THE EMPOWERS

Activity Kit

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Climate Change Maryland

NEED Putting Energy into Education

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

Table of Contents

1 Introduction

THE EmPOWERS Activity Kit

Background

THE EmPOWERS Activity Kit includes five activities that help educators talk about the intersections of energy and climate in their afterschool program, classroom, church, library, or at home. Instructions are provided for each activity, and there is also an additional resource page if educators want to go beyond this initial introduction. ***THE EmPOWERS*** were created to teach youth (and adults) about the different types of energy sources that provide us with electricity in Maryland. ***THE EmPOWERS*** can be found throughout the kit providing helpful tips and information. Check out more information about each of ***THE EmPOWERS*** in the section "Meet ***THE EmPOWERS.***"

Time

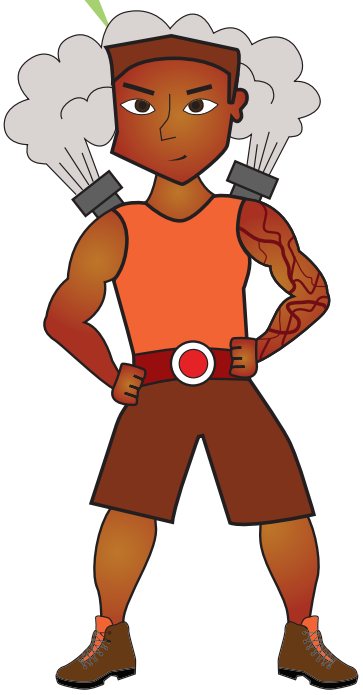
THE EmPOWERS Activity Kit is designed to take as few as five sessions of 30 – 45 minutes each. Educators are encouraged to expand the time if their schedule allows.

Objectives

Upon completion of ***THE EmPOWERS*** Activity Kit, students will be able to:

1. Explain the main things energy enables us to do;
2. Differentiate between forms and sources of energy;
3. List the forms of energy and give examples;
4. Understand the transformation of energy into electricity;
5. Describe the connections between energy use and greenhouse gases; and
6. Identify ways to reduce energy in the home and school.

Tip: Look for us throughout the Activity Kit to get extra information about ***THE EmPOWERS*** energy sources!



Overview of the Activities

Activity 1: Science of Energy

Students need to learn the science of energy before they can learn about the sources of energy, electric power production, and energy efficiency and conservation. Students learn the forms of energy (heat, light, motion, sound, electricity) and how energy is transformed from one form into other forms. This activity will introduce students to the different forms of energy.

Activity 2: Sources of Energy

We use many different energy sources to do work for us. Energy sources are classified into two groups—nonrenewable and renewable. In the United States, most of our energy comes from nonrenewable energy sources. Coal, petroleum, natural gas, propane, and uranium are nonrenewable energy sources. They are used to make electricity, heat our homes, move our cars, and manufacture all kinds of products. This activity will teach students about the different types

of energy sources that are used to create electricity in Maryland. Electricity is a secondary source which means we get it from conversion of other sources of energy like coal, natural gas, or solar. Those are called primary sources. The energy sources we use to make electricity can be renewable or non-renewable but electricity itself is neither renewable or non renewable. This activity will have students match the types of energy sources to their definitions and details.

Activity 3: Electricity in Maryland

Electricity is a mysterious force. We cannot see it like we see the sun. We cannot hold it like we hold coal. We know when it is working, but it is hard to know exactly what it is. Electricity is simply moving electrons. Power plants use many fuels to make electricity and we will find out how that electricity gets into the home. This activity will allow students to trace where their electricity comes from in Maryland.

Activity 4: Sources of Pollution

Carbon dioxide (CO_2) is the primary greenhouse gas emitted through human activities. According to the EPA, in 2012 CO_2 accounted for about 82 percent of all U.S. greenhouse gas emissions. Coal-fired power plants are one of the largest sources of CO_2 pollution in the United States that creates air pollution. The pollution from power plants contributes to water quality issues and human health problems such as asthma, bronchitis, cancer and other lung diseases.

Electricity is used to power homes, business, and industry. Burning fossil fuels to generate electricity is the largest single source of CO_2 emissions in the nation, accounting for about 38 percent of total U.S. CO_2 emissions and 31 percent of total U.S. greenhouse gas emissions in 2012. Additionally, the burning of fossil fuels, such as gasoline and diesel to transport people and goods, is the second largest source of CO_2 emissions, accounting for about 32 percent of total U.S. CO_2 emissions and 27 percent of total U.S. greenhouse gas emissions in 2012.

Reducing the amount of energy that we use in our homes, schools, work, and where we play can significantly reduce the amount of air pollution that we create. Saving energy also reduces our use of nonrenewable natural resources, such as coal, petroleum and natural gas. This activity will focus on our transportation sector.

Activity 5: Efficiency and Conservation

We will discuss the basics of reduce, reuse, repair, compost, recycle, and conserve. The things we do every day make a difference. If everyone saves just a little energy, it adds up to a lot. In this activity students will learn how energy is used, about efficient technologies, and ways to conserve energy at home and at school.

ICE BREAKER: Energy Bingo

Ice breakers are a fun, interactive way to get students to start talking about energy and electricity and to get to know each other better.

JOURNALIST CORNER: This Week in Conservation

This activity gives students an opportunity to research, write, and report a story about energy conservation in an engaging way.

CREATIVITY CORNER: The Power of Wind

The Art of Electricity – Earth without ART is just Eh...this activity allows students to get creative with alternative energy.

THE EmPOWERS

Meet *THE EmPOWERS*

Who is Aqua Marine?

Before becoming one of the EmPOWERS, Aqua Marine worked at Assateague Island State Park managing the waterways and helping animals in their natural habitat. One day as she was swimming on the Chesapeake Bay side of the Island where she found a blue crab wrapped in an old fishing line.

While untying the crab, a storm started rolling in from the ocean. She became tangled up with the crab and its claw wrapped around her wrist. While making their way toward the shore, they were struck by lightning.

When she woke up on the beach, she saw the tiny eyes of the crab looking up at her and he said "are you okay?" Shocked and confused, she thought it was all a dream. The next day at work, she was walking along the shore and every fish jumped out of the water and said "hello" to her. She realized she could talk to them.

She called her friend Gavin (Solar Flair) to tell him that she could talk to marine animals. He was so excited because his other friend Plantasia was bit by a spider and could talk to land animals. The next weekend, they all met and became friends.

As an EmPOWERS, she and Solar Flair help Plantasia grow organic fruits and vegetables that they all eat on Mondays.

What is Hydro Energy?

Hydro comes from the Greek word meaning water. **Hydropower** is the energy we make with moving water. Moving water has a lot of energy. We use that energy to make electricity. There are two major ways we use water to create **electricity**: **water wheels** and **dams.**

Water wheels use the energy of moving water. A water wheel has buckets or boards around a big wheel. The buckets fill with water at the top of the wheel. The weight of the water turns the wheel and dumps the water at the bottom. Early settlers used them to grind grain and run sawmills. Factories also used water wheels to run their machines. In many countries, water wheels are still used.

Dams are usually built across a river. They stop the water from flowing which makes a big lake behind the dam. This lake is called a reservoir. When gates in the dam are opened, water flows down big pipes called penstocks and turns giant wheels, called turbines. The turbines power generators to make electricity.

Hydropower is clean, **renewable** source of energy. No fuel is burned, so the air is not polluted. It is the cheapest source of electricity because the water is free to use. And we won't run out of water because of the water cycle.

This EmPOWERS Origin Story was compiled from entries submitted by Gilr (WH), Mikyna (Last), Elizabeth Nambooze (WW), Alajah Wade & Mekayla Scott (AE), Tomecca & Kaniyah Myers (MP), Melanie Pickrell (Walkersville), Teandre Taylor (first), Terra (LP), Akiyan & Arabia (WH), Shawntae Wilson & Dalonne McCullough (WH), Kameron & Arthur(MP).

Who is Cole?

Before becoming one of the EmPOWERS, Cole worked at Frostburg State University, Maryland at the Bureau of Mines helping to inspect mines in Western Maryland. One day while he was inspecting a lost mine that had been forgotten for decades, he stumbled across a piece of coal that was left behind.

While he was holding the piece of coal in his hand he could feel all the energy in the rock. As he continued with the inspection, he realized he was moving faster. The rock gave him super speed. The piece of coal was transferring its energy to him.

When he got back to his lab, he called his friend Methaniel and told him about the rock. That night, they had dinner together with Plantasia. Cole's favorite meal was steak and potatoes. At dinner, Plantasia asked if they had ever heard of Meatless Mondays. Meatless Mondays is about skipping meat one day a week to help the environment.

As an EmPOWERS, he maps abandoned mines in Western Maryland and raises awareness of the destruction that coal can bring to the environment and the health of Marylanders.

What is Coal Energy?

Coal looks like shiny, black rock. Coal has lots of energy in it. When it is burned, it makes heat and light energy. Coal was formed hundreds of millions of years ago, before the dinosaurs. Back then, much of the Earth was covered by huge swamps. They were filled with giant ferns and plants. As the plants died, they sank to the bottom of the swamps. Over the years, thick layers of plants were covered by dirt and water. They were packed down by the weight. After a long time, the heat and pressure changed the plants into coal.

Coal is called a **fossil fuel** because it was made from plants that were once alive. The energy in coal came from the sun Most coal is buried under the ground. We must dig it our or mine it to use it to create electricity. If the coal is deep in the ground, tunnels called mine shafts are dug down to the coal. Machines dig the coal and carry it to the surface. After the coal is mined, it is cleaned and shipped to market. Most coal is moved by trains to power plants and factories. Sometimes it is moved on barges along rivers. Power plants burn the coal to make **electricity**. Coal is one of our most used energy sources because it has been cheap to produce.

The coal we use today took millions of years to form. We can't make more in a short time. That is why it is called **nonrenewable.** Though there is enough coal in the United States to last between 180 and 250 years, burning it can pollute our air. Keeping coal in the ground is one way to reduce greenhouse gas emissions.

This EmPOWERS Origin Story was compiled from an entry submitted by Aiden J.G (WW)

Who is Dr. Fission?

Before becoming one of the EmPOWERS, Dr. Fission was born Brittany Ashley Fission. Both of her parents worked for Calvert Cliffs Nuclear Power Plant. Because they worked so much, she often went with them and played in the corner.

One day she found two beautiful, gold-colored rocks and began clicking them together. She did not know that these rocks were called uraninite, which is the most common ore mined to extract uranium. She just liked how they looked. As she was clicking them together, they sparked! The spark shot up both her arms and gave her green streaks in her hair.

When the family got home that night, Brittany was first to go into the house. As she walked through the front door, all of the lights came on, the tv turned on,and the oven was hot. No one knew what was happening but every time Brittany was near an electrical appliance, it turned on without her touching it. She told her parents about the gold-colored rocks and they realized that she was given an extraordinary power - she could create energy just by being near things.

As an EmPOWERS, she uses her Ph.D in Nuclear Energy to tour the state and talk about pathways toward clean energy.

What is Nuclear Energy?

Nuclear energy is the energy stored in the nucleas of an **atom**.
Everything in the world is made of atoms, which are tiny, tiny particles that hold the atom together. To use this energy, we have to set it free. There are two ways to free the energy in atoms: **fusion** and **fission.**

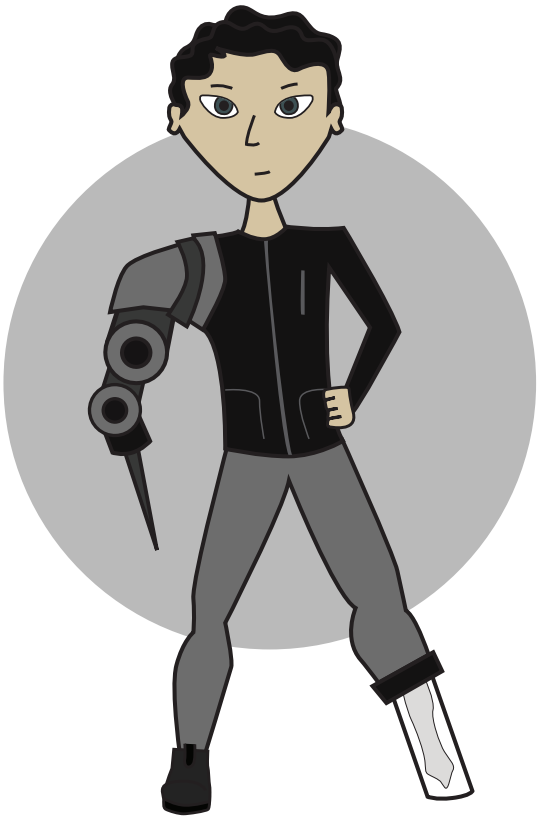
Fusion is when atoms are combined to make a new atom. The energy from the sun comes from fusion. Inside the sun, small hydrogen atoms combine to make larger helium atoms. Helium atoms don't need as much energy to hold them together. The extra energy is released as light and heat.

Fission is when one atom is split into two smaller atoms. The two smaller atoms don't need all the energy that held the larger atom together. The extra energy is released as heat and radiation.

We create nuclear energy by splitting **uranium** atoms. Uranium is a mineral found in rocks in the ground which means it is **nonrenewable** because we can't make more. When the atoms are split, the extra energy is released as heat. This heat is used to make **electricity**. During fission, heat isn't the only energy that is released. Rays of energy, like x-rays, are also given off. These rays of energy, called **radiation,** can be dangerous in large amounts. Large amounts of radiation can kill our cells and poison our food and water.

The fuel from nuclear power plants produces radiation for a long time. After the fuel is used, it still is **radioactive**—it gives off radiation. It can't be put into a landfill. It must be carefully stored.

This EmPOWERS Origin Story was compiled from an entry submitted by Byron Franchi (LP).



Who is Methanial?

Before becoming one of the EmPOWERS, Methanial was a little boy from Bel Air who liked to collect rocks. He would spend all day scrambling around his big backyard and digging for specimens for his collection.

One day, the earth trembled and a mighty boulder rolled on top him, pinning him to the earth and crushing his right arm and left leg. While trapped, he noticed a gas was coming out of the ground. No one else could see this gas because it was odorless, colorless and tasteless.

He was rushed to the closest hospital--a top-secret research facility--where he talked the surgeon into giving him a drill for an arm and a siphon for his leg. Once he was released, he started using his new tools to track this gas.

As an EmPOWERS, he and Cole raise awareness about fossil fuels and they stress the importance of keeping them in the ground or capturing the emissions when they are burned. He once saved the day when he stopped thieves by controlling the concrete of a building to capture the thieves.

What is Natural Gas Energy?

Natural gas is similar to air—it is a mixture of gases you can't see, smell, or taste. But it is different, too. It has a lot of energy in it. You can burn it to make heat.

Natural gas was formed in the Earth long before the dinosaurs lived. Oceans covered much of the Earth and were filled with tiny sea plants and animals. When the plants and animals died, they sank to the bottom and were covered by sand. Layers of dead plants, animals, and sand built up over time and turned into sedimentary rock. Heat from the Earth and pressure from the rock layers above turned the remains of the plants and animals into natural gas and petroleum. Since natural gas is made from the remains of plants and animals, it is called a **fossil fuel.**

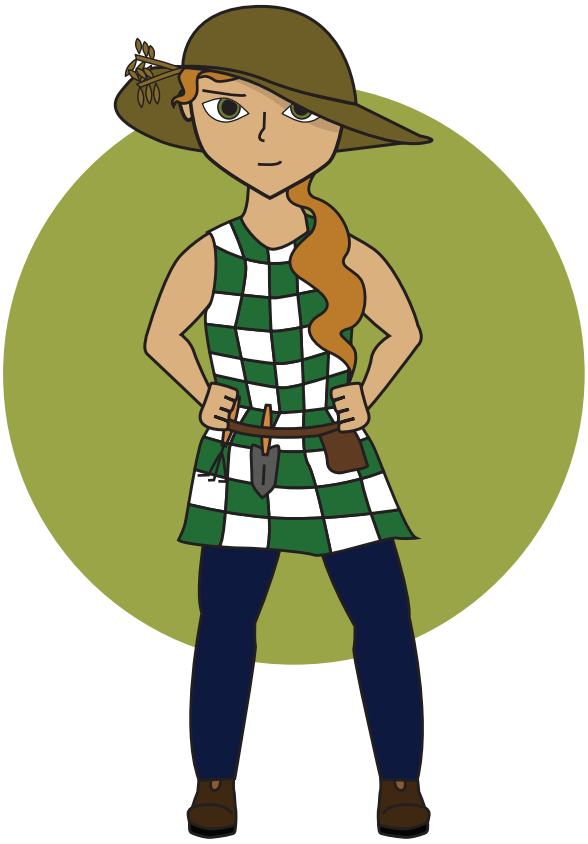
The plants and animals received their energy when they were alive from the sun. It was stored in them when they died. This is the energy in natural gas. The natural gas we use today took hundreds of millions of years to form. That's why we call it a **nonrenewable** energy source. We can't make more in a short time.

Natural gas is found underground in pockets of rock. We drill wells into the ground to reach the gas so that it can flow to the surface. The natural gas is piped from the wells to machines that clean it and remove any water. We move natural gas from one place to another in pipelines. Power plants burn natural gas to make **electricity.**

Natural gas is the cleanest burning **fossil fuel**. It doesn't pollute the air as much as coal or oil but there are finite amounts of it available to us. Keeping it in the ground would help reduce greenhouse gas emissions a lot.

This EmPOWERS Origin Story was compiled from entries submitted by Jonathan Fatak (LP), Carmine Petrecca (WW).

Who is Plantasia?



Before becoming one of the EmPOWERS, Plantasia was born on the Ferguson Family Farm in Baltimore County. The farm is surrounded by the beautiful Pretty Boy Watershed and she would play outside from the minute she woke up until she went to bed.

One day when she was playing in the dirt she was bitten by a garden spider. The spider bite didn't hurt at all, but it did turn her eyes two different colors; brown and green. In the next few weeks, she began to see things differently. She noticed that through her brown eye she could communicate with land animals and with her green eye she could see into the roots of plants.

One of the animals she began communicating with was a Black bear cub named Sneaky. After playing together, Sneaky would always poop in the same area. After a few months, as the poop became part of the soil, that area was overgrown with mushrooms.

