6TH GRADE
STEM & ART 1 LESSON
In this lesson, students will:

- distinguish the difference between energy sources that are renewable and nonrenewable;
- understand the pros and cons of nonrenewable energy sources such as coal and oil versus green energy such as wind and solar;
- describe ways to reduce energy consumption in a sustainable way; and
- create a design for a wind turbine.

National Learning Standards:
Science: MS-PS3-3; MS-ESS3-3; MS-ETS1-1; MS-ETS1-2
Art: Cr2.1.6a; Cr2.3.6a
Before beginning this lesson, ask students to interview their parent or guardian to find out the source of energy used within their home. Depending on the location of your district, many students will probably have municipal energy.

During the next class period, show the website for one of the energy providers in your area and have students identify what method is used to produce their energy. Ask students to tell you what types of energy they’ve heard of before and write the list on the board. Some student responses might include solar, oil (petroleum) or wind. Define renewable and nonrenewable, and ask students to sort the energy list into those two categories. Complete the list by filling out any energy sources they haven’t come up with yet. Energy sources listed should include coal, oil, natural gas, nuclear power, biomass, wind, hydropower, geothermal and solar.

Break the students into pairs or small groups and assign each student group one energy source. Students will do quick research to find one pro and one con of their assigned energy source and present them to the class. Explain that, while some energy sources may be cleaner than others, all energy resources require some sort of energy to install the infrastructure required to run and maintain them. This infrastructure can be cost prohibitive when it comes to installing green energy. Sometimes reducing the amount of energy someone uses can be more cost effective AND nearly as green as using sustainable energy.

For this reason, it is important to also learn how to conserve energy. Many old buildings are not energy efficient, but can be with some slight modifications.

As a class, investigate the classroom and the school to examine where energy waste may be present. Look for worn-out caulk and seals on windows or bathroom lights that are constantly left on. Touch walls or windows to check for transfer of heat or cold from the weather outside. Ask students to brainstorm ideas to help the school eliminate this energy waste and convert the building to conserve more energy.

Texas produces the most wind energy in all of the United States with over 20,000 megawatts (MW) per year. The next closest state is Iowa with almost 7,000 MW per year.
Students will brainstorm or research methods of energy conservation such as glass technology, insulation or subterranean building. Students will use their new knowledge, and review the methods of energy conservation discussed in class, to choose a room or building they are familiar with to convert with energy efficient upgrades. Students will create a scale model of the room or building and retrofit the space with recycled materials such as old clothes or milk cartons to reflect how they will update the energy efficiency of that area. While water conservation is also important, the focus should remain on energy unless water is being used to help maintain the space’s temperature.

**METAMORPHOSIS**

Conserving energy is great, but what about completely changing the energy source you use to a cleaner, more sustainable version? The renewable energy field is constantly growing to enable more people to do this. Choose your favorite renewable energy source and use your knowledge, as well as design software, to create a renewable energy prototype such as a new style of turbine or a new way to harness energy or water.

**UPCYCLE**

Through the Lens

Divide students into pairs or small groups, and have them take a trip around the inside and outside of the school. They should stop at each location where they see an example of energy waste. Using a smartphone or other recording device, have students take turns filming each other describing the evidence that indicates energy is being wasted. Make sure they also include suggestions for how to fix the issue and eliminate the energy waste. Once each group has finished, use an app such as Flipgrid to combine the clips and have the students present their video to the principal.
eARTh

Wind turbines convert kinetic wind energy into mechanical power. Wind energy is an amazing source of energy for many reasons: it’s low cost, renewable, has enormous power and causes no pollution. In fact, one of the only complaints that people have regarding wind energy is the way that the turbines look!

Because this is a real issue for some people, artists and designers have begun creating more aesthetically pleasing wind turbines. They are beautifully designed pieces of art, and they not only help save the environment, but they add an aesthetic element to the space that they inhabit.

