Harvest or Recycle For Paper

Grades: 4-5
State Standards:
Grade 4 Science, Investigation and Experimentation; 6.c Students will formulate and justify predictions based on cause and effect relationships. Grade 5, Science, Investigation and Experimentation 6.c Students will plan and conduct a simple investigation based on a student developed question and write instructions others can follow to carry out a procedure.
Groups: of 6
Preparation Time: 25 minutes
Activity Time: 30 minutes day one, 40 minutes day two
Key Words: natural resources, carbon dioxide, landfill**,** kraft pulping, lignin, humus

OBJECTIVE

In this lesson, students will learn about how trees are harvested to make paper. They will participate in an experiment and make a recycled piece of paper from newspaper. Students will understand where paper comes from and the impacts of not recycling.

MATERIALS

Students *(for six groups of five students)* bucket, tub, or tray (one per group), material to cover tables or floor, newspaper (twelve sheets per group), "Paper Prediction" worksheet (one per student), pencils to flatten wet paper.
Teachers: "From Tree to Paper" overhead (two options), water to fill buckets, two large bags of used newspaper, rolling pins or dowels to flatten paper

BACKGROUND

Trees provide numerous benefits to humans and the environment. They provide habitat for wildlife species and absorb carbon dioxide, giving off oxygen we breathe. Trees also enhance the environment, in which we live by providing wind breaks and altering climate, temperature and air quality. Trees provide economic benefits as timber for building materials, furniture, paper products, fuel, and food. The word "paper" comes from the Egyptian word "papyrus," a plant whose leaves were used as sheets for writing. Today, most paper is made from wood harvested from trees. Most of the trees harvested for the papermaking process are planted for this purpose. Another source of material for making paper is wood scraps from saw mills where lumber is made. Wood is made up of strong fibers or strands of cellulose that are stuck together by lignin. Lignin allows a tree to stand up. It gives the tree strength. The papermaking process separates and reorganizes these fibers to produce a flat sheet of paper. It takes approximately seventeen trees to make one ton of paper in addition to many other resources including energy and water, to name a few. When paper is recycled, the recovered paper can be used to make recycled paper, saving trees, water, and energy required to make a new sheet of paper from raw materials.

Recycling one ton of newsprint saves about 1 ton of wood while recycling 1 ton of printing or copier paper saves slightly more than 2 tons of wood. This is because kraft pulping requires twice as much wood since it removes lignin to produce higher quality fibers than mechanical pulping processes.

Lignin plays a significant role in the carbon cycle, sequestering atmospheric carbon into the living tissues of woody perennial vegetation. Lignin is one of the most slowly decomposing components of dead vegetation, contributing a major fraction of the material that becomes humus as it decomposes. The resulting soil humus generally increases the photosynthetic productivity of plant communities growing on a site as the site transitions from disturbed mineral soil through the stages of ecological succession, by providing increased cation exchange capacity in the soil and expanding the capacity of moisture retention between flood and drought conditions.

Approximately one-third of all household waste is paper. It is reported that a staggering 14 percent of landfill space is taken up by newspaper alone. Keeping paper out of landfill sites and reducing the number of trees cut is why it is important to recycle paper.

Another benefit of keeping paper out of landfills is that decomposing paper releases methane gas, which is a potent greenhouse gas (20 times more potent than carbon dioxide). Reducing greenhouse gases will reduce the effects of climate change. Therefore recycling paper also has a wide global environmental benefit.

Vocabulary
Kraft pulping: describes a technology for conversion of wood into wood pulp consisting of almost pure cellulose fibers.
Lignin: is a complex chemical compound most commonly derived from wood.
Humus: is natural compost extracted from a forest or other spontaneous source for use to amend soil. It is also used to describe a topsoil horizon that contains organic matter.
Cation (pronounced cat-eye-on) ***Exchange Capacity:*** is the measure of how many negatively-charged sites are available in your soil that attract and hold positively-charged plant nutrients such as Calcium, Magnesium, Potassium and Sodium

PROCEDURE

Be prepared to organize students into groups of six. If possible ask other adults to assist on day two. Have extra towels on hand for cleanup.
Day One:
1. Ask the students where they think paper comes from. Review the background section and discuss trees as a natural resource.

2. The practice of recycling paper not only saves trees, but it also conserves other resources such as energy and water while reducing pollutants that are released in the environment during the manufacturing process.

3. Post the overhead “From Tree to Paper” and explain how paper is made by describing the steps listed on the overhead.

- Forests are logged and transported to a paper mill
- Paper mill processes virgin wood to make paper removing lignin and bleaching fibers.
- Paper is transported to the marketplace
- Paper is used and discarded
- A recycling facility separates the recyclable paper from other recyclable materials
- Recyclable paper is transported to a paper mill and the process continues to make new paper from recycled paper

4. Have students raise their hands if they recycle paper at home or school. Ask students to predict what happens to paper when it gets recycled. Write their predictions on the board.