Because of her new found vision, Plantasia could see that the decomposed bear poop helped different plants grow. From then on, she spoke to all of the animals on her farm and convinced them to poop in the same spots. She was able to use their poop for two things – the decomposing poop produced gases she used to generate electricity on the farm, and she used the poop-enriched soil to help grow organic fruits and vegetables.

As an EmPOWERS she shows others how to use the plants and poop that surround us in a positive way.

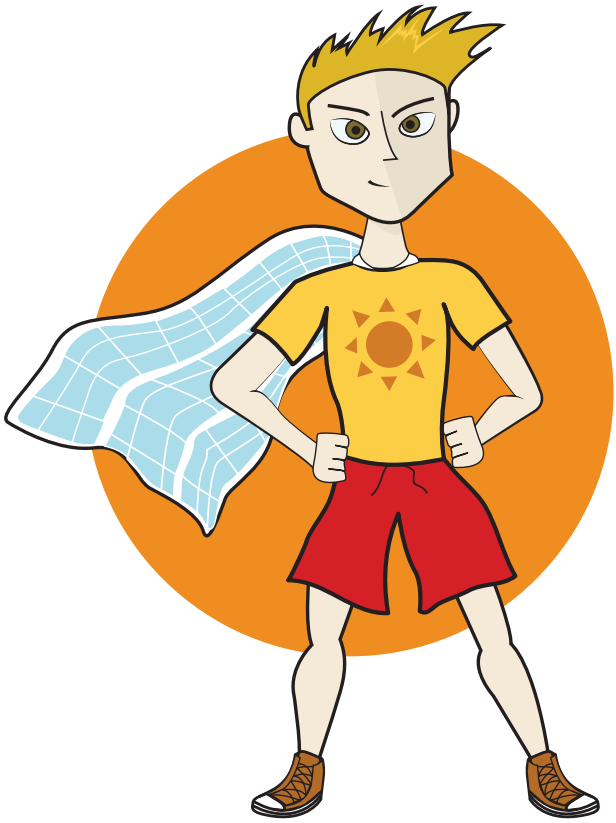
What is Biomass Energy?

Biomass is anything that is alive. It is also anything that was alive a short time ago. Trees, crops, garbage and animal waste are all biomass. Most of the biomass we use for energy today is wood. We burn wood to make heat. Biomass gets its energy from the sun. Plants store the sun's energy in their leaves and roots. When we eat biomass, we use the energy to move and grow. When we burn biomass, we use the energy to make heat. We can also change the energy in biomass into gas and liquid fuels.

Biomass can be used to make **electricity.** Some towns have to **waste-to-energy** plants that make electricity. There are two types of waste that can be used to make electricity: our **garbage** which is burned instead of going to a landfill and our/animal waste which is turned into a biogas and burned like natural gas.

Although biomass is **renewable,** which means more biomass can be made in a short time, there is one down side. When we burn it, we pollute the air. Waste-to-energy plants work to scrub the air from the burning waste to reduce pollution and smells.

This EmPOWERS Origin Story was compiled from entries submitted by Lana (online), Tyler Marine & Jayzanay Blessett & Daniel & Ms. Myeisha (SW Baltimore), Ariyana Wells & Virginia Goodson & Princeston M (AE), Kayla & Danielle (TJ), Mia Randolph (WW).



Who is Solar Flair?

Before becoming one of the EmPOWERS, Gavin grew up near the Goddard Space Flight Center in Greenbelt. He always wanted to be an astronaut.

One day, while he was in training in Earth's orbit for a trip to Mars, a giant solar flare burst across the sky and slammed right into him. He saw a white hot flash of light and felt his blood turn to fire. He waved at his fellow astronauts to signal he was okay, and a ball of fire shot out of his fingertips and into the dark sky!

Back on earth, he tested his powers and found he could create a forcefield of fire or a shield that protected him (and others) from the sun. He also noticed that when bad people tried to touch him, his skin can turn to fire and he can melt rocks with his super energy.

As an EmPOWERS he is able to use the sun's energy for good. His cape can capture energy and turn it into electricity. He helps people, communities and municipalities put solar panels on roofs to make electricity.

What is Solar Energy?

Solar Energy comes from the sun.The sun is a star, a giant ball of gas that sends out huge amounts of energy every day. That energy travels from the sun to the Earth in rays. Some are light rays that we can see. Some rays we can't see, like x-rays. Most of the energy goes off into space and only a small part reaches the Earth, but this amount is large enough to provide energy for many things!

We use **solar energy** in many ways. Sunlight turns into heat when it hits things.Without the sun, we couldn't live on the Earth—it would be too cold. Plants use the light from the sun to grow. Plants take the energy in light and store it in their roots and leaves. That energy feeds every living thing on Earth. We can also burn plants to make heat.

The energy from the sun makes rain fall and wind blow. We can capture that energy with **dams** and **wind turbines. Coal**, oil, and **natural gas** were made from prehistoric plants and animals.

Solar energy is free, clean, and **renewable.** So, why don't we use the sun for all our energy needs? The hard part is capturing the sunlight. It shines all over the Earth and only a little bit reaches any one place. On a cloudy day, most of the light never reaches the ground at all.

One way to capture the sunlight is by putting solar panels up. Solar panels capture the sunlight and turn it into heat. That heat can them be used for **electricity.** Right now it is only a small portion of our total **electricity** in the country but will be more soon.

This EmPOWERS Origin Story was compiled from entries submitted by Gavin & Mikah (MP), Oscar Chen (TJ), Ousmane Sail (TJ), Bennett (MP), Aaliyah & Giovanni Gayadeen (HP), Tierra (WW).

Who is Vesuvias?

Before becoming one of the EmPOWERS, Vesuvias began working at a new energy facility owned by his father, Mr. S, who was from Hawaii. One day when Vesuvias was at work, he walked over the catwalk and steam shot up and covered him. He was covered with the steam for over ten minutes before a co-worker found him.

The first thing his co-worker noticed was his left arm, it was hot to the touch and full of veins. All of a sudden Vesuvias could pick up things that were twice his weight, it was incredible. He also began to notice other changes as well. Whenever he got mad, smoke would come out of his ears and his eyes could shoot out heat rays.

His father, Mr.S was a billionaire and created tools to help him harness these newfound powers. He was given a power pack on his back that would capture the steam when he got mad. He also had a power belt. When he pushed the button once, he could shoot fire. When he pushed the button on his belt twice, he could summon the other EmPOWERS.

As an EmPOWERS, he cooks for them using his heat vision and every Sunday you can find him cheering on the Baltimore Ravens.

What is Geothermal Energy?

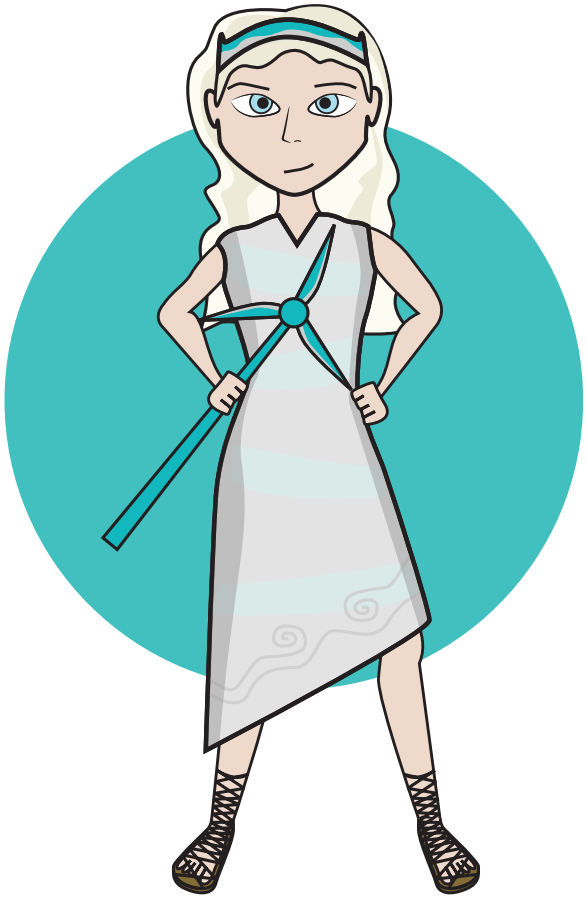
Geothermal comes from the Greek words ***geo*** (earth) and ***therme*** (heat). Geothermal energy is heat inside the Earth. The inside of the Earth is very hot. Sometimes this heat comes near the surface. We can use this heat to warm our houses. We can make electricity with it.

Geothermal energy is everywhere under the ground, but sometimes it is hard to reach. The Earth is made of parts or layers, like a hard boiled egg. At the center is a **core** of iron. Around that is an outer core of iron and rock so hot the rock is melted. This liquid rock is called **magma**. The middle layer is a mixture of rock and magma called the mantle. The shell of the Earth—with the oceans and mountains—is called the **crust.** In most places, the **crust** is miles thick. **Magma** is near the surface in only a few places.

When the magma comes close to the Earth's surface, it heats the water underground. We can use this heated water. We dig wells and pump the hot water and steam out of the ground. Power plants use steam from geothermal wells to make electricity. The steam is used to spin **turbines**. The turbines spin magnets in coils of copper wire to make electricity. The power plants are built close to the wells. The steam is pumped straight from the wells to the power plants.

Geothermal energy is a clean and **renewable** energy. No fuel is burned, so there is no air pollution. The steamis turned into water and put back into the Earth.

This EmPOWERS Origin Story was compiled from entries submitted by Rashad Kahlil Waleed (WH), Ricky H & Brandon S (HP), Robert Kelly (HP), Joseph Okolorie (MP), Aidan (LP), Joey (TJ), Peace Walker & Ke'Asia Braxton (WH), Melki Scott (AE), Lincoln (AE), Tavon Lyles (AE), Carlos & Kai Wilson (WH).



Who is Zephyra?

Before becoming one of the EmPOWERS, Zephyra went skydiving on her 18th birthday. As she fell toward the earth over Ocean City, she dropped through a rather strange cloud. It was filled with colorful gases from around the world and spun like a hurricane.

When she came out the other end, things were different. The wind called her name, and she had a new windmill-shaped beauty mark appeared on her shoulder. She now had the power of the wind at her fingertips. She could spin herself into a tornado to stop storms from blowing the land away or use the wind to braid her long, flowing hair.

Once on land, she contacted her friend Vesuvias and asked if his dad, Mr. S could create a wand that would capture the wind. She also befriended a dove she named Quiet Storm who is able to communicate with other birds across long distances so they safely fly around wind turbines.

As an EmPOWERS, she brings wands to people around the state. She is constantly flying around Maryland, inspiring students and professional engineers to design new wind turbines that are safer for birds.

What is Wind Energy?

Wind is moving air. The energy in wind comes from the sun. When the sun shines, some of its light reaches the Earth's surface.

Some parts of the Earth absorb more solar energy than others like the Equator. When the Earth's surface absorbs the sun's energy, it turns the light into heat. The air over the land usually gets warmer than the air over the water. As air warms, it expands. The warm air over the land becomes less dense than the cooler air and rises into the atmosphere. Cooler, denser air nearby flows in to take its place. This moving air is what we call wind. It is caused by the uneven heating of the Earth's surface.

Some places have more wind than others. Areas near the water usually have a lot of wind. Flat land and mountain passes are good places to catch the wind, too.

Today, we use **wind turbines** to capture the wind. When the wind blows, it pushes against the **blades** of the wind turbines. The blades spin around. They turn a **generator** to make **electricity.** Most wind turbines only run between 65 and 90 percent of the time because it is not always windy.

Wind is a clean, **renewable** energy source. As long as the sun shines, there will be winds on the Earth. We will never run out of wind energy. It is also free since no one can own the sun or air and it doesn't burn any fuel.

This EmPOWERS Origin Story was compiled from entries submitted by Elia Wells (Waldorf Library), Emma Sekonde (Waldorf), Deianeira Pender & Bryce Carlson (WW), Kiya & Corey Thomas (WW), Nicolette Davis (WH), Jasmine & Shadia Mond (WH), Te'Lisa Smith (AE), Lilynei Brown (online), Faith & Mya (MP), KK & Naeema & Jake (HP), Mildred & Brielle (HP), Chloe M (LP), Ashleigh (LP), Blake Franchi (LP), Daniel Y (LP).

THE EmPOWERS

THE EmPOWERS were brought together by the billionaire Mr.S whose ultimate goal is for a just transition in Maryland where we have100% renewable energy by 2030. Though THE EmPOWERS are all independent contractors with no health benefits they come together to help Renew Maryland. This new Maryland will have clean energy, a strong economy, and healthy people.

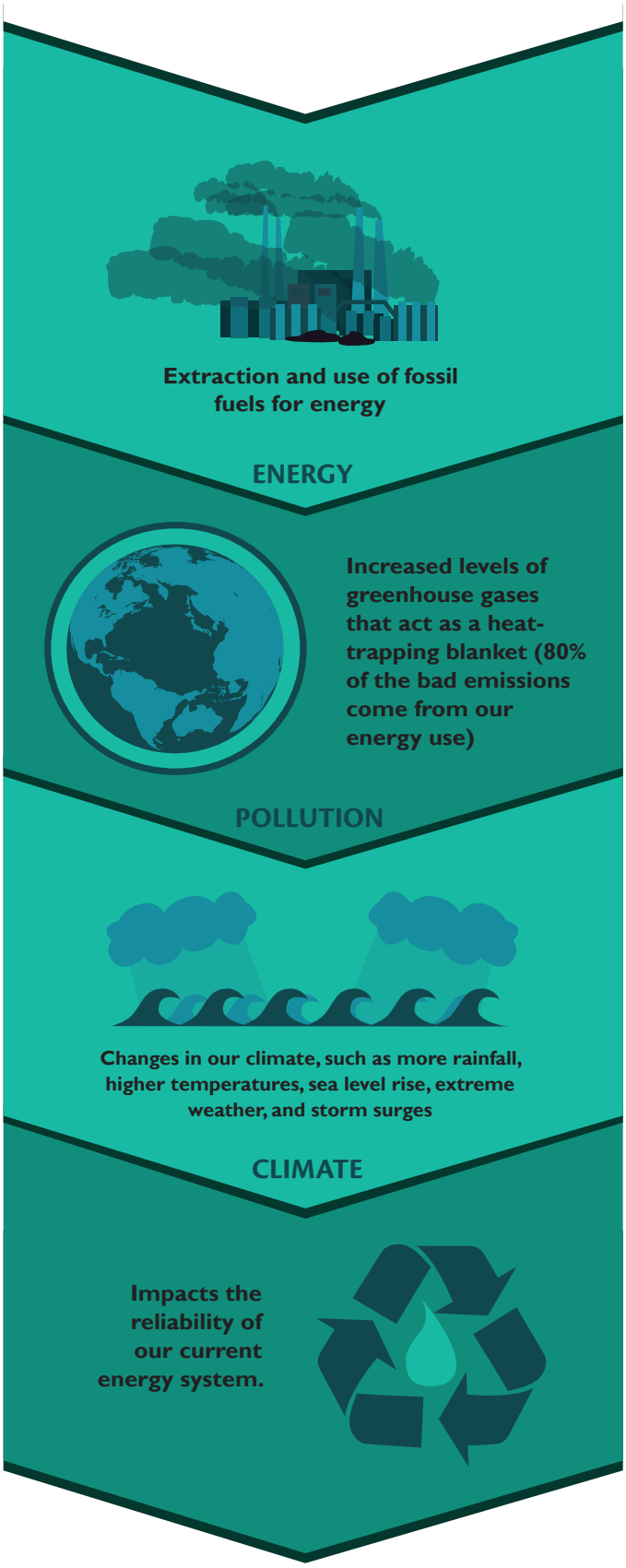
The Connection Between Energy and Climate

There is a relationship between our energy choices and our changing climate.

Climate change is caused, in part, by the man-made blanket of carbon dioxide that is building up around the Earth and trapping the heat. The heat-trapping blanket[1] is thickened by burning large quantities of fossil fuels such as coal, oil, and natural gas. By burning these fossil fuels, we release carbon dioxide into the air where it builds up and traps heat that would otherwise escape. This blanket effect leads to the warming of the planet, and the atmospheric balance that keeps the climate stable is disrupted. Dirty energy causes harmful air pollution, contaminates our water, makes us sick and is making our weather strange and more dangerous.

As a result of more rainfall, higher temperatures, sea level rise, and especially more extreme storms, our current energy system becomes less reliable and more susceptible to blackouts and power outages.

There are solutions. We can reduce the amount of energy we use in our homes, libraries and schools. We can also start transitioning to renewable energy sources such as geothermal, solar, and wind. The first step is knowing where our electricity comes from so we so we understand our power sources.



1 This metaphor comes directly from National Network for Ocean and Climate Change Interpretation (NNOCCI) framework- http://www.nnocci.org/

THE EmPOWERS Origin Stories were collected during the Summer of 2015 as part of the Summer Reading Program themed, "Every Hero Has a Story." The Maryland Department of Eduction Division of Library Development and Services and Maryland Out of School Time Network (MOST) were partners as we collected stories from around the state. We received entires from the following locations: Arlington Elementary (AE), Harford Heights (HH), Henderson Hopkins (HP), La Plata/Discovery Academy (LP), Moravia Park (MP), Morell Park (MP), Online, Samuel Coleridge Taylor(SCT), Southwest Baltimore Charter (LAST), Thomas Jefferson (TJ), Waldorf, Windsor Hill (WH).

Activity 1

Science of Energy

Forms of Energy

READY

The students will work as a large group to talk about the different forms of energy.

SET

Read through the GO Section to make sure you have everything you need.

Print out the images of the different forms of energy on pages 19 to 21 to show students or have them displayed through a projector.

GO

This activity is about engaging the students in questions about energy and the forms of energy so they can differentiate among them.

Learning Objective:

Explain the main things energy enables us to do and list the forms of energy—light, heat, motion, sound and growth. Give examples.

Links to National Science Education Standards: K-4

Content Standard B: Physical Science

- Properties of Objects and Materials
- Light, Heat, and Magnetism

Content Standard D: Earth and Space Science

- Properties of Earth Materials

What is Energy?

