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ABSTRACT

This instructional unit contains eight classroom lessons dealing with a history of energy in the United States for use in grade eight and nine social studies, science, and mathematics courses. The lessons were developed by teachers. The overall objective is to help students understand the present necessity to reexamine and perhaps alter our present energy patterns. Students study about the impact that the different types of energy used from colonial times to the present have had on U.S. culture and learn about the physical properties of wood, coal, and oil, particularly about the ability of these substances to give heat. The activities in which students are involved include answering questions based on short reading selections; gathering and interpreting materials from a picture; comparing the uses of energy by a colonial farm family and by a family of today; constructing a can calorimeter; learning how to determine the energy content of wood; applying the principles of scientific motivation to energy data; constructing and interpreting graphs; making a model of a steam turbine; and learning how to determine the heat content of oil. The amount of time needed to teach each lesson varies from one to four classroom periods. Each lesson is self-contained, and includes instructions for the teacher and student materials. The eight lessons are organized into three units: (1) America's Wooden Age (1650-1820); (2) The Coming cf Coal (1840-1920); and (3) Oil: Bright Promise (1880-present). (Author/RM)

HCP/U 3841-0004

Interdisciplinary Student/Teacher Materials in Energy, the Environment, and the Economy

An Energy History of the United States

Grades 8-9

January 1978

National Science Teachers Association

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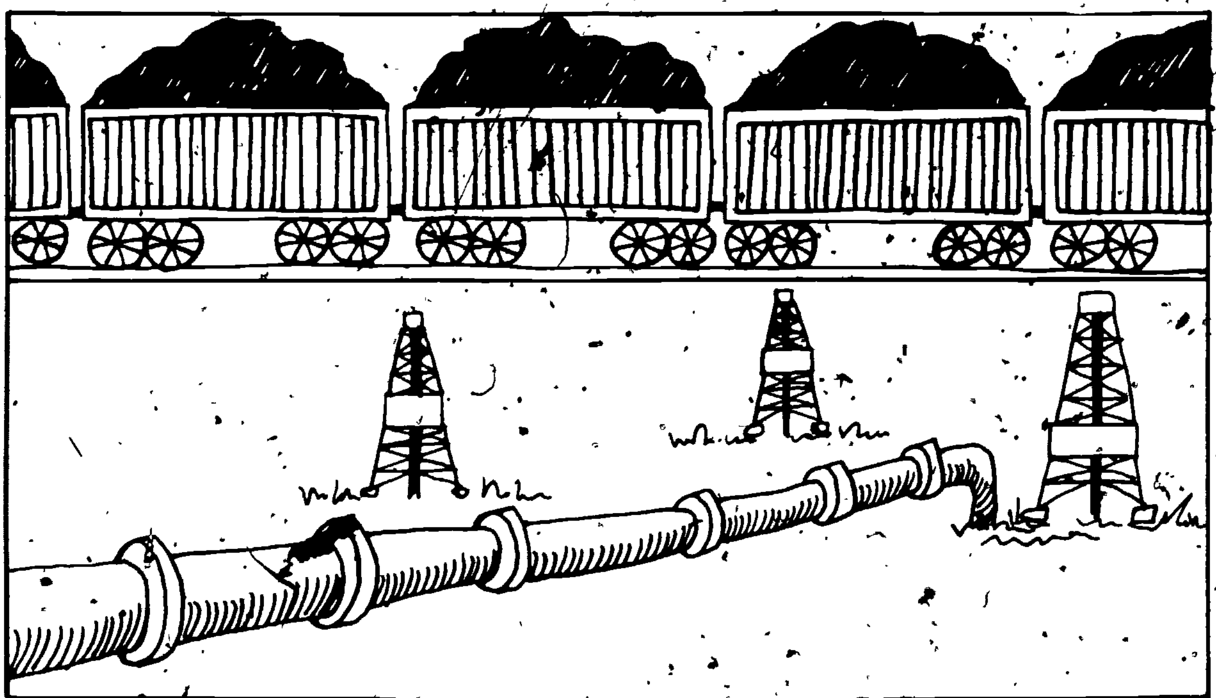
AN ENERGY HISTORY OF THE UNITED STATES



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December 1977
John M. Fowler
Project Director

DRAFT

AN ENERGY HISTORY OF THE UNITED STATES

Today, as in the past, the United States depends on several primary sources of energy to satisfy its large demands. The historical part of the energy story covers two almost complete transformations of the nation's energy base. The first occurred around 1850 when the nation changed from wood to coal. The second occurred after World War II when the nation moved into the Petroleum Age.

Each of the earlier energy eras, the age of wood and the age of coal, affected the culture of the time period. Each of the changes in primary energy source was brought about by the interaction of changes in technologies, population growth and the availability of resources. Each transformation brought both benefits and harm to the society.

Since World War II, the U.S. has lived mainly in an oil based culture. There is much evidence that this will change.

This is essentially an historical unit. It is aimed at giving the students an understanding of the influence of the type of energy used on the culture and the impact of energy change. Students study the physical properties of wood, coal and oil, particularly the ability of these substances to give heat. The students have practice with the mathematics necessary to understand energy conversion. It is hoped that cultural and historical perspective, along with the mathematical and scientific knowledge, will help the students understand the present necessity to reexamine and perhaps alter our present energy patterns.

AMERICA'S WOODEN AGE (1650-1820)

Target Class	Brief Description
Social Studies	Through pictures, maps and readings students learn the relation between energy and cultural patterns.
Science	Students examine the energy content of wood by constructing a Calorimeter, reading a thermometer, and weighing a given amount of wood.

Math	Students calculate the energy in wood and develop an increasing ability to work with large numbers.

THE COMING OF COAL
(1840-1920)

Target Class	Brief Description
Social Studies	Students develop tentative hypotheses about why the nation changed from wood to coal and then test these hypotheses with data.
Science	Students learn about the formation of coal, the different types of coal and how coal is used in the production of electricity.
Math	Students interpret various kinds of graphs, and then construct a series of graphs using energy-related data.

OIL: BRIGHT PROMISE
(1880-present)

Target Class	Brief Description
Social Studies	The students examine the changing needs and technologies that led to the increased value and use of oil. They predict changes in the culture if the present oil consumption, price rises and imports continue.
Science	Students conduct a lab activity to determine the heat content of oil.

The Colonial Period
AMERICA'S WOODEN AGE (Social Studies)

Overview

The period from the founding of the country to the three-quarter mark of the 19th century can be understood partly in the light of the primary energy sources available to the people. These were renewable resources of the sun, wind, water and wood as well as animal and muscle power. The interaction of human needs and wants with the resources of energy helped to shape the culture of the developing nation. As new technologies developed, as population grew and as desires increased, new sources of energy were needed. This lesson ends with the shift to coal power.

Target Audience

8th grade social studies.

Time Allotment

Two-three class periods.

Objectives

Students should be able to:

1. State reasons for the reliance on wood and animal power.
2. Make inferences from a variety of data.
3. Identify attitudes about energy use from selected primary source material.
4. Explain the relationship between energy use and various cultural patterns.

Materials

Dittoed copies of the Student Guide.

Teaching Strategies

Begin the lesson by asking the students to visualize themselves in a forest wilderness with a few simple tools such as a saw, ax, pick, and hand plow. They wish to farm the land. What tasks must be done? Who will do them? How? Would you like to do this kind of work? Why?

To help the students realize the enormous effort that goes into clearing land you could have them describe experiences of chopping wood or carrying wood for their fireplaces. Perhaps if there are wooden desks in the room, the students could carry the desks to see how heavy wood can be.

Activity 1

Pass out class sets of student Hand-Out 1, "The Death of Trees." Have students read the selection and then answer the questions. (Answers to the questions can be found in the Teacher's Guide.)

THE DEATH OF TREES
(Student Hand-Out 1)

Until the Elizabethan days (the days when Elizabeth I was the queen of England), there had been a very low level of energy use throughout England. There was enough fuel for everyone to help themselves and move on when supplies ran out.

The fuel was wood, and wood was everywhere. Whole forests covered the home counties. It needed no processing... It provided for all the needs in the home and for the few young industries that existed then. No one noticed the sharp rise in energy demand and the sharp rise in wood consumption (use) until the wood began to run out.

By the 1550's, the woods of several counties were all used up, and the ground had been converted to pasture... more and more remote forest areas were opened up and used up, and as the supplies shrank, the growing industries moved out after them. Iron works were set up in the middle of forests.

When even the forests of Scotland were destroyed and supplies came to an end, what followed came close to a national disaster. Over whole areas of the British Isles the use of wood for heating homes died out because there was barely enough fuel for cooking... most of the population lived at a subsistence level or starved. This was the energy supply situation.

"The Death of Trees", An Index of Possibilities, John Chesterman, et al. Pantheon Books, New York, 1974, p. 92.

Answers to Student Questions

Student Hand-Out 1

1. When and where does this account take place? *(British Isles, 16th century.)*

2. What was the most widely used fuel at this time? Why was it such a good source? *(Wood; it was available in great quantities. It was also free.)*

3. What were some of the uses of wood during this time? *(Heating homes, cooking food, some new industries.)*

4. According to the reading, what did the people do when the local supply of wood ran out? *(Moved to new areas.)*

5. Why was there no attempt to conserve (save) forests at this time? *(The people believed that there was an unlimited supply of wood.)*

6. The reading suggests that the demand for wood increased after 1550. What reasons can you give for this? *(Growing industry and growing population.)*

7. The reading states that when wood ran out many people lived at subsistence level or starved. Explain why you think this happened. *(The number of animals that lived in the forest declined as the forests disappeared. Traditional jobs were no longer available.)*

8. Why did the industries clear the woods? *(To get at the coal which was necessary for industrialization.)*

9. Although some people suffered when forests were cleared, some people benefited. Describe who might have benefited. *(The people who worked in the new factories, the owners of factories, the people who used the products of the factories.)*

10. Can you think of an energy situation today that is similar to England's in the past? *(Students can discuss the oil situation.)*

Activity 2 This activity asks the students to consider the attitudes of two groups of people toward the same resource - wooded land. They are asked to see how this attitude affects the life style of the two groups.

Have students read Hand-Out 2: "The Indian View of the Pilgrim Landing" and "William Penn". Then answer the questions.

(Student Hand-Out 2)

THE INDIAN VIEW OF THE PILGRIM LANDINGS

(The characters in this story are fictional, but the story is based on a true event.)

"Grandfather," said the small Indian lad, "I have been to Plymouth. What happened there?"

The chief spoke softly and sadly. "I asked you not to go there, but now that you have... I shall tell you the sto[illegible]

"I was a small boy when the white man came to our [illegible] I saw the small speck at sea become a huge canoe with white blankets to catch the wind. Then the white man landed. What a strange sight they made! As we watched from the forest, we wondered why they had come. We watched them chop down our trees. Some of the braves said that it looked like they had come only for firewood and would soon leave. At first they seemed to be afraid of us... They told us there would be land enough for us all, and we could live side by side like brothers. We signed a peace treaty with them and taught them how to plant corn. Without us, their village would have failed the first year."

Inquiry USA
Ralph Kane and Jeffrey Glover,
Globe Book Company, New York,
1971, pp. 13-14.

WILLIAM PENN: The New Land

The soil is even richer than we had hoped. Even the poorest places produce large crops of vegetables and grain. We produce from thirty to sixty times as much corn as in England.

The land requires less seed to produce a crop than in England.

We also find that everything that grows well in England grows well in the colony - corn, roots, wheat, barley, oats... onions, garlic, and Irish potatoes.

Our cattle fatten up for market on weeds, and there is plenty of hay for the winter from our swamps and marshes.

Answers to Student Questions

Student Hand-Out 2

1. The chief spoke of a huge canoe with white blankets. What did he mean? *(A sailing ship.)*

2. Why was the chief sad? *(The settlers broke the treaties. The Indians and the settlers could not seem to share the land. The settlers were cutting down a lot of the trees.)*

3. What uses did the Indians have for the forests? *(Firewood and canoes.)*

4. Why was William Penn so happy with the land in the New World? *(The land was very rich and could produce crops without too much effort.)*

5. Why did the settlers cut down the trees? *(To use the wood. To clear the land so that they could plant crops and to have room for cattle to graze.)*

6. Compare the attitudes of the Indian Chief with William Penn about the use of land and trees. *(The Indians lived within the forest, using only what they immediately needed. The settlers cut down the forest to get the land to produce more food.)*

Activity 3

This activity asks the students to gather and interpret materials from a picture. Have students look carefully at the picture and then answer the following questions.

Answers to Student Questions

Student Hand-Out 3

1. What are the uses of wood in the picture? *(Students' answers will vary; but should include specifics under these headings: housing, energy, tools, furniture, etc.)*

2. What are examples of energy being used in the picture? *(Boy carrying wood, man chopping wood, wood burning inside and outside, and woman churning butter.)*

3. What examples show that human muscle power was used to produce the necessities of life? *(Butter churn, handmade furniture, spinning wheel.)*

4. Why were wood and human energy used more in the colonial period than today? *(These were the only resources available; machines and tools were simple and did not need other forms of energy.)*

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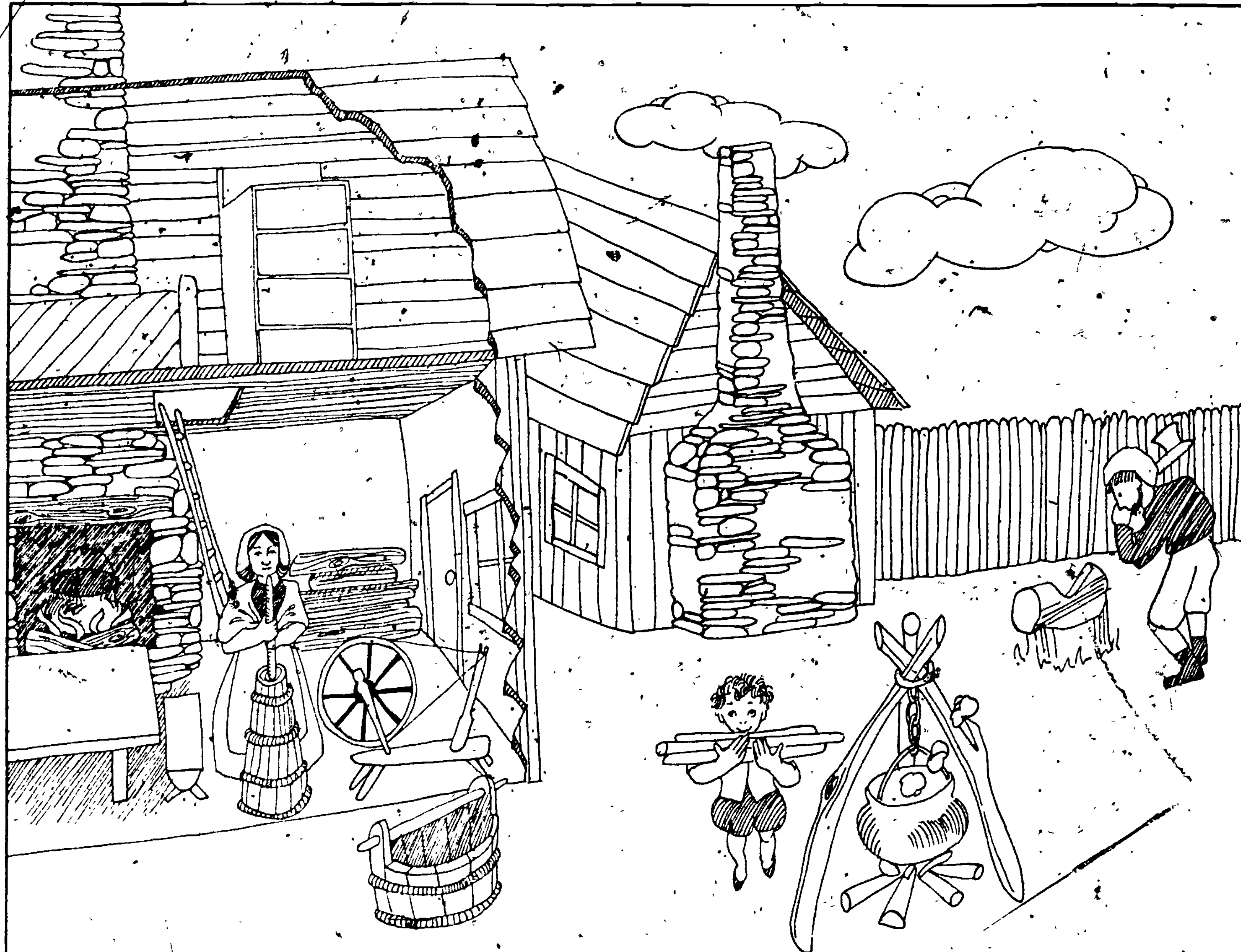


Activity 4 This activity asks the students to compare the types and uses of energy in two different cultures the colonial farm family and the family of today. The student is also asked to examine relations between energy use and cultural patterns.

Distribute the "Diary of a Colonial Farmer". Have students read the selection and answer the questions on the worksheet. Then have students complete the same worksheet for their families.

Discuss with the class the differences in types of energy in the two time periods. How do family roles and patterns differ? What makes a family wealthy today?

Special Note

> This might be a good time to encourage your math teaching colleague in the unit. The math portion of this unit comprises Student Activity 7. This is mainly intended to involve energy-related problems and reinforce math skills traditionally developed in 8th grade. Ideally, we would like to see the science teacher, the math teacher, and you, the social studies teacher team up or correlate the teaching of these segments in AMERICA'S WOODEN AGE part of this unit. For the science teacher we have a series of experiments that help students discover the energy content in wood. These labs comprise the next section of this unit.

Student Hand-Out 4.

Read the selection below. Then fill in the chart using the information from the Diary.

Diary of a Colonial Farmer

5:00 am	Got up and fed the oxen, pigs and chickens. Wife started fire and cooked breakfast. A cold morning. Frost everywhere. Milked the cow.
6:00 am	Ate pork and buttered cornbread for breakfast. Have to make another chair so our youngest child will have a place to sit. Maybe I can do it tomorrow.
7:00 am	Hitched up the oxen to the plow. Started to plow half our field. Will have to get ready to plant wheat and corn. Hope to plow the other half next week.
11:00 am	Weather finally warmed up some. Wife and children spent the morning hoeing in the garden. Soon the time will come to plant onions, melons... Finally finished plowing. Took oxen back to the barn.
12:00 pm	Finally had lunch. Still thinking about making that needed chair. Had fruit, salted pork, and cornbread for lunch.
12:30 pm	Went to work in the orchard. Hope the blackbirds don't eat too much of the fruit. Have to cut off all the dead limbs on the fruit trees. Only worked on some of the trees. After cleaning up the lunch dishes, wife spent the afternoon spinning thread. We all need some new clothes for summer. I'm thinking about trading a pig for new shoes for the family. Haven't got time to make shoes. Children finally got to go fishing.

Diary of a Colonial Farmer (continued)

4:30 pm	Too tired to trim any more fruit trees. Had hoped to remove some tree stumps from the field. Maybe I can get to that before too long. Neighbor Thomas will help. Last week I helped him pull up stumps. Wife began to prepare supper. I'm glad children caught fish. We'll have them for supper with some boiled cabbage.
5:00 pm	All of us had supper. Still thinking about making that chair. Wife and children got supper dishes cleaned up. Children brought in some firewood. I milked the cow and fed the livestock again.
7:00 pm	Started to get cold again. Said evening prayers and children went to bed. I repaired a broken plow and wife patched some clothes. Reminded myself to get wood for that chair I must make.
8:30 pm	Wanted to clean my rifle first, but instead used the remaining light from the fire to write in my diary and read the bible.
9:15 pm	So tired. Went to bed.

"The Life of the Farmer", The Americans, Edwin Fenton, Editor, Holt, Rinehart and Winston, New York, 1975, pp. 45-46.

Answers to Student Questions

Activity 4

Energy and Cultural Patterns: The Colonial Farm

Using the information from the diary, the picture of the farm family and the previous readings, complete the following chart.

1. What sources of energy were available to the settlers?
   (Wood, water, animal and human power.)

2. Show how the following tasks were done by the settlers. What energy was used in these tasks?

   a. Producing food
      (Children fish; father clears land by oxen and hoes by hand.)
   b. Preparing food
      (Wood fire for cooking, all food prepared at home, woman churns butter at home.)
   c. Building homes and barns
      (Human energy.)
   d. Lighting and heating homes
      (Wood hand carried.)
   e. Preparing clothing
      (Woman spins by hand and makes shoes by hand.)
   f. Making furniture
      (Father carves the furniture by hand.)

3. List two jobs performed by each member of the family.

   a. Mother
      (Spins and cooks.)
   b. Father
      (Clears land, farms.)
   c. Children
      (Carry wood, fish.)

4. In the colonial period, what made one family wealthier or better off than another?
   (The number of people who could work, the health and strength of the family members, the amount of land the family could cultivate.)

AMERICA'S WOODEN AGE (Science)

Overview

After serving as the main source of fuel for many centuries, wood was largely abandoned when technology made fossil fuels more widely available. With the increasing importation and rising cost of fossil fuels, however, wood may again become a viable alternative fuel. This possibility is raised in this lesson as students examine the energy content of wood.

Target Audience

8th grade science.

Time Allotment

One-two class periods.

Objectives

Students should be able to:

1. Construct a can Calorimeter.
2. Read a thermometer accurately.
3. Weigh a given amount of wood.
4. Determine the energy content of wood.

Background Information

In the years 1850-1860 it has been estimated that 17.5 cords of wood per year were used to heat the typical American home. Although wood is no longer an important fuel as far as its percentage contributed is concerned, large amounts are still burned.

The fuel values vary for different types of wood. Hardwood (oak), has more heating value than soft wood, for example, pine. Heating values per cord of wood also vary greatly. For example, two pounds of dry hardwood have about as much heating value as a pound of good coal.

