Shining Star

Valerie Adams
John H. Taggart Elementary School

Do you remember the year 2020? It was the C-19 monster rising from purgatory taking everyone by atomic storm relentlessly in its vicious pursuit of people's authenticity. Hundreds of well-known greats; genuinely memorable people, and surely many unforgettable folks lost their lives at the clutches of this viral monster. Ill-equipped worldwide for what the year had in store and how the permanent repercussions were as harmful as the slow-burning, world changing damage done by our carbon footprints here on Earth. This unit will attempt to communicate to elementary grade students and families the value of our Sun's energy. Students will examine in retrospect why the Sun's energy is a valuable resource; to compare renewable energy sources to nonrenewable sources; and establish how the Sun is an essential part of life.

This model public school within the Philadelphia School District is a K-8 with a population of approximately 500 students used to support my opinion. The school's demographic is largely of Asian and Hispanic descent. In addition to that it is a Title 1 school with 99% of the population below the poverty level. The students therefore have access to free breakfast and lunches but most of the students refuse to eat the food so, about 80% of the food is wasted. I realize the nutritious food that is served in this particular school is not the type of food this population normally eats. I feel as a result, this becomes a problem for students to remain focused in order to achieve their best work doing school hours. Consequently, state assessment scores have been below average. In all likelihood this unit will not persuade students to eat school lunches but its purpose is to teach them the importance of nutrition in foods, the environment, and the footprints they leave behind.
Life on earth would not be possible without the Sun. This is in part due to its radiating ability to readily form bonds with other atoms, giving flexibility to the form and function that biomolecules can take, such as DNA and RNA, which are essential for the defining characteristics of life: growth and replication. Earth's most valuable natural resource is our star the Sun which flourishes this planet with an abundance of resources both renewable and nonrenewable. Advancing farther into the unit to take a "birds eye view" students will evaluate how the Sun benefits and endangers the planet and everything on it.

Biomolecule, also called biological molecule, any of numerous substances that are produced by cells and living organisms. Biomolecules have a wide range of sizes and structures and perform a vast array of functions. The four major types of biomolecules are carbohydrates, lipids, nucleic acids, and proteins.
My question then becomes, how will students truly delve deeper into environmental renewable resources without awareness of how global warming and climate changes are dramatically diminishing all three primary forms of alternative energy? I realize the answer to that question is in the future. For now, this is the unit where students will examine how they play a role in reducing their nonrenewable footprints in order to build a better, more sustainable environment. This unit will teach students the importance of their voice and why they matter. With this unit the students will analyze their character traits, beliefs and customs in order to explore the task of determining "How much do we value the environment, our neighbors here as well as around the world?"

This unit will use the NGSS (Next Generation Science Standard) to examine the energy production of renewable resources. This unit will include lessons where students can gather evidence to support the

reliance of renewable resources, examine the importance of how energy can be transferred from place to place by advanced technology and why this is the direction of the future.

This unit will also use the Pennsylvania Common Core State Standards of Science and Engineering Practices. The Science and Engineering Practices are behaviors that are critical in investigating, modeling and explaining the world, as well as in developing solutions to societal problems.

Problem Statement:

In my opinion, I strongly feel that students at the elementary levels in the public school system are only exposed to basic science processes with minimal hands-on activity time due to the scheduling constraints placed on teachers. More than ever before a huge chunk of the school day is allotted to the "other" focus areas of the content subjects. Consequently, science continues to be thrust farther to the back burners of learning. Unless you run into those special group of teachers who can juggle and integrate all content area subjects into the sciences. Unfortunately, there are only a few. As a result, when science time rolls around the initial expectation is to teach and have students maintain a growing science journal of the conducted investigations, whereas even illustrations are encouraged, mind you there is little action going on in the notetaking area, mainly because students get so excited with the limited time for collaborative investigation they forget. An doesn't time pass so rapidly when learning is enjoyable. Surely, students benefit from the manipulatives and experimentations but the retention of stated objectives or learned purpose is lost in all the excitement of working collectively and independently.

Although the concrete examples for the lesson objective are accessible, what gets flouted is the cognitive analytical conception of the stated objective. How do teachers handle that along with the minimal amount of time per week given to the sciences?

Sometimes science lessons can be a hit or miss especially when reading and math are the main focus of achievement. The department of education in the United States has determined that students should be reading on grade level by the fourth grade. Just a few years ago it was by the third grade. So that gives everyone more time to meet the mark.

Keep in mind, when teachers must compartmentalize science instruction many students need most of that learning time to be designated to building organizational skills and writing skills. So, in reality, instead photocopies of graphic organizers for lesson objectives get passed out which get lost or trashed, and time is spent repeating the purpose of the lesson. Putting it succinctly each science lesson builds on the previous lesson, but most of the time that is not the case.

On top of that, some of the difficulties and frustrations faced by a new or veteran teacher are the sudden sometimes overwhelming changes of administrations' expectations, or not being able to use the facility when necessary and that means ones' water intake is sparce, which can lead to various physical problems, or those 45 – 50 minutes of meetings held during blocked learning periods, along with the everyday dreaded behavioral issues, governing how to incorporate the differentiation of instructions for exceptional students, while handling internal combustion of cooperative grouping difficulties, just to name a few obstacles that prevent high quality science from taking place within the classroom. Oh, did I mention over crowdedness! Many of these interferences make teaching and learning arduous.

Despite all that, this unit's purpose is to share with students the importance of healthy eating and taking care of the environment which will be their inheritance at some point, that is if the human species is still in existence.

