DOCUMENT RESUME

ED 250 190 SE 045 169

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TITLE Energy and Transportation Lessons for the Middle Grades.
INSTITUTION Indiana State Dept. of Public Instruction, Indianapolis. Div. of Curriculum.
SPONS AGENCY Department of Energy, Washington, D.C.
PUB DATE Oct 84
GRANT DE-FG45-76CS60038
NOTE 103p.; For related documents, see SE 045 168-170.
PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Careers; *Energy; *Energy Education; Grade 7; Grade 8; Junior High Schools; *Learning Activities; Science Education; Secondary School Science; *Social Studies; *Transportation

ABSTRACT

The five lessons presented in this guide are designed to: create an awareness of the present energy situation and its relation to various aspects of transportation systems; provide knowledge of energy resources, choices, and alternative actions; develop critical thinking skills about energy and individual roles in the energy management process; encourage problem-solving habits as students examine alternative solutions to energy and transportation issues; and influence participation as students practice consumer roles and decision-making in their homes, school, and community. These lessons, which explore transportation and energy use, bicycles, mopeds, and school buses, include: an overview (which lists inquiry, decision-making, and action objectives; and states the lesson's purpose, time needed, and the readability of student materials); a glossary; a factsheet (which provides background material for completing other activities); classroom activities; a case study (which presents a problem or issue for students to discuss); a home study; a community study; a section which explores the short-, intermediate-, and long-range future of issues/problems presented in the lesson; a career-oriented activity; and a list of resources. Also provided is a list of seventh and eighth grade social studies textbooks indicating energy and transportation concepts and the page numbers on which they appear. (JN)

Energy and Transportation Lessons

for the Middle Grades

energy education curriculum program

Lt. Gov. John M. Mutz, Director
Indiana Department of Commerce

Harold H. Negley, Superintendent
Indiana Department of Education

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--Harold H. Negley, State Superintendent of Public Instruction

ENERGY AND TRANSPORTATION LESSONS

FOR THE

MIDDLE GRADES

Division of Energy Policy
Indiana Department of Commerce
Lieutenant Governor John M. Mutz

Division of Curriculum
Indiana Department of Education
Harold H. Negley, Superintendent

October 1984

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FOREWARD

A society's future resides in its vision. As Indiana educators work with students on energy and transportation issues and problems, together they will explore alternatives for prosperity in the 21st century. What they imagine decades ahead will be created in the classrooms of today.

We believe that students of all ages must understand the relationship between transportation choices and available energy resources. More efficient, effective use of energy will insure a more prosperous future. To help middle school teachers achieve this significant goal, we are pleased to introduce a new Middle School Energy Education Curriculum. This exciting and innovative program contains important goals, materials, activities, and resources for you and your students.

We encourage you and your students to study these lessons. We hope you will use them to inquire deeply into energy and transportation issues and problems, to explore decisions, then to consider actions. We trust you will go beyond these lessons to enlist the support of other teachers, students, and their parents, other citizens, and community agencies. A broad commitment among Indiana's people is necessary for dealing with this critical energy issue.

Harold H. Negley
State Superintendent
Indiana Department of Education

John M. Mutz
Lieutenant Governor
State of Indiana

ACKNOWLEDGEMENTS

The Energy Education Curriculum Project (EECP) is coordinated by the Indiana Department of Education, Division of Curriculum, with the support and assistance of the Indiana Department of Commerce, Division of Energy Policy.

The development of these Energy and Transportation Lessons for the Middle Grades required careful review, criticism, and advise. The quality of these lessons has been enhanced by the input from the following advisors:

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State Department of Education

Special thanks is given to Joe Wright and Helen Ritchie who worked most closely with the project director in managing the development of these lessons.

Likewise, special thanks is given to the curriculum development team. The interdisciplinary blend of the talents of the following Ball State University faculty broadened coverage of issues and sharpened insights into the complex relationship between energy and transportation: Dr. Francis Parker, Acting Chair and Professor, Urban Studies and Planning and Dr. Devon Yoho, Director of the Center for Economic Education and Associate Professor of Economics who prepared the Energy and Transportation Lessons for the Middle Grades; Dr. Mildred Ballou, Professor of Early Childhood and Elementary Education, Mrs. Martha Lane, Instructor of Elementary Education at Burris Laboratory School, and Dr. Marianne Talafuse, Associate Director of the center for Economic Education and Associate Professor of Economics who assisted in the development of a conceptional framework and an organizational format for these lessons.

The graphic art work prepared by Mrs. Cheryl King, Educational Media Center, assured the creation of visually-appealing materials.

Careful evaluation of lessons by the following teachers at Burris Laboratory School upgraded the quality of the lessons and increased the likelihood of their being used by other teachers: Dr. Theresa Greenwood, Dr. Carl Keener, Mrs. Nancy Mannies, and Mrs. Sandra Murray.

Support staff members -- from Carol Richard and Alicia Sink who edited copy and typed, revised, and retyped several drafts of the lessons to Brian Blann and Juli Steffens, graduate assistants from the Department of Educational Psychology, who conducted analyses of texts and reviewed energy and transportation literature -- deserve recognition.

Preparation of these lessons was supported by the U.S. Department of Energy (DOE) Grant No. DE-FG45-76CS60038. However, any options, findings, conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the DOE.

Roy A. Weaver
Project Director
Teachers College
Ball State University

INTRODUCTION

Transportation involves the carrying of people, goods, and ideas from one place to another. In order to move these things energy -- a source of power -- is required.

Throughout history, a variety of power sources have been used. Muscle power -- human and domesticated animal -- provided the earliest form of energy for transportation. Centuries ago, the Chinese attached sails to wheelbarrows to take advantage of the wind as a power source. Early voyagers used the water in rivers and oceans for transportation.

In 1776 in England James Watt put engines, powered by steam, to work. Within two decades Englishman Richard Trevithick used steam to power a railroad locomotive and Robert Fulton used it for the steamboat. Gradually, coal began to replace steam in moving the locomotive.

Energy sources for modern forms of transportation can be traced to:

1800	Electricity is produced in Italy by Volta who invents the battery and gives his name to the volt
1859	Oil is discovered in Pennsylvania by Edwin Drake
1860	The internal combustion engine is invented in France by Lenoir, who creates an explosion inside a cylinder
1884	The steam turbine and accompanying electrical advances are perfected by Charles Parsons in England
1892	The oil-burning engine is invented by Rudolf Diesel
1903	Gasoline is used to power the Wright brother's plane.

Historically, the form of transportation accessible to members of a society has been tied to energy resources. Then and now, the extent to which these resources have been available for powering transportation has depended largely on the consumption of non-renewable resources. The level of consumption has been influenced by lifestyles and the values and behaviors supporting them.

The Critical Role of Energy Education

Producing appropriate student knowledge and behaviors to maintain and to improve the delicate balance between available energy resources and demands on these resources is the primary role of energy education. To carry out this role, classroom teachers are challenged to accomplish the following tasks:

1. To understand and to communicate basic concepts in energy education;

2. To foster appropriate student attitudes toward energy consumption by sharing insights on the consequences of unwise lifestyles and by modeling energy conservation behaviors;

3. To prepare students to examine thoroughly energy issues and problems and to develop thoughtful plans for resolving them; and

4. To motivate students to help educate citizens in their communities about ways to improve the quality of life while safeguarding non-renewable energy resources.

In these lessons, the preceding four tasks are presented in the context of transportation. The study of energy in relation to transportation is compelling because it pervades so much of our daily living. Where we work, study, shop, and play and how we get to those places provides but a sample of questions resulting from the study of energy and transportation. The costs of the choices we make is as intriguing.

The Indiana Department of Education, in cooperation with the Division of Energy Policy, Indiana Department of Commerce has organized curricula in the past to help teachers and students explore important energy issues and problems. The lessons that follow illustrate the continuing commitment of these agencies in assuring that tomorrow's decision makers will have been prepared to make wise choices — promoting a better quality of life.

Development of the Energy and Transportation Lessons

The first step in developing the energy and transportation lessons for the middle grades involved a careful analysis of concepts presented in state-adopted social studies texts in grades 7 - 8. On pages 4 - 7 the publishers, titles of the texts, concepts related to energy and transportation, and the page numbers on which the concepts appear are listed. We have included the listing so that you can supplement these lessons with readings from available texts in your school system.

The second step in lesson development was to define goals. Five goals were identified:

1. To create an awareness of the present energy situation and its relation to the transportation system;

2. To provide knowledge of energy resources, choices, and alternative actions;

3. To develop critical thinking skills about energy and individual roles in the energy management process;

4. To encourage problem-solving habits as students examine alternative solutions to energy/transportation issues; and,

5. To influence participation habits as students practice consumer roles and decision-making in their homes, school, and community.

In relation to these five goals three areas of educational development were emphasized:

1. <u>Inquiry</u>:

   (a) identifying an issue or problem,

   (b) understanding background to the issue or problem,

   (c) examining tentative solutions,

   (d) collecting data,

   (e) analyzing data, and

   (f) reaching a conclusion;

2. <u>Decision-Making</u>:

   (a) recognizing the need to make a decision,

   (b) analyzing alternative decisions,

   (c) predicting consequences of decisions, and

   (d) ranking alternative decisions;

3. <u>Taking Action</u>:

   (a) Recognizing issues or problems where action should be taken,

   (b) analyzing evidence upon which action should be developed,

   (c) selecting actions,

   (d) predicting consequences,

   (e) initiating action, and

   (f) evaluating the results of action.

Each lesson begins with an overview listing inquiry, decision-making, and action objectives. A brief description of the purpose of the lesson is included, along with the approximate time required for completing the lesson, and the reading level of the materials.

The second component of each lesson is a GLOSSARY. Terms critical to an understanding of the lessons are defined.

The third component of each lesson is a FACTSHEET. The FACTSHEET is a handout that may be reproduced and distributed to students for their reading. Or, it may be adapted for use in a lecture. The FACTSHEET provides background material for completing other activities. Illustrations to go with the FACTSHEET are included at the end of the RESOURCES section of the lesson.

The fourth component of each lesson is CLASSROOM ACTIVITIES. Ideas are presented for in-class study.

The fifth component in each lesson is a CASE STUDY. The CASE STUDY presents a problem or issue for students to discuss. The CASE STUDY is written in such a way as to encourage analysis of alternative points of view.

A sixth component is the HOME STUDY. The HOME STUDY activity is designed to get students to apply what they have learned in class to the home environment. The HOME STUDY activity is intended to engage family members in the exploration of energy and transportation problems and issues.

The seventh component of each lesson is the COMMUNITY STUDY. The COMMUNITY STUDY activity is intended to get students to examine the complications of energy and transportation decisions on communities — local, state, national, and international.

The eighth component of each lesson is a 21st CENTURY. The purpose of 21st CENTURY is to explore the short — (3-5 years), intermediate — (6 to 15 years), and long-range (16-30+ years) future of issues and problems presented in the lesson.

SELECTED RESOURCES are identified at the conclusion of each lesson. The listed films, filmstrips, games, computer software, magazines, books have been chosen carefully to support instruction of the lesson.

Analysis of Middle Grade Texts

SOCIAL STUDIES BOOKS

GRADE 7

Exploring Our World: Latin America and Canada, Follett Publishing Company

Land Use: 10, 34, 132, 192, 299, 307, 375, 397
Oil Refineries: 135, 136, 213

Social Studies, Scott, Foresman and Company

Choices: 25-26, 55, 88, 222, 236-237
Community: 60-61, 143, 297
Economic Power: 261-265, 286-289, 290-291,
Goals: 306, 321-326
Natural Resources: 173, 317-319
Transportation: 306-308, 350, 358, 364, 365-366, 369-371, 372-373

Sources of Identity, Harcourt, Brace, Jovanovich

Distribution: 420-421
Economic Growth: 430-431, 438, 440-441, 444, 448, 470, 475, 479-480
Energy: 332, 387, 396-398
Goals: 26, 28, 32, 78
Human Resources: 356, 357, 408, 426, 428, 474
Natural Resources: 326, 328-329, 339, 340, 342, 348, 352, 354-356, 357, 360, 361, 388-389, 390, 394, 399, 406, 408, 426, 436, 448, 459-460, 470, 474, 480
Productivity: 418, 426, 437, 464
Supply: 416
Trade: 271-272, 348, 453
Transportation: 420-421

The Story of Latin America, Field Educational Publications, Inc.

Oil: 152, 158-159, 290, 316, 374, 375
Trade: 211, 312-313, 374
Transportation: 32, 132, 134, 136, 137, 171, 184, 186-187, 188-189, 190-194, 196, 284, 314-315, 316, 363, 374-375

Challenges of our Time, Allyn and Bacon

Part 1 - Technology: Promises and Problems

Community: 2, 94
Efficiency: 64-65
Mechanical Energy: 42
Nuclear Power: 78-79, 139
Production and Industry: 3, 55, 59, 61, 78, 99, 101, 106, 107, 113, 119, 124-125, 127, 128, 130
Resources: 39, 61, 77, 92-93, 96, 98, 106, 143
Transportation: 102

Part 4 - Choices and Decisions: Economics and Society

Natural Resources: 5, 11, 25
Overproduction: 11-12, 41-43
Production: 9-12, 15, 20, 25, 27, 30, 35, 38-39, 41-43, 50-51, 81, 92, 95, 98, 111
Supply: 39, 41, 43
Transportation: 19-23, 29-31, 53, 112, 150

Part 5 - Lands of Africa

Resources: 19, 148-149, 150-151, 154-155
Trade: 44-45, 47, 49-50, 51, 55, 58-59, 61-62, 69, 75, 76, 101, 106, 108, 116, 118, 146

The Afro-Asian World, Allyn and Bacon

Community: 330
Oil: 42-43, 195, 196, 303-304, 346, 353-355, 401, 430-432, 436, 579
Resources: 561-568, 579
Trade: 150, 183, 209-210, 214, 276, 341, 345, 384, 390, 392, 481-482, 579

World Geography, Litton Educational Pub., Inc.

Conservation: 68
Energy Fuel: 66, 68, 139
Resources: 57, 65, 68, 74, 75, 76
Transportation: 85, 176, 187, 188
Trade: 198

GRADE 8

The Free and the Brave - 3rd Edition, Rand, McNally and Company

Oil: 476-478, 477, 620, 693-694
Production: 592, 656-657, 664-665, 694-697
Trade: 132-133, 163-167, 173, 233, 239-240, 283, 285, 286, 288, 289, 306-308, 313, 337, 427, 588-589
Transportation: 203, 293, 306-307, 307-308, 337, 360-362, 481-484, 520, 546, 604-607

We the People, D. C. Heath and Company

Community: 19, 20, 31, 555
Conservation: 365, 424, 425
Fuel: 110, 311, 314, 335, 394
Oil: 183, 311, 334, 335, 461, 549, 572
Resources: 110, 310, 311, 314, 329, 336, 365, 546-547, 548-550, 560
Trade: 36-38, 42-43, 48, 66, 71, 111, 112, 126-128, 146, 147, 152, 177, 182-184, 193, 200, 221, 228, 233, 234, 239, 248, 250, 254, 255, 272-273, 374-375, 382, 389, 500, 560
Transportation: 248-250, 255, 256, 272, 311-314, 340-341, 500, 501, 502, 516, 523-524, 560, 561

America - It's People and Values - 2nd Ed. Revised,
Harcourt, Brace, Jovanovich

Conservation: 477, 564, 654, 655, 657, 661, 780, 781, 782, 786-787
Natural Resources: 536-45, 581-85, 776, 780-83,783-88
Oil: 411, 538-39, 540, 584-85, 588, 646-47, 692, 716, 753, 761, 762, 776, 776-781, 781, 782, 783-785
Trade: 14-18, 16-17, 57-59, 102-107, 135-136, 182, 194, 257, 262-264, 265, 266, 298, 312, 313, 314, 336, 347-352, 348, 350-351, 352, 359-360, 455, 458-59, 541-543, 643, 673-674, 678, 787
Transportation: 94-95, 141, 183, 198, 305-310, 310-316, 317-321, 422-424, 494, 500, 508, 531, 583, 592, 596-598, 598-600, 603-606, 640-641, 644-645, 776, 777, 779, 780, 788-789, 805

The American Way, Holt, Rinehart, and Winston Publisher

Energy Program: 702
Trade: 183-184, 272, 273-274, 411, 528, 533, 694

Energy and Transportation Field Study Sites

Field trips can be an integral part of the school curriculum. Indiana has a variety of interesting museums, parks, and other sites devoted to energy and transportation. A listing of these sites is included for planning class field trips and for encouraging parents to take their children on tours of the sites:

1. CANALS AND RIVERBOATS

Howard Steamboat Museum
1101 E. Market St.
Jeffersonville, IN 47130

Victorian mansion with original 1893 furnishings, also a collection of navigational equipment, paddle wheels and steamboat replicas. Emphasis on Ohio River steamboat era and on the boat-building industry in Jeffersonville.

Whitewater Canal State Memorial
Box 88
Metamora, IN 47030
(317) 647-6512

Ten miles of the original Whitewater Canal (built 1845) have been restored, incl[illegible] g masonry locks and feeder dam, and the only wooden covered [illegible]idge adequate in America. An authentic wooden canal boat, drawn by horses, makes 30 minute trips at the town of Metamora on summer weekends.

Newburgh Lock and Dam
Highways 662 and 66
Newburgh (Warrick Co.), IN 47630
(812) 853-8470

Picnic ground and overlook with view of locks and dam. Watch barges and boats on the Ohio River. Open March - October.

2. RAILROADS and INTERURBANS

Indiana Transportation Museum
Forest Park
Noblesville, IN 46060
(317) 773-0300

Large collection of railroad passenger cars, freight cars and locomotives, also buggies and wagons. Special emphasis on the electric interurban lines which radiated from Indianapolis in the years 1904-1940. Two mile demonstration ride on a restored interurban car. Open daily Memorial Day-Labor Day, weekends April-May and September-November, 1-6 p.m. School tours welcome by reservation.

Museum is also responsible for "Fair Train" — a diesel powered train ride between Carmel and Indiana State Fair grounds during the weeks of State Fair in August.

Whitewater Valley Railroad
P.O. Box 406
Connersville (Indiana Rt. 121), IN 47331

A 34 mile round trip train ride, pulled by authentic steam and diesel locomotives. Track parallels the scenic Whitewater River and is laid on the towpath of the original Whitewater Canal. Train runs Saturday and Sunday, May-October. Leaves Connersville 12:01 p.m., returns 5:00 p.m.., with 2 hour stopover in Canal town of Metamora. Special school trips (by reservation) are run Wednesday-Thursday-Friday during May, feature lecture on area and transportation history as the train makes its trip.

