



THE WORLD AROUND US

Experiments and Activities
Investigating Our Environment



OKLAHOMA
Environmental
Quality



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THE EARTH IS A HUGE COLLECTION OF ECOSYSTEMS!

An ecosystem is any place on earth where plants, animals, air, water, and land balance and support each other.

In ecosystems all over the earth, plants and animals depend on each other to live. Read below to see how plants and animals need each other.

- ★ As green plants grow, they add oxygen to the air.
- ★ Animals must breathe oxygen to stay alive and hunt for food.
- ★ All animals create waste in the form of digested food and carbon dioxide (a gas that comes out of animals when they breathe).
- ★ Worms and insects feed on animal waste and rotted plants and help make the soil rich for growing plants.
- ★ Plants need carbon dioxide and good soil in order to grow.



EVERYTHING IS CONNECTED IN ONE WAY OR ANOTHER!

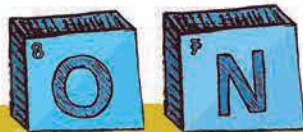
As you read and work through the projects and experiments in this booklet, you will see how ecosystems go through a continuous cycle of use and reuse.

AIR, AIR, EVERYWHERE!

All the air surrounding the earth is called the atmosphere. The need for air is basic to life – but often taken for granted.

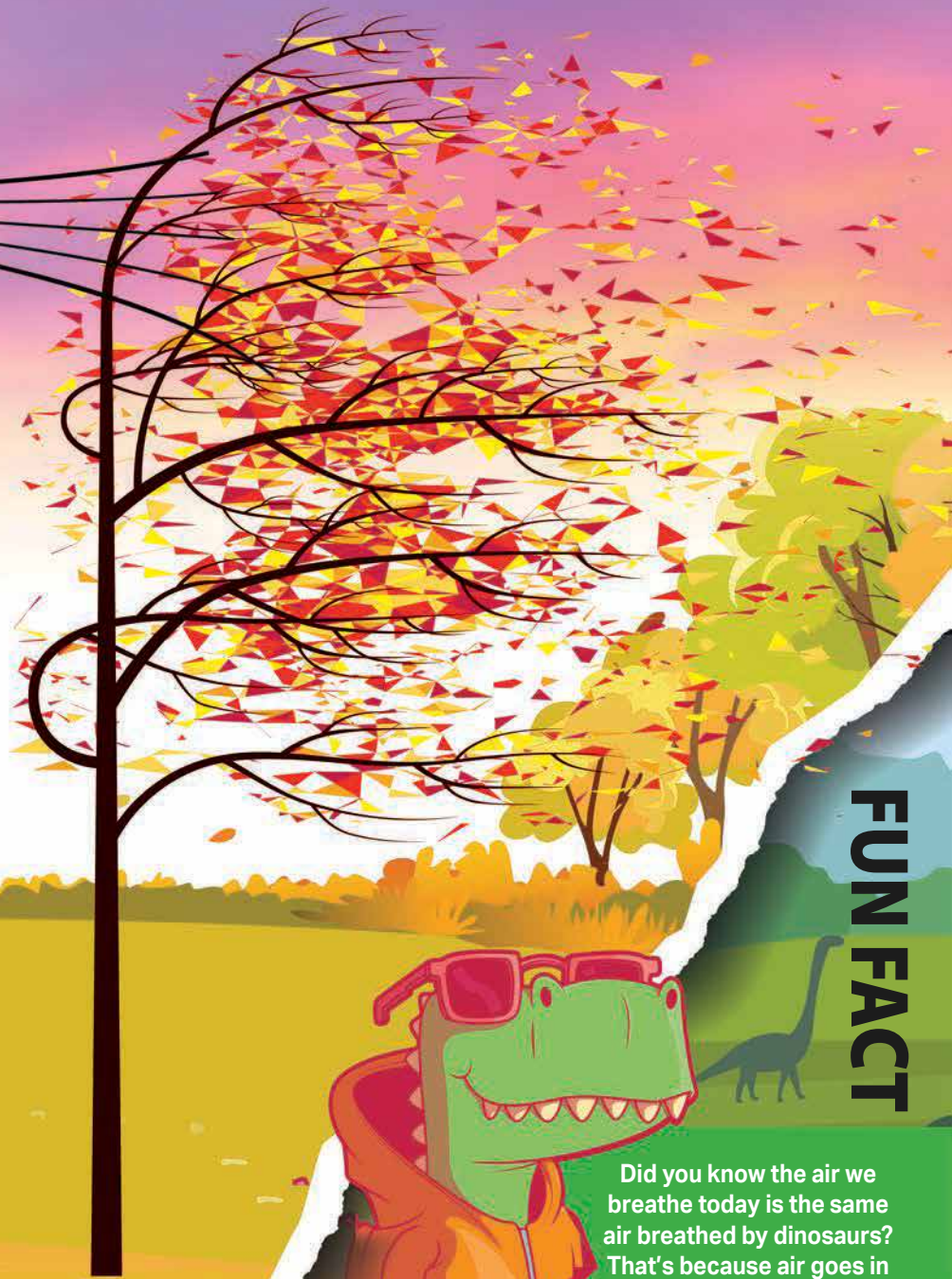
WHAT EXACTLY IS AIR?

