Bay Area Scientists in Schools Presentation Plan

Lesson Name What is Renewable Energy?

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Grade Level 4th **Standards Connection(s)** 3-PS: Energy comes from Sun to Earth in the form of light. Energy can be stored in many forms. 4-PS: You can build series and parallel circuits with wires, batteries, and bulbs. Electrical energy can be converted into heat, light, and motion.

Next Generation Science Standards:

4-PS3-1. Use evidence to construct an explanation relating the speed of an object to the energy of that object.
4-PS3-2. Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

Common Core Standards:

ELA/Literacy:

RI.4.3 Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

Mathematics:

MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.

FOSS Connections:

Grade 4 Module: *Magnetism and Electricity*
Investigation 2: *Making Connections*

Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (**4-PS3-3**) *Planning and Carrying Out Investigations* Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (**4-PS3-2**)	*PS3.A: Definitions of Energy* The faster a given object is moving, the more energy it possesses. (**4-PS3-1**) Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (**4-PS3-2**),(**4-PS3-3**) *PS3.B: Conservation of Energy and Energy Transfer* Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (**4-PS3-2**),(**4-PS3-3**) Light also transfers energy from place to place. (**4-PS3-2**) *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. (**4-ESS3-1**)	*Cause and Effect* Cause and effect relationships are routinely identified and used to explain change. (**4-ESS3-1**) *Energy and Matter* Energy can be transferred in various ways and between objects. (**4-PS3-1**), (**4-PS3-2**),(**4-PS3-3**),(**4-PS3-4**) *Connections to Engineering, Technology, and Applications of Science* *Interdependence of Science, Engineering, and Technology* Knowledge of relevant scientific concepts and research findings is important

Teaser:

Students will learn about the important concepts of renewable resources, particularly solar energy and wind energy through two fun activities. First we will simulate the mechanics of a solar cell and demonstrate with solar car kits. Then we will explore wind energy through assembling mini wind

turbines. We want to emphasize the benefits of energy from the sun vs. energy from fossil fuels, and get students talking and thinking about energy in new ways.

Vocabulary/Definitions: *3 – 6 important (new) words*

- Fossil Fuel
- Renewable
- Solar Cell
- Wind Turbine

Materials:

What will you bring with you?

- 40 ft string or rope, with 10 knots 2 feet apart (the rest is unknotted)
- big cardboard circle (sun)
- big cardboard square (solar cell)
- solar cars (x2)
- flashlights
- wind mills (x6)
- plastic bottles (x6)
- screw driver
- Worksheets
- Chalkboard / Whiteboard
- Floor fan
- Photographs of windmills and solar panels

What should students have ready?

- pencils

Classroom Set-up: *Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed*

- Split students into 2 groups

Classroom Visit

1.
Personal Introduction:

Who are you? What do you want to share with students and why? How will you connect this with students' interests and experiences?

Topic Introduction:

What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge…

I. Before Exercise #1:

- What is energy? What are some ways that we use energy?
  -Energy gives us the ability to do things such as climb a mountain, play soccer, and even think. And there are many types of energy--some is stored in our muscles and brain cells, some is used to move around and play, while other types of energy are

used to light a street lamp, heat or cool our homes, cook our food, and power buses, planes and cars.

•Humans need energy to play, move, stay warm, and think, etc. What gives your body energy?

-Our energy comes from food. [What about plants?]

•What about machines like cars, lights, TVs, ipods? Where do they get their energy?

We give energy to machines by burning things like coal or oil or gasoline which are called fossil fuels. Has anyone ever been to the gas station with their family? What do you put in the car? Gasoline gives the car the energy it needs to drive. It's similar with our TV's and microwaves. We burn off fossil fuels at a big power plant and the power gets sent through wires to our houses. That's why we plug things into the wall. So when we burn fossil fuels we can also generate electricity.

• What are fossil fuels? Where do they come from?

-Let's break this term down. What are fossils and can you tell me some examples that you know about? The remains of living things from a long time ago. What are fuels? Things that have a lot of energy that we can burn to create electricity or run our machines. Plants decomposed 300 million years ago under the surface of the earth and we use these remains as fuel. Coal, natural gas and gasoline are common examples of fossil fuels. Fossil fuels are non-renewable fuels, because they come from things decomposing over millions of years. The weight from mud and rock created pressure and heat that changed the plants and animals into fossil fuels.

•What is the problem with using fossil fuels?