Materials	1 small cardboard orange juice can/metal bottom 1 stirring rod 1 larger juice can 1 ring stand with clamp 100 ml water 1 thermometer - 10° - 110° C wire screen platform balance woodshavings (different kinds)
Opening the Lesson	Ask: "What kinds of wood do you burn in your fireplace?" "Do you think all wood produces the same amount of heat? Why or why not?" *(Hardwoods have more heating value than soft woods.)* Tell the students that they will now do a lab activity to determine the heat content of wood.
Developing the Lesson	Divide the class into small groups of 4-5 students each. Distribute the materials needed for the lab and the Lab Activity Sheet. Review the Lab Activity Sheet with the students. Then allow the students to do the lab.
Concluding the Lesson -	Students may be interested in knowing why there were different results even though they had the same mass of wood shavings. Refer to the math section (number 3) if students are interested in determining how many Calories of heat are needed to heat their home. Ask what other factors might explain the difference. Ask how the types of wood differed. Lead class to a generalization that shows resinous wood has greater heat content than non-resinous wood.

Lab Activity Sheet

AMERICA'S WOODEN AGE (Science)

How Can We Find the Energy Content in Wood?

Materials (per group)
- 1 small cardboard juice can with metal bottom
- 1 14 oz. juice can
- 1 ring stand
- 100 ml. water
- wire screen
- 1 thermometer
- 1 platform balance
- 1 glass stirring rod
- wood shavings (different kinds)
- graduate cylinder

Procedure

(Note: To aid in setting up the apparatus - see diagram on next page.)

1. Cut a piece of screen wire as shown in diagram (next page).

2. Bend the legs of the wire down and the sides up - this will prevent the wood shavings from falling off.

3. Weigh 2.75 grams of wood shavings and carefully place them on the wire basket.

4. Set a match or two in the wood shavings (for easy lighting).

5. Punch 2 holes in the sides of the small juice can near the top rim. Put the glass stirring rod through these holes. Attach to ring stand (see diagram).

6. Measure out 100 milliliters of water. Put it into smaller can (1 ml. of water = 1 gm or .1 kg). Record on data sheet.

7. Take the temperature of H_2O before heating. Record on data sheet.

8. Remove the bottom from the large can. Ignite the wood shavings and quickly place the larger can over the burning wood shavings.

9. Lower the small can into the larger can using the ring clamp.

10. Use your thermometer to measure the temperature of the water after heating. Record on the data sheet.

11. Record the change in the temperature of the water on the data sheet.

12. Multiply the temperature change x the mass of the water x .001 to get the heat gained by water. Record on data sheet. (The .001 is for changing grams x Celsius to Calories.)

13. Find the heat content of the wood.

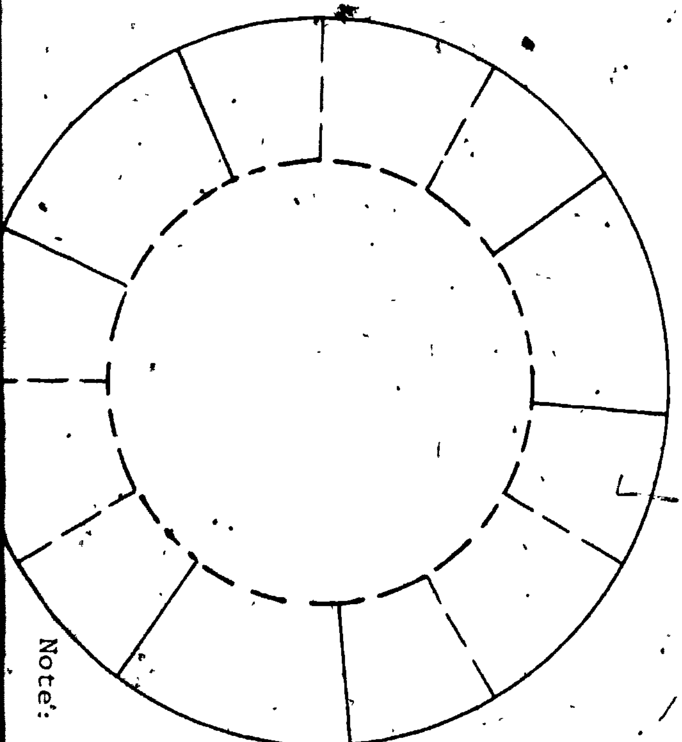
$$\frac{\text{heat output}}{\text{mass of wood}}$$

Record on data sheet.

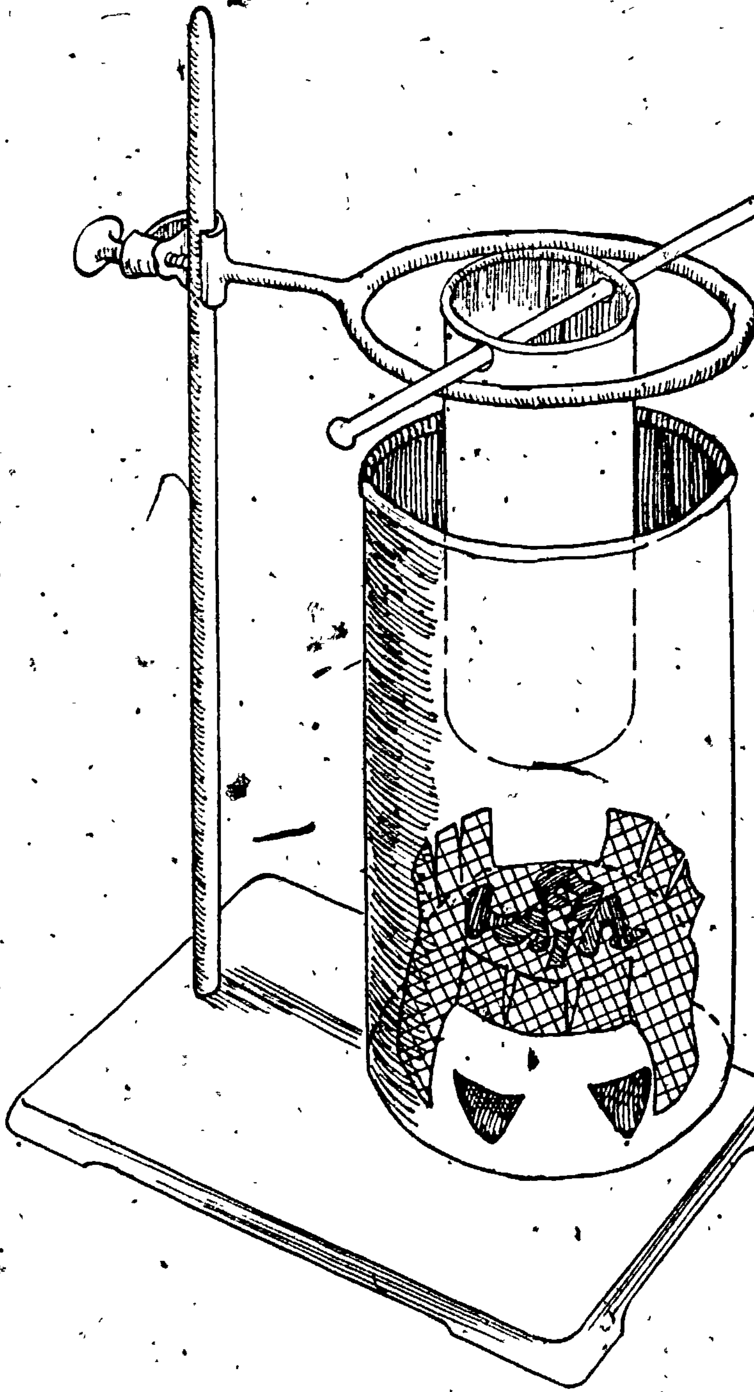
14. An approximate value for the heat content of wood is 1250 Calories/lb or 2.76 Cal/gm.

15. How do your experimental results compare with the accepted value of wood?

Percent difference = $\frac{\text{experimental results}}{\text{accepted value}}$



Note: Cut along solid lines



A. Data Sheet and Calculations

1. Mass of water *100 ml = 100 gms or = 1 kg*
2. Mass of wood shavings *2.75 gms*
3. Temperature of H_2O before heating *13.5°C* *(may vary)*
4. Temperature of H_2O after heating *50.0°C* *(may vary)*
5. Temperature change of H_2O. *(Numbers depend on wood type.)*
6. Heat gained by H_2O = temperature change x mass of H_2O x 1 Cal/g-c° =
   36.5°¢ x .100 k¢ x 1 Cal/¢-¢ = 3.65 Cal
7. Heat content of wood = $\frac{\text{heat output}}{\text{mass of wood}}$ =
   $\frac{3.65\ Cal}{2.75\ gm}$ = *1.36 Cal/gm*
8. Percent difference = $\frac{\text{experimental results}}{\text{accepted value}}$ =
   Sample Answer $\frac{1.36\ Cal/gm}{2.76\ Cal/gm}$ = *.49 = 49%*
9. *Answers will vary, but heat loss should be mentioned.*
10. *Accept all responses.*

AMERICA'S WOODEN AGE (Math)

Overview: Wood was the main source of heat energy in colonial America. The over-riding purpose of this activity is to help students use the information provided by their own calculations to reinforce their understanding and to develop an increasing ability to work with large numbers. Basic skills involving powers of ten and scientific notation will be developed in a set of problems that use the energy in wood as an organizer.

Target Audience: Math classes.

Time Allotment: Two class periods.

Key Terms and Concepts: 1. Apply the principles of scientific notation to energy data.

Note: This lesson assumes students have had experience in writing numbers in scientific notation, multiplying and dividing bases to powers and in doing operations using numbers written in scientific notation.

The NSTA Math packets provide lessons introducing and explaining these ideas and skills.

Energy related applications of skills learned. (Answers to Student Hand-Out 2 - "Woody Problems")

1. A one-acre woodlot produces 1.875×10^6 BTU's of energy per year by direct burning. How many Calories are equivalent to the number of BTU's of energy in one acre of wood? (There are .25 Calories in one BTU.)

($1.875 \times 10^6 \times .25 = 47 \times 10^6$ Calories of heat energy.)

2. There are 7.5×10^8 acres of woodland in the U.S. Using the findings in problem 1, how many Calories of fuel energy are in the trees growing in the United States?

(7.5×10^8)(.47 $\times 10^6$) = 3.525×10^{14} Calories of heat energy in trees growing in the U.S.)

3. A family uses 17.5 cords of wood to heat an average size home. A cord of wood produces approximately 5×10^6 Calories of heat energy. How many Calories of energy were used to heat one home for one year?

($17.5 \times 5 \times 10^6 = 8.75 \times 10^7$ Calories to heat one home for one year.)

4. Use the number of energy Calories needed by a family for a year to heat a home from the previous problem. If there are 5.4×10^7 families in the United States, how many heat Calories are required for all of the families in the United States?

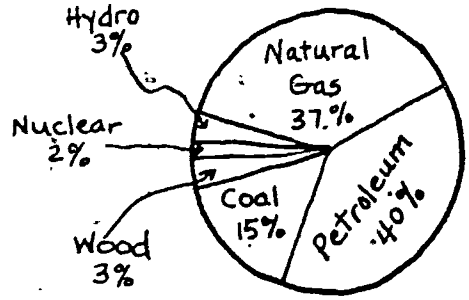
($8.75 \times 10^7 \times 5.4 \times 10^7 = 4.7 \times 10^{15}$ Calories needed in U.S. for one year for heat alone.)

5. The total number of Calories used by the people of the United States in 1976 was 20×10^{15}. Using the number of Calories of energy in the trees growing in the U.S., find what percent of the energy could be supplied by this source for that year.

(3.525×10^{14}) $\div$ (2.0×10^{16}) $\doteq$ .02 or 2% of the energy used in the U.S. could be supplied by trees.)

6. The energy available from trees is about $.5 \times 10^{15}$ Calories per year, and the energy the people of the United States used in 1976 was 20×10^{15} Cal. Divide a rectangle into squares that represent all of the energy used in the U.S. Assign each square some convenient value. Let the squares represent the energy available from all sources. Students may wish to do some research to determine the amounts of various types of energy used in the U.S. This could also be hypothetical - a suggestion for wiser use of an energy source. Students may wish to present some of their findings to the class orally.

(Percentages given in graph are suggested theoretical amounts. Answers will vary.)



Rectangle representing energy sources:

G	G	G	G	N / H
W / G	G	G	G	P
P	P	P	P	P
P	P	C	C	C

.5 blocks for trees
3 blocks for coal
7½ blocks for natural gas
8 blocks for petroleum
½ block for nuclear
½ block for hydro

Note: You may wish to use this problem for students needing a greater challenge. The research could constitute an extra credit project.

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Suggested Activity

Ask the students to bring an average size log to school. Weigh the log and multiply the number by 5 to determine the weight of an armload of wood. (Have student give answer in kilograms.)

2.2 lbs = 1 kilogram

If one kilogram contains 2760 Calories, how many Calories of energy are in the armload of wood?

(The weight of an average size log is about 2.5 kg. Answers may vary.

5 x 2.5 = 12.5 kg (Approx. weight of armload of wood.)

12.5 x 2760 = 34500 Calories of energy in an average armload of wood.)

THE COMING OF COAL[1] (Social Studies)

Overview	Throughout the colonial and early national period, the vast resources of wood, water, animal and human power provided the energy for the small, mostly agricultural population of the new nation. With a growing population and the development of new technologies, demand developed for a new type of energy: one that could power machines and that could be more easily transported. Coal, which had previously been of use primarily to the blacksmith, became the basis of the new economy and culture. This unit discusses why wood gave way to coal and the effects that this energy change had on the culture of the industrializing nation.
Target Audience	8th grade social studies.
Time Allotment	Two-three class periods.
Objectives	Students should be able to: 1. List the reasons that coal replaced wood as the major source of energy after 1885. 2. Explain two effects of the energy change on the culture of the nation. 3. Interpret information from a graph. 4. Construct a graph from a set of data. 5. Develop and test an hypothesis.
Materials	Class copies of Student Guide.
Teaching Strategies	The students examine a chart showing changes in energy sources. They are asked to develop tentative hypotheses about why this change occurred. Students examine three pieces of data.

Student hypotheses are tested using this data.

Introducing the Lesson

Ask the students to name the types of energy that they use. Ask them why they use the types of energy they named. *(Some of the answers could be that that is all that they have, it's the only kind available. They need oil to run cars or heat their homes.)* Ask what changes in the economy or culture would make them change the type of energy that they use.

Tell the students that this unit studies an historical period from 1860 to 1920. The students' task is to find out why energy sources changed during that period and what effect this had on the culture of that time period.

Developing the Lesson

Activity 1

Distribute copies of the chart "Changing Fuel Sources in the United States." Have students examine the chart and answer the questions.

After examining the chart and answering the questions, ask the students why they think this changed occurred. Direct their answers to other factors in a culture such as population changes and new industries. Point out to the students that they are making educated guesses about the relation of two things. This is an hypothesis. List these hypotheses on the board.

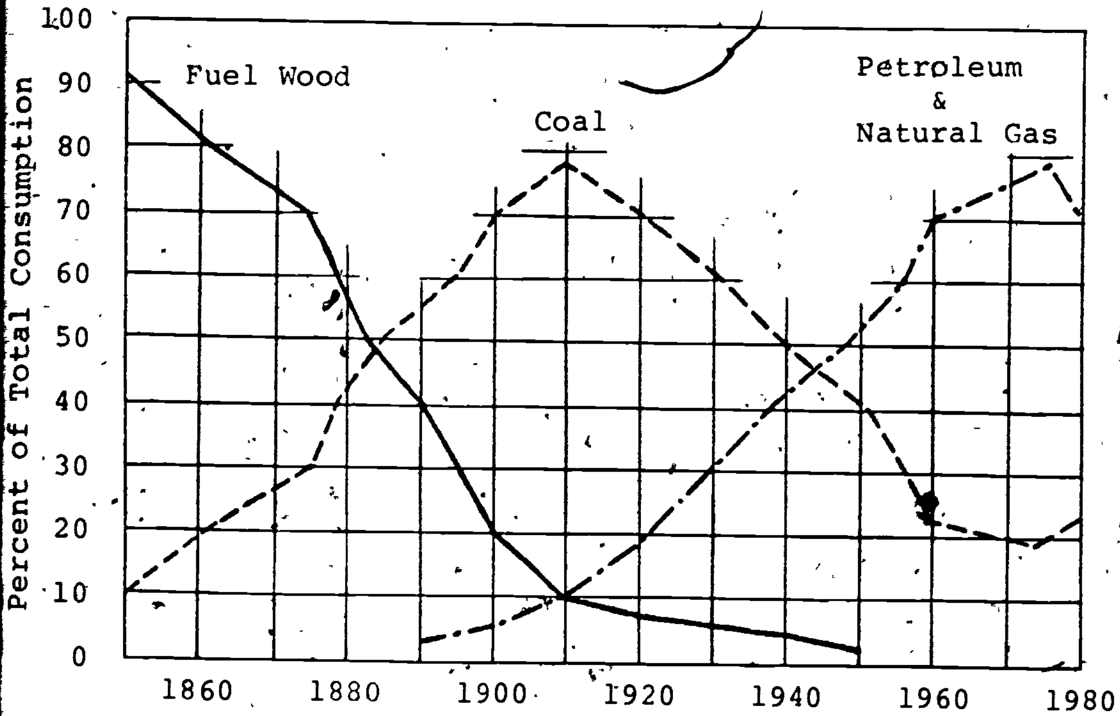
During this part of the lesson, do not have the students discuss each other's hypotheses. After the hypotheses are listed, you might have the class decide which of the three of four are the most likely to be true.

After the hypotheses are listed, have the class make the list of possible data or information that would need to support their hypotheses.

Special Note

Activity 2 of this lesson contains three types of data: growth of railroads, growth of steel production and population growth.

CHANGING FUEL SOURCES IN THE UNITED STATES
(Student Hand-Out 1)



Answers to Student Questions

Student Hand-Out 1

This graph shows the changes in the major energy sources in the United States.

1. In what year did wood make up over 90% of the energy used in the U.S.? *(1850.)*

2. In what year was energy supplied equally by wood and coal? *(1883.)*

3. In what year did coal reach its peak of importance as an energy source? *(1910.)*

4. Based on this graph, what period of time would you label "The Age of Coal"? Why? *(Answers may vary. 1880-1940 is the time period when coal made up over fifty per cent of the energy used in the U.S.)*

The rest of this unit deals with the question of why coal rose and then fell in importance. Before going on to the other lessons, list as many reasons as you can for this change. When you have finished the unit, look back on this list. Make whatever changes you feel necessary.

Some of the students' hypotheses might call for data or information that are not provided in the package. For example, a student might say that the nation changed from wood to coal because the nation ran out of wood. Direct the student to a reference book to find out the total amount of available wood or the amount of virgin or re-forested wood.

Each student could be given the assignment to bring in a piece of information, chart, graph, etc. from home.

Activity 2

Graphs A & B:	Growth of railroads. Students examine two graphs, answer questions and then construct a pictograph.
Graph C:	Growth of steel. "Production of Steel Ingots in the United States." Students answer questions and then relate this graph to the graph on railroad growth.
Table I:	Population growth. Students construct a graph from a table and then relate the data to railroad and steel production and energy use.

After examining the data, ask the students to refer back to their hypotheses. Ask if the data supports their "educated guesses". What other information would they need to be more sure of their hypotheses?

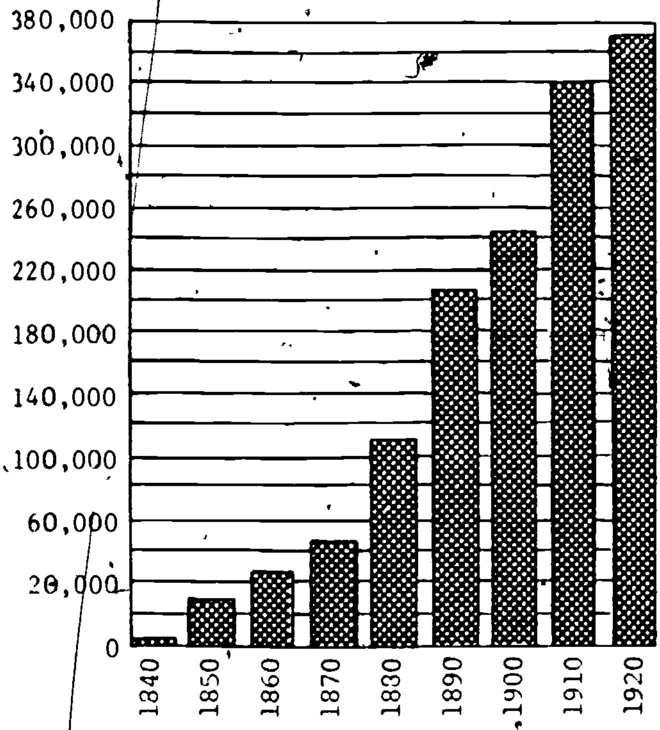
At the conclusion of the lesson, have the students write a brief paragraph explaining the relation between the growth of coal and the other factors discussed.

Special Note

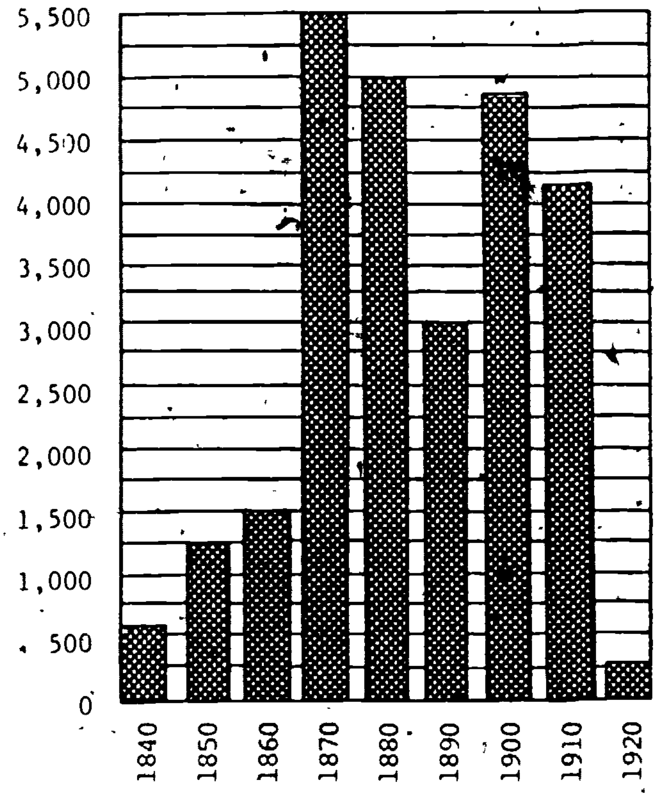
> The lesson is designed to reinforce data interpretation. This takes time. If students have particular difficulty, you could have them examine the chart on railroad growth. Have the students relate just this piece of data to their hypotheses.