Content Objective:

Let's start at the core of it all so we clearly know why renewable resources are heavily promoted as the way of the future. The top three renewable resources examined in this unit will be the energy collected from the Sun, wind and water. All made possible by the Sun's power. Why are we so adamant about renewable energies? Globally we are being told that nonrenewable resources such as fossil fuels and coal are rapidly being depleted yet we continue to destroy the environment by using coal and petroleum which also attributes to global warming.

Energy is the focus of this unit. What is energy? Energy is an abstract concept that will be used to support students' discovery of the Sun's energy through the use of concrete inquiry.

Energy is the capacity to do work. Make a change. Convert one source into a new product. Power and force play a dominate role in the platform as well. Stay focused because here is where I throw in a curve ball. In order to do work the Sun now needs to be mentioned. How is the Sun involved with energy you might ask? How can the Sun help reduce the overheating of our planet which some say is known as global warming, you ask?

What is the Sun?

The word sun comes from the Old English word sunne, which itself comes for the older Proto-Germanic language's word sunnon. In ancient times the Sun was widely worshipped as a god. It was known as the Sun god. Ancient Greeks called the Sun Helios, and this word is still used today to describe the Sun. (16) It is a giant ball of gas at the center of our Solar System. It is the source of almost all the light and heat on Earth. Without this ball of gas-mostly hydrogen, the basic building blocks of humans, animals, plants, trees and soils would not exist.

2.5 Million years ago, during the times when there were prehistoric animals, forest, and a world mysterious in many ways, there is one thing that has been acknowledged, and that is when that world ceased to exist; it became the fossil fuels and coal we use today. Those resources such as coal, natural gases, and petroleum are being exhausted today in a world where humans seem unable to function without it on this planet.

What is the Sun Cycle?

The Sun cycle is the cycle that the Sun's magnetic field goes through approximately every 11 years. (17)

Our Sun is a huge ball of electrically-charged hot gas. This charged gas moves, generating a powerful magnetic field. The Sun's magnetic field goes through a cycle call the solar cycle. (17)

How can elementary students clearly understand and be able to explain what they cannot see? The concrete activities in this unit will be used to reveal the analytical concept of energy transfer. These hands-on activities should be beneficial for students to visualize energy transfer. Throughout these investigations all evidence collected is valuable and a necessary procedure in order to construct an explanation as to why and how the renewable energy resources benefit the environment/world.

Take the sun for example. Our star is the major source of light energy for this galaxy that makes the Earth a sustainable place. Light is a type of energy that travels as a wave. If you could run at the speed of light you could travel around the Earth 7.5 times in 1 second. Light does not need matter to travel because it is an electromagnetic wave. Light waves can travel through empty space or matter. These waves consist of electric and magnetic fields which is not made of matter, like the gravitational field of Earth which pulls all things toward it. For example, the magnetic fields of a magnet can attract opposite charged objects and repel like charged objects.

It takes about 8.3 minutes for light to travel from the sun to Earth. The Earth is one hundred fifty kilometers (1 kilometer =1000 meters) away from the sun. The EM waves from the sun are the major source of energy here on Earth.

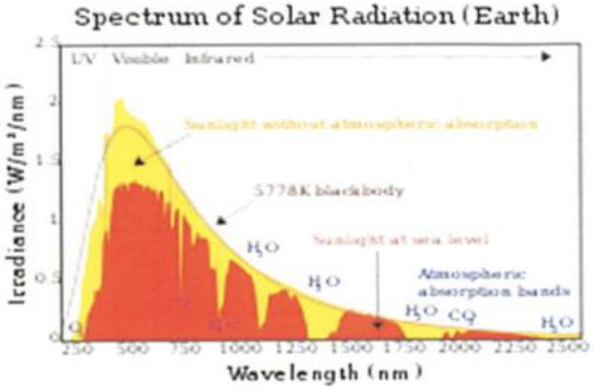
To top that every 11 years or so, the Sun's magnetic field completely flips. This means that the Sun's north and south poles switch places. Then it takes about another 11 years for the Sun's north and south poles to flip back again. How does this affect the planet Earth you might ask? As the magnetic field changes so does the energy on the Sun's surface sending powerful burst of energy and material into space which can cause auroras (which is light in the night sky), which can impact radio signals or even affect electricity grids here on Earth. This cycle can also affect satellite electrons and the radiation can be harmful to the astronauts working outside the International Space Station. (17) These are some reasons scientist study the space weather conditions. These are also a few of the similar reasons we observe the weather on Earth in order to determine the best time for outdoor activities.

What is Photo Voltic (PV) Power?

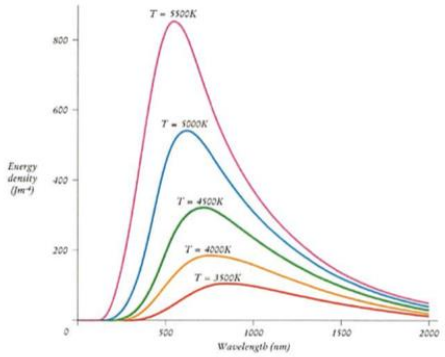
These are the solar panels we all hear so much about. These materials or devices are capable of converting the energy contained in light photons into an electrical voltage and current. The concept of light tells us that both light and matter consists of tiny particles which have wavelike properties associated with them. Light is composed of particles called photons, and matter is composed of particles called electrons, protons, neutrons. (18) The energetic photon can cause an electron in photovoltaic material to break free of the atom that holds it. Nearby charges may produce an electric field sweeping those charges toward metallic contacts as an electric current. So why are all solar panels dark in color? The answer comes from the Stefan-Boltzmann Relation known as Black Body.(14)

