Module 2:

Learning More About Indiana's Environment and You:

Unit A: Air

Take a deep breath. Can you feel your lungs expanding as you take air into them? Now exhale through your nose. Do you hear the air leaving your body? Air is all around us, but we don't normally see, taste or smell it. That is because clean air is a mixture of several colorless, odorless gases. The gases, nitrogen and oxygen, make up 99% of the air around us.

Many of us never think about the air we breathe, but we could not live without it. All life on Earth depends on air to survive. Plants and animals depend on clean air to survive and humans depend on plants and animals for food. When this air becomes polluted and dirty, all living things can suffer.

Clean air is necessary for your health and survival. Each day you breathe about 35 pounds of air. That is the weight of a medium-sized dog. You take over 20,000 breaths each day and breathe in 2,860 gallons of air! In your lifetime, you may take about 635 million breaths! Humans can live only a few minutes without air; but we usually don't think about how important clean air is.

Air pollution comes in many forms. It is usually found as a gas or as tiny particles in the air. Air pollution can also be found in a liquid form, called acid rain. Acid rain is the result of gases and liquids mixing in the air. There are also many examples of solid particles in the air. They include: soot from smokestacks, dirt stirred up by cars on gravel roads and dust from bulldozing or mining. Mother Nature also produces her share of "natural" air pollution. Erupting volcanoes pollute the atmosphere with toxic fumes. Smoke from forest fires produces harmful particles and lightning generates ozone, a gas which is harmful to breath.

Activity #5:

Air in Motion

Purpose: To show that even though air is invisible, you know it's there because you can see the effects of air in motion, and you can feel the pressure of wind.

Materials: Paper, crayons

Instructions: Take students for a walk to the playground to determine how they know the air is there. Ask them to draw and record what they see or smell. For example: a flag blowing in the breeze, leaves rustling in trees or on the ground, blowing dust, trees swaying, etc. Have students draw other examples of the presence of air. If they need help getting started, ask students to wave their hands and feel the air. Can they see anything moving in the air, like dust?

Discussion/Follow-up: Students will use their senses to learn about the nature of air. Although we usually don't see air, we frequently experience the effects of air's actions, what are some other effects air has on our environment?

1. At Home

There are many forms of transportation used today, the most common one in Indiana is a vehicle, such as a car, truck, van or SUV. A majority of the vehicles in Indiana use gasoline to power them. A car's engine is used to convert gasoline into power so your car goes forward. An engine burns gasoline inside of it to power your car, but not all of the gas burns. The byproduct of unburned gas comes out of your vehicle's tailpipe. A few of the pollutants are carbon monoxide, hydrocarbons, nitrogen dioxide and particulate matter. Since vehicles are an important part of life for most people, let's look at a few ways to help the environment by cutting down on pollution created by vehicles.

- Carpool or use public transportation.
- Combine errands into one trip. If you need to go to the grocery store and the library in the next few days, go to both places in the same trip.
- Ride your bike to run errands and visit your friends. It's good exercise and doesn't pollute the environment.

Activity #6:

Where transportation takes us

Purpose: To encourage students to realize what things they do everyday that involves using a car, and what activities might be cut back, changed or eliminated.

Materials: Paper, pencil or pen

Instructions: Have students keep a diary of how they and their families get around to various activities (school, work, store, etc.). Ask students to write down every mode of transportation each member of their family uses each day over the five days. Use this information to make individual charts or class charts on various types of transportation. Include in the charts the number of times each type of transportation is used, how many people in the family use each type, how often there is more than one person in the vehicle, and where they are going for most of the trip, etc. Encourage students to use visuals to show the various methods of transportation, note the distance traveled, and each travel destination (i.e. – to work, the grocery, to sports activities, to visit friends).

Discussion/Follow-up: Encourage students to talk about why it is difficult for people to use their cars less (convenience, habits, jobs, etc.). Discuss ways to encourage people to commit to using their cars less, especially for trips they make when only one person is in the car. Have students chart alternatives for their travel from home to town and to school.

2. At School

Each day, 24 million children around the country ride a bus to school. When riding a bus or seeing one when it passes by, have you ever seen or smelled the smoke coming out of the tailpipe? If you have, you are seeing or smelling used diesel gas. Used diesel gas escapes through the tailpipe of vehicles. It contains significant levels of small particles, know as fine particulate matter or fine particles. Fine particles are so small that several thousand of them could fit on the period at the end of this sentence. Fine particles can also remain suspended in the air and travel long distances. For example, a puff of exhaust from a diesel truck in Chicago, Illinois can end up traveling over to Cleveland, Ohio. Not only can fine particle pollution harm humans but it can also settle on soil and water harming the environment.

When a buses engine is running without moving, it is called idling. When school buses idle outside school buildings, they emit exhaust fumes that can enter both the buses and the school building through ventilation systems, doors and open windows. Diesel exhaust from idling school buses pose a health risk to both students and drivers. Diesel exhaust contains fine particles which can pass through the nose and throat and lodge themselves in the lungs. These fine particles can aggravate conditions such as asthma which is the number one chronic disease among children. The American Lung Association of Indiana estimates that 174,825 children living in Indiana have asthma, with the number of cases reported each year increasing.

