

THE THREE R'S (REDUCE, REUSE, RECYCLE)

Objectives:

1. To understand how we as humans have developed the means by which to produce “new” things made from nature. Talk about the responsibility to go along with the power to produce things.
2. To discuss different ways we can recycle, reduce, and reuse. Be sure to distinguish between the three. Also help them understand that all three are equally important.
3. To learn that paper and other materials are made of things found in nature. Some of these things are biodegradable and some of these things are not biodegradable.
4. To learn that used paper can be recycled, and a method of making paper as evidenced by producing a paper sample.
5. To learn source of air and water pollution.

Key Vocabulary:

1. **Recycle** = To turn previously used items into other usable items (cans into car parts).
2. **Reduce** = To use less (to turn off lights we are not using).
3. **Reuse** = To use items over again (use the same shopping bag each time at the store).
4. **Biodegradable** = Something that will break down over time.
5. **Decomposed** = Decayed or rotten.
6. **Pollution** = Undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities.
7. **Renewable** = Something we can grow or produce more of and are not in real danger of running out of (trees).
8. **Nonrenewable** = Something of which there is a limited supply and no way to get new once we run out (oil).
9. **Run-off** = Rainfall or other water that is not absorbed into the soil and drains off the street or land.
10. **Pulp** = Any soft or soggy mass.

Equipment:

Used office paper, water, blender, molds, sponges, plastic transparency sheets, vats, cards and felt board to review how paper is produced and graphs. (Buried items should already be in place).

Pre-Class Procedure:

1. Set up must be done ahead of time. Office paper should be shredded into ½” pieces and soaked in water for at least two hours (overnight is fine).
2. Gather felt board and cards and review path of recycling paper. Also review how to tie in graphs and data to the path of recycling.
3. Know where buried items are.

Procedures:

1. Where do things come from? (10min)

- A Have the students brainstorm items/materials that are produced from animals, plants, and natural minerals

- From plants-wood, paper, cotton, linen, rubber, wax, and oils
 - From animals-leather, wool, fur, oils, wax
 - Natural minerals -steel, iron, gold, coal, oil, etc.
- B Discuss the benefits these items/materials give humans, then also the problems that go along with producing these materials.
- Pollution, Use of resources (renewable vs. nonrenewable), less room to dump waste, etc.
 - That some of these materials are biodegradable and some of these materials are not, in addition time period for biodegrading can be included.
 - That all of the natural minerals are limited and can be used up.
- C Explain that we live on a planet which appears at present to be the only body in the solar system capable of supporting life. Therefore we need to take care of our planet. There are steps that we as humans can take to help save the environment.

2. Play Paper Production Game. (15min)

- A Pass out the laminated cards to groups of two to three. And explain that each group need to show how they think the paper goes from trees into pulp and then what happens to it after we are done with it. Tell them that not all the cards may be used.
- B Begin to review with the groups on the felt board the correct path that paper takes and the alternate paths of recycling and going to the dump.
- C Use this time to show them some of the graphs and information about paper and how much is wasted and reused.

3. What do you know about Recycling? (5min)

- A Introduce the Three R's Recycle, Reduce, Reuse
- Brainstorm Benefits of the Three R's
 - i. Lowers depletion rate of natural materials, lowers waste, can lower pollution, etc.
- B Brainstorm ways we can recycle, reduce, and reuse
- Recycle – community programs
 - Reduce – low water flow shower heads, using less hot water, using less paper
 - Reuse – write on back side of paper, kitchen material (paper plates vs. reusable plates)
- C Brainstorm where we can recycle
- here at camp, at school, at home
- D Brainstorm what we can recycle
- paper, cardboard, plastic, glass, aluminum, tin, etc.

4. Let's Make Paper! (30min)

- A Start by placing a handful of soaked paper in the bottom of the blender. Fill blender the rest of the way up with water. Blend on low speed for about 30 seconds, then on high speed for about ten seconds (or more, until the pulp is fine). The resulting mixture should be somewhat thick and creamy. If it is too thin, add more soaked paper and blend again.

- B Pour the pulp into a plastic vat. Repeat step number four until the pulp is about 5-6" deep in the vat. Stir well after making each sheet of paper.
- C Dip the mold into the pulp, sliding it from a vertical to a horizontal position. Lift it out of the pulp. It seems to work best if the mold is not tilted as it is lifted, although this does create thicker paper sample. After a few seconds, hold the mold vertically to drain for about ten seconds.
- D Roll paper off of mold and onto plastic transparency sheets (placed on damp sponges to absorb excess water). From the plastic sheets, roll the home-made paper onto sheets of newspaper to dry. Dry outside if possible, or in front of a fan.
- E Have students make their own paper. If they want to, encourage them to be creative and include plant materials, sawdust, wasp nests, threads, etc. Those who are waiting to use equipment can collect materials to include in their sheet of paper. Scoop water off of the top of the vats (after pulp has settled to the bottom) and re-use that water in the blender. This keeps the level of pulp and water in the vats from getting too high and also wastes less water. After the paper samples have been made, students may continue to decorate them with flower petals or leaves.