Stefan-Boltzmann Relation

1. A black body idealization: A body where all the radiation incident on it is absorbed, until its' heat capacity is nearly satisfied and it starts radiating energy.
    a. For a black body, the energy emitted is proportional to a power of its temperature.
    b. The radiation dynamic range is large, at low values we have the IR *(infrared)* usually associated with heat, but their values span from meters to nanometers.
    c. In the case of the sun surface, its temperature is high (˜5,800C), so the amount of energy radiated is large (˜10^{15}Wh). On the earth surface one receives approximately 1kW of power per square meter on a sunny day



2. The Wein Displacement Law states that for a black body, the maxima in the solar spectrum emitted is displaced to shorter wavelengths as the temperature increases. This empirical result relates that the hotter the thermal source, the more energetic radiation it emits (brighter).



When you see light before seeing the sun in the morning that is the solar radiation received from the Sun without having been scattered by the atmosphere. It is known as "beam" radiation. Comparable to early in the morning and late in the afternoon when it's clear to read, but the sun is below the horizon, the light photons are received after multiple scattering events with molecules and colloidal particles in the atmosphere, that radiation is called "diffused" radiation. (19)

So how do we get energy from the sun? Photovoltaic (PV) is one of the most promising and prominent techniques for electricity generation based on solar energy. (19) PV cells convert light energy into electricity. Most of the PV cells help in electricity generation by absorbing light from the visible range of the solar spectrum. The output generated by the PV cells is very low, so the cells are grouped together to increase the electricity output. In other words, solar panels absorb the sun, which is the source, necessary to convert and produce electrical energy. Solar panels are black bodies for the reason that they emit energy proportional to a power of its temperature. There are other materials necessary to convert the light/heat energy into electrical energy but that gets too technical for the elementary grades so it will not be covered in this unit.

What is a turbine?

It's the mechanics behind wind and water energy production.

A turbine is a machine used for producing continuous power in which a wheel or rotor, typically fitted with vanes, is made to revolve by a fast-moving flow of water, steam, gas, air, or other fluid. (4)

A turbine is a device that harnesses the energy of motion which is called kinetic energy. This energy is some fluid that can be a material flowing easily and includes both liquids and gases - such as water, steam, air, or combustion gases - and turns this into the rotational motion of the device itself.(5)

In the 2021 TIP course "Renewable Energy Schemes" our Professor Jorge J. Santiago-Aviles discussed how the Francis, Pelton, and Impulse turbines operate in comparison. In his view the Pelton turbine is the most common and cheapest turbine used. Professor Aviles also informed us that the Impulse turbine which is a force acting for a short time is advantageous as well because it acts with a tremendous amount of force. Apart from that the Francis turbine is a low head hydro turbine. Keep in mind the head is the height to which the water falls; it's obviously evident that moving water has kinetic energy.

Pelton Turbine

Francis Turbine

Google images

What is Wind Energy?

We can't see the wind but we know it exist because we can see its effect on objects around us. Sometimes the wind is easy and other times it can cause devastating results in nature.

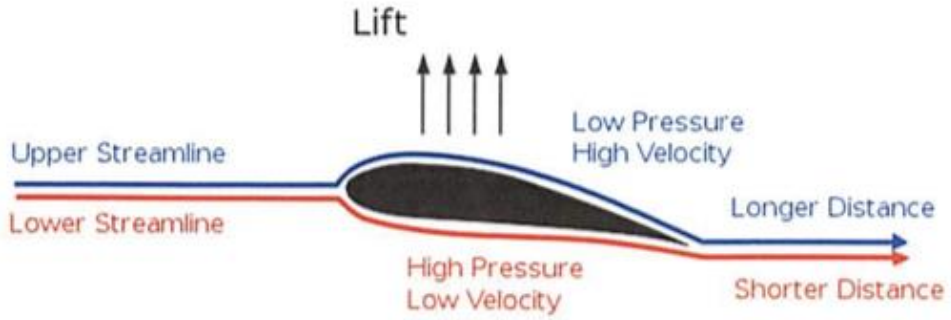
Wind is kinetic energy-which is energy in motion, so we can say wind is energy in motion and that makes it an extremely beneficial natural resource for producing energy. The wind is caused by the differences in air temperature. When the temperature rises or decreases the atmosphere can produce winds of different pressure causing changes in the air around us. When selecting to use the renewable resource of a wind turbine; also known as Eolic one must look at the source availability.

So, I have been told China is the leader worldwide in Eolic power with 145 GW (one gigawatt = 1,000 megawatts = 1 billion watts) of power production. The United States is in second place producing 74 GW of Eolic power.

Wind Turbines

On top of that, the question becomes where is the best place to harness wind, the optimum results dependents significantly on geography as the wind energy is related to the sun radiation input on earth. Interestingly, according to the Betz Limit not all the energy from the wind can be used, only about 60%, (owing to the wind in the far side of the turbine will be stagnant). A German physicist Albert Betz in 1919 concluded that this value is 59.3% which is the theoretical maximum efficiency of kinetic energy from wind that can be used to spin a turbine and generate electricity.