Air is a mixture of chemicals (mostly oxygen and nitrogen).



Unfortunately, humans have added some pretty nasty stuff to the air! The chemicals in the air that are harmful to human health and other living things are called

AIR POLLUTION.



Did you know the air we breathe today is the same air breathed by dinosaurs? That's because air goes in and out of animals and plants year after year, century after century.

WHAT ARE SOURCES OF AIR POLLUTION?



Fill in the blanks below with the letters A, I, or R to learn where air pollution comes from.

F _ C T O _ Y F U M E S

C _ R E X H _ U S T



D U S T _ N D D I _ T



S M O K E F _ O M F _ _ E S



Let's continue to see what else affects the air and environment.

SMOG!

Smog makes the sky look gray or brown and doesn't smell very good. It can cause your eyes to burn and make it difficult to breathe, especially for people with asthma or other respiratory problems.

WHAT IS SMOG?

Smog is a mixture of particles from smoke and fog. Originally, smog got its name in London from the heavy haze created when smoke from burning coal mixed with misty fog in the air. The smog left a sooty film over everything.

Today, one big contributor to smog is smoke from wildfires. Smog is also caused by sunlight reacting with chemicals emitted from cars, factories, and power plants burning fossil fuels. These chemical reactions form tiny airborne particles and ground-level ozone, which together can make up what we call smog.

Smog is a common sight in big cities, mainly because of the amount of traffic on the roads and the industries that support the surrounding area. Laws have been passed to reduce the amount of smog, but it can still be a big problem.





The image above shows Shanghai, China when the air is clear (right) and when the air is full of smog (left).

HOW CAN WE HELP?

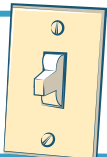







There are many ways to clean up the air. Everybody can help, including you!

Put an X in the "Kids" column next to kid-friendly activities.

Put an X in the "Adults" column next to activities that are done by adults.

Note that both kids and adults may do some activities.

WAYS TO PREVENT AIR POLLUTION		KIDS	ADULTS
	Turn off lights, computers, and other electronics when you aren't using them. To make electricity, power plants burn fuel, which creates air pollution. You can help by using less electricity.		
	Fuel up vehicles during cooler times of the day, like mornings and evenings. This helps prevent gas fumes from heating up in the sun and forming ozone.		
	Ride your bike or walk instead of using a car. (Kids, make sure you have an adult's permission first!)		
	Use low-VOC paints. Ask your local hardware store for options. (Volatile Organic Compounds, VOCs, are gasses emitted from certain solids or liquids, like paint and fuel for the car.)		
	Avoid gas-powered lawn equipment, like gasoline mowers and edgers. If possible, use electric versions.		
	Take care of the car. Properly inflated tires and regular oil changes reduce emissions.		
	Ride the bus or carpool when you can. Vehicles are a major source of air pollution. When people take the bus or carpool, it lowers the number of vehicles on the road. (Kids, make sure you have an adult's permission first!)		
	Drive less by completing several errands together rather than doing them separately on different days.		
	Skip the drive-thru line and go inside when you visit the bank or fast-food restaurants. This will reduce the amount of exhaust going into the air and save on gas.		
	Be sure your campfire is completely extinguished (put out) before leaving the area to prevent forest fires. (Kids, ask an adult for help with this one)		

BONUS ACTIVITY



Share the tips in the table above with the adults in your life. Let's work together to clean up the air!

