answer questions in order to seek help, get information, or clarify something that is not understood. (K-ESS3-2)
SL.K.5 Add drawings or other visual displays to descriptions as desired to provide additional detail. (K-ESS3-1)
Mathematics -
MP.2 Reason abstractly and quantitatively. (K-ESS3-1)
MP.4 Model with mathematics. (K-ESS3-1), (K-ESS3-2)
K.CC Counting and Cardinality (K-ESS3-1), (K-ESS3-

Storyline Chart
K-2

Question	**Phenomena**	**Engineering and Scientific Practice(s)**	**Disciplinary Core Idea (DCI) What we figured out.**	**Cross Cutting Concepts (CCC)**
Do I use a resource?	Take students outside to experience the wind by observing a flying kite. Read a fiction book on wind. Students are taken outside the classroom on a warm sunny day and are asked about	Communicate solutions with others in oral and/or written forms using models and/or drawings that provide detail about scientific ideas. Asking questions and	Things that people do to live comfortably can affect the world around them. They can make choices that reduce their impacts on the land, water, air, and other living things.	Events have causes that generate observable patterns.

	how they feel. Students are taken outside to blow bubbles in the wind. They are asked to explain what takes bubbles away.	defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.		
Do the resources I use ever run out?	Students complete a KWL about renewable and nonrenewable resources. As an introductory phenomenon, students will view a video/song about renewable and nonrenewable resources. How does this get to run out?	Obtaining, evaluating, and communicating information and uses observations and texts to communicate new information Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.	Events have causes that generate observable patterns.
What is wind?	Learners are taken outside the classroom on a windy day.			
What is a wind turbine?	Field trip to the site of a wind turbine.	Obtaining, evaluating, and communicating information and uses observations and texts to communicate new information.	Designs can be conveyed through sketches, drawings or a physical model.	Events have causes that generate observable patterns.

		Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that could be tested.		

Lesson 1: Do I use a Resource?

Lesson 1 Objective: By the end of the lesson, learners should be able to identify a natural resource they use?

Engagement	Exploration	Explanation	Extension	Evaluation
As an introductory phenomena, take students outside and let them experience the flying of a kite. Do not tell them that you want them to experience the wind. Ask students: What did you observe outside? What did you feel? Was there something you felt that was moving your hair and clothes? Take a balloon or some dust in your hand and let it go in the wind. Ask students what happened and why? What was it? How did it make you feel? Take the students in the	Question: How can I make the ping pong ball move faster using blown air and a hand held fan? Tell students that they will be creating their own wind by a blowing air and by using a hand held fan that is moved fast near an object. Materials: Ping Pong Ball, hand held fan. Tell the students that they have to move the ping pong ball from their table to a point the teacher has created. They may blow air on the ping pong ball first. Then they can use the hand held fan to complete the task.	Students present their posters to the class explaining what they discovered about how wind was created, and how it was used to move the ping pong ball faster with one method.	Teacher brings several balloons filled with air and some that are not filled with air in the class. Ask students: Is the air in the balloon the same as the one used to move the ping pong ball? Where does wind come from? Is it always there? Does it only happen when I move something, like I moved the hand held fan? Show a short video (1-2 min) of the hot air balloons? Ask students: What is	Students are given a fill in the blanks worksheet that they may illustrate or write their answers. 1. The _____ blew my hair. (Wind) 2.I use the wind to _____my balloons.(Fill) 3. It was faster for me to move my ping pong ball from one place to the next using _____.(My hand held fan) 4. The wind is a _____. (Natural Resource). 5. The hot air balloon is one other way

class after the brief discussion and ask them to write on the board what they THOUGHT of the WIND, and WHAT QUESTIONS they have about the WIND. Tell the students- I will read a book and then I will ask a few questions about it. Read a fiction book about the Wind: Example- *The Wind Blew.* Ask students: What caused the events in the story? Have you ever had an experience with the wind in the book? How can we **make wind** in the classroom? How do we use wind?	Task: Students illustrate on a poster paper the path the ping pong ball took when it was moved from one location to the next. They will use the classroom clock to keep track of time.		it? How does it move? If the wind was taken away from the hot air balloon, what would happen to the balloon? Generate discussion about how wind is a **natural resource** and it is always there for **use**. What is the meaning of **Natural**? (Nature Made) What is the meaning of **Resource?** (Something that I may use) We have used the wind in what two ways today? Could wind be used for any other purpose?	_____ is used. (Wind).

STEM Connections:

Science: DCI-Things that people do to live comfortably can affect the world around them. People can make choices that reduce their impacts on the land, water, air, and other living things.

Technology: Use of manipulatives

Engineering: Design to obtain qualitative data from structured exploration

Mathematics: Analysis of qualitative data from exploration

Lesson 1

Do I use a Resource?

1.1. What will you do today?

You will go outside to the playground and ***observe*** the following things that the teacher will demonstrate:

a. Bubbles being blown from a source.

b. Dust or dirt being blown from the teacher's hand.

c. Flying a kite.

1.2. Making Sense: You are provided with a small whiteboard and a dry erase pen –

1. Draw to explain what you saw happen in 1.1.a.

2. Draw to explain what you saw happen in 1.1.b.

3. Draw to explain what you saw happen in 1.1.c.

1.3. Your teacher will ask you to explain in words what you observed.

2.1. What will you do?

a. You will move a ping-pong ball from location marked "A" on your table to location marked "B" by blowing on the ping-pong ball.

b. This task needs to be completed two times.

2.2. Predict: Write and draw to explain what you think will happen.

2.3. Draw the path the ping-pong ball took when it moved from one location to

the next.

a. Path 1:

b. Path 2:

3.1. Present your poster with your group to your peers. When you present your poster explain:

a. Where you placed the ping-pong ball at the start of the investigation?

b. What did you have to do to get the ping-pong ball to move from location “A” to location “B”?

c. Did you find it challenging to move the ping-pong ball by blowing on it?

3.2. Explain, in your own words, what caused the pin-pong ball to move.

4.1. Making Sense: Discussion

Observe a demonstration conducted by your teacher. The teacher will take a few balloons and fill them with air as students observe. The teacher will ask you the following questions:

a. Is the air filled in the balloon the same as the as the air you used to move the ping-pong ball?

b. Is the air always there?

c. Does the air only happen when I blow something like a ping pong ball?

4.2. Video on hot air balloons and air. Some questions will be asked after you view the video/s.

Wind by Bill Nye the Science Guy ***https://www.youtube.com/watch?v=uBqohRu2RRk***

Sun, Air, and Wind for Kids
https://www.youtube.com/watch?v=tfAB4BXSHOA

Wind and Air
https://www.youtube.com/watch?v=niZ_cvu9Fts

a. What was the video about?

b. Where is air?

c. Where does the wind come from? Is it always there?

d. If something is always there, what is it called?

e. Is air and wind the same thing?

f. How is air and wind different?

g. What does Natural mean?

h. What does resource mean?

5.1. What did I learn?

Fill in the blanks:
You will demonstrate your learning by answering the listed questions. You may work with your peer or on your own.

1. The _____ blew the balloon and the kite.
2. Moving air is called_____.
3. I used blowing air to _____ the ping-pong ball.
4. The teacher used _____ to fill the balloons.
5. Hot air is used in hot air _____.
6. The wind is always present. It is _____.
7. If I use something it is called a _____.

8. The wind is a ___________________ _________________________.

Lesson 2: **Do the resources I use ever run out?**

Lesson 2 Objective: By the end of this lesson, learners should be able to describe natural resources that are renewable and nonrenewable.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
Students complete a KWL about renewable and nonrenewable resources. As an introductory phenomenon, students will view a video/song about renewable and nonrenewable resources. https://www.youtube.com/watch?v=mmgyNPF0n1k https://www.youtube.com/watch?v=MHutG0e58os After viewing the video, students will be asked questions about what they discovered about resources that run out (nonrenewable) and ones that don't (renewable).	Students will be provided with many children's picture books on several resources. They will go over the books. Each group will get one kind of resource. Students will take turns to read aloud about the resource. 1.Sun Power A book about renewable energy 2. This is the tree 3.Natural resources 4. Energy Island (Wind) 5.Energy for Keeps 6.Look after your planet 7. Waiting for Ice	Students will need to role play the information they obtained about the particular renewable and nonrenewable resource they have been provided. Students also create an illustration of the renewable and nonrenewable resource allocated to them, as it is demonstrated in the poster below from Pinterest.	Students will play a Natural Resource Card Sort game in their groups. This card game contains 18 cards with definitions and pictures of renewable and nonrenewable resources. Free Source: Teachers pay Teachers Natural resource card sort Students can sort cards as renewable and nonrenewable resources as well as match the definition. This product can be used as a simple assessment of student understanding of natural resources. The teacher discusses	Students complete the "L" from the KWL chart on the board. A smart board lesson is conducted which draws meaning of nonrenewable and renewable resources. Smart board exchange lesson: Natural Resources in my home. http://exchange.smarttech.com/details.html?id=a804b6f7-1249-4e49-a664-5b186e8b4569 Discussion about what happens when a resource we need is no longer available.

Student questions from "W" of the KWL chart are written on the board and discussed.		 https://www.pinterest.com/pin/145452262942637267/	Nonrenewable and Renewable resources with students. They ran out.	

STEM Connections:

Science: Content about renewable and nonrenewable resources

Technology: View content about renewable and nonrenewable resources through videos

Engineering: Learners design and create illustrations of renewable and nonrenewable resources

Mathematics: Learners sort and play a card game related to renewable and nonrenewable resources

Lesson 2

Do the resources I use ever run out?

1.1. What will you do today?

There is a KNOW-WANT TO KNOW-LEARNED (KWL) chart below about Renewable and Nonrenewable Resources.

You need to write two points about **Renewable** and two points about **Nonrenewable** resources for what you know (K), and for what you want to know (W). Do not write about Learned (L) right now?

K:_____
_____
_____
_____

W:_____
_____
_____
_____

L:_____
_____
_____

1.2. Making Sense: You are provided with an I-Pad or a device. You need to view and listen to two locations from the following two web links**.**

a. A song

https://www.youtube.com/watch?v=mmgyNPF0n1k

b**.** Video on Renewable and Nonrenewable Resources

https://www.youtube.com/watch?v=MHutG0e58os

After viewing the videos you will write

1. QUESTIONS on the (W) section of the KWL (page 1) of this handout.

2. On the small whiteboard, with a dry erase pen provided to you, explain

   What did you **discover** about resources that run out (nonrenewable) and ones that don't (renewable) from the two videos you viewed?