There are many benefits in reducing the amount of time school buses idle each day. It helps protect the health of student passengers and school bus drivers. It reduces the emissions that contribute to air pollution and climate change. Reducing idling also saves money by lowering fuel consumption. In general, a diesel vehicle burns approximately one gallon of fuel for every hour it idles. If each bus idled 30 minutes less each day, a school operating 16 buses could save over $2,500 per school year in fuel costs. Less idling also saves on maintenance costs and increases the life of the engine. The School Transportation Association of Indiana has a school bus idling policy that includes recommendations for idling as follows:

a. All buses arriving at schools which are going to remain at the school longer than three minutes will turn off their engines after the appropriate cool-down time and leave them off until the buses are ready to depart.
b. At 32 degrees or above, buses will be allowed to idle for up to 5 minutes.
c. From 20 degrees to 32 degrees buses will be allowed to idle for up to 15 minutes.
d. From 20 degrees and below, buses will be allowed to idle for up to 30 minutes; or until front windows are defrosted and all safety equipment is operable.

Activity #7:

Stick 'em Up

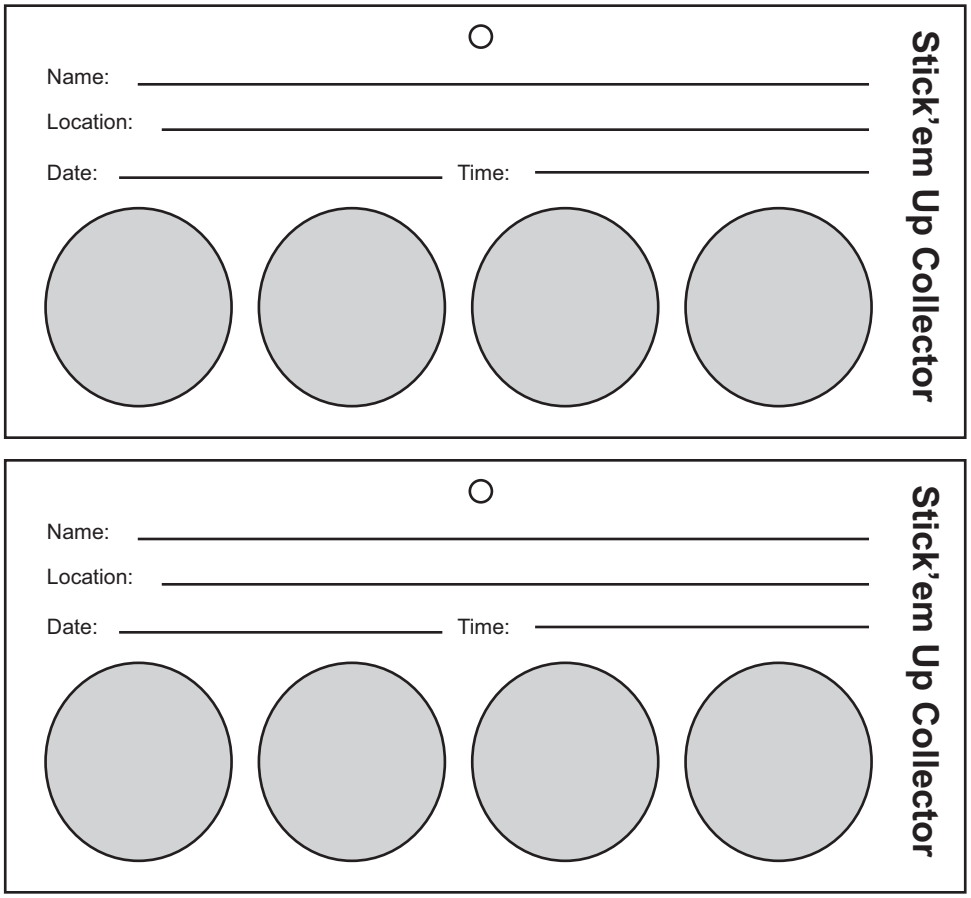
Purpose: Students will learn that tiny particles are floating around in the air we breathe. Students will also collect, observe and analyze these particles from various locations around their school.

Materials: Copies of "Stick 'em Up" worksheet, scissors, clear tape, string, hole punch, magnifying glasses (microscopes optional), marker

Instructions: First, copy the "Stick 'em Up" collectors so that each student has a particulate collector. Second, cut four holes ± 1.25 inches in diameter in the strip as marked. Using a hole punch, make a hole in the top and tie the string into a loop. Third, cover one side of the strip with clear tape so that the holes are covered on one side. DO NOT TOUCH THE STICKY SIDE OF THE TAPE SHOWING THROUGH THE HOLES. Fourth, select different sites around the school to hang the Stick 'em Up collectors. On each strip, write the student's name, location, date and time it is hung. Site selections may include your classroom, the hall outside your classroom, the gym, bathrooms, the cafeteria, the office, the teacher's lounge, outside near a tree, near the parking lot, etc. The collectors should be placed where they can hang freely – not touching other surfaces and where they will not be touched by other students. Be sure to let the custodial staff know about your experiment too. Finally, after a week, retrieve the Stick 'em Up collectors and analyze them. Have the students make a quick inspection, reviewing the strips with the naked eye. What did they find? Next, have them inspect the strips with the magnifying glass or a microscope. What did they find?

Discussion/Follow-up:

1. Can we see air pollution? How do we know air pollution exists?
2. Give examples of visible air pollution.
3. Discuss the concept of particulate matter.
4. List some sources of air pollution, both visible and invisible. Can a single source provide both visible and invisible air pollution?
5. How might air pollution in the country on a farm differ from air pollution in a town or city?



Activity courtesy of S.C. Department of Health and Environmental Control's Air Education and Outreach Section.

3. At Work

In Indiana and across the country, the pollution from diesel engines is an issue many cities are working on reducing. The familiar black soot from buses, trucks, and boats contaminates the air and dirties our cities.