LET'S MAKE SMOG

In this experiment, you will see how pollution in the air combines with fog, creating brown or gray air called smog.



CAUTION!

Adult Supervision is Required!

What you will need:

- Glass jar
- Foil
- Lighter or match
- Paper
- Ice cubes (2-3)
- **ADULT SUPERVISION**

Instructions:

1. Get a piece of paper and cut a 10 inch long by 1/2 inch wide strip. Fold the strip in half to make a 5 inch by 1/2 inch strip and then twist it around. Make sure it's not too tight but not too loose either.



2. Take the foil and measure a square that is big enough to fit over the top of the jar like a lid. It should come down the sides about 1/2 inch so that you can get a good seal.
3. Take the jar to the sink and put enough water in the bottom that when you swirl it around the sides of the jar get wet. Dump the water out. Gently shake the jar so there aren't any large drops or puddles on the bottom.
4. Put the foil over the top of the jar. Place the ice cubes on top of the foil. Let this sit for about 30 seconds so that the air inside the jar will cool down.
5. **Here's where the ADULT comes in.** Have the adult use a match or lighter to light the end of the twisted piece of paper so that it's on fire.
6. Once the paper is lit, remove the foil lid and have the **adult** drop the paper inside the jar. Be careful to not drop the ice cubes.
7. Quickly put the lid back on the jar with the ice cubes on top.

Observe:

You should begin to see the smoke and fog condensing inside the jar. This happens because the heat and smoke from the paper makes some of the water in the jar evaporate and turn into water vapor. The warm damp air meets up with the cold air underneath the ice cubes and creates a mist. Tiny water droplets from this mist accumulate and, since there is no air moving in the jar, it appears as fog.

Discussion:

Why is smog a problem? _____

Based on what you have read so far, what is one way that you can help stop smog from forming? _____

The air gives us oxygen to breathe, but it also contains substances called pollutants. Air pollutants are the compounds and chemicals that can harm human health and the environment. Man-made sources such as exhaust from vehicles, planes, and trains, as well as smoke from factories, emit a lot of pollutants into the air. Natural sources include volcanoes, lightning, forest fire smoke, and even decomposing plant and organic material. Chemicals like sulfur, nitrogen, and hydrocarbons from these different sources mix with water in the atmosphere and can come back down to Earth when it rains. This combination of rain and chemicals is called acid rain. To see how this might happen, try the following experiment.

RAINBOW RAIN EXPERIMENT

CAUTION!



Ask an adult for permission before beginning this activity. Besides, they may want to join in the fun!

Be careful with the food coloring. It will stain whatever it gets on. Keep it in its container, and put some type of parchment paper, newspaper, or towels under your project to keep your area clean.

What you will need:

- 2/3 Cup of vegetable oil (150mL)
- Liquid food coloring
- Drinking glass
- Large glass container or jar
- 3 Cups of very cold water (700 mL)
- Wooden stick
- Parchment paper, newspaper, or towels

Instructions:

Cover the surface of your work area with parchment paper, newspaper, or towels.

Pour the vegetable oil into a drinking glass.

Add several drops of the food coloring (dye).

Stir vigorously (really fast), with a wooden stick.

Put the cold water in the large glass container.

Then, slowly pour the oil and dye mixture into the larger glass container of water.

Give it some time; it may take a few minutes for the colored "rain" droplets to fall out of the oil and into the water. The oil will have to separate and go to the top of the water.

Observe:

What happened when you poured the oil mixture into the water?