   _____
   _____
   _____
   _____
   _____

2.1. A book is assigned to you.

You are in a group of three peers. You are assigned a book. Each team member will take turns to read aloud a section of the book.

My book is: _____

2.2. What will you do?

a. You will discuss the book with your group. Name the book you were provided.

My book is: _____

The questions you will discuss are:

a. What is the book about? _____

b. What did you learn from the book? _____

3.1. Your group will role play the information from the book you read aloud and discussed. You have 2 minutes to summarize the book with your peers.

3.2. You will create a poster about renewable and nonrenewable resources with your group. You will present your poster to your peers.

4.1. Making Sense: Play a Natural Resource Card Game in your group.

How you will play the card game?

This card game contains 18 cards with definitions and pictures of renewable and nonrenewable resources. Your group will sort cards as renewable and nonrenewable resources as well as match the definition. This product can be used as a simple assessment of student understanding of natural resources.

Show and tell your teacher when your group completes the game.

5.1. What did I learn?

a. Fill in the Learn "L" from the KWL chart found on page 1 of the lesson.

b. Write on the smart board section about the "L" you wrote in your student booklet.

5.2. What did I learn?

Answer the following questions:

a. What is one resource you use that **will** run out?

_____

b. What is one resource you use that **will not** run out?

_____

Now your teacher will discuss what you learned from the lesson on renewable and nonrenewable resources.

Lesson 3: **What is wind?**

Lesson 3 Objective: By the end of this lesson, learners should be able to describe what wind is and demonstrate what it is able to do.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
Learners are taken outside the classroom on a windy day and they are asked to observe what happens to their clothes and hair when outside. Learners are asked to observe it for a few minutes. Learners view a short video of a tornado to observe what wind could do. Learners are asked to write questions about what they observed outside and in the videos. The teacher creates a large organizer of the	Learners will complete a jigsaw puzzle about wind. Learners work with a partner and build a wind detector with a popsicle stick and yarn. The learners will go outside and observe what happens to the yarn on the popsicle stick. The learners will observe what will happen to the yarn when they are in a sunny spot, a shaded spot and inside the classroom. The learners will draw on the provided worksheet what they saw happen to the yarn in these three locations.	After the exploration, the teacher will gather the learners to a central area, where the learners will explain what their drawings of their observations were. The teacher will ask questions about their observations. The teacher will ask: What happened to the yarn on the popsicle stick when it was in the classroom, in the sunny outdoors, and in the shaded area. Did you observe a difference in the observations in the three locations? Why do you think there was a	The teacher will use a picture chart to show what happens over the ocean water when the sun heats the water. The teacher describes what wind is and how it is formed. The picture chart will have stick parts which individual students will be asked to come up and paste on the board based on the story as it is being described by the teacher. The teacher goes over student generated questions in the engagement section of the lesson. The teacher discusses the questions and addresses them	The teacher prepares exit slips. Learners are given sticky parts of the section on what is wind and how it forms and they are asked to paste it on an assessment board.

KWL chart on the board and students write about what they know about what they observed when they were outside and what questions they have about what they observed in the video. The teacher goes over the observations listed on the board. The teacher asks the students what they observed about what was happening to their clothes and hair when they went outside. Expected answer: Clothes and hair were moving fast. The Teacher asks the students to describe why their clothes and hair were moving. Expected answer: The wind was causing the clothes and hair to move. The teacher asks: What is wind?		difference in the observations?	through discussion with learners.	

Expected answers: It makes leaves of plants move. It causes my dress to sway. The teacher will inform the learners that they will explore the wind today.				

STEM Connections:

Science: Identify the characteristics of wind

Technology: Manipulate the Popsicle stick

Engineering: Design a tool with the Popsicle stick and yarn to identify wind and its direction

Mathematics: Qualitatively identify what happens to the yarn when there is high or low wind

Lesson 3

What is Wind?

1.1. What will you do today?

You are taken outside the classroom with your teacher.

Draw and write what you felt outside.

Draw:

Write:_____
_____
_____

1.2. Making Sense: You will view two videos about a tornado.

a. Video 1

https://www.youtube.com/watch?v=x8eWEHuCtUk

b. Video 2

https://www.youtube.com/watch?v=vH4YT9secVw

After viewing the videos you will think of and write two questions.

a. Question 1:
_____
_____

b. Question 2:
_____
_____

2.1. What will you do?

a. You are placed in pairs. You are provided with a Popsicle stick and yarn. You need to tie the yarn at the top of the Popsicle stick so that most of the yarn is hanging from the Popsicle stick.

b. You will take the Popsicle stick with the yarn outside the class with your partner and your teacher.

c. You will place the Popsicle stick in three locations outside. You may hold up the Popsicle stick with the yarn by raising your arm towards the sky or roof of your class. You will need to draw/sketch what happened to the yarn that is tied to the Popsicle stick.

1. A shady spot (under a tree)

2. An open spot (not under a tree)

3. In the classroom

Draw or sketch in the appropriate column:

A shady spot (under a tree)	An open spot (not under a tree)	In the classroom

2.2. Making Sense: Students will explain

Your group will role play and explain for your peers what you illustrated in 2.1.

Your teacher will ask you several questions regarding what you observed while you were working with your Popsicle stick outdoors and indoors.

3.1. Making Sense: Your teacher will explain the process of formation of wind due to evaporation.

The story of the movement of the wind is illustrated by the teacher. Students are encouraged to ask questions based on the story about how wind is created over the ocean and the teacher discusses the questions.

4.1. What did I learn?

You will obtain an **Exit Slip** from your teacher. The exit slip is to be completed by you independently. After writing the answer on the Exit Slip, post it on the board which has a sign "Exit Slip".

The questions asked on the exit slips are:

1. What is wind?
2. Where does it form?
3. How can you show what wind does?
4. Explain what happened to the yarn on the Popsicle stick in the shade.

5. Explain what happened to the yarn on the Popsicle stick in the classroom.

6. Why does wind blow?

Lesson 4: **What is a wind turbine?**

Lesson 4 Objective: By the end of this lesson, learners should be able to identify a wind turbine and learn how wind is used.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
Learners are taken on a field trip to the site of a wind turbine. They are asked to observe it for a few minutes. A guest speaker is invited to speak to the class at the site of the wind turbine. Learners are encouraged to ask questions about the wind turbine. Learner's questions are also collected by the teacher as they will be discussed in class after the field trip is over. All the questions are posted on the board.	Learners are provided with paper to assemble and build a wind turbine in their groups (pinwheel). http://www.wikihow.com/Make-a-Pinwheel Guidance is provided by the teacher and the instructions provided. Small fans are used to provide wind to make the wind turbines work for students. If the day is windy, learners are taken outside to test the pinwheels they have made.	Learners will observe carefully how each part of a pinwheel was assembled to make the wind turbine. Learners will have a poster provided with each part of the wind turbine illustrated. Learners will write or sketch to explain what each part of the wind turbine is doing to make the wind turbine work. Learners will present the information to the class, while the teacher is able to add to the information they have been able to observe from the assembled and working wind turbine.	The teacher will read aloud a book - *The Boy Who Harnessed the Wind*. A video clip is shown to the learners about how a wind turbine is made to work. Clean Green Energy Cartoon https://www.youtube.com/watch?v=Quy-b_ZOxBA Wind Power for Kids https://www.youtube.com/watch?v=niZ_cvu9Fts After viewing the video, teacher initiates	Independently, students complete an exit quiz on wind turbines. What is wind? What does a wind turbine do? Why are wind turbines useful? I can make a pinwheel that resembles a wind turbine using the following materials - Paper Stick A small pin A small fan A foot ruler Glue Pencil

	Students are asked - how is a pinwheel similar and different to a wind turbine?		discussion about what a wind turbine is useful for and how it is used these days.	Scissors

STEM Connections:

Science: How can wind be harvested?

Technology: The wind turbine

Engineering: The designs and development of wind turbines that harvest the most wind to generate electricity

Mathematics: How can wind speed be quantified?

Subject/Grade (DCI): <u>Science/Earth Science/ /3-5</u> (Use of Natural Resource, Energy and fuels that humans use are derived from natural resources and their uses affects the environment in multiple ways, **DCI**).

Big Idea Statement: How do natural resources yield renewable and nonrenewable resources (**CCC**)?

NGSS Standard: Earth and Human Activity

3- ESS 3-1: Performance Expectation

Students who demonstrate understanding can:

Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. (Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; nonrenewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels).
*Specific Disciplinary Core Idea: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not***.**

Common Core State Standards Connections:
Connections to other DCIs in third grade: N/A
Articulation of DCIs across grade-levels:
K.ESS3.B; K.ETS1.A; 4.ESS3.B; 4.ETS1.A; MS.ESS3.B
Common Core State Standards Connections:
ELA/Literacy —
W.3.1 Write opinion pieces on topics or texts, supporting a point of view with reasons. (3-ESS3-1)
W.3.7 Conduct short research projects that build knowledge about a topic. (3-ESS3-1)
Mathematics —
MP.2 Reason abstractly and quantitatively. (3-ESS3-1)
MP.4 Model with mathematics. (3-ESS3-1)

Storyline Chart

3-5

Question	**Phenomena**	**Engineering and Scientific Practice(s)**	**Disciplinary Core Idea (DCI)** **What we figured out?**	**Cross Cutting Concepts (CCC)**
Lesson 5: **Is it important to use renewable resources?**	Read or present audio/video of *The Lorax*- by Dr. Seuss https://www.youtube.com/watch?v=r18SCHVsUX4 The Lorax speaks for the trees, which everyone, everyone, everyone needs. In this read along story book for children, read aloud to them. Adults read more into this book than children, but every kid sees that the Once-ler regrets destroying in order to create. A great lesson can be learned with this book.	Obtaining, Evaluating, and Communicating Information Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods. .	ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. **Connections to Engineering, Technology, and Applications of Science** Interdependence of Science, Engineering, and Technology Knowledge of relevant scientific concepts and research findings is important in engineering. Influence of Engineering, Technology, and Science on Society and the Natural World Over time, people's

				needs and wants change, as do their demands for new and improved technologies.
Lesson 6: **How can you use a renewable resource like wind to make energy with a wind turbine?**	Disney music is played- https://www.youtube.com/watch?v=HvvZ1TEQRB8 Learners are asked to imagine they are trees in the woods and while the music plays, they need to pretend they are blowing in the wind. Questions asked: 1. How would a tree move in a gentle breeze? 2. How would the tree look like if it rains and the wind becomes strong? 3. How would the tree look like if there is a tornado?	Obtain and combine information from books and other reliable media to explain phenomena.	ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	**Connections to Engineering, Technology, and Applications of Science** Interdependence of Science, Engineering, and Technology Knowledge of relevant scientific concepts and research findings is important in engineering. The Influence of Engineering, Technology, and Science on Society and the Natural World

Lesson 7**: How can more energy be obtained from the best designs of wind turbines?**	A video on wind power is played for students to view. https://www.youtube.com/watch?v=niZ_cvu9Fts	Obtain and combine information from books and other reliable media to explain phenomena.	ESS3.A: Natural Resources Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	**Connections to Engineering, Technology, and Applications of Science** Interdependence of Science, Engineering, and Technology Knowledge of relevant scientific concepts and research findings is important in engineering. Influence of Engineering, Technology, and Science on Society and the Natural World Over time, people's needs and wants change, as do their demands for new and improved technologies.