French Lick, West Baden and Southern Railway
Highway 56
French Lick, IN 47432
(812) 936-2405

A 20 mile round trip, pulled by steam or diesel locomotives. Leaves restored French Lick depot at 10:00 a.m., 1:00 p.m. and 4:00 p.m., Saturday and Sunday from April through November. Features ½ mile long tunnel and rural scenery. Also a 2 mile electric trolley car ride between French Lick and West Baden, a restoration of a trolley operation which connected the two towns between 1903 and 1918. School trips possible by reservation.

Little River Railroad
P.O. Box 178
Angola, IN 46703
(219) 825-9182

A 10 mile round trip steam train ride between Angola and Pleasant Lake, 1:30 p.m. on weekends from Memorial Day through mid October. (During 1984 check for schedule due to major track renovations underway).

LaPorte County Historical Steam Society
Hesston, IN
Mail address 2940 Mt. Claire
Michigan City, IN 46360
(219) 872-7405

A 3 mile steam train ride, also steam farm machinery and sawmill. Open Memorial Day weekend through October, weekends 1-6 p.m. Major show held Labor Day weekend.

Logansport Iron Horse Museum
One Iron Horse Square
Logansport, IN 46947
(219) 753-6388

Restored Railroad Station and exhibits. Iron Horse days, held second week-end in July, features steam train rides and other exhibits.

The Children's Museum
30th and Meridian Streets
Indianapolis, IN 46208
(317) 924-5431

Museum includes large display of model trains, and locomotive from original Madison and Indianapolis railroad. Open Monday-Saturday, 10:00 a.m.-5:00 p.m.; Sunday, Noon-5:00 p.m.

Fort Wayne Railroad Historical Society
P.O. Box 11017
Fort Wayne, IN 46855

Society has restored a large Nickel Plate Road steam locomotive, built in 1944. The locomotive pulls a variety of special excursions each summer in Indiana and adjoining states. Write for current schedules.

Evansville Museum of Arts and Sciences
411 S.E. Riverside Drive
Evansville, IN 47713
(812) 425-2406

Museum displays include a steam train and replica passenger depot. Open Tuesday-Saturday, 10:00 a.m.5:00 p.m; Sunday 12:00-5:00 p.m.

The Depot
370 E. Jefferson Street
Franklin, IN 46131
(317) 736-6334

Renovated 1906 train station and exhibits. Open Monday-Friday, 8:00-Noon, 1:00-5:00 p.m.

Rochester Depot Museum
Lakeview Park
Race and E. Ninth Streets
Rochester, IN 46975
(219) 223-4436

Restored 1874 Train Station and exhibits. Open June-August, Monday-Friday 9:00 a.m.-5:00 p.m; Sunday 2:00-4:00 p.m.

Leiters Ford Depot Museum
Fulton County Historical Society
7th and Pontiac
Rochester, IN 46975
(219) 223-4436

Restored 1880 Erie railroad depot and exhibits. Open June-August, Monday-Friday, 1:00-5:00 p.m.

Grand Trunk Depot Museum
201 S. Broad
Griffith, IN 46319
(219) 924-2155

Restored railroad station. Open June-August, Wednesday, 10:00 a.m.-2:00 p.m.; Sunday 2:00-4:00 p.m.

3. <u>AUTOMOBILES</u>

Auburn-Cord-Duesenberg Museum
1600 S. Wayne Street
Auburn, IN 46706
(219) 925-1444

Large collection of classic and antique cars in restored automobile show-room. Open 10:00 a.m.-5:00 p.m. October-April, 9:00 a.m.-9:00 p.m. May-September.

Studebaker vehicle collection from wagons through cars. Open Tuesday-Friday, 10:00 a.m.-4:30 p.m.; Saturday, 10:00 a.m.-4:00 p.m.; Sunday, 1:00-4:00 p.m.

Indianapolis Motor Speedway and Hall of Fame Museum
4790 W. 16th Street
Speedway, IN 46224
(317) 241-2500

Collection of antique and classic race cars. Open 9:00 a.m.-5:00 p.m.

Early Wheels Museum
817 Wabash Avenue
Terre Haute, IN 47808

Collection of cars, wagons and bicycles. Open Monday-Friday, 10:00 a.m-4:00 p.m.

4. AIRPLANES

Grissom Air Force Base Aircraft Museum
State Highway 31
46971
(317) 689-5211

Collection of military aircraft. Tours by advance appointment.

Wilber Wright Birthplace Memorial
RR 2, Box 258 A
Hagerstown, IN 47346
(317) 332-2513

Restored house. Open Sunday and Tuesday, 1:00-5:00 p.m.; Wednesday-Saturday, 9:00 a.m.-5:00 p.m.

To keep up to date on festivals commemorating special energy and transportation related events and newly established museums, contact:

Tourism Development Division
Indiana Department of Commerce
One North Capitol
Suite 700
Indianapolis, IN 46204
(Tourism Hotline: 1-800-622-4464)

Sources for Free and Inexpensive Materials

A number of energy and transportation agencies and industries provide free materials or reasonably inexpensive materials for classroom use.

For example. an energy and transportation decision-making computer software program was developed for this project. The program can be obtained by writing to: Division of Curriculum, State House, Room 229, Indianapolis, IN 46204. Once you receive the software disk, copy it, then return it to the Division of Curriculum.

Please take advantage of these materials by writing to the following organizations and agencies.

American Petroleum Institute
Publications and Distribution Section
2101 L Street, N.W.
Washington, DC 20037

Amoco Educational Services
Public Affairs - MC 3705
P.O. Box 5910-A
Chicago, IL 60680

Amoco Teaching Aids
P.O. Box 1400K
Dayton, OH 45414

Chevron U.S.A. Inc.
"Career Awareness"
742 Bancroft Way
Berkeley, CA 94710

Division of Curriculum
Room 229, State House
Indianapolis, IN 46204

Division of Energy Policy
1 North Capitol Avenue
Indianapolis, IN 46204

Exxon Company, U.S.A.
Public Affairs Department
P.O. Box 2180
Houston, TX 77001

Exxon Corporation
1251 Avenue of the Americas
New York, NY 10020

Federal Highway Administration
U.S. Department of Transportation
400 - 7th Street, S.W.
Washington, DC 20590

General Motors Corporation
Energy Management Section
3044 W. Grand Blvd.
Detroit, MI 48202

Government Printing Office
Superintendent of Documents
Washington, DC 20402

Gulf Oil Corporation
P.O. Box 1166
Pittsburgh, PA 15230

Indiana Department of Highways
1101 State Office Building
100 N. Senate Avenue
Indianapolis, IN 46204

Indiana Department of Transportation
143 W. Market
Indianapolis, IN 46204

National Coal Association
1130 - 17th Street, N.W.
Washington, DC

National Petroleum Refiners Association
1725 DeSales Street, N.W.
Suite 802
Washington, DC 20036

National Wildlife Federation
1412 - 16th Street, N.W.
Washington, DC 20036

Phillips Petroleum Company
16 D3 Phillips Building
Bartlesville, OK 74004

Public Documents Distribution Center
Consumer Information
Pueblo, CO 81009

Standard Oil Company (Indiana)
Public and Government Affairs
Mail Code 3705, P.O. Box 5910-A
Chicago, IL 60680

Standard Oil Company (Indiana)
200 East Randolph Drive
Chicago, IL 60601

Texaco Inc.
2000 Westchester Avenue
White Plains, NY 10650

Union Oil Company of California
Corporate Communications, Dept. A
P.O. Box 7600
Los Angeles, CA 90051

U.S. Department of Commerce
Washington, DC 20230

U.S. Department of Energy
Educational Programs Division
Washington, DC 20585

U.S. Department of Energy
James Forrestal Building
1000 Independence Ave.
Washington, D.C. 20585

U.S. Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, TN 37830

U.S. Department of the Interior
Bureau of Mines
Mineral Industry Surveys
Washington, DC 20241

U.S. Office of Education
Energy and Education Action Center
Room 514, Reporters Bldg.
300-7th Street, S.W.
Washington, DC 20202

PURPOSE: This lesson provides an overview of introductory energy concepts. Different forms ot energy and measurement units are covered. The lesson also introduces the concept of energy as related to distance and scarcity.

APPROXIMATE TIME: If each of the following activities is used, approximately eight class hours will be needed. This estimate does not include use of supplementary resources described in the lessons.

READABILITY: The Bormuth Readability Index was used to determine the reading level of text material in this lesson.

Ave. Word Length: 4.61

Ave. Sentence Length: 17.5

Readability Index: 59.3

Grade Level Equiv.: 7-8

OBJECTIVES

INQUIRY	DECISION-MAKING	TAKING ACTION
1. Students will explore different forms of energy.	1. Students will recognize conditions under which fuel consumption is altered.	1. Students will determine when energy use becomes problematic.
2. Students will demonstrate ways to measure energy.	2. Students will explore fuel consumption in their community.	2. Students will analyze data to determine the nature of an energy use problem.
3. Students will propose the most appropriate transportation uses of energy.	3. Students will predict the consequences of increased transportation use on availability of energy resources.	3. Students will explore the need to propose a change in energy use.
4. Students will examine energy efficiency.	4. Students will rank order the most efficient transportation uses of energy.	4. Students will propose alternative strategies for energy use.
5. Students will analyze the impact of transportation use on energy availability.		5. Students will examine the result of their proposal for alternative energy use.
6. Students will develop a conclusion concerning appropriate fule consumption.		

LESSON 1: TRANSPORTATION AND ENERGY USE

Energy

Glossary

TRANSPORTATION

Bbl - Abbreviation for barrel, as a unit of oil consumption. One barrel = 42 gallons of oil.

BTU - British Thermal Unit. The amount of heat energy that will raise the temperature of one pound of water 1 degree Fahrenheit.

Calorie - A unit of heat energy. The amount of heat energy that will raise the temperature of one kilogram of water 1 degree Celsius.

Fuel Consumption - The rate at which fuel is burned to produce useful work, as, for example, miles per gallon of gas.

MPG - Miles per gallon. Used to measure fuel efficiency of motor vehicles.

Quad - One quadrillion BTUs. A unit used to measure national energy consumption.

Stored energy - Potential energy which has been temporarily stored for future use. Examples include a charged storage battery, a heavy fly-wheel revolving at high speed, or a reservior into which water is pumped during the night, in order to release it to run an electric turbine during peak hours.

Transformed energy - Energy which has been put in some other form for ease of distribution or use, for example energy from burning coal transformed into electricity.

Urban Density - The number of people and/or houses per acre or per square mile. Urban density is usually highest in the center city.

VMT - Vehicle miles traveled. The measure of total traffic in the community.

DEFINING ENERGY TERMS

Energy is a term we use to express the amount of work done in a particular system. Energy is a quantity, which can be expressed as a force times a distance, or in terms of units of heat produced. Energy can occur in many forms, and can be changed from one form to another. In fact it can be transformed, but it cannot be created. The first law of thermodynamics (also called the law of conservation of energy) states "Energy can neither be created or destroyed." We use energy, and secure useful work, heat and light from it, but we cannot create new energy. This is the first basic point about energy: it is not unlimited.

The second law of thermodynamics suggests another consequence of energy use. The second law states that energy, as it is used, is always transformed from a more concentrated and useful form to a more diffuse and irrecoverable form. Energy is not destroyed, but it is transformed. During transformation, heat energy may be spread around too much to use economically. So it is wasted in the environment where it may be harmful. This is the second point about energy: when we use it, we create unintended problems of energy impact on our environment.

Energy use is described in a bewildering variety of units, including some very large and some very small. Units of one type can be converted into another type using conversion factors.

One familiar small unit of energy is the calorie. Calories are used to describe the amount of energy contained in a candy bar or an ice cream cone, but they could also be used to describe the energy in a gallon of gasoline or a lump of coal. The calorie is a common unit of heat energy. It is the amount of heat that will raise the temperature of one kilogram of water 1° Celsius.

A second common unit is the BTU or British Thermal Unit. This is not a metric unit, but uses the traditional units of British measurement which we still use widely in the U.S. One British Thermal Unit is the amount of heat energy that will raise the temperature of one pound of water 1 degree Fahrenheit.

Question: Can we translate from Calories to BTUs?

Yes, if we know the conversion factors. One kilogram is equal to 2.2046 lbs. One degree Celsius is equal to 9/5 of a degree Fahrenheit. If one BTU heats one pound of water 1° Fahrenheit, how many calories is this?

(Answer: $2.2046 \times 9/5 = 3.968$)

Roughly, then, one calorie equals 4 BTUs.

These small units are directly useful for describing the energy stored in a small quantity of fuel, or used in a small heat demonstration. The units are too small to be useful when we talk about energy use in a city or country. We need a bigger figure to use. One such unit is the Quad - which stands for one quadrillion BTUs. This is almost an inconceivably large number. It is equal to 1000 trillion BTU, (1,000,000,000,000,000 BTU). Total energy use in the United States in 1982 was 73.2 quads.

Another way in which energy use is described is in units of some familiar fuel. Fuel is really energy in a stored form. One ton of bituminous coal (2,000 lbs.) has a heat value of 5.92 million calories, so we could describe energy use either in calories consumed or in the equivalent number of tons of coal.

Coal is measured by weight (tons). Oil is measured by volume. One barrel of oil (abbreviated bbl) is equal to 42 gallons or about 306 lbs. One barrel of crude oil (the raw product from wh gasoline and other fuels are produced) has a heat value of 1.46 mi calories.

Question: Can we convert from barrels of oil to equivalent tons of coal?

Yes, if one ton coal = 5.92 million calories, one bbl of crude oil = 1.46 million calories, then one ton of coal has the same heat value as 4.05 bbls of oil, or 168 gallons (42 gallons = 1 bbl).

Since crude oil is such an important source of our world's energy, we sometimes express energy use in terms of barrels (bbls) of oil, even when the actual fuel used is something else.

Remember that all fuels are actually different forms of stored energy. It is not so hard to convert figures from one unit to another if you remember (or can find) the conversion factors. Don't be baffled by the big terms people use to measure energy use.

Transportation and Energy Use

Total U.S. energy consumption in 1982 was 73.2 quadrillion BTUs, or Quads. About one quarter of this energy was used for transportation, including all cars, trucks, planes, trains, ships and pipelines. Figure 1 shows where energy was used and what source it came from. The largest direct consumption of energy was to generate electricity, which then in turn was used in other sectors like residential, commercial and industrial. Transportation ranked third as a direct user, after electricity generation and industry, but well ahead of residential and commercial use. A 10% saving in energy used for transportation would save more than twice as much energy as a 10% saving in residential energy use. We can make large energy savings if we use transportation energy more wisely.

Figure 1: U.S. Energy Consumption

Transportation energy saving is also important because transportation energy comes so heavily from one critical fuel. Almost 96% of the energy used in transportation comes from oil, and transportation used more than ½ of the oil consumed for all purposes. More than 10 times as much oil is used for transportation as for either residential, or commercial, or electric generation (Figure 1). The only other fuel that is used in significant amounts for transportation is natural gas, burned to run the pumps that deliver more natural gas through pipelines. The result is that if we want to focus specifically on saving oil, transportation is a good place to start.

How is transportation energy distributed? Figure 2 shows the end uses of transportation in 1972. (The relative amounts have not changed much since). We can divide the diagram in several ways. One way is to divide it between passenger and freight use. Sixty-nine percent of transportation energy is used to move people and only 26% is used to move things. A final 5% is more military transportation of both people and things.

Look at the share used by the automobile. Forty-three percent of all transportation energy was used by automobiles for local or city driving. Another 17% was used by the automobile for inter-city trips. Together, 60% of all transportation energy was used by the automobile, and the largest share of that was for local driving.

If we look back at our first figure, how much total energy is used by the automobile?

(Answer: 60% x 18.6 Quad = Quadrillion BTU)

If we use conversion factors, how many gallons or barrels of crude oil is this equivalent to?

(Answer: One barrel of oil contains 1.46 million calories.
This converts to 5.84 million BTU

$$\text{Divide } \frac{11.1 \text{ Quadrillion}}{5.84 \text{ Million}} = 1.9 \text{ billion barrels of oil}$$

1.9 billion x 42 gals/barrel = 79.8 billion gallons of oil.)

It is difficult to comprehend, let alone remember, such large numbers. We do have the ability to translate figures of one type into figures of another, so we can compare figures for energy use. Measured by any standard, the automobile uses directly about 15% of all the energy used in this country. More importantly, all of that energy comes from oil, a particularly scarce resource. The automobile uses 30% of all the oil used in this country. By saving gas, we can reduce our oil imports. We can improve our balance of payments with other countries. We can reduce our dependence on politically troubled parts of the world. We can reduce the pollution which results from fuel use. We can postpone the day when oil supplies become scarce. And, we can postpone the day when that scarcity turns into very high prices. Automobile energy conservation pays off at the national level and at the personal level.