(Student Hand-Out 2A)

RAILROAD TRACK IN THE UNITED STATES
1840 TO 1920



NUMBER OF MILES OF RAILROAD BUILT
1840 TO 1920



Answers to Student Questions

Student Hand-Out 2A

Instructions:

Teacher answers in italics.

1. What do the horizontal lines in both graphs tell you?
   (The years covered in the graphs.)

2. What time period is covered by the graphs?
   (1840-1920.)

3. What does the vertical axis show in Graph A?
   (The total amount of railroad in the country.)

4. What does the vertical axis in Graph B show?
   (The amount of railroad track built each year.)

5. How many miles of track were there in 1860?
   (1,500.) In 1870? *(40,000.)* In 1920? *(375,000.)*

6. How many new miles of track were built in 1860?
   (1,500.) In 1870? *(5,500.)* In 1920? *(250.)*

7. Write a statement showing the trend in railroad growth in the United States.
   (While amount of new track varied, the total amount of new track rose continually.)

8. Write one or two sentences showing the differences between the two graphs.
   (Point out that Graph A shows new track and Graph B shows total.)

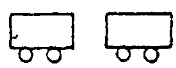
MAKING A PICTOGRAPH
(Student Hand-Out 2B)

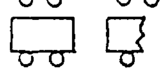
You have looked at two graphs showing railroad growth. Now you are to make a new type of graph. The graph is called a pictograph. Pictures are used to show different amounts of railroad track.

The title of the graph is "Number of Miles of New Railroad Track 1840-1920". Be sure to use the correct graph from Hand-Out 2A to complete your pictograph.

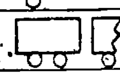
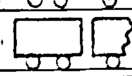
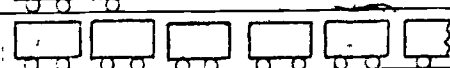
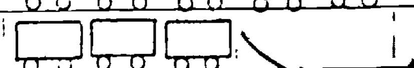
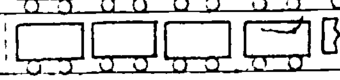
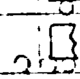
To make things easier, round off the numbers to the nearest hundred. For example, 649 becomes 600. If the number ends with 50 or more, raise the number to the next hundred. For example, 650 rounds off to 700.

On this graph, each railroad car represents 1000 miles of track. You must estimate what fractional part of a car you will need to draw to show some numbers. Look at the example below.

2,000 - 

1,600 - 

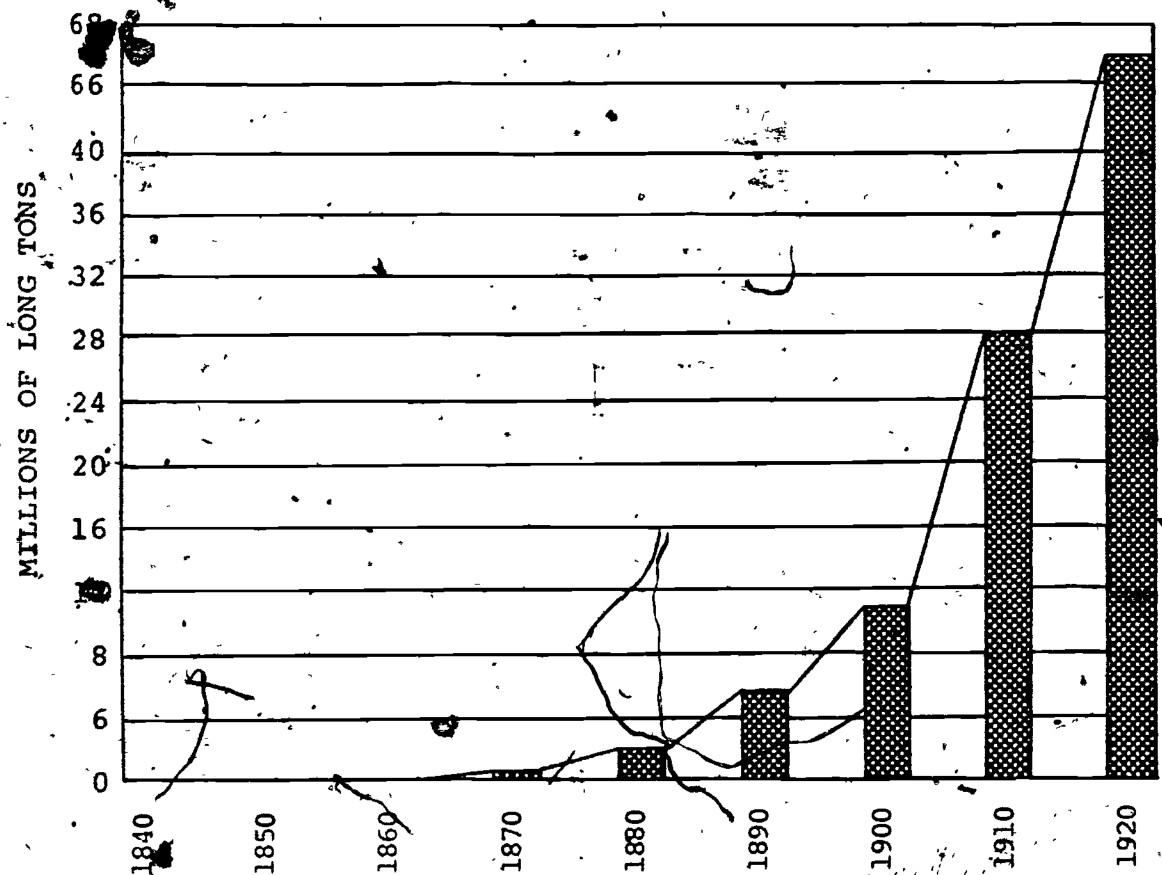
Now, fill in this chart: (One is already done for you)

Year	Miles of New Track	Round off to nearest hundred	Pictograph (Use one column for each car or part of car)
1840	606	600	
1850	1,261	1,300	
1860	1,500	1,500	
1870	5,658	5,700	
1880	5,006	5,000	
1890	3,000	3,000	
1900	4,894	4,900	
1910	4,122	4,100	
1920	314	300	

Look at the pictograph that you have just completed. What ten year period showed the greatest growth in railroad production?

a. 1850 to 1860 (b.) 1860 to 1870 c. 1880 to 1890

PRODUCTION OF STEEL INGOTS & CASTINGS
IN THE UNITED STATES, 1840-1920
(Student Hand-Out 2C)



Look at the graph on this page. Then answer each question on the next page on your own paper.

PRODUCTION OF STEEL INGOTS & CASTINGS
IN THE UNITED STATES, 1840-1920
(Student Hand-Out 2C)

1. What kind of graph is this? Is it a bar graph or a pictograph?
   (Bar graph.)

2. What does the vertical axis show?
   (Tons of steel produced.)

3. What does the horizontal axis show?
   (The years.)

4. What period of time is covered on this graph?
   (1840-1920.)

5. When was steel first produced in this country?
   (Between 1860 and 1870.)

6. Between what years was there the greatest jump in the production of steel?
   (1900-1910.)

7. What trends do you see in the production of steel?
   (The production of steel increased every decade.)

8. After examining the chart on steel production, look back at the graph on railroad growth. What similarities and differences do you see?
   (Steel production beginning in the decade that railroads have their greatest growth 1870-1880. Steel production continues to grow after railroad production levels off and declines.)

9. What is the relation between steel production and railroads?
   (Steel is necessary for track and for the railroad cars and engines.)

10. What is the relation between steel production and coal?
    (Coal is needed to make steel.)

POPULATION OF THE UNITED STATES
(Table I)
(Student Hand-Out 2D)

1850	23,261,000
1860	31,513,000
1870	39,905,000
1880	50,262,000
1890	63,956,000
1900	76,094,000
1910	92,407,000
1920	106,461,000

1. What trend do you see in the population table?
   (Population increased every year.)

2. What is the relation between a growing population and the need for coal?
   (The increasing population will need increased supply of energy.)

3. Use the data in the table to make a graph. You can make a bar graph or a pictograph. Be sure to label the vertical and horizontal axes. Write a title on your graph.

Concluding the Lesson

Ask the students to think about the differences that the growth of railroads, the increased production of steel and the growth of population might make on the culture. The students could write a brief story about "The Coming of the Railroad to a New Town".

What are some of the advantages that the railroad brought? What were some of the disadvantages?

THE COMING OF COAL (Science)

Overview

Coal is the most abundant fossil fuel in the United States. This lesson is designed to give the students an understanding of the formation of coal, and how coal is used to produce electricity.

Target Audience

Science classes.

Time Allotment

Three-four class periods.

Objectives

Students should be able to:

1. Explain the formation of coal in a series of pictures.
2. Trace the route of energy from coal - beginning with the earth and ending with a plug in the wall.
3. Make a model of a steam turbine.
4. Explain how electricity is produced.

Materials

- bar magnet and U magnet
- cardboard tube
- copper wire
- galvanometer
- small cardboard orange juice can with metal bottom
- metal top from small orange juice can
- tin shears
- small strip of metal or support for the tin disk
- Bunsen burner
- medicine dropper
- test tube
- support rod
- needle
- thimble
- scissors
- pencil/eraser
- manila circles
- ruler
- compass
- cork

Teaching Strategies

Probably the best way to introduce this lesson is to get a piece of coal and show it to the students. If you can't get a sample, show a picture of coal. Ask the students to describe coal. Lead into the gist of the lesson by asking: Did you know that it takes about five to eight feet of rotted plant and animal life forms, and millions of years to make one foot of coal? (Put this statement in metric as well.)

Developing the Lesson

Activity 1

Distribute the pictures of coal formation. Then ask the students to write several sentences - at least one for each picture - that describe in words how coal is formed. Allow sufficient time for students to complete this activity. Later discuss their descriptions in class.

Activity 2

The focus of this activity is to have students trace coal from the mine site to a plug in the house wall. Distribute the scrambled pictures on Hand-Out 2. Then suggest to your students that they put a number 1 over the first step; 2 over the second, and so on. Discuss the proper sequencing in an informal class discussion period.

Activity 3

Ask your students to explain in their own words what they think happens in a power plant. What makes steam? What does the steam do? How is electricity produced?

Tell students that they are going to make a model of a steam turbine. Note: Depending on the level of ability and interest of your students, you may have to decide which activity sheet to use. These have been labelled 3A and 3B, with the latter requiring more steps, and more sophisticated equipment.

Activities 4A and 4B

Discuss how the potential energy in coal is converted to electrical energy at the power plant. Than have your students complete Activities 4A and 4B: "How is Electricity Produced When a Coil of Wire Cuts Across A Magnetic Field?"

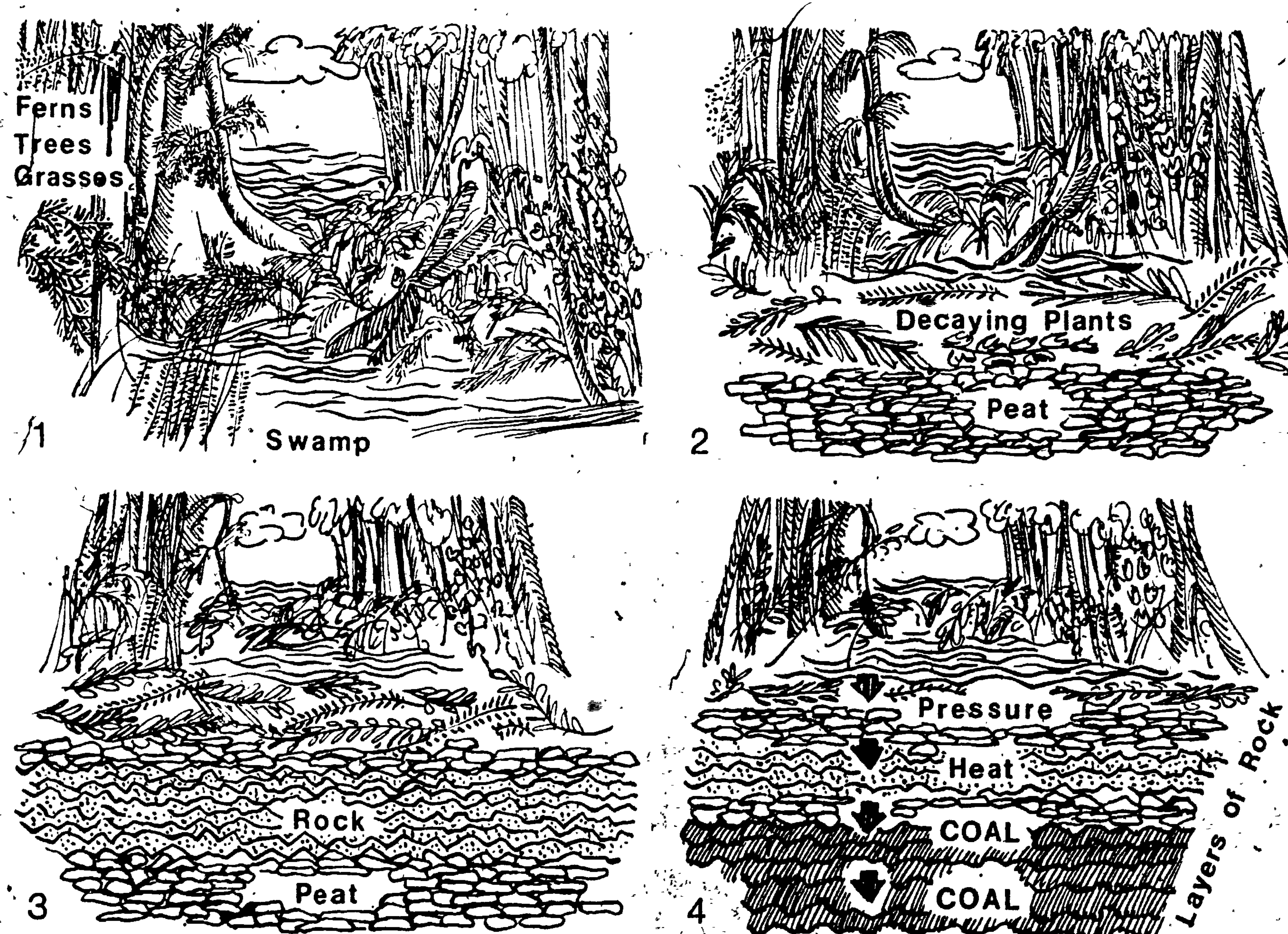
Activity 5

Discuss the relation between the models that the students made and the picture of the power generating plant. Have the students identify each of the parts of the plant and discuss the relation of that part to the next. For example, coal is used to produce steam which turns the turbine which turns the generator to produce electricity.

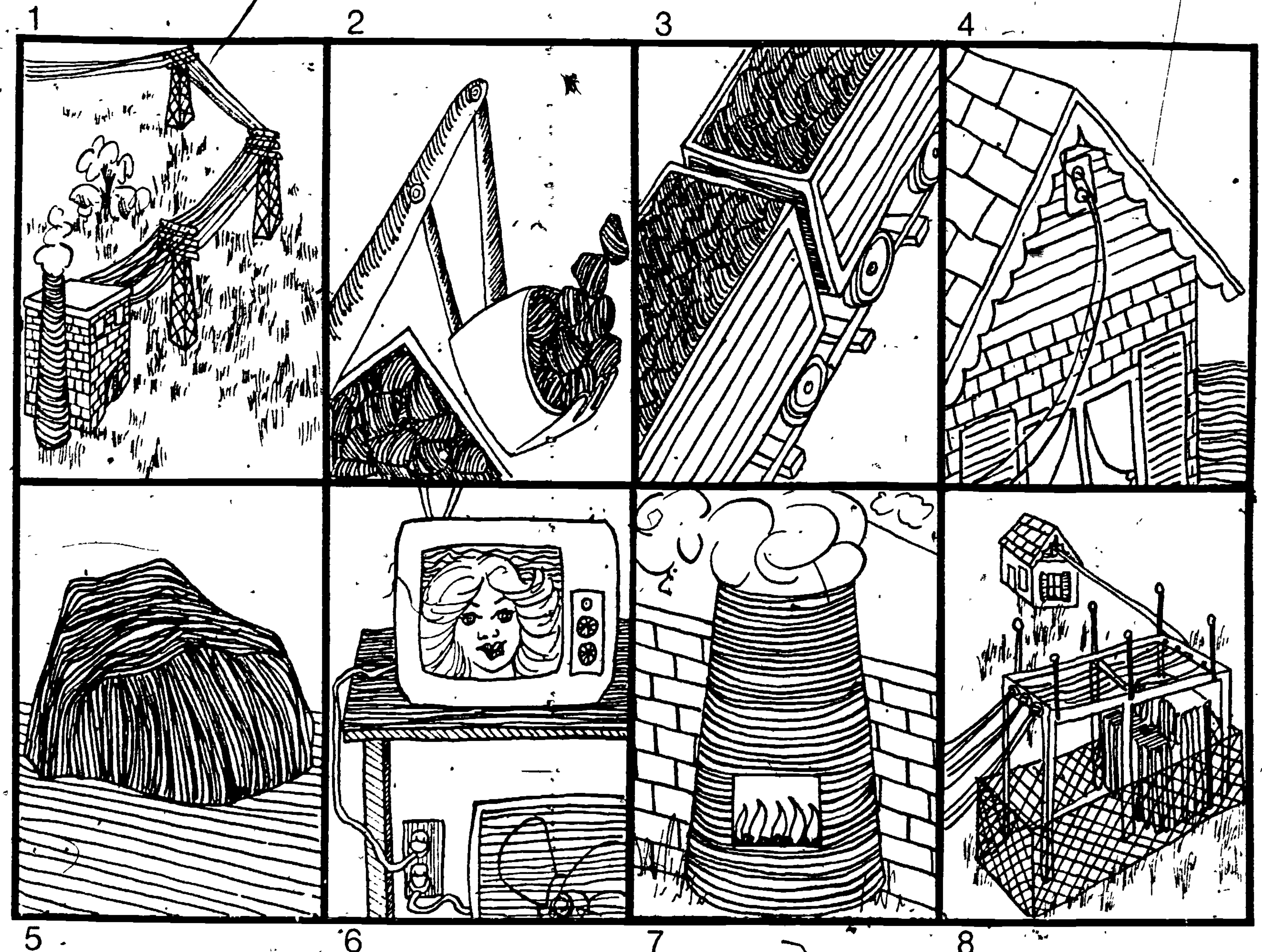
Depending on the ability of the students you might wish to discuss how one form of energy is being converted to another form of energy during this process.

(Student Hand-Out 1)

HOW COAL WAS FORMED



Activity 2
(Student Hand-Out 2)



Activity 3A — A Working Model of a Steam Turbine

Purpose	This activity will show that steam can turn a turbine (which is what happens at a power plant).

Materials

- medicine dropper
- test tube (attached to support rod)
- Bunsen burner
- stopper (one-holed)
- needle
- thimble
- scissors
- pencil with an eraser
- manilla circles
- ruler
- compass

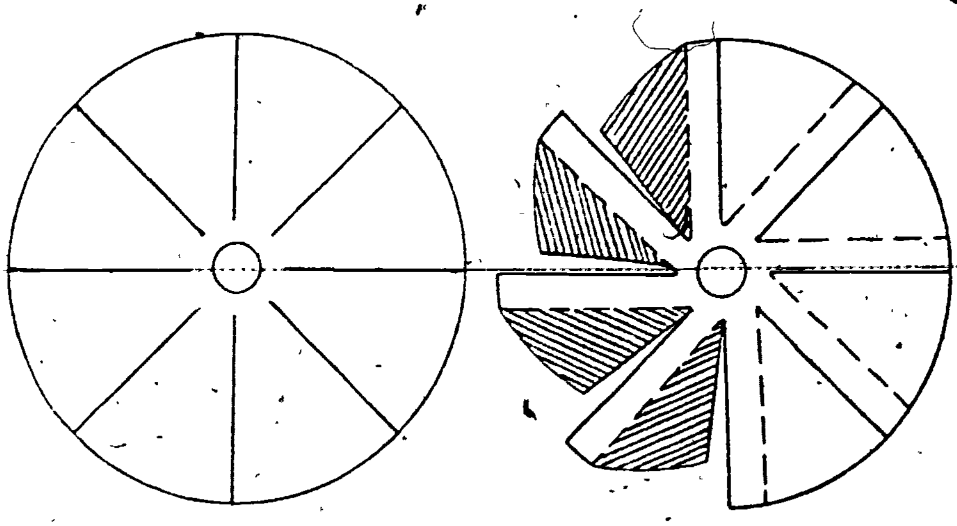
Directions

Make the turbine wheel first. Use the compass to draw a circle five inches in diameter on the manila folder. Use the same center for the compass, and draw a 1 inch diameter circle inside the larger circle. Place the thimble open end down on the center of the circle you have drawn, and draw a third circle around the thimble.

Use the scissors to cut along the inside of this small circle. Use the ruler to draw eight equal parts.