With your class, take a look at this article and discuss some of the different examples of artfully designed wind turbines. What do they have in common? How are they different? Encourage students to use proper vocabulary regarding the principles of design and elements of art when they discuss the examples.

Now, have students design their own wind turbine. They also need to think about the type of space that it would inhabit, such as an open field or somewhere more populated like atop a downtown office building. Be sure they brainstorm and create preliminary sketches before deciding on a final design. As they create their designs, remind them to keep these things in mind:

- What kind of space will it be placed in?
- How will it affect the space that it is in?
- What color(s) will it be?
- What shapes will it include?
- Will it create sound?

Encourage students to push their creativity. The final project can either be a detailed drawing of their turbine, or they can build an actual 3D model of their design. When they have finished, the students should present their ideas to the class.

Community Garden

Many resources for your community’s homeless population use volunteer labor to meet the needs of the individuals they serve. Many people are able to donate time but not necessarily money. Buildings such as food pantries and shelters, however, have operating expenses such as utilities that keep the building at a comfortable temperature.

Visit your community’s homeless resource buildings and use your knowledge of energy conservation methods and renewable energy sources to formulate a plan to reduce their operating expenses. Even a small reduction in energy costs can help them serve more people!
CAREER CONNECTION

Wind Turbine Technician - Wind turbine technicians specialize in the installation, maintenance and repair of wind turbines. This is a great career if you love heights! This career requires a high school diploma and technical school. Most of the time, technicians also complete an internship.

Community Market Coordinator - Community market coordinators set up the market, recruit vendors and help manage booths. They also help market patrons find the goods they are looking for. This career requires a high school diploma, plus experience in customer service and managing people comes in handy.

Civil Engineer - Civil engineers are responsible for almost all aspects of designing, building and maintaining a city. They work on infrastructure, including roads, bridges, buildings, sewer and water systems. Anything you see in your city is probably the result of the work of a civil engineer. This career requires a bachelor’s degree, although more advancement opportunities are available with a master’s degree.

Architect - Architects plan and design buildings. They may create something as small as a tiny house for the homeless to something as large as a stadium. This career requires a bachelor’s degree.

Drafter - Drafters use designs from engineers and architects to create technical drawings using design software. This career requires an associate’s degree.

CAREER HIGHLIGHT

Dan Corson incorporated solar power and art when he created his famous “Sonic Bloom” lighted sculptures outside of the Pacific Science Center in Seattle, WA. Not only do the giant flowers produce light at night, but they also demonstrate that even rainy environs such as Seattle can access solar energy.
6th Grade
STEAM & Social Studies
Driving Question:
How can knowledge of potential and kinetic energy help a community transit system go green?

Materials Needed:
Science notebook or sketchpad, writing utensil, magnets, small turbines, model vehicles, small gears, other prototyping materials such as glue, small balsa rods, etc., computer design program (in place of physical prototypes)

In this lesson, students will:
• use knowledge of kinetic and potential energy to brainstorm ideas to make a community transit system more sustainable.

National Learning Standards:
Science: MS-PS2-3; MS-PS3-1; MS-PS3-2; MS-PS3-5
Social Studies: VIII.a
Art: Cr1.1.6a; Cr2.1.6a; Cr2.3.6a; Pr5.1.6a
Begin by watching a quick video on potential versus kinetic energy with your students. After the video, tell students that everything has energy – either kinetic energy or stored as potential energy. Also, energy changes based on how it is acted upon by forces such as gravity. Ask students to brainstorm the ways forces change energy and write their ideas on the board. Some ideas that should be included are gravitational, frictional, magnetic and muscular force.

Explain that most energy we use to power homes or vehicles comes from the movement of gasses being captured by turbines or pistons. In gasoline powered engines, the combustion of gasoline produces a gas that is under pressure and moves pistons in the engine. As far back as steam locomotives, the steam energy produced from burning coal was able to move an entire train. To give an example of how a moving turbine converts energy from wind, water or gas, watch a short video. Discuss how turbines can be used for more than just energy production in homes. Ask students to brainstorm ideas for how air movement and turbines can be used to help capture energy to power vehicles such as trains and busses.