Lesson 5: **Is it important to use renewable resources?**

Lesson 5 Objective: By the end of this lesson, learners should be able to describe the differences between using renewable and nonrenewable resources for energy needs.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
The teacher will gather all learners on a mat and ask them a few question. 1. What happens when your favorite cereal runs out at home? 2. What do you do if your parent's car runs out of gas? Learner answers will vary. Teacher will inform the learners that today they will be reading a book by Dr. Seuss. Ask learners what are some of the books they have read that are written by Dr. Seuss. Read or present audio/video of *The Lorax*- by Dr. Seuss	The Teacher informs all that all learners will participate in an activity. The class will be divided into groups of 4. Materials Needed: Each group will need a bag with 16 pieces of popcorn, 4 paper towels, and a pencil and paper. Teacher will need the bag with leftover popcorn to replenish the used resources. Section 1:Renewable Resource Activity 1. Each team begins with 16 pieces of popcorn. Each student must take at least 1	Teacher will discuss with learners: What did the students do in "using" the resource Waste that occurred (popcorn dropped on the floor) and, whether any thought was given to students coming afterwards. There were protests from other students using degraded quality of popcorn towards the end (everyone's hands were in it before, and it's been crushed into smaller, less desirable pieces). Questions for further discussion.	The teacher goes over a A PowerPoint presentation on renewable and nonrenewable resources with all learners. The PPT is included in the lesson plan. It provides content information as follow up from the activity. Follow up questions are discussed with learners. Which resources would continue to be available no matter how much people used them? Under what circumstances would a renewable resource not	Independently learners will group the following as renewable or non - renewable resources. 1.A field of corn 2.Oil in the Arctic tundra 3.Coal in the Appalachian mountains 4.Sunshine 5.Trees in a forest 6.Tuna in the ocean 7.Sand on a beach 8.A breeze over the Texas plains 9.Water in a river Summary question: What did you learn from

https://www.youtube.com/watch?v=r18SCHVsUX4 The Lorax speaks for the trees, which everyone, everyone, everyone needs. In this read along story book for children, read aloud. Adults read more into this book than children, but every kid sees that the Once-ler regrets destroying in order to create. A great lesson can be learned with this book. The teacher will ask some questions about the book. 1. What is this book about? 2. What do you learn from this book? 3. Why are trees important for all? A discussion is initiated based on these questions and the discussion leads to Renewable and Nonrenewable	piece of popcorn per round to survive, and may take as many as he/she likes. 2. One student per team records the number of pieces each team member takes per round, and the number of pieces remaining for the team. 3.The resource is then "renewed" by half (if there are 8 remaining pieces after round 1, the teacher will add 4 more pieces to the bag for round 2). 4.6 rounds are played in this manner. The object of the game is to have the most pieces of popcorn per team member after the final round. *At the end of the game, discuss different strategies used by teams:* *Some may not need the*	" "	be renewable?	the activity and information presented in the lesson?

resources.	*resource because they'll consume too much of the resource early on* *Others may take one piece at a time and build up a store by the end* *Others may take more throughout but will always keep enough in reserve to be sufficiently renewed* Section 2: Nonrenewable Resource Activity 1.Students each pick up a slip of paper from a bag (there are 4 "1st generation", 6 "2nd generation", 9 "3rd generation," and 14 "4th generation" slips) 2. Teacher goes to the front of the classroom with a bag of popcorn, and leads a brief discussion of what it means when one generation finds a resource and how future generations are affected			

	by it. 3.1st generation students then come up and take as much popcorn as they want back to their seats. 2nd generation students then do the same, followed by 3rd and 4th generations.			

STEM Connections:

Science: Renewable and Nonrenewable Resources

Technology: The use of renewable and nonrenewable resources by humans – where do these resources get used?

Engineering: The designs in place to promote the use of renewable and nonrenewable resources – oil in car; and trees for wood and paper

Mathematics: Analysis of what resources get used and what is left for future generations

Lesson 5

Is it important to use Renewable Resources?

1.1. What will you do today?

The Lorax by Dr. Seuss is read to you. You will answer the following questions about the book:

a. What is this book about?

_____
_____
_____

b. What did you learn from this book?

_____
_____
_____

c. Why are trees important?

_____
_____
_____

d. What questions come to your mind?

_____

_____

_____

1.2. Making Sense: You will participate in an activity about renewable resources using uncooked popcorn.

There will be four members in each group.

You will need: A bag with 16 pieces of unpopped popcorn, 4 paper towels, a pencil and paper.

Section 1: Renewable Resource Activity

1. Each team will begin with 16 pieces of popcorn. Each student must take at least 1 piece of popcorn per round to survive, and may take as many as he/she likes.
2. One student per team records the number of popcorn each team member takes per round, and the number of pieces remaining for the team.
3. The resource is then "renewed" by half (if there are 8 remaining pieces after round 1, the teacher will add 4 more pieces to the bag for round 2).
4. 6 rounds are played in this manner. The object of the game is to have the most pieces of popcorn per team member after the final round.

Discussion question:

What were some strategies your team used to conserve popcorns?

_____

_____

_____

Section 2: Nonrenewable Resource Activity

1. You team will pick up a slip of paper from a bag (there are 4 "1st generation", 6 "2nd generation", 9 "3rd generation," and 14 "4th generation" slips.
2. You need to go to your teacher who is in the front of the classroom with a bag of popcorns.
3. Describe on the board what it means when one generation finds a resource and how future generations are affected by it.

   _____
   _____
   _____

4. 1st generation students will go up to the teacher and take as much popcorn as they want to and return to their seats. 2nd generation students then do the same, followed by 3rd and 4th generation students.

5. Describe what it means when one generation finds a resource and uses it up so that future generations are not able to use it.

   _____
   _____
   _____

2.1. Making Sense

You are to discuss in your group about how you used your popcorn.

2.2. What will you do?

You will discuss the following questions with your group first.

The questions you will answer are:

c. How did you use the resource? _____

d. How did you waste the resource?

_____

3.1. Your teacher will provide some information via a presentation on renewable and nonrenewable resources.

3.2. What will you do? Follow up questions:

a. Which resource would continue to be available no matter how much people use it?

Explain.

_____
_____
_____

b. Under what circumstances would a renewable resource not be renewable?

_____
_____
_____

4.1. What did I learn?

Independently, you will group the following as renewable or non -renewable resources

1. A field of corn

2. Oil in the Arctic tundra

3. Coal in the Appalachian Mountains

4. Sunshine

5. Trees in a forest

6. Tuna in the ocean

7. Sand on a beach

8. A breeze over the Texas plains

9. Water in a river

Renewable Resources:

_____

_____

_____

Nonrenewable Resources:

_____

_____

_____

Lesson 6:

How can you use a renewable resource like wind to make energy with a wind turbine?

Lesson 6 Objective: By the end of this lesson, learners should be able to use a wind turbine and demonstrate how wind could be used.

Engagement	Exploration	Explanation	Extension	Evaluation
Disney music is played- https://www.youtube.com/watch?v=HvvZ1TEQRB8 Learners are asked to imagine they are trees in the woods while the music plays. They need to pretend they are blowing in the wind. As the questions are asked all learners need to role play to answer the question. Questions asked: 1. How would a tree move in a gentle breeze?	Class discussion is initiated about the video based on the questions asked in Engagement. What is the meaning of Energy? How is Energy obtained from a wind turbine? Learners learn about how wind turbines work. A section of reading is assigned to all the groups from the energy.gov website. http://energy.gov/articles/how-wind-turbine-works	Learners are divided up into groups and they are asked to discuss the following questions: Describe the attempts used to get the wind turbine to lift an item to the group. The teacher will select one member of each team to present their descriptions to the class. The description needs to demonstrate how a wind turbine makes energy from wind.	Learners make a wind powered boat. This extension provides another method of using wind to power a balloon boat. Items needed: Tub of water Plastic Egg Balloon Scotch Tape 1. Blow up the balloon. 2. Tape one side of the balloon onto the wider part of the bottom of the egg as shown above (leaving room for the air to escape.)	Learners complete an assessment. The following questions are answered in groups of two and handed to the teacher. 1. What happened to the plastic straw and the plastic egg when the air from the balloon is released? 2. How did you know that power was created to move the paper-made wind turbine? 3. Explain how power was used to move the balloon boat.

2. How would the tree look like if it rains and the wind becomes strong? 3. How would the trees look like if there is a tornado? Learners are asked what they know about the wind, wind turbine and energy. What is wind? What is a wind turbine? What is energy? How are wind, wind turbine and energy related? The answers to these questions are posted in an online form in a popplet page that is shared with the class. The teacher posts in popplet for all to view. http://popplet.com/app/#/home After posting all the answers on the popplet	After the reading, The teacher discusses with the learners how wind turbines work. The questions for discussion follow. 1. What is the principle on how wind turbines work? 2. How many blades do most wind turbines have? 3. What is the rotor? 4. What drives the generator? 5. Name the instruments that measures wind speed and direction? 6. What does the Yaw drive do? The teacher informs all that learners will be making their own balloon-straw wind turbine. The balloon-straw wind		3. Have your learner/s hold onto the balloon so that the air cannot escape. 4. Place the balloon with the egg boat pointed in the direction of the other end of the tub. 5. Have the learner release the balloon and watch what happens. Examine and Discuss how the release of air from the balloon created wind power which caused the egg to move in the water. Discuss by talking about how various 'things that go' are powered by something like the air/wind. Learners: Illustrate how the balloon filled boat moved. Learners view another video on how two children make a wind turbine with materials from a kit.	4. Explain how a wind turbine uses wind to provide it with energy. 5. What are your ideas about using wind to produce energy that does a task for us?

page, learners view the video from youtube about WIND POWER https://www.youtube.com/watch?v=niZ_cvu9Fts The phenomenon from youtube video is discussed by the teacher with the students.	turbine created will be used to see how long it moves. https://www.youtube.com/watch?v=hB8Wv_iHrd8		https://www.youtube.com/watch?v=BNPpvQQIKoE	

STEM Connections:

Science: How wind is used by humans

Technology: Manipulating a wind turbine to lift an item

Engineering: Designing a wind powered boat using a balloon and a plastic egg

Mathematics: Qualitatively describe the use of wind for simple work like lifting an item and powering a boat

Lesson 6

How can you use a renewable resource like WIND to make energy with a wind turbine?

