

Essay: Fueling the Fires of Industrialization

Introduction

The United States underwent a period of dramatic change during the first half of the nineteenth century. Previously a predominantly rural nation with many small farms, by the beginning of the Civil War, America had begun a transition towards a more urban and industrial society. Propelled by an influx of European immigrants, in addition to many technological advances, U.S. cities and industry grew at a quick pace. Between 1860 and 1910, the transformation of America into a world industrial power took shape. Historians often call these years of rapid industrialization and urbanization, the American Industrial Revolution. Although sometimes overlooked, wood played an instrumental role in fueling the fires of industrialization in the United States.

Early Forest Products

Even before the United States made its transition to an industrial nation, wood was an essential resource for most Americans. In 1836, lawyer, judge, and writer, James Hall (1793-1868), articulated this point when he stated, “Well may ours be called a *wooden country*; not merely from the extent of its forests but because in common use wood has been substituted for a number of most necessary and common articles – such as stone, iron, and even leather.” Besides serving as the material used to build most houses through the nineteenth century, wood also was used to construct fences, furniture, roads, bridges, and carriages. Moreover, Americans used wood to cook meals and heat their homes. In fact, by the late 1700s the average American family consumed between 20 and 40 cords of wood each year. In addition to domestic purposes, wood also contributed to the production of iron – a metal of increasing importance to the U.S. economy. Popular because of its plentiful supply and ease in producing fire, wood was used in the smelting of iron throughout the eighteenth and

much of the nineteenth centuries. Recent estimates indicate that approximately 5 to 6 million acres of forests were cleared to produce iron during the 1800s.

Wood Begins to Fuel the Industrial Fire

During the latter half of the nineteenth century, use of products from the forest continued to increase. Although coal replaced wood as the major fuel source both in the home and in industry, and brick, iron, and steel were the major components of many machines and buildings of the period, the demand for wood failed to decline. Between 1850 and 1900, the U.S. population tripled from 23 million to 76 million people. Extensive forestland was cleared to make room for the new population and to fuel the increasing industrialization transpiring across the country. For instance, by 1850 over 700 steamboats traversed the American waterways, carrying both goods and people to and from bustling commercial ports. Commonly constructed of wood, steamboats also consumed vast amounts of fuelwood on a daily basis. Steamboats often had to stop twice daily at local “wooding stations” (small, independent operations typically run by squatters, or people with no legal title of ownership to the land they were clearing). Despite coal’s widespread use for fuel during the 1800s, the majority of steamboat operators continued to use wood because of its cheap cost and widespread availability.

Make Way for the American Railroad



Figure 1. Construction ended on the Great Northern Railway's transcontinental railroad on January 6, 1893. Great Northern Railway photo, *Forest History Society collection*.

Although many changes occurred during America’s industrial age, the railroad quickly became the symbol of the nation’s rapid progress. In 1847, the noted statesman and lawyer Daniel Webster remarked that the railroad, “towers above all other inventions of this or the preceding age.” The railroad altered people’s perceptions of time, space, and distance. Whereas traveling by foot or on horse

could take days or weeks, railroads oftentimes accomplished the same trip in mere hours. The new mode of transportation facilitated both the dissemination of information and goods; railroads bridged the distance barrier between the different regions of the country helping to forge political, fiscal, and corporate networks. All things considered, railroads not only made traveling easier, but more importantly, tied the growing nation together.

Consisting of only 3,000 miles in 1840, by 1910, the miles of U.S. railroad tracks leapt to 240,000. Despite earning the nickname “iron road,” railroads utilized a greater amount of wood than any other material and accordingly placed a great strain on American forests. For example, except for the engine and rails, most other components of railway systems such as railroad cars and stations, telegraph poles, bridges, trestles, and fences all were made of

wood. Furthermore, crossties, the beams or rods that support the rails, constituted the most significant railroad use of wood. On average, each mile of track required over 2,500 crossties. And, due to deterioration caused by environmental factors like humidity, water, and fungi, wooden



Figure 2. Wooden Crossties (1913). *Forest History Society* photo.

crossties had to be replaced every 5 to 7 years on average. By the late 1800s, railroads accounted for between 20 and 25 percent of U.S. timber consumption and led to the clearing of vast amounts of forestland – in 1900 alone, over 15 million acres of forests were cleared just to replace railroad ties!