Diesel engines are a durable and affordable source of power that is important to our economy. The Indiana Department of Environmental Management (IDEM) is currently working to reduce tailpipe emissions from diesel powered vehicles. With the help of IDEM, many schools have begun to add filters to tailpipes to reduce pollution before it gets into the air. Think of the filter like a coffee filter used when making coffee. A coffee filter keeps the small particles (coffee grounds) from ending up in the cup.

Adding on filters to reduce pollution is called retrofitting. Retrofitting existing trucks, buses, and other diesel equipment will help reduce pollution.

Diesel retrofits can help improve the working environment of those operating diesel powered equipment, and reduce emissions, smoke and odor from diesel engines.

Activity #8:

Transportation of Goods

Purpose: Diesel trucks have an important history in Indiana and the U.S. when it comes to moving goods from one location to another. This activity will show students that goods come from all over the world to be purchased in Indiana.

Materials: Map (World, U.S., Indiana), paper, pencil/pen

Instructions: Pick a clothing item and look at the label to see where it was made. Locate the country on a world map and figure out how it ended up in Indiana. Could it have been shipped as cargo on a boat, by plane, tractor trailer or maybe by several modes of transportation?

Discussion/Follow-up: What are the environmental benefits of buying goods from an Indiana company or U.S. company vs. buying goods from a different country?

Unit B: Land

Recycling is part of everyday life for a lot of homes, schools and businesses across Indiana. You put an aluminum can in a bin where it is taken to a recycling center to be made into a new can. Sounds simple, right? It is simple to recycle, but first, lets' look at where recycling first started.

Recycling was first observed in nature. Leaves and branches that fall to the forest floor form a rich moist leaf litter that protects the roots of plants and provides a home for nature's recyclers: invertebrates (insects and earthworms), and microorganisms (bacteria and fungi). These natural recyclers feed on the organic matter, turning it into compost. As the leaf litter decomposes, nutrients essential to plant growth are released into the soil and absorbed through the roots of plants. The new leaves and branches that grow eventually die and fall to the ground and the cycle continues.

Recycling is a series of activities that includes the collection of items that would otherwise be considered waste, such as leaves or aluminum cans. To complete the recycling process items are processed into new and useful products, which are then purchased and used by consumers.

Activity #9:

Making Soil

Purpose: Students will have a better understanding of the ingredients of soil, the processes involved in making soil and how long it takes for decomposition to occur.

Materials: Sticks, small rocks (pebbles work well), soil, leaves, baggies, hand lenses

Instructions: Students collect small rocks, sticks, and leaves and place the materials into a bag. Have students walk on the bag (they can leave a small opening in the baggie so it does not pop). After the students have walked on the material, have them inspect the bag to see what has happened to their material and if it turned into soil. Use the hand lenses to inspect the soil. On the board list other ingredients that could be found in soil.

Discussion/Follow-up: Show students a bag of soil and ask them about the missing ingredients from their materials list that would have turned their ingredients into soil? (Answer: Time, decomposition by bacteria, fungi, worms, etc).

1. At Home

You have just finished dinner and there are empty soup cans and a plastic soda bottle on the counter, and eggshells in the sink. There is leftover lettuce, green beans and chicken. The adults are sitting down to drink a cup of coffee and read the newspaper. So what should you do with all of the left over food? Your everyday actions and decisions have a direct impact on the amount of waste generated in Indiana. Even a simple act like throwing out food scraps, which seems like a very small amount of waste, can quickly add up.

You can recycle the soup cans and plastic soda bottles, just make sure you rinse them out before placing them in a recycling bin. The leftover food can be put inside a reusable container to eat later. The eggshells, lettuce, green beans, coffee grounds and filter, and even the newspaper can be recycled. There is a fun way to recycle your food waste – let worms eat it. Worms are very efficient scavengers and eat their weight in food scraps every day.

Worm composting, or vermicomposting, utilizes nature's process of recycling nutrients by creating a worm-friendly environment. Food waste is added in and consumed by red worms. Newspaper, the bedding to house the worms, is also consumed by the worms. The worms will then produce castings which are a valuable soil amendment that provides an excellent source of organic nutrients for houseplants and gardens.

Using worms to decompose food waste offers several advantages, for one it can produce fewer odors and attracts fewer pests than putting food wastes into a garbage container. Second, it saves water and electricity that kitchen sinks and garbage disposals use. Third, it produces a free, high-quality fertilizer.

The materials needed to start a vermicomposting system are; a worm bin, bedding, water, worms and your food scraps.

- Worm Bin: A suitable bin can be constructed of untreated, non-aromatic wood, or it can be a plastic container. If a plastic container is used, it should be thoroughly washed and rinsed before the worms and bedding are added. The bin size depends on the amount of food produced by your household. The general rule is one square foot of surface area for each pound of garbage generated per week.

- Bedding: The worms need bedding material in which to burrow. It should be a non-toxic, fluffy material that holds moisture and allows air to circulate. Suitable materials include shredded paper (such as black-and-white newspapers, paper bags, computer paper, or cardboard); shredded, decaying leaves; or any combination of these. Do not use glossy paper or magazines.

- Water: The bedding must be kept moist (but not wet) to enable the worms to breathe. Worms don't have lungs; they must take in oxygen through their moist skin.

- Worms: It is important to get the type of worms that will thrive in a worm bin. Only red worms or "wigglers" which are "composting worms" should be used (do not use night crawlers or other types of worms). Red worms can be found at pet stores or bait shops.