1.1. What will you do today?

Listen to the Music from "Colors of the Wind" from Pocahontas. You will role play the answer as the teacher reads the questions.

a. How would trees move in a gentle breeze?
b. How would trees look when it rains and the wind is strong?
c. How would trees look if there is a tornado?

1.2. Making Sense: You are placed in groups of two. You are provided with an iPad or a device. You need to go to a popplet page at http://popplet.com in your group. The popplet page has been preset for your group at the site provided on the board. Your group needs to answer the following questions in the popplet site page. The answers you provide are based on your own knowledge and discussion with your peer group. You do not need to look for answers in a text.

a. What is wind?
b. What is a wind turbine?
c. What is energy?
d. How are wind, wind turbine and energy related?

After writing the answers to the questions listed above, view the video at this site:

https://www.youtube.com/watch?v=niZ_cvu9Fts

After viewing the video, you will write on the popplet page you used earlier to modify your answers you have written.

3. Modify your answers you wrote in popplet.
4. Write QUESTIONS that come to your mind when you viewed the video.

2.1. A reading is assigned to you from a site. You and your peer group need to read and view the site independently. The site is listed below.

http://energy.gov/articles/how-wind-turbine-works

After the reading, your peer group will answer the following questions listed in 2.2.

2.2. What will you do?

a. You will discuss the following questions with your group.

The questions you will discuss are:

e. What is the principal on how wind turbines work?
f. How many blades do most wind turbines have?
g. What is a rotor?
h. What drives the generator?
i. Name the instruments that measure wind speed and wind direction?
j. What does the Yaw drive do?

After the discussion and writing of answers, your teacher will discuss the questions with the class. You can modify the answers if you think the answers needed more information.

3.1. What will you do next?

After the discussion with the teacher, you will construct your own balloon- straw wind turbine after viewing the video listed below.

https://www.youtube.com/watch?v=hB8Wv_iHrd8

You are provided with:

a. Three different sizes of balloons
b. Three straws
c. Tape
d. Pencil with an eraser at the end
e. A nail or thumb tac

Construct the balloon-straw wind turbine and see which one works the best from the ones you made.

3.2. One member of your group will present the best balloon- straw wind turbine and explain why it worked the best.

Sketch:

Explain:

4.1. Making Sense: Make another WIND powered boat

How you will make the boat?

The materials provided to you are:

a. Tub of water
b. Plastic Egg
c. Balloon
d. Scotch Tape

Directions:

1. Blow up the balloon.
2. Tape one side of the balloon onto the wider part of the bottom of the egg as shown above (leaving room for the air to escape).
3. You will hold onto the balloon so that the air cannot escape.
4. Place the balloon with the egg boat pointed in the direction of the other end of the tub.
5. You will release the balloon and watch what happens.

Show and tell your teacher and your peers what you saw happen.

The teacher will discuss with your class the following questions:

1. How did the release of air from the balloon created wind power caused the egg to move in the water?
2. What are some 'things that go' that are powered by something like the air/wind?

4.2. You will view another video with your peer group. The site is listed below.

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

This video is to inform you how wind turbines may be constructed with a kit.

5.1. What did I learn?

Answer the following questions:

c. What happened to the plastic straw and the plastic egg when the air from the balloon is released?

_____

d. How did you know that power was created to move the paper-made wind turbine?

_____

e. Explain how power was used to move the balloon boat.

_____

f. What are your ideas about using wind to produce energy that is used to do a task for us?

_____

Lesson 7**: How can more energy be obtained from the best designs of wind turbines?**

Lesson 7 Objective: By the end of this lesson, learners should be able to examine different wind turbine designs and discuss which design is able to harvest wind to the maximum.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
The teacher investigates learners' previous knowledge about what caused the balloon-straw pinwheel, and balloon/plastic egg to move and other questions are asked. 1. What caused the voltmeter needed to move when using a paper-made wind turbine? 2. How did the air filled balloon cause the plastic egg boat to move? The learners are shown several images of wind turbines.	Learners explore two designs of wind turbines. The kind of wind turbine they used with ideas from the site listed below is explored with their own ideas. https://www.youtube.com/watch?v=ZGmMkMkQ_gc The following materials are used for this activity. How can we use a pinwheel to lift pennies? Materials: Pennies, pinwheel pattern on cardstock, round pencils with	Learners illustrate the exploration. Learners are grouped in 2's. They describe to their peers. 1. What variables are used in this experiment? 2. Which variable was changed and why while conducting the experiment? 4. Why is more speed important for a wind turbine?	Observe the turbines built by others in your group. How are they similar? How do they differ? What are some features of the turbines that lift the most pennies? We need energy to do work. Moving or lifting something is work. Lifting 4 pennies 20 inches is twice as much work as lifting 4 pennies 10 inches. Describe how your turbine uses wind energy to do work.	Learners will be asked to write their independent responses on the board for the questions listed below. 1. What improvements did you make in your initial pinwheel design for a wind turbine? 2. What allows the pinwheel to lift most pennies? 3. What new ideas did you develop about a wind turbine? 4. Describe how your wind turbine uses wind energy to do work.

http://energy.gov/energysaver/small-wind-electric-systems	erasers, string (cotton or poly works best), paper or plastic cups, paper clips, tape, box fan, stopwatch or watch with a second hand. Describe all attempts: 1. What is the maximum number of pennies your machine is able to lift? 2. How long does it take your machine to lift four pennies? 3. How long does it take to lift eight pennies? Is it twice as long? Describe your first design. What works well? What do you want to improve? Describe all designs you used and how well each worked.			

STEM Connections:

Science: Workings of Wind turbines

Technology: Different types of wind turbines

Engineering: Designing a pinwheel

Mathematics: Qualitatively demonstrating the working of a pinwheel to show impact of wind.

Lesson 7

How can more energy be obtained from the best designs of wind turbines?

1.1. What will you do today?

Answer the following questions:

- **d.** What permitted the balloon-straw pinwheel/ and plastic egg made wind turbines to move?
- **e.** What caused the voltmeter needed to move when using a paper-made wind turbine?
- **f.** How did the air filled balloon cause the plastic egg boat to move?

You will observe this video:

http://energy.gov/energysaver/small-wind-electric-systems

1.2. Making Sense:

You are placed in groups of two.

1. You will explore the site listed below:

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

2. Materials you will need:

1. Pennies
2. Pinwheel pattern on cardstock,
3. Round pencils with erasers,

4. String (cotton or poly works best),
5. Paper or plastic cups,
6. Paper clips,
7. Tape,
8. Box fan or hair dryer,
9. Stopwatch or watch with a second hand.

What is the question you want to explore?

Question: _____

Name **one variable** you will change in the investigation: _____

Name the other variable that will not change in the investigation:

_____

2.1. What you will do next: Test your designs and record your observations.

An observation Table is provided for you to complete as you complete the task.

Observation Table:

	Number of Pennies	**Design of pinwheel used**	**Number of Twirls in 30 seconds**	**Did you try this indoors/outdoors?**
Design 1				
Design 2				
Design 3				

2.2. What did you find out?

a. You will discuss the following questions with your group.

The questions you will discuss are:

1. What variables are used in this investigation?

   _____

2. Which variable was changed while conducting the experiment, and why?

   _____

3. What kind of pinwheel was able to lift the most pennies?

   _____

4. Why is more speed important for a wind turbine?

   _____

After the discussion and writing of answers, your teacher will discuss the question with the class. You can modify the answers if you think the answers needed more information.

3.1. What will you do next?

You will explain to your teacher what your group did and what the findings were.

1. Describe to your teacher what you were able to find out with this investigation.
   _____
   _____

4.1. Making Sense: Observe other presentations.

Observe the turbines built by others in your group.

How are they similar?

_____
_____

How do they differ?

_____
_____

What are some features of the turbines that lift the most pennies?

_____
_____

4.3 Making Sense:

We need energy to do work. Moving or lifting something is work. Lifting 4 pennies 20 inches is twice as much work as lifting 4 pennies 10 inches.

Describe how your turbine uses wind energy to do work.

_____
_____
_____

5.1. What did I learn?

Answer the following questions:

g. What improvements did you make in your initial pinwheel design for a wind turbine?
_____

h. What allows the pinwheel to lift most pennies?
_____

i. What new ideas did you develop about a wind turbine?
_____

j. Describe how your wind turbine uses wind energy to do work.

_____

Subject/Grade (DCI): Science/Earth Science/6-8 (Human Impacts on earth systems, **DCI**).
Big Idea Statement: Human Impacts in Earth Systems:

NGSS Standard: How Earth and Human Activity can minimize impact on the Environment?