Technology Conserves the Forest

Throughout most of the nineteenth century the plentiful supply of wood in the United States meant that people often wasted the natural resource. Farmers cut so much wood for crossties that railroad companies were oversupplied. Because the

supply (the amount of goods available for meeting a demand or for purchase at a given price) exceeded the demand (the amount of goods that people are ready to buy for a given price) railroad companies had no incentive to conserve trees or search for more efficient production techniques. By the late 1880s a change in thinking occurred that prompted a change in the practices employed by many American railroad companies. Responding to growing public concern that America's industrial movement was rapidly depleting U.S. forests, which in turn would cause a sharp increase in the price of wood, some railroad executives invested money in technical research and development to decrease the amount of wood consumed by their companies. The most prominent example of this attempt to preserve trees involved the chemical treatment of wooden crossties.

Many European railroad companies experimented with methods to prolong the life of wooden railroad ties throughout the nineteenth century (due in great part to a timber shortage throughout much of the continent) and similar efforts began in the United States in the 1870s. Most experts agreed that wood was the best material for crossties mainly because of its ability to absorb the impact of fast-moving and heavy trains without breaking. The early ties, typically about 8 inches wide and 6 inches thick, were durable, but also deteriorated quickly when exposed to humidity and moisture. As

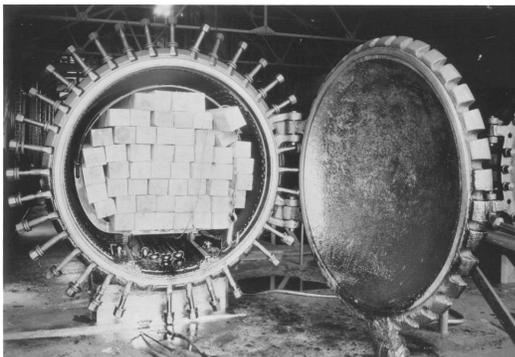


Figure 3. Treatment of wooden crossties (date unknown). Northern Pacific photo, *Forest History Society* collection.

the supply of timber nearby railroad tracks began to dwindle into the late nineteenth century, more and more railroad personnel realized the value of implementing techniques to increase the average life of the crosstie. By 1900, 14 small plants oversaw the chemical treatment of wooden crossties. Only four years later, the number of plants increased to 33, a number that rose further still to 102 by 1915. As the price of wood continued to rise amid worries of a timber famine,

research studies finding that treating ties with a chemical like creosote could increase the life of the structure, prompted many railroad companies to adopt the practice. Today, most railroads, both in the United States and abroad, still use wooden crossties. Moreover, nearly all modern ties are chemically treated, resulting in an average life of 30 to 40 years, as opposed to a 5 to 7 year life without addition of any preservatives. The technological innovation of chemically treating crossties therefore not only saved railroad companies much money, but also significantly reduced the use of wood for crossties thereby making forests available for other purposes.

More Technological Advancements

Another prime example of how technology helped alleviate the strain placed on American forests during the Industrial Revolution appeared in the treatment of wooden fences. From the colonial period through the mid-nineteenth century, wood was used in the construction of fences. In addition to private farms, fences also appeared around logging camps, railroad tracks, and Western ranches. By 1850, there were approximately 3.2 million miles of wooden fences in the United States, enough to encircle the earth 120 times! Similar to the crossties used in American railroads, wooden fences, when exposed to the elements rotted at a quick pace, and had to be replaced frequently. However, when chemically treated, much like crossties, wooden fences lasted much longer and therefore decreased the number of trees cut on an annual basis for the building of fences.



Figure 4. Hand-split rails stacked in zigzag fashion were commonplace across early America. Fences such as the one above, consumed large quantities of wood and deteriorated quickly. *Forest History Society* photo.

Besides the treatment of wooden crossties and fences, another technological innovation also alleviated the strain placed on U.S. forests: the invention of barbed wire. Used most frequently by western ranchers and homesteaders, barbed wire fences

helped transform the West from a land known for its open spaces, to an area with increasing boundaries and emphasis on private ownership. Although cowboy ballads and songs such as Cole Porter's, "Don't Fence Me In," lamented the loss of freedom in the American West, barbed wire fences proved more effective than their wooden counterparts in preventing the loss of livestock and the open grazing of cattle and sheep. Furthermore, since wood was scarce on American prairies and plains, the use of barbed wire for fences proved much less expensive than wood and in turn helped reduce the strain on eastern forests.