In fact, the wind turbine is fundamentally a dynamo (DC motor) or alternator (AC motor) with rotor blades placed in the motor shaft. The blades are in the shape of an airfoil such as the wings of an airplane. The blades produce lift, generating rotary motion. (14)

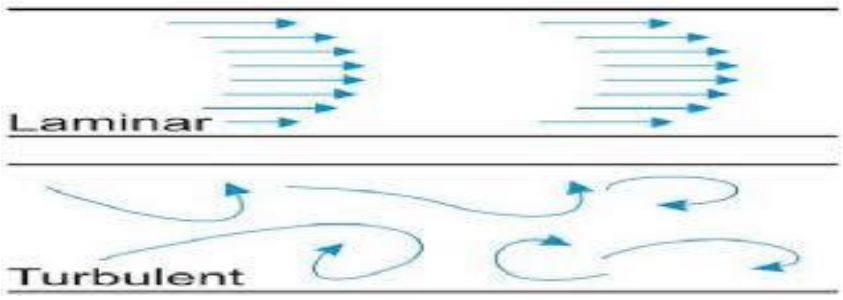


Wind Turbine Blade

Offshore Wind Turbines

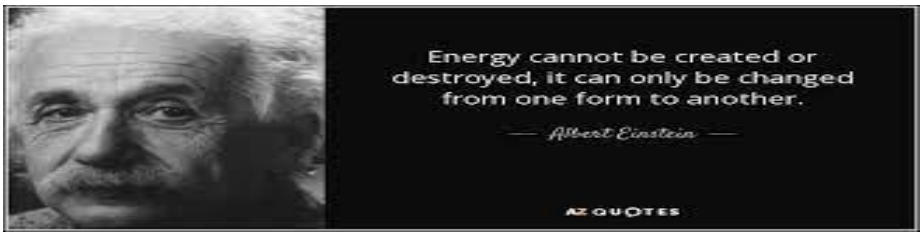
More over in many instances the Rayleigh Wind Speed Distribution is used to determine wind speed distribution in order to determine the performance of wind energy systems for a given location and time. When the wind speed probability distribution is known the wind energy distribution can easily be obtained.

Great Plains geographically is one of the best places in the Unites States for wind due to its flat land topography. This type of landscape has what is known as the Laminar Flow; which is the smooth flow of a fluid over a surface. Wind is a fluid and in fluid dynamics, laminar flow is characterized by fluid particles following smooth paths in layers, with each layer moving smoothly pass the adjacent layers with little or no mixing.



Wind and water both use turbines to produce electrical energy.

What is Water Energy?
Beyond question moving water has mass which is gravitational potential energy, also it is fluid therefore it holds kinetic energy. In reality water is abundant consequentially due to the hydrologic cycle. Water is approximately one thousand times the density of air.
Water power is measured using the formula $P=pghQ_3$. Where P=power in watts, h=the hydraulic head which is the distance the water falls in meters, Q=the water flow in liter/sec or gallons/mins. g=the acceleration due to gravity($9/8m/s^2$), and p=the mass density of water in kg/m^3.
Work is causing an object to move into or out of some position, especially when it moves against a resistance. Therefore, waters energy has the ability to convert from source to produce electrical energy. Remember the quote:



When you have stability that means minimum work is being done.
Finally, let us be mindful that the Sun is responsible for our atmosphere existing as it is. Meaning the hydrologic cycle, wind cycle, and the air we breathe has energy that is capable of supplying the world with the renewable energies discussed above. So, in conclusion the Sun is our source of survival.

Teaching Strategies

We as teachers are constantly searching for new or different strategies to build confidence in our students. Lately, I find girls becoming more assertive in classroom participation**, so my strategy is to give those students a means to express their thoughts in a scientific manner.** Students in this age group understand the world around them somewhat and often become anxious about the future. Many students want to be more confident in their work and are usually eager to participate and even sometimes demand involvement. So, let them participate or help set up experiments. If possible, allow them to assist the ELL/ESOL students. All these strategic activities instill confidence in them and enhance their developing science skills, which will increase as they participate and understand more.
In support of the **Food for Thought** activity have students **utilize their developing math and problem-solving skills.** Math skills are increasing at this age and students should be able to measure accurately and begin to think critically in order to problem-solve situations. Provide opportunities for students to measure the materials, both liquid and dry ingredients, using metric and standard measurements in the food for thought activity. Allowing this age group opportunities to solve problems on their own or in a group setting encourages independent thinking.
I strongly feel, to alleviate boredom with this activity; where some students may become easily frustrated and impatient while waiting for developmental results of the experiment, have them do short spans of intense work during those wait periods. For an example have them utilize a writing skill such as

documenting the steps of the procedures, writing a short essay or poem pertaining to the investigation, draw and color illustrations of observations in their science journals, perhaps setting up the possible next steps of the experiment. Students may also benefit from reading interesting books on the science topics they're studying.

In support of the previous strategy encourage skills through consistently reminding students about documenting in their science journal. Students develop their written communication abilities by using a science journal. It's a permanent place to record thoughts, data, and drawings about observations and experiments, as well as results based on experiences. Using a science journal also strengthens students' grasp of the science process skills and scientific method by recording each step of an experiment while it's performed.

The Sun Shine activity scaffolds **students from a concrete concept to an abstract concept.** This age group of students are moving toward thinking logically and abstractly. Build on the possibility that the students are able to deal with multiple variables, such as increased numbers and adding several components to an experiment. These parts of thinking aid in understanding science better. The hands-on investigations and concepts for this age should have more detail. By third grade, students are expected to perform an experiment in order to determine why the sun is part of living and non-living entities.

Consider the activity Burn Baby Burn to **encourage independent investigation.** This age group is naturally curious and interested in investigation. Provide them with science tools, such as a magnifying glass, and magnets. Offer supervision and guidance, but allow students to experiment independently. They are able to make their own discoveries using their science supplies. Seeing results in action helps students develop critical thinking.