MS-ESS3-3: Performance Expectation

Students who demonstrate understanding can:

(6-8) MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment (Clarification Statement: Examples of the design process include examining human impacts can include water usage (such as the withdrawal of water from streams; land use, and pollution of air, water or land).
Specific DCI: *Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise*

Connections to other DCIs in this grade-band:
MS.PS1.A (MS-ESS3-1); MS.PS1.B (MS-ESS3-1); MS.PS3.A (MS-ESS3-5); MS.PS3.C (MS-ESS3-2); MS.LS2.A (MS-ESS3-3),(MS-ESS3-4); MS.LS2.C (MS-ESS3-3), MS.LS4.D (MS-ESS3-3),(MS-ESS3-4); MS.ESS2.D (MS-ESS3-1)
Articulation of DCIs across grade-bands
3.LS2.C (MS-ESS3-3),(MS-ESS3-4); 3.LS4.D (MS-ESS3-3),(MS-ESS3-4); 3.ESS3.B (MS-ESS3-2); 4.PS3.D (MS-ESS3-1); 4.ESS3.A (MS-ESS3-1); 4.ESS3.B (MS-ESS3-2); 5.ESS3.C (MS-ESS3-3),(MS-ESS3-4); HS.PS3.B (MS-ESS3-1),(MS-ESS3-5); HS.PS4.B (MS-ESS3-5); HS.LS1.C (MS-ESS3-1); HS.LS2.A (MS-ESS3-4); HS.LS2.C (MS-ESS3-3),(MS-ESS3-4); HS.LS4.C (MS-ESS3-3),(MS-ESS3-4); HS.LS4.D (MS-ESS3-3),(MS-ESS3-4); HS.ESS2.A (MS-ESS3-1),(MS-ESS3-5); HS.ESS2.B (MS-ESS3-1),(MS-ESS3-2); HS.ESS2.C (MS-ESS3-1),(MS-ESS3-3); HS.ESS2.D (MS-ESS3-2),(MS-ESS3-3),(MS-ESS3-5); HS.ESS2.E (MS-ESS3-3),(MS-ESS3-4); HS.ESS3.A (MS-ESS3-1),(MS-ESS3-4); HS.ESS3.B (MS-ESS3-2); HS.ESS3.C (MS-ESS3-3),(MS-ESS3-4),(MS-ESS3-5); HS.ESS3.D (MS-ESS3-2);(MS-ESS3-3),(MS-ESS3-5)
Common Core State Standards Connections:
ELA/Literacy -
RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ESS3-1), (MS-ESS3-2),(MS-ESS3-4),(MS-ESS3-5)
RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ESS3-2)
WHST.6-8.1 Write arguments focused on discipline content. (MS-ESS3-4)
WHST.6-8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content. (MS-ESS3-1)
WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several

sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ESS3-3)
WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ESS3-3)
WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ESS3-1), (MS-ESS3-4)

Mathematics -

MP.2 Reason abstractly and quantitatively. (MS-ESS3-2), (MS-ESS3-5)
6. RP.A.1 Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities. (MS-ESS3-3), (MS-ESS3-4)
7. RP.A.2 Recognize and represent proportional relationships between quantities. (MS-ESS3-3), (MS-ESS3-4)
6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. (MS-ESS3-1), (MS-ESS3-2), (MS-ESS3-3), (MS-ESS3-4), (MS-ESS3-5)
7. EE.B.4Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (MS-ESS3-1), (MS-ESS3-2), (MS-ESS3-3), (MS-ESS3-4), (MS-ESS3-5)

Storyline
6-8

Question	Phenomena	Engineering and Scientific Practice(s)	Disciplinary Core Idea (DCI) What we figured out.	Cross Cutting Concepts (CCC)
8. How can a better design of a wind turbine blade be investigated?	Learners view a video on paper plane designs and which flies the faster and farthest. https://www.youtube.com/watch?v=-AZOcCdmEo4 Ask learners to make 3 different types of paper planes and test their design. The purpose is to find out which paper plane goes the furthest. This phenomena will link to a previous experience the learners may have had when they were much younger. Learners are asked - what did they consider when designing a paper plane?	Apply scientific principles to design an object, tool, process or system.	Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	Connections to Engineering, Technology, and Applications of Science Influence of Science, Engineering, and Technology on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus

				technology use varies from region to region and over time. Cause and Effect: Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
9. How can human impact on the environment be reduced by using a wind turbine?	Learners view this video on youtube titled: Are you REALLY saving the ENVIRONMENT investing in a wind farm or a solar plant? https://www.youtube.com/watch?v=Ah5tM4kw9To	Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.	Human Impacts on Earth Systems Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.	Cause and Effect Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.
10. How does it compare when energy is produced by a wind turbine or with burning	Learners view this video on Wind Power vs. Coal Power. They are asked to indicate what they choose and why. What questions emerge?	Apply scientific principles to design an object, tool, process or system.	Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on	Connections to Engineering, Technology, and Applications of Science

coal?	https://www.youtube.com/watch?v=H65Co1W_BCQ		Earth unless the activities and technologies involved are engineered otherwise.	Influence of Science, Engineering, and Technology on Society and the Natural World The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. Cause and Effect: Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.

Lesson 8**: How can a better design of a wind turbine blade be investigated?**

Lesson 8 Objective: By the end of this lesson, learners should be able to examine different wind turbine blades and indicate which blade design is better for harvesting wind to produce power.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
Learners view a video on paper plane designs and which flies the faster and farthest. https://www.youtube.com/watch?v=-AZOcCdmEo4 The teacher investigates learners' previous knowledge about paper planes. Ask learners to make 3 different types of paper planes and test their design. The purpose is to find out which paper plane goes the furthest. This phenomena will link to a previous experience the learners may have had when they were much younger.	Translating the significance of better design with paper planes, learners will view a video on wind turbine blade design for production of more electricity. https://www.youtube.com/watch?v=vkd50JWyoi4 The teacher asks students to indicate their learning from the video. Learners will explore Information and Content provided by in pdf - from U.S. Department of Energy: Energy Education Different Wind Turbine	Learners illustrate the exploration. Learners are grouped in 3's. They describe to their peers: 1. The variables used in the exploration. 2. Which variable was changed and why while conducting the experiment? 3. Which design produced the most power for the turbine? 4. Why is more power important for a wind turbine? 5. How did the voltage/amperage/wattage change as a result of	Learners construct a graph for the data obtained in Exploration of Power Production in wattage on the vertical axis and variable tested on the horizontal axis. The graph displayed needs to document each variable for blade tested with a different color. Learners also describe the issues they encountered with each variable. Learners also mention what could be done differently when conducting such an investigation.	Learners complete the "L" part in the KWL chart and talk about the new learning from the investigation. Learners are asked to illustrate and describe their findings from the investigation by answering the question about how could a better design of a wind turbine blade be investigated and a determination be recommended.

Learners are asked - what did they consider when designing a paper plane The learners are asked: Which paper design worked the best and why? A discussion follows where learners are invited to write questions about plane design for greater distance covered on the board. The learner questions are discussed. The teacher informs the learners that they will be designing three different wind turbine blades and determining which kind of blade is better. Learners start a KWL sheet with information about wind turbine blades.	Blades kits will be obtained for classroom use from - http://www.kidwind.org/ or Windpower.org and Renewable Energy Canada. A model wind turbine can be set up in the classroom for learners to explore. Learners may be asked questions about a wind turbine as they explore the model. Learners are informed that they will explore blades of a wind turbine. Learners are asked about the question they would like to explore relating to turbine blades. The variables the learners could consider for a turbine blade are: Length; Number, Material; Shape, Curvature of blade; Weight; angle of blade.	change in variable? 6. What kind of effect does the variable change have on power production?	An optional question could be explored by learners for extra credit. Power in WIND Power (W) = Voltage(V) Current (A) Record Amps not milliamps 1A = 1,000 mA Learners are asked to manipulate data in this formula to determine: which is the most important variable to obtain the maximum power from wind?	

	Materials Needed: -2-3 Box fans -Images of large turbines -Blade construction materials Learners will submit a investigation question and plan related to blades. There will be 3 learners per group. A data table with the following will be provided to each group for calculation of power. For three trials per variable the following items need to be listed in the data table Variable Voltage V Ampere A.			

	V * A = Power (Watts)			

STEM Connections

Science: Factors effecting the harvesting of wind

Technology: Wind turbine blades

Engineering: Design of wind turbine blades

Mathematics: The impact of multiple variables and quantitative analysis of turbine blades vs maximum generation of electricity

Lesson 8

How can a better design of a wind turbine blade be investigated?

1.1. What will you do today?

View the video at the location listed below.

https://www.youtube.com/watch?v=-AZOcCdmEo4

After you view the video, you and a partner will make three different designs of a paper plane.

Test the three designs to find out which paper plane goes the furthest.

Predict which design works the best:

_____

Designs	Design Illustration	Distance 1	Distance 2	Distance 3
Design 1				
Design 2				
Design 3				

Which Paper design went the furthest? Illustrate the design.

Why do you think this design worked the best?

1.2. Making Sense:

You are placed in a group of two with your peers.

a. You will explore the site listed below:

https://www.youtube.com/watch?v=RNPIRfxUTQ4

What did you learn from viewing the video?

_____

_____

_____

2.1. What you will do next: A model wind turbine is set up in the classroom. You will be provided with materials. In your pairs, decide which question relating to wind turbine blades you would like to explore.

Get approval from your teacher regarding your exploration question.

Wind Turbine Blade Design Question:

_____

2.2. Test your designs and record your observations. There are several variables you could consider for your exploration- length of blade; number of blades; shape of Blade; curvature of blade; angle of blade

Name the variables you would like to consider for your exploration.

1._____

2._____

3._____

Materials you are provided:

1. 2-3 Box fans
2. Images of large turbines
3. Blade construction materials

An observation table is provided for you to complete as you complete the task.

Observation Table:

	Variable	**Voltage (V)**	**Ampere (A)**	**Power = V* A (Watts)**
Design 1				
Design 2				
Design 3				

2.2. What did you find out?

a. You will discuss the following questions with your group.

The questions you will discuss are:

5. Which variables are used in this investigation?

   _____

6. Which variable was changed while conducting the experiment, and why?

   _____

7. What kind of Turbine Design was able to produce the most power (P)?

   _____

8. Why is more power important for a wind turbine?

   _____

9. How did the Voltage, Amperage, Power change as result of change in variable/s?
   _____
   _____
   _____

After you discuss the answers with your partner, your teacher will discuss the question with the class. You can modify the answers if you think the answers needed more information.

3.1. What will you do next?

You will construct a graph for the data you listed in the observation table. Power output vs design needs to be displayed on the graph.

3.2. Analyze the graph:

1. Describe what information is displayed by the graph.

_____
_____
_____
_____
_____

2. What could be done differently when conducting such an investigation?

_____
_____
_____
_____
_____

4.1. Making Sense: Optional Question

Which is the most important variable to obtain the most power from wind, and why?

_____
_____
_____

a. What did I learn?

Answer the following questions:

k. Describe your findings from the investigation.

_____
_____
_____

l. What did you learn from this investigation?

_____
_____
_____

m. What new ideas did you develop about a wind turbine?

