

# Lesson 7

## From Tree to Paper

v. 1.0.0



### Topic(s)

The 4Rs—Reduce, Reuse, Recycle, Rot  
 Conservation  
 Waste Prevention  
 Renewable Resources

### Duration

Lesson Steps—60-90 minutes over two days  
 Extension Ideas—varies

### 21st Century Learning Skills

- Collaboration
- Communication
- Creativity
- Critical Thinking

### Grade Level(s)

Fourth and Fifth

### Teacher Preparation

1. Be prepared to organize students into groups of 4-5.
2. Ask other adults to assist on day two if possible.
3. Have extra towels on hand for cleanup.

### Materials and Supplies

#### Students

1. *From Tree to Paper* rubric (one per student) **Page 5**
2. *From Tree to Paper* worksheet (one per student) **Page 6**
3. *Listen and Respond* worksheet (one per student) **Pages 7-8**
4. Bucket for soaking newspaper (can also use a tub or similar container—one per group of 4-5 students)
5. Tray for rolling wet newspaper (one per group of 4-5 students)
6. Material to cover tables or floor

(continued)

## SUMMARY

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 evaluate efforts to conserve paper at each level of the 4Rs hierarchy.

## CORRELATION WITH STANDARDS

### NEXT GENERATION SCIENCE STANDARDS

#### Fourth Grade

#### Fifth Grade

#### Standard and Performance Expectation

4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

#### Disciplinary Core Ideas

ESS3.A Natural Resources: Energy and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not. (4-ESS3-1)

ESS3.C Human Impacts on Earth Systems: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments. (5-ESS3-1)

### COMMON CORE STATE STANDARDS

#### Fourth Grade

#### Fifth Grade

#### Lesson Focus Standards

#### Speaking and Listening

SL.4.3: Identify the reasons and evidence a speaker provides to support particular points.

SL.5.3: Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence.

W.4.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

#### Supporting Standards

Reading: Informational Text  
 RI.4.1, RI.4.3, RI.4.7

Reading: Informational Text  
 RI.5.1, RI.5.3, RI.5.7

Speaking and Listening  
 SL.4.1, SL.4.6

Speaking and Listening  
 SL.5.1, SL.5.6

7. Newspaper (twelve sheets per group)
8. Rolling pins, dowels, or pencils to flatten wet paper.

## Teachers

1. Interactive whiteboard, document camera, or overhead projector (photocopy transparencies of visuals if needed)
2. *4Rs Pictographs* **Page 9**
3. *From Tree to Paper* visual **Page 10**
4. Warm water to fill buckets
5. Two bags of used newspaper

## VOCABULARY

**Harvest:** To collect or obtain (natural resources) for future use.

**Natural Resource:** Living and nonliving materials that come from the Earth such as fossil fuels, minerals, plants, animals, water, air, sunlight, and other forms of energy.

**Paper:** A thin material made of pulp from wood, rags, or other fibrous material often used for writing, printing, or packaging.

**Recycle:** A series of activities by which material that has reached the end of its current use is processed into material utilized in the production of new products.<sup>1</sup> Some recycled materials become new versions of the same thing, such as used aluminum cans being made into new aluminum cans. Others are made into entirely new items, such as used car tires being made into rubber mats or a playground surface.

**Renewable resources:** Naturally occurring raw materials or form of energy that has the capacity to replenish itself within a relatively short amount of time (e.g., a human lifetime) through ecological cycles and sound management practices (e.g., trees, agricultural crops, grasses).

## LEARNING OBJECTIVES

Students will...