The colored droplets that you created represent acid rain. When acid rain falls into soil and bodies of water, it can damage trees, plants, fish, and other wildlife.

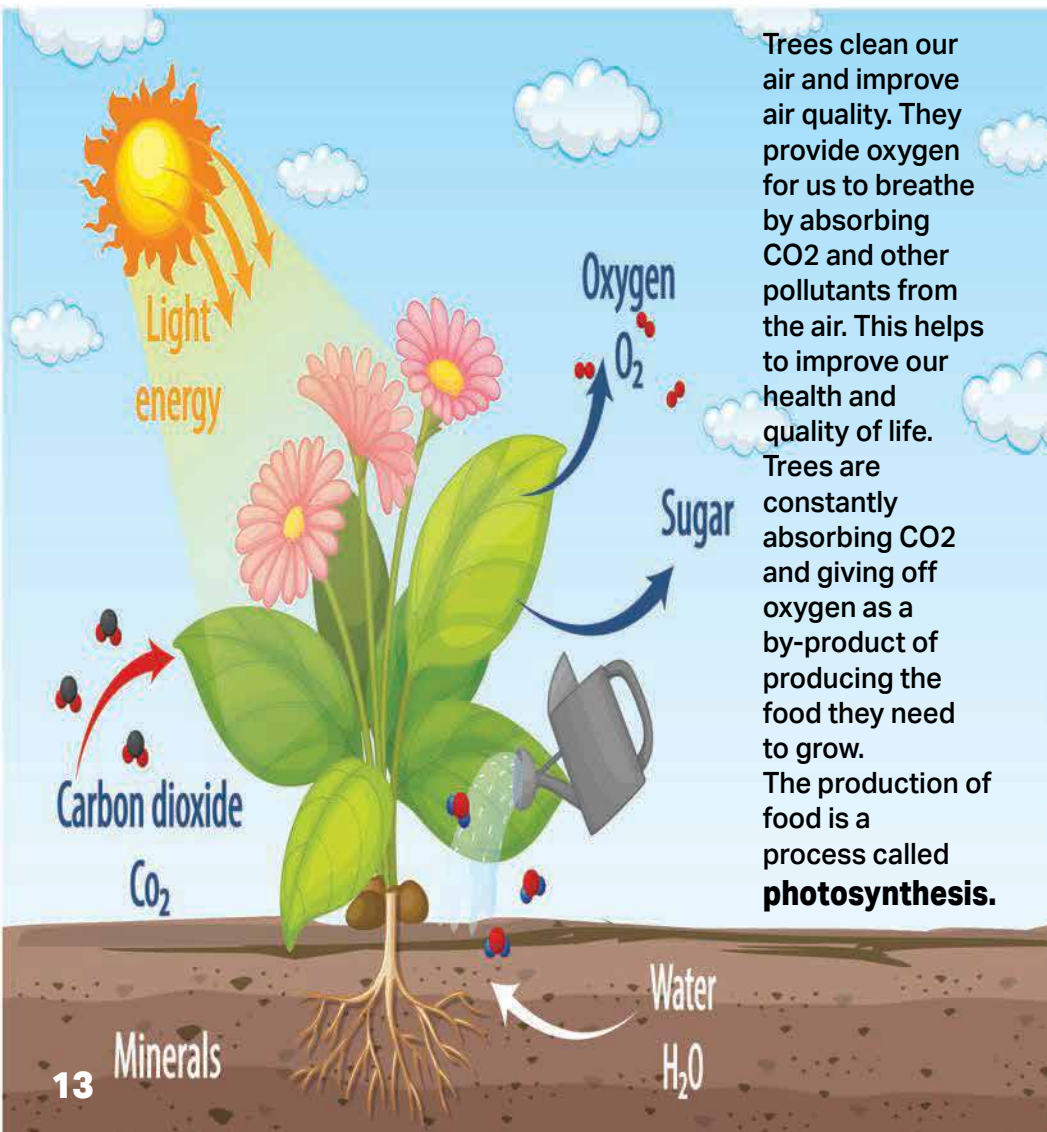


Trees keep us cool by providing shade. They also produce great things to eat (like apples!) and turn amazing colors in the fall.