Develop the mind further through the usefulness of vocabulary. Recording vocabulary words in a science journal provides a reference for future use. Vocabulary words are essential for perceiving foundational science concepts and deepening comprehension. Learning new vocabulary words also increases students' ability to think, reason, draw conclusions, and communicate effectively.

Engage students by asking questions and having them make predictions for possible outcomes. Critical thinking skills are part of brain maturation for this age group and need to be encouraged and stimulated. Forming a hypothesis by predicting what will happen in an experiment provides an ideal opportunity to foster critical thinking. Help them along by asking questions, such as: What will happen next? Why did that happen? How might you design another way to change the outcome? Thinking through their answers pushes kids to order their thoughts and helps them begin to see how the world works.

Lastly, use the encouragement strategy by telling students they are scientist in the making. They are doing what occupational scientist do when investigating and experimenting. Through observation and experimentation, students are performing "real science." Find areas of science to share with the class and allow them discussion time to find an area of interest. Fostering a love for science helps students encounter the world at a deeper level giving opportunities to discover science careers of interest. (12)

Classroom Activities

Title: Sun Shine….

Objective: Students will be able to determine how valuable the sun is in order to distinguish why its' usefulness is a necessity on Earth.

Standard: 5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. (NGSS)

Grade Levels	3rd – 5th
Subjects	Physical Science
Duration	Preparation: 10mins. Activity 1: 10 mins, Activity 2: 30 mins.
Setting	Classroom

Materials:
Sunshine "Yes or No" Worksheet (see appendix0
Everyday objects: pencil, paper, textbook, plant, t-shirt, plastic container, rock, water, soda, tree branch, soil, computer (*if you cannot acquire these objects list them on a 3x5 card with an illustration*).

Create your own "Sunshine" **Activity**: White paper plates/white construction paper, acrylic paints in yellow and red, paint brushes, small plastic containers, water.

Character Profile Worksheet

Vocabulary Terms:

Carbon: a chemical element.

carbon dioxide: usually present as a gas.

atmosphere: the gases around the Earth.

decompose: to be broken down physically and chemically by bacterial or fungal action; to rot.

Sun: the star around which the earth orbits.

Sun cycle: a cycle of disturbances in the sun and its atmosphere of an average length of about 11 years.

Background for Teachers:

At the elementary level identify for students where the Sun is located in our solar system, it's structure and that it is made of hydrogen gas. Every 1.5 millionth of a second the Sun releases more energy that all humans consume in an entire year. Let students suggest what would happen if the Sun was not large enough to heat the Earth. Without the Sun there would be no light, no warmth, and no life. The Sun energy influences all the planets, moons, and other objects in the solar system. The Sun is 1,000 times larger than Jupiter. Since it is so big it gives off massive heat. That's a lot of hydrogen held together by tons of gravity, which means a whole lot of pressure inside that big ball of gas. (17) So, this is how the process of nuclear fusion is able to release energy while creating a chain reaction that allows it to occur over and over again.

Introduction:

Start this lesson by introducing to the students a picture of the Sun (you can find a picture for this in the appendix). Have them list all they Notice and Wonder on the chart in the appendix. Ask students to share their notice and wonder in order to elicit whole group conversation.

Continue to motivate within this lesson by doing an informal observation of students' awareness of everyday useful objects. If you cannot bring in the objects listed; label them on a 3X5 card or cut and paste a picture on a 3X5 card, then label the reverse side. Hold up each item or card and share with the students or have the students share out the name of each object. Give students the "Sunshine Yes or No" worksheet, allow them 3-5 minutes to complete it independently. Then transition them into small groups to share the results of their work for another 3-5 minutes, finally bring them into whole group for final results. After that you can have the students make their own sunshine painting. Once the painting is complete have them describe in the science journal the steps taken to complete the painting and describe the usefulness of the Sun. Finally, for a written assessment of the learning objective have each student explain in writing three values of the Sun's usefulness here on Earth.

Activity:

As an ice breaker start students' activities with the character profile. Students get an opportunity to share their thoughts about who they are and how they feel about themselves. This worksheet can be used as an ongoing informal assessment of students' independent growth and intellectual identities.

Next, with the everyday objects collected or labeled on 3X5 cards have students decide individually if the Sun played a role in its production. Have them complete the worksheet: **Sun Shine "Yes or No"**. Next place them in small groups to discuss and explain their decisions. Then bring the class together for whole group discussion. Inform students the origin of all the objects. In the end they should accept that all the objects had some contact with the Sun.

*Sun Shine Painting Activity: Each child should have some type of protecting cover over their clothes such as an old T-shirt in case of spills. Have students volunteer to bring in large white paper plates or use white construction paper and cut into 12inch diameter circles. One for each student in your class.
Directions: Share a small amount of yellow acrylic and red acrylic paint in small containers. You can dilute water-base acrylic paint to stretch the amount of paint available. Remember not to make the paint watery thin. The thicker the better the results. Each child should get a paint brush. Students start with the yellow as the base of their sun painting and add red to make it more intense. Allow paintings one day to completely dry. Finally, as an assessment have students write an essay or poem describing the Sun and it's many uses.

Title: Food for Thought…

Objective: SWBAT(Students Will Be Able To) use models to describe how energy in food was once energy from the sun IOT (In Order To) demonstrate how the food cycle happens.

Standard:
PA. Integrated Standards for Science Environment Ecology Technology Engineering Grade K5.
Life Science
From Molecules to Organisms: Structures and Processes
Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

NGSS**:** 5-PS3-1: Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun.