1. Learn how paper is made from trees
2. Make recycled paper and learn ways to conserve resources by recycling paper
3. Write a summary of the process for recycling paper in class

## TEACHER 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. 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.

## LESSON STEPS: DAY 1

### Activating Prior Knowledge

1. Ask the students where they think paper comes from. Students can discuss responses with a partner or small group (e.g., “I think paper comes from \_\_\_\_\_ because \_\_\_\_\_.”) Chart their responses.
2. Tell students that paper is made from trees that are harvested for wood. Trees are considered a natural resource. Remind students that natural resources are living and nonliving materials that come from the Earth such as fossil fuels, minerals, plants, animals, water, air, sunlight, and other forms of energy.
3. Review the 4Rs hierarchy by:
  - Displaying the *4Rs Pictographs*.
  - Having students hold up four fingers and say each word chorally as they point to a finger (i.e., “First—reduce. Second—reuse. Third—recycle. Fourth—rot.”) You may also choose to teach students gestures, hand motions, or key words to match the 4Rs and aid memorization. (Reduce = Use Less. Reuse= Use it Again. Recycle = Turn it into something new. Rot = Decompose.)
  - Having student volunteers post the *4Rs Pictographs* in the correct hierarchy—Reduce, Reuse, Recycle, Rot.

**Reduce:** The best way to limit waste and decrease our use of natural resources is to use less stuff in the first place.

**Reuse:** After reduce, the next best option is reuse because additional natural resources aren't required and there is no manufacturing.

**Recycle:** When reuse isn't possible, the next level in the hierarchy is recycling because it extends the life of existing resources and uses less resource-intensive manufacturing processes.

**Rot (or compost):** Finally, organic materials (originally living plants or animals) that cannot be reused or recycled can be decomposed (rot) to produce compost, a rich soil amendment that helps plants grow.

4. Brainstorm ways to conserve trees as a natural resource through each of the 4Rs reviewed above, e.g., reuse paper bags, use both sides of a piece of paper, use durable napkins, plates, etc., instead of disposables.
5. Inform students that this lesson is about the process of recycling paper, which not only saves trees and protects fish and wildlife habitat, but also conserves other resources such as energy and water while reducing pollutants that are released into the environment during the manufacturing process.

## Building Background

6. Display the *From Tree to Paper* visual and explain how paper is made by describing the steps listed on the visual.
7. 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. Students might record their predictions on a Post-it note or individual whiteboard to increase engagement and accountability.
8. Ask students to look back at the *From Tree to Paper* visual. Have students predict which step(s) of the papermaking process are not needed when paper that gets recycled is used to make new paper.
9. If students are not yet ready to describe the steps outloud or in writing, consider scaffolding by having students point directly to the visual or hold up one finger for wood mill, two fingers for paper mill, etc.
10. 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.

## Check for Understanding

11. Reread the paragraph at the bottom of the visual. Pause on Tier 2 academic vocabulary words such as *processing* or *bond*, as well as Tier 3 academic

vocabulary words such as *cellulose* or *pulp fibers*. Have students say the words on which you paused.

12. Invite partners to retell how paper is made, using the displayed *From Tree to Paper* visual as a reference. Encourage the use of temporal words such as *first*, *next*, *then*, and *finally*.
13. Ask students to discuss the following questions with a partner or small group:
  - Are trees a renewable or nonrenewable resource? How do you know? (Renewable; we can plant more trees)
  - Your friend tells you, "I don't need to recycle paper. We can just plant more trees." Explain to your friend why it's still important to conserve renewable resources. (Compared to paper made from trees, the process of manufacturing recycled paper requires less water and energy, and releases fewer pollutants into the environment. It also protects the habitat of fish, wildlife, and other plants that depend on the trees for their survival.)

## Activities

14. Display the lesson rubric, and review the expectations for this lesson.
15. 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 pieces of paper from newspaper.
16. Pass out the *From Tree to Paper* worksheet to each student. 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."
17. Model for students how to turn their prediction statement into a testable question about what will happen to newspaper when it is placed in water. For example, "Will newspaper lose its strength when soaked in water overnight?"
18. Organize the students into groups of 4-5. Distribute to each group at least six sheets of newspaper and a bucket filled with warm water. Ask the groups to write their group number on a piece of tape and place it on the bucket.
19. 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.