SPINNING THE COCOON

KERNEL OF KNOWLEDGE

Turn your engine off at red lights! Idling for 10 seconds consumes more fuel than re-starting your engine.
Student groups will get together to brainstorm ideas for how to create a city bus or train that runs, at least partially, on green energy. Students should create a concept that uses turbines and gears to either completely power a vehicle, or to power a vehicle after it has been started by a battery or other power source.

Before starting a prototype, students can draw a plan illustrating how to start the vehicle and also how turbines or pistons might be placed to capture energy. An example of student ideas might be placing turbines on top of a bus where the wind from the bus’s movement would cause it to spin, allowing the turbine to capture more energy for use by the bus’s engine. Students can build models of their energy producing system and attach them to model cars or put them on model wheels and chassis to test them on a downhill ramp. Students can make modifications to their prototypes to increase their concept’s potential for perpetual motion.

With students still in groups, ask them to identify the reasons why mass transit, like subways and buses, have become available in urban areas. They can write their reasons on sticky notes and place their group’s ideas on the board or share with the class as they are called on. Students should understand that there is a correlation between the population and how many public transit options are available. Next, ask students to brainstorm with their group ways to reduce carbon emissions by utilizing the ideas generated from the previous science lesson. Have them consider why it would be important to improve air quality in high-population areas and why society and government should care. Their group’s responses can be recorded on sticky notes or shared verbally.

Have students work in small groups to create three-minute videos on Flipgrid that tell a story about green transit systems and why they are needed. The films can be narrative or documentary. Stage a screening of the films in the classroom with popcorn or another treat, and ask students to lead short Q&A sessions after their respective films to share what they learned from making their film and to promote class dialogue about ways to increase green transit systems.
As a class, create posters focusing on the importance of mass transit to reducing our carbon footprint. Contact the nearest mass transit authority and ask if you can hang the posters inside the cars or display them on the walls of the waiting areas.

Reducing our carbon footprint is important for many reasons, and the choices that we make regarding transportation have a huge impact on this. After discussing the importance of mass transit and carbon footprint reduction, have the students brainstorm other transportation methods that are greener. Some examples might include bicycle, scooter, skateboard, car pool or walking. Allow the students to call out their examples and write them down on the board.

Now, either in pairs or individually, tell the students that they are going to create an advertisement for a green form of transportation. They can either use one of the examples that were previously discussed, or they may invent their own. The sky’s the limit - there are no wrong answers. Allow them to be as creative as possible with this! To begin, they should create sketches of their ideas for green transportation. When they decide on their final product, they should create a drawing, or if possible, a prototype of their form of green transportation. When finished, have them record a commercial promoting their design. Have them pretend they are selling their product to a green transportation company, so they should address how their transportation is good for the environment as well as aesthetically pleasing. If you are not able to create a commercial, have the students make an advertising poster for their design highlighting the same points.
CAREER CONNECTION

Transit or Light Rail Operator - These operators drive public transit vehicles that operate on rail systems, including subway trains, trams and elevated trains. Operators are responsible for making sure that passengers get on and off vehicles safely. The education needed for this job includes a high school diploma or GED.

Engineer in Renewable Energy - This position is part of the growing sector of green jobs that involve environmentally conscious energy production. These individuals maximize the energy potential of clean energy sources including wind, solar, geothermal and hydropower. Renewable energy engineers monitor and develop alternative energy outputs. For this, you need a bachelor’s degree and various licenses.

CAREER HIGHLIGHT

Alfred Ely Beach was an American inventor who designed New York City’s earliest predecessor to the subway system that we know today. Created in the 1860’s, it was called the Beach Pneumatic Transit. Beach proposed the underground transportation system to help relieve traffic congestion in New York.
In this lesson, students will:

- compare the pros and cons of various energy sources. They will then create solutions to the detrimental air quality effects of some of the sources.