5. Have students look at the overhead and describe which steps of the papermaking process are not needed when paper that gets recycled is used to make new paper.

6. Tell the students they will learn about how recycled paper is made and participate in an activity that will test whether newspaper can be recycled to make new paper in the classroom.

Activity:
1. Show students the tools they will be using to make recycled paper out of newspaper. Ask the students to describe how they might use these tools to make a new piece of paper from newspaper.

2. Pass out the "Paper Prediction" worksheet to each student.

3. Have students predict what will happen to the newspaper if it is placed in a bucket of water and left to soak overnight. Ask them to record their prediction on the worksheet and justify it using a cause-and-effect relationship. For example, "I predict that the paper will begin to fall apart because the wet paper will not be as strong as dry paper."

4. Now have the students write a testable question based on their prediction statement about what will happen to newspaper when it is placed in water. For example, "Will newspaper lose its strength when soaked in water overnight?"

5. Organize the students into six groups. Students will remain in the same group for the Day Two activity.

6. Pass out at least six full sheets of newspaper to each group and a bucket (or small tubs or trays) filled with water.

7. Have the groups tear or cut the newspaper into small pieces (approximately two inches by two inches) and soak the paper pieces in warm water for at least one day.

8. Ask the groups to write their group number on a piece of tape and place it on the bucket.

Day Two (Making Paper Pulp)
1. Organize students into their groups from the day before.

2. Introduce students to the materials that each group will collect. Describe or model how the materials will be used.

3. Assign two students from each group to collect their group's bucket and sheets of newspaper. Each student in the group will share one set of supplies so they will have to take turns making paper.

4. Have the students observe what happened to the newspaper in the bucket, tubs or trays from the day before and record their observations on their worksheet.

5. Ask students to describe whether or not their predictions were correct. Have them answer the question they wrote on their worksheet based on their observations.

6. Using their hands, have the students squeeze water from lumps of soaked paper (wood fibers) in the bucket.

7. Have students spread out the paper pulp onto a tray lined with sheets of dry newspaper and flatten out the pulp using their hands, rolling pin or pencil.

8. After a day or two, or when the pulp is dry, have the students describe whether or not they were able to make new paper out of newspaper. Then have them write instructions for a friend that describes how to make recycled paper from newspaper using the same steps they followed in the classroom.

Discussion
1. Discuss different uses for recycled paper and share examples of products made from recycled paper, e.g., paper towels, cereal boxes, writing paper, toilet paper.

2. Ask students what natural resources are saved by recycling paper.

3. Brainstorm ways to conserve trees as a natural resource, e.g., reuse paper bags, use both sides of a piece of paper, use durable napkins and plates, etc., instead of disposables.

4. Have students describe how the practice of recycling paper saves natural resources and reduces waste to our landfill. Ask the students what the class can do to conserve paper consumption and recycle more. Implement the students' suggestions.

Extension
1. Paper is made by processing wood from trees by first chipping the log into small pieces and then placing the pieces in a large pressure-heated digester where the chips are mixed with water and chemicals. When the wood is broken down into cellulose fibers,

the fibers are then rinsed and a mushy mixture of water and wood remain. This is called "pulp." The pulp is sprayed onto large screens where the water begins to drain from the pulp fibers. As the pulp fibers begin to dry, they bond together in a mat that will soon become a sheet of paper.

Have students participate in a papermaking activity in the classroom. When making paper, add seeds to the pulp and plant the seed cards in a garden or planter using compost or potting soil. Have students research the history of paper and describe how the process of making paper has changed throughout time. A historical timeline can be created to illustrate their findings.

2. Have students apply reduction, reuse, and rebuy principles into the classroom. For example, the classroom can make a commitment to use both sides of every sheet of paper used in the classroom. Another option is when feasible students could use a mini whiteboard to complete math problems instead of paper.

ANALYSIS

Students understand paper waste recycling and reuse to reduce the amount of wasted paper in our landfills. They will apply the knowledge they gain by making changes in some of their consumer use choices. As with many other forms of recycling, the energy used in recycling materials is much less than that used in working with virgin materials. The total amount of energy used to recycle paper can be anywhere between 28 percent and 70 percent less, which represents significant environmental benefits.

Paper Prediction

Day One:
1. Write your **prediction** of what will happen to newspaper that is torn up and placed in a bucket of water overnight.

2. Write a **testable** question based on your prediction above about what will happen to newspaper when
it is place in water.

Day Two:

3. Observe and record what happened to the newspaper in the bucket.

4. Was your prediction correct? Based on your observations, answer your testable question above.

5. Write instructions for a friend describing how to make recycled paper from newspaper using the same steps you followed in the classroom.

From Trees to Paper Overhead

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