Energy makes change—it produces a change of some kind; it does things for us. We use energy to move cars along the road and boats over the water. Energy is used to bake a cake in the oven and to keep ice frozen in the freezer. It provides power so we can listen to our favorite songs on the radio and light our homes. Energy makes our bodies grow and allows our minds to think. Scientists define energy as the ability to do work. Energy is found in many different forms such as light, heat, motion, sound, and growth.

Discussion Questions

1. What changes occur with the objects in the pictures? (Images A, B, C, D, E)
2. Where does the girl get her energy? (Food that she eats) How is she using energy? (to move, see, hear, think, stay warm or cool)
3. Where does the television get its energy? (Electricity) What kind of energy does it make? (sound, light, heat)
4. Where does the car get its energy? (Battery and gasoline) What kind of energy does it make? (motion, sound, heat)
5. Where does the rain get its energy? (The sun and gravity drive the water cycle)
6. Where does the corn get its energy? (Light from the sun)

Activity

Look around the classroom and point out things that are using energy. (computer, clock, lights, plants, animals) Decide where each item gets its energy and how it uses it.

Light is Energy

We use light energy every day. We use it to see things. Without light, our lives would be very different. We use light energy for more than seeing. The energy in light helps plants grow. Doctors use special light to help in surgery. We can also use light to make products and electricity. What is light? Light is energy that travels in waves. All the energy we get from the sun travels in waves or rays. Some of that energy is in light waves we can see—it is visible light.

Discussion Questions

1. How do the things in the pictures make light? (Images F, G, H, I)
2. Why is light important to us?
3. What other things make light?
4. How is the light from the moon produced? (Sunlight is reflected from the surface of the moon.)
5. What is life like at home at night when the power goes off and you have no light?

Activities

1. Have the students close their eyes and imagine a world without light.
2. Turn down the lights in stages (and close the blinds) and notice the effect on what you can see.

Heat is Energy

We use heat, called thermal energy, every day. We cannot see heat, but we can feel it. Our bodies make heat, and our stoves and lights do, too. We heat our houses, our food, and our water. Sometimes there is too much heat and we move it. Refrigerators take heat away from the food inside. Air conditioners take heat from inside the house and move it outside. Swimming pools take heat from our bodies, so more people in a pool will make the temperature go up!

Discussion Questions

1. How do the things in the pictures make heat? (Images J, K, L, M)
2. How is heat important to us?
3. What other things make heat? (Toaster, pets, clothes dryer, TV, oven, etc.)
4. How do jackets help keep us warm? (They hold in the heat from our bodies.)
5. How do you keep your house warm in the winter? (Turn on a heating system.)

Activities

1. Have the students rub their hands together quickly to feel the heat produced by friction.

2. Have the students put one hand in the sun and one in the shade to feel the difference as the sunlight hits their skin. The sunlight will be warm on their skin.

Motion is Energy

Look around you. Many things are moving. They are in motion. Motion is a change in an object's position. Clouds drift across the sky. Leaves fall from trees. A car speeds by. Birds fly. Hearts pound. Bells ring. Babies cry. Plants grow and so do you. The Earth moves, the air moves, and so does every living thing. All of this motion takes energy. Nothing can move without energy. Cars get their energy from gasoline. The clouds move because of energy in the wind. The wind gets its energy from the sun. So do growing plants. All of your energy comes from the sun, too.

Discussion Questions

1. Where do the things in the pictures get the energy to move? (Images N, O, P, Q)

2. What gives you the energy to move? (The energy in the food you eat, which comes from the sun as plants absorb light.)

3. What makes a ball roll down a hill? (Gravitational potential energy – the force that pulls objects toward each other.)

Activities

1. Have the students think of all the things moving within their bodies, even when they are holding very still.

2. The forces of push, pull, and gravity are responsible for putting an object in motion. Take students to the playground. Have students identify the forces at work and types of motion as they play.

Tip: Biomass energy is renewable, which means more biomass can be made in a short time. We can always grow more plants.

Sound is Energy

Energy is moving around you all the time—energy in the form of sound waves. Sound waves are everywhere. Even on the quietest night you can hear sounds. Close your eyes, hold very still, and listen for a moment. How many different sounds can you hear?

Sound is a special kind of kinetic, or motion, energy. Sound is energy vibrating through substances. All sounds are caused by vibrations—the back and forth motion of molecules. The molecules collide with each other and pass on energy as a moving wave. Sound waves can travel through gases, liquids, and solids. The sounds you hear are usually moving through air. When a sound wave moves through air, the air molecules vibrate back and forth in the same direction as the sound. The vibrations push the air molecules close together, then pull them apart.

Discussion Questions

1. How do the things in the pictures make sound? (Images R, S, T, U)
2. How is sound important to us? (Communication, music, entertainment)
3. What makes some sounds pleasant and some unpleasant? (Pitch, volume, personal choice)
4. How does your throat make sounds? (The muscles in your chest push air past your vocal chords, making them vibrate.)

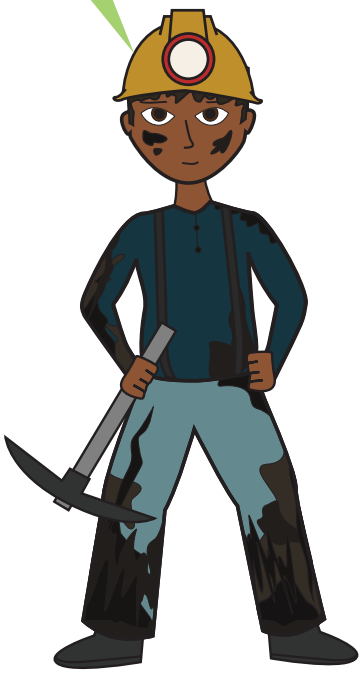
Activities

1. Have the students feel their throats while humming to feel the vibrations.
2. Have the students explore the range of sounds they can make with their voices.
3. Have the students tap different objects with a pencil and notice the difference in the sounds.

Growth is Energy

Every living thing is growing all the time. Sometimes they grow bigger. Sometimes they do not get bigger, but they still grow. They grow new cells to replace old ones. It takes energy to grow — chemical energy stored in simple sugars. The energy to make these sugars comes from light energy. Most of this light energy comes from the sun. Plants absorb the light energy and store it in their leaves, stems, fruits, and roots as chemical energy. They use the energy to grow. When we eat the plants, we absorb the chemical energy. When we eat animals we absorb their chemical energy that came from the plants they ate.

Tip: The coal we use today took millions of years to form. We can't make more in a short time. That is why it is called nonrenewable. There is a lot of coal in the United States. There is enough to last between 170 and 240 years.



Discussion Questions

1. How do the things in the pictures get their energy to grow? (Images V, W, X, Y)
2. Can you get energy straight from the sun to grow? (No, but plants can.)
3. What happens if you eat more food than you need? Not enough food?

Activities

1. Have the students draw an energy flow from a carnivore (meat eater) back to the sun.
2. Look at the calories on packages of food. Calories are a measure of the energy in the food.

Activity Images

A

B

C

D

E

F

G

H

I

Activity Images

J

K

L

M

N

O

P

Q

R

Activity Images

S

T

U

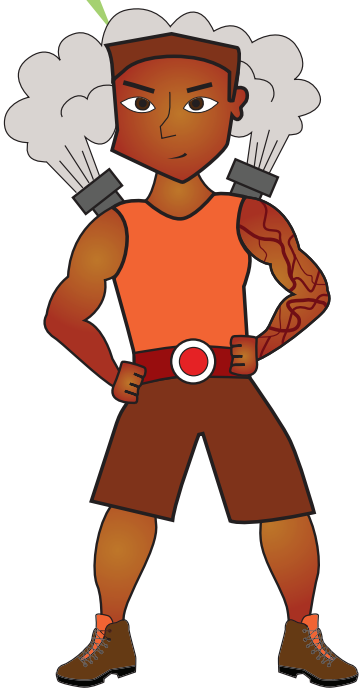
V

W

X

Y

Tip: The hot water we use will be replaced by rain. The heat inside the Earth will always be there. More heat is made every day in the Earth's core. We won't run out of geothermal energy. It is a renewable energy source. Geothermal energy is clean energy. No fuel is burned, so there is no air pollution. The steam is turned into water and put back into the Earth. And geothermal energy is cheap—once a new power plant is built, it can make electricity for less cost than a coal or natural gas plant.



Activity 2

Sources of Energy

Energy Source Memory

READY

The students will work in small groups to match the energy source to their definitions and their EmPOWER Ranger.

SET

Review the directions for the activity in the GO Section.

Print out the flash cards — one set needed for every four kids.

GO

We use many different energy sources to do work for us. Energy sources are classified into two groups—nonrenewable and renewable. In the United States, most of our energy comes from nonrenewable energy sources. Coal, petroleum, natural gas, propane, and uranium are nonrenewable energy sources. They are used to make electricity, to heat our homes, to move our cars, and to manufacture all kinds of products.

These energy sources are called nonrenewable because their supplies are limited. Petroleum, for example, was formed hundreds of millions of years ago from the remains of ancient sea plants and animals. We cannot make more petroleum in a short time.

Renewable energy sources include biomass, geothermal energy, hydropower, solar energy, and wind energy. They are called renewable energy sources because they are replenished in a short time. Day after day the sun shines, the wind blows, and the rivers flow. We use renewable energy sources mainly to make electricity.

Electricity is a secondary source which means we get it from conversion of other sources of energy like coal, natural gas, or solar. Those are called primary sources. The energy sources we use to make electricity can be renewable or non-renewable but electricity itself is neither renewable or non renewable.

For more details about each of the energy sources: http://www.need.org/files/curriculum/guides/Primary%20Energy%20Infobook.pdf

Learning Objective:

To be able to understand the different types of energy sources and learn facts about the eight types that provide Maryland with energy.

Links to National Science Education Standards: K-4

Content Standard B: Physical Science

- Properties of Objects and Materials
- Light, Heat, Electricity, and Magnetism

Content Standard D: Earth and Space Science

- Properties of Earth Materials

Flashcard Activity Images

I generate 42.2 % of the nation's electricity. I'm transported mostly by trains.	I'm America's and Maryland's most abundant fossil fuel. 92% of me is consumed by electric utility companies to produce electricity.	I heat more than half of the nation's homes. I'm odorless and colorless. I'm transported mostly by pipeline.	My chemical name is methane. I'm a cleaner burning fossil fuel.
I'm the nation's third leading source for generating electricity. I was first used in 1957 to make electricity.	My power plants store my spent fuel waste products on site. I'm presently being used in over 100 reactors in the U.S.	I supply 5-10 percent of U.S. electricity, depending on the amount of rainfall. I'm limited to certain geographic areas of the U.S. I require Earth's gravity to work.	My power plants were first built at the end of the 19th century and were a major source of electricity well into the 20th century. My facilities can disrupt wildlife and fish populations.
Methane gas can be made from me. Photosynthesis stores radiant energy in me. I get my energy from wood, garbage, and agricultural waste.	Ethanol can be made from me and used as a transportation fuel. Burning me can produce air pollution.	I produce less than one percent of U.S. Energy. I can be used for home heating.	My energy comes from the Earth's core. I get my energy as a result of radioactive decay.
I convert my motion energy directly into electrical energy with no cost for fuel. I produce no air pollution.	I first appeared in Denmark in 1890. I'm caused by uneven heating of the Earth's surface.	I'm not available at all hours of the day. I can be converted directly into electricity using photovoltaic cells.	I'm great for water and home heating. My energy is stored in fossil fuels. I'm free to use, but you have to purchase and maintain my equipment.

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Activity 3

Electricity in Maryland

Where Our Energy Comes From

READY

The students will work in small groups to trace the path of electricity from energy sources to their home.

SET

Read through the GO Section to make sure you have everything you need. You will have to find out from which energy supplier your school/library gets their energy—BGE, Delmarva, Pepco, Potomac Edison, SMECO or another supplier. By clicking on the hyperlink for the company, you will find out what their fuel mix is and then you can find out which power plants are closest to you: http://www.powerplantjobs.com/ppj.nsf/powerplants1?openform&cat=md&Count=500. You will find out how far that power plant is from your school/library in miles. During the activity, let the students know how far that power plant is from the school/library so they can draw it on their map.

GO

Electricity is a secondary energy source. We use primary energy sources, including coal, natural gas, petroleum, uranium, solar, wind, biomass, and hydropower to convert chemical, nuclear, radiant, and motion energy into electrical energy. Coal, which is nonrenewable, can be used to make electricity. So can hydropower, a renewable energy source. The energy source we use can be renewable or nonrenewable, but electricity is neither.

Most of the electricity we use in the United States is generated by large power plants. These plants use many fuels to produce electricity. Thermal power plants use coal, biomass, petroleum, or natural gas to superheat water into steam, which powers a generator to produce electricity. Nuclear power plants use fission to produce the heat. Geothermal power plants use heat from inside the Earth. Wind farms use the kinetic energy in the wind to generate electricity, while hydropower plants use the energy in moving water.

We use more electricity every year. One reason we use so much electricity is that it's easy to move from one place to another. It can be made at a power plant and moved long distances before it is used. There is also a standard system in place so that all of our machines and appliances can operate on electricity. Electricity makes our lives simpler and easier.

Learning Objective:

Explain which forms of energy provide Marylanders with electricity and how electricity is transmitted.

Links to National Science Education Standards: K-4

Content Standard B: Physical Science
- Properties of Objects and Materials
- Light, Heat, and Magnetism

Content Standard D: Earth and Space Science
- Properties of Earth Materials

Content Standard F: Science in Personal and Social Perspectives
- Science and Technology in Local Challenges

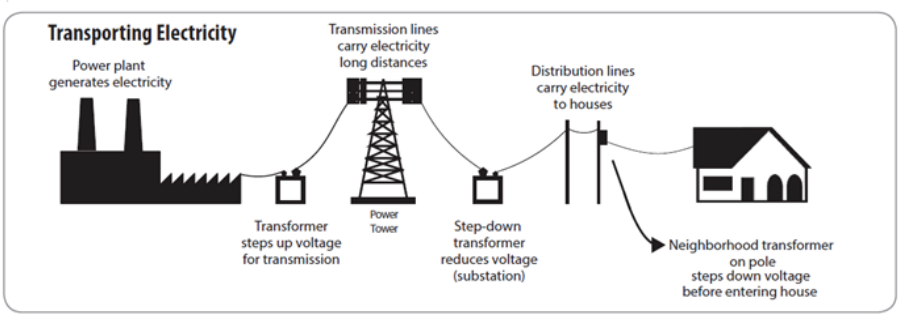


Figure 3.1 Transporting Electricity

Let's follow the path of electricity from a power plant to a light bulb in your home. First, the electricity is generated at a power plant. It travels through a wire to a transformer that steps up, or increases, the voltage. Power plants step up the voltage because less electricity is lost along the power lines when it is at a higher voltage.

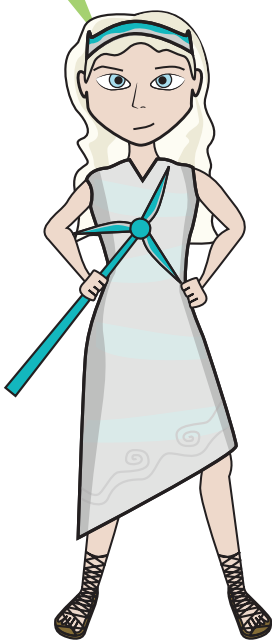
The electricity is then sent to a nationwide network of transmission lines. This is called the electric grid. Transmission lines are the huge tower lines you see along the highway. The transmission lines are interconnected, so if one line fails, another can take over the load.

You can view Maryland's energy distribution in Figure 3.2 on the next page.

Fuels that Make Electricity

Four kinds of power plants produce most of the electricity in the United States: coal, natural gas, nuclear, and hydropower. Coal plants generate about 37 percent of the electricity we use. There are also wind, geothermal, waste-to-energy, and solar power plants, which together generate less than 10 percent of the electricity produced in the United States.

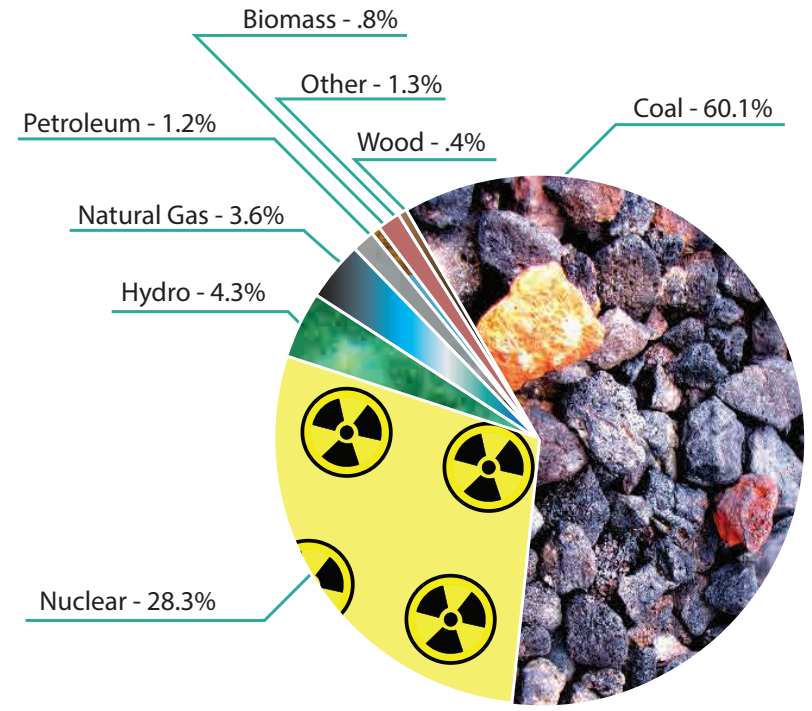
Tip: As long as the sun shines, there will be winds on the Earth. We will never run out of wind energy. It is a renewable energy source. It is also free since no one can own the sun or the air.



Fossil Fuel Power Plants

Fossil fuel plants burn coal, natural gas, or oil to produce electricity. These energy sources are called fossil fuels because they were formed from the remains of ancient sea plants and animals. Most of our electricity comes from fossil fuel plants. Power plants burn the fossil fuels and use the heat to boil water into steam. The steam is channeled through a pipe at high pressure to spin a turbine generator to make electricity. Fossil fuel power plants produce emissions that can pollute the air and contribute to global climate change.