-Fossil fuels are usually found very deep down in the ground and it can be very difficult for us to take them out. If we use them all, we would have to wait millions of years before we get more so they are limited resources. Also, burning fossil fuels causes pollution which is bad for the environment and can make us sick. Finally, fossil fuels are usually found very deep in the earth's crust and are hard to pull out of the earth. This process can get very very expensive.

• What is renewable energy? What are some examples of renewable energy?

-Solar cells, wind turbines, biomass (plant material used to produce fuels), solar-thermal (sources that convert radiant to heat energy) are energy sources that can be reused again and again. Because the sun has an expected life span of 5 billion more years, these energies are considered renewable (In other words the sun won't burn out for a very long time).

•What about wind. Does the wind have energy in it? How do we know? Can we see and feel it? Does the wind move things? Yes, the wind can move things and that's one way we know it has energy and we can use that energy to do lots of useful things which we are going to learn about right now.

2. Learning Experience(s):

What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring… Describe in order, including instructions to kids.

Now, we're going to learn about two different types of renewable energy: solar and wind. Half of the class will learn about solar energy first, half will learn about capturing the energy of the wind. Then, we will switch so that everyone gets to try both activities.

Exercise One: Solar Simulation and Solar Car Kits

A. Introduction

Ask the students the following lead-in questions:

- How many of you know what a solar cell is?
- Does anyone know what a solar cell does?
- Solar cells turn light from the sun into electricity we can use.

While you are facilitating these questions you can pass around a couple of pictures of solar cells.

B. Simulation

- Does anyone know what light is made out of?
- Light is made up of little pieces called "photons".
- Does anyone know what little pieces of electricity are called?

Electrons

Place circle, square, rope on the ground, identify each one and describe what they do (referring to the worksheet and drawing pictures on the board):

- The circle represents the sun, which gives light, or photons, to the solar cell
- In the solar cell, the photons give their energy to electrons, which move through the solar cell and through the wire
- If we connect the wire to something like a motor or a light bulb, we can use the energy from the electrons to turn on the motor or light bulb.

Get a few kids to pretend to be photons, and the others to be electrons.

Explain the rules:

- Electrons each hold a knot in the rope
- First photon moves from the sun to the solar cell
- Photon tags the first electron and says "Zzzzzzzzzing!" (giving energy to the electron), then sits down
- First electron moves to the next knot and tag the electron at that knot, who tags next electron...
- Last electron to get tagged moves along the rope and yells something that uses electricity (electron gives energy to something else) and keeps moving to the front of the electron line
- Repeat until all the photons are gone.

Go over what happened.

C. Solar Car Demo

Ask students a few more questions:

●Does anyone know what makes cars go?

- They may say motors, wheels, etc.
- Gasoline: gasoline is a kind of fossil fuel, which means it is not renewable.

●Do you think we could use solar energy for cars instead of gasoline?

●Right now, we don't use solar energy for cars because cars use a lot of energy, so we would need lots of solar cells. But, we can very easily power small toy cars with solar cells. Also, scientists and engineers often use models to test and illustrate different ideas. We're going to model for you one way that we can use solar energy.

Bring out solar cars, ask kids to point out solar cell, motor, wheels, wire

●This is just like the game we just played, only there are real wires instead of the rope and the electrons run a motor!

●Right now, the cars aren't moving. Why not? (We are not giving them any light yet.)

- If it's night-time or a cloudy day, we can't collect solar energy either. But when it is sunny, we can collect a lot of energy.

Warn kids not to look at flashlight, it is very bright just like the sun!

Shine flashlight on cars and watch them move!

Exercise Two: Wind Turbines

A. Introduction – 5 minutes

Ask the students the following lead-in questions:

- How many of you know what a windmill or wind turbine is?
- How many of you have seen one before?
- Who knows what a wind turbine does?

While you are facilitating these questions you can pass around a couple of pictures of wind turbines.

Scientists and engineers often use models to test and illustrate different ideas. Today we're going to build model wind turbines to learn how a wind turbine turns wind into electricity.

B. Building the Turbines – 10 minutes

A wind turbine is made up of 4 main parts: the base, the turbine, a gear, and a generator. Hold up each part.

What do we need each part for?

•The base holds up the wind turbine to a place that there is wind. Often times the best wind is very high up in the atmosphere. That is why the base can be very tall. The tallest windmill is 442 feet tall. That is as tall as about 120 third graders standing on each others' shoulders!

•The wind pushes on a turbine, which captures the energy by rotating (turning in a circle).
•The rotating turbine will cause the generator to rotate, which is how electricity is formed.
•The gear turns the big and slow rotation of the wind turbine into a small and fast rotation needed by the generator. How many of you have ridden a bicycle with gears before? This is just like that. When you change gears on a bicycle you and you pedal faster you have changed to a smaller gear. When you change gears and are pedaling slower you g changed to a bigger gear.