**National Learning Standards:**
Science: MS-ETS1-1; MS-ETS1-2; MS-ETS1-4; MS-LS2-4; MS-ESS3-3
Social Studies: III,h; IX,d
Art: Cr1.2.6a; Pr5.1.6a; Cn10.1.6a

**Driving Question:**
How can items from nature be used to help improve air quality from polluting sources? How do various energy sources compare when it comes to air quality?

**Materials Needed:**
- Sketchbook or science notebook,
- ozone samples from around town,
- schoenbein paper, filter materials such as coffee filters, sand, gravel and charcoal,
- paraffin candles, carbon dioxide probe
Prior to beginning this lesson, take ozone samples at various places around town or in surrounding towns. One sample should be near some type of energy producing source, whether it is green energy or nonrenewable energy. Identify a city near you that has a coal-fired power plant as well as an area producing wind energy and find them on the American Lung Associations (ALA) “State of the Air” map.

Ask students to name possible sources of energy production and write these sources on the board. Briefly discuss the pros and cons of each source such as availability, infrastructure required and sustainability. Ask students for ideas of other parameters which might be considered when choosing which energy sources a city uses. Show students the ALA air-quality data as well as the ozone tests for the two areas you selected, and ask them to hypothesize what causes the differences in air quality. Discuss how most renewable energy sources such as wind and solar emit almost no volatile organic compounds (VOCs) or measurable carbon, whereas as coal-generated plants, for example, do. Explain that other factors do come into play when it comes to air quality such as the location of the power plant.

Explain to students that many cities don’t necessarily have the budget to relocate a polluting power plant but can sometimes retrofit the facility with cleaners and scrubbers that help prevent the pollution from leaking out. These cleaners filter the air similar to the way that at-home water filters clean potable water further. As a class, read an article or watch a video that shows the materials used to make common water filters.

Even though coal use is declining in the United States, it is still the second-largest source of greenhouse gas emissions, according to the Energy Information Administration, and coal ash is one of the largest waste streams in the country.
METAMORPHOSIS

In small groups, have students briefly research methods for water filtration and apply the data they found in their research to air quality. Students will use the information they researched to design at least three air filters on paper. While in the design phase, student groups must also consider the budget that would be required to make the filters on a larger scale. After designing their filters on paper, have each group create prototypes to test. Under the supervision of a parent or teacher, students can use paraffin candles in a vacuum with a CO2 monitor to test their prototypes. Students should record the amount of carbon dioxide that gets through their filter or another method to test the success of their filters. At the end of the prototyping phase, student groups should get together and share their results. As a class, they should discuss what were the most successful materials and design based on their results. Students should also discuss the potential costs associated with building such a filter. Based on this discussion, the students will work as a peer community to design and create a prototype of what might be the ultimate air filter.

UPCYCLE

The students will use the information from the Metamorphosis section to build a cost analysis for building their ultimate air filter prototype on a scale large enough to function on a nearby polluting power plant. Students will interview officials at the power plant or research the dimensions needed and calculate the costs of building and implementing their filtration system. Student groups will then research the costs associated with installing green energy infrastructure such as a wind-powered plant and compare the costs associated with creating a new, green-energy plant with that of retrofitting existing polluting plants.
Facilitate a discussion with students exploring why technology drives the movement of people and economic sectors. Typically, where there are large concentrations of people a power plant is not far off. Discuss why this is so, including how people and businesses use power and how those uses have changed over time. Have students discuss how people have been impacted by climate. For example, the climate in Texas during the summer is hot while the climate in Alaska during winter is cold and without modern technology, like central air and heat people and businesses would not choose to reside in these places. However, energy sources allow individuals the ability to live and work anywhere because of the availability of air conditioning and heating. This creates an air-quality problem due to the power plants that are needed to provide energy to the population.