## LESSON STEPS: DAY 2

### Activities, cont.

20. Organize students into their groups from the day before. Assign two students from each group to collect their group's bucket and sheets of newspaper, as well as a tray.
21. The students will observe what happened to the newspaper in the bucket from the day before and record their observations on their worksheet.
22. Ask students to describe whether or not their predictions were correct. Students will answer the questions they wrote on their worksheet based on their observations.
23. Using their hands, have the students squeeze water from the lumps of soaked paper (wood fibers) in the bucket.
24. Have students spread out the paper pulp onto a tray lined with sheets of dry newspaper and flatten out the pulp using their hands, a rolling pin, or a pencil.
25. 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.

### Wrap-Up

26. Students will write instructions for a friend that describe how to make recycled paper from newspaper using the same steps they followed in the classroom. This is the last question on the *From Tree to Paper* worksheet.
27. Discuss different uses for recycled paper and share examples of products made from recycled paper, e.g., paper towels, cereal boxes, writing paper.
28. Remind students of their earlier discussion about how they'd respond to a friend who doesn't think recycling paper is important. Solicit a few volunteers to share with the whole class. Emphasize the point that conserving trees by reducing our paper usage

is higher on the 4Rs hierarchy than recycling. Like all recycling, paper recycling reduces environmental impact; it doesn't eliminate it.

29. Listen to the American Public Media (APM) story [Everything you ever wanted to know about recycling](http://goo.gl/eQueN5) (7:05) without taking notes. (Story available at <http://goo.gl/eQueN5>) Note: The text found at this link is not a substitute for listening to the audio clip; it is not a transcript of the audio.
30. Pass out the *Listen and Respond* worksheet. Students will listen to the APM story one more time, noting the speaker's points, reasons, and evidence.
31. Complete the *Listen and Respond* worksheet by having students read the article that accompanies the audio. If possible, have students read the article on classroom computers or one-to-one devices to conserve paper. If making paper copies, consider providing one copy to each pair or trio of students. Students can use the information in the article to check their work or expand on their answers.

### Extension Ideas

- Provide students access to the [Reduce, Reuse, Recycle Guide for Napa County](#). Invite students to turn the recycling guide into a student-friendly brochure, poster, or multimedia presentation.
- Have students choose and campaign for one of the solutions brainstormed during the *Listen and Respond* worksheet activity.
- 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.

## REFERENCES

Tier 2 and Tier 3 Academic Vocabulary Vocabulary <http://achievethecore.org/aligned/including-tier-2-vocabulary-instruction-in-curricular-materials/> and/or <http://www.readingrockets.org/article/choosing-words-teach>

<sup>1</sup> National Recycling Coalition. Forthcoming. <http://nrcrecycles.org/nrc-updates-definition-of-recycling/>

Alameda County Waste Management Authority and Recycling Board. *Doing the 4Rs – A Classroom Activity Guide to Teach Reduce, Reuse, Recycle and Rot*. 2010. Web. 18 November 2014. <<http://www.stopwaste.org/recycling/schools/curriculum-and-videos>>.

City of Napa, County of Napa, and Napa Recycling & Waste Services. *Reduce, Reuse, Recycle Guide for Napa County*. 2016. Web. 19 July 2016. <<http://schools.naparecycles.org/wp-content/uploads/2016/09/Napa-Recycle-Guide-2016.pdf>>.

## From Tree to Paper

### Rubric

A rubric is a scoring tool that helps you understand how your work will be evaluated. This rubric is provided to show you the expectations for your performance and engagement during the lesson based on specific tasks.