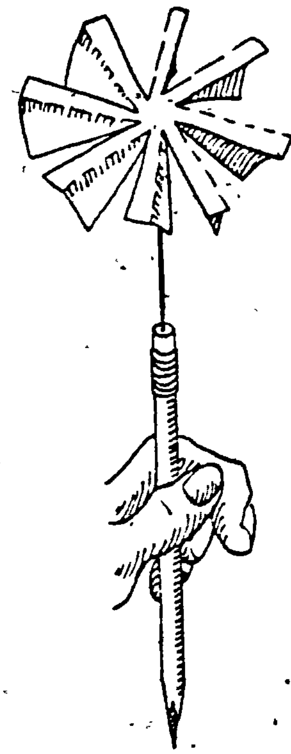
Cut along the lines to the drawn inner circle. Next, bend half of each section back along the dotted lines in the diagram (see Diagram 1). The paper halves should show right angles.

Diagram 1



Insert the needle into the rubber eraser of a pencil. Place the paper turbine wheel over the tip of the thimble and set the inside of the thimble on top of the needle. (See Diagram 2)

Diagram 2

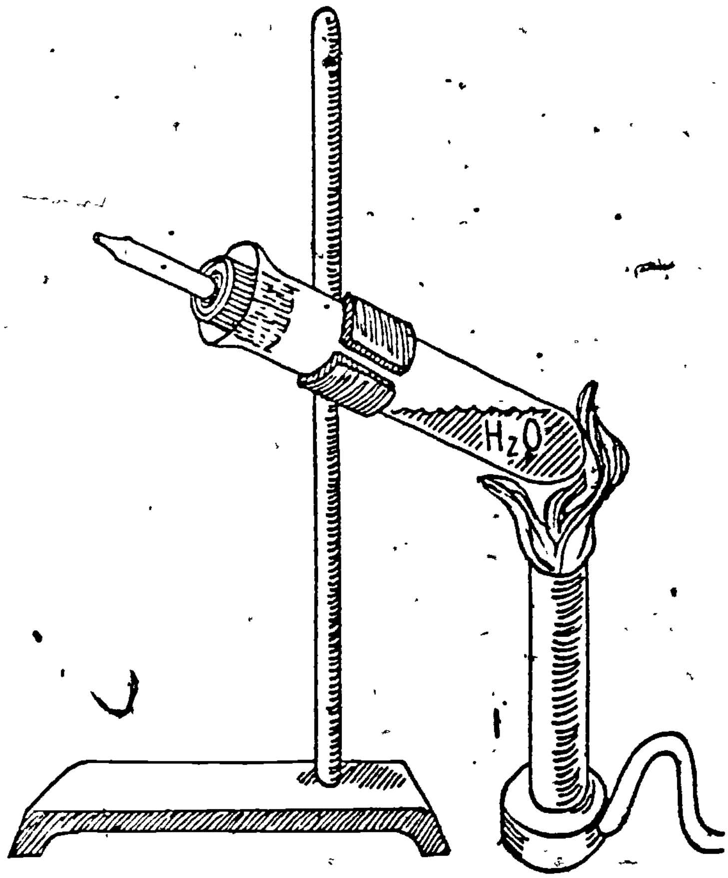


Operation

Operating the Turbine

Put about 1 inch of water in a test tube and assemble the equipment. Remove the rubber bulb from the medicine dropper. Moisten the outside of the medicine dropper and insert it carefully through the one-hole stopper. Insert the stopper into the open end of the test tube, but don't push it in too tightly. Light the Bunsen burner and heat the water in the test tube. (See Diagram 3)

Diagram 3



Answer these questions.
Hold the pencil with the thimble top of the turbine attached in such a way that it turns freely, and direct the path of the steam against the paper blades of the turbine.

1. What is happening to the blades?

2. Can you explain why this is happening?

Activity 3B — Making a Working Model of a Turbine
(Optional Activity - Gifted)

Purpose To make a working tin can model of a turbine.

Materials
16 oz. orange juice can with metal bottom
tin shears
cork, screw, metal glue
support
top from larger juice can
Bunsen burner

Directions

1. Make a turbine blade from the larger juice lid by making slits.
2. About ½ inch from the edge of the lid, punch a small hole for the escape of steam.
3. Next to the small hole, punch a larger hole.
4. Bend a flexible piece of support metal to hold the turbine blade. Then glue it next to the small hole.
5. Fill the can about ½ full of water.
6. Glue the lid on the juice can and insert the cork.
7. Turn on the Bunsen burner.

Student Questions

1. What happens to the blades?
2. Can you explain why this happens?
3. Can you see how your model works on the same principle as a real turbine at a power plant?

Activity 4A **Producing an Electric Current**

Purpose: To show that by passing a magnet through a closed coil of wire we can produce electricity.

Materials:
A bar magnet
A cardboard tube
Copper wire
A galvanometer (a device that detects the pressure of an electric current)

Directions:
1. Set up apparatus as shown below in Figure 1.

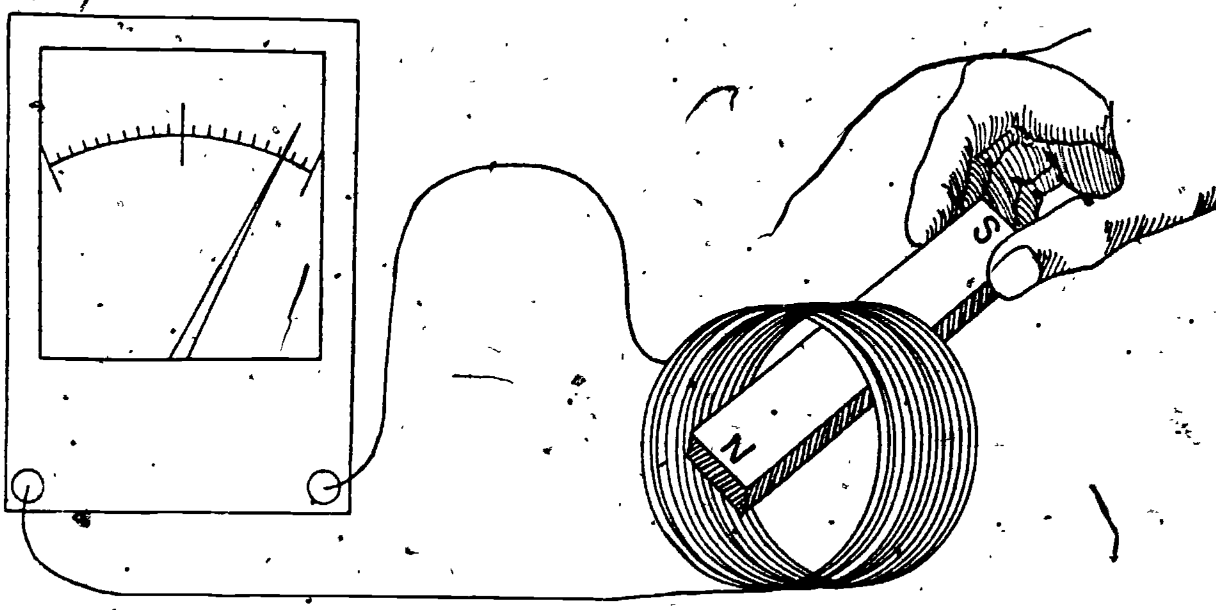


Figure 1

2. With a back and forth motion, move the bar magnet into and out of the coil of wire.
3. Look at the needle on the galvanometer and observe what happens.

Student Question: How can you produce a stronger electric current? Write your idea in the space below.

Activity 4B Producing an Electric Current

Directions

1. Set up apparatus as shown in Figure 1.
2. Connect the ends of a flexible wire to the terminals on your galvanometer.
3. Holding the wire vertically, move it briskly between the poles of the U magnet (cutting across the magnetic field).
4. Observe what happens to the needle of the galvanometer.
5. Now make a coil of wire (25-40 turns) and move the coil between the poles as shown in Figure 2.
6. Observe what happens.
7. Is it necessary to have wires cutting across a magnetic field to produce electricity? Why?

Figure 1

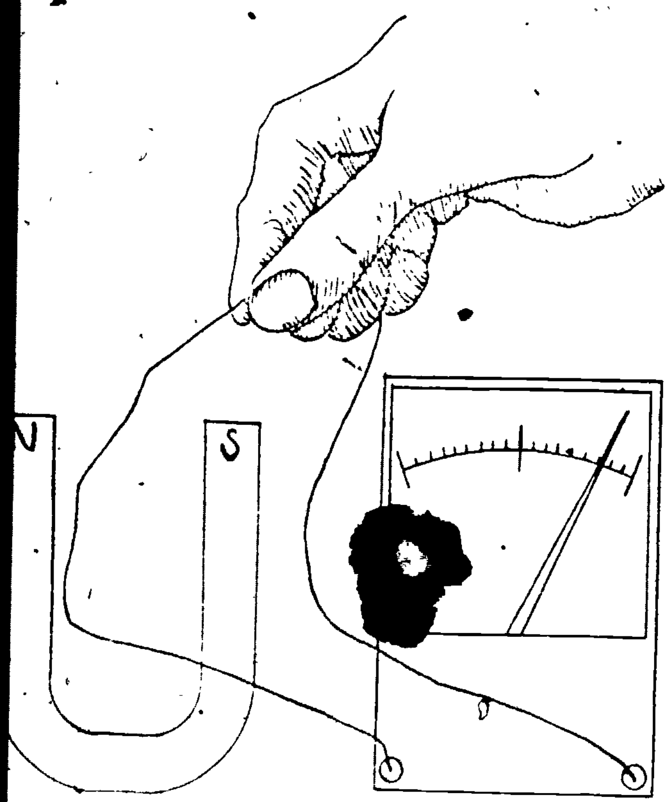
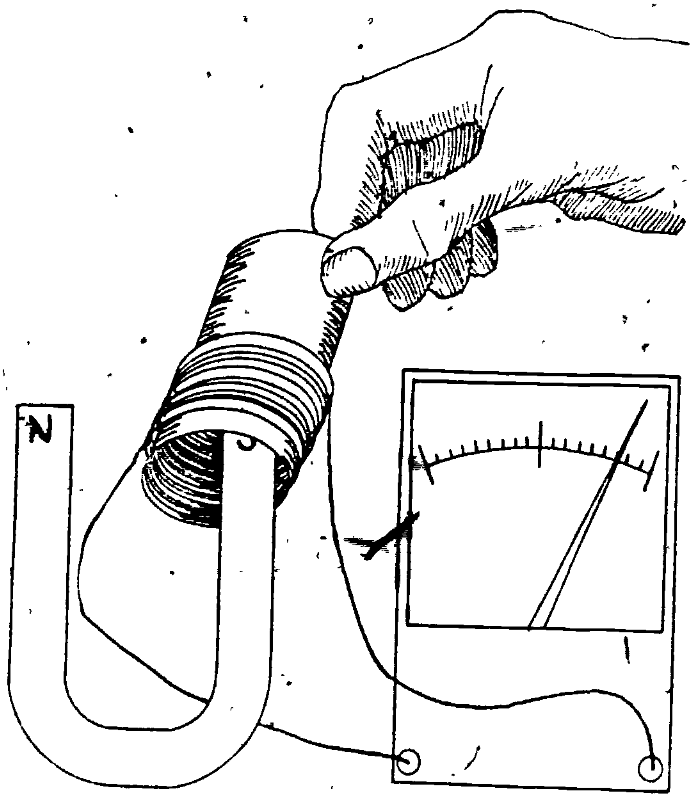
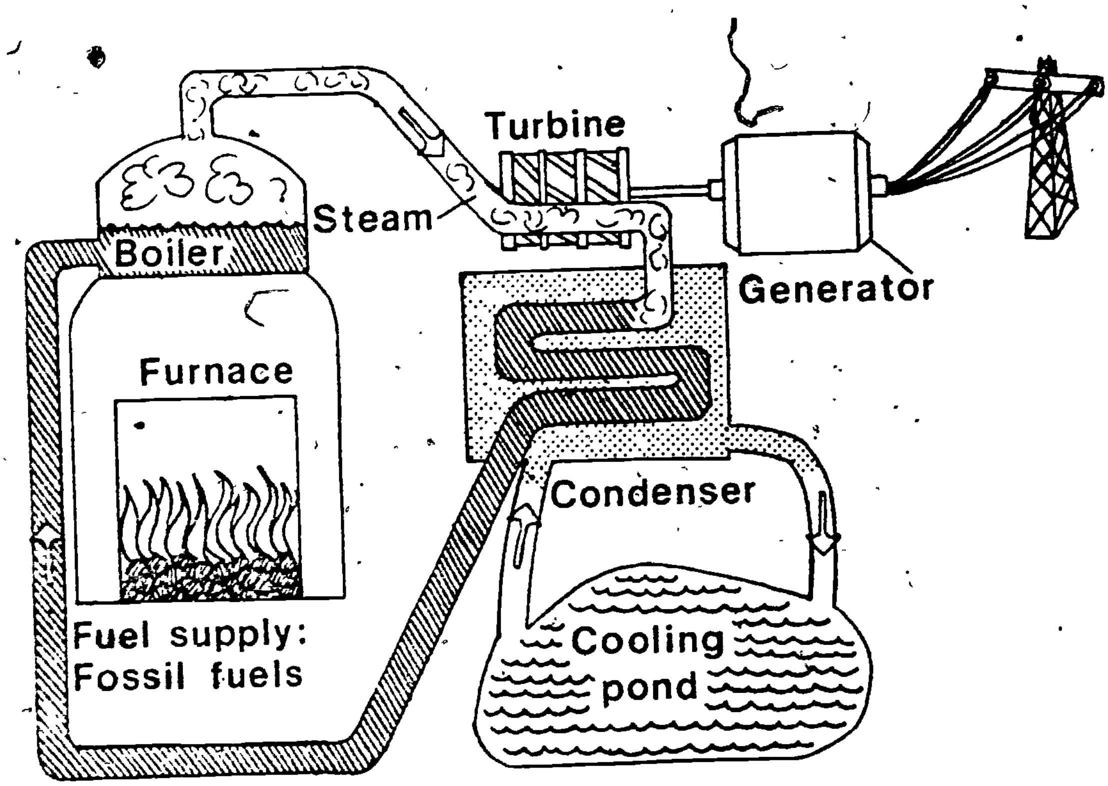


Figure 2



Activity 5

Compare each part of the picture to the models you have made.



Based on this picture and your models explain the step by step method of how coal is used to make electricity.

OIL: BRIGHT PROMISE (Social Studies)

Overview	This is the third part of a unit on Energy History of the United States. This section focuses on the resources for the shift from coal to oil as the primary energy source and the effects that this change had on the cultural patterns of the nation. The unit touches briefly on the role of oil and oil-based products in the nation today. Finally, the unit poses the question of what will happen if oil prices continue to rise.
Target Audience	8th grade social studies.
Time Allotment	Three-four class periods.
Objectives	Students should be able to: 1. List reasons for the development of oil as the primary source of energy in the United States. 2. Explain the effects of oil-based industries on the present American culture. 3. Show the relationship between the automobile and the economic, social and family patterns in the United States. 4. Read, interpret and draw conclusions from prepared sources. 5. Organize data under appropriate headings.
Materials	Class sets of student activities.
Teaching Strategies	Activity 1 Students examine a list of oil-based products and discuss which are luxurious and which are necessary.

Activity 2

Students read a section on the development of oil as an energy source.

Activity 3

Students examine graphs showing increased consumption, importation and price of oil and discuss the effects on the culture of the United States in the future.

Developing the Lesson

Ask students to name things that are made from oil. List these on the board.

Activity 1

After a few minutes, ask the students to suggest appropriate headings for the items. Write the headings on the board.

Distribute class copies of the products related to oil. Allow enough time for the class to examine the list.

Working alone or in small groups have students place items under the headings listed on the board.

After the students have categorized the items, tell them that the amount of oil available in the country has been cut in half. They must eliminate half ~~of~~ the items on the list.

After they have done this, ask them how the decision was made to cut the list in half. What did they consider absolute necessities? What did they consider luxuries? Why do students have different answers?

Activity 2

Have students read the selection of the development of oil in the Student Guide and answer the questions.

Answers to Student Questions

Student Hand-Out 2

1. Was oil valuable to the people in the United States around 1800? *(Oil had limited value. It could be used for medicine, sealing and lighting*

2. Was oil used as an energy source before 1800? *(Only for some lighting.)*

3. Why did farmers dislike finding oil? *(The farmer had little use for oil and it damaged the soil for farming.)*

4. List three reasons why the demand for energy increased between 1820 and 1920. *(Growth of population, growth of cities, growth of factories, changing life style, increased transportation.)*

5. Why did investors put their money in oil development after 1850? *(They thought they could make a profit by producing oil.)*

6. What does the term "energy intensive" mean? *(Large amounts of energy are put into the manufacture of items.)*

7. What does the term "Drake's folly" mean? *(People thought that he was making a foolish mistake.)*

8. In the last paragraph, why is a strike of oil compared to a gold rush? *(By 1859 the value of oil had increased.)*

Activity 3

Have students examine the graphs in the Student Guide.

Questions 18 and 19 can best be handled as discussion questions.

Answers to Student Questions

Student Hand-Out 3

1. What is the title of Graph #1? *(U.S. Production and Consumption of Petroleum.)*

2. What does the vertical axis (the line on the left that goes up and down) show? *(Billions of Barrels.)*

3. What does the horizontal axis (the bottom line that runs left to right) show? *(Years.)*

4. What is the time span of the graph? *(1860-1980.)*

5. What does the term "consumption" mean?
(Have students look up word in dictionary.)

6. What does the term "production" mean?
(Have students look up word in dictionary.)

7. What does the solid line show?
(Production of crude oil in the U.S.)

8. What does the broken line show?
(U.S. consumption of crude oil.)

9. What is the trend in consumption?
(Increases at a high rate.)

10. What is the trend in production?
(Increases at a high rate, slightly higher than consumption.)

11. Between which years was U.S. production greater than U.S. consumption? *(Between 1945 and 1950.)*

12. If the trend for the period between 1960 and 1970 continues, what will be the relation between U.S. production and U.S. consumption?
(The U.S. will consume more than it produces.)

Bonus Question:
Where does oil come from that is not produced in the United States? *(Imports from the Middle East.)*

13. What is the purpose of Graph #2?
(To show the percentage of oil that is imported compared to total oil consumption.)

14. What per cent of the oil used in 1966 in the United States was imported? *(9%.)*

15. What per cent of oil used in the United States in 1976 was imported? *(41%.)*

16. What do you think this dramatic increase tells us about United States oil production today? *(Not enough.)*

17. Look at Graph #3. What can you learn from the title? *(Price of oil from the Middle East.)*

18. Compare the three graphs in this section. What reasons can you give for the rise in the price of Persian oil? *(The increased demand in the United States and the fact that the U.S. cannot produce all the oil that it needs.)*

19. What effects do you think the rising price of oil will have on the U.S. culture and economy? *(Answers will vary. Use the question as a discussion starter.)*

OIL:BRIGHT PROMISE (Social Studies)
(Student Hand-Out 1)

Antenna cable
Credit cards
Permanent-press clothes
Heart valves
Crayons
Disposable diapers
Parachutes
Telephones
Enamel
Transparent tape
Antiseptics
Vinyl siding
Safety flares
Overcoats
Bubble bath
Bookends
Planters
Deodorant
Panty hose
Bedspreads
Tubs
Shag rugs
Lunch boxes
Jerseys
Windshield wipers
Phonographs
Car sound insulation
Garment bags
Fences
Kitchen counter tops
Windbreakers
Pillows
Dune buggy bodies
Checkers
Soap dishes
Syringes
Shoes
Volley Balls
Synthetic rubber
Sleeping bags
Electrician's tape
Midi-skirts
Mascara
Sweaters
Bread boxes

American flags
Aspirin
Oxygen masks
Ink
Hair spray
Steering wheels
Food wraps
Stretch pants
Rubber duckies
Seed tape
Card tables
Golf cart bodies
Slips
Warm-up suits
Ping-pong paddles
Purses
Weed killers
Football pads
Puzzles
Carbon paper
Mattress covers
Dishdrainers
Crabgrass killer
Puppets
Pajamas
Upholstery
Hearing aids
Racks
Dresses
Track shoes
Pond liners
Protractors
Earphones
Whistles
Clothesline
Carpet sweepers
Chess boards
Yardsticks
Slip covers
Paddles
Patio screens
Exercise mats
Refrigerator linings
Floor wax
Panelling
Sneakers
Earrings

Eyelashes
No-wax floors
Golf balls
Lighter fluid
Attache cases
Wet suits
Laxatives
Trash cans
Brassieres
Wall coverings
Acrylic paints
Vacuum bottles
Shoe trees
Bearing grease
Rafts
Sockets
Flippers
Tiles
Air conditioners
Wallets
Backpacks
Rubbing alcohol
Epoxy paint
Oil filters
Mailboxes
Uniforms
Welcome mats
Pacifiers
Cassettes
Dominoes
Luggage
Antifreeze
Flashlights
Motorcycle helmets
Antibiotics
Shower doors
Shorts
Sugar bowls
Decoys
Darkroom trays
Tobacco pouches
Pencils
Model cars
Garden hoses
Lawn sprinklers
Playing cards
Dolls

Bubble gum
Coasters
Tennis shoes
Straps
Tires
Rulers
Boat covers
Unbreakable dishes
First-aid kits
Watchbands
Toothpaste
Tents
Finger paints
Glycerin
Foot pads
Nightgowns
Lamps
Ice cube trays
Swimming pool liners
Shirts
House paint
Cough syrup
Hair dryers
Styrofoam coolers
Brake fluid
Bathrobes
Shawls
Draperies
Audio tape
Car battery cases
Hockey pucks
Fertilizers
Knitting yarn
Sandwich bags
Raincoats
Sports car bodies
Smocks
Tablecloths
Ring binders
Tote bags
Toothbrushes
Notebooks
Darts
Flea Collars
Stadium cushions
Foul weather gear
Hang gliders
Refrigerants
Sandals
Lipstick
Typewriter cases
Electric blankets
Ear plugs
Drinking cups
Lamp shades
Rollerskate wheels
Guitar strings
Maxi-skirts
Jugs
Eyeglasses
Vinyl tops
Ice chests
TV cabinets
Measuring tape
Ice buckets
Hiking boots
Water softeners
Microfilm
Floor polish
Stoppers
Tennis balls
Measuring cups
Reclining chairs
Dishwashing liquid
Extension cords
Combs
Flight bags
Drip-dry dresses
Plastic varnish
Badminton birdies
Bird feeders
Rugs
Hair curlers
Laminates
Visors
Laundry softeners
Tennis rackets
Canisters
Computer tape
Movie film
Ammonia
Gaskets
Monkey bars
Venetian blinds
Digital clocks
Life jackets
Model planes
Insect repellent
Fishing nets
Hair coloring
Rubber cement

THE DEVELOPMENT OF OIL
(Student Hand-Out 2)

The cry "we've struck oil" made farmers angry in 1800. Some people knew how to use the dark, gooey substance for medicine. Others could use it to seal roofs and boats. Some used oil for light. For the most part, however, oil hurt the farmer. It ruined the soil.