Fossil fuel plants are sometimes called thermal power plants because they use heat energy to make electricity. (***Therme*** is the Greek word for heat.) Coal is used by most power plants because it is cheap and abundant in the United States. There are many other uses for petroleum and natural gas, but the main use of coal is to produce electricity. Almost 93 percent of the coal mined in the United States is sent to power plants to make electricity.



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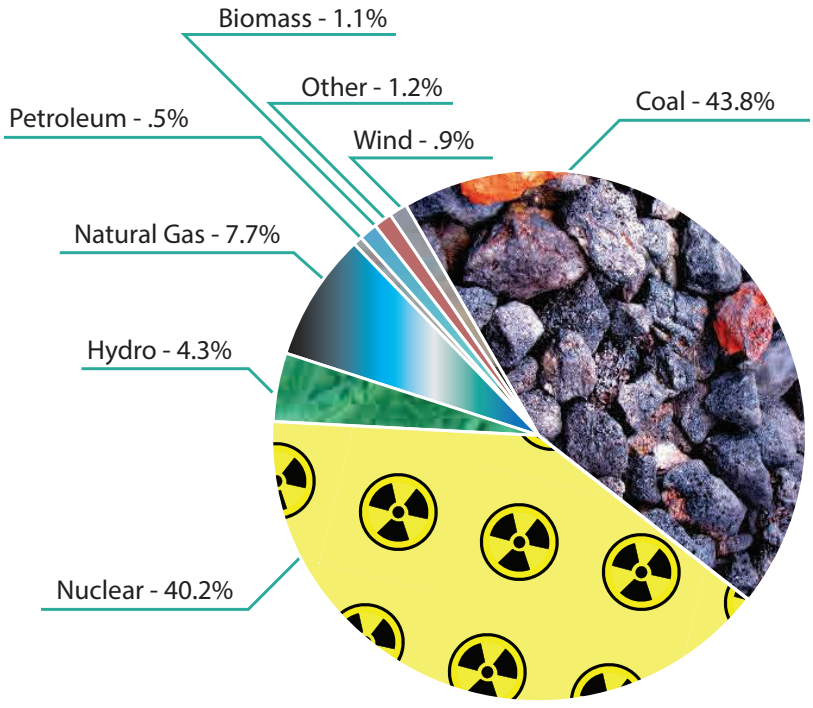

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Figure 3.2 Electricity Distribution in Maryland

Nuclear Power Plants

Nuclear power plants are called thermal power plants too. They produce electricity in much the same way as fossil fuel plants, except that the fuel they use is uranium, which isn't burned. Uranium is a mineral found in rocks underground. A nuclear power plant splits the nuclei of uranium atoms to make smaller atoms in a process called fission that produces enormous amounts of thermal energy. The thermal energy is used to turn water into steam, which drives a turbine generator. Nuclear power plants don't produce carbon dioxide emissions, but their waste is radioactive. Nuclear waste must be stored carefully to prevent contamination of people and the environment.

Hydropower Plants

Hydropower plants use the energy in moving water to generate electricity. Fast-moving water is used to spin the blades of a turbine generator. Hydropower is called a renewable energy source because it is renewed by rainfall.

Energy in Maryland

Discussion Questions

1. Who is your electricity supplier and what is their energy mix? BGE, Delmarva, Pepco, Potomac Edison, SMECO or another supplier?
2. How far is the closest power plant to your home, school or library?
3. How can you change where your electricity comes from so it doesn't have to travel so far?

Activity

1. Show the students the Transporting Electricity image on page 30.
2. Give them a map of their neighborhood (GOOGLE it) and then have them create their own map of transmission—noting all the places where they lose electricity along the way.
3. Once you have created the maps, you can watch the video about Smart Grids (http://www.pbslearningmedia.org/resource/nsn11.sci.engin.systems.smartgrid/smart-power-grid/) to show the difference between our current system and what could be.

Tip: Hydropower is a clean source of energy. No fuel is burned, so the air is not polluted. It is the cheapest source of electricity because the water is free to use. And we won't run out of water—it is renewable.

Activity 4

Sources of Pollution

What's Your CO_2 Contribution?

READY

Working in small groups, students find out how far they live from school. Then the students work together to find out their individual and group CO_2 contribution.

SET

Review the directions for calculating the CO_2 contribution.

Print out the CO_2 poster for students to see the different types of transportation.

GO

Introduction

Before doing the activity, open with this statement:

Every move you make—you change the world. Every breath you take—you change the world. You change the world every day—and that's okay. Just think of the many ways you change the world. You eat plants and animals that eat plants. You wear clothes made out of plants, like cotton. You step on plants. You burn plants. You use energy to get you places. You use energy to keep you warm and keep you cool. You use energy to light up the dark and run your TV and charge your electronics. You drink water and take baths and swim. You wash your clothes and your dishes. You flush the toilet. You buy toys and gum and soft drinks. You throw away lots of trash. You breathe in air full of oxygen. You breathe out air full of carbon dioxide. All day, every day, you change the air around you. All of the animals breathe air, too. They breathe in oxygen. They breathe out carbon dioxide. When we burn wood, or coal, or oil, or natural gas, we use up oxygen and make carbon dioxide.

Do you know that plants breathe, too? They take in carbon dioxide. They put out oxygen. Just the opposite of you. Today, we make a lot of carbon dioxide. Lots of people are in the world, and they all breathe. Lots of people and factories and power plants burn wood, coal, oil, and gas. We make more carbon dioxide than the plants can use. We are changing the balance in the air.

Many scientists think this will make the Earth warmer—not a lot warmer, but a little bit. They call this climate change, or global warming. They think it is bad for the Earth. They think we should lower the amount of carbon dioxide we put into the air. We can't stop breathing, so we need to stop burning so much wood, coal, oil, and gas. This might change the way we live. We might not be able to drive our cars as much as we do now. We might have to stop using so much energy every day.

Learning Objective:

This activity will help students identify how much carbon dioxide is released into the atmosphere through the transportation sector.

Links to National Science Education Standards: 5-8

Content Standard A: Science as Inquiry

- Abilities Necessary to Do Scientific Inquiry
- Properties of Objects and Materials
- Light, Heat, and Magnetism

Content Standard D: Earth and Space Science

- Properties of Earth Materials

Calculate Your Carbon Footprint

Today we are going to calculate our personal, group, and class contribution of CO_2 due to vehicle use using these steps:

1. Using a map, have each student estimate the distance from their home to school in miles.
2. Have each student identify their type of family vehicle based on the table listed below.
3. How do you get to and from school? Pick out the type of car/transportation from chart. If the number is 5 miles, then it would actually be 20 miles a day because you have to go back and forth.
4. Take that number and multiply by 5 since there are 5 days in a week. So it would be 100 miles for the week.
5. Divide that number by the miles per gallon (on chart) to determine the gallons of gas burned. So if you have a compact car it would be 100/24 = 4.16 gallons of gas will be used
6. Multiply the released per gallon (on chart). So it would be 4.16 gallons of gas X 20 = produces 83.20 pounds of CO_2 per week.
7. How much is 1 lb of CO_2? – Fill up an exercise ball = 1 lb of CO_2, remember that CO_2 is a gas, we can't see it or smell it one small balloon would be about 1/8 or 1/10th of 1 pound. Think about how much you weigh and that is probably closer to the amount of CO_2 you put into the atmosphere just by coming to and from school
8. Now let's find out how much we create as a class? Add everyone's number and place on the board.
9. Ask what the students could do differently to change the amount of CO_2 they are putting into the atmosphere.

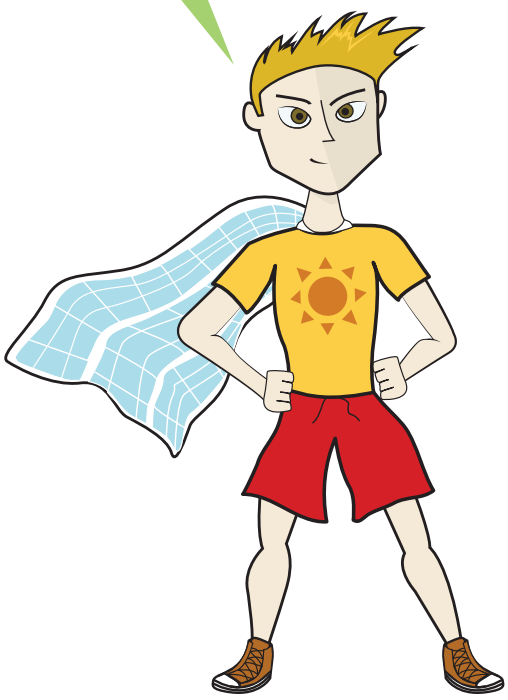
Tip: Some people don't think we should use nuclear energy. They think the radiation is too dangerous. Other people think nuclear energy is a clean, safe way to make electricity.

What's Your CO^2 Contribution?

	mpg	pounds CO_2 per gallon
	24	20
	16	20
	13	21
	8	22*
	0	0
	0	0

*Buses add more CO^2 per gallon, but they carry more passengers, so be sure to consider contribution by passenger, not just vehicle.

Tip: Solar energy is free and clean. There is enough for everyone, and we will never run out of it. Solar energy is renewable. The sun will keep making energy for a very long time. Why don't we use the sun for all our energy needs? The hard part is capturing the sunlight. It shines all over the Earth and only a little bit reaches any one place. On a cloudy day, most of the light never reaches the ground at all.



Activity 5

Efficiency & Conservation

The Energy I Used Today

READY

Working in small groups, students find out how far they live from school. Then the students work together to find out their individual and group CO2 contribution.

SET

Review the directions for calculating the CO2 contribution.

Print out the CO2 poster for students to see the different types of transportation.

GO

The United States uses a lot of energy—over two million dollars worth of energy per minute, 24 hours a day, 365 days a year. With less than five percent of the world's population, we consume about 20 percent of the world's energy resources.

All of us use energy every day—for getting from one place to another, cooking, heating and cooling rooms, making products, lighting, heating water, and entertainment.

We use a lot of energy to make our lives comfortable, productive, and enjoyable. Most of that energy is from nonrenewable energy sources. It is important that we use our energy resources wisely.

Energy Efficiency and Conservation

The choices we make about how we use energy have environmental and economic impacts. There are many things we can do to use less energy and use it more wisely. These actions include both energy conservation and energy efficiency.

Energy conservation is any action or behavior that results in using less energy. Energy efficiency focuses on technologies that use less energy to perform the same tasks or the same amount of work. Buying a dryer that uses less energy is an example of energy efficiency. Drying clothes outside on sunny days is an example of energy conservation. More detailed information about how we use energy can be found in this document: http://www.need.org/files/curriculum/guides/Saving%20Energy%20Student%20Guide.pdf

Learning Objective:

This activity is designed to help students become aware of the ways they use energy every day.

Links to National Science Education Standards: 5-8

Content Standard A: Science as Inquiry
- Abilities Necessary to Do Scientific Inquiry

Content Standard E: Science and Technology
- Understandings About Science and Technology

Content Standard F: Science in Personal and Social Perspectives
- Science and Technology in Local Challenges

Activity

Print out a copy of the Energy Bucks for all students, one page per child. They will each receive 20 Energy Bucks. (Template below.)

Have the students put their Energy Bucks aside. Instruct them to go through the list and put a check in the right column for the type of energy they use in a typical day.

After they have all completed it, go through the list and tell them how many Energy Bucks each activity costs. They will then have to choose which activities they will pay for since they only have 10 Energy Bucks. Most, if not all, of the students will run out of Energy Bucks before they are through the cards.

Have the students go through their cards again, changing their choices until they can make it through the day with the Energy Bucks they have. Discuss the activity and the concepts listed on the previous page with the students.

Explain to them that most adults, including their parents, make choices like these every day. Suggest that they share the activity sheet at home with their siblings and parents.

Tip: The earth has a limited amount of water. That water keeps going around and around and around and around and in what we call the "Water Cycle".

As long as we have water, we have energy. That is why it is a renewable energy source.

Energy Worksheet - Teacher

How You Use Energy	Energy Bucks
What device woke you up this morning?	
Alarm Clock or Radio	**2**
What devices were used to make your breakfast?	
Microwave	**2**
Stove/Oven	**5**
Toaster Oven	**3**
Refrigerator	**3**
What devices did you use to get ready for school this morning?	
Air Conditioning/Heating	**10**
Radio/CD Player/MP3 Player/iPod	**2**
TV/DVD Player	**3**
Gaming System	**3**
Shower/Bath	**3**
Hair Dryer	**3**
Curling Iron/Curlers/Flat Iron	**3**
Telephone/Cell Phone	**2**
Computer	**3**
iPad/Tablet	**2**
What rooms had lights turned on this morning?	
Bedroom	**2**
Bathroom	**2**
Kitchen	**2**
Family Room	**2**
Other	**2**
How did you get to school today?	
Walk	**0**
Bicycle	**0**

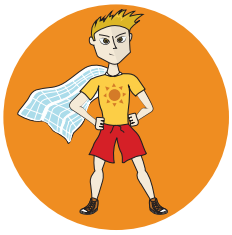
How You Use Energy	Energy Bucks
School Bus	1
Carpool	2
Family Vehicle	5
What devices did you use after school yesterday?	
Air Conditioning/Heating	10
Travel in Vehicle	5
Lights	2
Computer	3
iPad/Tablet	2
Gaming System	3
Radio/CD Player/MP3 Player/iPod	2
TV/DVD Player	3
Telephone/Cell Phone	2
Snack Preparation	2
What devices were used at home last night?	
Air Conditioning/Heating	10
Microwave	2
Stove/Oven	5
Toaster Oven	3
Refrigerator	3
Grill	2
Lights	2
TV/DVD Player	3
Gaming System	3
Shower/Bath	3
Hair Dryer	3
Telephone/Cell Phone	2
Computer	3
iPad/Tablet	2
Radio/CD Player/ MP3 Player /iPod	2
Total Energy Bucks Used	

Energy Worksheet - Student

How You Use Energy	Your Amount
What device woke you up this morning?	
Alarm Clock or Radio	
What devices were used to make your breakfast?	
Microwave	
Stove/Oven	
Toaster Oven	
Refrigerator	
What devices did you use to get ready for school this morning?	
Air Conditioning/Heating	
Radio/CD Player/MP3 Player/iPod	
TV/DVD Player	
Gaming System	
Shower/Bath	
Hair Dryer	
Curling Iron/Curlers/Flat Iron	
Telephone/Cell Phone	
Computer	
iPad/Tablet	
What rooms had lights turned on this morning?	
Bedroom	
Bathroom	
Kitchen	
Family Room	
Other	
How did you get to school today?	
Walk	
Bicycle	

How You Use Energy	Your Amount
School Bus	
Carpool	
Family Vehicle	
What devices did you use after school yesterday?	
Air Conditioning/Heating	
Travel in Vehicle	
Lights	
Computer	
iPad/Tablet	
Gaming System	
Radio/CD Player/MP3 Player/iPod	
TV/DVD Player	
Telephone/Cell Phone	
Snack Preparation	
What devices were used at home last night?	
Air Conditioning/Heating	
Microwave	
Stove/Oven	
Toaster Oven	
Refrigerator	
Grill	
Lights	
TV/DVD Player	
Gaming System	
Shower/Bath	
Hair Dryer	
Telephone/Cell Phone	
Computer	
iPad/Tablet	
Radio/CD Player/ MP3 Player /iPod	
Total Energy Bucks Used	

Energy Bucks

Energy  Buck	Energy  Buck
Energy  Buck	Energy  Buck
Energy  Buck	Energy  Buck
Energy  Buck	Energy  Buck
Energy  Buck	Energy  Buck

Activity 1

Ice Breaker: Energy Bingo

Get to Know Your Group

Learning Objective:

Icebreakers are a fun way for a group to get to know each other and a quick way to introduce a new topic.

Ready

Duplicate as many Energy Bingo sheets (found on page 29) as needed for each person in your group. In addition, decide now if you want to give the winner of your game a prize and what the prize will be.

Set

Pass out one Energy Bingo sheet to each member of the group.

Go

Give the group the following instructions to create bingo cards:

This bingo activity is very similar to regular bingo. However, there are a few things you'll need to know to play this game. First, please take a minute to look at your bingo sheet and read the 16 statements at the top of the page. Shortly, you'll be going around the room trying to find 16 people about whom the statements are true so you can write their names in one of the 16 boxes.

When I give you the signal, you'll get up and ask a person if a statement at the top of your bingo sheet is true for them. If the person gives what you believe is a correct response, write the person's name in the corresponding box on the lower part of the page. For example, if you ask a person question "D" and he or she gives you what you think is a correct response, then go ahead and write the person's name in box D. A correct response is important because later on, if you get bingo, that person will be asked to answer the question correctly in front of the group. If he or she can't answer the question correctly, then you lose bingo. So, if someone gives you an incorrect answer, ask someone else! Don't use your name for one of the boxes or use the same person's name twice.

The first person to get all the squares on their board filled wins, but you will still go through the board to find out what people answered.

Answers:

A. Students should share location

B. Coal, petroleum, natural gas, propane

C. No answer needed

D. Student should be able to describe a clothes line

E. Student should describe the location or inside of the plant

F. Turning off lights, insulation, saving water, etc (lots of responses)

G. No answer needed

H. Cans, bottles, paper, (lots of responses) and could say composting

I. No answer needed

J. Student should describe volcano, geyser, or hot spring

K. Student should list where: home, street light, building, calculator, etc

L. Hydro, solar, geothermal, wind, biomass (or could name ***THE EmPOWERS***)

M. BGE, Delmarva, Pepco, Potomac Edison, SMECO or other

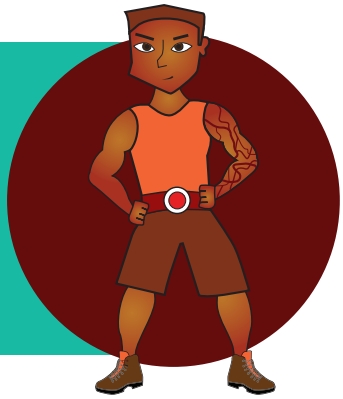
N. Pipeline

O. Propane

P. Fission

Energy Bingo!