_____
_____
_____

Lesson 9**: How can human impact on the environment be reduced by using a wind turbine?**

Lesson 9 Objective: By the end of this lesson, learners should be able to demonstrate how impact on the environment could be reduced by using a wind turbine for energy production

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
Learners view this video on youtube titled: Are you REALLY saving the ENVIRONMENT investing in a wind farm or a solar plant? https://www.youtube.com/watch?v=Ah5tM4kw9To	Learners explore Energy.gov site http://energy.gov/eere/wind/advantages-and-challenges-wind-energy Learners are divided into groups to explore the advantages and challenges of using a wind turbine for harvesting wind to produce electrical energy. Each group will have three members **Group 1**: Explore **Advantages** of Wind Power Questions students will	After the exploration, learners will provide a presentation of their discoveries related to the questions for each group. The groups will present their popplet and descriptions.	Peers will be provided an opportunity to open one more popplet and comment and elaborate on their peer work. The peers mention one positive and one suggestion listed on one question in the popplet. Wherever possible, cite source. After peer review, there is a discussion led by the teacher what each group added to another group's work on popplet and explain their reasoning for adding that information based on experience or information they	A short exit quiz is conducted on the questions listed for all the groups. Advantages and Challenges of using wind power. How can wind power be profitable? Why can wind power have its challenges? How can those challenges be addressed? What are your ideas?

	explore and post information on **popplet.com** 1. What is the meaning of clean fuel source? 2.Examine and Describe the meaning of " Wind is a domestic source of Energy" 3. Explain how "Wind can be considered Sustainable". **Group 2: E**xplore **Advantages** of Wind Power Questions students will explore and post information on **popplet.com** 1. How is "Wind Power Cost-Effective"? 2. How effective is it when Wind Turbines are built on existing farms or ranches? 3. How does wind power create jobs and improve the economy? **Group 3: E**xplore **Challenges** of Wind		obtained from another source.	

	Power Questions students will explore and post information on **popplet.com** 1. Explain with an example - How Wind Power must still compete with conventional generation sources on cost. 2. Since more wind is existing in rural and less populated areas, how can this be a challenge? **Group 4: E**xplore **Challenges** of Wind Power Questions students will explore and post information on **popplet.com** 1. Elaborate on - Wind resource development might not be the most profitable use of land. 2. Provide example/s on -Turbines have caused			

	noise and aesthetic population. 3. How could turbine blades damage local wildlife?			

STEM Connections

Science: What is wind power and how is it an advantage to use it?

Technology: How is technology used to understand use of wind for electricity production?

Engineering: How does design of technology used to prove the advantages of wind power?

Mathematics: Examination of measurement of impact positive/negative impact of wind power to a society.

Lesson 9

How can human impact on the environment be reduced by using a wind turbine?

1.3. What will you do today?

View the video at the location listed below.

https://www.youtube.com/watch?v=Ah5tM4kw9To

After you view the video, you and a partner will describe:

What are your findings after viewing the video?

_____
_____
_____
_____
_____

1.4. ***Making Sense:***

You will explore and read the site listed below:
http://energy.gov/eere/wind/advantages-and-challenges-wind-energy

You will be placed in groups of 3 students.

You will identify the advantages and challenges of using a wind turbine.

Advantages of using a wind turbine:

_____
_____
_____
_____
_____

Disadvantages of using a wind turbine:

_____
_____
_____

2.1. What you will do next: You will be using an iPad or a laptop. Use Chrome as your browser for the internet. You will be asked to go to Popplet.com. On the popplet page, create a popplet with your group.

http://popplet.com/app/#/3668365

ID:a-singh@wiu.edu

PW: 462qwwxppq

Group 1: Explore the Advantages of WIND POWER

Questions your group will address in the popplet site:

1. What is the meaning of clean fuel source?
2. Examine and describe the meaning of "Wind is a domestic source of Energy."
3. Explain how "Wind could be considered Sustainable."

Group 2: Explore the Advantages of WIND POWER

Questions your group will address in the popplet site:

1. How is wind power cost effective?
2. How effective is it when wind turbines are built on existing farms or ranches?
3. Hoe does wind power create jobs and improve economy?

Group 3: Explore the Challenges of WIND POWER

Questions your group will address in the popplet site:

1. Explain with an example - How Wind Power must still compete with conventional generation sources on cost.
2. Since more wind is existing in rural and less populated areas, how can this be a challenge?

Group 4: Explore the Challenges of WIND POWER

Questions your group will address in the popplet site:

1. Elaborate on - Wind resource development might not be the most profitable use of land.
2. Provide example/s on -Turbines have caused noise and aesthetic population.
3. How could turbine blades damage local wildlife?

3.1. What will you do next?

You and your group will provide a presentation to your peers about the questions your group had to answer. You will showcase the popplet you created and the answers you wrote.

4.1. Making Sense:

Your peers will have an opportunity to access the popplet you created and comment and elaborate on your answers. They will provide **two positives** and **one suggestion** to your answers at the popplet site. Your group will be identified by the teacher.

_____
_____
_____

5.1. What did I learn?

A short exit quiz is conducted. The questions are:

a. How can wind power be profitable?

_____
_____

b. Why can wind power have its challenges?

_____
_____

c. How can those challenges be addressed? What are your ideas?

_____
_____
_____

Lesson 10**: How does it compare when energy is produced by a wind turbine or with burning coal?**

Lesson 10 Objective: By the end of this lesson, learners should be able to use ratios to demonstrate a comparison of using wind and coal for energy production.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
Learners view this video on Wind Power vs. Coal Power. They are asked to indicate what they choose and why. What questions emerge? https://www.youtube.com/watch?v=H65Co1W_BCQ	Learners will play a game at NASA's climate kids site. http://climatekids.nasa.gov/menu/energy/ First: Learners will play - PLAY POWER UP. It is about using wind turbine to power up a town. http://climatekids.nasa.gov/power-up/ Second: Learners will explore The story of fossil fuels, Part 1: Coal http://climatekids.nasa.g	The data gathered by learners in the exploration phase related to ratios and described by each group is analyzed. If there is positive for wind, the group gives 1+ for that question. If there is a negative response for that question, the questions obtains -1. The +1's and -1's are placed in a tally to find out what groups find out from each response. The teacher brings the discussion together to	The learners complete a ratio development activity they develop that compares wind power to solar power.	Learners write about how development of ratios is able to explain the use of wind power vs coal power.

	ov/fossil-fuels-coal/ Learners will gather at a center point in the class, and discuss the findings. Based on the views: each group will develop a set of 5 questions about coal and wind power based on information gathered from their peers.	talk about the pros and cons of wind power as compared to using burning of coal to produce electricity.		

STEM Connections

Science: How is wind power compared to coal power?

Technology: How is technology used to obtain power from wind, and coal?

Engineering: How does design of technology used to prove the advantages/challenges of wind power vs coal power?

Mathematics: How can wind power vs coal power be proved mathematically?

Lesson 10

How does it compare when energy is produced by a wind turbine or with burning coal?

1.1. What will you do today?

You will view the video listed below on the smart board/screen.

https://www.youtube.com/watch?v=H65Co1W_BCQ

What questions emerge after viewing this video?

g. Question 1:_____
h. Question 2:_____
i. Question 3:_____
j. Question 4:_____

The teacher will discuss your questions with the class.

2.1. What you will do next: You will play a game. The game is at the site listed below. It is NASA's climate kids' site. You are placed in a group of 3 members.

http://climatekids.nasa.gov/menu/energy/

First: You will play - PLAY POWER UP. It is about using wind turbine to power up a town.

http://climatekids.nasa.gov/power-up/

Second: Learners will explore- The story of fossil fuels, Part 1: Coal

http://climatekids.nasa.gov/fossil-fuels-coal/

2.2. What did you find out?

Learners will gather at a center point in the class, and discuss the findings.

Based on your views: Each group will develop a set of 5 questions about coal and wind power based on information gathered from their peers.

3.1. What will you do next?

You will explain to your teacher what your group did and what the findings were. This is related to the game you played.

The data gathered by learners in the exploration phase related to ratios and described by each group is analyzed.

If there is positive for wind, the group gives 1+ for that question. If there is a negative response for wind, the question obtains -1. The +1's and -1's are placed in a tally to find out what groups find out from each response.

_____
_____
_____
_____

You will discuss with your teacher about the pros and cons of wind power as compared to burning coal to produce electricity.

4.1. Making Sense: Observe other presentations.

Compare coal to wind power with the use of ratios.

How are they similar?

_____
_____

How do they differ?

_____
_____

5.1. What did I learn?

n. You will write a paper on google docs about how development of ratios is able to explain the use of wind power vs coal power.

Subject/Grade (DCI): **Science/Earth Science/ 9-12** (Natural Resources; Human Impact on Earth Systems/Developing Possible Solutions, DCI).

Big Idea Statement: How to evaluate possible solutions to human impacts?

NGSS Standard: Earth and Human Activity

HS-ESS3: Performance Expectation

Students who demonstrate understanding can:

(9-12) HS- ESS3-4: Evaluate or refine a technological solutions that reduces impacts of human activities on natural systems. (Clarification Statement: Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean)

Specific DCI: Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation

.

Connections to other DCIs in this grade-band:

HS.PS1.B (HS-ESS3-3); HS.PS3.B (HS-ESS3-2),(HS-ESS3-5); HS.PS3.D (HS-ESS3-2),(HS-ESS3-5); HS.LS1.C (HS-ESS3-5); HS.LS2.A (HS-ESS3-2),(HS-ESS3-3); HS.LS2.B (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-6); HS.LS2.C (HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-6); HS.LS4.D (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-6); HS.ESS2.A (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-6); HS.ESS2.D (HS-ESS3-5); HS.ESS2.E (HS-ESS3-3)

Articulation of DCIs across grade-bands

MS.PS1.B (HS-ESS3-3); MS.PS3.B (HS-ESS3-5); MS.PS3.D (HS-ESS3-2),(HS-ESS3-5); MS.LS2.A (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-3); MS.LS2.B (HS-ESS3-2),(HS-ESS3-3); MS.LS2.C (HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-6); MS.LS4.C (HS-ESS3-3); MS.LS4.D (HS-ESS3-1),(HS-ESS3-2),(HS-ESS3-3); MS.ESS2.A (HS-ESS3-1),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6); MS.ESS2.C (HS-ESS3-6); MS.ESS2.D (HS-ESS3-5); MS.ESS2.E (HS-ESS3-3),(HS-ESS3-4); MS.ESS3.A (HS-ESS3-

1),(HS-ESS3-2),(HS-ESS3-3); MS.ESS3.B (HS-ESS3-1),(HS-ESS3-4),(HS-ESS3-5); MS.ESS3.C (HS-ESS3-2),(HS-ESS3-3),(HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6); MS.ESS3.D (HS-ESS3-4),(HS-ESS3-5),(HS-ESS3-6)