In the early 1800's most Americans earned their living on farms. These early farms used little energy. Wood and coal, along with animal and human muscle, provided most of the needed power. For light, lard or tallow candles and whale oil or petroleum lamps were used. Few people travelled further than they could walk. Most of the items used were made in the home.

Over the next hundred years the nation changed tremendously. The total number of people, the way they made a living and where they lived all changed.

Population grew rapidly. There were less than 100,000 people living in the United States in 1820. By 1920 there were over a million people. Many of these people lived in cities rather than on farms. The table below will give you an idea of just how fast the cities grew.

CITY	1820	1860	1880	1900
New York	152,000	1,174,800	1,912,000	3,437,000
Philadelphia	63,000	565,500	847,000	1,294,000
Boston	43,300	177,800	363,000	561,000
Baltimore	62,700	212,400	332,000	509,000
Cincinnati	9,600	161,000	255,000	326,000
St. Louis	10,000	160,800	350,000	575,000
Chicago		109,300	503,000	1,698,000

Cities need more energy than rural areas. Streets and factories must be lit. Large buildings must be heated. People and supplies must be transported.

The Industrial Revolution attracted people to the cities, and the cities grew. This "revolution" was a change in the way things were made. In the past, items such as cloth, furniture and rifles had been made at home by hand. Now, they were made in factories by workers using machines. With machines, a few workers could produce many more items at a cheaper cost than they could without machines. However, the machines required great amounts of energy to work. The manufactured items then had to be transported to the buyers. This also required a great deal of energy. As a result, the factory system of manufacturing is often referred to as an "energy intensive" system.

With the growth of population, the growth of cities and the growth of the factory system the demand for energy increased enormously. This increased demand for energy drove the price of energy up. As the price rose, investors saw a way of making a great profit: find a cheap, unlimited supply of efficient energy.

Scientists and engineers around the world conducted experiments to find this new source of energy. In Canada, Abraham Gesner used natural oil to produce "Keroselain". This was later called "kerosene". In Pittsburgh, Samuel M. Kier used petroleum produced by salt well. He developed a way to refine the oil. By 1858, Kier's firm was selling great quantities of "Carbon Oil" at $2.00 a gallon. But the demand for oil was still greater than the supply and the price kept rising.

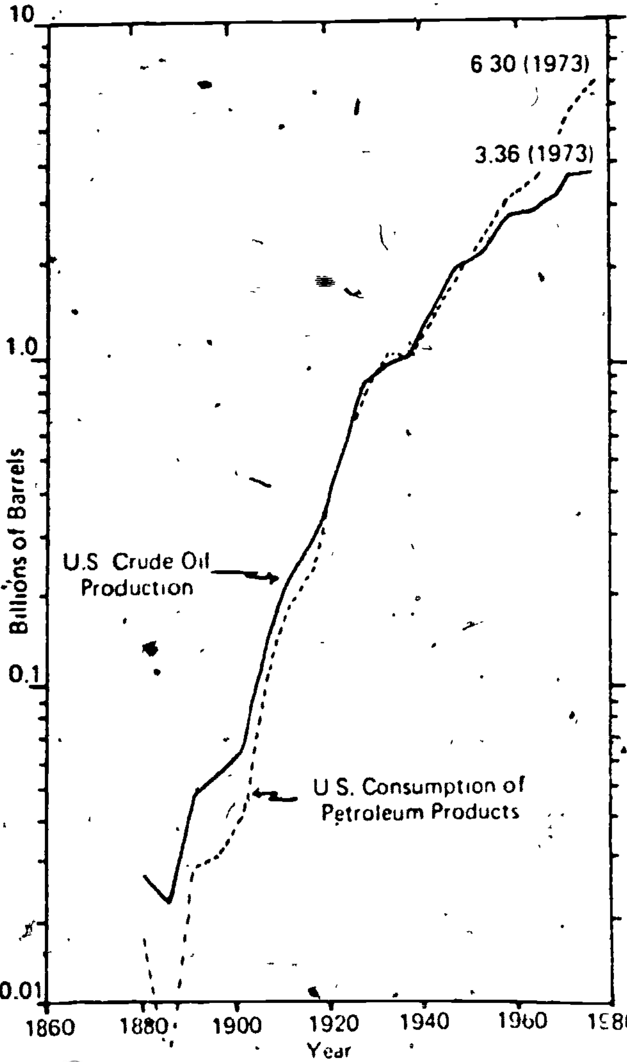
In another part of Pennsylvania, a group of businessmen led by James M. Townsend formed a company to drill for oil. They reasoned that this would be a profitable way to invest their money. They hired Edwin L. Drake, a retired railroad conductor, to undertake drilling operations. The site chosen was on the banks of Oil Creek at Titusville, Pennsylvania.

Drilling went slowly. People began calling the project "Drake's folly". Laborers quit. The townspeople ignored the project. But the developers still thought they would reach oil and make a profit. They continued to risk their money. The investors hired W.A. Smith as the chief driller.

On Saturday, August 27, 1859, Smith stopped the drill at 69 1/2 feet. Late the following day, Smith walked past the well. He noticed something strange. A dark, green fluid filled the hole. He lowered a cup and pulled it up. The cup was filled with oil. "We've struck oil!" "We've struck oil" became the cry of a new gold rush

GRAPH #1.

U.S. Production and Consumption of Petroleum

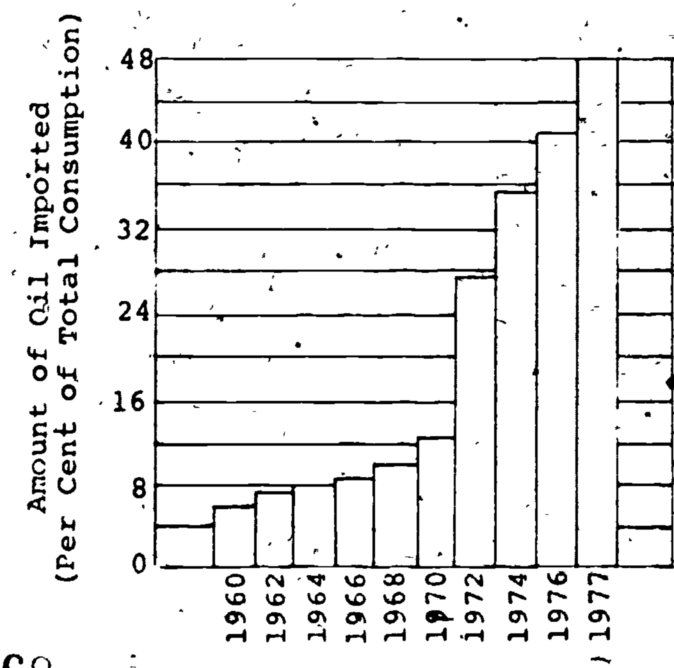


Schurr and Netschert, Energy in the American Economy, 1850 1975. Baltimore The Johns Hopkins Press, 1960.

Bureau of Mines, U.S. Department of the Interior.

GRAPH #2

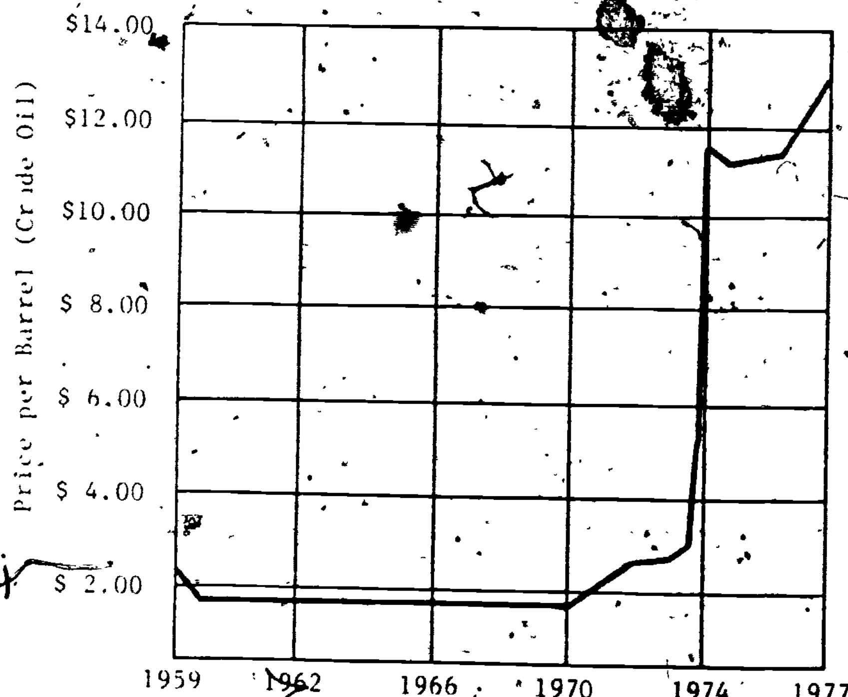
UNITED STATES OIL IMPORTS



Student Hand-Out 4

GRAPH #3

ARABIAN & PERSIAN GULF CRUDE OIL PRICES



OIL: BRIGHT PROMISE (Science)

Overview	This lesson is designed to provide students with an understanding of some of the uses of oil and the energy content of oil.
Target Audience	8th grade science.
Time Allotment	One-two class periods.
Objectives	Students should be able to: 1. Determine the heat content of oil.
Materials	fiberglass insulation; glass stirring rod; bunsen burner; ring stand with clamp; 8 oz. juice can with metal bottom; thermometer (40°-150°C); 3-in-1 oil; platform balance; screen wire; scissors; matches; 16 oz. metal can
Teaching Strategies	Introduce the lab activity which will show the energy content of a hydrocarbon (oil). (Note: At first, remind students that igniting the oil will produce a black smoke. This will soon subside. DON'T BE ALARMED.)
Lab Activity	Distribute the Student Activity Sheet and materials for this lesson. Note: Fiberglass insulation can easily be obtained from a lumber yard or hardware store. However, instead of using fiberglass insulation, you may want to use ashes. Put ashes in a baby food jar lid and then add 3-in-1 oil.
Extending the Lesson	Compare the energy content of wood (Activity 1, America's Wooden Age) to that of oil.

OIL: BRIGHT PROMISE (Science)

HEAT CONTENT OF OIL
(Student Hand-Out I)

Purpose To determine the heat content of oil.

Materials
- Fiberglass insulation
- Glass stirring rod
- Bunsen burner
- Ring stand with clamp
- Thermometer (40°-150°C)
- 8 oz. juice can with metal bottom
- 16 oz. metal can
- 3-in-1 oil
- Platform balance
- Screen wire
- Scissors
- Matches

Procedure

1. Weigh 100 ml. of water and pour in juice can. Record on data sheet.

2. Read the temperature of the water. Record it on data sheet.

3. Make a small stand out of the piece of wire screen. See diagram in America's Wooden Age (Science).

4. Cut a piece of fiberglass insulation about 2.5-3 cms. in width and length.

5. Place the small wire screen and fiberglass insulation on the platform balance.

6. Slowly drip 20-22 drops of 3-in-1 oil into the fiberglass. Record the mass of the screen stand, fiberglass and 3-in-1 oil on data sheet. (Weight should be about .3 gms or .003 Kg.)

7. Use a beer can opener to put holes in the sides of the larger can as shown in diagram.

8. Remove the bottom from the larger can.

9. Using your scissors, punch a small hole in the top (sides) of the small juice can for the stirring rod. Insert stirring rod.

10. Now remove the wire screen, fiberglass and oil from the balance.

11. Leaving the fiberglass on the wire screen, ignite the oil.

12. Raise the large can and cautiously push the burning oiled fiberglass under the juice can containing the water.

13. Lower the large can over the burning oiled fiberglass.

14. After the oil has burned off the fiberglass, record the temperature of the water on the data sheet.

15. Cautiously raise the larger can and remove the wire screen containing the unburned fiberglass. Weigh the screen and fiberglass to see if you burned all the oil that you started out with.

16. Determine the heat content of oil. See data sheet.

Answers to Student Questions (All answers are approximate.)

DATA SHEET

1. Mass of water *100* ml = *100* g or *.1* Kg

2. Temperature of water before heating *16.5* °C

3. Mass of screen stand, fiberglass and oil before heating *1.5* gms

4. Mass of screen stand, fiberglass and oil after heating *1.2* gms

5. Mass of oil *.3* gms or *.003* Kg

6. Temperature of water after heating *35* °C

7. Change in water temperature *18.5* °C.

*8. Heat gained by water = temperature change x mass of water x 1 = *1.85* Calories

9. Heat content of oil = $\frac{\text{Heat output (Heat gained by } H_2O)}{\text{Mass of oil}}$
= *6,167* Cal/Kg

**10. Accepted value for heat content of oil is *10,000* Cal/Kg

11. % difference = $\frac{\text{experimental result}}{\text{accepted value}}$ = *.57*

*To change Kilogram Calories to Calories, multiply by 1.

**Data taken from Energy and the Environment, by John M. Fowler (McGraw-Hill Book Company), p. 427, 1975.

Student Guide

THE DEATH OF TREES
(Student Hand-Out 1)

Until the Elizabethan days (the days when Elizabeth I was the queen of England), there had been a very low level of energy use throughout England. There was enough fuel for everyone to help themselves and move on when supplies ran out.

The fuel was wood, and wood was everywhere. Whole forests covered the home counties. It needed no processing... It provided for all the needs in the home and for the few young industries that existed then. No one noticed the sharp rise in energy demand and the sharp rise in wood consumption (use) until the wood began to run out.

By the 1550's, the woods of several counties were all used up, and the ground had been converted to pasture... more and more remote forest areas were opened up and used up, and as the supplies shrank, the growing industries moved out after them. Iron works were set up in the middle of forests.

When even the forests of Scotland were destroyed and supplies came to an end, what followed came close to a national disaster. Over whole areas of the British Isles the use of wood for heating homes died out because there was barely enough fuel for cooking... most of the population lived at a subsistence level or starved. This was the energy supply situation.

"The Death of Trees", An Index of Possibilities, John Chesterman, et al. Pantheon Books, New York, 1974, p. 92.

Student Hand-Out 1

1. When and where does this account take place?

2. What was the most widely used fuel at this time? Why was it such a good source?

3. What were some of the uses of wood during this time?

4. According to the reading, what did the people do when the local supply of wood ran out?

5. Why was there no attempt to conserve (save) forests at this time?

6. The reading suggests that the demand for wood increased after 1550. What reasons can you give for this?

7. The reading states that when wood ran out many people lived at subsistence level or starved. Explain why you think this happened.

8. Why did the industries clear the woods?

9. Although some people suffered when forests were cleared, some people benefited. Describe who might have benefited.

10. Can you think of an energy situation today that is similar to England's in the past?

(Student Hand-Out 2)

THE INDIAN VIEW OF THE PILGRIM LANDINGS

(The characters in this story are fictional, but the story is based on a true event.)

"Grandfather," said the small Indian lad, "I have been to Plymouth. What happened there?"

The chief spoke softly and sadly. "I asked you not to go there, but now that you have... I shall tell you the story."

"I was a small boy when the white man came to our land. I saw the small speck at sea become a huge canoe with white blankets to catch the wind. Then the white man landed. What a strange sight they made! As we watched from the forest, we wondered why they had come. We watched them chop down our trees. Some of the braves said that it looked like they had come only for firewood and would soon leave. At first they seemed to be afraid of us... They told us there would be land enough for us all, and we could live side by side like brothers. We signed a peace treaty with them and taught them how to plant corn. Without us, their village would have failed the first year."

Inquiry USA
Ralph Kane and Jeffrey Glover,
Globe Book Company, New York,
1971, pp. 13-14.

WILLIAM PENN: The New Land

The soil is even richer than we had hoped. Even the poorest places produce large crops of vegetables and grain. We produce from thirty to sixty times as much corn as in England.

The land requires less seed to produce a crop than in England.

We also find that everything that grows well in England grows well in the colony - corn, roots, wheat, barley, oats... onions, garlic, and Irish potatoes.

Our cattle fatten up for market on weeds, and there is plenty of hay for the winter from our swamps and marshes.

Student Hand-Out 2

1. The chief spoke of a huge canoe with white blankets. What did he mean?

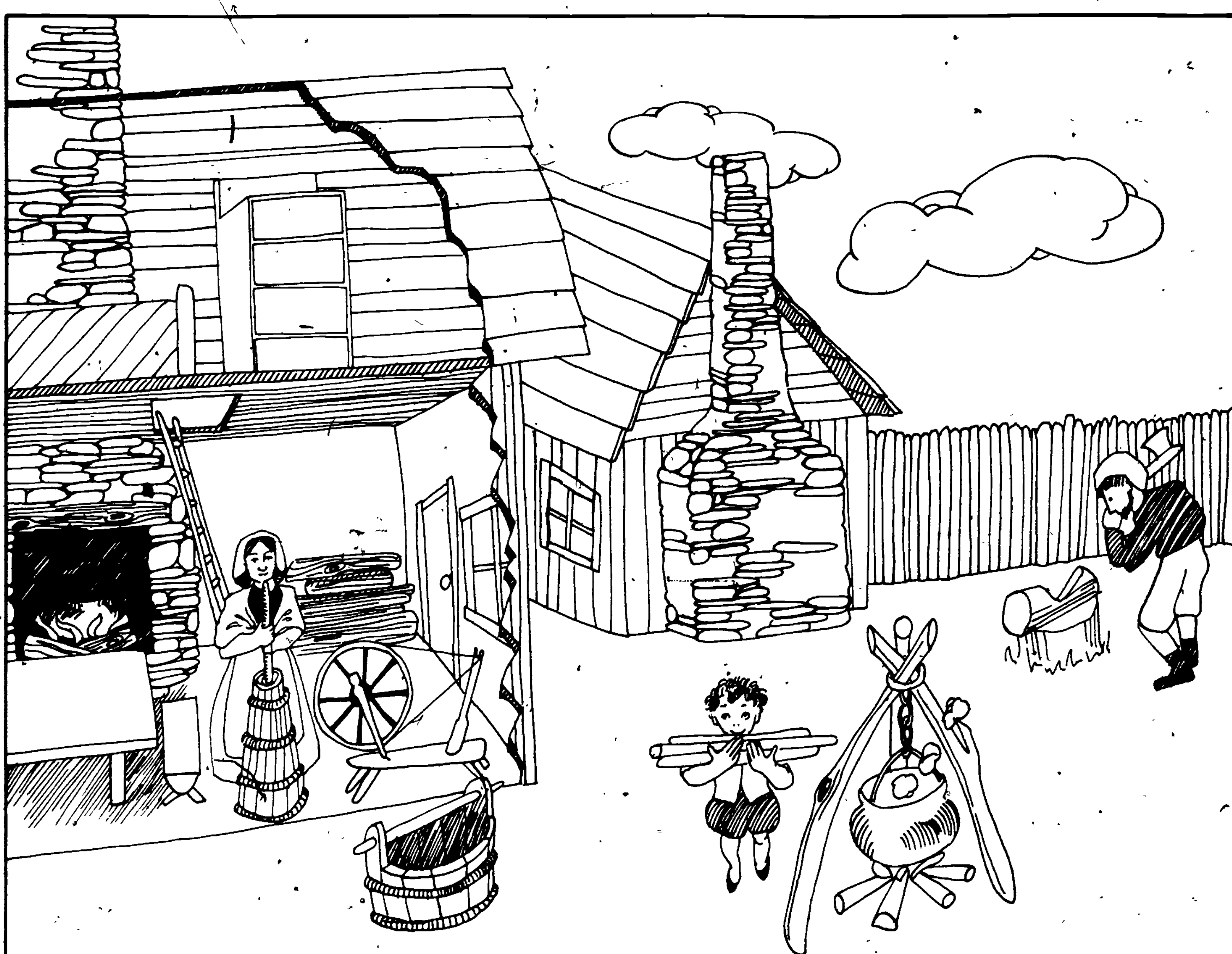
2. Why was the chief sad?

3. What uses did the Indians have for the forests?

4. Why was William Penn so happy with the land in the new world?

5. Why did the settlers cut down the trees?

6. Compare the attitudes of the Indian Chief with William Penn about the use of land and trees.



Student Hand-Out 3

1. What are the uses of wood in the picture?

2. What are examples of energy being used in the picture?

3. What examples show that human muscle power was used to produce the necessities of life?

4. Why were wood and human energy used more in the colonial period than today?

Read the selection below. Then fill in the chart using the information from the Diary.

Diary of a Colonial Farmer

5:00 am	Got up and fed the oxen, pigs and chickens. Wife started fire and cooked breakfast. A cold morning. Frost everywhere. Milked the cow.
6:00 am	Ate pork and buttered cornbread for breakfast. Have to make another chair so our youngest child will have a place to sit. Maybe I can do it tomorrow.
7:00 am	Hitched up the oxen to the plow. Started to plow half our field. Will have to get ready to plant wheat and corn. Hope to plow the other half next week.
11:00 am	Weather finally warmed up some. Wife and children spent the morning hoeing in the garden. Soon the time will come to plant onions, melons... Finally finished plowing. Took oxen back to the barn.
12:00 pm	Finally had lunch. Still thinking about making that needed chair. Had fruit, salted pork, and cornbread for lunch.
12:30 pm	Went to work in the orchard. Hope the blackbirds don't eat too much of the fruit. Have to cut off all the dead limbs on the fruit trees. Only worked on some of the trees. After cleaning up the lunch dishes, wife spent the afternoon spinning thread. We all need some new clothes for summer. I'm thinking about trading a pig for new shoes for the family. Haven't got time to make shoes. Children finally got to go fishing.