QUESTIONS FOR STUDY

1. Why is the first law of thermodynamics referred to as the law of conservation?

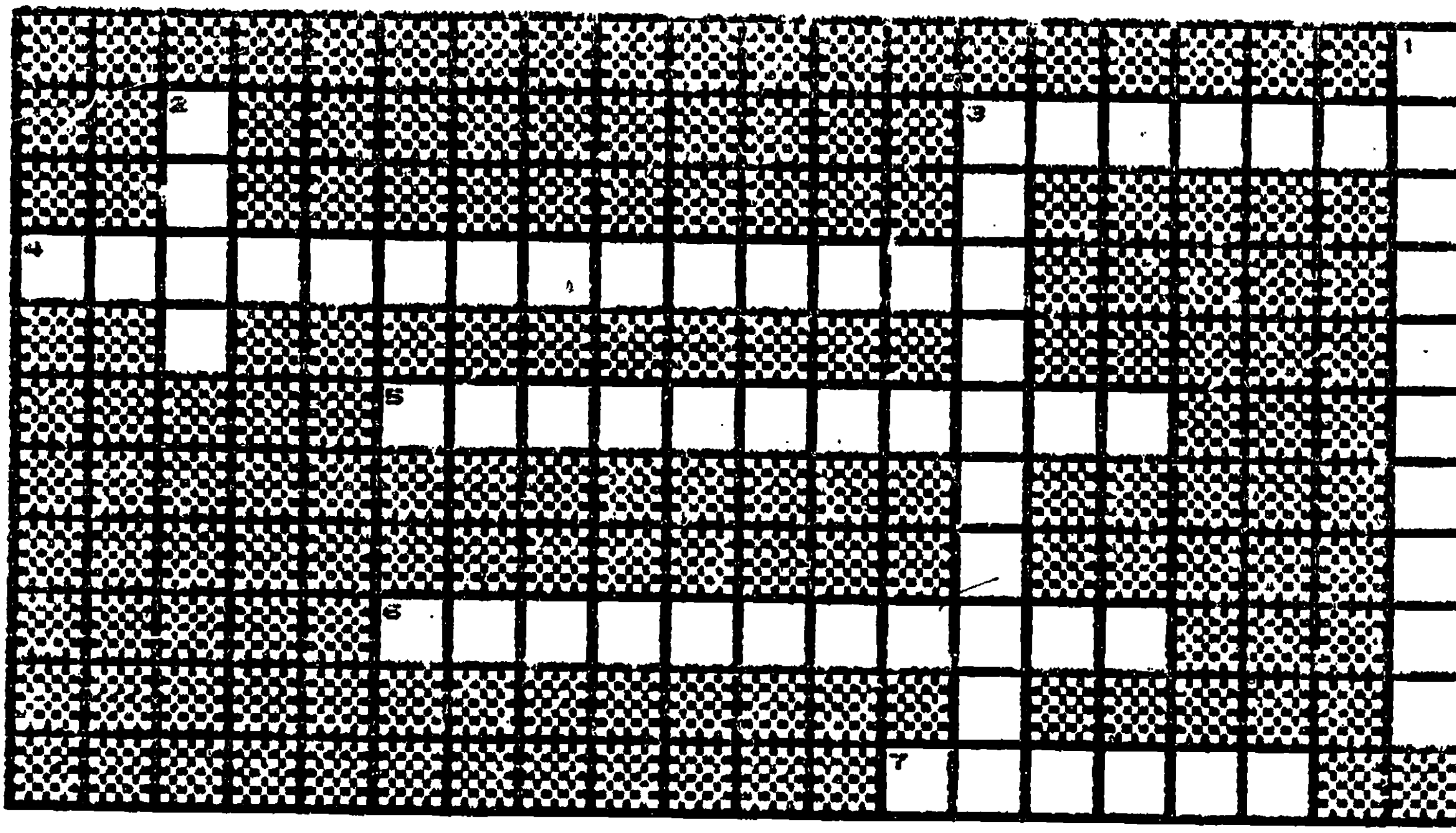
2. What does the second law of thermodynamics indicate as the consequence of energy use?

3. What is transportation's rank as a direct user of energy? How important is transportation energy conservation to the overall conservation of energy?

4. What portion of transportation energy is used to transport things? What percentage of transportation energy is used by the automobile? What percentage of all energy used in the United States does the automobile consume?

5. If the total fuel consumption of the automobile could be reduced by 10%, how many barrels of oil could be conserved?

6. To maximize energy conservation, what type of automobile use would you try to reduce? Explain.

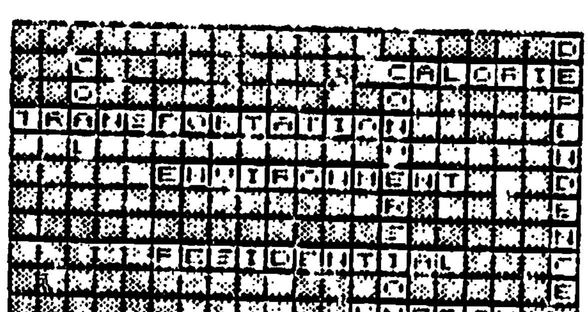


ACROSS CLUES

3. MEASUREMENT OF ENERGY IN FOOD
4. THIRD LARGEST USE OF ENERGY
5. ENERGY USE IMPACTS ON THIS
6. RANKED FOURTH IN ENERGY USE
7. A SCARCE RESOURCE

DOWN CLUES

1. SAVING ENERGY WOULD REDUCE THIS
2. SOURCE OF ENERGY MEASURED IN TO
3. TO CHANGE CALORIE TO BTU



Energy

Case Study

TRANSPORTATION

The purpose of this case study is to estimate how much energy is used for transportation within your own community, and to calculate what may happen if the cost of energy changes dramatically.

1. Start with the following 1980 figures for motor fuel consumption in Indiana.

Indiana

Total 1980 Population	5,490,260
Total 1980 Gasoline	2,619,601,000 gallons
Total 1980 Other Motor Fuel	604,041,000 gallons
1980 Gasoline per capita	477 gallons
1980 Other motor fuel, per capita	110 gallons

2. Find out the population of your community.

3. Multiply population times the per capita figures above, to determine how many gallons of gasoline and of other motor fuels (basically diesel) are used in your community in a year.

4. For 1980, Indiana averaged 11.5 vehicle miles traveled (all types) per gallon. Using an estimate of 18 miles per gallon for cars and 5 miles per gallon (of diesel fuel) for trucks, estimate the number of miles driven in your community in a year's time. Divide this by 365 to determine how many miles are driven each day.

5. Multiply the number of gallons by the current pump price for gasoline and diesel fuel, to determine how much is being spent for gasoline and diesel fuel per year. (Use an average of the price for different grades of gas).

6. Divide the total price by the number of people in your community to find how much each person (on the average) is paying for fuel per year.

7. Studies have shown that the actual cost of operating a medium-sized car is about 3½-4 times the cost of the gasoline. Using these figures, estimate how much is actually spent in the community on automobile transportation each year.

8. A small part of the money spent on gasoline goes to pay the person who pumps it (or the cashier at the self-service station). This money stays in the community and buys other things. The rest of the money leaves the community (since no Indiana community has an oil well). Discuss what would happen if a transportation means were found which could keep more of the transportation money in the community.

9. Fuel-prices have been steady for several years, but are expected to increase in the future. One study has made the following estimates of prices, based on an "optimistic" scenario and a "petroleum problem" scenario:

Price per gallon

Year	Optimistic Scenario	Petroleum Problem Scenario
1990	1.68	2.77
2000	2.24	4.75

(a) Discuss what could lead to the "optimistic" or the "problem" scenario.

(b) Calculate what the community would be paying in total for fuel, assuming the same consumption as in 1.90.

(c) Recalculate, using the estimate (for cars) of 30 mpg fleet average achieved by 1990. How much money would that save the community?

10. These figures are obviously approximate, since they assume that per capita use in this community is the same as in the state. Discuss whether they think their community uses more or less than others in the state. One study indicated the following variation in daily energy use per household in a metropolitan area:

Urban Density	Daily fuel use per household
Inner High	2.3 gallons
Fringe High	3.1 gallons
Fringe Low	4.3 gallons

Energy

Home Study

TRANSPORTATION

1. With your family discuss the figures on future estimated price per gallon:

Price per gallon

Year	Optimistic Scenario	Petroleum Problem Scenario
1990	$1.68	2.77
2000	2.24	4.75

Source: U.S. Department of Transportation (June, 1982). Transportation energy conservation through land use planning.

2. Ask your family head which of the following things she would do if gasoline prices double within the next 10 years.

   (a) move closer to work;
   (b) buy a car that uses less gas;
   (c) join a carpool to work;
   (d) ride the bus; and
   (e) walk or bike.

3. Bring in your responses to class and tally them. Compare your results with findings from a survey in Phoenix, Arizona which showed the following citizen reactions if faced with a doubling of gasoline prices.

Item	Have Done (%)	Will Do (%)
Move closer to work	8	9
Buy a car that uses less gas	18	30
Join a carpool to work	5	25
Ride the bus	2	16
Walk or bike	2	16

Energy

Community Study

TRANSPORTATION

1. Invite the city engineer or city planner to meet with the class and discuss possible actions which the city has considered in the event of sizeable increases in gasoline prices. This discussion may be focused around the following themes:

   (a) actions taken to increase VMT (vehicle miles traveled) per gallon of fuel used;

   (b) actions taken to reduce the overall VMT by carpooling, bus, walking, etc.;

   (c) actions taken to reduce the need for travel (e.g. by putting major activity centers closer together); and

   (d) actions taken to substitute local energy resources for expensive energy imported into the community.

2. Survey how citizens in the community behaved during the energy crisis of the early 1970s. Potential survey questions might include:

   (a) How did higher gas prices affect: visiting friends and relatives, shopping, going on extended trips?

   (b) How often did you get gas?

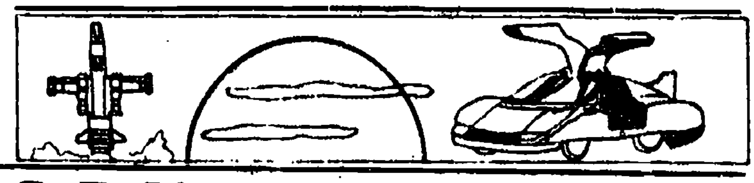
   (c) What did you consider a reasonable price for gas?

   (d) Whose "fault" was the energy crisis?

   (e) If another crisis occurs, how would you change your behavior? Why?

Energy

21st Century



TRANSPORTATION

The scenario is a story about what might happen in the future. A scenario is different from science fiction — based primarily on imagination — in that facts over several decades may be used to project the future. Choose one of the following possible futures and write a 3 - 5 page scenario. Before you write the scenario read several articles related to the topic. In your scenario, include yourself and people you think will be a part of your life. Describe as much about yourself and what you will be like then.

Possible futures in the year 2020:

1. Oil production has dropped 60% from the 1980s. Describe the impact of such a projection on lifestyle, energy and transportation use.

2. A method has been discovered to create an efficient fuel from water for all transportation forms.

3. Through wise decisions, non-renewable resources remain stable and choices concerning energy and transportation in 2020 are not much different from the 1980s.

Read your stories aloud in class, post them on bulletin boards, or copy them and put them in a booklet to examine in 2020.

As a related activity, list the changes resulting from each possible future described above. For example, under possible future number 1, a common result is likely to be significantly less use of autos. Tally the number of times a result appears in other students' scenarios. Once a list is compiled from all the reports, analyze why some results appeared many times, others just a few times.

Energy

Careers

TRANSPORTATION

1. List all the occupations in your community which depend on energy use (specifically on the automobile)

2. Interview or invite employees of these jobs to class -- gas station jobs, auto dealers, mechanics, fuel distributers -- to determine:

   (a) training needed to enter the occupations;

   (b) benefits of working in these occupations: hours worked, wages, contact with people, and so forth; and

   (c) long-range predictions on the stability of the jobs.

3. Numerous jobs are required in the production of petroleum. Choose one of the following jobs and investigate (a) the amount of training needed, (b) hours worked, (c) wages, and (d) benefits.

Chemical engineer	Instrument repairman
Civil engineer	Laboratory technician
Construction foreman	Machinist
Derrickman	Mechanic
Draftsman	Plant superintendent
Driller	Pumper
Electrician	Truck driver
Gas agent	Welder

For more information, request Petroleum industry careers from Amoco Educational Services, P. O. Box 5910-A, Chicago, IL 60680.

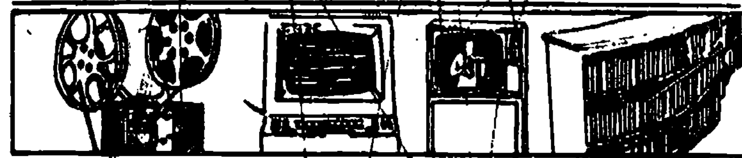
4. Other helpful information can be obtained by writing to:

   (a) Society of Petroleum Engineers
   6200 North Central Expressway
   Dallas, TX 75206

   (b) American Petroleum Institute
   1801 K. St., N. W.
   Washington, D.C. 20006.

Energy

Resources



TRANSPORTATION

1. The local city planner may be able to tell the class about energy plans being considered by the city.

2. The state department of transportation may be able to provide figures on motor fuel use in your community.

3. A gas station owner may be able to talk about changes in his business in recent years (for example, many gas stations have closed or have been converted to other uses, and the class may be able to point some of these out).

4. The U.S. Department of Transportation publishes many documents dealing with energy use. Examples include:

   (a) U.S.D.O.T. (1982). Cost of owning and operating automobiles and vans. Washington, D.C.: Federal Highway Administration.

   (b) U.S.D.O.T. (1982). Transportation energy conservation through land use planning. Washington, D.C.: Federal Highway Administration.

5. The following film can be obtained from Indiana University Audio Visual Center:

   Energy: New sources NSC 1485

   Examines the strengths and weaknesses of several energy sources and how they can be applied to home, industry, and business. Supplies views of protypes of generators, vehicles, and heating units capable of utilizing the new sources.

   The following films can be obtained from Modern Talking Picture Service, Film Scheduling Department, 5000 Park Street, North, St. Petersburgh, FL 33709:

   (a) Faces of energy

   Details petroleum exploration and production

   (b) Offshore

   Describes balancing offshore oil drilling and environmental protection

   (c) Refinery

   Presents the story of crude oil and the production of petroleum products

Figure 1

U.S. ENERGY CONSUMPTION IN 1982 BY SOURCE AND USE-SECTION

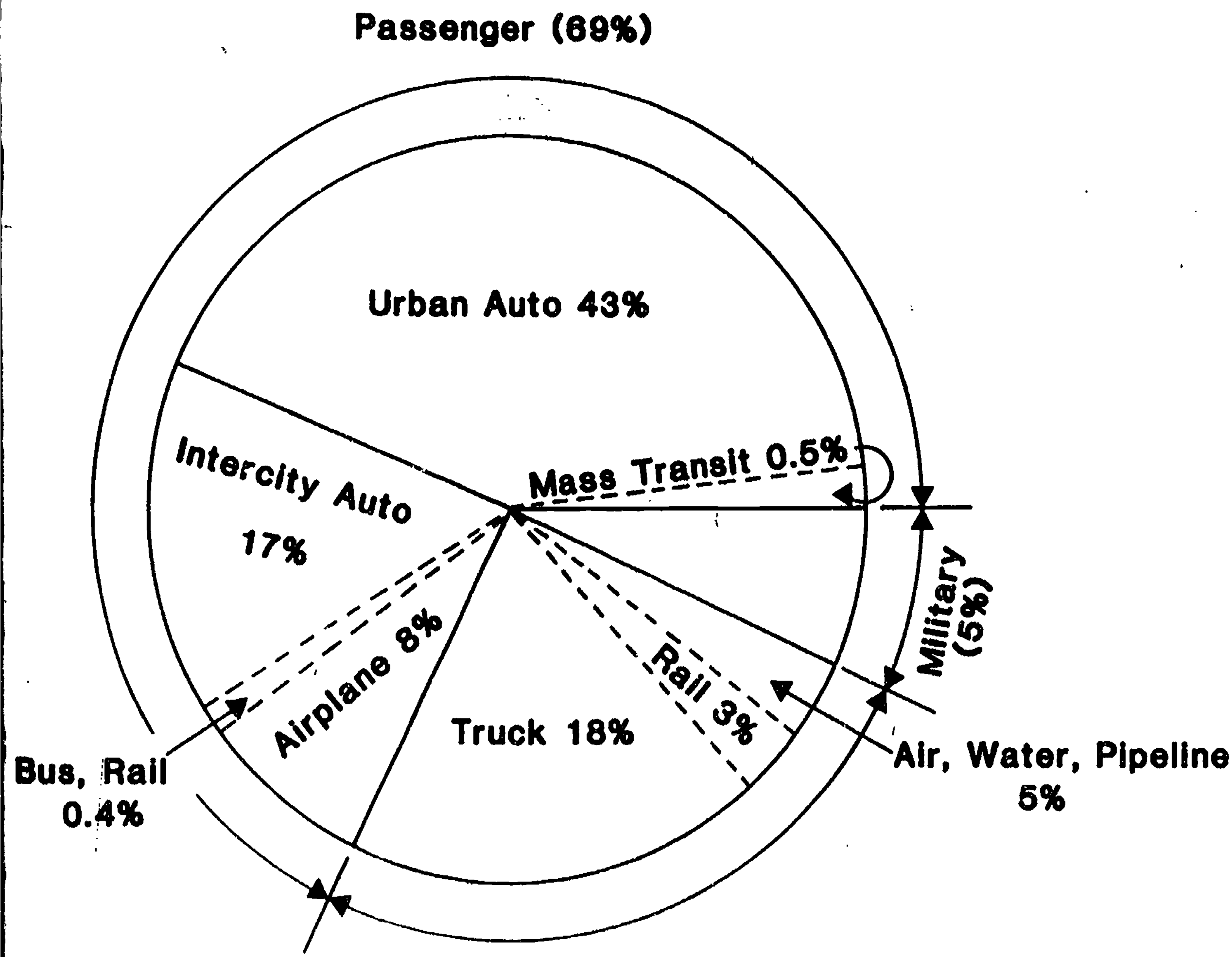
(In quadrillions of British thermal units)

	Residential	Commercial	Industrial	Transportation	Electricity	Total
Coal	0.1	0.1	2.6	neg.	12.7	15.5
Biomass	0.8	0.1	1.7	neg.	neg.	2.6
Nat. Gas	4.9	2.6	6.9	0.6	3.3	18.3
Oil	1.8	1.2	7.7	18.0	1.5	30.2
Hydro	–	–	neg.	–	3.3	3.3
Nuclear	–	–	–	–	3.0	3.0
Solar, Wind, & Geothermal	neg.	neg.	neg.	–	0.2	0.2
Total Direct Consumption	7.7	4.0	18.9	18.6	24.0	73.2
Electricity (point of use)	2.4	2.0	2.6	neg.		7.0

Source: U.S. Department of Energy – Office of Policy and Analysis – 1983

Figure 2

DISTRIBUTION OF TRANSPORTATION FUEL USES - 1972



The purpose of this lesson is to show how new forms of energy make possible new transportation networks and to suggest how these networks may lead to other transportation forms. This purpose is explored by examining the electric interurban.

APPROXIMATE TIME: If each of the following activities is used, approximately nine class hours will be needed. This estimate does not include use of supplementary resources described in the lessons.

READABILITY: The Bormuth Readability Index was used to determine the reading level of text material in this lesson.

Ave. Word Length: 4.7

Ave. Sentence Length: 18.3

Readability Index: 60.7

Grade Level Equiv.: 7-8

OBJECTIVES

INQUIRY	DECISION-MAKING	TAKING ACTION
1. Students will examine how the interurban became an important form of transportation.	1. Students will recognize conditions under which the interurban should be considered an important transportation alternative.	1. Students will determine when an energy problem would warrant use of the interurban.
2. Students will illustrate changes in energy use which made the interurban system possible.	2. Students will explore the efforts of the interurban in a variety of situations.	2. Students will analyze data upon which the introduction of an interurban system would be beneficial.
3. Students will weigh the possibility of redeveloping interurban systems.	3. Students will predict the consequences of interurban use on personal convenience, energy consumption, and economics.	3. Students will determine when a change to an interurban system would be feasible.
4. Students will examine energy efficiency of the interurban.	4. Students will rank order most effective uses of the interurban under varying conditions.	4. Students will explore potential effects of a decision to introduce the interurban system.
5. Students will compare energy efficiency of the interurban to its effectiveness as a form of transportation.		5. Students will propose an interurban system in the community.
6. Students will develop a conclusion as to the most beneficial use of the interurban in terms of energy consumption.		6. Students will judge the results of their actions.