- Food Scraps: Feed your worms any non-meat, organic waste such as vegetables, fruits, eggshells, tea bags, coffee grounds, paper, coffee filters, and shredded garden waste. Do not add meat scraps or bones, dairy, fish, greasy or oily foods, fat, tobacco, or pet or human manure - these items will cause odors, attract pests, and contaminate the finished compost.

A few things to keep in mind with a worm bin is that the winters in Indiana are too cold to keep your worms outside year round, you will have to bring them in during the winter. Be careful not to overfeed, it could attract insects or mammals. Worms don't like the light- if you use a see through container you will need a dark place for the bin to be housed.

Activity #10:

Worms Move the Earth

Purpose: To encourage students to learn the importance of a worm's role in the environment, the design of a worm's body, and how they move.

Materials: Worms (10 each of red and earth worms), 3 large jars with lids (mayonnaise jars work well), dark soil- possibly from a compost pile, light colored soil, black construction paper, leaves, rubber bands or tape

Instructions: Construct five layers in each jar, using a layer of dark, light, dark, light, dark soil. Place a few leaves on the very top. Punch air holes in the top of each lid. Place red worms into Jar A, earth worms into Jar B, and Jar C will have no worms. Place black construction paper around the jars, worms are light sensitive. Sprinkle water into all three jars ever few days or if you notice the jar is dry, the worms will dry out if there environment is not moist. After a few weeks, remove the construction paper.

Discussion/Follow up:

1. Do you see any worms in Jar A or B?
2. Are there any tunnels?
3. What are the differences between Jars A, B, and C?
4. Is the soil mixed in the Jars with worms? Without worms?
5. Take off the lids, what are the differences between the Jars?
6. Did the Jars A and B show any signs of how worms help the decay process?
7. Why are worms important to their environment?

Source: Westley, Joan. Rocks, Sand, and Soil. Creative Publications: California, 1988.

Worms Move the Earth Data Sheet

Question: What do you think will happen to the jars with worms in them vs. the jar with no worms?

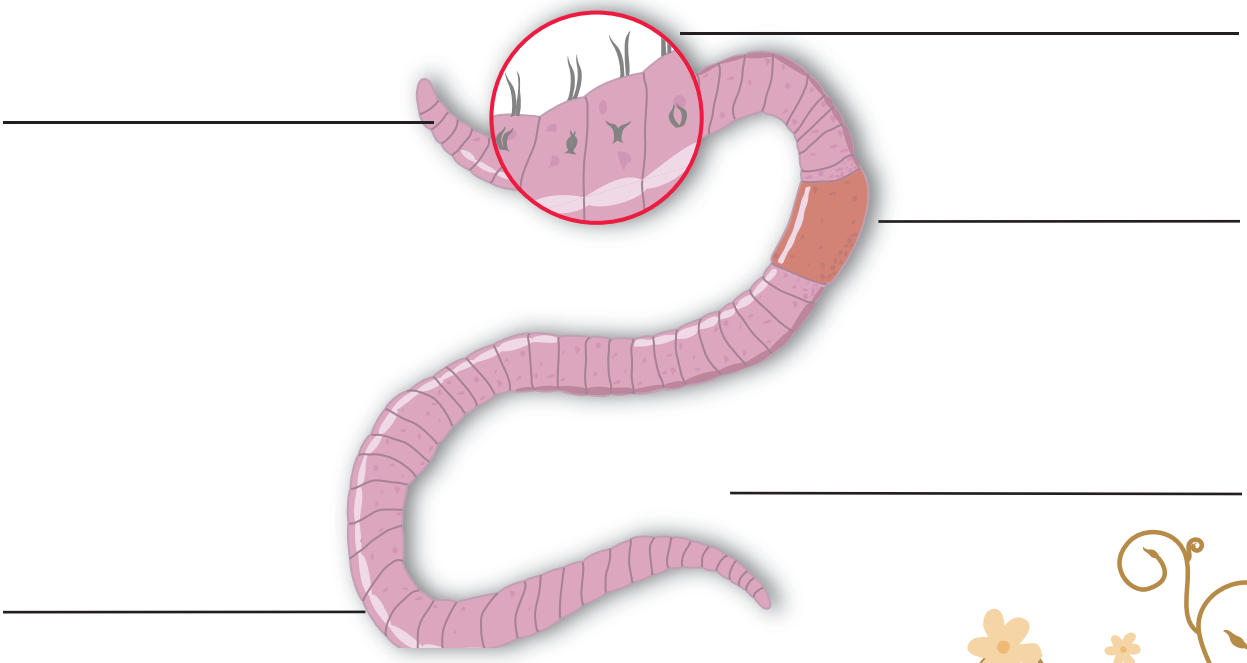
Hypothesis (Make a guess as to what you think will happen):