After placing students into groups of 2-5, have them brainstorm how they as citizens can address the air quality issue, which should include a proposal to a local lawmaker. Have them create a video explaining their ideas and upload it to Flipgrid.

Some questions to post on the board while they are working include:
1. How can we limit emissions and improve air quality?
2. What options will bring the greatest results?
3. Will any options bring immediate results?
4. What are some ideas that may help businesses save money in the long-run?
5. How can we gain support for these ideas?
6. Are there dire consequences of not doing anything? If so, explain.

Remind students that their video should be clear and concise to get their point across. Providing a time limit may also help.
The Air Quality Index, or AQI, is the Environmental Protection Agency’s (EPA) index for reporting the daily air quality. The EPA calculates AQI for five major air pollutants regulated by the Clean Air Act: ground-level ozone, particle pollution (also known as particulate matter), carbon monoxide, sulfur dioxide and nitrogen dioxide. For each of these pollutants, the EPA has established national air-quality standards to protect public health. Visit this [link](#) to see the colors associated with each level. Review these levels and the colors associated with them with your class, and make a list of the things that would cause both the least and greatest effects to the air-quality index.

Now, introduce your class to the definition of a triptych. A triptych is a group of three artworks that are meant to be displayed or appreciated together. The three works are joined by a relationship in subject matter or technique used. Next, talk about what a monochromatic artwork is. This is a piece of art that is created using different tones and shades of one color or hue.

Once the class has an understanding of monochromatic and triptych art, the students will create a triptych based on three different color levels of the Air Quality Control Index. For each color that they choose, they must also choose something that might be the cause, or one of the causes, for that level of air quality. For example, if they choose green, they might draw a picture of someone riding a bicycle. If they choose red, they might draw a freeway packed with cars emitting smoke. Each individual piece needs to be monochromatic, so the green piece with the bicycled would all be painted in shades and tones of green, whereas the one depicting traffic pollution would be created in only shades and tones of red.

Once the students have finished their triptychs, they should present them to the class and discuss the content of each piece, how it relates to the color that they chose, and how they have successfully created a triptych using monochromatic techniques. Display the pieces so other students, administrators and visitors can view them. This would be a great exhibit to create for an Earth Day celebration!
Emergency Management Specialist - Emergency management specialists coordinate disaster response or crisis management activities, provide disaster preparedness training, and prepare emergency plans and procedures for natural (e.g., hurricanes, floods, earthquakes), wartime or technological (e.g., nuclear power plant emergencies, hazardous materials spills) disasters or hostage situations. This career requires a bachelor’s degree or higher, experience and specialized certifications.

Economist - Economists study the ways a society uses scarce resources such as land, labor, raw materials and machinery to produce goods and services. They analyze the costs and benefits of distributing and consuming these goods and services. A master’s degree is needed for this job.

CAREER HIGHLIGHT

In 1981, Hans Tholstrup and Larry Perkins became the first individuals to cross a continent in a solar-powered car that they built. Tholstrup is also the creator of the World Solar Challenge in Australia.
6th Grade
STEAM & SOCIAL STUDIES
Driving Question:
How does the number of trees in an urban area affect organisms, including humans, in that ecosystem?

Materials Needed:
Photos of a healthy versus stagnant pond or waterway, calculator, aerial views of town, access to Google Maps, a device for research, science notebook or sketchbook, writing utensil, temperature probe, online resources such as The Oxygen Project.

In this lesson, students will:
- recognize the importance of urban trees, both to the oxygen/carbon cycle and heat islands.