Common Core State Standards Connections:

ELA/Literacy -

RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-ESS3-1), (HS-ESS3-2), (HS-ESS3-4), (HS-ESS3-5)

RST.11-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms. (HS-ESS3-5)

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-ESS3-5)

RST.11-12.8 Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. (HS-ESS3-2), (HS-ESS3-4)

WHST.9-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (HS-ESS3-1)

Mathematics -

MP.2 Reason abstractly and quantitatively. (HS-ESS3-1), (HS-ESS3-2), (HS-ESS3-3), (HS-ESS3-4), (HS-ESS3-5), (HS-ESS3-6)

MP.4 Model with mathematics. (HS-ESS3-3), (HS-ESS3-6)

HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-ESS3-1), (HS-ESS3-4), (HS-ESS3-5),(HS-ESS3-6)

HSN.Q.A.2 Define appropriate quantities for the purpose of descriptive modeling. (HS-ESS3-1), (HS-ESS3-4), (HS-ESS3-5), (HS-ESS3-6)

HSN.Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-ESS3-1), (HS-ESS3-4), (HS-ESS3-5), (HS-ESS3-6

Storyline Chart

9-12

Question	**Phenomena**	**Engineering and Scientific Practice(s)**	**Disciplinary Core Idea (DCI)** **What we figured out?**	**Cross Cutting Concepts (CCC)**
Lesson 11: **How can I design better wind turbine blades for increased energy production?**	Learners view a short video on various current designs of wind turbines especially for rural and urban environments. https://www.youtube.com/watch?v=fNudnI5tzf8 After viewing the video, learners are asked to write: A. Two questions B. Two comments about the video viewed. Learners are asked to post their questions and comments on the class KWL chart on the board.	Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds on K–8	ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-ESS3-2),(secondary HS-ESS3-4)	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1) Systems and System Models When investigating or describing a system, the boundaries and initial conditions of the system need to be defined and their inputs and outputs analyzed and described using models. (HS-ESS3-6) Connections to Engineering, Technology, and Applications of Science Engineers continuously modify these technological systems by applying scientific knowledge and

		experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific knowledge, principles, and theories. Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1) Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized		engineering design practices to increase benefits while decreasing costs and risks. (HS-ESS3-2),(HS-ESS3-4) Connections to Nature of Science Science is a Human Endeavor Science is a result of human endeavors, imagination, and creativity. (HS-ESS3-3)

		criteria, and tradeoff considerations. (HS-ESS3-4)		
Lesson 12: **How can national wind turbine data be used to provide evidence to address the use of a natural resource for energy production?**	Each member of the team will have a laptop or an iPad and they will access the site listed below. http://en.openei.org/wiki/Wind_for_Schools_Portal Each group will access wind turbine data from one location from download historical data site. Choose two locations from the pull down menu and select the year and submit. The data is obtained for one location at a time. The wind turbine data regarding the wind and the amount of electricity produced in Kilo Watt Hours is observed. Learners develop a data table to indicate 1.Wind	Analyzing and Interpreting Data Analyzing data in 9–12 builds on K–8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data. Analyze data using computational models in order to make valid and reliable scientific claims. (HS-ESS3-5) Using Mathematics and Computational Thinking Mathematical and computational thinking in 9-12 builds on K-8 experiences and progresses to using algebraic thinking and analysis, a range of linear and nonlinear	ESS3.A: Natural Resources Resource availability has guided the development of human society. (HS-ESS3-1) All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New technologies and social regulations can change the balance of these factors. ESS3.C: Human Impacts on Earth Systems The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3)	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1) Stability and Change Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-3),(HS-ESS3-5) Feedback (negative or positive) can stabilize or destabilize a system. (HS-ESS3-4) Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

	2.Electricity (KWH) produced for each month of the year	functions including trigonometric functions, exponentials and logarithms, and computational tools for statistical analysis to analyze, represent, and model data. Simple computational simulations are created and used based on mathematical models of basic assumptions. Create a computational model or simulation of a phenomenon, designed device, process, or system. (HS-ESS3-3) Use a computational representation of phenomena or design solutions to describe and/or support claims and/or explanations. (HS-ESS3-6)	Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. (HS-ESS3-4). ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-ESS3-2),(secondary HS-ESS3-4)	(HS-ESS3-2),(HS-ESS3-4) New technologies can have deep impacts on society and the environment, including some that were not anticipated. (HS-ESS3-3)

Lesson 11**: How can I design better wind turbine blades for increased energy production?**

Lesson 11 Objective: By the end of this lesson, learners should be able to design and test wind turbine blades for increased energy production

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
Learners are asked what they know about what it means to design a wind turbine. Learners are asked what designs of wind turbines are available currently. Learners view a short video on various current designs of wind turbines especially for rural and urban environments. https://www.youtube.com/watch?v=fNudnI5tzf8 After viewing the video, learners are asked to write: A. Two	Learners will work in groups of 3. Initial Question: Which kind of blade design is best for a wind turbine? Learners will use various kinds of materials to design and test wind turbine blades. https://www.dropbox.com/s/umtuqc3bv5m69c1/Unit%202.pdf?dl=0 Materials provided: 1. A model wind turbine on which blades can be changed. 2. A voltage/current data	Each group will present what they did and an analysis of the data obtained. Each group will also describe what they learned from this activity to their peers. Each group can ask another group 2 questions about the design and analysis.	How is wind used to make electricity? Each individual will read the content located at the site below http://windeis.anl.gov/guide/basics/ In each group: Learners will use a google document and answer the following questions. Each member of the group will answer two questions. 1. What form of energy is wind power? 2. How is wind caused? 3. What is the difference	Learners complete an exit – what you learned from the lesson narrative detailing – 1.Choice of Blade design 2. Analysis of Data 3. How is electricity made by harvesting the wind?

questions B. Two comments about the video viewed. Learners are asked to post their questions and comments on the class KWL chart on the board.	recorder. 3. A box fan 4. A ruler 5. Resources for students to read. Blade materials 1.Card Stock 2. Card Board 3. Paper Plates 4. Plastic Cups, 5. Index Cards 6.1/4 dowels 7.Duct tapes/ glue 8. Scissors Learners will design and build two designs. The two designs will need to complete two experimental runs and data will need to be collected to demonstrate which design produced maximum output of current. Blade Design: 1. Learners can choose from the materials provided to build a wind turbine.		between – wind power and wind energy? 4. Explain: Mechanical Power or Electricity. 5. How does a wind turbine make electricity? 6. Describe –Cost Issues, environmental concerns and supply and transport issues dealing with using wind power.	

	2. Materials that are pre-made by a company cannot be used. 3. The turbine blades cannot be more than 15'' in length. 4. Sharp edges of any blade cannot be developed. Data Recording from Experimental Tests The data needs to be recorded in tables listed below. To calculate power output – Use the formula: P=VI Watts =volts* amperes Experimental test Data Tables: 1 | Volt | Amp | P High Wi |			

	nd				
	Low Wind				

2	Volt	Amp	P
High Wind			
Low Wind			

The data from the tables needs to be plotted in a line graph with two experimental design tests showing on the same graph.

Questions to answer:
1. Which material did you choose to build the blades and why?
2. Which design worked best for power output, and why?
3. What changes could you make to your blade

	designs to create more power output? 4. Write a short narrative to explain data from your tables and graph.			

STEM Connections

Science: Wind and how it ensures the generation electricity

Technology: The development of a devise that is able to harvest wind to generate electricity

Engineering: The design and testing of the turbine blades

Mathematics: The application of P=V*I formula to determine power output by each design

Lesson 11

How can I design better wind turbine for increased energy production?

1.1. What will you do today?

Answer the following questions:

1. What do you know about designing a wind turbine?

_____
_____
_____
_____

2. What designs of wind turbines are available currently?

_____
_____
_____
_____

1.2. Making Sense:

You are provided with an iPad or a device. You need to view a video at the link provided below.

a. Video on current designs of wind turbines for rural and urban environments.

https://www.youtube.com/watch?v=fNudnI5tzf8

After viewing the video you will write

5. TWO QUESTIONS on the (W) section of the KWL on the class KWL chart on the board.
   Question 1:
   _____
   _____
   Question 2:
   _____
   _____

   On the small whiteboard with a dry erase pen provided to you explain

6. Write TWO COMMENTS about the video on the comment section of the board.
   Comment 1:
   _____
   _____

   Comment 2:
   _____
   _____

2.1. You will investigate wind turbine blades design. The question you will explore is: Which Kind of Blade design is best for a wind turbine?

You are in a group of three peers.

The materials you are provided with:

1. A model wind turbine on which blades can be changed.
2. A voltage/current data recorder.
3. A box fan
4. A ruler
5. Resources for students to read.

Blade materials you are provided:

1. Card Stock
2. Card Board
3. Paper Plates
4. Plastic Cups,
5. Index Cards
6. 1/4 dowels
7. Duct tapes/ glue
8. Scissor

Your group will design and build two designs. The two designs will need to complete two experimental runs and data will need to be collected to demonstrate which design produced maximum output of current.

Blade Design Requirements:

1. You can choose from the materials provided to build a wind turbine.

2. Materials that are pre-made by a company cannot be used.

3. The turbine blades cannot be more than 15" in length.

4. Sharp edges of any blade cannot be developed.

2.2. What will you do?

Test your blade designs and record your observations on the data table provided. The blades need to be tested for low and high wind on the designed blade.

To calculate power output, a formula will be used. It is:

Power (watts) = Voltage (V)* Ampere (A)

Observation Table

	Sketch of Blade Design	**Voltage**	**Ampere**	**Power**
Design 1				
High Wind				
Low Wind				
Design 2				
High Wind				
Low Wind				

3.1. Your group will analyze the data from the observation table by showing the data on a graph provided below. Plot a line graph of the data in the table.

3.2. Making Sense of the data in the table and the graph:

Your group will answer the following question:

1. Which material did you choose to build the blades and why?

   _____
   _____
   _____

2. Which design worked best for power output, and why?

   _____
   _____
   _____

3. What changes could you make to your blade designs to create more power output?

_____
_____
_____

4. Write a short narrative to explain data from your tables and graph.

_____
_____
_____
_____
_____
_____
_____
_____

4.1 . Making Sense: Your group will present what you did and an analysis of data.

Question 1: Describe what you learned from this activity to your peers.

_____
_____

4.2 . Making Sense: Your group can ask another group 2 questions about the design and the analysis.