For each letter, find one person about whom the statement is true. Write their name in that box below.



a) Has seen a wind turbine	**b)** Can name two fossil fuels	**c)** Has never seen coal	**d)** Uses a solar clothes dryer
e) Has visited a power plant	**f)** Can name two ways to save energy at home	**g)** Uses a hand-operated can opener	**h)** Can name two things that can be recycled
i) Recycles aluminum cans	**j)** Has seen geothermal energy	**k)** Has a photovoltaic cell	**l)** Can name two renewable energy sources
m) Knows the name of their electric company	**n)** Knows how natural gas is usually transported	**o)** Knows which fuel is used in barbeque grills	**p)** Knows how uranium atoms give off energy

J Journalist Corner

This Week in Energy Conservation

READY

Prior to class, make copies of the four lead stories (found in the GO Section) that you will be distributing among the student groups. You may also want to gather the supplies students may use in constructing props to accompany their energy stories.

SET

Review with the students the structure of an actual news program. Explain the role of an anchor in providing the background information or "lead-in" to a news story. Ask the students to recall the various ways they have seen news stories covered in the past (in a studio, on-site, through interviews, or video recordings). This will help them understand what they will be asked to do during the "This Week in Energy Conservation" show.

Divide the class into six groups, and distribute a news lead to each group. Groups should be made up of 4-6 students.

GO

This activity is designed as a television show with student correspondents reporting on a variety of energy conservation topics. This activity will introduce students to ways of saving in the home, school or library.

Introduction

Explain to the students that each group is now a team of energy reporters. They should read the introduction to their segment of "This Week in Energy Conservation", making note of the energy conservation tips listed below each lead. Their job will be to develop a story that follows the guidelines of the anchor's introduction and includes six of the energy tips listed on their sheet of paper. Each story should be limited to two or three minutes, and the groups will be allowed 20 minutes to develop and rehearse their stories.

After each story is presented, the other groups will have one minute to try to list 3-4 energy tips from the presentation they just heard. Next, the presenting group reveals their tips.

Each group grades themselves using the honor system, getting one point for every tip they remembered correctly. Tally the scores of all the groups watching the presentation, and award this amount to the presenting group. This gives the presenters an incentive to do a thorough job conveying their facts and information to the audience. The team with the highest score after all the presentations is the winner. Either you or a student from each group can serve as the anchor, providing the show's introduction and the lead-in to each news story.

OPTIONAL: This activity can be expanded to include props and costumes for actual public service announcements on school TV stations for Energy Awareness Month or Earth Day.

Learning Objective:

This activity is designed as a television show with student correspondents reporting on a variety of energy conservation topics. This activity will introduce students to ways of saving in the home, school, or library.

STORY 1: Hot Water Heating Energy News Team

Now for tonight's micro-cam report: We have once again miniaturized a member of our Energy News Team staff to give you an inside look at what actually goes on inside your hot water heater. Heating water is the second largest energy job in the home, so it's important to know what these drops of water are thinking while they're still inside the tank. We find their biggest fear is that their lives may be wasted by carelessness. Here's _____, who always seems to be getting into hot water, with this in-depth report.

1. Do not let hot water run needlessly. About 18 percent of all the energy we consume in our homes is used to heat water.
2. Use cold water instead of hot water when running the garbage disposal and when rinsing dishes before they go in the dishwasher. Using cold water saves energy.
3. Repair leaky faucets promptly. A leaky faucet can waste gallons of water in a short period of time. A leak of one drip per second can cost $1 per month.
4. Wash and rinse clothes in cold water. Operating a washing machine takes very little energy. Most of the energy used by clothes washing machines goes to heating the water.
5. Use low-flow shower heads. These easy-to-install devices save energy and still provide more than adequate shower pressure.
6. Lower the water heater's thermostat to 120 degrees. Most hot water heaters are set for 140 degrees or higher. You can save on your energy bill by lowering the temperature.
7. Insulate hot water storage tanks and water pipes connected to the water heater.

Tip: The natural gas we use today took hundreds of millions of years to form. That's why we call it a nonrenewable energy source. We can't make more in a short time. Garbage sometimes produces methane, the main gas in natural gas. Methane from rotting garbage is a renewable energy source because there will always be garbage and waste.

STORY 2: Home Heating Energy News Team Introduction

The theft of home heating energy is a normal occurrence. So why the next story? Because our undercover reporter has been able to infiltrate a gang of home heating energy criminals. For the first time ever, we can bring you the story from the point of view of the criminals. Seeing how they operate might help you, our Energy News Team viewer, prevent them from stealing your energy dollars.

1. Keep heating equipment well maintained. To get the most from your heating fuel, keep furnace filters clean and equipment well tuned.
2. Add insulation in the attic and walls where needed. Adding insulation can pay for itself within a few years.
3. Plant trees to act as a windbreak. Trees act as a natural barrier to cold air in the winter and hot sun in the summer.
4. During the winter, set the thermostat to 68 degrees during the day, and lower at night or when no one is home. Use a programmable thermostat to easily adjust the temperature for different times of the day. Lowering the thermostat 7 to 10 degrees for eight hours can save approximately 10 percent of your energy costs a year.

5. Close off unoccupied rooms, and shut off their heating vents. Shutting heat vents in rooms that are not used every day saves fuel.

6. Caulk and weatherstrip doors, windows, and other areas in the home where drafts might occur. Caulking and weatherstripping is one of the quickest energy—and money—saving tasks you can do.

7. Keep draperies and shades open in sunny windows, and closed at night. Energy from the sun provides natural warmth. Close drapes in summer when you want the house cooler.

STORY 3: Cooking Energy News Team Introduction

Do you hate to cook? If slaving over a hot stove isn't your idea of a good time, tonight's Energy Gourmet segment is for you. Imagine telling your family, "We're having microwave pizza for dinner tonight because I'm trying to save energy." The Energy Gourmet has a few simple tips that will save you energy and money. Who knows, you may even save enough money to eat out more often.

1. Always boil water in a pan that is covered. Water will boil faster and use less energy in a covered pan.

2. Whenever possible, use a toaster oven or microwave instead of a regular oven. These smaller appliances take less time to cook food so you save energy.

3. When baking, keep the oven door closed rather than opening it to look inside. An open door lets valuable heat escape; maintain the heat by keeping the door shut.

4. Clean range pans (under the burners) regularly. A clean range pan reflects more heat than a dirty one.

5. Only preheat the oven for five minutes or not at all. It's also a good energy practice to cook several dishes in the oven at once to make maximum use of this concentrated heat source.

6. Use the right size pan for each burner. A small pan on a large burner wastes energy because the air surrounding the pan will be heated, too.

STORY 4: Lighting Energy News Team Introduction

And now for the segment of the show that enables you, the viewer, to help put a dangerous energy criminal behind bars. It's time for America's Most Wanted Energy Criminals. The FBI has just put Killer Kilowatt-Hour on its most wanted list. He has been terrorizing homes throughout the nation by forcing families to waste energy in lighting their homes. Recently, he forced a family to leave ten 100-watt light bulbs on for an hour. If you recognize him from this next segment, please don't try to apprehend him yourself, just call our toll-free number, 1-800-TURNOFF. Remember, he's very dangerous because he's very bright.

1. Make sure lights are turned off in rooms where you don't regularly go, such as the basement or attic. Consider installing indicator lights to tell you when those unseen lights are on.

2. Use outdoor lights only when needed. Consider using an automatic timer that switches off outdoor lighting in themorning.

3. Use fluorescent lights, CFLs, or LEDs whenever possible. A fluorescent light lasts 10 times longer and uses 75 percent less energy than an incandescent bulb. LEDs use even less energy and last even longer

4. Dust bulbs and light fixtures frequently because dirt absorbs light. Clean fixtures and bulbs give you more light.

5. Reduce light in non-working areas. Lighting needs vary with each task. Over-lighting an area wastes lots of energy. Adjust your lights accordingly.

6. Turn down three-way light bulbs to the lowest setting when watching television. Dimmer light reduces glare on the TV and saves energy.

7. Use one large bulb, instead of several small ones, in areas where bright lights are needed. Concentrate lighting in study areas and in stairwells where it's needed for safety.

Creativity Corner

The Power of Wind

READY

Working individually students will create their own wind turbine out of paper and decorate it.

Learning Objective:

This activity will allow students to explore how the energy of the wind or breath is transferred into the turning or rotational motion of a pinwheel.

SET

Make sure you have the materials for this activity, print out the windmill template, scissors, brass fasteners, straws.

GO

A wind turbine is the modern advancement of the windmill. Instead of using the wind to lift water or move heavy rocks to grind seeds, wind is used to turn an electrical generator to make electricity. While a fan uses electricity to produce wind, a wind turbine uses the wind to produce electricity! [1]

How Wind Turbines Work

To put it simply, the wind turns the blades, which spins a shaft, which connects to a generator, making electricity. The electricity is sent through transmission lines to a substation, then on to homes, business and schools.

Wind turbine blades spin because of lift, the same force that allows airplanes to fly. If the blades are all oriented in the same direction they will start to spin, just as the wind spins a pinwheel. The blades are attached to a hub, which spins as the blades turn. Most modern wind turbines have three blades. The blades and the hub together are called the rotor. As the rotor turns, it spins a drive shaft which is connected to a generator inside the housing at the top of the tower. This housing is called the nacelle. The spinning generator produces electricity. The generator inside of a wind turbine converts the mechanical energy of moving wind into electrical energy that we can use in our houses. Depending on the size of the wind turbine there may be a gearbox between the spinning rotor and the generator. This is to help the generator spin fast enough to make electricity for the grid. Generators on the large grid connected turbines spin at 1600 RPM.

The amount of electricity that a turbine is able to produce depends on the diameter of the rotor and the speed of the wind that propels the rotor. The wind turbines that are manufactured today range greatly in their output capacity from as little as 100 watts to as much as 5 Megawatts—enough to power a small town! Wind Turbines are often grouped together in wind farms to produce large amounts of electricity. Some wind farms have only a couple turbines, but the largest wind farms are made up of hundreds and hundreds of wind turbines.

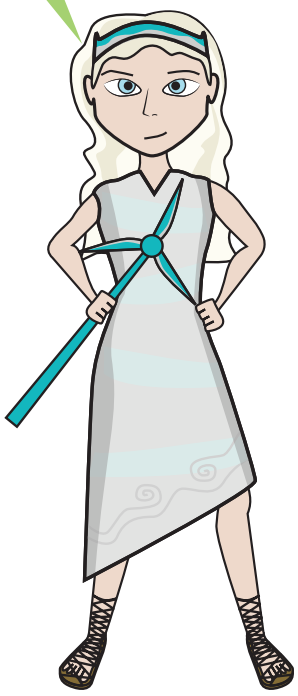
Pinwheels are like wind turbines. They need wind to move. We are going to make our own to see how energy is created.

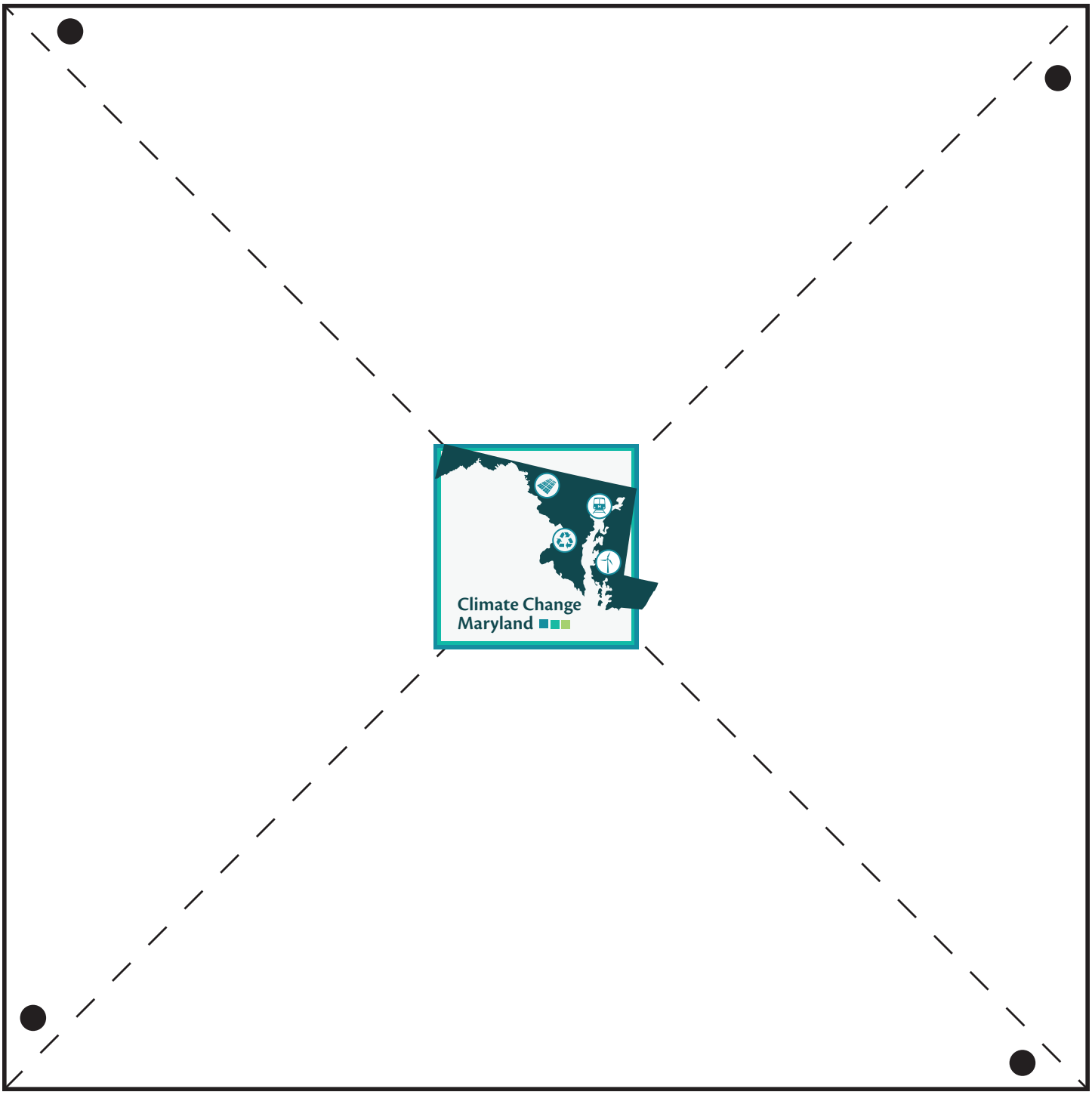
1 This information comes from the website, Kid Wind Project: http://learn.kidwind.org/learn/wind_basics_power

Making the Pinwheel

1. Color inside the square with whatever design you want.
2. Cut out the square and then cut along the dashed lines. Be careful NOT to cut all the way to the center.
3. Punch out the holes with the brass fastener.
4. Curl up the corners. The corner holes should line up with the center hole.
5. Push the brad through all the holes and into the side of the pencil eraser.
6. Hold the straw and blow straight into the pinwheel so it goes round!
7. Pretend you're the wind, blowing on a wind turbine. When the blades go around, the turbine makes electricity. Electricity is what makes lights and TVs turn on when we flip the switch.

Tip: One wind turbine doesn't make much electricity. Most wind farms have many wind turbines. Wind farms can take up a lot of land. Most of the land they are on can still be farmed or used to graze animals. Wind is a safe, clean, renewable energy source for making electricity.




Climate Change
Maryland

Appendix

A

Energy Definitions

Definitions and Additional Resources

Definitions

BIOMASS: Biomass is grasses, trees, garbage or yard waste—basically anything that is or was plant fiber.

COAL: Coal comes from deep inside the earth and is burned for heat or to make electricity.

ELECTRICITY: Electricity is a secondary energy source because it is produced from other forms of energy such as coal, natural gas, hydropower, fuel cells or photovoltaic (PV) cells.

ENERGY: The ability or capacity for doing work by a body or a system. The measurement of the total heat in a system. Heat can be converted between a number of forms including light, motion, electricity, and warmth.

ENERGY CONSERVATION: The practice of extending the useful life of the earth's energy resources through wise and efficient management.

GEOTHERMAL: Geothermal energy comes from heat within the earth and is used to make electricity and provide heating.

HYDROGEN: Hydrogen gas is the simplest element known to man. When used as a fuel, its only by-product is water.

HYDROPOWER: Hydropower is energy produced by moving water. It often is used to generate electricity.

NATURAL GAS: Natural gas is a fossil fuel which most scientists believe formed millions of years ago from the remains of dead plants and animals. It often is used to heat homes or to power stoves and water heaters.

NUCLEAR ENERGY: Nuclear energy is used to provide electricity.

PETROLEUM: Petroleum, a fossil fuel formed from plants and animals, is used to power cars and trucks.

PROPANE: Propane comes from natural gas and petroleum wells. It is used to fuel appliances such as ranges, ovens, space heaters, furnaces, air conditioners' and outdoor grills.

SOLAR: Solar energy is the light and heat provided by the sun.

WIND: Wind provides energy to turn windmills and turbines to generate electricity.

Additional Resources

Climate Communication Consortium of Maryland
http://www.climatemaryland.org/

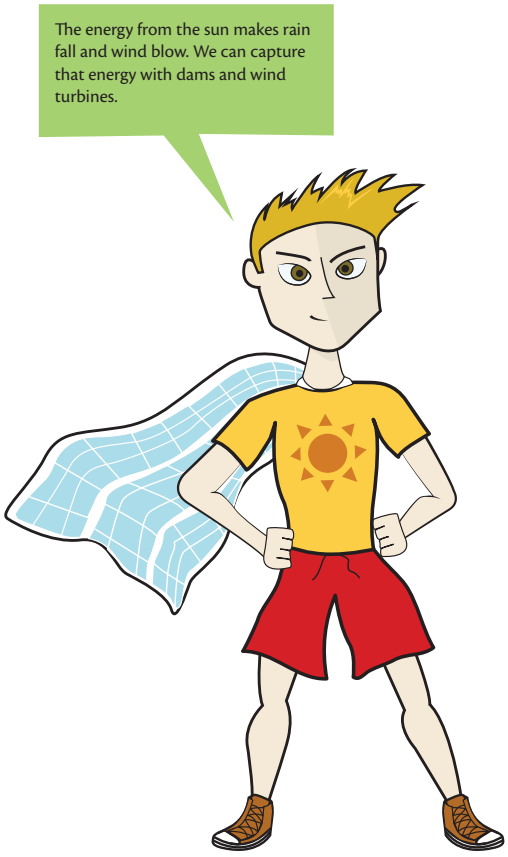
Climate Interpreter
http://climateinterpreter.org/resource

Maryland Association for Environmental and Outdoor Education – Maryland Green Schools Program (MDGS)
http://maeoe.org/green-schools/maryland-green-schools-program-overview/

MADE CLEAR Maryland and Delaware Climate Change Education Assessment and Research
http://www.madeclear.org/

National Wildlife Federation, Mid Atlantic Regional Center
http://www.nwf.org/Eco-Schools-USA/Our-Partners/Maryland-Green-Schools.aspx

National Energy Education Development Project
http://www.need.org/curriculum



Appendix
B

Origin Story

2015 Summer Library Program: Every Hero Has a Story

Learning Objective:

The purpose of an origin story is to tell a good story. It is also an opportunity to tell the history of the characters and what drives them as *EmPOWERS*.