Glossary

Energy TRANSPORTATION

AC - Alternating current. Current in which the flow of electrons is rapidly reversed, 60 times per second in modern household AC current. The interurbans transmitted power using high voltage AC, since this had less energy loss along the wire. The current was then "stepped down" and converted to DC.

DC - Direct current. Electric current in which the flow of electrons is in one direction. Storage batteries produce DC. Interurbans ran on DC power.

Interurban - Literally "between cities." The name for both the interurban electric railway and for the individual cars which ran on it.

KV - 1000 volts. Early power lines were 10 to 33 KV. Modern high tension lines go up to 500 KV.

Right-of-way - The land upon which the track, electric poles, etc., of the interurban was built.

Trolley pole - The pole which contacted the trolley wire to bring electricity into the interurban car. Sometimes the cars themselves were described as "trolleys."

Trolley wire - The overhead wire, carrying 600 volts DC, from which the cars took their power.

Volt - A measure of electric pressure. Higher voltage requires more insulation and is more dangerous to handle. Household current is 120 volts. Most interurbans ran on 600 volts. Power is transmitted at thousands of volts.

Energy

Factsheet

TRANSPORTATION

THE INTERURBANS IN INDIANA

As new forms of energy appear, new forms of transportation follow. Sometimes they last. Sometimes they disappear again as other forms of energy appear. While they are here, we take them for granted (as we now take for granted the automobile). By realizing how they came and went, we can be better prepared to think about the future, not taking for granted anything that is here now.

The Indiana interurbans are a dramatic case history in transportation change. The first true interurban car in Indiana ran between Anderson and Alexandria starting in 1898. By 1914 there were 2137 miles of interurban route in Indiana, operated by 1670 electric cars. Nearly 400 cars per day entered Indianapolis. Yet, by 1941 all of this disappeared, with the sole exception of the South Shore line between Chicago, Michigan City, and South Bend. In a little over 40 years an entirely new technology appeared, blossomed, and then withered and disappeared. Why did this happen?

To start with, what was the interurban? It was a hybrid, combining elements of the city streetcar and the conventional railway. Like the streetcar, it operated single car trains, powered by electricity taken from an overhead wire. Like the streetcar, it ran on tracks located in the middle of city streets, stopping at street corners to pick up passengers. Like the conventional railway, the interurban did not stop at the city limits, but connected two or more cities together. When out in the country, the interurban, like the conventional railway, ran on its own right-of-way, usually parallel to a conventional railway. The name "interurban" was coined by an Anderson man, Charles L. Henry, to describe his Union Traction Company, which made its first 11 mile trip between Anderson and Alexandria in 1889.

Figure 1: The Interurban

The interurban was made possible by the development of effective electric power. In 1883 Thomas Edison and Charles Van Depoele demonstrated working electric railways in Chicago, and by 1885 there were electric street railways operating in Indianapolis, Richmond, Kokomo, Vincennes, Fort Wayne, Anderson, Muncie, Elwood, Terre Haute, Columbus, Logansport, and South Bend. The electric street railway replaced horse car or mule car lines which had operated since the civil war. The electric motor made the cars faster and more reliable than the animal-drawn cars. The cars ran on the same tracks, with the addition of an overhead wire from which power was taken by a trolley pole on top of the car. The term "trolley" came to mean the electric streetcar itself as well as the pole which received its power.

The streetcars ran on direct (DC) current, unlike our modern alternating (AC) current. This was because direct current was easier to control for motors running at a range of speeds like those in streetcar service. Low voltage DC current was easy to control, but inefficient to transmit, since it lost much of its energy as frictional heat in the transmission wire. The street railways settled on 600 volts DC as a compromise which could be safely controlled and also sent for up to 5 miles through a wire. Beyond that, much of the energy was lost, but that distance was enough to power the local streetcar lines.

As streetcar lines reached the edge of town, the next logical step was to extend them into the country until they connected one city to another (hence the name "Interurban", meaning "between cities"). The problem was the inability to transmit current the distances required. The problem was solved when it became possible to convert AC current to DC. Alternating cur. nt was generated at the power house, usually by a coal fired steam boiler and engine or steam turbine driving a generator. The AC current was sent through long-distance transmission lines at 10,000 to 33,000 volts, with relatively small transmission losses. At distances of every 6 or 7 miles along the electric railway, electric substations converted the high voltage AC into 600 volt DC, which went through the trolley wire to power the actual cars. As a car moved along the track, it picked up power first from one substation and then from another. The substations were built of brick to safely house the electrical equipment, and often they were combined with passenger stations so that one man could look after the electrical equipment as well as sell tickets.

New inventions in electric generation, transmission, and conversion were what made the interurban possible. When these problems had been solved, there was an explosive development. The first interurban car entered Indianapolis on January 1, 1900, and by the end of the year, 678 miles of electric lines were in operation. By 1908 this rose to over 2300, almost the highest figure reached. The entire system was built essentially within one decade from 1898 to 1908. When finished, it reached from Louisville to South Bend, and on to Michigan City and Chicago, and from Terre Haute to Richmond and on to Columbus, Ohio. A separate system operated around Evansville. Twelve lines radiated in all directions from Indianapolis, and came together in the Indianapolis Traction Terminal, built in 1904 and the largest interurban station in the U.S. On Market Street between the Capitol Building and Monument Circle, the station had nine tracks under a high arched roof. Trains left at all times of day, including ones with dining and even sleeping car service.

The interurban, in its short life span, changed the way of life in Indiana. It was not faster than the regular railroads, but it was much more convenient. It ran frequently throughout the day. It stopped almost anywhere to pick up passengers, and it went conveniently down the main street of each town. It carried freight as well as passengers. A local merchant could order goods from Indianapolis in the morning and have them left off at the curb in front of his store that afternoon. The farmer could send milk cans to the city by hauling them to the nearest road crossing for the early morning milk car to pick up. Mail, express, and even corpses rode the interurbans. Interurbans served the combined function of bus, truck, and car. They gave long distance mobility to Indiana. The map shows how extensively they connected the cities of Central Indiana, and how they emphasized the importance of Indianapolis as the center of the state.

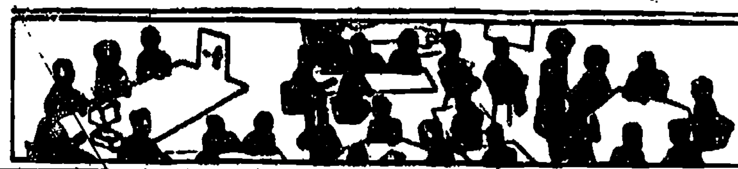
Figure 2: Indiana Interurban Map

In many ways the interurbans were an ideal transportation system. They were quiet, clean, and didn't pollute the air. They used energy efficiently. They went where people wanted to travel. They were frequent and relatively fast. But by 1941 they were gone. What happened?

The interurbans were competing with another form of transportation which was perfected at about the same time: the automobile. Just as the interurban offered greater convenience than the railroad, the private car offered greater convenience than either. The automobile became widely available less than a decade after most of the interurbans were built. In 1917 the first abandonments occurred, although the main system remained profitable through most of the 1920s. The automobile and the depression of the 1930s are credited for the downfall of the interurbans. By the 1930s the original tracks and equipment were badly in need of replacement, but ridership was not high enough to generate money for the replacement. The speed and comfort of the service deteriorated, and more passengers switched to automobiles, or didn't travel at all. It was a vicious circle. Some high speed aluminum interurbans were purchased in 1931 after the remaining interurbans were combined as the Indiana Railroad. They were very good cars, but were limited by the poor condition of the track. Major abandonments took place throughout the 1930s, and the last line, from Indianapolis to Louisville, closed in 1941.

Actually one line remained. The one exception was the Chicago, South Shore and South Bend, which had been extensively modernized in the 1920s. In some ways it was no longer a typical interurban, since it had replaced much of its street tracks with high speed private track. Instead of single cars, it often ran long trains, although they were powered by electricity just like the other interurbans. The South Shore line, as it was known, continued to operate through the 1950s and 1960s.[8] In the 1970s it might have followed the others into oblivion, but by then the energy crisis was a reality. People throughout Northwestern Indiana began a campaign to save the South Shore. State and Federal governments provided money to buy brand new equipment and upgrade the electrical system. Ridership began increasing.

The South Shore is a success story. It is interesting to speculate what might have happened if some of the other interurban lines had lasted into the modern era of energy consciousness. Their problem was competition with the automobile during an era when energy conservation was not important. But imagine what it would be like if one could still go to the station just off Monument Circle in Indianapolis and take one of 16 trains each day to Muncie, 9 to Fort Wayne, Louisville, or Terre Haute. The trip would be reasonably fast (1 hour and 40 minutes to Muncie), offering roominess not found in the car or bus. Less energy would be used per person than with the automobile. Perhaps there is still a role for something like the interurban in Indiana's future.



QUESTIONS FOR STUDY

1. What was the interurban? Who coined the word? Was your city connected to the Indiana interurban system?

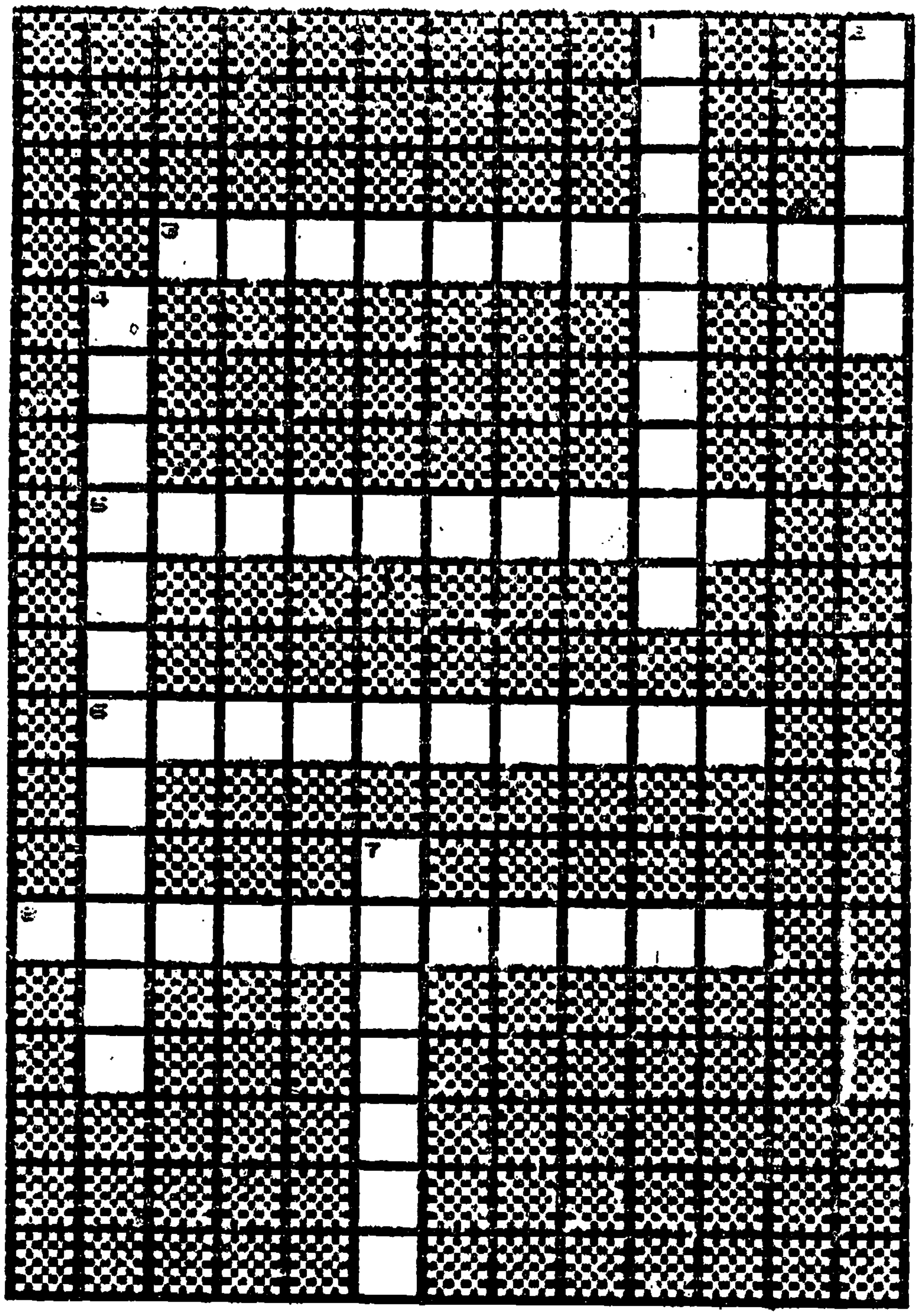
2. What inventions and technological changes made the interurbans possible?

3. In what ways were the interurbans an ideal transportation system?

4. Why did the automobile replace the interurban system in Indiana?

5. What role did the interurban play in the transportation of things?

6. Is there a future for interurbans in Indiana? Explain.



ACROSS CLUES

3. ADVANTAGE OF PRIVATE CAR
5. IT CONNECTED CITY TO CITY
6. REPLACED THE INTERURBANS
8. POWERED THE INTERURBANS

DOWN CLUES

1. OPERATED ON DIRECT (DC) CURRENT
2. AN ADVANTAGE OF THE INTERURBANS
4. HUB OF INDIANA INTERURBAN SYSTEM
7. ANOTHER NAME FOR THE STREETCAR

50

Energy

Case Study

TRANSPORTATION

In Philadelphia, a trolley operates along the Delaware River waterfront. Penn's Lending is being revitalized as a tourist attraction. Attractions include a boat basin, sailing ships, a submarine, and an historic cruiser. The Interurban functions as an additional ride or attraction, rather than as a transportation link.

In Seattle a similar development has occurred. A streetcar uses former railroad tracks in Alaskan Way, a tourist waterfront district. The streetcar connects Pioneer Square, the ferry terminal, Seattle Aquarium, Pike Place Market with many restaurants and shops.

Develop a proposal for the introduction of a trolley system in your community or for the state capital, Indianapolis. In your plan, consider:

1. What would be the purpose of the trolley system?

2. Where would it begin and end?

3. What energy resources would be needed?

4. How much would the system cost?

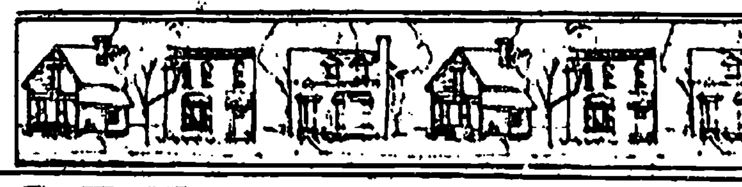
    In Seattle, four interurban cars were purchased from Melbourne, Australia. The cars weigh 16.5 tons, have a top speed of 25 miles per hour, 160 horsepower, a 52-seat capacity, standing room for 41 passengers. Each car cost $5000 plus $20,000 each for shipping.

5. How would the system be financed?

Collect your ideas as a class. Try to evaluate information, reach consensus, and prepare a class plan. Send the plan to the city council where your trolley system is proposed.

Energy

Home Study



TRANSPORTATION

"If" and "then" exercises are helpful for exploring ideas. Share the following "Notice" with your parent(s). The "Notice" completes the "If" statement. Questions you ask your parent(s) or guardian(s) complete the "then" statement.

NOTICE

Beginning on October 14, a local interurban system will take you from a stop at your block to the major shopping center. This new service will operate Saturday-Sunday, April through November, also Thursday-Friday in summer. The system will operate every 30 minutes between 11:00 a.m. and dusk. The fare will be $1.00 for round trip.

If this "Notice" appeared in your local paper, how would this new transportation affect:

1. Use of an automobile to shop?
2. Use of an automobile to visit friends?
3. How much money might such a system save you on gas for an automobile?
4. Use of a bus to shop or visit friends?
5. ____?
   (fill in your own)
6. ____?
   (fill in your own)

Energy

Community Study

TRANSPORTATION

1. Find out if your town was on a interurban line, and if so, what years it operated. This can be done easily by checking the book <u>Electric railroads of Indiana</u>, if your library has it (see resources page). A telephone call to the Indiana Transportation Museum could also give the information.

2. Find the tracks. Old city maps will often show them. Sometimes the track may actually still be buried in a city street, showing as a pattern of cracks in the pavement. In the country, the right-of-way may still be visible, either alongside a highway or parallel to a railroad track. Look especially where a road crosses a stream. The old bridge abutments may show where the track was. Powerlines are sometimes another clue, since the interurbans were the basis of modern power companies.

3. Find the station. Often the interurban station just looked like a store on a main street, and may still be there as a store. The electrical substation may still exist, by itself or as part of another building. It can be spotted as a 1½ story brick structure, with few windows, and with three little openings near the top for the 3-phase transmission lines to enter.

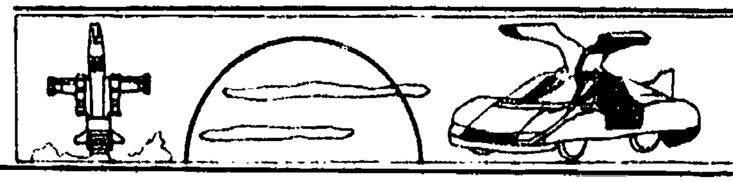
4. Talk to someone who remembers the interurban. There are still people in most towns who rode the interurbans when they were young, and a few people who worked on the interurbans. Ask them what they remember, and try to find out how convenient it was for them to use it. Would they still use it today if it were here?

5. Visit an operating interurban museum (see resources) or ride the South Shore line. Compare notes on whether this would still be a good way to travel today.

6. Construct a map showing where the interurban went in your community.

Energy

21st Century



TRANSPORTATION

The interurban is gone, but there are people seriously proposing that new super-interurbans, electrically powered, should be built. The Indiana State Department of Transportation, along with agencies in Ohio and Michigan, has studied the possibility. In Ohio voters actually had a statewide ballot to decide whether to raise taxes to build such a line. It was defeated in the ballot, but the idea is still alive.

Suppose that gas prices do go up to $4.75 a gallon by 2000, as one study has suggested, and that electricity, generated by American coal, is widely available to power an electric interurban.

1. Could such a line make sense in your community?

2. Where would it go?

3. How would it come into town, and where would it stop.

These are decisions that may be made someday throughout Indiana. Use maps of the state and of your city to plot where you think the lines should go. As you draw lines on your map, place an X to indicate where the Interurban would stop. For each stop, explain <u>why</u> you would have the interurban stop there.