Grade Levels	3rd – 5th
Subjects	Physical Science
Duration	Preparation: Activity: daily 20-30 minutes
Setting	Classroom

Materials: various types of lettuce and herb seeds, soil, plastic recycled salad containers, water, ruler, light source (natural or artificial)

Vocabulary:

respiration: the action of breathing; the movement of oxygen from the outside environment to the cells within tissues, and the removal of carbon dioxide in the opposite direction.

photosynthesis: the process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water.

Background for Teachers:

Teachers keep in mind this activity may take about 1-2 months in order for the food to be harvested and enjoyed. All living things need sunlight to grow and sustain life plants are no different. Photosynthesis is a

process used by plants and other organisms to convert light energy into chemical energy that through cellular respiration can later be released to fuel the organism's metabolic activities. During photosynthesis, plants take in carbon dioxide (CO_2) and water (H_2O) from the air and soil. Within the plant cell, the water is oxidized, meaning it loses electrons, while the carbon dioxide is reduced, meaning it gains electrons. This transforms the water into oxygen and the carbon dioxide into glucose. The plant then releases the oxygen back into the air, and stores energy within the glucose molecules. (20) Plant respiration involves using the sugars produced during photosynthesis plus oxygen to produce energy for plant growth. Plants use the carbon dioxide from the environment to produce sugars and oxygen which can later be used as a source of energy. (20)

Introduction:

Students will analyze what it takes to grow lettuce and herbs in order to make a small edible salad. Here is a brief outline of the nutritious information for lettuce; it is a source of vitamin K which helps strengthen bones. Consuming adequate amounts of vitamin K can also reduce the risk of bone fracture. Water makes up over 95% of raw lettuce. Salad greens contain vitamin A, C, Beta-carotene, calcium, folate, fiber and phytonutrients. Leafy vegetables are a good choice for a healthful diet because they do not contain cholesterol and are naturally low in calories and sodium. As a result, eating lettuce also hydrates the body. Students will observe how without the light energy these seeds would not germinate. Once the salad materials are ready to harvest you may ask students bring in other additions such as tomatoes, carrots and their favorite salad dressing. Let the students discuss how the grown food is healthy, alive, and edible. Remind students that carbon is found in all living objects. The food they are eating was alive until they extracted it from the soil. They themselves are also eating the energy these plants acquired from the light to get energy for themselves. Ask them to share their ideas about how the plant cycle happened and why the Sun is important to the planet.

Activity:

Students are responsible for keeping a journal log of all activities.

Have each student bring in one small plastic recycle container with a lid. These containers may be obtained by asking a restaurant or neighborhood store frequented in the community for donations. Have students use measuring tools and fill the contain with soil about 1 inch from the top. Have students mark the 1 inch to discuss any changes that may happen during the investigation process. Once students are ready to plant. Have them read the instructions on the reverse side of the packaging for planting and follow the depth for placing the seed. Have students examine the seeds using a magnifying glass and draw an illustration in the science journal along with the procedures followed. Have students draft a log in the science journal to keep track of the plant growth. Once the seeds germinate students should start documenting the data. When the seedlings are about one-centimeter measurements students need to start documenting growth until the vegetables and herbs are harvested. Students should also illustrate in the journals what is taking place. Teachers use the journals as your formal assessment.

Title: Burn Baby Burn…
Objective 1: SWBAT make observations to provide evidence that energy can be transferred from place to place by light, sound, and heat IOT construct an argument that sun has energy.

Objective 2: SWBAT use evidence to construct an explanation relating to the investigation using the time it takes for the paper to change in color, shape or size IOT document light energy and energy production.

Standard: Next Generation Science Standard (NGSS)

4-PS3-2-Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

Grade Levels	3rd – 5th
Subjects	Physical Science
Duration	Preparation: Activity: 15-25 mins.
Setting	Classroom, Schoolyard

Materials: magnifying glass, blank sheet of white paper, or a snowy area if conducted in the winter, and Sun light

Vocabulary:
beam radiation-is the solar radiation received from the Sun without having been scattered by the atmosphere
diffused radiation-is that solar radiation received from the Sun after its direction has been changed by scattering by the atmosphere
light – the natural agent that stimulates sight and makes things visible
energy-the ability to do work
chemical reaction- a process in which one or more substances, the reactants, are converted to one or ore different substances, the products.

Background:

Introduction: This activity depends on the strength of the Sun's light energy. Students will use the magnifying glass to change the paper through energy transfer in order to show that abstract enengy is happening.

Directions:
This activity will work best outside on a warm sunny day around noon when the sun it at its zenith.
Students are responsible for keeping a journal log of all activities.
Students will conduct a transfer of sunlight energy to heat and sound energy,
Students know the sun has heat energy since they feel it on hot summer days or as they watch snow melt with the heat of sunrays. When objects are magnified it increases the intensity of the heat. The light shining onto and through the magnifying glass when directed onto the paper will change the paper's color, shape and size. Students will observe how the change happens. Students will use the evidence from the investigation to explain that light/heat energy can be transferred from the source to produce a chemical reaction causing a chemical change with a transfer of energy.

Activity:
Each student should have a magnifying glass and a sheet of lightly dense white paper (not construction paper). Direct the students to hold the magnifying glass about 3-4 inches above the paper on a 45- or 90-degree angle, depending on the location of the sun at the time of projecting. Tell the students to try and get the sun's ray projected onto the paper as a very small circle of light. The smaller the circle the stronger the radiation will be. Have the students hold it until they notice a change happening such as a rise of smoke or indicating the paper is starting to change. At that point have the students stop and discuss what just happened. Once all students achieved the chemical reaction take the investigation back into the classroom so they can document and discuss the process. Have a whole group discussion about the energy transfer describing what happened and why.