READY

The students will work independently or in small groups to determine the Origin Stories for ***THE EmPOWERS.***

It is suggested that grades K – 6 work on the Origin Stories for the individual ***EmPOWERS***. Grades 7 – 12 are encouraged to create Origin Stories for the collective group.

SET

Go through the descriptions of each of ***THE EmPOWERS*** energy sources with the students to determine which of ***THE EmPOWERS*** they want to focus on for the Origin Story.

Print out the Origin Story sheet for the students based on their suggestions.

GO

Start by reading students an Origin Story for one of the more popular superheroes like Super Man, Spider Man or Green Lantern and then give them time to come up with their stories.

Create a story for The EmPOWERS: Biomass

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.

Plantasia

1. **How did PLANTASIA become part of *THE EmPOWERS* and what is she like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

2. Does she have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps themhave super powers. You tell us.

3.What is her motivation as part of *THE EmPOWERS*? Why does she care so much about their energy source? What must they do to make sure that their energy sources becomes one of the major energy sources in the state?

Create a story for The EmPOWERS: COAL

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.

Cole

1. **How did COLE become part of *THE EmPOWERS* and what is he like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

2. Does he have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps them have super powers. You tell us.

3.What is his motivation as part of *THE EmPOWERS*? Why does he care so much about their energy source? What must they do to make sure that their energy source becomes one of the major energy sources in the state.

Create a story for The EmPOWERS: GEOTHERMAL

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.

Vesuvias

1. **How did VESUVIAS become part of *THE EmPOWERS* and what is he like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

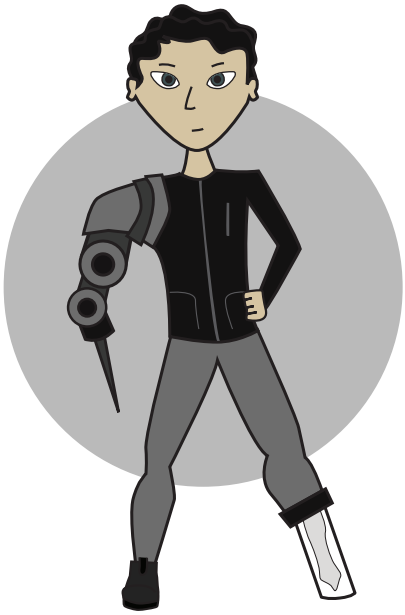
2. Does he have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps them have super powers. You tell us.

3.What is his motivation as part of *THE EmPOWERS*? Why does he care so much about their energy source? What must they do to make sure that their energy source becomes one of the major energy sources in the state.

Create a story for The EmPOWERS: Natural Gas

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.



Methaniel

1. **How did METHANIEL become part of *THE EmPOWERS* and what is he like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

2. Does he have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps them have super powers. You tell us.

3.What is his motivation as part of *THE EmPOWERS*? Why does he care so much about their energy source? What must they do to make sure that their energy source becomes one of the major energy sources in the state.

Create a story for The EmPOWERS: HYDRO

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.

Aqua Marine

1. **How did AQUA MARINE become part of *THE EmPOWERS* and what is she like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

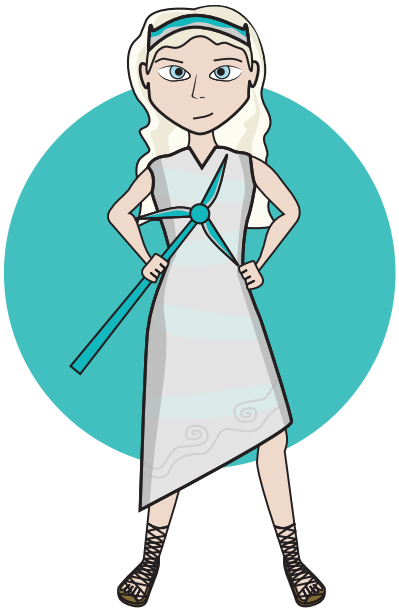
2. Does she have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps themhave super powers. You tell us.

3.What is her motivation as part of *THE EmPOWERS*? Why does she care so much about their energy source? What must they do to make sure that their energy sources becomes one of the major energy sources in the state?

Create a story for The EmPOWERS: WIND

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.



Zephyra

1. **How did ZEPHYRA become part of *THE EmPOWERS* and what is she like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

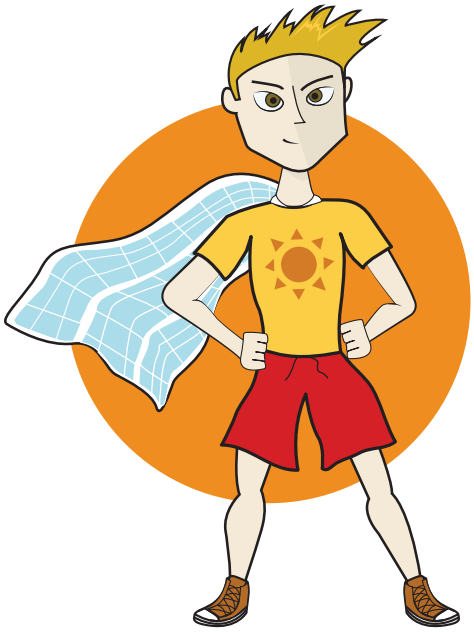
2. Does she have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps themhave super powers. You tell us.

3.What is her motivation as part of *THE EmPOWERS*? Why does she care so much about their energy source? What must they do to make sure that their energy sources becomes one of the major energy sources in the state?

Create a story for The EmPOWERS: SOLAR

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.



Solar Flair

1. **How did SOLAR FLAIR become part of *THE EmPOWERS* and what is he like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

2. Does he have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps them have super powers. You tell us.

3.What is his motivation as part of *THE EmPOWERS*? Why does he care so much about their energy source? What must they do to make sure that their energy source becomes one of the major energy sources in the state.

Create a story for *The EmPOWERS*: NUCLEAR

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.

Dr. Fission

1. **How did DR. FISSION become part of *THE EmPOWERS* and what is she like?** This is your opportunity to give us the back story. How old are they? What are their favorite hobbies or foods? Are they strong and confident? Quiet and shy? Sneaky and manipulative? Sassy and funny? Outrageous and flashy? Dark and conflicted? Give us as much detail as possible when creating their personality.

2. Does she have powers? If so, what are they and how did they come to be? Maybe one of the props they have helps themhave super powers. You tell us.

3.What is her motivation as part of *THE EmPOWERS*? Why does she care so much about their energy source? What must they do to make sure that their energy sources becomes one of the major energy sources in the state?

Create an Origin Story for *THE EmPOWERS*

We all have stories, we all came from somewhere — you have the opportunity to tell the story of one (or more) of *THE EmPOWERS*. EmPOWER Maryland is a statewide plan focused on decreasing our energy use 15% by 2015. *THE EmPOWERS* were created as a way for us to talk about the different types of energy sources that provide us with electricity in Maryland.

In October 2014, kids just like you suggested names for *THE EmPOWERS* but what's a name without a story? Here are some questions you can ask yourself when you are coming up with the Origin story for *THE EmPOWERS*.

1. Why are *THE EmPOWERS* together? *THE EmPOWERS'* individual origin stories are being created at the same time that the group story is being created. We don't know a lot about the individual ***EmPOWERS*** but we want to find out why they are working together. Are they friends who went to school together? Are they in competition for the same resources and decided to join forces?

2. Decide if your superhero has any main enemies. Who would the villains be? Why would ***THE EmPOWERS*** be fighting them? Remember, don't answer too many questions about the villains right off the bat; taking time to reveal their back-stories, true natures, and/or motivations will make them more engaging and mysterious.

3. Determine the community's relationship to *THE EmPOWERS*. Do people look up to them? If so, why? What are ***THE EmPOWERS*** doing for the community?

Appendix C

Environmental Comics

Graphic Novels about the Environment

While ***THE EmPOWERS*** are in need of Origin Stories, there are additional ways to incorporate art and reading into our outreach on ***THE EmPOWERS***. Environmental comics are not new but have multiplied owing to recent catastrophes: the Indian Ocean earthquake and tsunami in 2004, Hurricane Katrina in 2005, the Deepwater Horizon oil spill in 2009, the Haiti earthquake in 2010, and Superstorm Sandy in 2012.

Graphic novels are a way for students to elaborate on ***THE EmPOWERS*** stories. Below are a listing of 34 graphic novels compiled by Martha Cornog and Chelsea Leu. Feel free to add to the list below.

Children and Tweens

John Muir, Earth - Planet, Universe. Bertagna, Julie (text) & Goldsmith, William (illus.)

The world's most famous conservationist needs no introduction, but this graphic novel is a delightful place to start. Published by the Scottish Book Trust, John Muir, Earth-Planet, Universe details Muir's life from his childhood in the Scottish countryside to his tireless work exploring, enjoying and protecting America's wild places.

Finding Nemo: Reef Rescue. Croall, Marie (text) & Erica Leigh Currey (illus.)

Everybody's favorite clownfish is back, recruiting father fish Marlin and friend Dory to solve a mystery: the reef where they live is dying. Adventure, danger, and diplomacy follow, as the fish convince other underseas citizens to help find the cause of the problem and work out a solution. A story of courage and cooperation as much as one about ecological concerns, in lively color art.

The Green Queen of Mean. Dahl, Michael & Scott Nickel (text) & Jeff Crowther (illus.)

Halo Nightly's alter ego is Princess Candy, whose magic candy gives her superpowers. When Halo's archenemy Doozie Hiss tries to sabotage her science project on pollution, Halo's partner Flora Fawn conjures up her own Green Queen superpowers to fight Doozie. But things get out of hand pretty quickly. It's up to Halo to help Flora find a bettzer way to handle Doozie and create a beautiful flower garden as well.

Luz Sees the Light (The Future According to Luz). Dávila, Claudia.

Twelve-year-old Luz isn't thrilled when energy prices skyrocket so high that power outages interrupt her life. But she wants to do something for the environment, so she gets her two friends involved in turning an abandoned lot into a city garden, and she keeps at it despite community lethargy. A bonus chapter teaches kids how to make garden compost. Each future volume in this series will focus on a specific area of the environmental crisis, with a step-by-step how-to project at the end. Energetic, color illustrations.

The Flying Beaver Brothers and the Evil Penguin Plan.
The Flying Beaver Brothers and the Fishy Business. Eaton, Maxwell III.

Ace loves extreme sports and brother Bub loves napping, but when bad-guy penguins bring in a gigantic refrigerator to convert Beaver Island to polar-style living, the beaver brothers must work together to save their home from environmental catastrophe. In the second volume, the brothers discover that Fish Stix Environmental Manufacturing is really just a cover for extreme corruption all around and a nasty plot threatening the island's forests. The solution involves a hang-glider and 500 pancakes. Plenty of green-friendly humor with two-color art.

Jr. Graphic Environmental Dangers (series). Faust, David R. & John Nelson (text) & Dheeraj Verma (illus.).

Six short educational graphic novels about different environmental issues: After Earth: Living on a Different Planet; Collision Course: Asteroids and Earth; Energy Crisis: The Future of Fossil Fuels; Global Warming: Greenhouse Gases and the Ozone Layer; Polar Ice Caps in Danger: Expedition to Antarctica; Sinister Sludge: Oil Spills and the Environment

Beanworld. Bk. 1: Wahoolazuma! Marder, Larry.

Marder's engaging and complex saga, set in a wholly original universe populated by beanlike creatures, has been compared to Krazy Kat for its surrealistic oddness. Stories follow Mr. Spook and his fellow beings as they hunt for food, work together, and confront forces and individuals that threaten their future. Beanworld is a closed ecosystem in which all parts are interrelated and everyone depends on each other for survival. Echoing

concerns of our own world, major themes include ecology, environmental conservation, mutual support, and artistic expression. Several more volumes have been published, following the yearly cycle of life in Beanworld. Black and white art; appropriate for grade school to grad school. Click on preview link here.

Food Fight: A Graphic Guide Adventure. O'Donnell, Liam (text) & Mike Deas (illus.).

The Graphic Guide series stars a rotating, multiethnic cast of kids in action-based adventures, with nonfiction content relating to how-to skills and social change. In this volume, Nadia and Devin spend summer vacation at a university camp and unexpectedly happen upon a corporate plot to take over the U.S. food supply with genetically modified fertilizer. Educators can use the story to get young people thinking about where our food comes from, how the current production-delivery system evolved, and the advantages of eating locavore.

Claire and the Water Wish. Poon, Janice.

Claire solves kid-mysteries with a green-friendly vibe. The first volume featuring Claire, Claire and the Bakery Thief, concerns natural vs. artificial baking ingredients. In this second adventure, Claire and her friends work on a group science project involving a polluted lake and team up to find the source of the pollution. Both books include a craft project in the back. Cheerful, attractive black-and-white art.

Owly. Vol. 1: The Way Home & The Bittersweet Summer. Runton, Andy.

The nearly wordless, charming dramas of Owly and his friend Wormy introduce the youngest children to both friendship and affection for the natural world. In this first volume of the series, Owly saves Wormy's life and then, as best buddies, they befriend a couple of hummingbirds flying south. The story, depicted in expressive black-and-white art, comes across through characterization, action, gesture, and emotion symbols. Wonderful for pre-readers learning how to follow stories and deduce meaning from print symbols.

Teens and Up

I'm Not a Plastic Bag. Allison, Rachel Hope.

In the North Pacific floats the Great Pacific Garbage Patch, a concentrated mélange of debris shaped by ocean currents, reportedly three times the size of Texas. With lyrical and haunting painted art, Allison imagines how such an amorphous floating mass might come to be an actual island, growing out of a genesis from discarded plastic bags.

Green Pieces: Green from the Pond Up. Aquilina, Drew.

Slapstick and environmentally savvy, Aquilina's work stars an assorted collection of animals, a turtle, a dragonfly, a raccoon, and a frog, who live in a wetlands area with numerous other creatures. Puns and gentle satire characterize the four-panel color strip with simple, cartoony art.

The Pollinator's Corridor: A Graphic Novel. Birk, Aaron.

Parks, gardens, and other isolated patches of green bring beauty and health benefits to urban life. But plants cannot thrive without pollinators: insects and other creatures that fertilize the ecosystem. Will the pollinators cross from one green patch to another, across long stretches of barren concrete? In the 1970s Bronx, three friends work together to create a cross-town pollinators' corridor, stretches of flowering greenery functioning like bus routes to allow these vital insects access to the entire city. The heroes of this story don't wear capes but come by night with bike trailers loaded with potted trees. See sample illustration here.

H2O. Calof, Grant (text) & Jeevan Kang (illus.).

The year is 2250, the world has run out of water, and countries clash to tap the last known source: a lost glacier high in the Andes. Volcanologist Aaron Turner, a reluctant hero, must overcome technical and human barriers and release the unavailable water. Calof did considerable research on environmental trends, cutting-edge technologies, and water-producing schemes to present a credible scenario, useful for understanding the problem of dwindling water supplies.

Concrete. Vol. 5: Think Like a Mountain. Chadwick, Paul.

Concrete, a walking stone being turned travel writer, agrees to accompany a group of radical eco-warriors so he can understand and write about their struggle to save old-growth forest from a lumber company. Neither the loggers nor the environmentalists fit easily into good/evil dichotomies, and Chadwick loads in plenty of data about the environmental debates as Concrete gradually decides to take a more active role in the struggle. The original comic book series, a 1996 Parents' Choice Award winner, is collected here with bonus short stories. Realistic, skillfully drawn black-and-white art.

Oil and Water. Duin, Steve (text) & Shannon Wheeler (illus.).

In 2010, Duin (Comics: Between the Panels) and Wheeler (Too Much Coffee Man) joined a group of Oregonians touring the Deepwater Horizon oil spill sites, aiming to measure the disaster's impact, offer support to the locals, and tell a powerful story. Wheeler's atmospheric, ink-washed greys capture eccentric residents from crabbers to a pelican-rescue team, and Duin's script catches the ironic resiliency of people exploited

by the very industry that feeds them. However, not much background or reference information is provided. Valuable for high schoolers and adults as a glimpse into the crisis, and for general sensitization to environmental issues.

Neil Young's Greendale. Dysart, Josh (text) & Cliff Chiang (illus.)
Neil Young's 2003 album Greendale, which has been called a rock opera and an audio novel, explores the effects of crime, consumerism, and environmental damage on small-town California. In this adaptation of the album and related film, teenager Sun Green comes to discover her own unusual powers and those of other women in her family to confront mounting injustices. Adaptor Dysart, who describes his own political leanings as left of Lenin, pegs the theme as antiwar and pro-planet. Realistic, color art with a pastel-ish palette. For more on music-comics crossover, click here.

Cartoon Guide to the Environment. Gonick, Larry & Alice Outwater.
Using the ecological collapse of Easter Island as a case study, this guide works in the key concepts of green science: chemical cycles, life communities, food webs and agriculture, human population growth, sources of fuel and energy, waste recycling and disposal, urban centers, pollution and deforestation, ozone depletion, and global warming. Population dynamics, thermodynamics, and the behavior of complex systems are also discussed. Though published over 15 years ago and not up-to-date, for example, on the global warming debate, the guide remains useful since the principles of environmental science have not changed.