Energy

Careers

TRANSPORTATION

The interurban created a whole range of new occupations - motormen and conductors to operate the cars, substation operators for the electric system, skilled repairmen for cars and tracks and electric wires. All these occupations disappeared when the interurbans did. What happened to those people? Discuss the problems caused by technological changes, and the fact that people today may have more than one career in their lifetime.

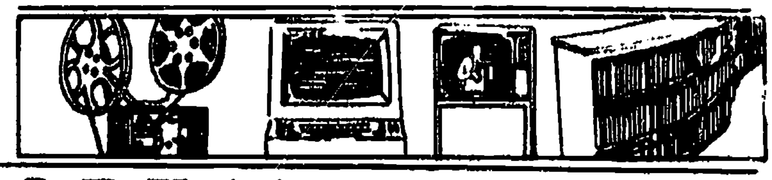
Supposing that the interurbans come back in the next century, as a response to scarce energy, what occupations would this create? In the left hand column list the skills needed for the "old" interurban. In the right hand column list the skills needed for the "new" interurban.

Skills for Working Out the "Old" Interurban	Skills for Working On the "New" Interurban
1. ______________________	1. ______________________
2. ______________________	2. ______________________
3. ______________________	3. ______________________
4. ______________________	4. ______________________
5. ______________________	5. ______________________
6. ______________________	6. ______________________

Explain causes for change from "old" to "new" skills required.

Energy

Resources



TRANSPORTATION

1. The following articles and books are useful:

   (a) D. Lester (1984, July-August). Electrifying experience: Indiana had nation's largest and best interurban railroad. Outdoor Indiana;

   (b) J. Marlette (1959). Electric railroads of Indiana. Indianapolis, Council for Local History;

   (c) G. W. Hilton & J. F. Due (1960). The electric interurban railways in America. Stanford: Stanford University Press;

   (d) Central Electric Railfan's Association (1975). Indiana railroad system. Chicago: CERA; and

   (e) Outdoor Indiana, 612 State Office Building, Indianapolis, IN 46204

2. Local libraries or historical societies may have maps showing where the interurban tracks were in your community.

3. A large collection of Indiana interurban artifacts, including full size cars, is located in Noblesville at the Indiana Transportation Museum, Forest Park, Noblesville 46060 (317) 773-0300. The museum frequently hosts school groups, and gives a 2 mile ride on a restored electric interurban car.

4. A 2 mile interurban ride is also available between French Lick and West Baden, operated by the French Lick, West Baden and Southern Railway Museum, Hwy 56, French Lick, IN 47432 (812) 936-2405. This line is a restoration of an interurban which used to connect the two Southwestern Indiana resort towns. School groups are welcome.

5. In Northwestern Indiana, the Chicago, South Shore and South Bend is a fully-operating and modernized interurban: the last in the U.S. It operates several trips daily to South Bend and frequent service between Michigan City and Chicago.

6. For more information on the use of electricity in transportation, write to:

   Edison Electric Institute
   90 Park Avenue
   New York, NY 10016.

Figure 1

THE INTERURBAN

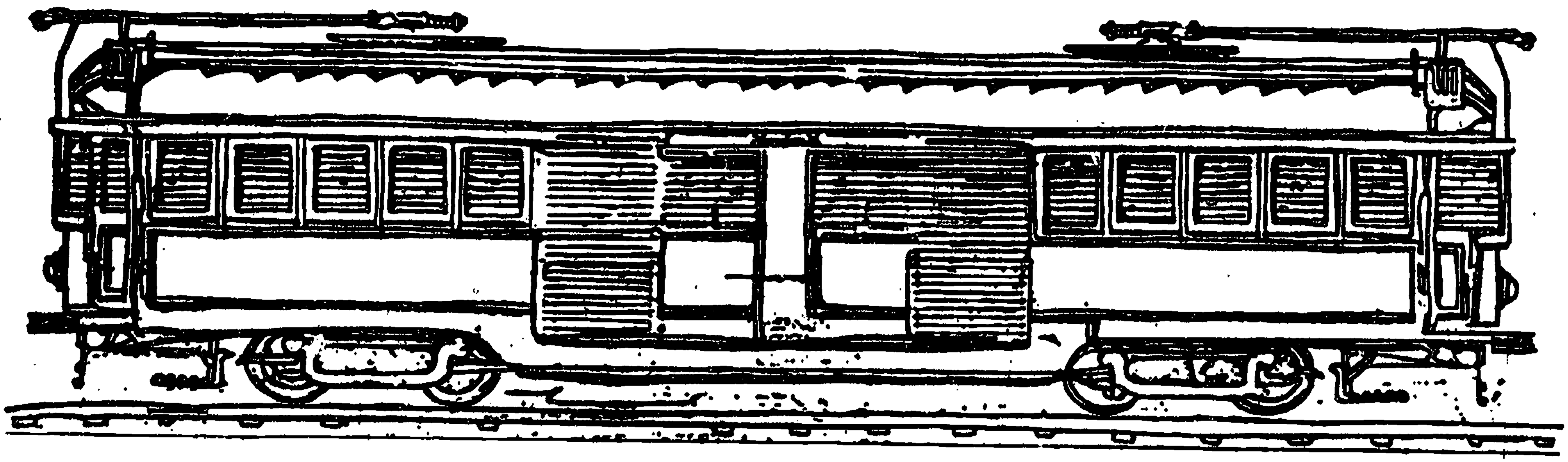
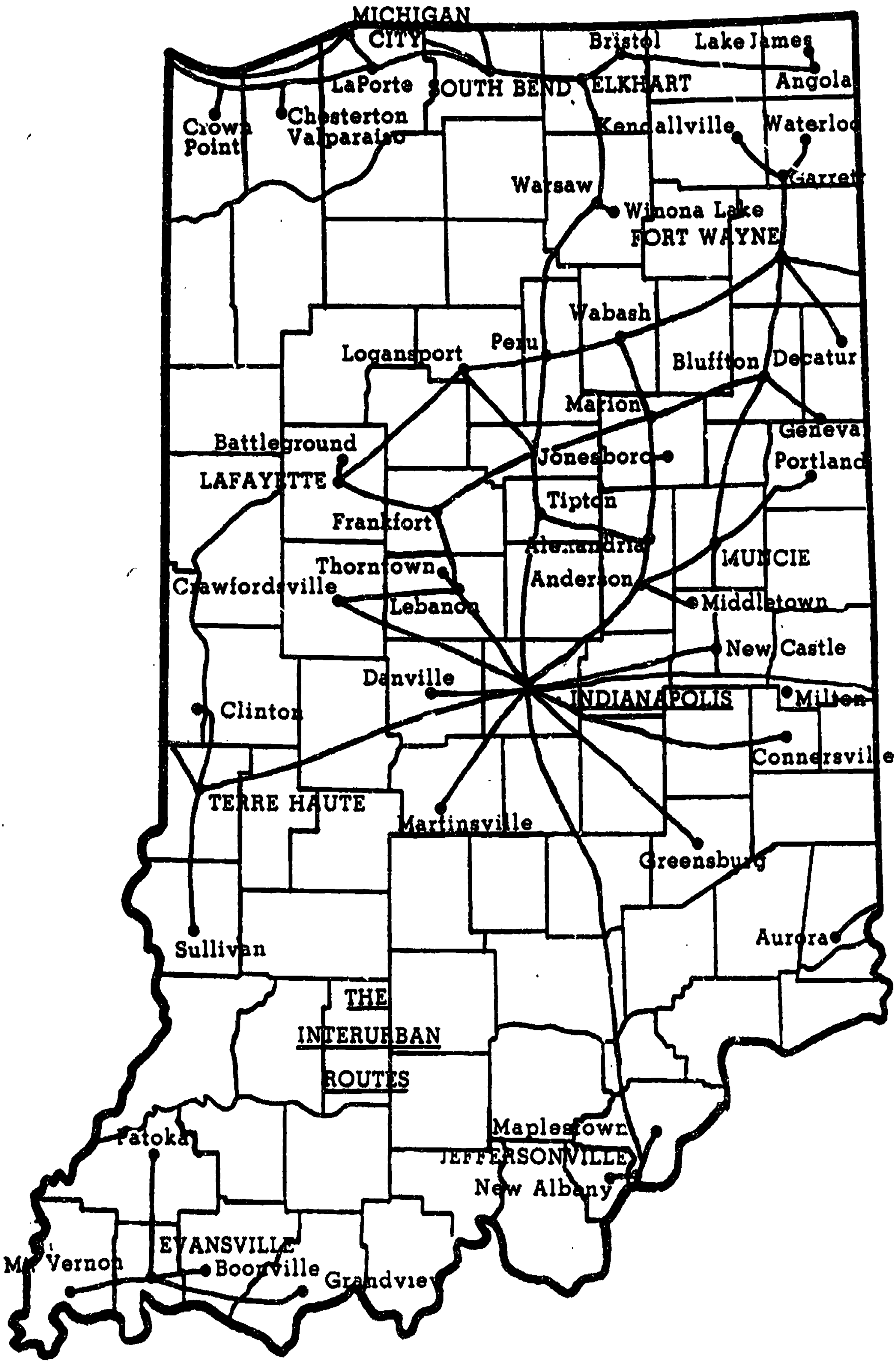


Figure 2


MICHIGAN CITY
Bristol
Lake James
Angola
LaPorte
SOUTH BEND
ELKHART
Crown Point
Chesterton
Valparaiso
Kendallville
Waterloo
Garrett
Warsaw
Winona Lake
FORT WAYNE
Wabash
Logansport
Peru
Bluffton
Decatur
Marion
Geneva
Battleground
Jonesboro
Portland
LAFAYETTE
Tipton
Frankfort
Alexandria
MUNCIE
Thorntown
Anderson
Crawfordsville
Lebanon
Middletown
New Castle
Danville
INDIANAPOLIS
Milton
Clinton
Connersville
TERRE HAUTE
Martinsville
Greensburg
Aurora
Sullivan
THE INTERURBAN ROUTES
Maplestown
JEFFERSONVILLE
New Albany
Patoka
EVANSVILLE
Mt Vernon
Boonville
Grandview

PURPOSE; This lesson encourages students to think about energy saving transportation by means of a vehicle with which they are familiar, the bicycle. The activities focus on looking at ways in which the bicycle can be used for serious transportation purposes, and ways in which the community can encourage bicycle use. It encourages them to think about the bicycle as part of a system.

APPROXIMATE TIME: If each of the following activities is used, approximately eight class hours will be needed. This estimate does not include use of supplementary resources described in the lesson.

READABILITY: The Bormuth Readability Index was used to determine the reading level of text material in this lesson.

Ave. Word Length: 4.74

Ave. Sentence Length: 20.7

Readability Index: 62.2

Grade Level Equiv.: 7-8

OBJECTIVES

INQUIRY	DECISION-MAKING	TAKING ACTION
1. Students will compare advantages and disadvantages of bicycle use	1. Students will recognize conditions under which the bicycle should be considered an important transportation alternative	1. Students will determine when a problem or issue related to bicycle use is severe enough to warrant taking action
2. Students will illustrate reasons for growing popularity of the bicycle	2. Students will explore the effects of bicycle use in a variety of situations	2. Students will explore evidence upon which actions should be taken in relation to a bicycle use problem or issue
3. Students will propose appropriate use for the bicycle	3. Students will predict the consequences of bicycle use on personal convenience, energy consumption, and economics	3. Students will determine when an action must be taken
4. Students will examine energy efficiency of the bicycle	4. Students will rank order the most effective uses of the bicycle under varying conditions	4. Students will predict the consequences of their action
5. Students will compare energy efficiency of the bicycle to its effectiveness as a form of transportation		5. Students will try out or simulate an action
6. Students will develop a conclusion as to the most beneficial use of the bicycle in terms of energy consumption		6. Students will judge the results of the action or a simulation of it

Glossary

Bikeways - Paths designed for bicycle use. Class I bikeways are for exclusive bicycle use. Class II bikeways are for semi-exclusive bicycle use, but may share right-of-way with pedestrians or autos.

Corridor - A general direction in which trips are made, as opposed to specific routes. For example, a single corridor from downtown to a suburb might include a freeway, several major streets, and possibly a bus line.

Destination - The ending point of the trip.

Origin - The starting point of a trip.

Right-of-way - The land on which a road, sidewalk, or bikeway is constructed.

Route - The actual path or sequence of streets that was used.

Trip - A single journey from an origin to a destination. Refers to local trips, such as shopping, as well as to long distance trips.

Factsheet

Energy

TRANSPORTATION

BICYCLES

Historical

Bicycles achieved widespread popularity in the United States in the late 1800s, primarily as a recreational vehicle for pleasure outings. The early high wheeled bicycle was unstable and required a very smooth surface, something not readily available in streets and almost non existent in rural dirt roads at that time. The result was widespread agitation for street paving in cities and surrounding areas. In political terms, the bicycle really preceded the automobile as a force pushing for better roads. Ultimately, in the U.S. the automobile replaced the bicycle and relegated it to status as a child's vehicle, although in other countries, and particularly in developing countries, the bicycle was often the primary or only family vehicle.

While neglected for years in the United States, bicycles were encouraged and widely-used in European cities for commuting as well as pleasure. The Netherlands is one such country. The terrain is flat and the climate relatively mild; conditions suitable for bicycling. In addition, public plans encouraged bicycle use by providing special bicycle lanes, separated both from automobiles and from pedestrians. It is estimated that the Netherlands now has nearly as many bicycles as it does people. Each morning some five million men, women and children depart for work, school or shopping on bicycles. In some Dutch cities, nearly half of all commuting is by bicycle.

Current Use

The last 10 years have seen a rebirth of interest in the bicycle in the United States. In 1972, bicycles outsold cars in the U.S. for the first time. In the 10 years ending in 1979, more bicycles than cars were sold in the United States: 103 million bicycles to 102 million cars. The bicycle has become popular not only because of energy efficiency, but because of the health and exercise benefits of bicycling. The multi-speed bicycle is technically far superior to the old children's bike, and a more efficient user of energy. It is no longer thought unusual for someone to commute by bicycle to an office job. By 1975 some 470,000 Americans commuted to work by bicycle. An extreme situation is that of commuters who live in Baltimore, Maryland and work in Washington, D.C. Each morning they leave their houses in Baltimore and bicycle to the Baltimore train station. Leaving their bicycles locked there, they take a train to Washington. In the Washington train station they unlock bicycles kept there and ride across town to their office! This example is perhaps unusual, but it indicates a creative combination of alternative transportation. In Europe, it should be noted, they would probably be able to check their bicycles on the train so as not to need two separate bicycles to reach work.

A few U.S. cities, typically university towns, have devoted special lanes and bikeways for exclusive bicycle use. In most cities, however, bicycles must compete for right-of-way with automobiles and truck, an often hazardous situation. In 1980 some 905 cyclists died, and city streets pose countless hazards for cyclists. As city budgets have become tight, street conditions have worsened, and the cyclist more than the automobile is constantly susceptible to potholes and rough streets. Even improperly maintained or aligned sewer gratings can throw a bicyclist. In many cities, the single thing limiting bicycle use the most is not the bicycle itself but the quality of the streets on which it must go.

Advantages

The chief energy advantage of the bicycle is its great energy efficiency. The bicycle, of course, uses <u>no</u> gasoline or other motor fuel.

The bicycle does use fuel in the sense of human exertion based on calories from food. Even here it is efficient, however. It has been estimated that bicycling is in fact three times as efficient as walking in terms of distance covered for calories consumed. The bicycle is in fact the most energy efficient means of transportation yet discovered.

Widespread use of bicycles would promote sizable energy savings and reductions in air pollution. In Indianapolis, it has been estimated that if a person used a bicycle instead of automobile for five miles each way to and from work, the following reductions would result:

1. 130 gallons of gas saved per year,
2. $182.50 saved on gas that costs $1.25 per gallon,
3. 297 pounds of carbon monoxide eliminated,
4. 13 pounds of nitrous oxides eliminated, and
5. 26 pounds of hydrocarbons eliminated.

Other advantages of the bicycle include its small size and ease of parking. Twenty bicycles can be parked in the space required to park one automobile, and the parking can often be unobtrusively provided adjacent to or even in the building where its rider works. In heavily congested areas, the bicycle may actually be faster than driving. Many motorists can recall creeping up to a traffic light, which may change several times before they can get through. Bicycles, in the meantime, come quickly past the waiting cars and are through the light before the cars reach it. When the time spent parking and walking to the final destination is included, the bicycle may well be faster in overall travel time for trips of several miles or more.

Another advantage is low cost. In addition to requiring no fuel, the bicycle needs few repairs and has a relatively low first cost. Few Indiana families would choose to own bicycles rather than a car (although some do, by choice rather than economic necessity). Many, however, could reduce their family expenses by maintaining only one automobile and using bicycles in place of a second or third car for commuting or school use.

A final advantage to be noted is the health benefit of regular exercise using the bicycle. The bicycle has the same health benefits as jogging, while also achieving useful transportion.

The bicycle is so simple, and so well known, that it is often overlooked as a solution to the energy problem. It may be one of the best solutions, particularly if steps are taken in more cities to have safe and pleasant rights-of-way free from hazardous traffic.

Disadvantages

The bicycle's disadvantages in Indiana include climate, where cycling may be distinctly unpleasant during winter months, and actually hazardous on streets not cleared of snow and ice after storms. Street conditions in many cities, especially in recent years, have deteriorated so that the bicycle has a hard time finding a smooth surface. With tight budgets, there may be a tendency to concentrate maintenance on heavily-traveled expressways, which are off limits to bicycles, and to allow regular surface streets to further deteriorate.

Other disadvantages include the problems of accommodating the low-speed, light weight bicycle in the same streets with high speed and heavy-motor vehicles. Motorists often fail to give sufficient space to bicycles. While bicyclists don't realize this fact, they themselves can also be a hazard to pedestrians, particularly if streets and sidewalks are crowded. The best use of transportation requires recognizing the individual space needs of each form.

The bicycle is susceptible to theft, because it is easy to move and hard to distinguish. Secure bike racks are needed, as well as expensive locks which cannot easily be cut.

Applications

Several communities have gained national attention by their efforts to provide for the bicycle. One such community is Davis, California, a university town of 36,000 population. In the early 1960s the Davis campus of the University of California expanded. Increased enrollment brought more bicycles as well as automobiles, and competition increased for right-of-way on the streets. Bicyclists argued that the city should provide bike lanes, and when the city council refused, pro bicycle candidates ran for political office in Davis, and won. In the ten years following their election in 1966, Davis constructed 28 miles of bikepaths. Today, Davis has 28,000 bicycles. On one heavily traveled street, traffic counts indicate that bicycles constitute 40% of the traffic. The emblem of the city is a gay nineties two-wheel bicycle.