National Learning Standards:
Science: MS-LS2-5; MS-ESS3-4
Social Studies: VIII.b
Art: Cr1.1.6a; Cr1.2.6a; Re.7.2.6a; Cn11.1.6a
Ask students if they’ve ever been near a stagnant, still waterway such as a pond or lake and ask them to describe it. Students might describe the smell of decay, the lack of organisms in the water, or the stillness of the pond. If students have not had exposure to waterways, the instructor should show images and describe what it is like. On the inverse, ask them to describe a healthy pond or lake. A healthy waterway is teeming with fish, aquatic plants, and other life forms and is generally relatively clear near the surface. Ask students what makes a waterway healthy or unhealthy. Tell students that factors such as pollutants, the amount of motion in a waterway, sunlight and temperature all impact the amount of oxygen in the habitat. Pollutants kill organisms which decrease oxygen due to decaying matter. Decreased motion also depletes oxygen. Changes to sunlight and temperature can cause a decline in aquatic plants further reducing oxygen.

Just like an aquatic environment, terrestrial environments need oxygen to thrive and be happy. Write the formula for photosynthesis on the board and review with students. Students should know that plants take in carbon dioxide from the environment and release oxygen for organisms to breathe. While much of our oxygen is provided by aquatic species, a large amount is provided by trees. Ask students if they can guess how many people one tree can support with oxygen. Tell them that, according to the University of Georgia, one large tree can support up to four people. Divide the number of students in class by four to determine the number of trees needed to provide oxygen for the class.

Watch the United States Census Bureau’s population clock to show students how quickly the world population is growing, and ask them if they think we are planting trees at the same rate to provide oxygen for all of those people. Explain that, rather than planting more trees, we are losing our forests rapidly. Show students this National Geographic video on deforestation and discuss what students can do to prevent tree loss in order to help continue providing oxygen and lowering carbon dioxide levels in our environment.

Explain to students that humans have been changing their environment for centuries. Ask students to come up with examples of human environmental modification. After they provide examples, explain how progress is the driving force for many world economies and trees are not typically on the priority list for many businesses. For example, if a business wants to maximize space and create profits they will not save the trees that are on the lot where they build.

Lead students on a quick trip outside and take the temperature in the shade of a tree versus in the direct sunlight. Discuss how, in addition to providing oxygen and sequestering carbon, trees also provide canopy to prevent heat islands in urban areas. During summers in Texas when temperatures soar, this tree canopy can mean the difference between health and heat stroke for individuals who might have to walk to work despite dangerous heat levels.
Student groups will begin by researching tree types that would be well suited to the local environment. Students should consider the following when examining tree types: lifespan of the tree, mature size, spacing requirements, watering requirements and what biomass it might produce (pine needles, nuts, leaves, etc.). Students should also keep in mind that selecting diverse trees is better than having a monoculture.

Students will use this information as well as aerial maps of the city to decide which trees to plant and possible locations to plant them. Students can use programs such as Google Maps’ street view to design tree canopies over public park sidewalks or redesign street medians with trees with small roots. Students should plan and design at least three areas that were previously uncovered, and use either art paper or a computer drafting program to create before and after images of the chosen areas. Students will present these images, the type and number of trees they chose, and how these trees will affect the carbon and oxygen in town.

**THROUGH THE LENS**

Document your process of painting your trees, from selecting the tree(s) to choosing the winning drawings to painting. Allow the students to provide commentary throughout the process and have each student speak about the importance of tree conservation and how this project will bring awareness to your cause.

**UPCYCLE**

Student groups should take their plans for planting trees a step further by applying for urban tree grants such as the urban forest grant in Austin, Texas. Students should research which grants are available in their area and either apply for them or prepare a presentation for their city council urging them to apply for them. If there are no grants available in their area, students should brainstorm ways to raise funds themselves.
As an extension, have students watch the original Lorax on their own (available on YouTube). Have them make connections from the lesson on deforestation to the movie. They can do this in a video response on Flipgrid or in an essay.

**KERNEL OF KNOWLEDGE**

Forest ecosystems store between 20 and 100 times more carbon per unit area than croplands.
eARTh

Trees play an integral role in our lives, from providing oxygen to breathe to creating shaded areas for temperature regulation. Unfortunately, as our cities grow and build, often trees are cut down and not replanted. This affects people across the globe. In response to this, some artists in India have started a project to raise awareness and offer solutions to this issue. They are painting trees to save them from being cut down because of development and road expansion. The images they paint on them vary, but they each have a deep meaning in Indian culture. Visit this link to see examples of these trees and read more about the artists’ goal.