The Rime of the Modern Mariner. Hayes, Nick.
Hayes's modern mariner puts to sea to find whalebone from which to make dominoes, taking potshots at floating garbage to escape boredom. A bird overhead offers more challenging sport, so he shoots the albatross, as in the Coleridge poem. Now the floating detritus surging through the waves isn't just something to shoot at for kicks but a living nightmare showing him the consequences of excessive human consumption. Swirling, evocative black-and-white ink with teal wash, both beautiful and haunting. (Currently available from Jonathan Cape via Amazon.co.uk; U.S. release scheduled for the fall.)

Charles Darwin's On the Origin of Species: A Graphic Adaptation Keller, Michael (text) & Nicolle Rager Fuller (illus.).
Darwin foresaw that his complex work would upset millennia of theological tradition about the origin of life, and indeed, the creation vs. evolution wars continue today. This lovely and multi-textured graphic novel follows Origin's original chapters, combining snippets of Darwin's text with quotes from letters, illustrative examples from his time and from the present, and occasional invented dialog. In drawings of three saber-toothed cats, for example, we can observe the imperfection of the geological record when the full skeleton of only one animal is preserved in a bog and discovered later. An afterword from Keller brings the scholarship up-to-date, from Gregor Mendel's pea plants to E.O. Wilson's sociobiology.

Some New Kind of Slaughter or Lost in the Flood (and How We Found Home Again): Diluvian Myths from Around the World. Lewis, A. David (text) & mpMann (illus.).
This collection of stories based on flood myths from across history and culture is tied together by a frame-story, a dream experienced by King Ziusudra, a Sumerian equivalent of Noah. One of the stories is not a classic myth but slice-of-life fiction about a modern woman searching for her family after a tsunami-like disaster. The dreamy, evocative color art belies and yet supports the overall theme, both illustrating past human visions and prophesying future watery catastrophes. A grand eco-fable focused into an evolutionary cautionary tale for the future.

Nausicaä of the Valley of the Wind. Miyazaki, Hayao.
This complex, seven-volume saga of environmental catastrophe unfolds in a post-industrial world where humans fight for the few unpolluted resources and nature tries to heal itself. A young princess from a tiny kingdom, Nausicaä works to establish peace among warring nations while tuning in to the essence and purpose of the supposedly toxic fungal forest, the Sea of Corruption. The well-known and highly regarded series was originally serialized from 1982 to 1994, and the first two volumes formed the basis for Miyazaki's 1984 anime film.

Princess Mononoke. Miyazaki, Hayao.
When a boar demon attacks Ashitaka's village, the young prince is forced to kill it but is cursed in turn: now superhumanly strong, he will die soon. He goes west in search of help, eventually arriving in the industrial village of Iron Town. Led by the aggressive Lady Eboshi, the town is locked in a struggle with the local forest gods, who are championed by wild girl San, herself raised by the wolf goddess and known among villagers as Princess Mononoke. The battle kills some of the forest gods, yet Ashitaka is healed through helping resolve the crisis. It is understood, however, that civilization and nature can never be completely reconciled and harmonious coexistence may be cyclical at best. This five-volume film comic (animanga) is based on the classic Miyazaki film of the same name.

A.D.: New Orleans After the Deluge. Neufeld, Josh.

Hurricane Katrina devastated millions of lives, including the seven profiled in this dramatic and painful documentary: social worker Denise, young couple Leo and Michelle, convenience store owners Abbas and Darnell, high school student Kwame, and physician Brobson. Neufeld, who volunteered for the Red Cross in the weeks after the storm, originally published the story as a web comic. Strong language may limit access to adults in some libraries. See sample color-wash art here.

Green Lantern/Green Arrow Collection. O'Neil, Dennis (text) & Elliot S. Maggin (illus.).

In one of the flagship attempts of the comics industry to address social problems during the 1970s, Green Lantern (Hal Jordan) and Green Arrow (Oliver Queen) team up for a roadtrip to rediscover America and confront racism, drugs, and environmental threats. One story finds the pair rescuing a small company town from an industrial pollution disaster despite the hostility of its citizens. This collection reprints issues #83, 87 and 89 of the comic book series.

Bumbling Through Borneo. Schmidt, Tom.

Bumbling Bob, an architect at loose ends, embarks on an uncertain journey into the heart of Borneo with an international group of backpackers. River travel, virgin rainforest, runaway logging trucks, and underground caverns await the group as they learn about Borneo's natural world and looming environmental problems. This combination of introduction for tourists, lighthearted adventure story, and environmental primer is done in black-and-white art interspersed with text and take-away points. The Bumbling Traveller adventure series promotes environmental and cultural awareness through entertaining mysteries and adventures, with a second volume focusing on Sumatra. (Note: these are not actual up-to-date travel guides.)

Older Teens and Adults

Black Orchid Deluxe Edition. Gaiman, Neil (text) & Dave McKean (illus.).

After botanist Susan Linden-Thorne is murdered by her abusive husband, her nice-guy botanist boyfriend revives her as a plant/human hybrid with superpowers: Black Orchid. Now she seeks the truth about her origins while attempting to cope with a corrupt world of humans. Gaiman integrates all the DC super-horticulturals into the plot, giving cameo roles to Poison Ivy and Swamp Thing. The limited series came out originally in 1988 and has been collected before, but with its ecological message, the story could become more popular now. Scroll down here to preview McKean's striking, orchidy art.

100 Months. Cutting Edge. Hicklenton, John.

Prince Charles warned in 2009 that we only had 100 months to save the planet. In this brutally violent and richly drawn allegory of Armageddon, warrior earth goddess Mara goes all out for revenge against Longpig, a demonic personification of capitalism whose followers look suspiciously like normal humans. The disturbingly beautiful art is reminiscent of Ralph Steadman and Peter Kuper. Hicklenton (1967, 2010) was a British artist well known for his work on 2000 AD and Judge Dredd.

As the World Burns: 50 Simple Things You Can Do To Stay in Denial. Jensen, Derrick (text) & Stephanie McMillan (illus.).

Using an upcoming alien invasion as a frame story, this simply drawn satirical comic pushes the message that damage to the environment caused by corporate and government policies far eclipses damage from consumer lifestyle choices. Thus, even if people switched to low-energy appliances and went vegan, the earth would still be on a downhill course. While Jensen (A Language Older Than Words; Endgame) and McMillan (Minimum Security) do not propose any remedies, their message may inspire readers to move beyond simplistic green movement solutions and work to influence business and civic leaders. Black-and-white line art; sample here.

Saga of the Swamp Thing. Moore, Alan (text) & Stephen Bissette & John Totleben (illus.).

Moore took over what was basically a standard man-turns-into-swamp-monster horror series and turned it into a frank commentary on environmental, political, and social issues, now considered a classic for both story and art. In Moore's version, instead of a monster that was once the scientist Alec Holland, Swamp Thing is an elemental plant entity that somehow absorbed the scientist's memory and personality. Heroic, powerful, and tragic, the creature uses the forces of nature and the wisdom of the plant kingdom to protect his swamp home and the wider natural world from threats and dangers. These two volumes reprint Moore's run on the series.

Climate Changed. Squarzoni, Phillippe

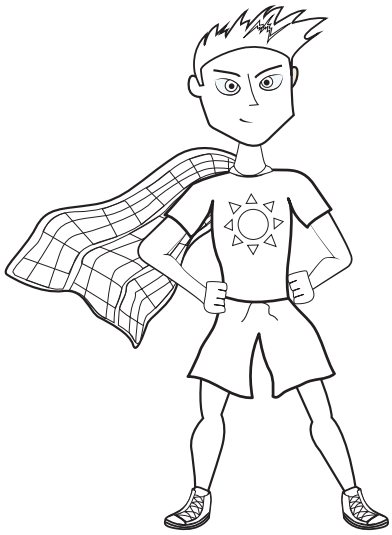
Climate Changed details Squarzoni's quest to educate himself on the basics of climate change. As meticulously researched as it is illustrated, the graphic novel is a crash course on the science, explaining everything from how the emissions in our atmosphere contribute to warming to the benefits and pitfalls of our renewable energy options. The book is also really long, weighing in at 467 pages (not including bibliography, sources, and an index), and its focus on the science makes it read at times like a beautifully illustrated textbook.