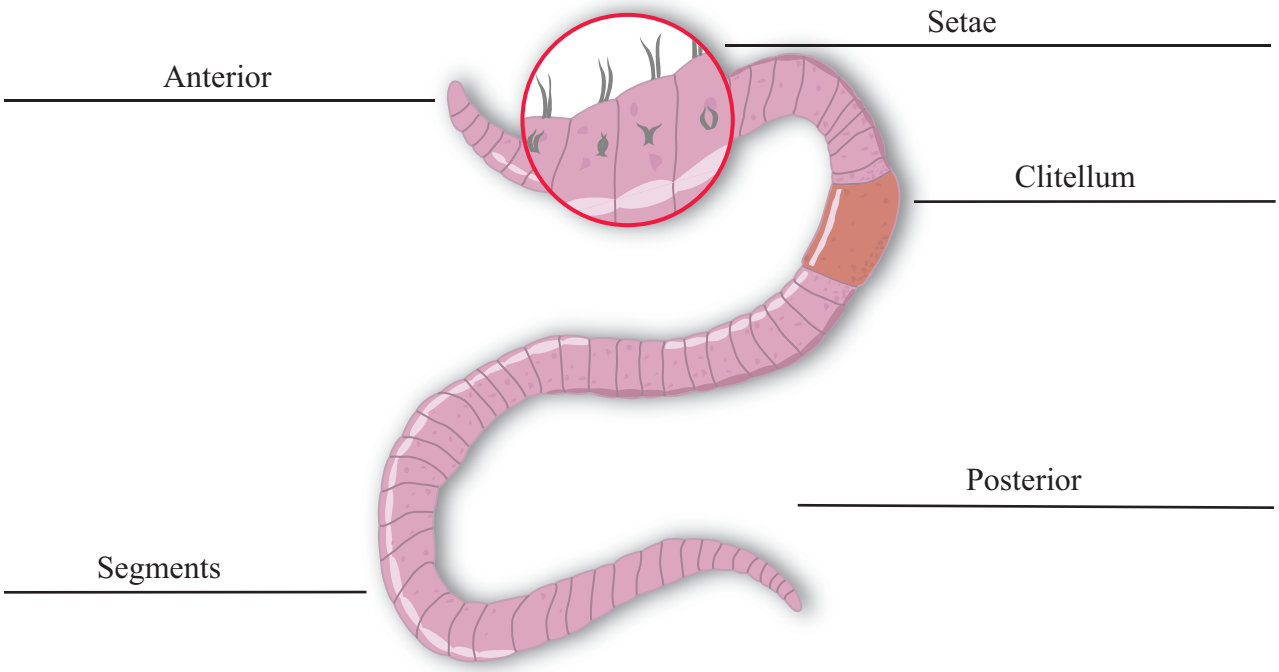
Observation (What happens):

Conclusion (Decide what your observation means):

Communicate Results (Share data with class):

Use the following terms to label the worm: Posterior, Anterior, Segments, Clitellum, Setae.





Additional Questions:

1. How do the different parts of a worm help it move?
2. How does the movement of a worms body move soil?

2. At School

Did you know that we throw away 20 percent of the food produced in the United States every year? We can reduce this waste by composting and also making sure we take only as much food as we are going to eat. Everyone can help in the effort to slow the usage of our natural resources simply by becoming aware of the amount of trash being produced and making an attempt to reduce it. Waste reduction slows the depletion of natural resources and reduces pollution associated with the extraction of raw materials and the manufacture of products. Garbage usually ends up in a landfill, and you can help by reducing the amount of waste produced. A few simple ways to reduce solid waste are to:

- Make your lunch "garbage free." Use reusable containers when packing your sandwich and drink. If you bring your lunch to school in a paper bag everyday and throw it away, you would use almost 200 paper bags in just one school year. Instead of a paper bag, use a reusable lunch box.
- Cut back on Styrofoam use. Styrofoam can be very useful, because it is good at keeping things hot and cold. But it can be bad for the environment. Most recycling programs in Indiana can't accept Styrofoam, so most Styrofoam isn't recycled. It stays in landfills forever and takes up a lot of room. Because Styrofoam is very light, it floats on water and may hurt animals that live or feed there. The best way to reduce Styrofoam is to use less of it. If your school uses Styrofoam trays, talk to your teacher or principal about switching to reusable plastic trays.
- Start recycling. Recycling helps keep valuable resources like metal, glass, paper and plastic out of the trash. If recyclable resources are collected properly, they can be made into useful things we all need and want.

Activity #11:

Lunch Trash

Purpose: Students will discuss waste in the cafeteria and possible solutions to cutting back on the waste.

Materials: Paper, pencil or pen

Instructions: Have students answer the following questions:

- What did you have for lunch and how was it packaged?
- Did you throw any trash away? If yes, what was it and why did you throw the items away?

Discussion/Follow up: Additional questions for students:

- What item was discarded the most for the whole class? Why do you think that is?
- Using the item that was discarded the most; calculate the amount your class would throw away in a week, month, and school year.
- Could any of the items be recycled or reused?

To learn more about composting visit IDEM at: www.recycle.IN.gov

3. At Work

When you go into a store, have you ever asked yourself where the products you were buying came from? The bottle of water you purchased goes through a long process before it ends up on a shelf in your local store: crude oil had to be drilled out of the ground and processed for the plastic bottle; the water had to go through a treatment process to make sure it is drinkable; wood had to be harvested to make the product label; a truck delivers the drinking water to your local store; and the empty bottle has to be disposed of when you're done with it.

Many industries in Indiana reuse waste that was generated during the manufacturing process and/or collected through a recycling program. The reused material is referred to as "recovered material." Indiana's industries benefit from using recovered material because it is already processed. A good example of a recovered material is aluminum. Industries like to reuse or purchase recovered aluminum because it has already been processed and is ready to be used.

Activity #12:

Leftovers from a Toy Company

Purpose: To demonstrate to students that when products are made there is waste generated.

Materials: Yellow, blue and red Play-Doh, Fun Factory Machines with dies and cutter, copies of "Waste Storage Shed"

Instructions: Divide students into groups of 5 or 6 students and have them select a name for their toy company. Provide each group with the fun factory, Play-Doh, and copies of "Waste Storage Shed". Assign students the following jobs:

1. Toy Operator: You make the toys and clean-up the machinery. You're the only person allowed to operate the machine and cutting devices.