Question 1:

_____
_____

Question 2:

_____
_____

4.3. What will you do? You will answer the following question.

Question 1: How is wind used to make electricity?

_____
_____
_____
_____

You will read the content from the site listed below independently:

http://windeis.anl.gov/guide/basics/

After reading the document, you will create a shared google document with your group. You will answer the following questions as a group.

1. What form of energy is wind power?
2. How is wind caused?
3. What is the difference between – wind power and wind energy?
4. Explain: Mechanical Power or Electricity.
5. How does a wind turbine make electricity?
6. Describe –Cost Issues, environmental concerns and supply and transport issues dealing with using wind power.

5.2. What did I learn?

Learners complete an exit slip provided by the teacher–
What you learned from the lesson narrative detailing the following subheadings.

1. Choice of Blade design
2. Analysis of Data
3. How is electricity made by harvesting the wind?

Lesson 12**: How can state/national wind turbine data be used to provide evidence to address the use of a natural resource for energy production?**

Lesson 12 Objective: By the end of this lesson, learners should be able to analyze and interpret wind turbine data to provide evidence to address the use of wind as a natural resource for energy.

Engagement	**Exploration**	**Explanation**	**Extension**	**Evaluation**
The teacher asks learners: What did you learn about designing blades for a wind turbine to generate electricity? Create a KWL chart about Wind Turbines. Learners will be taken to the Wind Turbine site close to the school. Learners will be presented with the information by the guide. The guide will direct learners to the site below to view wind maps and data.	Learners will be grouped in groups of 3 members. Each member of the team will have a laptop or an iPad and they will access the sites listed below. http://www.illinoiswind.org/ http://en.openei.org/wiki/Wind_for_Schools_Portal Choose two locations from the pull down menu and select the year and submit. The data is obtained for one location at a time. The	The groups provide an analysis of the wind turbine data for both locations selected. The comparison analysis is also presented to the whole class. Findings about the relationship between wind speed and electricity generated is presented.	Class survey is conducted. Information data about -How effective is wind power in comparison to coal with respect to 1. Cost involved? 2. Economy is conducted – Fossil Fuel vs Renewable Fuel? Learners obtain information from the site listed below to draw a conclusion on wind vs coal for electricity production. http://www.environment.nsw.gov.au/resources/households/WindEnergyf	The following questions are answered at the end of the lesson independently. 1. How is energy made from Coal and Wind? 2. How much does it cost to make a certain amount of electricity from coal as compared to wind? 3. What are the pros and cons of using coal or wind for generating electricity? 4. Why should common man be concerned by coal or wind as a resources of generating electricity?

http://apps2.eere.energy.gov/wind/windexchange/windmaps/ Learners are asked: 1. What do these wind maps and data convey? Learners will be informed that they will be viewing live data from wind turbines in the nation.	wind turbine data regarding the wind and the amount of electricity produced in Kilo Watt Hours is observed. Learners develop a data table to indicate 1.Wind 2.Electricity (KWH) produced for each month of the year A comparison is made with the two choices.		actsheet.pdf http://www.eia.gov/kids/energy.cfm?page=coal_home-basics The class will have two teams that will debate on Coal vs Wind Power to generate electricity. The two teams will debate on these questions: 1. How is energy made from Coal and Wind? 2. How much does it cost to make a certain amount of electricity from coal as compared to wind? 3. What are the pros and cons of using coal or wind for generating electricity? 4. Why should common man be concerned by coal or wind as a resources of generating electricity?	

STEM Connections

Science: Meaning of Wind Data

Technology: Application of wind turbines to gather wind data from the nation

Engineering: The use of effectively designed wind turbines ability to harvest maximum wind to generate electricity

Mathematics: Analyzing quantitative wind data (empirical) to predict the effective use of wind to generate electricity

Lesson 12

How can state/national wind turbine data be used to provide evidence to address the use of a natural resource for energy production?

1.1. What will you do today?

Answer the following questions:

3. What did you learn about designing blades for a wind turbine to generate electricity?

_____
_____
_____
_____

1.2. Making Sense:

Create a KWL chart about WIND TURBINES and complete how much you are able to:

Know (K):

_____
_____

Want to Know (W):

_____
_____

Learn (L):

_____
_____

2.1. You will go on a field trip to the WIND TURBINE LOCATION. The guide/instructor will demonstrate to show you the wind data collected at a site. The site is listed below.

http://apps2.eere.energy.gov/wind/windexchange/windmaps/

You are asked:

Question 1: What do these wind maps and data convey?

_____
_____
_____

2.2. What will you do?

1. You are placed in a group of three peers. Each group will have a laptop or an iPad for you to access the sites listed below.

Site 1:

http://www.illinoiswind.org/

Site 2:

http://en.openei.org/wiki/Wind_for_Schools_Portal

2. Choose two locations from the pull down menu and select the year and submit. The data is obtained for one location at a time. The wind turbine data regarding the wind and the amount of electricity produced in Kilo Watt Hours is observed.

3. Learners develop a data table to indicate

    1. Wind
    2. Electricity (KWH) produced for each month of the year

A comparison is made with the two choices.

	State/City	**Wind**	**Electricity**
Location 1			
Location 2			

3.1. Your group will analyze the data from the observation table above.

Your group will provide an analysis of the wind turbine data for both locations selected.

The comparison analysis is also presented to the whole class.

Findings about:

1. The relationship between **wind speed** and **electricity generated** is presented.

_____
_____
_____
_____
_____

4.1. What will you do? What do you think? A class survey is conducted. The answers are listed on the board.

Question 1: How effective is wind power in comparison to coal with respect to
a. Cost involved, b. Economy

_____
_____
_____
_____

Question 2: Fossil Fuel vs Renewable Fuel

_____
_____
_____
_____

4.2. Making Sense: You will access the sites listed below.

Site 1: http://www.environment.nsw.gov.au/resources/households/WindEnergyfactsheet.pdf

Site 2: http://www.eia.gov/kids/energy.cfm?page=coal_home-basics

The class will have two teams that will debate on Coal vs Wind Power to generate electricity.

Rules for the debate:

1. The teacher will choose the two teams.
2. The teacher is President of the debate and will decide on the winner.
3. The teacher will choose the two leaders for each team.
4. A coin toss will determine which team leader will start with opening statements.
5. The opening statements will be 1 minute in length.
6. The opening statements will not have any rebuttal.

7. After the opening statement, the team that won the toss will begin with the following questions. 1 min is provided and a rebuttal is provided for 1 min.

    a. Description of the fuel
    b. Cost involved with the production of the fuel
    c. Impact on livelihood
    d. Impact on environment (air/water/land)
    e. Impact on economy
    f. Impact on pollution

8. The interaction is limited to 4, one minute sections of back and forth.

5.1. What did I learn? Answer the following questions independently:

1. How is energy made from Coal and Wind?
2. How much does it cost to make a certain amount of electricity from coal as compared to wind?
3. What are the pros and cons of using coal or wind for generating electricity?
4. Why should common man be concerned by coal or wind as a resource of generating electricity?

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Dr. Singh earned her Ph.D. in Science Education from the University of Iowa, Iowa City, USA. She teaches undergraduate and graduate courses in science education and education. Dr. Singh has facilitated several science professional development (PD) for elementary, middle and high school in-service teachers for ISBE grant initiatives through the Regional Office of Education: 1. Northern Illinois Mathematics and Science (NIMS) for two years; 2. Science, Technology, Engineering and Mathematics (STEM) PD for Western Illinois Mathematics Teacher Transformation Institute (WI-MTTI) for two years; 3. PD for K-6 teachers in the integration of science and literacy through a grant from the Tracey Family Foundation. Her research is in the area of integrating science and literacy. She has presented at State, National and International Conferences and facilitates science education workshops for in-service science teachers.

James Olsen, Ph.D. Mathematics Education

Dr. James Olsen is a mathematics education faculty member at Western Illinois University. He taught high school mathematics for ten years in Nebraska. He holds two Master's degrees (Mathematics Education and Mathematics). His PhD, in Educational Mathematics is from the University of Northern Colorado. At W.I.U. he teaches mathematics courses and teaching methods courses for prospective and practicing teachers. His research interests are mental math, student understanding of the function concept, multiplicative reasoning (including proportional reasoning and rates), educational uses of technology, student understanding of fractions, decimals, and percent's, and problem solving.

Laverne Logan, Ph.D. Science Education

Dr. Logan earned his Ph.D. from the University of Iowa, Iowa City, USA. His area of specialization is Science and Middle Level Education. He currently serves as associate professor and teaches graduate and undergraduate courses in Science and Middle Level Education in the Quad Cities Center.

Dr. Logan joined the Science Education Center after teaching elementary, junior high and secondary science in the Iowa public schools. He has presented at past NSTA, ISTA, as well as other science conferences. He also has been involved in numerous grant activities. His area of interests includes environmental and physical sciences. As part of those interests he has been involved with the Living Lands and Water organization. Dr. Logan is also involved with Illinois Science Olympiad both at the regional and state level competition as an Event Supervisor. He also assists with the WIU Annual PreK-8 Science Update Conference.

Robert Mann, Ph.D. Mathematics Education

Dr. Mann earned his Ph.D. in Curriculum and Instruction with an emphasis in Mathematics Education from the University of Nebraska-Lincoln, USA. His research has been connected to standards in mathematics, student achievement and understanding in mathematics at the K-12 level, and the college-readiness of students as they transition from secondary to post-secondary work in mathematics.

Dr. Mann published many articles related to problem-solving tasks and activities to use in the K-12 classroom to promote mathematical learning, and have presented many talks and workshops about engaging and enlightening students with interesting and thought-provoking mathematics. Dr. Mann was also the past-President of the Illinois Council of Teachers of Mathematics (ICTM), a member of the leadership team of a state-wide multi-million dollar STEM grant, and a former chair of the editorial board of the NCTM journal Teaching Children Mathematics.

Kim Hartweg, Ph.D. Planning, Policy & Leadership/Multimedia Technology

Dr. Hartweg earned her Ph.D. in Planning, Policy & Leadership/Multimedia Technology from the University of Iowa, Iowa City, USA. Her Master's degree was in Elementary Education and Mathematics from Western Illinois University. Dr. Hartweg teaches Elementary and Early Childhood Mathematics Methods to prospective teachers. Her area of research is in the area of Mathematics Problem Solving. She participated in the -Improving of the Teaching of Mathematics through Lesson Study, a research study conducted by the Mathematics Education faculty in the Mathematics Department. Dr. Hartweg presents at State, Regional, National, and International Mathematics Education Conferences.