Trees are one of nature's biggest air filters. This is because they absorb harmful pollutants and release clean oxygen.

PHOTOSYNTHESIS



Trees clean our air and improve air quality. They provide oxygen for us to breathe by absorbing CO₂ and other pollutants from the air. This helps to improve our health and quality of life. Trees are constantly absorbing CO₂ and giving off oxygen as a by-product of producing the food they need to grow. The production of food is a process called **photosynthesis**.



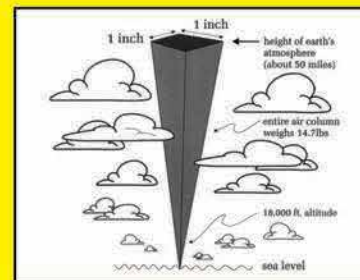
Leaves contain chlorophyll (the green coloring) which uses sunlight to break down carbon dioxide and water into sugars called glucose. Oxygen is released during this process.

Trees absorb and break down most of the major air pollutants, including ground-level ozone, sulfur dioxide, nitrogen dioxide, and carbon monoxide. The pollutants get into the trees when they are pulling in carbon dioxide. As the trees pull in CO₂, they are also pulling in pollutants and removing them from the air. Other pollutants are collected on the leaves and in the bark, where chemical reactions can convert them into non-harmful compounds. This amazing process means that large forests are like giant air purifiers cleaning our air and promoting health not just for us, but for all life on earth.

Tropical rainforests are some of the largest forests on the planet, and they create a great deal of the oxygen found in the atmosphere. Unfortunately, they are also the most endangered due to deforestation (cutting down the trees).

Trees and other vegetation slow down dust from storms, which is another reason plants are so important.

These are just a few of the reasons to plant trees around your home or in your community. Remember, trees are the air-cleaners that create the oxygen we need.



Did you know that air has weight? You don't notice it, but every square inch of your body has about 15 pounds of air weighing down on it.

During one year, 100 trees can remove 53 tons of carbon dioxide (CO₂) and 430 pounds of other pollutants from the air. That's more than the weight of 3 school buses!

FUN FACT



PLANTS:

THE INDOOR AIR PURIFIERS

Indoor plants are great at helping to lift our moods, which makes us feel better and improves our concentration. Indoor plants may even help clean the air like their much larger, outdoor relatives, the trees. They absorb carbon dioxide and other toxic gases from the air and release oxygen. This is accomplished by the process of photosynthesis. While it has not been completely proven that plants help eliminate harmful toxins, it has been shown that the presence of plants can help reduce the amounts of toxins in the air, particularly VOCs (Volatile Organic Compounds).

RAINFOREST IN A BOTTLE

To demonstrate how easy growing plants can be, the following project will help you get started on your plant discovery (and help make cleaner air in your room or somewhere else in your home). We will create terrariums to demonstrate the differences in plant types. You may choose to use either tropical plants and create a miniature rainforest, or you may want to use succulents, which are more of a desert type of plant.

This is a quick and easy terrarium to get you started. Some of the materials you will need may be in your home already, while others will need to be purchased at the store, with the permission of an adult.



Before you get started...

- Be careful if you have pets. Some plants make animals sick if they eat them!
- Be careful if you are using cactus plants. They can have sharp spines.

Here are some tropical plants that are safe for your pets:

- Spider Plant
- Areca Palm – also known as the Butterfly Palm
- Boston Ferns
- Mosaic Plant



FERN

SEDUM



These are just a few of the plants that won't harm your pet, but, like anything else, it is always good to do your research first, and ask an adult.

Here are some succulent plants you can use instead of tropical plants:

- Prickly Pear Cactus
- Zebra plants
- Hen and chicks
- Burro's tail
- Lithops, which are also known as living stones.



BURRO'S TAIL

Succulents won't require as much water as tropical plants because they store water in their leaves and stems. Succulents are great for demonstrating a drier, more desert-type of environment instead of a tropical forest. Another interesting thing about some of these plants is that they release oxygen at night instead of during the day.