2. Toy Operator Helper: You help the Toy Operator with cleaning the machinery and make sure the Toy Inspector is aware the toys are ready for inspection.

3. Toy Inspector: You decide if the toy is made well enough to sell to children. Is the shape, color, and size correct?

4. Toy Storage Shed Manager: You keep track of toys and waste when they are delivered to you.

5. Toy Manager: You are responsible for preparing Play-Doh material for use in the machine, and telling the Toy Operator what to make next.

6. Toy Waste Handler: You deliver finished toys, waste material, and clean-up waste to Toy Storage Shed Manager. This job can be done by the Toy Manager if you do not have enough students for a Toy Waste Handler.

Once students are assigned a job, inform them that when products, such as toys, are made there is product waste. The goal is to reduce the amount of waste and still have a quality toy. Waste will be separated by color and the type of waste. The types of waste are: did not pass inspection, which will be toys the Toy Inspector did not think were the right shape, color or size; toy waste, which is any material left in the machine that will be cleaned-up by the Toy Operator; recycle waste, yellow Play-Doh can be recycled to make more toys that are yellow.

If a yellow toy did not past inspection, it must first be counted as "did not pass inspection" and can then be recycled and made into more yellow toys. Blue and red Play-Doh can not be recycled, if they do not pass inspection place them in the "did not pass inspection" section on the copies of Waste Storage Shed sheet.

Customer Orders

1. 3 Yellow Stars, made the length of a Play-Doh can lid
2. 3 Blue Stars, made the length of a Play-Doh can lid
3. 6 Red Ropes, the length of a Play-Doh can without lid

Waste Storage Shed

	Did not pass inspection	Toy Waste	Products (Finished Toys)
YELLOW			
BLUE			
RED			

Discussion/Follow up:

1. Compare your "did not pass inspection piles." Is there a color you have more of? If yes, why do you think that is?
2. Compare your toy waste. Is there a color you have more of? If yes, why do you think that is?
3. Yellow waste products can be recycled, what should you do with blue and red waste products? Send them to a landfill, stop selling those color toys? If you stop selling blue and red toys what will the consumers think?
4. As a consumer would you be upset if your favorite toy was no longer made because the waste product could not be reused or recycled?

Activity courtesy of U.S. EPA

Unit C: Water

Water is a colorless, odorless, tasteless substance. Each water molecule consists of one oxygen and two hydrogen atoms. In its pure form, water is a good solvent, meaning, it can dissolve or mix with many substances. It is found everywhere and covers three-quarters of the planet. Water is found in our atmosphere, in our soil, and underneath the ground. In fact, in Indiana, only about 1% of the state is covered by water (not including wetlands). Fifty percent of Hoosiers get their water from underground. Take a survey of your class. Where does everyone's drinking water come from? Do they have well water? Does it come from a lake or reservoir? If the town provides water hookup, where does the town get its water?

The total amount of water on earth stays the same, and the same water we use now is the same water used by dinosaurs millions of years ago. Water can be found in all three states of matter (liquid, solid, and gas) on earth, most often in the liquid state. Ninety-seven percent of the water on earth is not in a form we can drink; it is either frozen or is salt water.

Water moves in a never-ending natural cycle. The forms of water are always changing. They move from the sky to earth and back to the sky again. This is called the water cycle. Water falls to earth as precipitation. Some of the water soaks into the ground and is stored as groundwater. The rest flows into streams, lakes, rivers, and oceans. The sun warms surface water and changes some of it into water vapor. This process is called evaporation. Plants undergo a similar process too, called transpiration. The heated water vapor rises into the sky and forms clouds. When the vapor in the clouds condenses, it falls back to the earth as precipitation. The water cycle has then come full circle and begins again.

Activity #13:

Water Purification by Evaporation and Condensation

Purpose: To demonstrate to students how the water cycle helps to purify water.

Materials: 4 cups of dirt or sand and a dozen stones, 2 quarts of water, short glass, large glass bowl with tall sides (mixing bowl), clear plastic wrap, a sunny day

Background: Evaporation is defined as the process through which a liquid becomes a vapor. Condensation is the process through which a vapor becomes a liquid, and is the opposite of evaporation. In the case of water, the main mechanisms for evaporation and condensation are heating and cooling, respectively.

Instructions: Mix the dirt (or sand) and water in a large bowl. Stand a clean and empty short glass in the center of the bowl. Place the bowl outside in the sun. Cover the bowl with the plastic wrap and weigh down the edges with the remaining rocks. Place one rock on the plastic wrap directly over the cup. Allow the bowl to remain in the sun for several hours. Look in the cup (it should contain some relatively clean water free of mud). Look in the bowl (it should contain the dried dirt).

Discussion/Follow-up: Add food coloring to water to demonstrate that this process does not remove all pollutants. This may be done simultaneously with the procedure above.

1. What are the two processes responsible for purifying the water? (Evaporation and Condensation) Water is also purified by filtration through soil or sand.
2. Where else do you see condensation? (Cold drink outside on a hot day)
3. How does this process work on Earth?
4. What is the plastic wrap? (Our atmosphere)
5. What is the condensation? (Clouds and rain)
6. What would happen if the plastic wrap was dirty? (Air pollution)

Activity courtesy of U.S. EPA 810-F-98-001 June 1998

1. At Home

At home have you ever wondered when it rains where does all of that water actually go?
The rain and everything it washes away with it drain into storm sewers. Water pollution is pollution that has entered our lakes, ponds, streams, oceans, etc., and is unhealthy for the plants and animals that depend on this water to live. Pollution can be divided up into two basic categories: point source pollution and non-point source pollution.