Appendix

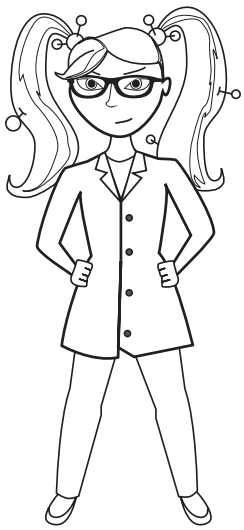
D

Coloring Pages

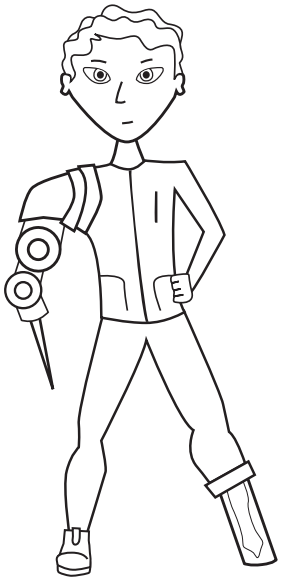
THE EmPOWERS



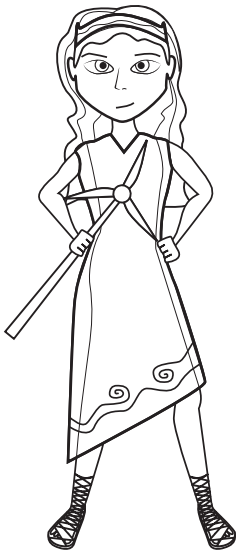
Solar Flair



Dr. Fission



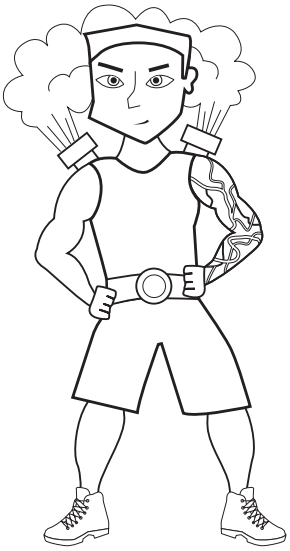
Methaniel



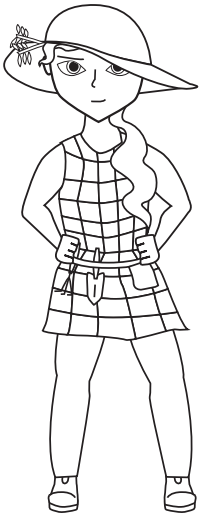
Zephyra

Aqua Marine

Cole

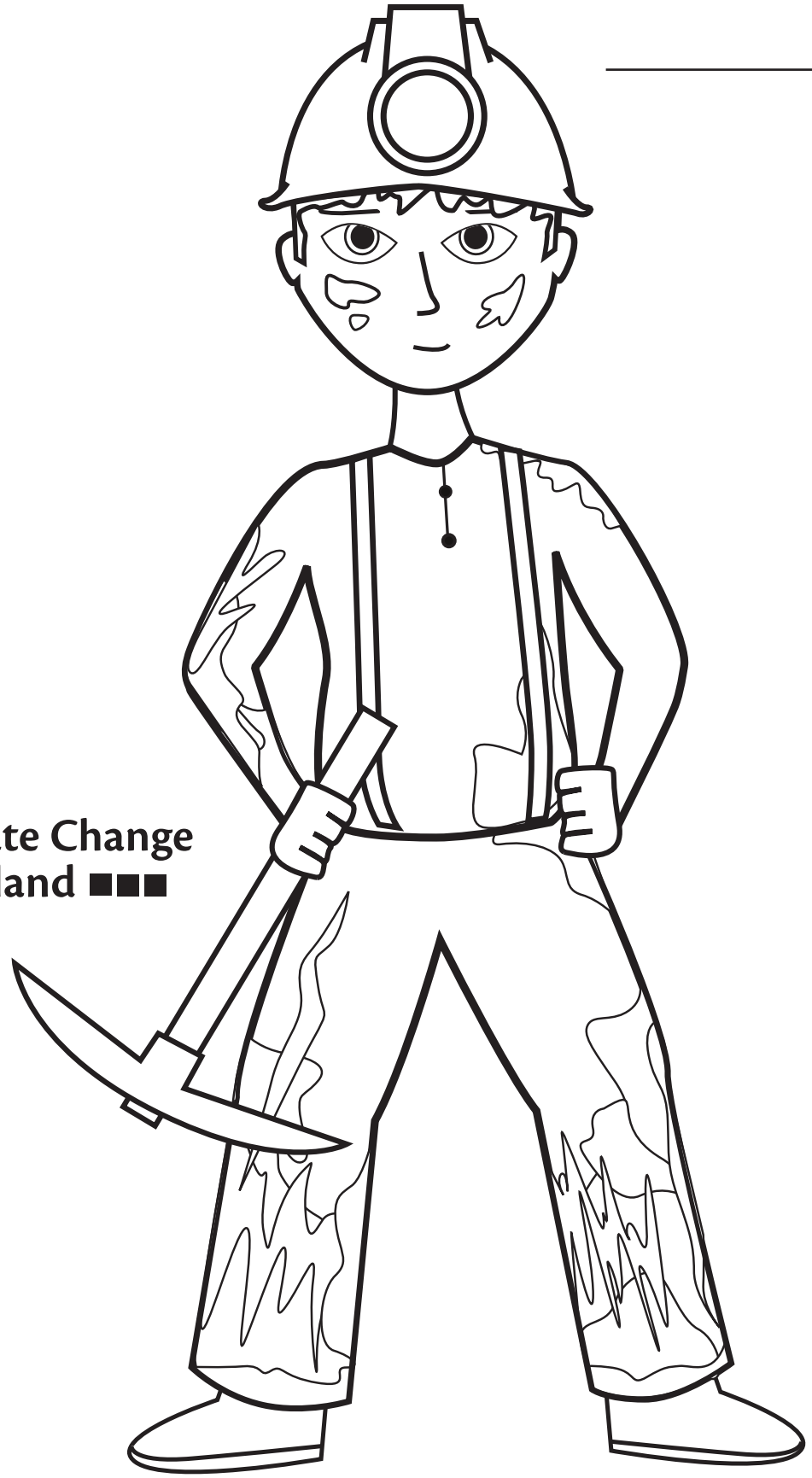


Vesuvias



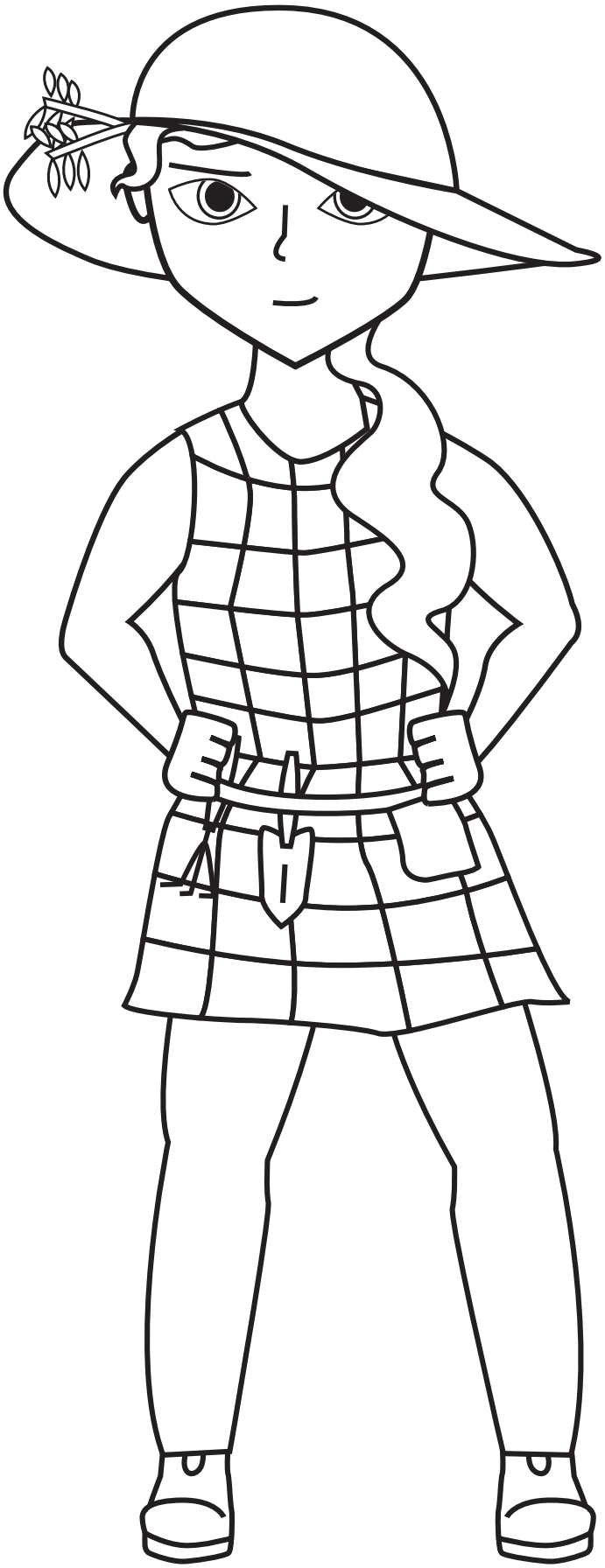
Plantasia

Cole



Climate Change
Maryland ■■■

Plantasia



Climate Change
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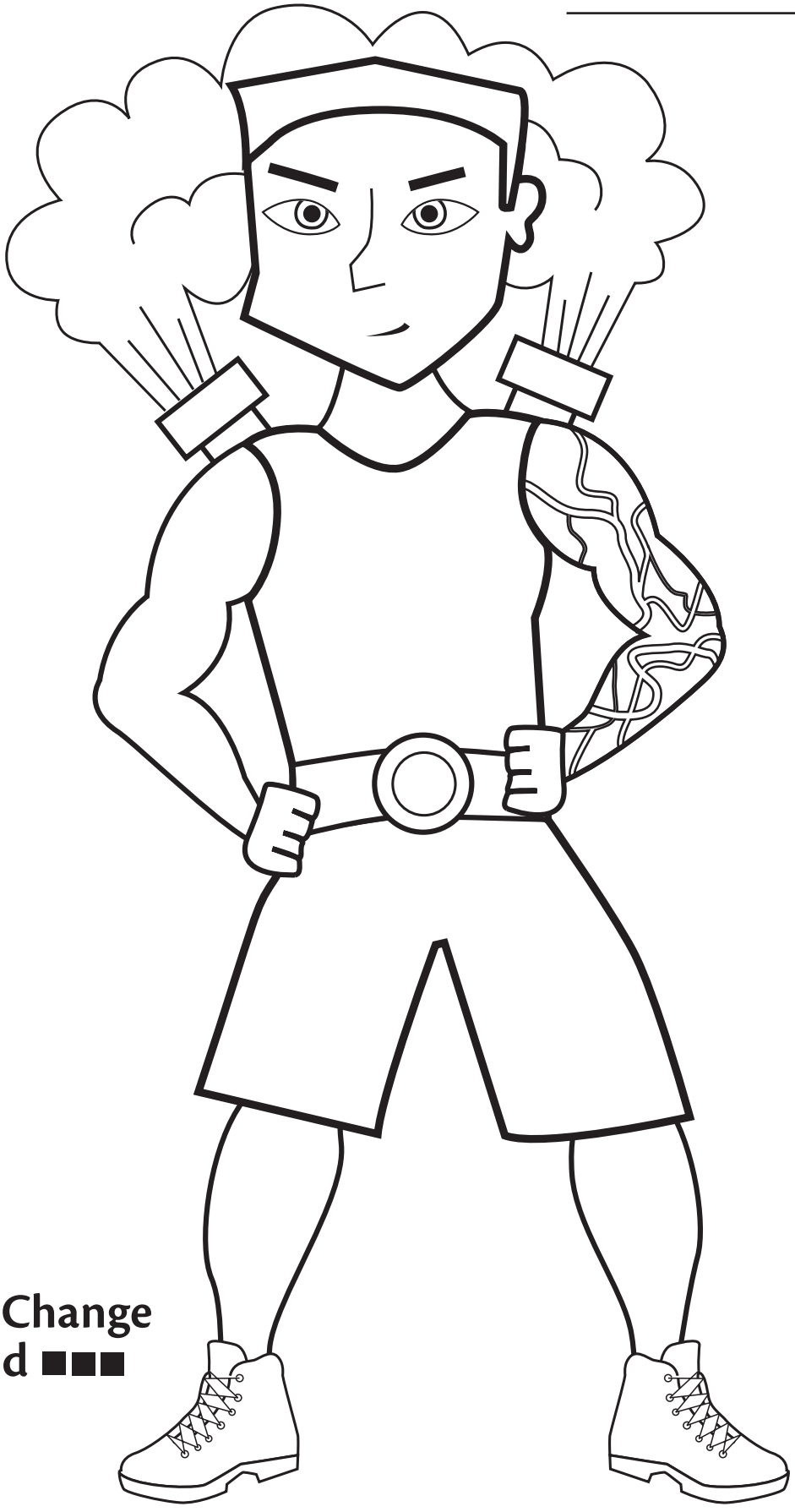
Vesuvias



Climate Change
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Aqua Marine

Climate Change
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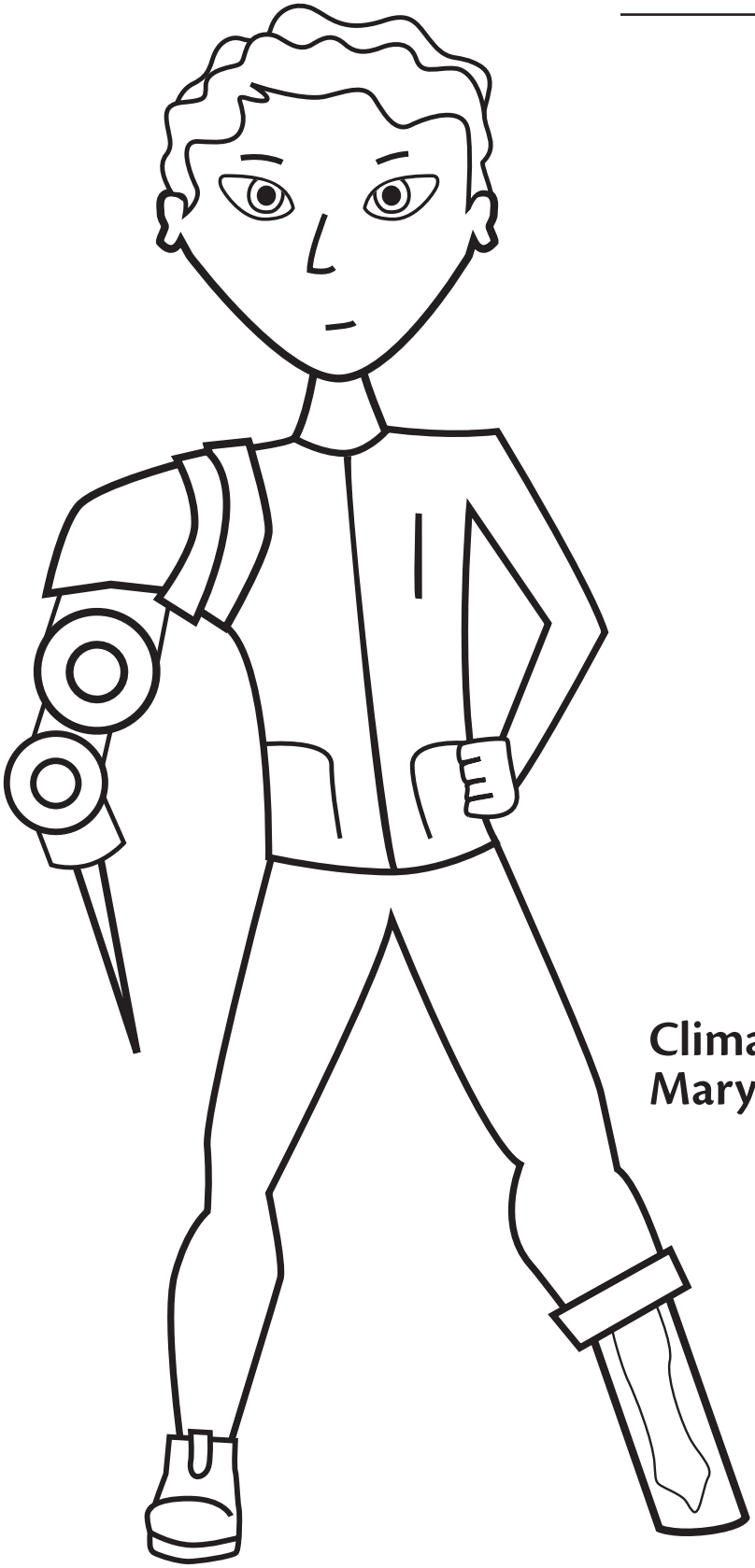
Methaniel



Climate Change
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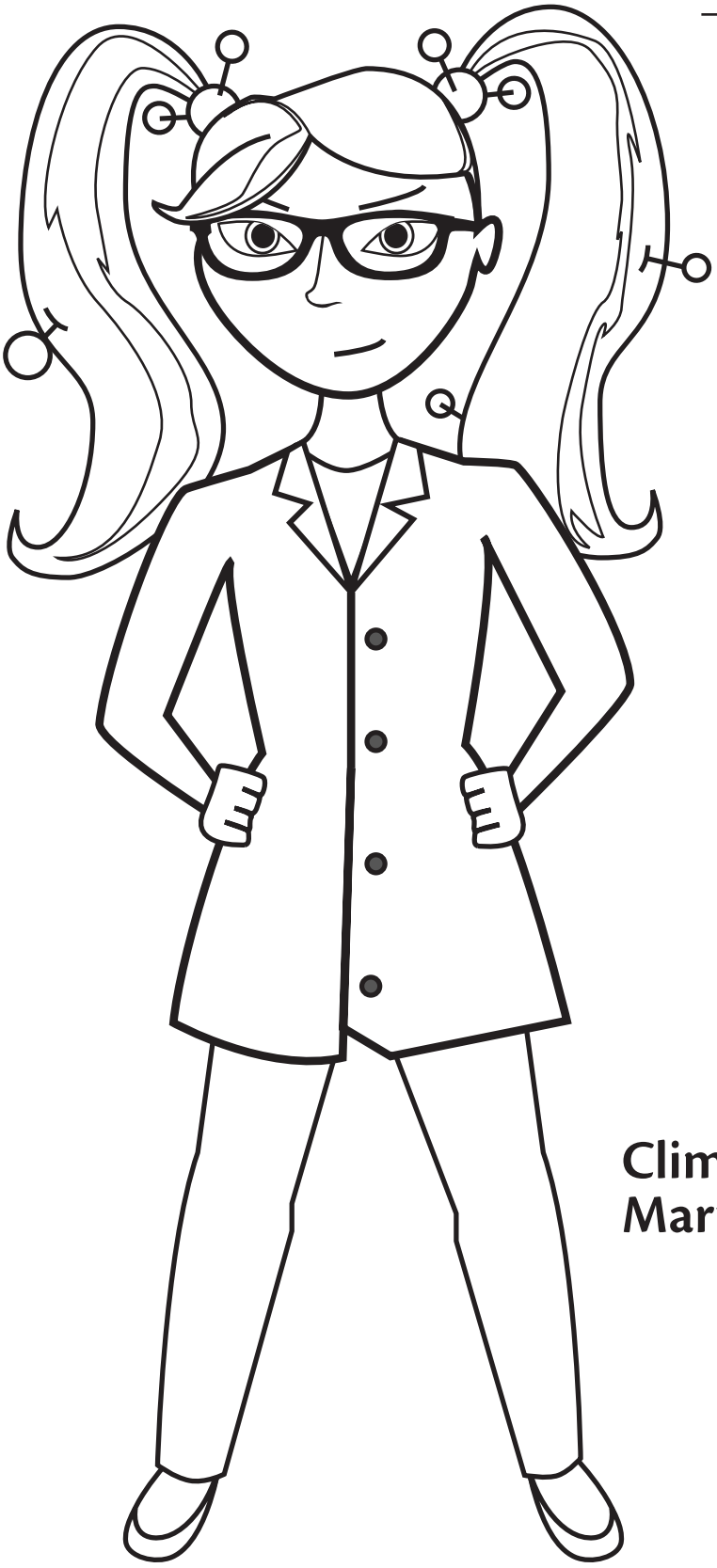
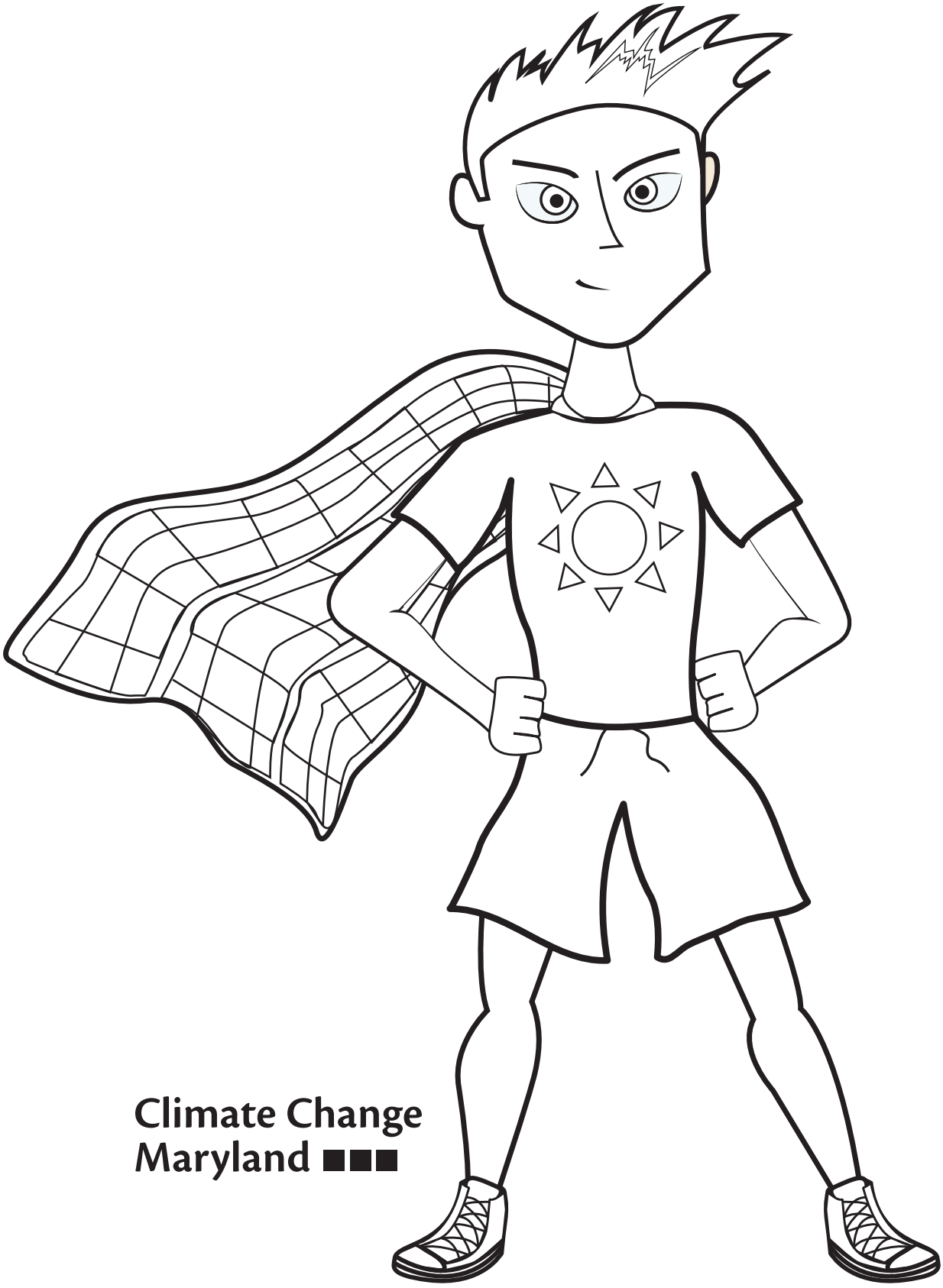
Dr. Fission



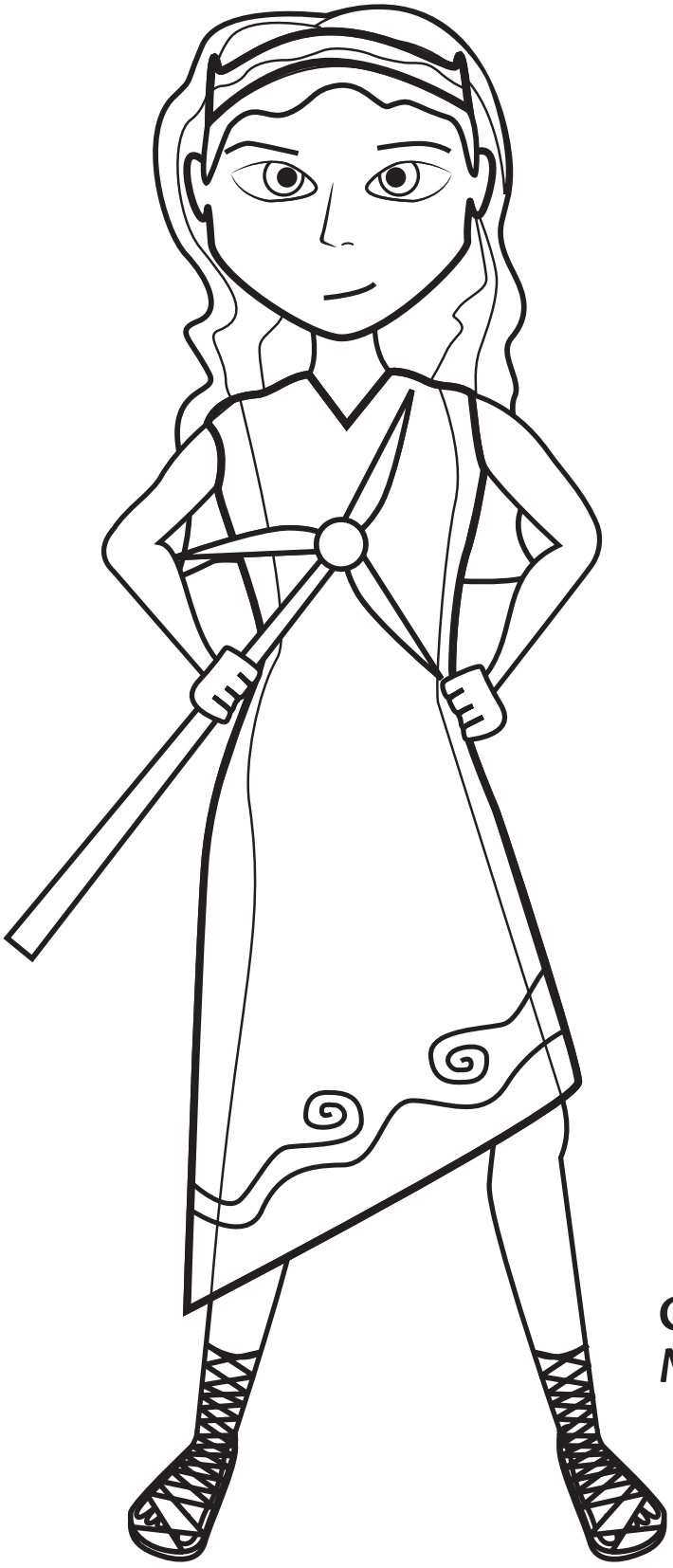
Climate Change
Maryland ■■■

Solar Flair



Climate Change
Maryland ■■■

Zephyra



Climate Change
Maryland ■■■

Climate Change
Maryland

For more information or to schedule an *EmPOWERS* visit, contact:

climate.change@maryland.gov
(410) 537-4080

Climate Change Maryland, a project of the University of Maryland Center for Environmental Science funded by the Town Creek Foundation is grateful to The National Energy Education Development (NEED) Project for permission to reproduce and include many NEED classroom resources in ***THE EmPOWERS*** Activity Kit. To learn more about NEED and to access their curriculum portfolio, visit www.need.org

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