Now, locate one or a few trees that you can paint around your school or community. Decide as a class the message that you would like to convey in the painting of your tree. It needs to focus on the importance of conservation and highlighting the value that trees provide. You could ask each student to create a sketch and then vote on the ones that the class feels truly reflects the message. If you are not allowed to paint the trees around your school or area, then you can wrap them in colorful yarn and hang drawings or important facts about tree conservation from the branches.

Community Garden
- Urban forests provide fruit and other foods for people to come and pick. Find a spot in your community where you and your students could plant an urban forest or community garden. You could even plant one at your school and have the students take turns taking the food home. They could create a dish at home with their family and bring it back to class for everyone to taste, or prepare the food as a class.
CAREER CONNECTION

**Horticulturist** - A horticulturist knows the science behind different plants, flowers and greenery. They conduct research in gardening and landscaping, plant propagation, crop production, plant breeding, genetic engineering, plant biochemistry and plant physiology. This generally requires an associate’s or bachelor’s degree.

**Landscape Architect** - Landscape architects design attractive and functional public parks, gardens, playgrounds, residential areas, college campuses and public spaces. They also plan the locations of buildings, roads, walkways, flowers, shrubs and trees within these environments. For this career, a bachelor’s degree and experience in the field is needed.

CAREER HIGHLIGHT

Theodor Suess Geisel, or Dr. Seuss, was a writer, poet and illustrator among other things. He was wildly creative and also highly invested in humans caring for both each other and the environment. In one of his most famous books, *The Lorax*, Dr. Seuss brings attention to the importance of trees and their conservation.
In this lesson, students will:

- recognize that, although thermal energy moves in a predictable pattern, energy transfer occurs at different rates depending on the type of material it is passing through.

**Driving Question:**
How do different building materials change the rate at which thermal energy is transferred?

**Materials Needed:**
- Sketchbook or science notebook
- Clear materials such as plastic, Plexiglas, cellophane, graph paper, computer, tablet or other technology for research
- Prototyping materials such as Plexiglas, glass, glue

**National Learning Standards:**
Science: MS-PS3-3; MS-ETS1-2; MS-ETS1-3
Social Studies: VIII,a
Art: Cr2.1.6a
SPINNING THE COCOON

Set up a demonstration with two panes of the same transparent substance with a light above each one and a cup of ice underneath each one. Before beginning the demonstration, ask students to hypothesize what will happen to the ice and write their responses on the board. As the ice melts, students should record or photograph what is happening. Ideally, the ice should melt at the same rate. As a class, discuss why this occurred. Explain that thermal energy travels in a predictable way from an area of higher heat to an area of lower heat, therefore it should travel through the same substance at the same rate. Give the class definitions for convection, conduction and density.

Set up a second demonstration with three different transparent panes such as glass, plastic wrap and Plexiglas with a cup of ice under them. Each transparent pane should have its own light source equal distance away. With the light on, students should observe and draw or photograph the progression of the ice melting under the transparent panes. Ice should melt at different rates due to the amount of thermal energy able to pass through each transparent material. Ask students for their ideas on why the ice melted at different rates. Student ideas should include that thermal energy will travel through different conductors at different rates based on parameters such as density.

Examine the windows in your classroom or other areas of your school. Ask students how the windows may affect the temperatures indoors.

Discuss how the higher temperatures in Texas mean that we need more efficient windows in buildings to better manage temperatures and reduce the environmental and economic costs of cooling indoor spaces.