1. Point Source Pollution:
   This is pollution that comes from a specific "point" or place, such as a pipe. It is easier to find where point source pollution is coming from, because you can normally just follow the pollution back to where it is flowing or leaking from.
   Examples:
   Pipes that either carry liquids or smoke away from some place (such as a factory, a sewage treatment plant, or even from our homes).

2. Non-Point Source Pollution:
   Non-point source pollution describes the pollution that water picks up as it flows across a surface such as our lawns, streets, farm fields, or a construction site. After it rains, water travels across these surfaces, picking up "stuff" along the way and then flows into streams, drainage ditches, or soaks down into the ground.
   Examples:
   Pesticides, herbicides (weed killers), fertilizers, or soil from farm fields and lawns; motor oil and other chemicals that run off of streets; chemicals that seep into the ground from landfills; bacteria and nutrients from farm animals, pets, or faulty sewage systems.

In Indiana, on average it rains about every third day. Each time it rains or when snow melts, water washes over impervious surfaces such as roads, parking lots and compacted soil and removes all of the oil, debris, soil and fertilizer. The water and pollutants are then washed into storm sewers and are carried to the nearest river, lake or into the groundwater.

The storm water is untreated when it empties into the waterway and because these pollutants come from several sources instead of one discharge point, it is called nonpoint source pollution.

Everyone, in some way, contributes to nonpoint source pollution through regular household activities. You don't have to live near water for your actions to affect water quality. A drop of oil spilled miles from a river will eventually find its way into ground water, a river or a lake.

Activity #14:

Nonpoint Source Pollution

Purpose: This activity is designed to demonstrate to students what an average storm drain collects during a rainfall event and how the water from storm drains can impact the water quality and aquatic environments of local streams and rivers.

Materials: Aquarium, plastic "water box" (a reusable container you get at a grocery story works well), watering can, spray bottle, pollutants, green food coloring (pesticides/fertilizer), vegetable oil (motor oil), soil/sand/pebbles (erosion), grass clippings (or shredded paper) and twigs, cafeteria waste and trash

Instructions: Fill the aquarium half-way with water and place it on an accessible area where it can be easily viewed by the students. Cut a hole in the bottom of the "water box" and place the box on top of the aquarium. The box represents the storm drain and the aquarium represents a river.

1. Storm drains and their systems empty into local rivers. Anything that goes into a storm drain such as paper, plastic, sticks, etc. travel through the storm drains and dump into the rivers without being treated or removed from the water to make it safe for the environment. The purpose of a storm drain is to remove large amounts of water and to prevent flooding. Have students list all of the things that they can think of that might enter a storm drain during a rain storm.

2. Assign a group of students to each pollutant. Discuss each pollutant, including its use or origin and how it could enter the storm drain.

3. Have each group of students place their pollutant into the storm drain. Use the watering can to create rain to wash the pollutant into the waterway. While washing each pollutant into the waterway, review the pollutant and its use or origin. Discuss the following questions: How does the pollutant damage the environment? Do the people who are responsible for the pollutant want to damage the environment? Why did they do what they did? How can this type of pollution be stopped?

4. After adding all of the pollutants, examine the contents of the waterway. Discuss how the waterway has changed and how viewing this change makes the students feel.

Discussion/Follow-up:

1. What types of the pollution are natural?
2. What types of pollution are added by people living in the local communities?
3. How can we remove the pollution from the water?
4. What could be done to stop pollutants from entering storm drains?

Have the groups of students responsible for the pollution think of ways to remove the pollution from the aquarium. Try some of the removal methods. Which pollutants were easy to remove? Which were difficult to remove?

Activity courtesy of U.S. EPA 810-F-98-004 June 1998

2. At School

When you get a drink of water out of a water fountain at school, do you know where that water comes from and where it goes? A clean, constant supply of drinking water is essential to every community. People in large cities frequently drink water that comes from surface water sources, such as lakes, rivers, and reservoirs. When you think about where your drinking water comes from, it's important to consider not just the part of the river or lake that you can see, but the entire watershed. The watershed is the land area over which water flows into a river, lake, or reservoir.

In rural areas, people are more likely to drink ground water that was pumped from a well. These wells tap into aquifers, the natural reservoirs under the earth's surface that may be only a few miles wide, or may span the borders of many states. Approximately fifty percent of Indiana's population uses ground water as its main source for drinking and household activities. As with surface water, it is important to remember that activities many miles away from you may affect the quality of ground water.

Water taken from a river or reservoir often contains dirt and tiny pieces of leaves and other organic matter, as well as trace amounts of certain contaminants. The water enters a water treatment plant where the dirt, leaves and organic matter is removed from the water (to learn more about the process, the "at work" water section below explains how water at a wastewater treatment plant is cleaned).

Ground water is naturally filtered as it passes through layers of the earth into underground reservoirs known as aquifers. Water that suppliers pump from wells generally contains less organic material than surface water and may not need to go through any or all of the treatments described in the previous paragraph. The quality of the water will depend on local conditions.

The most common drinking water treatment, considered by many to be one of the most important scientific advances of the 20th century, is disinfection. Most water suppliers add chlorine or another disinfectant to kill bacteria and other germs.

Activity #15:

Where Does Your Water Come From?

Purpose: This taste test will illustrate the difference between ground water and surface water, highlight some of the common contaminants in natural water, and encourage student thought on the sources of drinking water.