Tip: Check out examples of terrariums on YouTube for inspiration and ideas.

What you will need:

- One 2-Liter plastic bottle (These are good to use because you are also recycling or repurposing the plastic, which is always good for the air and environment.)

-OR-

- One glass jar (Instead of throwing away the empty jelly jar, you can use it for your plants. Even small, empty spice jars can be used to create your mini environment)
- Small gravel or rocks – this can come from the yard
Activated charcoal – small amount
- Spanish moss – (This can be found near the potting soil at home improvement stores or a greenhouse.)
- Soil – maybe some left over potting soil
- 3 - 4 Small tropical plants, like ferns and palms (not too big as you will need to leave some room for the plants to grow)

-OR- Succulents

- Spray bottle filled with water
- Sharpie
- Scissors
- (Optional) Toy animals

*Some of these items
can be found outside in
the yard or garage.*

Instructions:

1. (Skip this step if you are using a glass jar). With **adult supervision**, use the sharpie to draw a line around the plastic bottle, about 4 – 6 inches from the bottom.
2. (Skip this step if you are using a glass jar). Use the scissors to cut the bottle off at the line you marked but be careful not to cut yourself. **Keep the top part** because this will be the lid. The lid will help keep the moisture inside the terrarium and create that tropical feeling.

3. Add rocks to the bottom of the plastic bottle or glass jar. The layer of rocks should be about an inch high to form a good base. The rocks will also help with drainage.
4. Next, place a small amount of the activated charcoal on top of the rocks (not too much, just a little sprinkle). This is important to help minimize the smell as plants begin to grow and the soil and organic material begins to break down. It will also help to purify the water used on the plants.
5. Add the Spanish moss. This will keep the soil from falling inside the rocks.
6. Now add the soil. Leave about half an inch of empty space below where the bottle was cut.
7. Start adding in the plants. Put more of the moss on top when finished planting.
8. (Optional) Add toy animals to the terrarium.
9. Using the spray bottle, lightly spray the plants with water (If you made a succulent terrarium, watch for water vapor build up, because this is a great indicator that you are using too much water).
10. If using a plastic bottle, place the top of the bottle over the bottom to cover the plants. If using a glass jar, cover the jar with its lid.
11. Place your terrarium in a sunny spot next to a window.



Observe:

Eventually, you will begin to see moisture build up on the side of the bottle. This occurs because the heat from the sun evaporates the water. The water vapor in the air will form small droplets of water. When the air cools down, these droplets "rain" down the side of the bottle. This whole process is called the water cycle. If it is raining inside the bottle, wait a few days to water. (Evaporating is when liquid changes to a gas; in this case, it changes into water vapor.)

The most important parts of this activity are to have fun, explore your yard, and learn more about the air cleaning benefits of plants and plant material. You could even put a toy animal or something else fun inside of the terrarium to represent the rainforest or desert environment. **HAVE FUN** with this!

THE WATER CYCLE

Much like air, water does not stay in one place. It rises from the earth to the sky and falls back again in a never-ending cycle. Here's how it works:



- 💧 Heat from the sun causes water in lakes, streams, and the ocean to evaporate (become a vapor that rises into the atmosphere).
- 💧 Clouds fill with the evaporated water.
- 💧 When the clouds get heavy with evaporated water, rain falls from the clouds back to the earth.
- 💧 Rainwater filters through the ground and flows back into lakes, streams, and oceans.
- 💧 The whole cycle repeats over and over again.

Let's see the water cycle at work!

19 This activity will help you see how water keeps moving in the water cycle.

What you will need:

- Large glass mixing bowl
- String
- Coffee cup
- Pitcher of water
- Plastic wrap (like Saran Wrap)

Instructions:

Place the glass mixing bowl outdoors in the sun or in a very sunny window.

Fill the bowl about $\frac{1}{4}$ full, using water from the pitcher.

Carefully place the coffee mug in the center of the bowl.
Make sure no water gets into it!