Resources

Read Aloud -Don Quixote and the Windmills by Eric A. Kimmel
https://youtu.be/7JBur2YVm_Y

How a Wind Turbine operates – YouTube https://youtu.be/DILJJwsFl3w
Wind Cycle https://www.eia.gov/energyexplained/wind/

Student activity for carbon cycle https://youtu.be/5P2YDXxFANI

How to Make a paper Windmill https://youtu.be/4ufBW5Cfpgw

Carbon Cycle Role-Play https://www.calacademy.org/educators/lesson-plans/carbon-cycle-role-play
Where Does Wind Come From YouTube- https://youtu.be/0yXC45dgmSs
Where Does Water Come From YouTube https://youtu.be/vjDnh7zfO98

Always in Motion
http://www.chem4kids.com/files/atom_orbital.html (11)

Why does Wind blow?
https://scijinks.gov/wind/ (13)

Appendix

Next Generation Science Standards (NGSS)

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-PS3-3	Ask questions and predict outcomes about the changes in energy that occur when objects collide.
4-PS-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
5-PS3-1	Use models to describe that energy in animals' food (used for body repair, growth, and motion and to maintain body warmth) was once energy from the sun.
5-ESS1-1.	Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

Philadelphia District Science Standards
Pennsylvania Common Core State Standards

Science and Engineering Practices

The Science and Engineering Practices are behaviors that are critical in investigating, modeling and explaining the world, as well as in developing solutions to societal problems. The eight science and engineering practices are:

1. Asking questions and defining problems;
2. Developing and using models;
3. Planning and carrying out investigations;
4. Analyzing and interpreting data;
5. Using mathematics and computational thinking;
6. Constructing explanations and designing solutions;
7. Engaging in argument from evidence; and
8. Obtaining, evaluating and communicating information.

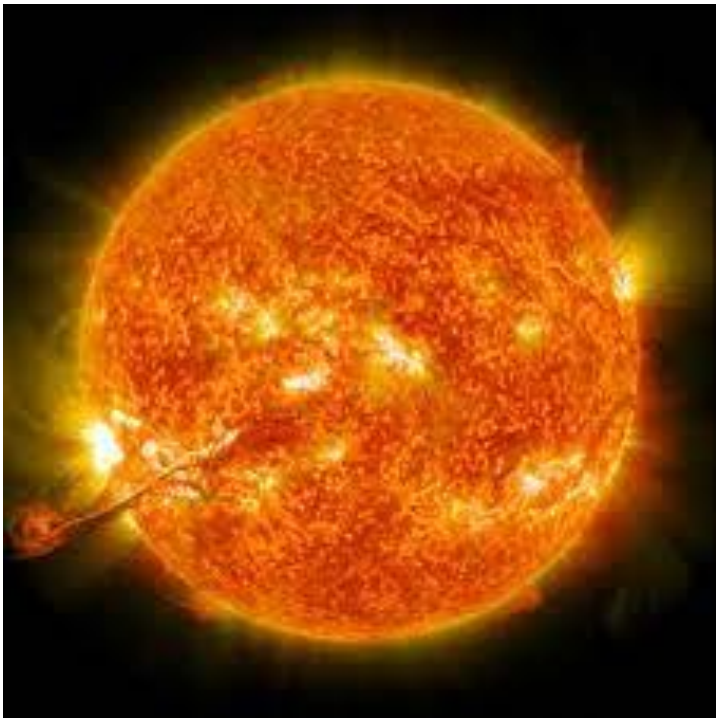
Teacher Materials:
Periodic table of elements https://ptable.com/#Properties
Carbon Cycle YouTube. https://youtu.be/xFE9o-c_pKg