Name \_\_\_\_\_ Date \_\_\_\_\_

Task	4	3	2	1
<b>Papermaking Experiment</b> (Individual or Group)	Student meets the expectations for collaboration by taking turns and staying on topic. Student demonstrates leadership by helping others and solving problems. Student follows directions successfully and creates recycled paper.	Student meets most of the expectations for collaboration, such as taking turns and staying on topic. Student may have some difficulty creating recycled paper.	Student participates in the experiment, but has trouble taking turns or staying on topic. Student does not successfully create recycled paper.	Student does not participate in the experiment.
<b>From Tree to Paper Worksheet</b> (Individual)	Responses are thorough and correct. Directions thoughtfully explain all of the steps to make recycled paper. Facts from discussion and experiment are integrated as supporting evidence.	Responses are correct, though may lack some detail. Directions correctly sequence all of the steps to make recycled paper. Some facts from discussion and experiment are integrated as supporting evidence.	Some responses are incorrect. Directions correctly sequence some of the steps to make recycled paper. Few facts from discussion and experiment are integrated as supporting evidence.	Responses are incomplete. Directions incorrectly or superficially sequence the steps to make recycled paper. Does not contain facts or evidence from class discussions or experiment.
<b>Listen and Respond Worksheet</b> (Individual)	Notes are thorough, neat, and accurate. Student correctly identifies the expert's statement and supporting details in the audio clip.	Notes are mostly correct, though may lack some detail. Student correctly identifies the expert's statement and supporting details in the audio clip.	Notes lack detail or are difficult to read, and may contain some errors. Student can locate some expert statements in the audio clip, but does not accurately identify evidence or reasoning.	Notes and responses are superficial and incomplete.

From Tree to Paper

From Tree to Paper Worksheet

Name \_\_\_\_\_ Date \_\_\_\_\_

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 placed in water.

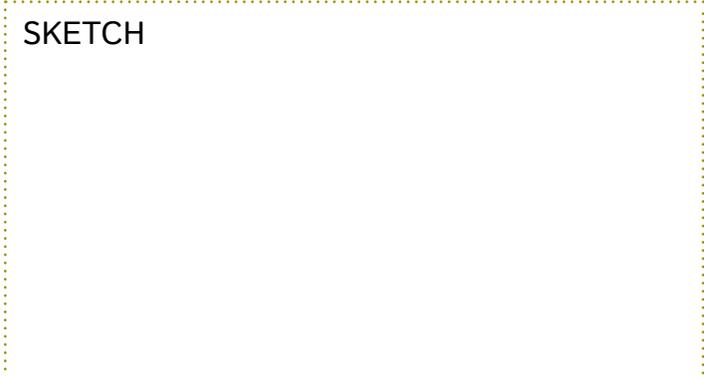
.....  
.....

Day Two:

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

.....  
.....  
.....  
.....

SKETCH



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 Tree to Paper

---

### Listen and Respond Worksheet (Page 1)

Audio clips, such as stories or reports heard on the radio, can be an effective way to learn information on a topic. Read the questions on this worksheet thoroughly BEFORE the audio begins, so you know what to listen for, then pay close attention to the information shared in the clip and take notes on what you hear.

Name \_\_\_\_\_ Date \_\_\_\_\_

**Name of audio clip:** Everything you ever wanted to know about recycling

**Reporter:** Sabri Ben-Achour, Marketplace

**Experts:** Thomas Attridge, General Manager of Sims Municipal Recycling

Kathryn Garcia, New York City Sanitation Commissioner

Ron White, Chief Process Improvement Officer at Owens-Illinois Glass Company

Sharon Kneiss, President and CEO of National Waste & Recycling Association

**Does it hurt for us to toss contaminated or non-recyclable items in the recycling bin?**

Thomas Attridge says .....

.....

He supports his point with the following reason or evidence: .....

.....

.....

**How do recycling facilities separate all the various types of materials in single stream recycling?**

Thomas Attridge says .....

.....

He supports his point with the following reason or evidence: .....

.....

.....

**Has recycling reduced the need for landfills?**

Sharon Kneiss says .....

.....

She supports her point with the following reason or evidence: .....

.....

.....