Place the plastic wrap over the top of the bowl.
Tie the string around the plastic wrap, so it seals tightly.

Sit down and watch or come back in 20 minutes and see what nature has done!

Discussion:

Think about what this experiment represents.

What happened to the water in the bowl? _____

Did some of the water end up in the coffee mug? Why? _____

What role did the sun play in the experiment? _____

This experiment illustrates the earth's water cycle. The sun's heat causes evaporation. Moisture collects on the plastic cover, showing how clouds fill with rainwater. Water in the mug illustrates how rain falls back to earth.

RESPECTING OUR NATURAL RESOURCES

Unscramble the highlighted words in each sentence below to learn about some natural resources.

Most animals would die within minutes without good **RAI** to breathe.

We depend on fresh **AWRET** to cook, clean, and drink. _____

FLOSSI fuels such as coal, oil, and natural gas help heat our homes and run our factories. _____

A farm without good **OSIL** will not produce many crops. _____

We use **ULRMEB** from forests to build our homes. _____



THE THREAT OF HAZARDOUS WASTE

Pollution harms ecosystems and natural resources worldwide. Hazardous waste is a contributor to pollution in air and water.

WHAT IS HAZARDOUS WASTE?

Hazardous waste is leftover material that can harm people and animals. When factories make things like oil or pesticides, they may create hazardous waste as well. This waste has to be disposed of carefully to protect our surroundings. In the environment, hazardous waste causes a very dangerous kind of pollution that can affect the air, land, and water.



An **oil slick** is a layer of oil that forms over water when oil is spilled nearby. Let's see what happens when an oil spill creates an oil slick.

What you will need:

Vegetable oil (You will use the oil for three separate phases of the experiment)

Paprika

Cup

Spoon

Bowl of water (large sized, if you have a square glass dish that is not too deep, it will work well for the experiment)

Large flat sided stick or something similar
(A popsicle stick works well)

Cotton balls

Dishwashing detergent (like Dawn)

Marbles or rocks

Feathers

Plastic toy animal

Small pieces of paper

Optional: blue food coloring can be added to make it look like the ocean. It may also help, along with the paprika, to see the difference between the water and the oil.



Instructions:

Put a few spoonfuls of vegetable oil into the cup. (You will need a few spoonfuls of oil for steps 6 and 7.)

Add some paprika into the cup to color the oil.

Pour the oil into the bowl of water --- this creates the oil spill. (Optional blue food coloring should be added to the water before adding the oil/paprika mixture)

Drop the marbles or rocks, feathers, a plastic toy animal, and pieces of paper into the bowl. After a few seconds, take them out again.

What happened to the items pulled out of the oil slick?

Now try to clean up the oil by skimming it off the water with the flat sided stick. What happened?

Add more oil to the bowl. Try cleaning it up by placing the cotton balls inside the bowl, at the edge of the water. What happened here? Add oil to the bowl again, put in a spoonful of dishwashing detergent. How did the detergent affect the oil?

Discussion:

This experiment illustrates how easily solid objects (the feathers, paper, etc.) can become covered with oil. This is how a real oil spill damages animals and other things in the environment.

The experiment also shows some techniques for cleaning up an oil spill. These methods are used on a much larger scale when a real spill happens.

FUN FACT

Dish soap is used to clean water birds and animals that get caught in oil spills.



NATURE'S AERATORS



Let's not forget the importance of soil and the creatures that live there.

Aerators create small holes in the soil to allow air to flow through it. Worms have a particularly important job! They are aerators, which means they create space for air, and they add nutrients to the soil. This activity will show the significant role that worms play in the animal/plant connection.



Before you get started...

- Ask an adult for permission before beginning this activity. Besides, they may want to join in the fun!

What you will need:

What you will need:

- 1 Glass jar (at least 10 inches deep) with a lid
- Black paper large enough to wrap around the outside of the jar
- Tape
- Spray bottle filled with water
- Sand
- Potting soil or Garden soil
- Decaying leaves and lettuce
- About 3-4 earthworms from the yard



Instructions:

Fill the jar with alternating layers of sand and soil. Leave 2 inches of empty space at the top, but do not pack the soil down. The worms need to be able to burrow into the soil.