KERNEL OF KNOWLEDGE

Artificial lighting accounts for 44% of electricity use in office buildings. Make it a habit to turn off the lights when you’re leaving any room for 15 minutes or more and use natural light when you can.
Using the classroom demonstration as a testing model, student groups will develop and test window prototypes that are best for energy conservation. Window prototypes should be transparent, but also energy efficient. Students should explore existing windows such as single pane glass, multi pane, and double hung windows to help contribute to their own ideas. Groups will complete brief drawings with a few lines denoting why they chose their specific design and material before creating and testing prototypes. Student groups will then choose their highest functioning prototype to present to the class. In their presentation, students will discuss the materials and design they chose as well as the results they concluded using the vocabulary terms learned in this unit.

**UPCYCLE**

Discuss with students the important role science has played in our society and its impact around the world. Ask them to research examples of technologies that are available all over the world. They may come up with examples like the iPhone, the internet or TV. Encourage them to think further back in time. For example, have them consider what U.S. farmers in the 1800s used to tend their crops and if the same technology was available in other countries then and now.

Explain that the resources we use are determined by the technology that is available, government policy and economic factors which can change over time. Batteries were not available until 1898 and are only recently being considered to power cars. The same concept applies to energy efficient windows, which were not available to the public until the energy crisis in the 1970s. This idea has grown into practice and is now the norm for many consumers and producers.

**THROUGH THE LENS**

Instead of having each student create their own individual sun-faded artwork, place a large piece of colored butcher paper outside and make it a group project. Using a time-lapse app, document the process and create a video unveiling the artwork at the very end.
As an extension or for extra credit, have students create a video to send to lawmakers that proposes a tax-cut for individuals and businesses that install energy efficient windows either on a new-build or as a replacement to conserve natural resources and minimize energy costs. Have them describe the design they created in the science lesson. They should emphasize how this scientific invention could help shape society in America and abroad. The video should provide several compelling reasons why the proposal will be beneficial to society, businesses and individuals.
eARTh

The sun provides a powerful source of heat and energy for our planet. Art is among the many things which the sun has influenced. Using the sun as a source of artistic inspiration is one of the ways that art and science work together, and artist Michael Papadakis has found a beautiful way to harness that relationship. He uses different sizes of magnifying glasses to burn lines into wood to create beautiful pieces of art. Share his work and his process with your students using this [link](#).

Now, your students will create their own sun art. There are a couple of ways to do this. Solar print paper will provide the most dramatic results. It is fairly inexpensive and can be found online or at many art and craft supply stores. If you are unable to find it, you can also use construction paper, which fades easily. Anything thicker, like card stock, will not work because it does not fade as easily.

Take your students outside to a sunny area. Using the solar print paper or construction paper, have them place various objects on the paper. You could use this project to focus on any of the elements or principles such as line, balance, movement, shape, etc. Also, the choice of object is up to you. Students may look for natural objects such as small leaves or rocks, or you can give them an assortment of small objects from which to choose. They will place the objects in a purposeful way on top of the paper and leave the paper outside for a few hours. The light from the sun will fade the paper and the spaces where the objects are placed will remain the original shade. Collect each of the pieces and discuss with your students why the paper faded the way that it did. Also, each student should be able to talk about their artwork using correct vocabulary and explain why they placed the objects where they did on their paper.
CAREER CONNECTION

**Window Installer** - Window installers fit pre-made windows into window openings and door frames of homes and buildings. Some installers work on residential or smaller commercial buildings, while others work on large commercial buildings. This job requires a high school diploma and on-the-job training.

**Environmental Engineer** - These engineers deal with the potential environmental impacts of geothermal plants. Although geothermal energy is an environmentally friendly source of electricity, environmental engineers must consider a site’s potential impact on local plants and wildlife. A bachelor’s and possibly a master’s degree is required for this career.

CAREER HIGHLIGHT

Harnessing solar energy is nothing new. In 1839 Alexandre Edmond Becquerel discovered the photovoltaic effect which explains how electricity can be generated from sunlight. Although it would be years before solar energy would begin powering spaces as large as homes, his ideas sparked breakthrough conversations and inventions.