Diary of a Colonial Farmer
(continued)

4:30 pm	Too tired to trim any more fruit trees. Had hoped to remove some tree stumps from the field. Maybe I can get to that before too long. Neighbor Thomas will help. Last week I helped him pull up stumps. Wife began to prepare supper. I'm glad children caught fish. We'll have them for supper with some boiled cabbage.
5:00 pm	All of us had supper. Still thinking about making that chair. Wife and children got supper dishes cleaned up. Children brought in some firewood. I milked the cow and fed the livestock again.
7:00 pm	Started to get cold again. Said evening prayers and children went to bed. I repaired a broken plow and wife patched some clothes. Reminded myself to get wood for that chair I must make.
8:30 pm	Wanted to clean my rifle first, but instead used the remaining light from the fire to write in my diary and read the bible.
9:15 pm	So tired. Went to bed.

"The Life of the Farmer", The Americans, Edwin Fenton, Editor, Holt, Rinehart and Winston, New York, 1975, pp. 45-46.

Activity 4

Energy and Cultural Patterns: The Colonial Farm

Using the information from the diary, the picture of the farm family and the previous readings, complete the following chart.

1. What sources of energy were available to the settlers?

2. Show how the following tasks were done by the settlers. What energy was used in these tasks?

   a. Producing food

   b. Preparing food

   c. Building homes and barns

   d. Lighting and heating homes

   e. Preparing clothing

   f. Making furniture

3. List two jobs performed by each member of the family.

   a. Mother

   b. Father

   c. Children

4. In the colonial period, what made one family wealthier or better off than another?

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AMERICA'S WOODEN AGE (Science)

How Can We Find the Energy Content in Wood?

Materials (per group)

1 small cardboard juice can with metal bottom
1 14 oz. juice can
1 ring stand
100 ml. water
wire screen
1 thermometer
1 platform balance
1 glass stirring rod
wood shavings (different kinds)
graduate cylinder

Procedure

(Note: To aid in setting up the apparatus - see diagram on next page.)

1. Cut a piece of screen wire as shown in diagram (next page).

2. Bend the legs of the wire down and the sides up - this will prevent the wood shavings from falling off.

3. Weigh 2.75 grams of wood shavings and carefully place them on the wire basket.

4. Set a match or two in the wood shavings (for easy lighting).

5. Punch 2 holes in the sides of the small juice can near the top rim. Put the glass stirring rod through these holes. Attach to ring stand (see diagram).

6. Measure out 100 milliliters of water. Put it into smaller can (1 ml. of water = 1 gm or .1 kg). Record on data sheet.

7. Take the temperature of H_2O before heating. Record on data sheet.

8. Remove the bottom from the large can. Ignite the wood shavings and quickly place the larger can over the burning wood shavings.

9. Lower the small can into the larger can using the ring clamp.

10. Use your thermometer to measure the temperature of the water after heating. Record on the data sheet.

11. Record the change in the temperature of the water on the data sheet.

12. Multiply the temperature change x the mass of the water x .001 to get the heat gained by water. Record on data sheet. (The .001 is for changing grams x Celsius to Calories.)

13. Find the heat content of the wood.

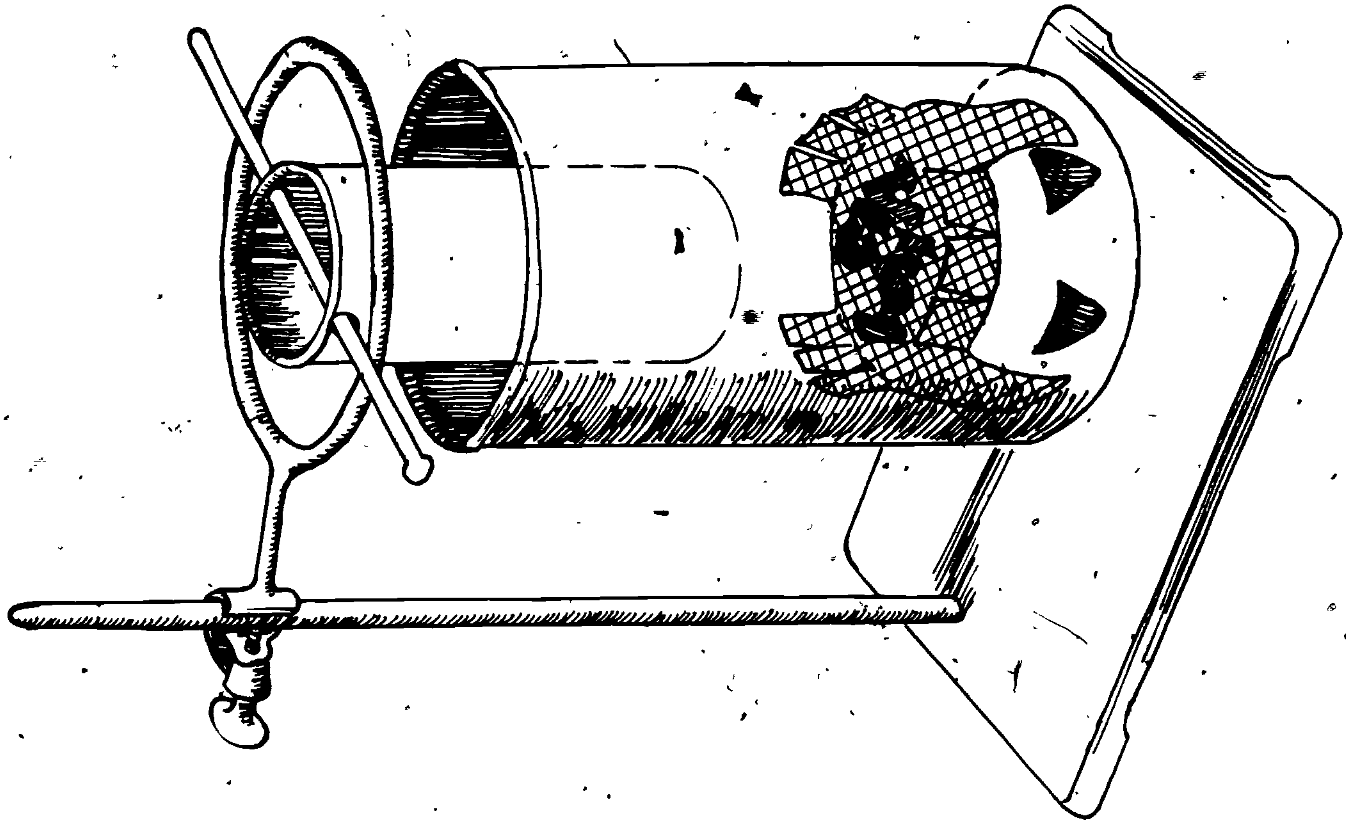
    $$\frac{\text{heat output}}{\text{mass of wood}}$$

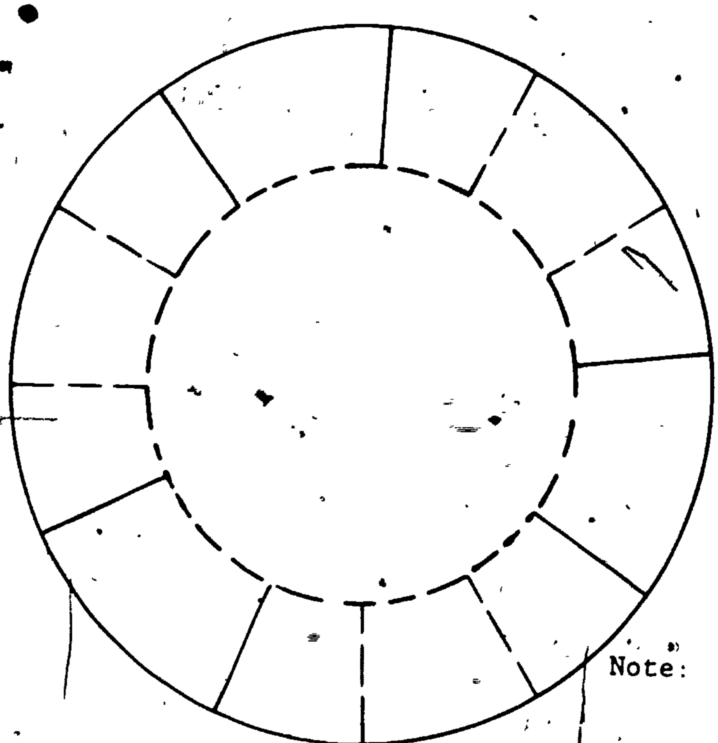
    Record on data sheet.

14. An approximate value for the heat content of wood is 1250 Calories/lb or 2.76 Cal/gm.

15. How do your experimental results compare with the accepted value of wood?

    $$\text{Percent difference} = \frac{\text{experimental results}}{\text{accepted value}}$$





Note: Cut along solid lines

Student Activity Data Sheet

1. Mass of water ________gms or ________kg
2. Mass of wood shavings ________gms
3. Temperature of water before heating ________°C
4. Temperature of water after heating ________°C
5. Change in temperature of water ________°C
6. Heat gained by H_2O = temperature change x mass of water ________________________
7. Heat content of wood = $\frac{\text{heat output}}{\text{mass of wood}}$

____

8. Percent difference = $\frac{\text{experimental results}}{\text{accepted value}}$

____

9. Why was your value probably lower than the average value for wood?

10. How might you improve the design of this experiment?

AMERICA'S WOODEN AGE (Math)
(Student Hand-Out 1)

Woody Problems

1. A one-acre woodlot produces 1.875×10^6 BTU's of energy per year by direct burning. How many Calories are equivalent to the number of BTU's of energy in one acre of wood? (Note: There are .25 Calories in one BTU.)

2. There are 7.5×10^8 acres of woodland in the U.S. Using the findings in problem 1, how many Calories of fuel energy are in the trees growing in the United States?

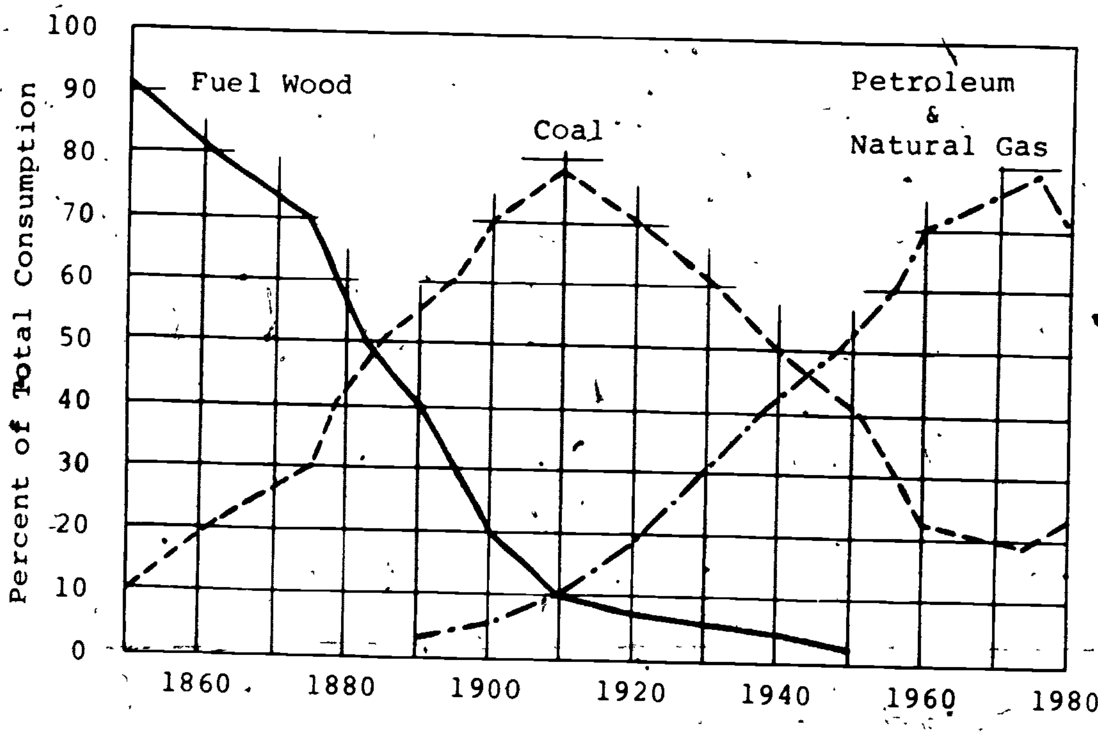
3. A family uses 17.5 cords of wood to heat an average size home. A cord of wood produces approximately 5×10^6 Calories of heat energy. How many Calories of energy are needed to heat one home for one year?

4. Use the number of energy Calories needed by a family for a year to heat a home from the previous problem. If there are 5.4×10^7 families in the United States, how many heat Calories are required for all of the families in the United States?

5. The total number of Calories used by people of the United States in 1976 was 20×10^{15}. Using the number of Calories of energy in the trees growing in the U.S., find what percent of the energy could be supplied by this source for that year.

6. The energy available from trees in the United States is approximately $.5 \times 10^{15}$ per year. The energy the people in the United States used in 1976 was 20×10^{15}. How can we show this information in a graph?

CHANGING FUEL SOURCES IN THE UNITED STATES
(Student Hand-Out 1)



THE COMING OF COAL (Social Studies)
(Student Hand-Out 1)

This graph shows the changes in the major energy sources in the United States.

1. In what year did wood make up over 90% of the energy used in the U.S.?

2. In what year was energy supplied equally by wood and coal?

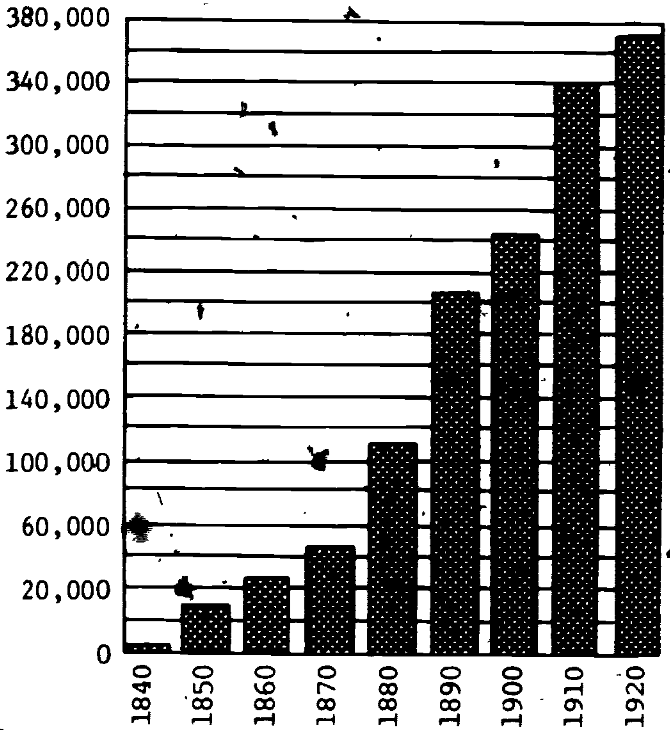
3. In what year did coal reach its peak of importance as an energy source?

4. Based on this graph, what period of time would you label "The Age of Coal"? Why?

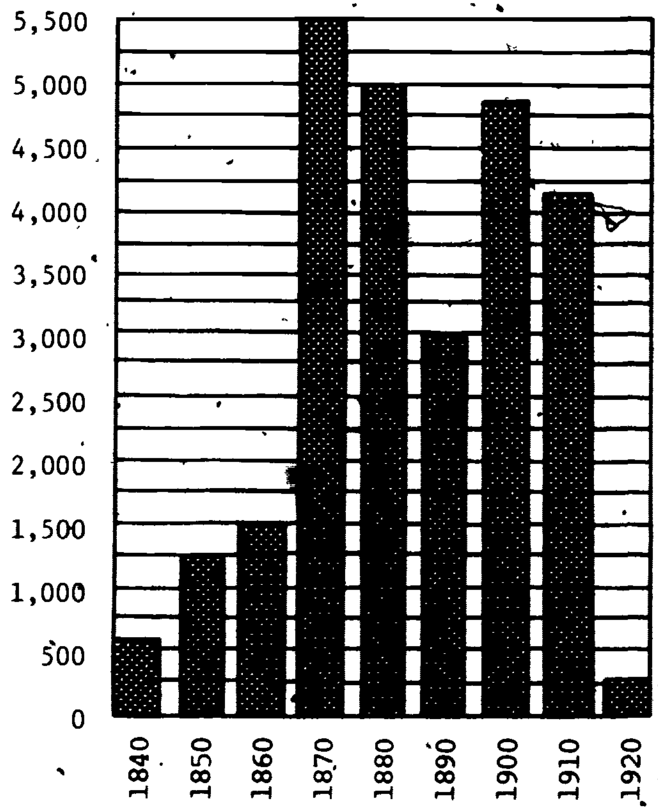
The rest of this unit deals with the question of why coal rose and then fell in importance. Before going on to the other lessons, list as many reasons as you can for this change. When you have finished the unit, look back on this list. Make whatever changes you feel necessary.

(Student Hand-Out 2A)

RAILROAD TRACK IN THE UNITED STATES
1840 TO 1920



NUMBER OF MILES OF RAILROAD BUILT
1840 TO 1920



Student Hand-Out 2A

Instructions:

Graphs A and B are called bar graphs. Why? These graphs have vertical axes (the straight up and down lines) and horizontal axes (the lines running from right to left). Look at the graphs. Then answer the questions.

1. What do the horizontal lines in both graphs tell you?

2. What time period is covered by the graphs?

3. What does the vertical axis show in Graph A?

4. What does the vertical axis in Graph B show?

5. How many miles of track were there in 1860? In 1870? In 1920?

6. How many new miles of track were built in 1860? In 1870? In 1920?

7. Write a statement showing the trend in railroad growth in the United States.

8. Write one or two sentences showing the differences between the two graphs.

MAKING A PICTOGRAPH
(Student Hand-Out 2B)

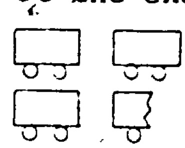
You have looked at two graphs showing railroad growth. Now you are to make a new type of graph. The graph is called a pictograph. Pictures are used to show different amounts of railroad track.

The title of the graph is "Number of Miles of New Railroad Track 1840-1920". Be sure to use the correct graph from Activity 2A to complete your pictograph.

To make things easier, round off the numbers to the nearest hundred. For example, 649 becomes 600. If the number ends with 50 or more, raise the number to the next hundred. For example, 650 rounds off to 700.

On this graph, each railroad car represents 1000 miles of track. You must estimate what fractional part of a car you will need to draw to show some numbers. Look at the example below.

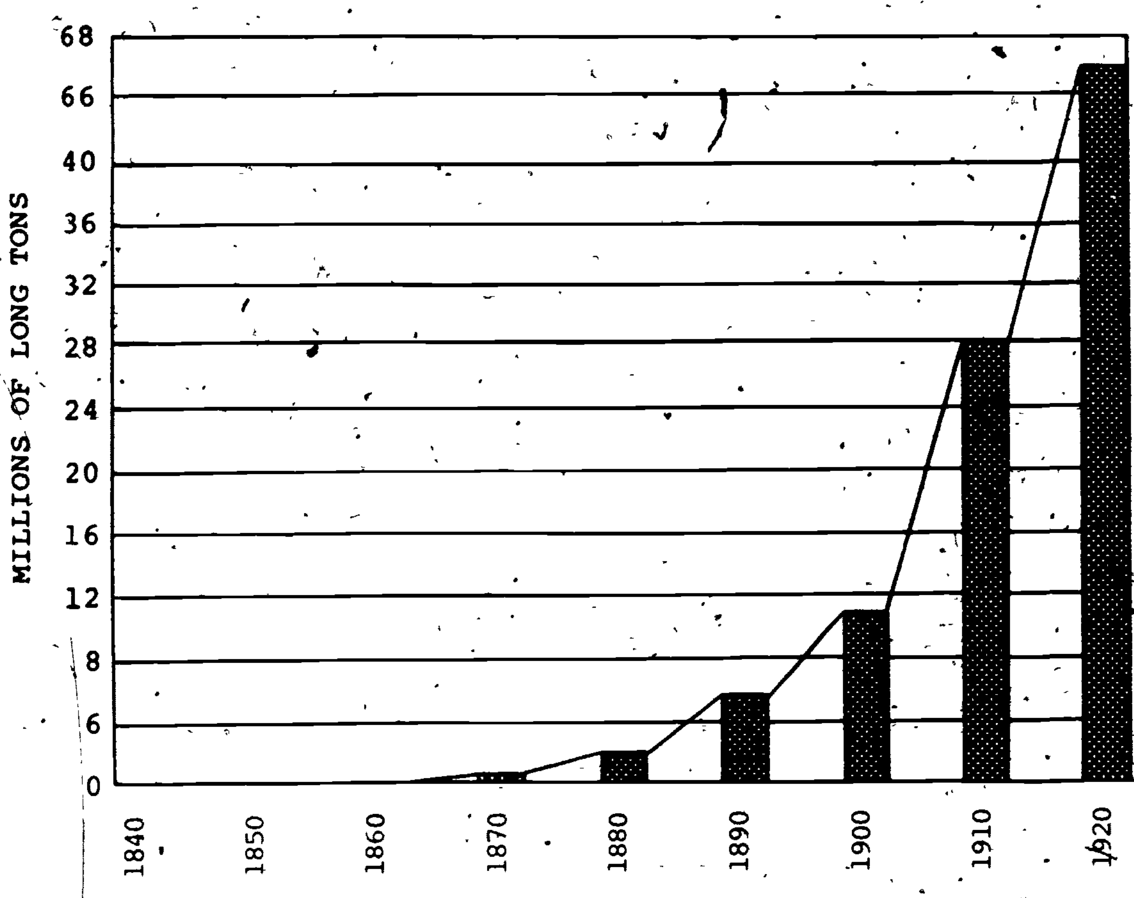
2,000 -
1,600 -



Now, fill in this chart: (One is already done for you)

Year	Miles of New Track	Round off to nearest hundred	Pictograph (Use one column for each car or part of car)
1840	606	600	
1850	1,261		
1860	1,500		
1870	5,658		
1880	5,006		
1890	3,000		
1900	4,894		
1910	4,122		
1920	314		

PRODUCTION OF STEEL INGOTS & CASTINGS
IN THE UNITED STATES, 1840-1920
(Student Hand-Out 2C)



Look at the graph on this page. Then answer each question on the next page on your own paper.