From Tree to Paper

Listen and Respond Worksheet (Page 2)

Name \_\_\_\_\_ Date \_\_\_\_\_

Does recycling make economic sense?

Kathryn Garcia says.....

She supports her point with the following reason or evidence:.....

After you've finished listening to the audio for the second time and completed the worksheet, go back to the website and read the [text that accompanies the story](#). You can use the text to check or improve your answers to the questions above, and then answer the following questions.

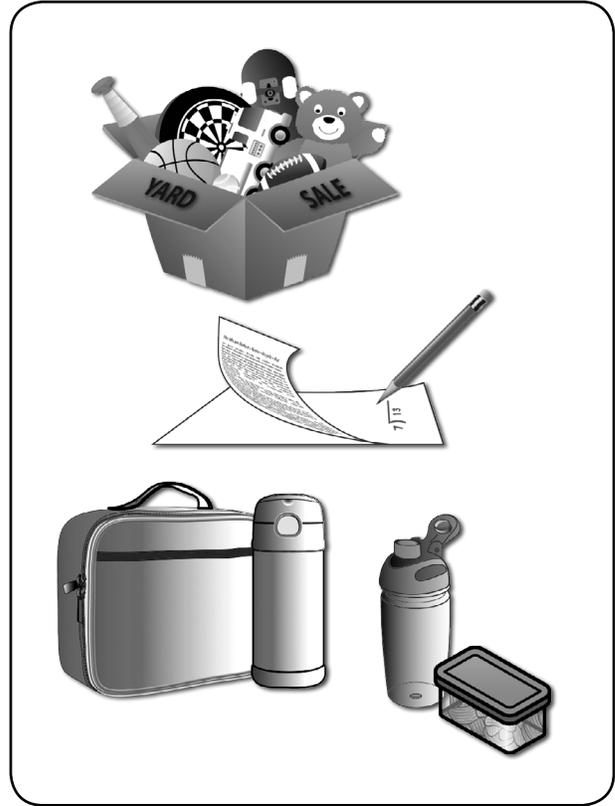
Why is Styrofoam not accepted in our recycling bins? Is it not possible to recycle Styrofoam, or is there another reason?

The text mentions that shredded paper is a problem for recycling facilities, but here in the Napa Valley shredded paper is acceptable IF it's in a clear bag. Why do you think it's important to put shredded paper in a clear bag?