Standards

Indiana-History

4th Grade

- 4.4.1 Give examples of the kinds of goods and services produced in Indiana in different historical periods.
- 4.5.6 Investigate the contributions and challenges experienced by people from various cultural, racial, and religious groups in Indiana during different historical periods by reading biographies, historical accounts, stories, and electronic media.

Indiana-Science

2nd Grade

- 2.1.7 Recognize and describe ways that some materials—such as recycled papers, cans and plastic jugs—can be used over again.

3rd Grade

- 3.1.8 Describe how discarded contribute to the problem of waste disposal and that recycling can help solve this problem.

4th Grade

- 4.1.9 Explain how some products and materials are easier to recycle than others.

5th Grade

- 5.1.5 Explain that technology extends the ability of people to make positive and/or negative changes in the world.
- 5.1.6 Explain how the solution to one problem, such as the use of pesticides in agriculture or the use of dumps for waste disposal, may create other problems.
- 5.1.7 Give examples of materials not present in nature, such as cloth, plastic, and concrete that have become available because of science and technology.

6th Grade

- 6.1.9 Explain how technologies can influence all living things.
- 6.3.4 Explain that we live on a planet which appears at present to be the only body in the solar system capable of supporting life.
- 6.3.8 Explain that fresh water, limited in supply and uneven in distribution, is essential for life and also for most industrial processes. Understand that this resource can be depleted or polluted, making it unavailable or unsuitable for life.
- 6.3.13 Identify, explain, and discuss some effects human activities, such as the creation of pollution, have on weather and the atmosphere.
- 6.3.14 Give examples of some minerals that are very rare and some that exist in great quantities. Explain how recycling and the development of substitutes can reduce the rate of depletion of minerals.
- 6.3.16 Explain that human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and farming intensively, have changed the capacity of the environment to support some life forms.

Michigan-Science

3rd Grade

- E.ES.03.41 Identify natural resources (metals, fuels, freshwater, farmland, and forests).
- E.ES.03.42 Classify renewable (fresh water, farmland, forests) and non-renewable (fuel, metals) resources.
- E.ES.03.43 Describe ways people are protecting, extending, and restoring resources (recycle, reuse, reduce, renewal).
- E.ES.03.44 Recognize that paper, metal, glass, and some plastics can be recycled.
- E.ES.03.51 Describe ways that humans are dependant on the natural environment (forest, water, clean air, earth materials) and constructed environments (homes, neighborhoods, shopping malls, factories, and industries).
- E.ES.03.52 Describe helpful or harmful effects of humans on the environment (garbage, habitat destruction, land management, renewable and non-renewable resources).

The Three R's Review Sheet

1. What do the Three R's stand for? _____

2. What are three reasons why we should practice the Three R's?

3. Name two things produce from plants. _____

4. Name two things humans produce from animals. _____

5. Was making paper easy or hard? Why? _____

6. Write out how paper goes from tree to paper. _____

7. Name four items that can be recycled. _____

8. What things did we need to make recycled paper? _____

9. Name one way we can reduce waste or pollution. _____

10. Name one item we can reuse. _____

Trees to Paper

The basic recipe - wood, water and energy - is adjusted to make just the paper that's needed.

First, workers harvest trees, mostly from special tree-growing areas called tree farms. After the trees are removed, more trees are planted in their place. While they are growing, the young trees produce lots of oxygen, and provide great habitat for deer, quail, turkeys and other wildlife.

The logs are transported to the paper company where they get a bath to rinse away dirt and other impurities before being turned into small chips of wood. The chips are then sorted according to size, and moved to the *pulping* operation, where they will be turned into pulp for making paper.

In the pulping stage, the individual wood fibers in the chips must be separated from one another. This can be accomplished using one or more pulping techniques. The type of paper that's being made determines the pulping process that is used. The finished pulp looks like a mushy, watery solution. But if you look at it under a microscope, you will see that the individual wood fibers have all been separated.

Now it's time to make paper out of our pulp. That mainly means getting the water out of the wood-fiber soup, since this papermaking *stock* is about 99% water. The first area in which this takes place is called the *wet end* of the papermaking machine.