Forest Products: Past and Present



Figure 5. Wooden bats. Photo by R.B. Russell USFS Forest Products Laboratory, *Forest History Society* photo.

Throughout the history of the United States, Americans have relied upon forest products in many facets of their lives. Colonists used wood to build houses, cook food, and fence in their animals. Early Americans enjoyed consumable goods like cider, maple syrup, and fruits and nuts – all products of trees. A variety of wood was used in the past, and continues even today, as the major components of furniture, such as tables, chairs,

bookcases, and cabinets. Additionally, wood, both in the past and present, also occupies an important position in American pastimes. Billiard tables, baseball bats, bowling pins, and jigsaw puzzles, to provide but a few examples, all are made of wood.

In the twenty-first century, Americans continue to rely upon forest products. Through extensive research and technological advances, we now have the knowledge to convert tree fibers, bark, wood components, and residues left behind following the making of paper, into a variety of household products. Cellulose, considered the basic building block of wood, resin, a sticky material found in many trees that hardens when exposed to air, and terpene, a compound derived from the oils of many conifer (cone-bearing) trees and plants, are just three examples of materials extracted from trees to aid in the production of many products. In fact, many commonplace items such as

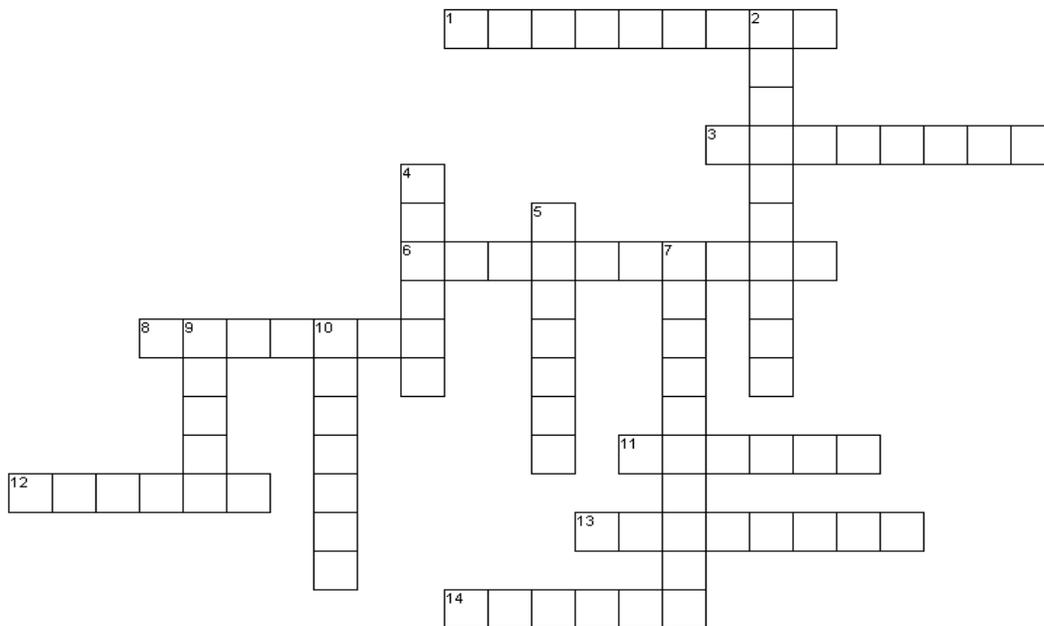
toothpaste, film, vinegar, cutting boards, and carpet all come from trees. In conducting a quick inventory of objects in your classroom or home, you most likely would be surprised regarding the many forest products used in both settings on a daily basis!

Conclusion

America experienced great changes during the nineteenth century. Sparked by technological advances and a large increase in population, the United States evolved into a leading industrial power. Wood played a significant role in America's transition from a principally agricultural nation to a country of thriving metropolises that manufactured a great variety of goods. The most striking example of the change, the railroad, although called the "iron rail," relied upon wood to connect the nation. Used to build crossties, bridges, and station houses, in addition to serving as an important source of fuel, wood kept the railroads running by fueling the fires of industrialization. Increased technology and a growing fear of a timber famine sparked advancements (such as the chemical treatment of wooden crossties and fences and the invention of barbed wire) that helped ease the strain placed on forests during the nineteenth and early twentieth centuries. Finally, throughout its history, the United States used many forest products. From furniture to sporting equipment, wood shaped American society and even popular pastimes. Today, forest products often appear in less obvious forms than in times past. As a result of research and development many household items from shampoo to postage stamps are derived from trees.