Materials: 1 gallon of distilled water, 1 gallon of tap water (identify the source), 1 gallon of mineral water (or private well water, if available), 1 gallon of filtered tap water, cups for the class

Background: Every day, the average American uses about 50 gallons of water for drinking, bathing, cooking, and maintenance. Most people, however, are unaware of the source of their water. In the United States, about 88 percent of the population is supplied by community water supply systems. The other 12 percent is supplied by non-community means, such as campgrounds, resorts, and private wells. Sixty-four percent of public water systems use surface water as their source, the other 36 percent use ground water from wells. The aesthetic properties of the drinking water from these public systems are often affected by the source of the water. Ground water often has a slightly metallic taste, and may contain high amounts of minerals. Surface waters, on the other hand, usually have a musty taste and look cloudy. Treatment techniques aim to produce water that is: safe for human consumption; appealing and good tasting to the consumer; and conforms with applicable State and Federal regulations at the lowest possible cost.

Instructions:

1. Mark a set of 4 cups for each student. Label each cup 1 through 4 and fill them with the different types of water. Make sure that similarly labeled cups contain the same type of water.
2. Indicate on the board the different types of water present in the four cups. Have the students work together in groups to try to identify different tastes, smells, and appearances in the water. Have each group write down their observations on each water sample, and identify which cup has which type of water.
3. After everyone has completed their observations, have the students mark their guesses on the board. Ask the students what types of impurities they would expect to find in the different types of water, and if their senses confirmed their intuitions. Record these observations on the board.
4. Reveal to the students which samples contained which type of water. Discuss with the students their observations and what other impurities might be found in these waters. Also discuss the source of water for the community. If anyone in the class lives in a location supplied by a private well, ask him/her to describe the water at their home, and how it compares to other water he/she drinks in the community.

Discussion/Follow-up:

1. What are some of the possible sources of water in your community?
2. Which type of water tasted best and why?
3. Which type of water would you consider safer to drink, groundwater from a spring, or surface water from a stream?

Activity courtesy of U.S. EPA 810-98-002 June 1998

3. At Work

Ever wonder what happens to the water in your shower, dishwasher, washing machine, or even your toilet? Pipes in your house carry water away from your house to pipes that are under the street. The pipes under the street are called sewer pipes. The water flows through the sewer pipes to a wastewater treatment plant. The water that ends up at the wastewater treatment plant is not safe enough to drink or to be released into the environment. The water entering the plant is called wastewater because it contains whatever you flushed or poured down the drains. So wastewater is the water from your house plus anything you add to it. Can you think of anything you add to water that leaves your house? Items such as: soap; hair; human waste; food; toilet paper; cleaning solutions; etc.

When people first started releasing wastewater into waterways, a natural process of purification began. There was more clean water then wastewater so bacteria and other small organisms in the water consumed the wastewater. But as populations grew, more wastewater was produced by the growing communities. Natural processes could no longer clean the wastewater like it had been able to in the past because there was more wastewater than clean water. Communities built wastewater treatment plants to keep dirty water from contaminating clean water.

Wastewater is collected not only from your houses, but also from businesses and many industries. Most of our treatment plants are built to clean wastewater for release into streams or for reuse. The process for treating wastewater is:

1. Screens: As wastewater enters a plant for treatment it flows through a screen, which removes large floating objects. The incoming water flows through the screen as large objects are unable to pass through the screens that can vary from ¾ of an inch to 3 inches.

2. Grit Chambers: A chamber is like a large tank where the flow of the wastewater is slowed. As the wastewater slows large objects that made it through the screens settle in the bottom of the chamber.

3. Primary Treatment: The wastewater flows into a new tank and is slowed again to allow solids to either sink to the bottom of the tank or float on top of the wastewater.

4. Secondary Treatment: During this stage about 85 percent of organic material in the wastewater is removed by adding bacteria to the water. Bacteria will consume the organic material.

5. Disinfect: The final step at a majority of wastewater treatment plants is to add chlorine to the water. The chlorine will kill any remaining bacteria or microorganisms in the water before the water is discharged into receiving waters.

Your local wastewater treatment plant is designed to treat water from your shower, dishwasher, washing machine and even your toilet. You can help your local wastewater treatment plant by not pouring anything down the drain that can affect your drinking water. Items to not pour down your drain include but are not limited to: mercury; fats, oils and grease from food products; household chemicals; liquid and solid medications.

Activity #16:

Food down the Drain goes to a Wastewater Treatment Plant

Purpose: Students will gain an understanding of what a wastewater treatment plant does with the solid materials it collects during the cleaning process of water.

Materials: Aquarium or large clear tub, water, eggshells, cereal, Crisco or lard, raisins, strainer, gravel siphon (optional)

Background: When wastewater leaves our house the items mixed in the water do not just go away. The wastewater treatment plant has to remove and dispose of items found in the water. Even if you have a garbage disposal at home, the ground-up items also have to be removed and discarded of. The items leaving your house don't just disappear.

Instructions:

1. Fill aquarium ½ way with water.
2. Add food items one at a time, ask students if they think the item will float or sink?
3. Once you have added the food use the strainer to remove the floating items, you may want to give the items time to sink before you go onto step 4.
4. Use a gravel siphon (used in fish tanks and can be purchased at any local pet store) to remove the items that have settled to the bottom. This can be messy and the heavy items (like raisins) will not be removed by the siphon.

Discussion/Follow-up:

1. Where do the items go after they have been removed from the water? (Landfill)
2. What are some steps we can each take to help our wastewater treatment plant?