# REDUCE



# REUSE



# RECYCLE

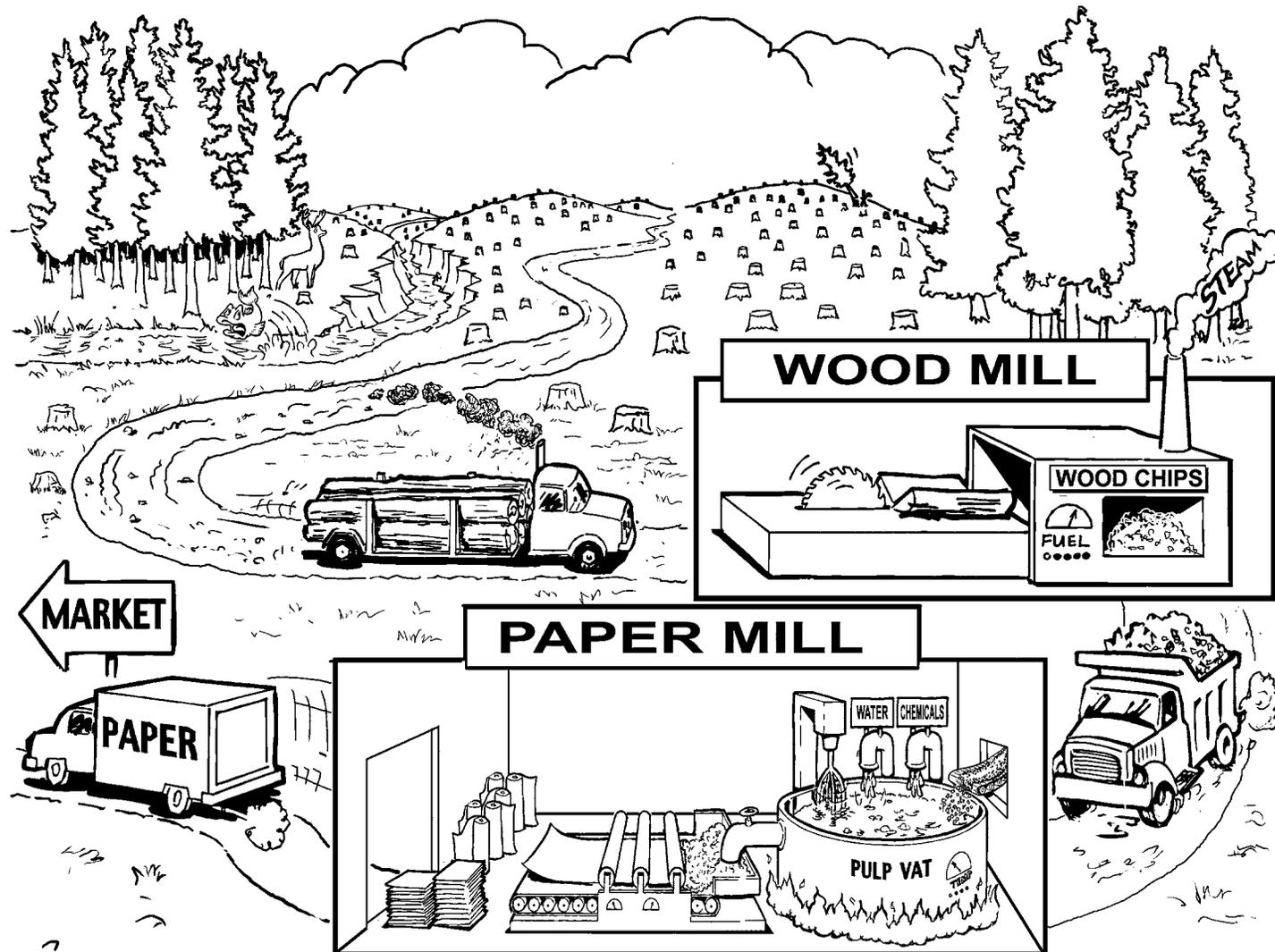


# ROT



## From Tree to Paper

## From Tree to Paper Visual



Paper is made by processing wood from trees. Wood is first chipped into small pieces, and those pieces are placed in a large digester. They are mixed with water and chemicals, then "cooked" under high-pressure and heat to break the wood down into cellulose fibers. The cellulose fibers are then rinsed, and the remaining mushy mixture —called "pulp" —is refined. Refining is done in different ways depending on the type of paper being made, but usually involves repeatedly pressing the pulp between metal bars or through rotating metal disks. The refining process cuts, separates, and softens the fibers, and frays their edges, allowing the fibers to more easily bond together. The refined pulp is sprayed onto large screens. As the water begins to drain and the pulp begins to dry, the fibers bond together in a mat that will soon become a sheet of paper. The process of making recycled paper is very similar, except that the pulp is made from paper instead of wood. By starting with paper instead of wood, the paper-making process requires less water and energy, uses fewer chemicals, and conserves raw materials.

Note: Not all paper can be recycled. Dirty or food-soiled paper, such as paper napkins, paper plates, paper towels, and tissue, can't be recycled and should never be put in the recycling bin. These types of paper introduce oils and other contaminants into the pulp, and should be composted instead of recycled. Even if they're clean and unused, these types of paper are not recyclable—their fibers are too short and lack the strength to bond effectively with other paper fibers during the recycling process—and should still be composted. Better yet, they should be replaced with cloth towels/napkins and reusable plates.