Worksheet 1: Keywords

Read the essay to complete the puzzle below.



Across

1. Considered the basic building block of wood.
3. The _____ drastically changed the perception of time, space, and distance in America.
6. The Industrial _____ was a period in American history marked by rapid industrialization, vast technological improvements and increased urbanization.
8. A framework consisting of vertical, slanted supports and horizontal crosspieces supporting a bridge.
11. _____ products come from the renewable resource of trees.
12. Amount of goods that people are ready to buy for a given price.
13. A beam or rod, typically made of wood, that supports and connects the rails of a railroad track.

14. Amount of goods available for meeting a demand or for purchase at a given price.

Down

2. Until the growth of railroads after the Civil War, _____ transported most people and goods in the U.S.
4. _____ wire helped shape life in the American West greatly reducing the number of trees used for wooden fence posts.
5. A cone-bearing tree, often evergreen.
7. New _____, most specifically the chemical treatment of crossties, helped reduce the amount of wood used by American railroads.
9. Sticky material found in many trees and plants that hardens when exposed to air.
10. An organic compound derived from the essential oils of plants and trees.



Worksheet 2: Essay Analysis

Read the essay to answer the questions below.

1. List three common uses for wood in America before the advent of the Industrial Revolution.
2. Describe how the rapid increase in the population of the United States during the latter half of the nineteenth century affected American forests.
3. How did steamboats place strain on American forests during the nineteenth century?
4. What role did the economic principles of supply and demand play in the amount of wood used during the American Industrial Revolution?
5. Provide two examples of how technology helped to conserve forests during the nineteenth and twentieth centuries. Supply evidence to support your two examples.
6. Explain how the nickname “iron road,” could be considered a misleading description of nineteenth-century American railroads.

Compare and contrast forest products of the past in the United States with modern goods derived from trees.

Worksheet 3: Wood Keeps the Fires Burning

Scenario: Recently a box was discovered that contained two old photos and a page of notes. The contents belonged to a local reporter on assignment from the 1920s writing a story about the role wood played in the American Industrial Revolution. It is up to you to use the evidence in this box to complete the reporter's story.

Problems:

1. Although the photos contain information about their origin, no explanation of its significance to the story is provided.
2. Despite the helpfulness of the notes, no conclusions are included that would explain their significance to the story.

Assignment: Use the two photos, notes, and information from the essay to create a five-minute television program exploring the role wood played in the industrialization of America between 1840 and 1910. Be creative, remembering that television can be a useful educational tool in its ability to captivate its audience. For example, music, posters, and realistic props are just a few ways to entertain while simultaneously teaching people about history. Before creating your program, analyze the two photos and page of notes. Complete the chart below by listing facts contained in these items and corresponding conclusions you can draw from this information. Use this chart to help you decide what material should be presented in your broadcast. An example of a fact and conclusion are listed below.

Fact	Conclusion
Many railroads had station houses.	From examining Photo #2 and reading the line of the poem " painted stations," you can conclude that these buildings were made of wood.

NOTES

- Was not until 1905 that railroad passenger cars were made of steel
- Rivers were the first U.S. "highways"
In 1840, almost 900,000 cords of wood sold for steamboat fuel (about one-fifth of all fuelwood sold).
- Called the iron road, but for most of 19th century only train engines and rails were made of iron
- Telegraphs used to dispatch trains beginning in 1851 (telegraph poles made of wood)
- Lumber production increased more than 8 times between 1850/1910 (from 5.4 billion board feet to 44.5 annually)
1850, lumber was second largest industry in US; in 1880, was 4th largest.
- mileage of U.S. railroads increased more than 30 times between 1850 and 1910.
By late 1800s railroads accounted for between 20-25% of total lumber consumption in US.
- wood = principal material in many 19th and 20th century modes of transportation - ~~used~~ used to construct most ships, riverboats, barges, plank roads, canal locks, and bridges.

From a Railway Carriage (1st stanza)
- Robert Louis Stevenson
Faster than fairies, faster than witches,
Bridges and houses, hedges and ditches;
And charging along like troops in a battle,
All through the sights of the hill and the plain,
All as if through the driving rain,
And ever again, in the wink of an eye,
Painted stations whistle by.