First, papermakers spray the stock onto a long, wide screen, called a wire. Immediately, water begins to drain out the bottom of the wire. This water is collected so that it can be reused over and over again. Meanwhile, the pulp fibers are caught on the top side of the wire, and begin to bond together in a very thin mat. The fiber mat remaining on the wire is then squeezed between felt-covered press rollers to absorb more of the water.

Even when this wet end work is over, the pulpy stuff on the wire is still about 60% water. But now it's time for the *dry end*.

In the dry end, huge metal cylinders are heated by filling them with steam. The wet paper, which can be up to 30 feet wide, passes through these hot rollers. Heating and drying the wet sheet seals the fibers closer and closer together, turning them from pulp into paper.

When you look at a piece of paper, can you find any difference in thickness in that single sheet? Probably not, thanks to a part of the paper machine called the *calender* - big, heavy cast iron rollers that press the drying paper smooth and uniform in thickness.

Sometimes the paper is coated, often with fine clay, to make it glossier and easier to print on.

A bit more drying, then rolled onto a big spool or reel, the pulp - a miraculous mat of fibers from trees - has become paper, ready for a thousand uses.

Collection and Transportation

You may take your sorted paper to a local recycling center or recycling bin. Often, a paper stock dealer or recycling center will collect recovered paper from your home or office. Your local dealer can tell you the options available in your community.

At the recycling center, the collected paper is wrapped in tight bales and transported to a paper mill, where it will be recycled into new paper.

Re-pulping and Screening

The paper moves by conveyor to a big vat called a pulper, which contains water and chemicals. The pulper chops the recovered paper into small pieces. Heating the mixture breaks the paper down more quickly into tiny strands of cellulose (organic plant material) called fibers. Eventually, the old paper turns into a mushy mixture called pulp.

The pulp is forced through screens containing holes and slots of various shapes and sizes. The screens remove small contaminants such as bits of plastic and globs of glue. This process is called screening.

Cleaning

Mills also clean pulp by spinning it around in large cone-shaped cylinders. Heavy contaminants like staples are thrown to the outside of the cone and fall through the bottom of the cylinder. Lighter contaminants collect in the center of the cone and are removed. This process is called cleaning.

Deinking

Sometimes the pulp must undergo a "pulp laundering" operation called deinking (de-inking) to remove printing ink and "stickies" (sticky materials like glue residue and adhesives). Papermakers often use a combination of two deinking processes. Small particles of ink are rinsed from the pulp with water in a process called washing. Larger particles and stickies are removed with air bubbles in another process called flotation.

During flotation deinking, pulp is fed into a large vat called a flotation cell, where air and soap-like chemicals called surfactants are injected into the pulp. The surfactants cause ink and stickies to loosen from the pulp and stick to the air bubbles as they float to the top of the mixture. The inky air bubbles create foam or froth which is removed from the top, leaving the clean pulp behind.

Refining, Bleaching and Color Stripping

During refining, the pulp is beaten to make the recycled fibers swell, making them ideal for papermaking. If the pulp contains any large bundles of fibers, refining separates them into individual fibers. If the recovered paper is colored, color stripping chemicals remove the dyes from the paper.

Then, if white recycled paper is being made, the pulp may need to be bleached with hydrogen peroxide, chlorine dioxide, or oxygen to make it whiter and brighter. If brown recycled paper is being made, such as that used for industrial paper towels, the pulp does not need to be bleached.

Papermaking

Now the clean pulp is ready to be made into paper. The recycled fiber can be used alone, or blended with new wood fiber (called virgin fiber) to give it extra strength or smoothness.

The pulp is mixed with water and chemicals to make it 99.5% water. This watery pulp mixture enters the headbox, a giant metal box at the beginning of the paper machine, and then is sprayed in a continuous wide jet onto a huge flat wire screen which is moving very quickly through the paper machine.

On the screen, water starts to drain from the pulp, and the recycled fibers quickly begin to bond together to form a watery sheet. The sheet moves rapidly through a series of felt-covered press rollers which squeeze out more water.

Drying

The sheet, which now resembles paper, passes through a series of heated metal rollers which dry the paper. If coated paper is being made, a coating mixture can be applied near the end of the process, or in a separate process after the papermaking is completed. Coating gives paper a smooth, glossy surface for printing.

Rolling and Cutting

Finally, the finished paper is wound into a giant roll and removed from the paper machine. One roll can be as wide as 30 feet and weigh as much as 20 tons! The roll of paper is cut into smaller rolls, or sometimes into sheets, before being shipped to a converting plant where it will be printed or made into products such as envelopes, paper bags, or boxes.