Bikeway systems have also been installed in Eugene, Oregon; Boulder, Colorado; and Chapel Hill, North Carolina. These are all university towns. An example of a different sort is Schaumburg, Illinois, a typical auto-oriented suburb of Chicago. Following the 1973-74 Arab oil boycott, citizens indicated a desire for more independence from the automobile. Since Schaumburg had been built as a typical auto-oriented town of the 1960s, most streets had been built without sidewalks or any provision for safe bicycling. With concerned citizens aroused, the village designed a bikeway plan, and enlisted the support of the local park district, the County Highway Department, and adjacent municipalities. Money for bikeways was obtained from the State Department of Transportation, from the U.W. Heritage Conservation and Recreation Service, and from local capital improvements programs. Local laws were changed so that new subdivisions must install bikeways to connect with the growing system. By 1980 Schaumburg had 16 miles of bikeways, with plans for a system of 40 miles by the year 2000. Of these, 25 miles would be for exclusive bicycle use. Schaumburg is an example of how a community, even one designed primarily for automobiles, can coordinate its plans to construct a useful bikeway system.

Even New York City made an effort, unfortunately temporary, to give bicycles special accommodation. When New York City mayor Edward Koch visited China in 1980, he was so impressed by the sight of vast numbers of Chinese bicycling through the cities that he spent $300,000 to construct 6 ft. wide bike lanes along two avenues in Manhattan. Despite (or because of) extensive bicycle use of the lanes, New York motorists objected that the lanes slowed down motor traffic. After only a three month period the lanes were removed. In many cities the bicycle still faces an uphill political battle.

Indiana cities have installed short segments of bicycle paths. Muncie has a well-used bicycle path along the White River. In Indianapolis the Hike, Bike and Bus Week Committee has sponsored a week of activities to demonstrate the usefulness of bicycles and other alternative forms of transportation. Events included a mass bicycle commuting demonstration, and a special trip to deliver a state senator to the Capitol via a bicycle built for two! Special events like this get good publicity for the bicycle, and are important in getting communities interested in taking action to encourage bicycling.

QUESTIONS FOR STUDY

1. Why was the bicycle introduced as a form of transportation?

2. How does bicycle use differ in European and Southeast Asian countries compared to ours? Why do these differences occur?

3. Why has the bicycle become more popular in the U.S. in recent years?

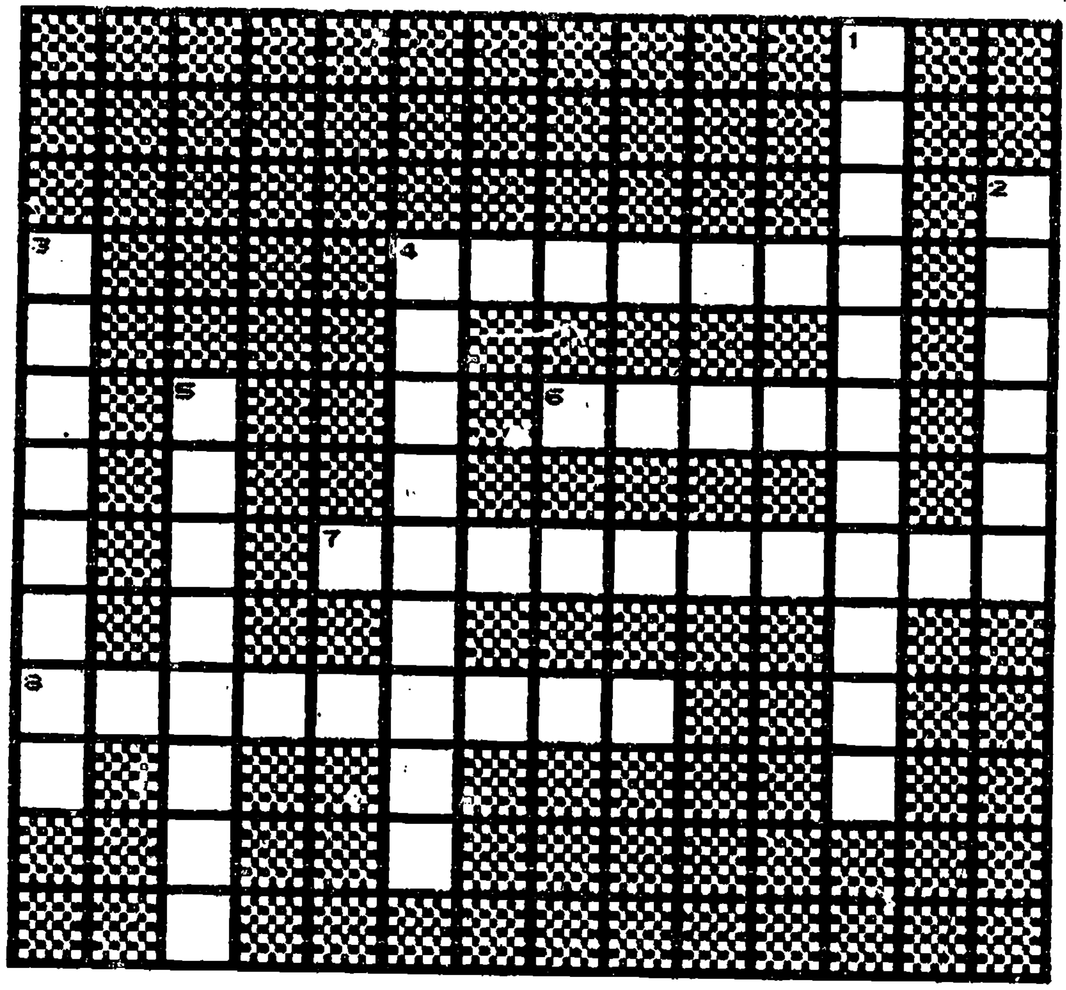
4. List three advantages to bicycle use.

5. List three disadvantages to bicycle use.

6. In what ways can bicycles be used as a major transportation alternatives in cities?

7. Make a map of the main streets of your community. Plan where you would put bike paths. Keep in mind, that adding bike paths are expensive to put in.

8. List ways you can increase your own bicycling safety.

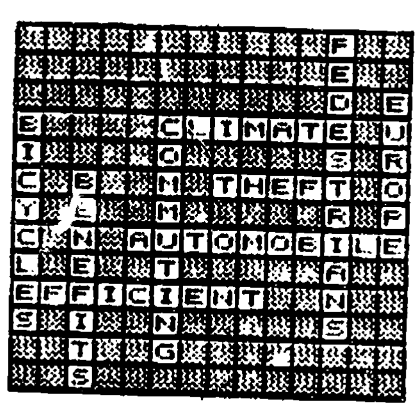


ACROSS CLUES

4. DISADVANTAGE TO BIKING IN INDIANA
6. REDUCED BY USING BIKE RACK & LOCK
7. IT REPLACED THE BICYCLE
8. ONE REASON FOR BIKE POPULARITY

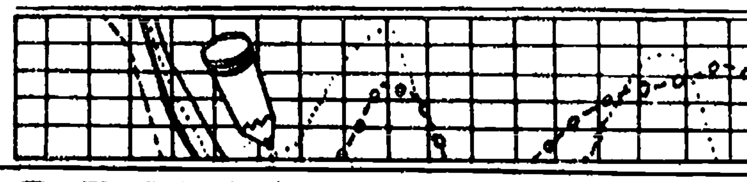
DOWN CLUES

1. BIKERS MUST WATCH OUT FOR
2. BICYCLES ARE VERY POPULAR HERE
3. MOST ENERGY EFFICIENT VEHICLE
4. ONE USE OF THE BICYCLE
5. OUTCOME OF BICYCLING



Energy

Case Study



TRANSPORTATION

In the spring of 1980, New Yorkers experienced what has been called "The most crippling strike in the city's history." For 11 days in April the buses and the subways did not move.

Mayor Ed Koch stood firm on his position that he would not be "bullied" into giving large increases in wages and fringe benefits to transit unions. Union leaders picketed bus and subway stations, saying that the city would die in a short time without transportation services.

An editorial writer for the <u>New York Times</u> described what citizens wanted:

> It wasn't easy to get to Manhattan and back yesterday, the dreaded day after the holidays. For some, commuting meant long waits that wore their patience thinner than their useless subway tokens.
>
> New Yorkers want a subway and bus system that can be operated for their convenience and comfort as well as for the benefit of those who work in it. Underground, they want reasonably clear trains with doors that work. In the streets, they want buses with signs they can read and engines that run quietly.

One proposal by a citizen's group urged the mayor to refuse to deal with the unions. The group suggested that most New Yorkers could ride their bicycles to work or to other locations -- grocery stores, department stores, banks, church, and so forth.

Respond to the "New Yorkers for Bicycles" proposal.

What would be the costs of permanently shutting down the mass transit system to:

1. commuters who currently use the mass transit system to get to New York City from Connecticut, Rhode Island and Massachusetts;
2. workers employed by the mass transit system;
3. bicycle shop owners;
4. business and industry in New York City;
5. business and industry in suburban and rural areas around New York City; and
6. consumers in suburban and rural areas around New York City.

Energy

Home Study

TRANSPORTATION

1. Use your bicycle or borrow one from a classmate for some family trip for which the automobile is normally used, such as shopping, or a trip to work, or some other local trip within the community. Keep notes, and write a report about the trip. The report should include:

   (a) the purpose of the trip (shopping, recreation, etc.);
   (b) the origin and destination (Usually the origin will be the student's home, and the destination will be the store, office, school, or whatever);
   (c) the trip distance (This can be estimated approximately or can be measured from a city map);
   (d) the time taken in each direction;
   (e) the actual route (This should include the types of streets used, (for example, quiet residential - ½ of trip, busy four lane - ¼ of trip, sidewalk - ¼ of trip. It should note shortcuts, sidewalks or streets used, and the ease or difficulty of each part of the trip);
   (f) parking arrangements (Was it possible to securely lock the bicycle at the destination? Was there a convenient bicycle rack?); and
   (g) particular problems encountered (Were there dangerous traffic conditions? Were there spots where the road surface was rough or hazardous? Were there problems with weather, or with carrying things?)

   The purpose of this report is to fully describe the trip, including the obstacles which make bicycle use difficult or hazardous. The outcome should be a judgment as to whether it would be practical to make that trip by bicycle on a regular basis.

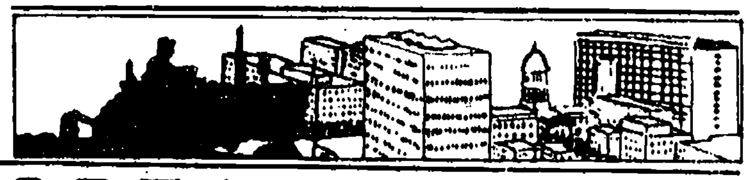
2. Make a list of suggestions for things which would make the trip more pleasant or safer. Often these are seemingly minor things, like repairing a particular pot-hole which forces bicycles to swerve out into traffic, or providing a sheltered bike rack near a store. List those things which need to be done if the community wants to encourage bicycle use.

3. Calculate the money and gasoline saved by using the bicycle instead of the car. Use an average figure of 20¢ per mile for local automobile use. This figure is the full cost of using a car, including gas, oil, license and insurance, repairs and depreciation. Most people don't think about these full costs, since they don't pay them at the time of each trip. For gasoline use, ask the usual driver of the family car what the approximate local miles per gallon is for the car. This will be less than the highway mileage, or the manufacturer's rating.

   Prepare your report for presentation in class. As you give your report, the routes could be traced on a copy of a city map to show what areas have been covered.

Energy

Community Study



TRANSPORTATION

In Indianapolis, and in other cities, there is a group which sponsors an annual alternative transportation week, including mass bicycle commuting rides. Presentations by such people can put across the idea of the bicycle as a serious form of transportation.

Use this community study in conjunction with individual home study reports.

1. Identify particular routes or corridors which seem to be attractive for bicycle use.

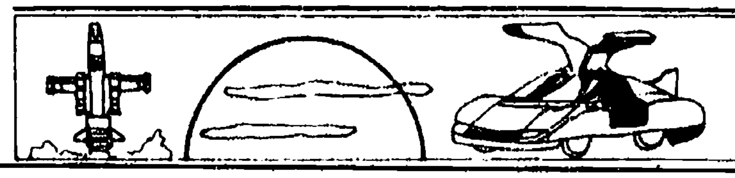
2. Within this plan, suggest places where a separate bikeway would make bicycle use easier and safer. Some communities have chosen to designate entire bikeway systems, including some shared routes and some exclusively for bicycles. Other measures might include programs for encouraging installation of bike racks; special days set aside for group rides or other promotional activity, and suggestions both for city government and for property owners to encourage bike use.

3. Group suggestions into priorities and arrange them according to short-term and long-term improvements.

4. Once priorities have been established, copy the list. Use the priority list to interview members of your community. Determine which of the priorities obtain the greatest support. Bring your findings to class and share them with other students.

Energy

21st Century



TRANSPORTATION

1. Imagine a possible 21st century situation where gasoline and other fuels have become so expensive that people have to rely heavily on bicycles for most local trips.

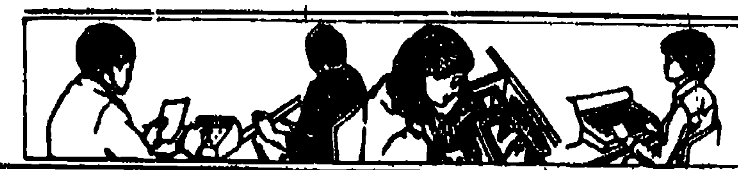
2. Imagine that your town will be completely rebuilt and redesigned for bicycle riders. Design this town, in words, in sketches and maps. The location will be the same, community size will be the same, and some of the buildings may remain. Feel free to move or eliminate anything that conflicts with efficient bicycle use. The object is not to achieve a precise design, but to understand the general implications of designing a town for bicycles rather than for automobiles.

3. Create a "Proclamation for Bicycle Use" in which a "whereas" section gives reasons for using bicycles, then a "Be It Resolved" section provides specific rules by which citizens in your community must abide.

4. Make copies of all of the proclamations. Send them to the mayor and city council members. Schedule a meeting with the major and city council members to get their reactions to the proclamations.

Energy

Careers



TRANSPORTATION

Visit the owner of a bicycle shop. Obtain answers to the following questions:

1. How did you get interested in owning a bicycle shop?

2. What kind of experiences are helpful in preparing to work in or own a bicycle shop?

3. What kind of education is useful?

4. What are the primary tasks involved in owning or working in a bicycle shop?

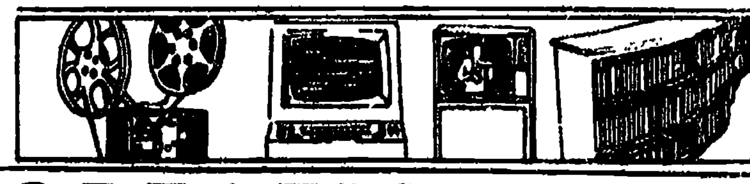
5. What salary range can a worker in a bicycle shop expect?

6. What are some of the benefits from working in a bicycle shop?

7. What are some potential problems resulting from work in a bicycle shop?

While you are at the bicycle shop, observe the jobs performed and keep notes on what you see. After you've compiled your notes, compare the work of:

(a) the stock clerk,
(b) the cashier,
(c) the salesperson, and
(d) the bicycle mechanic.



1. A number of cities have prepared bicycle plans, but these are often hard to locate. Contact the State Department of Transportation to ask if there are any examples near you.

2. The following organizations serve as clubs and contact points for promoting bicycling and have pamphlets and publications of their own:

   (a) Bicycle Federation, 1101 15th St., N.W., Washington, DC 20005;

   (b) Bicycle Forum Magazine, P.O. Box 8311-E, Missoula, MT 59807;

   (c) League of American Wheelmen, P.O. Box 988, Baltimore, MD 21203; and

   (d) International Human Powered Vehicle Association, P.O. Box 2068, Seal Beach, CA 90740.

3. A local bicycle store is probably the best place to find our about bicycle clubs in your area.

4. The following government publications are available by writing to the address indicated:

   (a) Bicycle transportation for energy conservation, U.S. Department of Transportation, Washington, DC 20590;

   (b) Bicycling laws in the United States, U.S. Government Printing Office, Washington, DC 20402; and

   (c) Actions needed to increase bicycle/moped use in the federal community, U.S. Government Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760.

5. The following film can be obtained from Indiana Council for Economic Education, Purdue University, West Lafayette, IN 47907.

   "We Decide," Trade-offs, 16mm film, 3/4 and ½ inch video on the allocation of school bike rack space.

6. For an extensive list of activities and resource organizations, write for Legs in action to: Division of Curriculum, Indiana Department of Education, State House, R. 229, Indianapolis, IN 46204.

PURPOSE: The purpose of this lesson is to explore the efficiency and effectiveness of the moped as a form of transportation.

APPROXIMATE TIME: If each of the following activities is used, approximately six class hours will be needed. This estimate does not enclude use of supplementary resources described in the lesson.

READABILITY: The Bormuth Readability Index was used to determine the reading level of text material in this lesson.

Ave. Word Length: 4.64

Ave. Sentence Length: 13.4

Readability Index: 56.7

Grade Level Equiv.: 5-6

OBJECTIVES

INQUIRY	DECISION-MAKING	TAKING ACTION
1. Students will examine how the moped became a popular form of transportation.	1. Students will recognize conditions under which the moped should be considered an important transportation alternative.	1. Students will determine when a problem or issue related to moped use is severe enough to warrant taking action.
2. Students will identify appropriate uses of the moped.	2. Students will explore the effects of the moped in a variety of situations	2. Students will analyze evidence upon which action should be taken.
3. Students will analyze the energy efficiency of the moped.	3. Students will predict the consequences of moped use on personal convenience, energy consumption, and economics.	3. Students will determine when an action should be taken.
4. Students will compare energy efficiency of the moped to its effectiveness as a transportation form.	4. Students will rank order the most effective uses of the moped under varying conditions.	4. Students will predict the consequences of their action.
5. Students will develop a conclusion as to the most beneficial use of the moped in terms of energy consumption.		5. Students will try out or simulate an action.
		6. Students will judge the results of the action or a simulation of it.

Energy

Glossary

TRANSPORTATION

Benefits - the valued output of economic activity.

Cost/benefit Analysis - an analytical technique used to determine what economic activity should be undertaken.

Costs - sacrifice of something to obtain something else; usually measured in dollars.

Demand - the amount of a good or service people are willing to sell at each possible price during some time period.

Efficiency - making the best use of our limited resources.

Equity - value judgements regarding fairness.