Photos

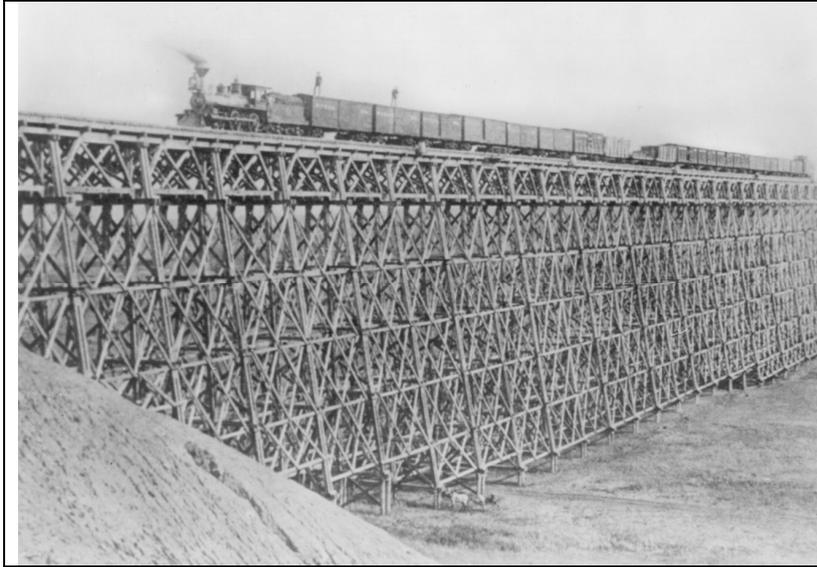


Photo #1 (Photo from *Forest History Society*)

Gasman Coulee Bridge

Located about 3 miles west of Minot, North Dakota.

Bridge was built between 1886 and 1887.

Bridge was 1,609 feet long, 102 feet high, and contained over 1 million feet of timber.



Photo #2 (Photo from Bumgarner, Matthew C. *Legacy of the Carolina & North-Western Railway* (Johnson City, Tennessee: Overmountain Press, 1996) Page 20.

June 5, 1884
Lenoir, North Carolina.

Crowd of approximately 5,000 people gathered in Lenoir to celebrate opening of railroad station.

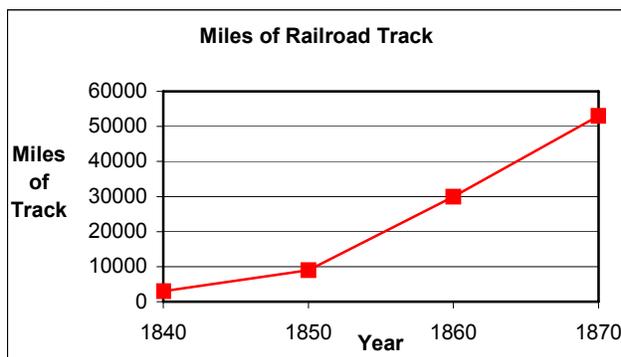
The Railroad and the Tie (Worksheet 4)

Part I. After reading the essay, “Fueling the Fires of Industrialization,” you already should have a basic understanding of both the expansion of American railroads during the nineteenth and twentieth centuries and the purpose and importance of the wooden railroad tie. Carefully read the following two paragraphs for more specific information about the railroad and the tie. (*Note:* All of the numbers below are estimated).

In 1880, sixty million wooden crossties were installed on American railroad tracks. By 1900, that number had increased by forty million. In 1921, records show that eighty-six million crossties were installed, a number that decreased by thirty-nine million in 1936. Most crossties were not treated with chemical preservatives until after 1900. Untreated crossties had to be replaced on average every five to seven years. Properly treated crossties, on the other hand, normally last between thirty and forty years. Statistics show that approximately three thousand crossties were installed per mile of railroad track. Just replacing railroad ties on a sustained basis required between fifteen and twenty million acres of forestland in 1900.

The mileage of U.S. railroads expanded rapidly during the latter-half of the nineteenth century and into the first few decades of the twentieth century. For instance, in 1880 there were 70,000 miles of railroad tracks, but by 1890 the number of miles increased by 84,000, and by 1900 had jumped to 193,000. In 1910, the United States had 240,000 miles of tracks, a number that increased by 10,000 two decades later.

Part II. Line graphs often are used when depicting changes over time. All graphs contain an “x” and a “y” axis. The “x” axis runs horizontally and the “y” axis runs vertically. Look at the example below to get a better understanding of a line graph.