Use the spray bottle to lightly moisten the soil.

Dig up 3-4 worms in the yard (ask an adult first) or buy some at a fish bait store.

Place the worms on the soil.

Add the leaves and lettuce on top of the worms.

Tape the black paper around the jar.

Punch a few holes in the lid.

Put the lid on loosely.

Place the jar in a cool dark place.

Lightly moisten the soil every day. Add more leaves and lettuce as needed. Otherwise leave the jar alone.

After 5 days, unwrap the jar and note what the worms have done.



Discussion:

What did the worms do with the leaves and lettuce? _____

What did the worms do to the soil? _____

In what ways could the worms' activities benefit plant growth? _____

In this experiment, the worms ate the plant matter (leaves and lettuce) and added nutrients to the soil in the form of digested foods. The worms' tunnels also kept the soil loose, which helps plants grow.



CONCLUSIONS

As you can see, everything presented in these pages is interconnected. If something happens to pollute the air that means water can become polluted when it rains. If the water becomes polluted, it can then have an effect on the soil. One system feeds into the other, and the other system feeds into another. This illustrates how everything and everyone in an ecosystem can have a positive or a negative impact on the environment around them.

BUT WAIT...THERE'S MORE!

The following websites have even more fun activities to try. There are word searches, crossword puzzles, and more information about the world around us. Please take a few minutes to check them out.

Templates for carving and decorating pumpkins:

<https://climatekids.nasa.gov/pumpkins/>

This one has lots of fun activities and more information about the atmosphere. There is even a link to the satellites used in space to monitor the earth!

NASA Climate Kids activities: <https://climatekids.nasa.gov/>

EPA activities about climate change for all ages:

<https://archive.epa.gov/climatechange/kids/index.html>

Home of the Air Quality Index: <https://www.airnow.gov/>

National Institute of Environmental Health Sciences:

<https://kids.niehs.nih.gov/games/index.htm>

This one has lots of games for grades 1-4.

ANSWER KEYS

WHAT ARE THE SOURCES OF AIR POLLUTION?

FACTORY FUMES

CAR EXHAUST

DUST AND DIRT

SMOKE FROM FIRES

HOW CAN WE HELP?

Answers may vary. An example is shown below.

Ways to Prevent Air Pollution	KIDS	ADULTS
Turn off lights, computers, and other electronics when you aren't using them. To make electricity, power plants burn fuel, which creates air pollution. You can help by using less electricity.	X	X
Fuel up vehicles during cooler times of the day, like mornings and evenings. This helps prevent gas fumes from heating up in the sun and releasing VOCs.		X
Ride your bike or walk instead of using a car. (Kids, make sure you have an adult's permission first!)	X	X
Use low-VOC paints. Ask your local hardware store for options.		X
Avoid gas-powered lawn equipment, like gasoline mowers and edgers. If possible, use electric versions.		X
Take care of the car. Properly inflated tires and regular oil changes reduce emissions.		X
Ride the bus or carpool when you can. Vehicles are a major source of air pollution. When people take the bus or carpool, it lowers the number of vehicles on the road. (Kids, make sure you have an adult's permission first!)	X	X
Drive less by completing several errands together rather than doing them separately on different days.		X
Skip the drive-thru line and go inside when you visit the bank or fast-food restaurants. This will reduce the amount of exhaust going into the air and save on gas.	X	X
Be sure your campfire is completely extinguished (put out) before leaving the area to prevent forest fires. (Kids, ask an adult for help with this one)	X	X

RESPECTING OUR NATURAL RESOURCES

Most animals would die within minutes without good RAI to breathe. AIR

We depend on fresh WATER to cook, clean, and drink. WATER

FLOSSI fuels such as coal, oil, and natural gas help heat our homes and run our factories. FOSSIL

A farm without good OSIL will not produce many crops. SOIL

We use ULRMEB from forests to build our homes. LUMBER



OKLAHOMA Environmental Quality

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