Interdependence of Market Prices - changes in one market have important effects in other markets. Markets do not operate in isolation from each other.

Market Economy - an economic system in which private economic decisions are made in the marketplace by the direct interaction of consumers, producers, workers, savers, and investors.

Minimum Wage - a government established wage for workers in designated industries.

Opportunity Cost - the lost of the next best alternative when scarce resources are used for one thing rather than another.

Resources - the inputs in the production of goods and services including land, labor, capital goods, and entrepreneurial ability.

Land - natural resources in their natural state, the nonhuman gifts of nature.

Labor - all types of human effort put forth in the process of production, physical as well as mental.

Capital - man-made buildings, equipment, and goods used in the production process.

Entrepreneur - the laborer who organizes new and special production processes. For his risk-taking activities, he hopes to receive a profit; but he may suffer a loss.

Satisfaction - the fulfillment of a need or want.

MOPEDS

Historical

Taking its name from the "mo" of motor and "ped" of pedal, the moped is rapidly becoming a very popular mode of transportation. The British probably originated the word. The French began the first manufacturing of bicycles with booster motors on a commercial scale. As now, most of the early mopeds were gasoline powered. A few were fueled by electricity.

Although a recent development in the United States, the manufacture and use of motor-assisted bicycles had been common for many years in other parts of the world. Their development and use grew out of the need to travel some distances using less energy and time. Bicyclists experimented by attaching small motors to their bicycles. The motor reduced the energy and time required for travel by bicycle.

The number of mopeds in the United States is estimated to be over 1 million. Purchases in the next few years should bring that number closer to five million.

Current Technology

The moped is not a bicycle with a motor. It is a specially built unit, considerably stronger than the ordinary bicycle. Mopeds usually weigh less than 100 pounds. Their single-piston engine with an output of 1.0 to 2.0 horsepower and a maximum displacement of 50 cubic centimeters can achieve 25 to 30 miles per hour. They are fuel efficient, getting 125 miles or more per gallon.

A few electric models are available. They suffer some of the same problems as the electric car. The lead batteries are heavy and they require considerable more attention than gasoline-powered mopeds. In addition, they have a considerable shorter cruising range: 7 to 10 miles compared to the 30 to 40 miles for the gasoline powered moped.

Advantages

The moped is energy efficient. Next to the bicycle it is the most efficient means of transportation. It permits travel at higher speed and over longer distances than the bicycle. It is highly maneuverable permitting it to go many places the automobile cannot go. It is easy to park.

The moped is inexpensive to own and operate. At 125 to 130 miles to the gallon many trips can be taken for work or leisure for substantially less money than the automobile. Mopeds sell for as little as $500 to as much as $1,500 or more.

Finally, the moped contributes less pollution per mile than the automobile. Greater use of the moped for trips to school and other short trips would substantially reduce pollution.

Disadvantages

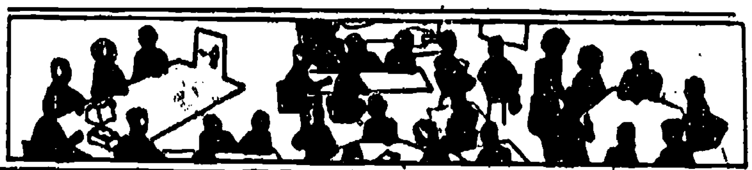
Safety is definitely a consideration. On rain slick roads, out of sight of automobile drivers, the moped is accident prone. When accidents occur, they tend to result in more serious injuries because of higher moped speeds. To reduce the risk of head injuries, moped users are encouraged to use helmets.

Security is also a disadvantage. A locking steering column and difficult pedaling, due to low gear ratio, make the moped more secure than the bicycle. Loud alarms and other theft-prevention devices are available.

Rain, ice storms, and winter snows make the moped essentially a fair weather means of transportation.

Applications

Travel to school, to run errands, and to work may all be done efficiently with greater speed and less time on a moped than a bicycle. In addition, the moped is a recreational vehicle.



QUESTIONS FOR STUDY

1. What motivated the development of the moped? What fuels do they use? How many have been manufactured?

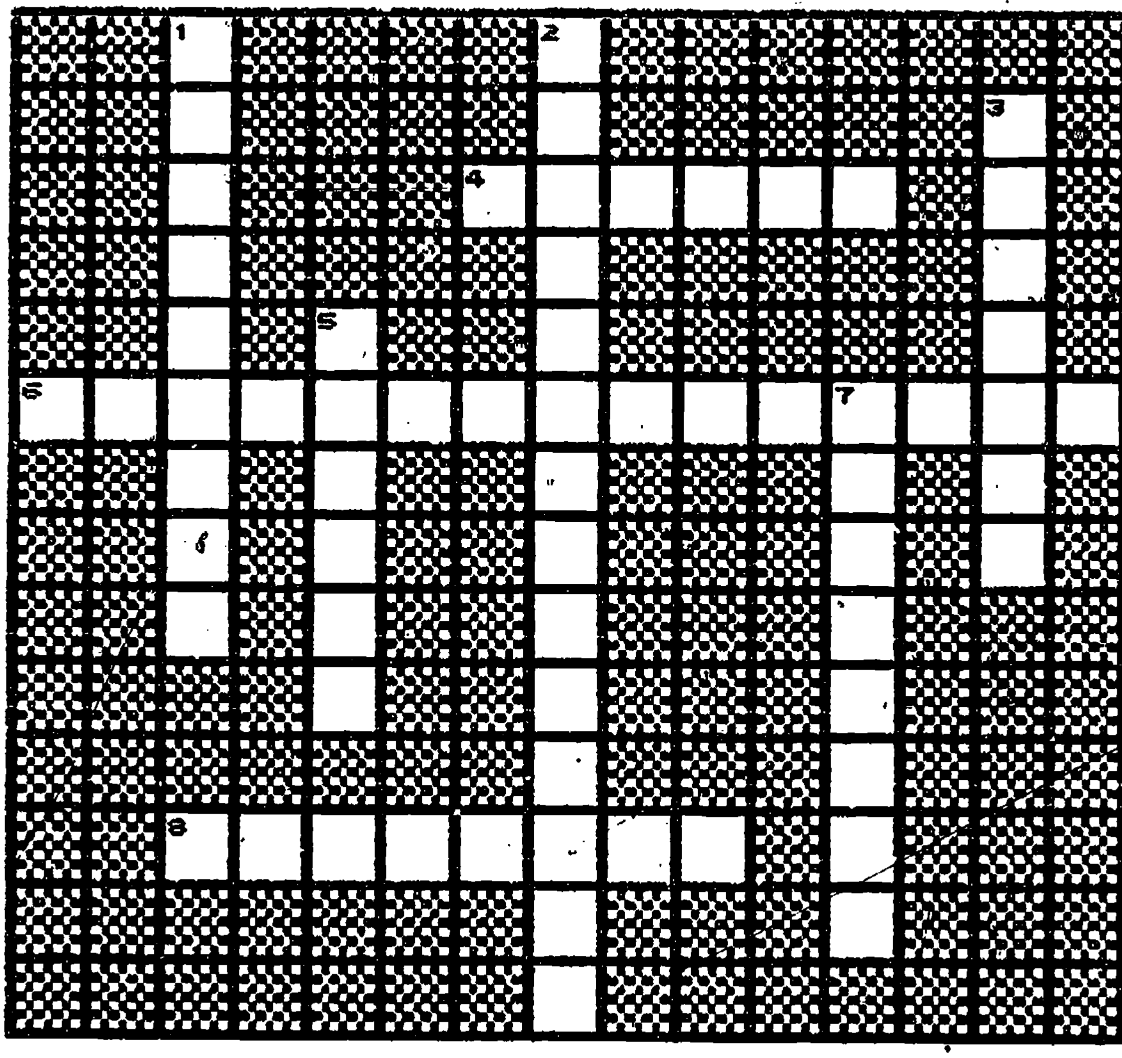
2. Compare the gasoline and electric mopeds. Which one is more fuel efficient? Why?

3. Which advantage of owning and operating a moped is most important to you? Explain.

4. What are the disadvantages of owning and operating a moped? What can be done to reduce the impact of these disadvantages?

5. How do the students in your school use their mopeds? How important is each type of use? Explain.

6. Given the choice between using a bicycle or a moped for transportation to school, which one would you use? Why? What are the energy conservation and energy dependence implications of your choice?

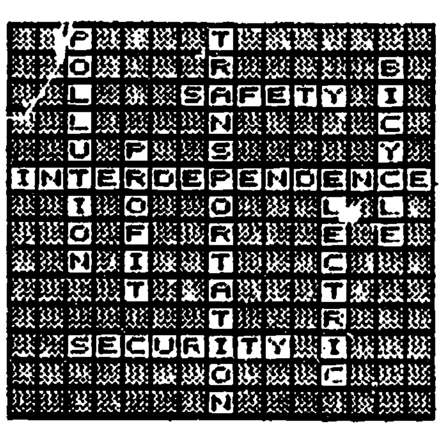


ACROSS CLUES

4. ONE DISADVANTAGE OF THE MOPED
6. CHARACTISTIC OF MARKETS
8. LOUD ALARMS INCREASE THIS

DOWN CLUES

1. MOPEDS CONTRIBUTE LESS OF THIS
2. MOPEDS ARE THIS
3. MOPED IS MORE EFFICIENT THAN THIS
5. THE GAIN FROM SALE OF MOPED
7. TYPE OF POWER FOR MOPEDS



Case Study

Energy

TRANSPORTATION

Time is a scarce resource. Transportation to school by moped saves time. The extra time used riding a bicycle has alternative uses. The next best use of that time is its opportunity cost. Suppose the time saved riding a moped could be used to sleep later or to study for a quiz. If you study for a quiz then the opportunity cost is the sleep you gave up. The monetary value of the time can be estimated using the minimum wage or some estimate of the monetary value of a unit of time.

In the space below calculate the time saved using a moped for transportation to school.

1. Time the trip for a bicycle and a moped.

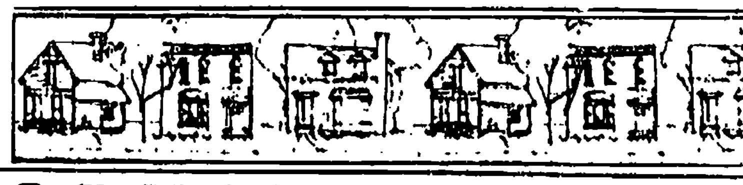
2. Calculate the difference. Identify the opportunity cost of the additional time used for the bicycle trip.

3. Calculate the dollar value of the time saved (use the minimum wage of $3.35). Describe the value of your time in dollars.

4. Consider other reasonable suggestions such as the dollar value of the time used to mow lawns. Defend the answer you give.

Energy

Home Study



TRANSPORTATION

1. Estimate the fixed and flexible expenses of owning and operating a moped. Fill in the following schedule:

	MOPED	AUTOMOBILE
Fixed Expenses:		
Installment payment		
Insurance		
License fees		
Registration		
Taxes		
Total Fixed Expenses		
Flexible Expenses:		
Gasoline		
Oil		
Tires		
Total Flexible Expenses		
Total Fixes/Flexible Expenses		

2. In the right-hand column fill in information for the automobile. Compare the energy and cost efficiencies of the automobile and moped. Which is more energy efficient? Why? Is the added efficiency worth the cost of slower, less comfortable, and riskier travel?

3. Do your estimated total monthly moped expenses approximate the amount of money you have to spend? If they are higher, or you are reluctant to make a commitment of the calculated amount, what can you do to reduce costs? Evaluate each of the following for their acceptability and add other alternatives:

   (a) Buy a less costly moped.
   (b) Purchase a more fuel efficient model of moped.
   (c) Pay cash thus eliminating interest charges.
   (d) Make a larger down payment to lower installment payments.
   (e) Reduce montnly payments by extending your installments over a longer period of time.

Energy

TRANSPORTATION

Resources must be used to bring about change. Since these resources have alternative uses, they must be bid away for use in moped safety. They have a cost. Something else must be given up to acquire better moped safety. Two directly related questions also arise: Who should incur the opportunity cost of the changes? Who should pay? One answer is those who benefit directly -- all who benefit, even if the benefit from greater moped safety is nonexistent. Although no right answer exists, the consequences of the choice may be less efficiency. In the case of moped safety, this could mean using too many resources, and/or creating costs greater than benefits.

1. Investigate the type of and causes of moped accidents in your community.

2. With this information develop a plan to make moped travel safer.

3. Estimate the costs involved in the improvements.

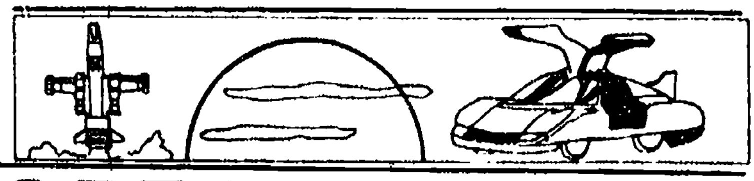
4. Present the information to the class.

5. Object to the project or to parts of the project where you do not benefit directly or only benefit indirectly. This procedure will demonstrate that costs exceed benefits.

6. Fully discuss the "who should pay" question by examining the consequences of all paying, including inefficiency and costs exceeding benefits for some and benefits exceeding costs for others.

Energy

21st Century



TRANSPORTATION

Consumer changes in purchasing patterns impact on economic and other community activity. The demand for other goods and services may either increase or decrease with the resulting increase or decrease in jobs and income. This outcome is characteristic of the interdependence of market economies.

Consider what changes would be required at your school if the number of mopeds increased substantially. Consider the availability of parking, measures necessary to provide adequate security, and the need to separate pedestrians from moped traffic.

1. What changes are required to meet the needs?

2. How will these changes impact on the economy and other aspects of the community?

3. What happens to energy usage?

4. Who will gain employment?

5. Who will lose employment?

6. What industry will experience increased profits?

7. What industry will experience decreased profits?

Energy

Careers

TRANSPORTATION

Visit a moped dealer. Obtain answers to the following questions:

1. Why did you decide to sell mopeds?

2. Describe the typical customer. Why does she/he want to buy a moped?

3. What are the primary tasks involved in selling mopeds?

4. What salary can a moped salesperson expect to earn?

5. Describe the work of a moped mechanic. What kind of training or experience is required?

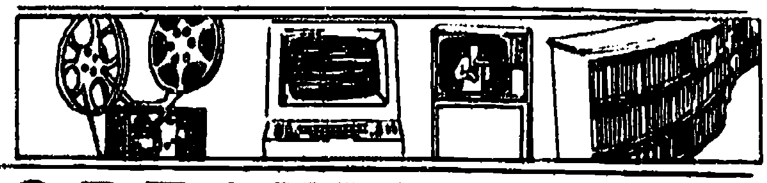
6. How much does a moped mechanic earn?

7. What are some of the benefits from working with mopeds?

8. What are some potential problems which result from working with mopeds?

Energy

Resources



TRANSPORTATION

1. The following articles provide valuable information on mopeds:

   (a) Motorized bikes and mopeds. (1981, May). Consumer Reports, pp. 261-266;

   (b) What you should know before you start commuting by moped. (1980, March). Popular Mechanics, p. 1025; and

   (c) Mopeds: Slow going at a penny a mile. (1980, December). Changing Times, pp. 57-59.

2. For free and inexpensive materials, write to:

   (a) American Honda Motor Co., Inc.
   100 W. Alondra Blvd.
   Gardena, CA 90247;

   (b) Cycles Peugeot, Inc.
   540 E. Alondra Blvd.
   Gardena, CA 90247;

   (c) Gitane Pacific, Inc.
   4925 W. 147th St.
   Hawthorne, CA 90250;

   (d) Malaguti of America, Inc.
   1845 Post Rd.
   Warwick, RI 02886;

   (e) Sachs Motors Corp. of U.S.A.
   6401 Regio Ave.
   Buena Park, CA 90620; and

   (f) Worldwide Cycle Group, Ltd.
   250 Broadway
   New York, NY 10007.

PURPOSE: The purpose of this lesson is to explore the efficiency and effectiveness of the school bus as a form of transportation.

APPROXIMATE TIME: If each of the following activities is used, approximately six class hours will be needed. This estimate does not include use of supplementary resources described in the lesson.

READABILITY: The Bormuth Readability Index was used to determine the reading level of text material in this lesson.

Ave. Word Length: 5.06

Ave. Sentence Length: 12.2

Readability Index: 60

Grade Level Equiv.: 7-8

OBJECTIVES

INQUIRY	DECISION-MAKING	TAKING ACTION
1. Students will examine why the school bus emerged as an important form of transportation.	1. Students will recognize conditions under which the school bus should be used as a valuable transportation alternative.	1. Students will determine when a problem or issue related to school bus use is severe enough to warrant taking action.
2. Students will explore the energy efficiency of the school bus.	2. Students will explore the effects of the school bus in a variety of situations	2. Students will analyze evidence upon which action should be taken.
3. Students will compare energy efficiency of the school bus to its effectiveness as a transportation form.	3. Students will predict the consequences of school bus use on personal convenience, energy consumption, and economics.	3. Students will determine when an action should be taken.
4. Students will develop a conclusion regarding the most appropriate use of the school bus in terms of energy consumption.	4. Students will rnak order the most effective uses of the school bus under varying condition.	4. Students will predict the consequences of their action.
		5. Students will try out or simulate an action.
		6. Students will judge the results of the action or a simulation of it.

LESSON 5: SCHOOL BUSES

Energy TRANSPORTATION

Glossary

Conservation - the process of saving a finite resource

Cost - sacrifice of something to obtain something else; usually measured in dollars

Economic Activity - production, distribution, investment activity directed to the fulfillment of human need and wants

Efficiency - making the best use of our limited resources

Employment - engaged in work

Goods - things that satisfy needs and wants

Income - money received from the sale of natural, human, or capital resources or from transfer payments

Market - exists when buyers and sellers of a product interact with one another and engage in exchange

Quantity Demanded - the amount people are willing and able to buy at a particular price. They buy more at lower prices, less at higher prices

Resources - the inputs in the production of goods and services including land, labor, capital goods, and business sense

SCHOOL BUSES

Historical

At first school buses were used solely in rural areas. One room schools were closed and students were transported to larger consolidated schools. Consolidated schools provided a broader based and better education at less cost per pupil. During the baby boom following World War II, school buses were used to redistribute students to schools in older parts of cities where vacant classrooms existed. Today, due to declining enrollments, school buses are used to redistribute students into a smaller number of buildings. Some school districts are using school buses to achieve racial balance in their schools. Students are transported from their neighborhood school to a distant school for education with children of various racial and ethnic origin.