Part III. Now that you have learned more about line graphs, you are ready to compose some graphs of your own. Go to Worksheet 4: “Using a Line to Graph History,” and complete as instructed.

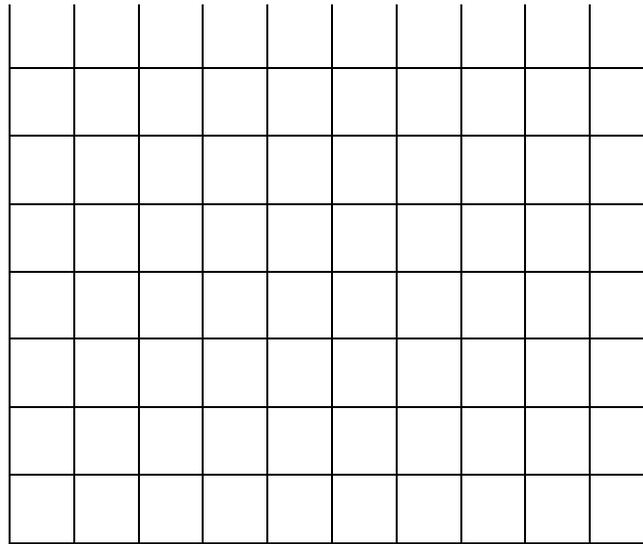
Part IV. Use the line graphs you drew in Worksheet 4, the essay, and the information from this page to answer the three questions below.

1. In the 10-year period between 1900 and 1910, how many new miles of track were built? How many crossties were installed for the tracks built between 1880 and 1940?
2. In what 10-year period between 1840 and 1930 was the rate of mile of track installed the greatest?
3. Over time did the miles of railroad track built increase or decrease? Over time did the number of crossties installed increase or decrease? How do you explain the discrepancy?

Worksheet 4: Using a Line to Graph History

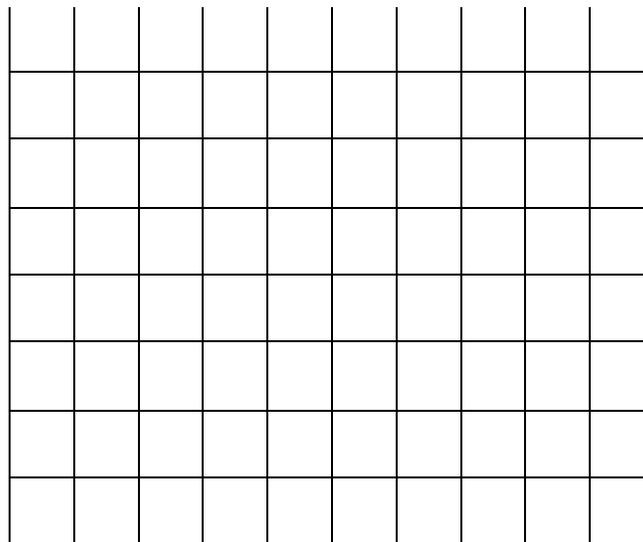
Directions: Use the information outlined in “The Railroad and the Tie” to draw two line graphs in the spaces provided below. The titles supplied for both graphs below should help you decide what information to include. Make sure to label the “x” and “y” axes. When you are finished, answer the questions in Part IV from “The Railroad and the Tie.”

Graph #1: Railroad Crossies



1880

Graph #2: Miles of Railroad Tracks (**Hint:** Use the sample graph in Part II from “The Railroad and the Tie” when completing the graph below).



1840

Worksheet 5: It Comes from a Tree

Directions: Use the objects in your box and “object cards” distributed by your teacher to complete the chart below. In the column labeled “Descriptive words or phrases,” make sure to describe each object *without* using any of the three *forbidden* words on the “object card.” Once your group has completed this worksheet, you will use this information to play a game to help teach your classmates more about forest products.

The Game: When instructed by your teacher, go to the front of the classroom. Without saying the name (or any portion of the name) of the first object from your chart or showing it to the class, first describe its connection to the forest. Once given the signal by your teacher you will have 30 seconds to describe the object to your classmates. The purpose of the game is to have the class guess the name of the object as quickly as possible. If you say the name of the item, show it to the class, or use any of the *forbidden* words, you will receive 0 points. A correct guess by the class within 10 seconds earns 3 points, 20 seconds earns 2 points, and 30 seconds earns 1 point. Repeat the above instructions with the second and third objects as well.

Name of Object	Connection to Forest	Descriptive Words or Phrases