PRODUCTION OF STEEL INGOTS & CASTINGS
IN THE UNITED STATES, 1840-1920
(Student Hand-Out 2C)

1. What kind of graph is this? Is it a bar graph or a pictograph?

2. What does the vertical axis show?

3. What does the horizontal axis show?

4. What period of time is covered on this graph?

5. When was steel first produced in this country?

6. Between what years was there the greatest jump in the production of steel?

7. What trends do you see in the production of steel?

8. After examining the chart on steel production, look back at the graph on railroad ~~growth~~. What similarities and differences do you see?

9. What is the relation between steel production and railroads?

10. What is the relation between steel production and coal?

POPULATION OF THE UNITED STATES
(Table 1)

(Student Hand-Out 2D)

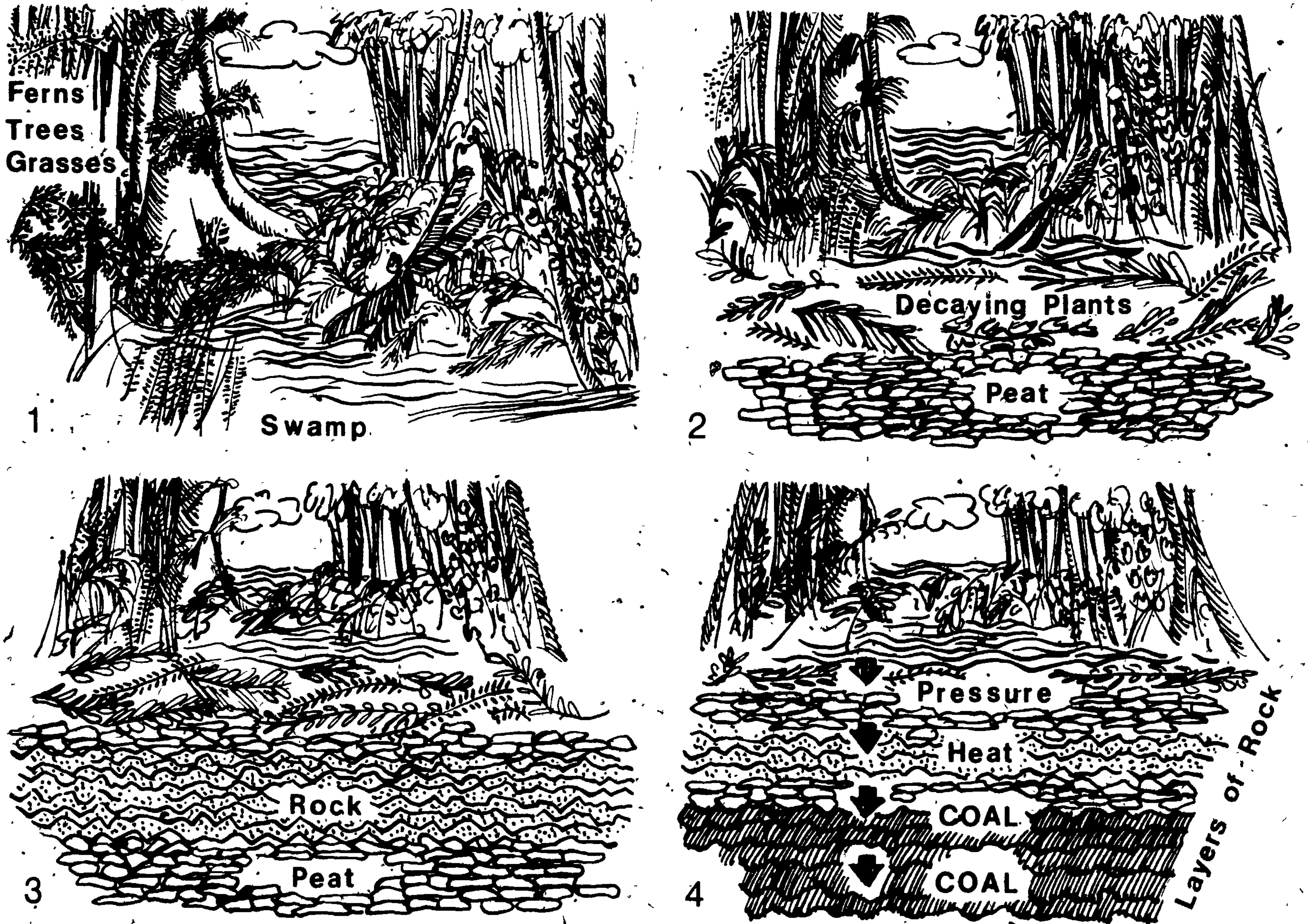
1850	23,261,000
1860	31,513,000
1870	39,905,000
1880	50,262,000
1890	63,956,000
1900	76,094,000
1910	92,407,000
1920	106,461,000

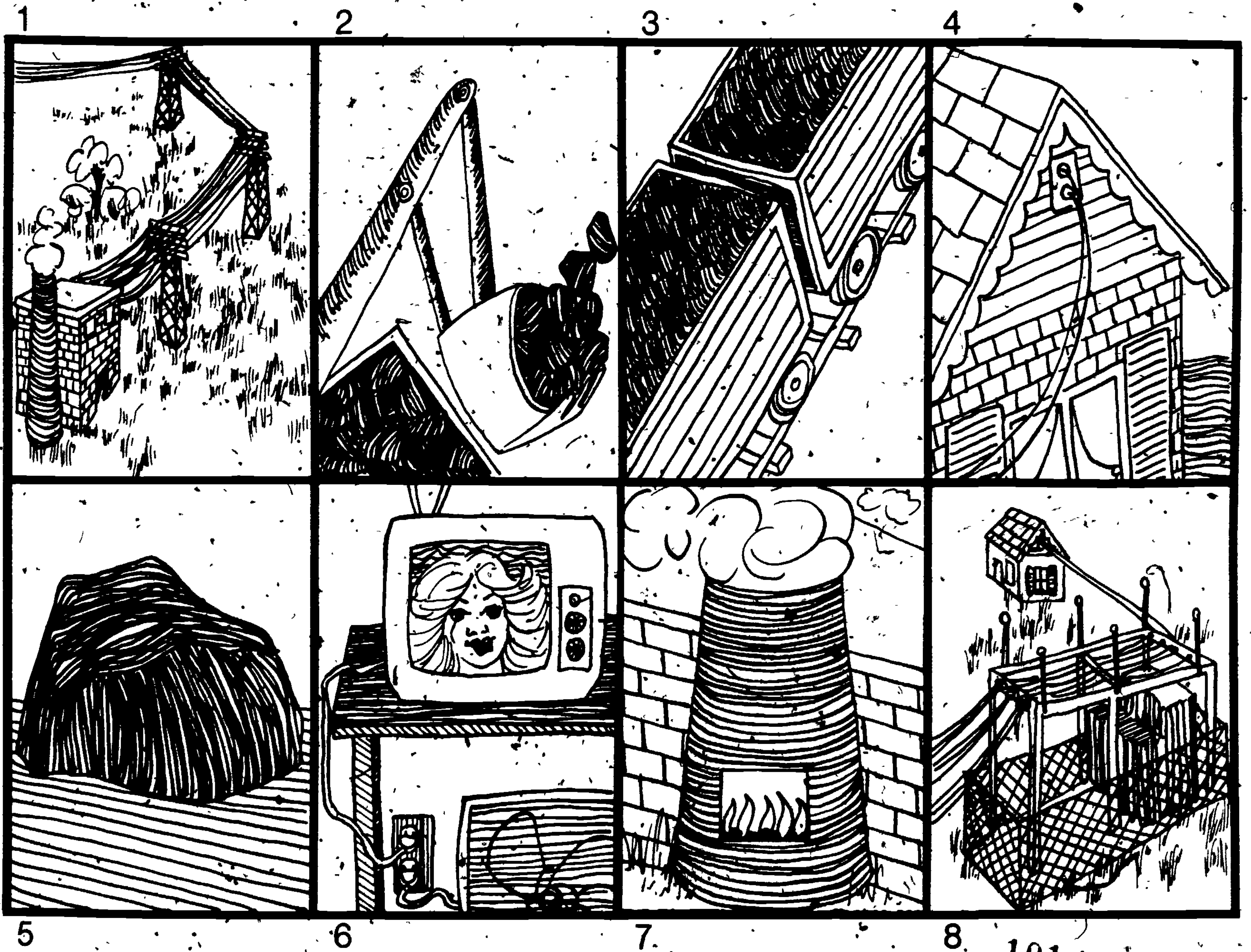
1. What trend do you see in the population table?

2. What is the relation between a growing population and the need for coal?

3. Use the data in the table to make a graph. You can make a bar graph or a pictograph. Be sure to label the vertical and horizontal axis. Write a title on your graph.

HOW COAL WAS FORMED




1
2
3
4
5
6
7
8

Activity 3A A Working Model of a Steam Turbine

Purpose This activity will show that steam can turn a turbine (which is what happens at a power plant).

Materials

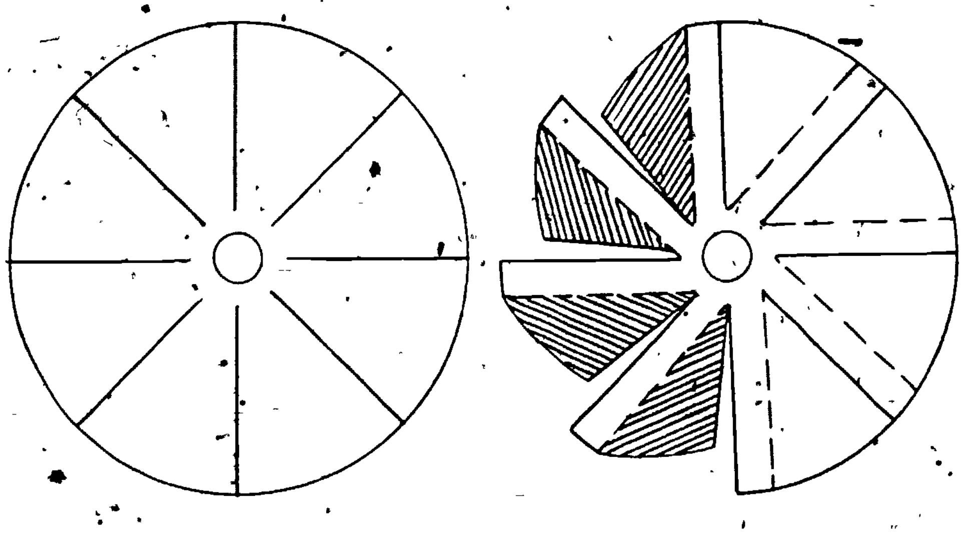
- medicine dropper
- test tube (attached to support rod)
- Bunsen burner
- stopper (one-holed)
- needle
- thimble
- scissors
- pencil with an eraser
- manila circles
- ruler
- compass

Directions Make the turbine wheel first. Use the compass to draw a circle five inches in diameter on the manila folder. Use the same center for the compass, and draw a 1 inch diameter circle inside the larger circle. Place the thimble open end down on the center of the circle you have drawn, and draw a third circle around the thimble.

Use the scissors to cut along the inside of this small circle. Use the ruler to draw eight equal parts.

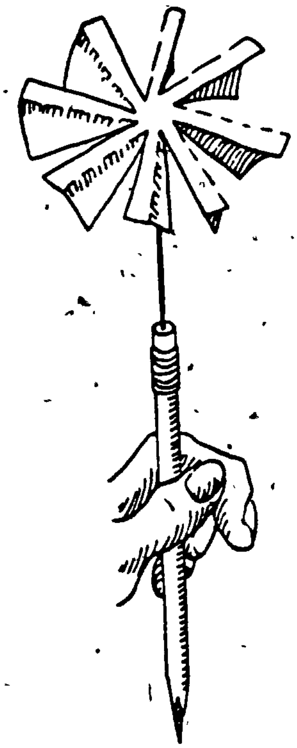
Cut along the lines to the drawn inner circle. Next, bend half of each section back along the dotted lines in the diagram (see Diagram 1). The paper halves should show right angles.

Diagram 1



Insert the needle into the rubber eraser of a pencil. Place the paper turbine wheel over the tip of the thimble and set the inside of the thimble on top of the needle. (See Diagram 2)

Diagram 2

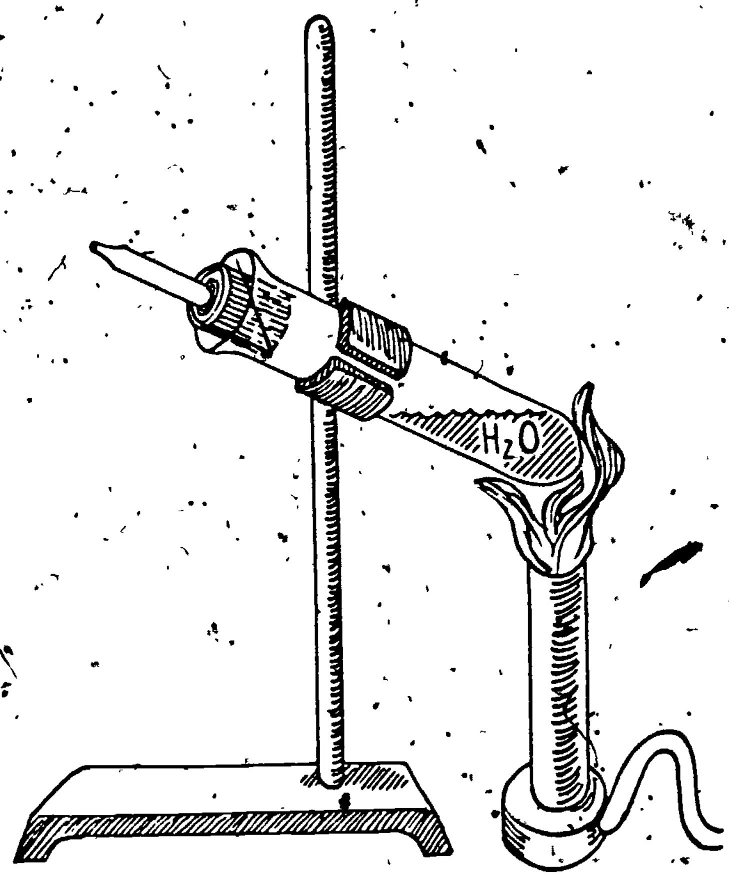


Operation

Operating the Turbine

Put about 1 inch of water in a test tube and assemble the equipment. Remove the rubber bulb from the medicine dropper. Moisten the outside of the medicine dropper and insert it carefully through the one-hole stopper. Insert the stopper into the open end of the test tube, but don't push it in too tightly. Light the Bunsen burner and heat the water in the test tube. (See Diagram 3)

Diagram 3



Answer these questions.
Hold the pencil with the thimble top of the turbine attached in such a way that it turns freely, and direct the path of the steam against the paper blades of the turbine.

1. What is happening to the blades?

2. Can you explain why this is happening?

Activity 3B — Making a Working Model of a Turbine
(Optional Activity - Gifted)

Purpose: To make a working tin can model of a turbine.

Materials:
16 oz. orange juice can with metal bottom
tin shears
cork, screw, metal glue
support
top from larger juice can
Bunsen burner

Directions:

1. Make a turbine blade from the larger juice lid by making slits.
2. About ½ inch from the edge of the lid, punch a small hole for the escape of steam.
3. Next to the small hole, punch a larger hole.
4. Bend a flexible piece of support metal to hold the turbine blade. Then glue it next to the small hole.
5. Fill the can about ¾ full of water.
6. Glue the lid on the juice can and insert the cork.
7. Turn on the Bunsen burner.

Student Questions:

1. What happens to the blades?
2. Can you explain why this happens?
3. Can you see how your model works on the same principle as a real turbine at a power plant?

Activity 4A Producing an Electric Current

Purpose: To show that by passing a magnet through a closed coil of wire we can produce electricity.

Materials:
- A bar magnet
- A cardboard tube
- Copper wire
- A galvanometer (a device that detects the pressure of an electric current)

Directions:

1. Set up apparatus as shown below in Figure 1.

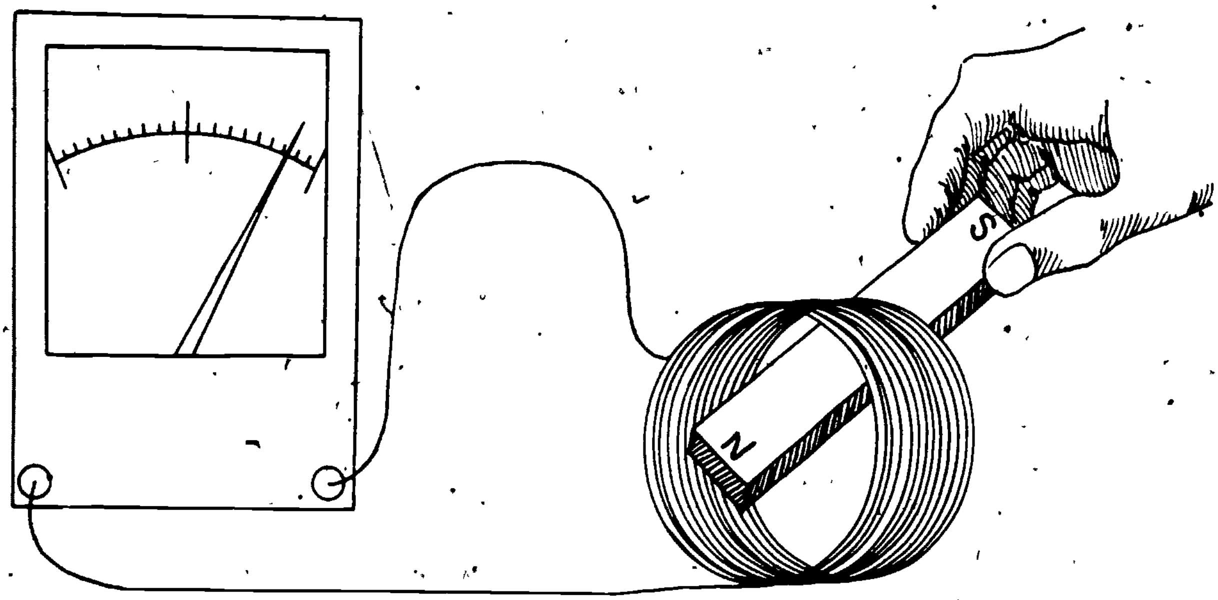


Figure 1

2. With a back and forth motion, move the bar magnet into and out of the coil of wire.

3. Look at the needle on the galvanometer and observe what happens.

Student Question: How can you produce a stronger electric current? Write your idea in the space below.

Activity 4B **Producing an Electric Current**

Directions

1. Set up apparatus as shown in Figure 1.
2. Connect the ends of a flexible wire to the terminals on your galvanometer.
3. Holding the wire vertically, move it briskly between the poles of the U magnet (cutting across the magnetic field).
4. Observe what happens to the needle of the galvanometer.
5. Now make a coil of wire (25-40 turns) and move the coil between the poles as shown in Figure 2.
6. Observe what happens.
7. Is it necessary to have wires cutting across a magnetic field to produce electricity? Why?