Current Technology

Most school buses are built using a standard truck chassis. They are diesel or gasoline powered. Usually equipped with two-way communication, they are simple in design. Most are manual shift. Most do not have air conditioning. The seating is generally less plush than city transit and intercity buses.

School buses are operated twice a day for five days during the school year. They are also used to transport students to extra-curricular events.

In many areas of the country they operate on unpaved roads under unfavorable conditions. These vehicles require special maintenance.

Advantages

School buses save energy. A typical bus will hold 66 students. Transportation by bus saves 131 round trips each school day. Car pooling would require 34 round trips for the same 66 students.

At senior high schools the use of school buses reduces the number of parking spaces needed for use by students.

Disadvantages

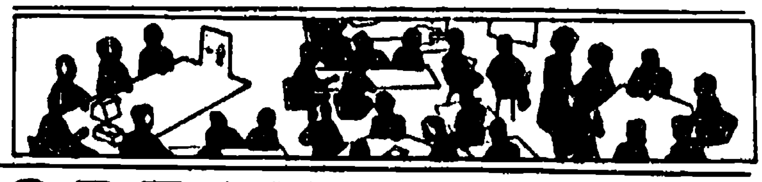
Many students must leave very early and travel for up to one hour to get to their schools. Weather delays can be disruptive to class scheduling. In addition, safety is a consideration. Safety experts suggest seat belts and high back seats to reduce the risk of injury from accidents.

Applications

There are 312,000 school buses in the United States operated by either school districts or by for profit firms contracting with them. This is 6 times as many buses as those operated by local bus companies. School transportation is the largest transportation system in the country. It involves over 22 million pupils. Approximately 47% of the student population in the public primary and secondary schools are transported to school. The system costs in excess of 2 billion dollars a year.

Figure 1: Busdrivers

School buses are subject to even more stringent safety regulations than conventional buses. Traffic laws and regulations give them protection not afforded to conventional buses.



QUESTIONS FOR STUDY

1. Where and for what purposes have school buses been used? What demographic factors influenced the changing uses of school buses?

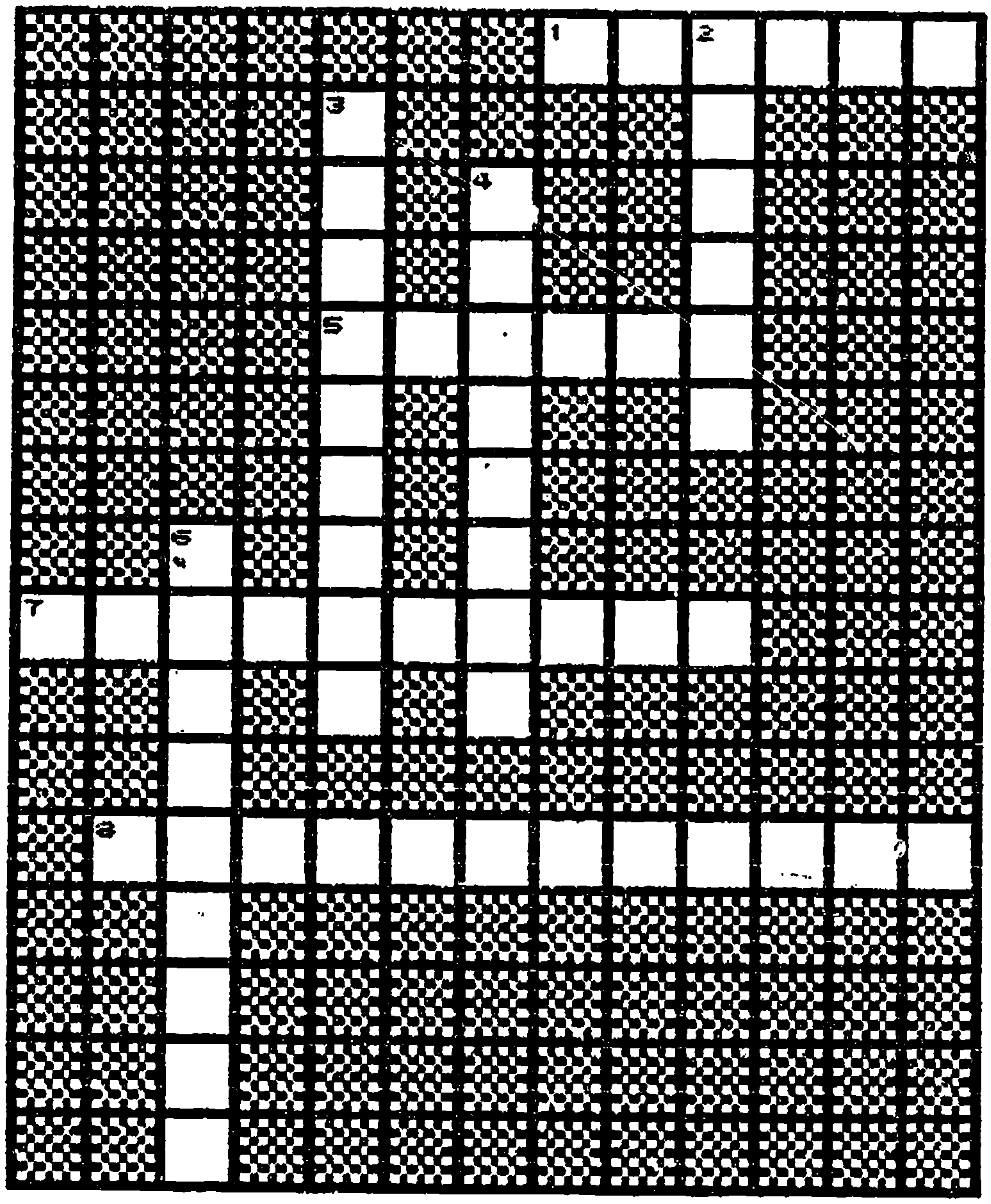
2. What kinds of fuel do school buses use?

3. Compared to car pooling students, do school buses save energy? Explain. What other advantages are there to bussing students to school?

4. What is the largest transportation system in the United State? How many people are transported? How much does it cost per year?

5. Who owns and operates the school bus systems in the United States? Who owns and operates your school's bus system?

6. What changes would you recommend be implemented for your school's bus system? What are the energy efficiency, safety, and cost effects of the changes?

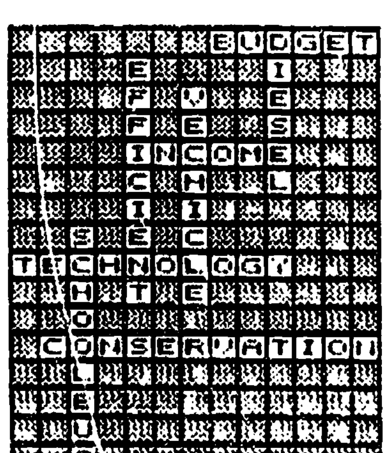


ACROSS CLUES

1. A SPENDING PLAN
5. MONEY PAYMENTS
7. KNOWLEDGE OF BUS PRODUCTION
8. SCHOOL BUSES SAVE ENERGY

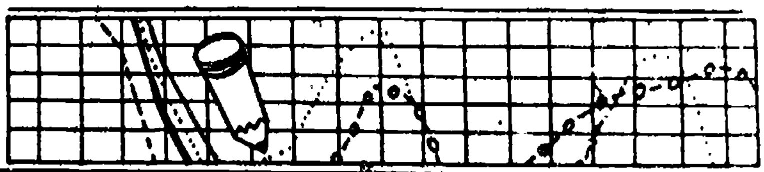
DOWN CLUES

2. FUEL USED BY SOME SCHOOL BUSES
3. TO USE SCARCE RESOURCES SPARINGLY
4. A SCHOOL BUS IS THIS
6. IT TRANSPORTS STUDENTS TO SCHOOL



Energy

Case Study



TRANSPORTATION

When the price of a resource (diesel fuel) increases the quantity demanded declines. Since less of the resource is used, the result is conservation. The resource is used only in its higher valued uses and more efficiently. As a resource becomes relatively more scarce, the market promotes conservation because price increases.

1. Secure from the school bus manager the budget for operating the system for one year. Identify the resources used to operate the system. Use three broad categories at first such as land, labor and capital. Next, identify all the resources and their share of the budget. Focus in on energy. Describe ways to save energy. Explore the role of the price of fuel in the conservation of energy.

2. Invite the bus manager to share with the class how the school handled the sharp increases in fuel costs in 1974 and again in 1979. What are current plans to contain the cost of operating the system? After the manager's presentation, review the comments as they relate to the effects of higher prices on fuel use. Pay attention to the point that as price increases quantity demanded decreases, e.g. less fuel is used.

Energy

Home Study

TRANSPORTATION

1. Use the information in the school bus budget to calculate the cost per ride. Compare it to the calculated cost for travel by auto. Ask the following questions:

   (a) Which mode of transportation is cheaper? Why?

   (b) Which is more energy efficient? Calculate passenger miles per gallon and compare.

2. Examine the chart below to explore the energy efficiency of different modes of transportation. Indicate under what circumstances you would fly. Energy efficiency is only one criteria of many that determine the chosen mode of transportation: What other criteria should be used?

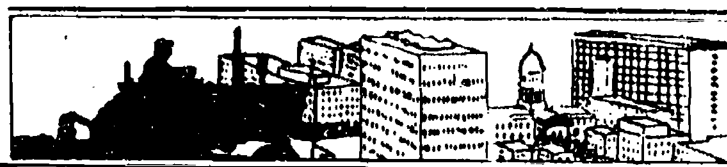
3. How would you respond to an increase and/or decrease in the cost of operating the school bus system? As you prepare your answers, focus on efficiency for cost increases and additional services or improved quality of service for cost declines.

Another good reason to travel by bus

Air	17	Passenger Miles Per Gallon
Auto	25 TO 41	Passenger Miles Per Gallon
Amtrak	44	Passenger Miles Per Gallon
Bus	126	Passenger Miles Per Gallon

Energy

Community Study



TRANSPORTATION

Economic activity creates goods and services to fulfill our needs and wants. To produce the goods and services resources must be employed. Their use generates income. A school bus system provides transportation services to some students. Resources must be used to provide the service. To reduce waste, the service must be provided efficiently.

1. Describe what transportation to school would be like if the bus system didn't exist. Focus on energy use, pollution, safety, traffic congestion and other developments. List the benefits of a school bus system.

2. Identify whose income depends directly on the school bus system.

3. Identify whose income depends indirectly on the school bus system.

While there are benefits to the school bus system, their are "trade-offs". At first school buses were used solely in rural areas. Buses made it possible to close the small, one-room schoolhouse, by transporting large numbers of students to consolidated schools. However, closing the smaller schools led to the decline of small towns where the local school served as the center of community activity.

1. Interview people in your community who recall the introduction of school buses. Try to reconstruct how the community was affected by the use of school buses.

2. Locate and study local newspaper coverage of the introduction of school buses to your community.

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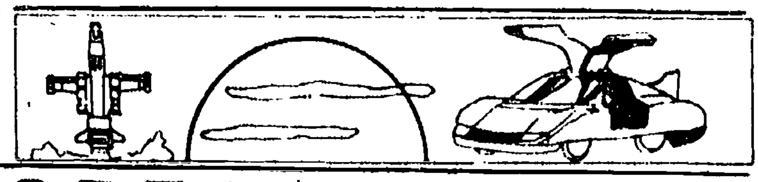
21st Century



TRANSPORTATION

Changing technology has many effects. Employment may increase in some industries and decrease in others. Resources such as energy may be used more efficiently. Services such as school bus transportation may be provided at lower costs.

1 Brainstorm ways that the computer might change the school bus system. Explore the computers potential impact on employment, cost of operation, travel time, safety, comfort, and pollution.

2. Ask the school bus manager what impacts computers have to date. Keep in mind the use of computers for bus maintenance.

3. If computers made it possible for most instruction to occur in the home, how would the school bus system be affected? What would be the savings? What would be the costs?

4. If buses exist in 2020, what will they look like?

   (a) Describe in writing what buses will look like?

   (b) Draw the "2020 bus."

5. If buses exist in 2020, how will they be powered? What energy will be used?

Energy

Careers

TRANSPORTATION

School bus drivers work only when school is in session, having off weekends, holidays, and summers. The majority of them work 20 hours or less each week. Bus drivers who take students on field trips and athletic events may work 30 hours or more each week. Two-thirds of all bus drivers in the U.S. drive school buses.

1. Interview two school bus drivers:

   (a) a bus driver who is employed full-time as a driver and

   (b) a bus driver who is employed part-time as a driver.

2. Ask each of them the following questions:

   (a) Why did you decide to become a school bus driver?

   (b) What do you enjoy most about drive a school bus?

   (c) What do you like least about driving a school bus?

   (d) How long have you been driving a school bus?

3. Write a brief report on the results of your interviews. Share your report with other students in your class.

4. Bus driver's qualifications are established by state and federal regulations. Most states require:

   (a) a chauffeur's license or a special school bus license;

   (b) the driver to be at least 18 years old;

   (c) the ability to read, write, and speak English well enough to prepare reports and to communicate with passengers; and

   (d) normal use of legs and arms 20/40 vision with or without glasses, and good hearing.

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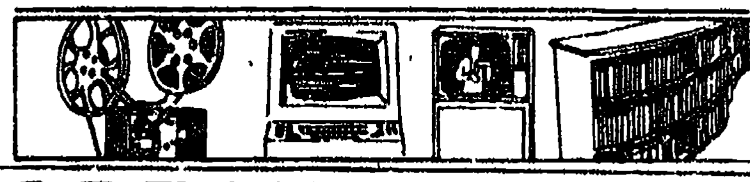
Resources



TRANSPORTATION

1. For general information on local transit bus driving, write to:

   (a) American Public Transit Association
   1225 Connecticut Avenue, N.W.
   Suite 200
   Washington, D.C. 20036 and

   (b) American Bus Association
   1025 Connecticut Avenue, N.W.
   Washington, D.C. 20036.

2. The following materials provide useful information on bus transportation:

   (a) Arco Editorial Board (1972). Bus maintainer - bus mechanic. NY: Arco Publishing, Inc.;

   (b) ________________ (1974). Bus operator; Conductor. NY: Arco Publishing Inc.; and

   (c) A. A. Paradis (1983). The intercity people movers, Opportunities in transportation. Lincolnwood, IL: VGM Career Horizons.

3. Write to the Indiana Department of Commerce, Division of Energy Policy, One North Capital, Suite 700, Indianapolis, IN 46204 for:

   (a) Fuel Saving Basics for Bus Drivers and

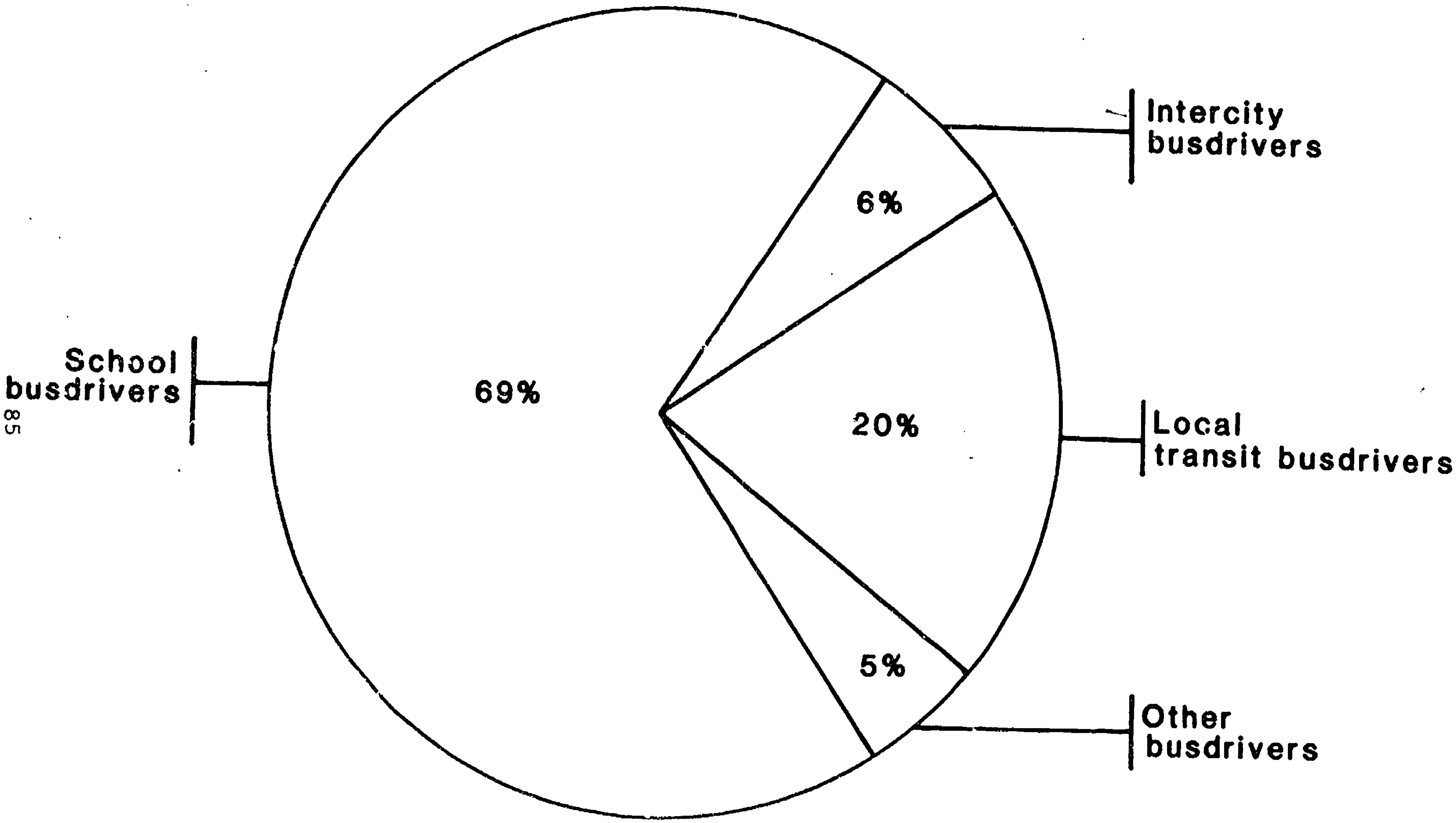
   (b) Save Fuel, Save Lives

4. For films, pamphlets and access to other resources, contact:

   State Department of Education
   Division of School Traffic Safety and
   School Emergency Planning
   3833 N. Meridian
   Indianapolis, IN 46204.

Figure 1

BUSDRIVERS



For further information or assistance, contact:

Division of Curriculum
State House, Rm 229
Indianapolis, IN 46204
(317)-927-0111