Notice and Wonder Worksheet

NAME DATE

WHAT I NOTICE	WHAT I WONDER

Sun Images



SUN SHINE WORKSHEET

Name: **Date:**

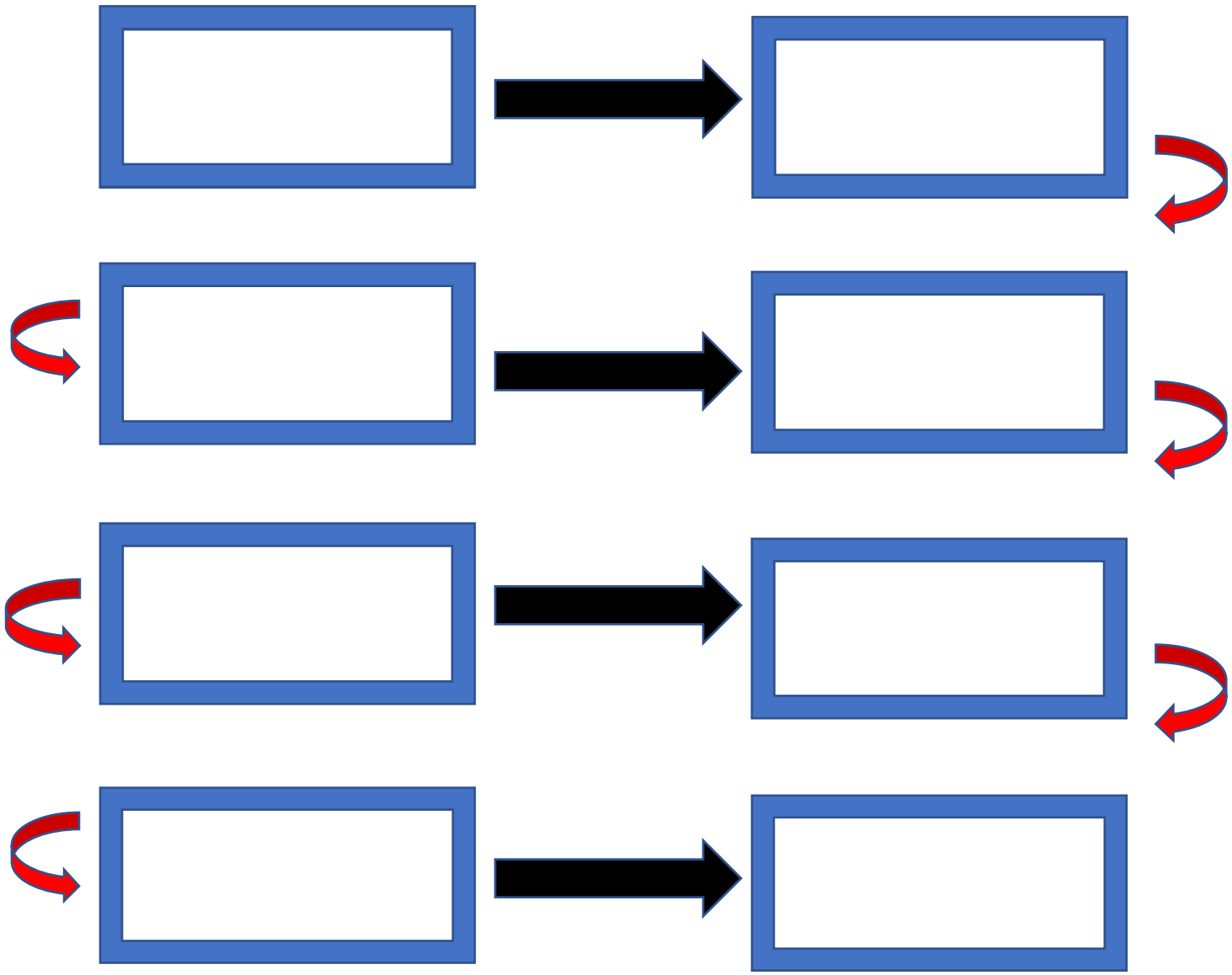
Worksheet: Sun Shine "Yes or No"

Did the object need sunlight for development?	Yes	No	Explain
pencil			
paper			
textbook			
plant			
T-shirt			
plastic container			
rock			
water			
carbonated soda			
tree branch			
soil			
computer			

ENERGY TRANSFORMATION WORKSHEET

NAME DATE

Energy Transformation



Vocabulary Terms

Energy
Carbon
Carbon Cycle
Energy level
Photon
Photovoltaic
Electron
Solar
Wind
Water
Chemical reaction

Bibliography:

Carbon (from Latin: carbo "coal")
https://en.wikipedia.org/wiki/Carbon

By mass, about 96 percent of our bodies are made of four key elements: oxygen (65 percent), carbon (18.5 percent), hydrogen (9.5 percent) and nitrogen (3.3 percent).
Posted on July 2, 2015 Elements That Keep Us Alive Also Give Color to Fireworks
by Ruchi Shah https://biobeat.nigms.nih.gov/

Life on earth would not be possible without **carbon**. This is in part due to **carbon's** ability to readily form bonds with other atoms, giving flexibility to the form and function that biomolecules can take, such as DNA and RNA, which are **essential** for the defining characteristics of life: growth and replication. Dr. Tim Doheny-Adams.
https://www.futurelearn.com/

What is Carbon
https://www.theguardian.com/environment/2011/feb/03/carbon

Carbon Origins
https://www.rsc.org/periodic-table/element/6/carbon

YouTube of Professor Dave discusses Carbon
https://youtu.be/ULiLt2rtpAg

Carbon Cycle with a 2-minute video
https://oceanservice.noaa.gov/

What is a turbine? https://energyeducation.ca/encyclopedia/Turbine (4)

WiseGeek. (September 2, 2015). What is a Turbine? [Online].
Available: http://www.wisegeek.org/what-is-a-turbine.htm (5)

Valence Electron (6)
Dictionary.com

Atomic Shells
http://www.chem4kids.com/files/atom_orbital.html (7)

How do we know that things are really made of atoms?
Earth Story
http://www.bbc.com/ (8)

Seeing Atoms

http://www.physicscentral.org/explore/action/atom.cfm (9)

Scanning Tunneling Microscope
http://www.iap.tuwien.ac.at/www/surface/STM_Gallery/stm_schematic.html (10)

Article-Tips for teaching science to elementary students.
https://learning-center.homesciencetools.com (12)

Professor J. Aviles Documents. Handout (14)

What is the Sun https://solarsystem.nasa.gov/solar-system/sun/overview/ (17)

What is Photovoltaic https://www.energy.gov/eere/solar/solar-photovoltaic-technology-basics (18)

Beam and Diffused Radiation https://www.sciencedirect.com/topics/engineering/beam-radiation (19)

Photosynthesis
https://www.nationalgeographic.org/encyclopedia/photosynthesis/ (20)

Google.com

Uncovering Student Ideas in Science Vol.3
By Page Keeley, Francis Eberle, Chad Dorsey
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Holt Science Modern Chemistry
by Dull, Metcalfe, and Williams

Holt Science and Technology
Sound and Light