Figure 1

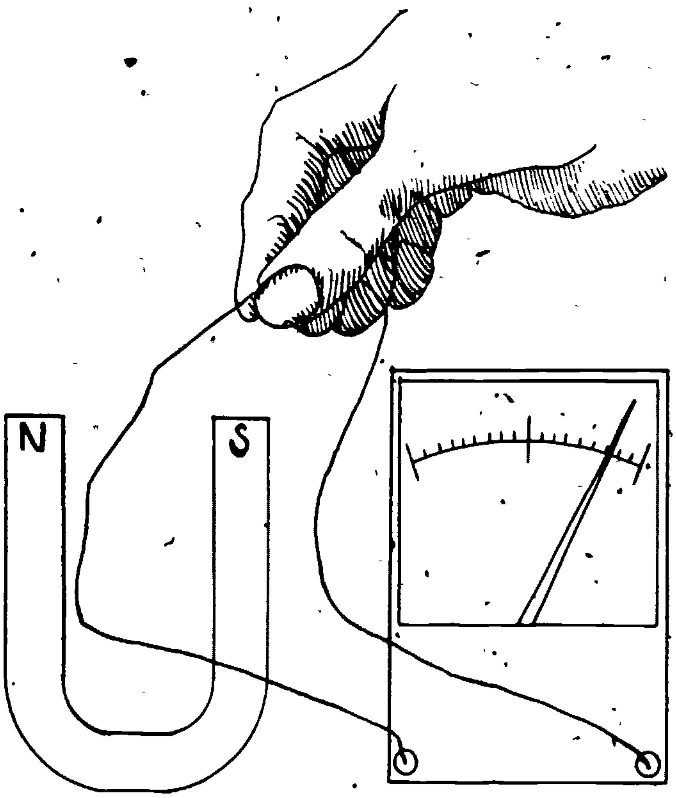
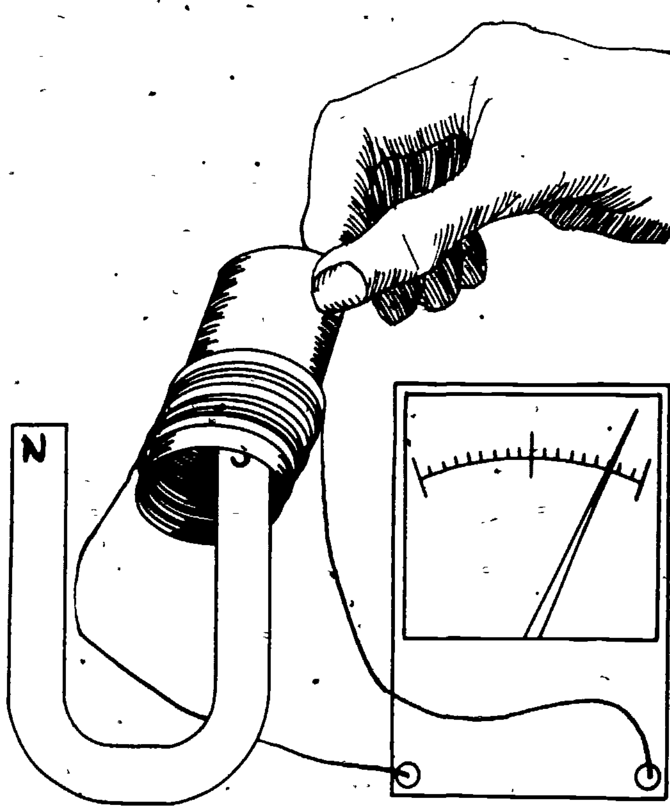
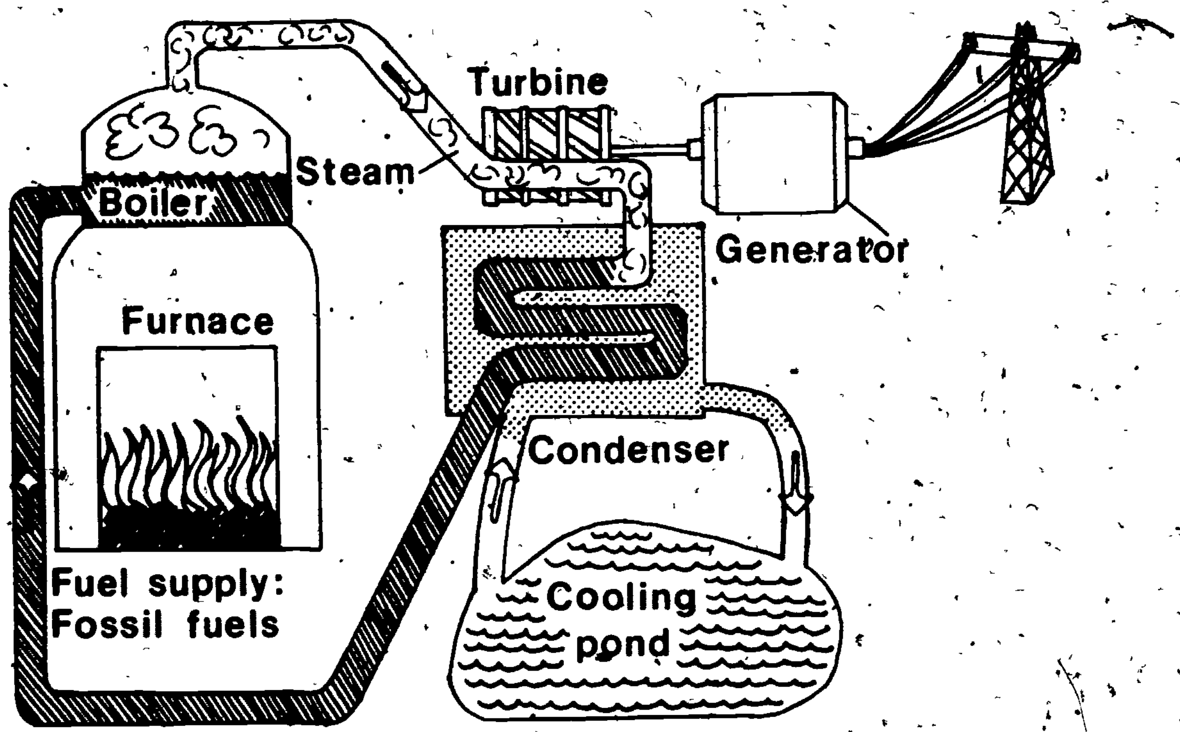


Figure 2



Activity 5

Compare each part of the picture to the models you have made.



Based on this picture and your models explain the step by step method of how coal is used to make electricity.

OIL:BRIGHT PROMISE (Social Studies)
(Student Hand-Out 1)

Antenna cable
Credit cards
Permanent-press clothes
Heart valves
Crayons
Disposable diapers
Parachutes
Telephones
Enamel
Transparent tape
Antiseptics
Vinyl siding
Safety flares
Overcoats
Bubble bath
Bookends
Planters
Deodorant
Panty hose
Bedspreads
Tubs
Shag rugs
Lunch boxes
Jerseys
Windshield wipers
Phonographs
Car sound insulation
Garment bags
Fences
Kitchen counter tops
Windbreakers
Pillows
Dune buggy bodies
Checkers
Soap dishes
Syringes
Shoes
Volley Balls
Synthetic rubber
Sleeping bags
Electrician's tape
Midi-skirts
Mascara
Sweaters
Bread boxes

American flags
Aspirin
Oxygen masks
Ink
Hair spray
Steering wheels
Food wraps
Stretch pants
Rubber duckies
Seed tape
Card tables
Golf cart bodies
Slips
Warm-up suits
Ping-pong paddles
Purses
Weed killers
Football pads
Puzzles
Carbon paper
Mattress covers
Dishdrainers
Crabgrass killer
Puppets
Pajamas
Upholstery
Hearing aids
Racks
Dresses
Track shoes
Pond liners
Protractors
Earphones
Whistles
Clothesline
Carpet sweepers
Chess boards
Yardsticks
Slip covers
Paddles
Patio screens
Exercise mats
Refrigerator linings
Floor wax
Panelling
Sneakers
Earrings

Eyelashes
No-wax floors
Golf balls
Lighter fluid
Attache cases
Wet suits
Laxatives
Trash cans
Brassieres
Wall coverings
Acrylic paints
Vacuum bottles
Shoe trees
Bearing
Rafts
Sockets
Flippers
Tiles
Air conditioners
Wallets
Backpacks
Rubbing alcohol
Epoxy paint
Oil filters
Mailboxes
Uniforms
Welcome mats
Pacifiers
Cassettes
Dominoes
Luggage
Antifreeze
Flashlights
Motorcycle helmets
Antibiotics
Shower doors
Shorts
Sugar bowls
Decoys
Darkroom trays
Tobacco pouches
Pencils
Model cars
Garden hoses
Lawn sprinklers
Playing cards
Dolls

Bubble gum
Coasters
Tennis shoes
Straps
Tires
Rulers
Boat covers
Unbreakable dishes
First-aid kits
Watchbands
Toothpaste
Tents
Finger paints
Glycerin
Fo[illegible]
Ni[illegible]s
Lamps
Ice cube trays
Swimming pool liners
Shirts
House paint
Cough syrup
Hair dryers
Styrofoam coolers
Brake fluid
Bathrobes
Shawls
Draperies
Audio tape
Car battery cases
Hockey pucks
Fertilizers
Knitting yarn
Sandwich bags
Raincoats
Sports car bodies
Smocks
Tablecloths
Ring binders
Tote bags
Toothbrushes
Notebooks
Darts
Flea Collars
Stadium cushions
Foul weather gear
Hang gliders
Refrigerants
Sandals
Lipstick
Typewriter cases
Electric blankets
Ear plugs
Drinking cups
Lamp shades
Rollerskate wheels
Guitar strings
Maxi-skirts
Jugs
Eyeglasses
Vinyl tops
Ice chests
TV cabinets
Measuring tape
Ice buckets
Hiking boots
Water softeners
Microfilm
Floor polish
Stoppers
Tennis balls
Measuring cups
Reclining chairs
Dishwashing liquid
Extension cords
Combs
Flight bags
Drip-dry dresses
Plastic varnish
Badminton birdies
Bird feeders
Rugs
Hair curlers
Laminates
Visors
Laundry softeners
Tennis rackets
Canisters
Computer tape
Movie film
Ammonia
Gaskets
Monkey bars
Venetian blinds
Digital clocks
Life jackets
Model planes
Insect repellent
Fishing nets
Hair coloring
Rubber cement

THE DEVELOPMENT OF OIL
(Student Hand-Out 2)

The cry "we've struck oil" made farmers angry in 1800. Some people knew how to use the dark, gooey substance for medicine. Others could use it to seal roofs and boats. Some used oil for light. For the most part, however, oil hurt the farmer. It ruined the soil.

In the early 1800's most Americans earned their living on farms. These early farms used little energy. Wood and coal, along with animal and human muscle, provided most of the needed power. For light, lard or tallow candles and whale oil or petroleum lamps were used. Few people travelled further than they could walk. Most of the items used were made in the home.

Over the next hundred years the nation changed tremendously. The total number of people, the way they made a living and where they lived all changed.

Population grew rapidly. There were less than 100,000 people living in the United States in 1820. By 1920 there were over a million people. Many of these people lived in cities rather than on farms. The table below will give you an idea of just how fast the cities grew.

CITY	1820	1860	1880	1900
New York	152,000	1,174,800	1,912,000	3,437,000
Philadelphia	63,000	565,500	847,000	1,294,000
Boston	43,300	177,800	363,000	561,000
Baltimore	62,700	212,400	332,000	509,000
Cincinnati	9,600	161,000	255,000	326,000
St. Louis	10,000	160,800	350,000	575,000
Chicago		109,300	503,000	1,698,000

Cities need more energy than rural areas. Streets and factories must be lit. Large buildings must be heated. People and supplies must be transported.

The Industrial Revolution attracted people to the cities, and the cities grew. This "revolution" was a change in the way things were made. In the past, items such as cloth, furniture and rifles had been made at home by hand. Now, they were made in factories by workers using machines. With machines, a few workers could produce many more items at a cheaper cost than they could without machines. However, the machines required great amounts of energy to work. The manufactured items then had to be transported to the buyers. This also required a great deal of energy. As a result, the factory system of manufacturing is often referred to as an "energy intensive" system.

With the growth of population, the growth of cities and the growth of the factory system the demand for energy increased enormously. This increased demand for energy drove the price of energy up. As the price rose, investors saw a way of making a great profit: find a cheap, unlimited supply of efficient energy.

Scientists and engineers around the world conducted experiments to find this new source of energy. In Canada, Abraham Gesner used natural oil to produce "Keroselain". This was later called "kerosene". In Pittsburgh, Samuel M. Kier used petroleum produced by salt well. He developed a way to refine the oil. By 1858, Kier's firm was selling great quantities of "Carbon Oil" at $2.00 a gallon. But the demand for oil was still greater than the supply and the price kept rising.

In another part of Pennsylvania, a group of businessmen led by James M. Townsend formed a company to drill for oil. They reasoned that this would be a profitable way to invest their money. They hired Edwin L. Drake, a retired railroad conductor, to undertake drilling operations. The site chosen was on the banks of Oil Creek at Titusville, Pennsylvania.

Drilling went slowly. People began calling the project "Drake's folly". Laborers quit. The townspeople ignored the project. But the developers still thought they would reach oil and make a profit. They continued to risk their money. The investors hired W.A. Smith as the chief driller.

On Saturday, August 27, 1859, Smith stopped the drill at 69 1/2 feet. Late the following day, Smith walked past the well. He noticed something strange. A dark, green fluid filled the hole. He lowered a cup and pulled it up. The cup was filled with oil. "We've struck oil!" "We've struck oil" became the cry of a new gold rush.

Questions for Student Hand-Out 2

1. Was oil valuable to the people in the United States around 1800?

2. Was oil used as an energy source before 1800?

3. Did farmers like to find oil on their land? Why or why not?

4. List three reasons why the demand for energy increased between 1820 and 1920.

5. Why did investors put their money in oil development after 1850?

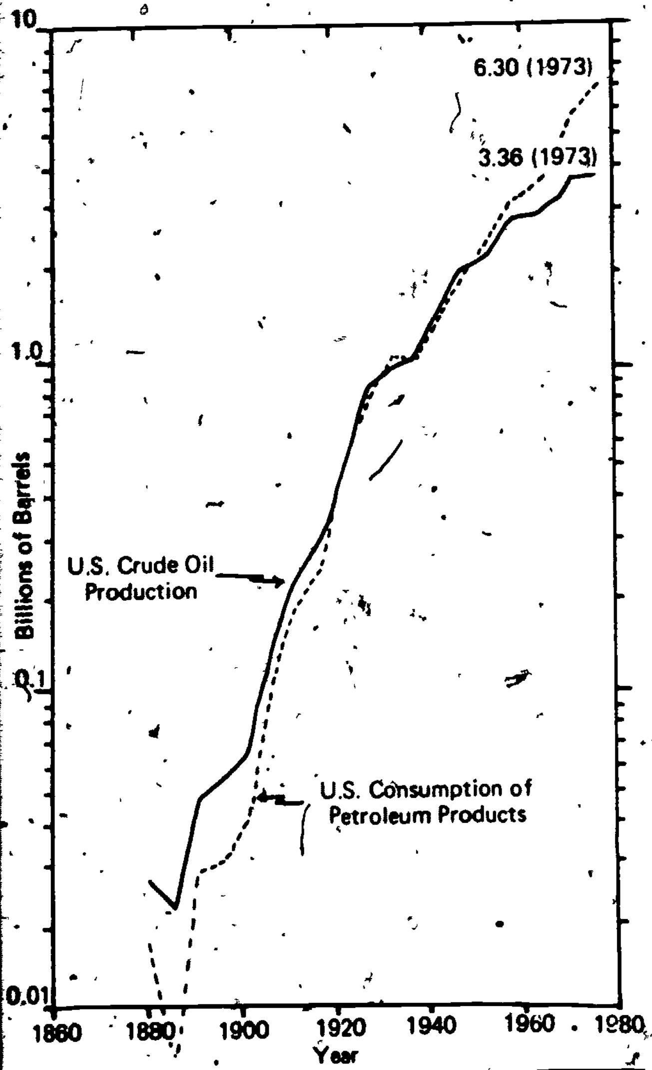
6. What does the term "energy intensive" mean?

7. What does the term "Drake's folly" mean?

8. In the last paragraph, why is a strike of oil compared to a gold rush?

GRAPH #1

U.S. Production and Consumption of Petroleum



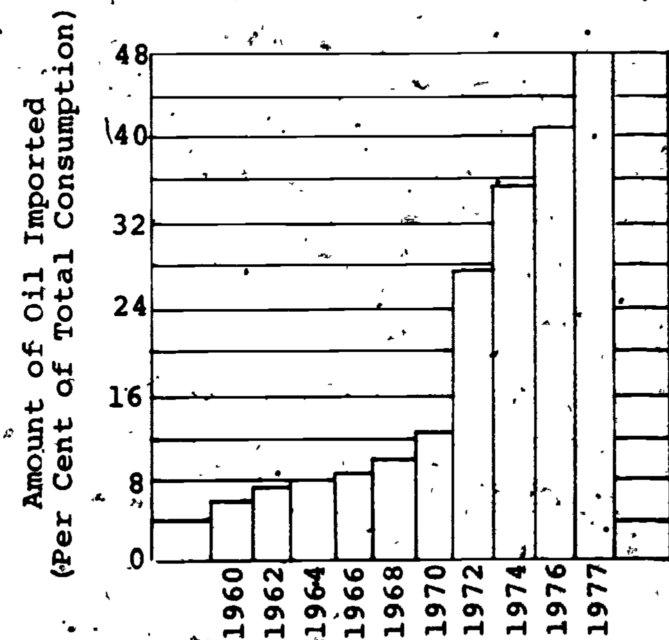
Data from Schurr and Netschert, Energy in the American Economy, 1850-1975. Baltimore: The Johns Hopkins Press, 1960,

and: Bureau of Mines; U.S. Department of the Interior.

Student Hand-Out 3

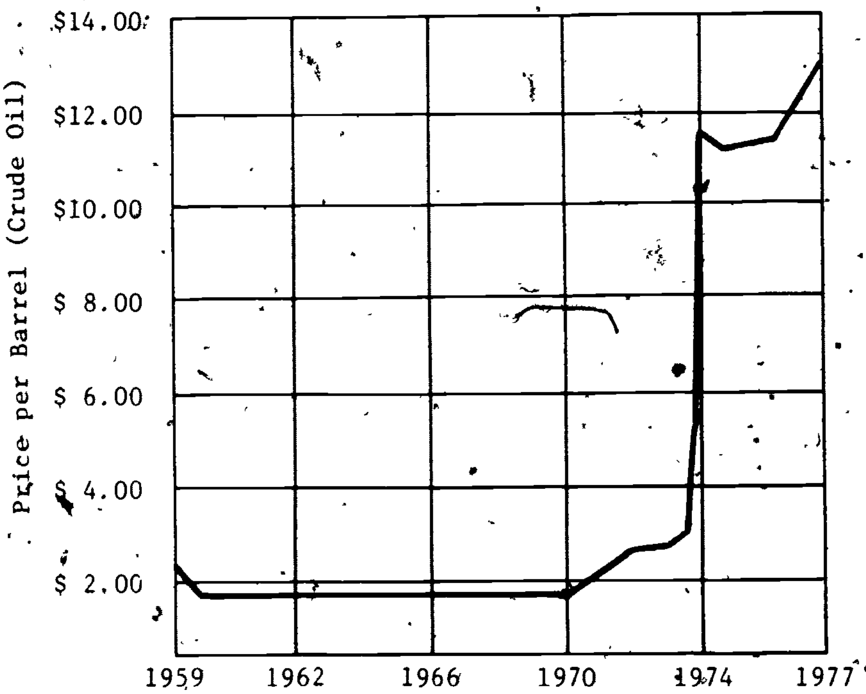
GRAPH #2

UNITED STATES OIL IMPORTS



GRAPH #3

ARABIAN & PERSIAN GULF CRUDE OIL PRICES



Student Hand-Out #3

1. What is the title of Graph #1?

2. What does the vertical axis (the line on the left that goes up and down) show?

3. What does the horizontal axis (the bottom line that runs left to right) show?

4. What is the time span of the graph?

5. What does the term consumption mean?

6. What does the term production mean?

7. What does the solid line show?

8. What does the broken line show?

9. What is the trend in consumption?

10. What is the trend in production?

11. Between which years was U.S. production greater than U.S. consumption?

12. If the trend for the period between 1960 and 1970 continues, what will be the relation between U.S. production and U.S. consumption?

Bonus Question:
Where does oil come from that is not produced in the United States?

13. What is the purpose of Graph #2?

14. What per cent of the oil used in 1966 in the United States was imported?

15. What per cent of oil used in the United States in 1976 was imported?

16. What do you think this dramatic increase tells us about United States oil production today?

17. Look at Graph #3. What can you learn from the title?

18. Compare the three graphs in this section. What reasons can you give for the rise in the price of Persian oil?

19. What effects do you think the rising price of oil will have on the U.S. culture and economy?

OIL: BRIGHT PROMISE (Science)

HEAT CONTENT OF OIL
(Student Hand-Out I).

Purpose To determine the heat content of oil.

Materials

- Fiberglass insulation
- Glass stirring rod
- Bunsen burner
- Ring stand with clamp
- Thermometer (40°-150°C)
- 8 oz. juice can with metal bottom
- 16 oz. metal can
- 3-in-1 oil
- Platform balance
- Screen wire
- Scissors
- Matches

Procedure

1. Weigh 100 ml. of water and pour in juice can. Record on data sheet.
2. Read the temperature of the water. Record it on data sheet.
3. Make a small stand out of the piece of wire screen. See diagram in America's Wooden Age (Science).
4. Cut a piece of fiberglass insulation about 2.5-3 cms. in width and length.
5. Place the small wire screen and fiberglass insulation on the platform balance.
6. Slowly drip 20-22 drops of 3-in-1 oil into the fiberglass. Record the mass of the screen stand, fiberglass and 3-in-1 oil on data sheet. (Weight should be about .3 gms or .003 Kg.)
7. Use a beer can opener to put holes in the sides of the larger can as shown in diagram.
8. Remove the bottom from the larger can.
9. Using your scissors, punch a small hole in the top (sides) of the small juice can for the stirring rod. Insert stirring rod.
10. Now remove the wire screen, fiberglass and oil from the balance.
11. Leaving the fiberglass on the wire screen, ignite the oil.
12. Raise the large can and cautiously push the burning oiled fiberglass under the juice can containing the water.

13. Lower the large can over the burning oiled fiberglass.

14. After the oil has burned off the fiberglass, record the temperature of the water on the data sheet.

15. Cautiously raise the larger can and remove the wire screen containing the unburned fiberglass. Weigh the screen and fiberglass to see if you burned all the oil that you started out with.

16. Determine the heat content of oil. See data sheet.

DATA SHEET

1. Mass of water ______ml = _____g or ______Kg

2. Temperature of water before heating _____°C

3. Mass of screen stand, fiberglass and oil before heating ______gms

4. Mass of screen stand, fiberglass and oil after heating _____gms

5. Mass of oil _______

6. Temperature of H_2O after heating _____°C

7. Change in water temperature _____°C

*8. Heat gained by water = temperature change x mass of water x 1 = _____Calories

9. Heat content of oil = $\frac{\text{Heat output (Heat gained by } H_2O)}{\text{Mass of oil}}$ = ______Cal/Kg

**10. Accepted value for heat content of oil is _____Cal/kg

11. % difference = $\frac{\text{experimental result}}{\text{accepted value}}$ = ______

*To change Kilogram Calories to Calories, multiply by 1.

**Data taken from Energy and the Environment, by John M. Fowler (McGraw-Hill Book Company), p. 427, 1975.

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