Once you have explained the parts to the students, divide them into groups of two or three. Give each group a set of pieces to make a wind turbine. Have the students put the turbines together, following the teacher who will demonstrate how. Once the pieces are put together, the students can bring them up to the teachers, who will screw the turbine to the base and add their turbine to the "wind farm".

C. Wind Farm Demonstration – 5 minutes

Set the wind turbines up all facing the same direction.
·This is a wind farm that is supposed to generate electricity to light up these lights. Why is no electricity is being produced at the moment?

Let's see what happens when there is a low wind.
Set the fan on low. Some of the lights should turn on. They may not be very bright.
· What happened?

Let's see what happens when there is a strong wind.
Set the fan on high. All LED lights should turn on and be bright.
· Why is there a difference between low and high wind?

Let's see what happens when the wind changes direction.
Let the fan rotate. Not all the lights will light up anymore.
· What happened?

As we can see, the location of the wind farm is very important. If we put it in a place where it is strong and is blowing in the right direction, the wind turbines can produce a lot of electricity!

Wrap-up: Sharing Experiences

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

- What did we learn about? Rewrite points on the board.

- Why do we say solar energy and wind energy are renewable?

- Did you have to pour anything into the solar car like you pour gas into a car at the gas station? Do you get the gasoline back after your car uses it?

- What do solar cells do?

- What are some of the things we learnt about how to use energy from the sun? Is it always available? Is it always the same?

- What did we learn about the wind? What happens when the wind is not blowing strongly? What happens when the wind is coming from many different directions?

3. Connections & Close:

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

- Try to think about energy sources throughout your day. Anytime you see something moving or producing heat and light, ask yourself where does it come from? How do we get the energy to cook our food? There are many sources of energy, and only some of them are renewable.

- Think about how important electricity is to your life. Can you think of anything you do that doesn't require electricity? What would your life be like if we didn't have any sources of energy for driving cars and powering our homes?

- That's why we need to find sources, so we can use energy for ever and ever, even your kids and your kids' kids.

Total 50 – 60 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to build wind turbine. Write vocabulary words on the board and read words aloud. Vocabulary words can also be visually demonstrated using an illustration or action and redefined in very simplistic terms.

Advanced Learners: Have students think of more efficient wind turbine designs and allow them to test their designs. Students can also experiment with different wind angles.

Follow-up Possibilities

ELA Activity:

-Suggest students write a letter explaining "How we learned about renewable energy (solar and wind…"

-Students can make a list of energy sources and their pros and cons.

Reading Connections:

- Fossil Fuel Power by Josepha Sherman - Introduces the history, uses, production, advantages and disadvantages, and future of fossil fuel energy as a power resource. http://books.google.com/books/about/Fossil_Fuel_Power.html?id=IZH-qAlDtFAC

- Global Warming by Seymour Simon - In the brilliant Seymour Simon format, this book provides a photo essay examining global warming and the devastating facts regarding this enormous world issue. This NSTA/CBC Outstanding Science Trade Book for 2011 presents the facts in a clear text within the range of most readers from middle elementary to secondary level. http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=20612

- How We Know What We Know about Our Changing Climate: Scientists and Kids Explore Global Warming by Lynne Cherry and Gary Braasch http://www.amazon.com/Know-What-About-Changing-Climate/dp/1584691034

- 365 Ways to Live Green for Kids: Saving the Environment at Home, School, or at Play – Every Day! By Sheri Amsel http://www.amazon.com/365-Ways-Live-Green-Kids/dp/1605506346

- The Everything Kids' Environment Book: Learn how you can help save the environment – by getting involved at school, at home, or at play by Sheri Amsel http://www.amazon.com/Everything-Kids-Environment-Book-environment/dp/159869670X/ref=pd_sim_b_2

- The New 50 Simple Things Kids Can Do to Save the Earth by Sophie Javna http://www.amazon.com/Simple-Things-Kids-Save-Earth/dp/B003F76HOS/ref=pd_bxgy_b_img_b

Mathematics Activity:
-Students can graph the number of light bulbs that light up at different wind turbine speeds.
-Students can calculate the velocity of the solar car.

Other:
This website has fun activities about energy efficiency and renewable energy sources: http://www.eere.energy.gov/kids/. They also have a list of energy related lesson plans for teachers. Students can write a letter to their parents or to the governor's office about why it's important to use renewable energy.