This collection of instruction modules studies the interactions of science, technology, and society (STS) using five activity sets. The introduction module includes activities which show students the STS relationships in their world, develop good organizational skills, develop an understanding of who and what a scientist is, develop graphing skills, and aid in organizing data. Module 1 studies "the auto and energy" from a heat aspect. Activities include studies changing energy from one form to another, heat energy converted to mechanical energy, energy conversions (chemical to light), and making a thermistor. Module 2 examines "selecting your dream car." Student activities used are determining what the interior, exterior, and performance should be, costs of owning an automobile, and analyzing advertising methods in search of valid information. Module 3 stresses "transportation and your community." Skills developed include map making and reading, method of transportation and mileage, and the effects of different cars on gas usage. Module 4 covers "AUTO issues--the speed limit, seat belts, and you." Topics studied include local and national speed limits, fuel consumption and speed, and seatbelt safety. Each activity includes processes developed, instructional objectives, questions, materials and data, and a teacher evaluation form. In some modules, extras such as vocabulary words or word search games are included. (MVL)
The PITT Project

INTRODUCTION MODULE

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

INTERRELATIONSHIPS SCIENCE - TECHNOLOGY - SOCIETY
THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

INTRODUCTION MODULE

INTERRELATIONSHIPS SCIENCE - TECHNOLOGY - SOCIETY

developed by

Inservice Workshop Participants

with the Primary Writing Team

June, 1988

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THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Introduction Module

Interrelationships Science - Technology - Society

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Interrelationships Science - Technology - Society

COMPETENCIES

A. Processes
1. Observing
2. Classifying
3. Inferring
4. Predicting
5. Measuring
6. Communicating
9. Formulating Hypotheses
10. Experimenting
11. Recognizing Variables
12. Interpreting Data

ACTIVITIES
1. Science - Technology - Society Inventory
2. Gift of STS
3. Picture A Scientist!
4. Graphing
5. Intro Cards

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. identify and compare at least five changes in our society over the last 100 years, in relation to transportation, homes, food, communication, health, occupations, education, and/or clothing.

2. list at least five reasons "why" having good organizing skills is essential for the student in today's society.

3. identify possible relationships between two variables.

4. create a physical representation of collected data.

5. devise a scale appropriate to the data to show direct relationships.

6. interpret prepared graphs.
Activity 1. Science - Technology - Society Inventory

Objectives: Students will be able to identify and compare changes in our society over the last century in relation to transportation, homes, food, communication, health, recreation/forms of entertainment, occupations, education, and clothing.

Student Activity Sheets: SAS 1.1 Inventory I
SAS 1.2 Inventory II

Teacher Background:

This activity is designed to help students understand the interrelationships between Science - Technology - Society.

The aim is to generate discussion between teacher, student, and family members about changes in our society that have come about due to advances in science and technology.

It is hoped that this activity will begin the process of making science more relevant to the student and his family and help to develop a rapport between student and teacher.

The design of each module in the set of five modules is the same. White pages in the module contain teacher information (which may/may not be shared with students). The yellow pages are Student Activity Sheets (SAS) to be duplicated for individual student use. All pages are consecutively numbered in the modules.

Example of Introductory Anticipatory Set

Teacher. "What disease are you afraid of? concerned about?" 
Student. "(AIDS, cancer, etc.)"
Teacher. "Is anyone concerned about polio, diphtheria, scarlet fever? etc."
Teacher. "Tonight, or during one of the next several days, ask your parents if they are afraid of these diseases."

Teacher. "100 years ago what diseases do you think people were afraid of in Pittsburgh?"

Pass out STS Inventory I to be completed by students after they interview their parents, grandparents, other relatives or using their own ideas and resources.

Resources:

Science 84, November 1984 - This is an excellent reference that illustrates scientific discoveries that have had an impact on our lives.

Other science magazines and journals have had similar issues devoted to technological advances that have impacted our lives.
Directions: Complete the chart below with your own ideas, by asking your parents or grandparents or referring to reference books.

<table>
<thead>
<tr>
<th>Category</th>
<th>1886</th>
<th>1930</th>
<th>1960</th>
<th>1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation</td>
<td>Kinds</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homes</td>
<td>Heating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lighting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Appliances</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>Produced (where obtained)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prepared</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stored</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Where eaten</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Most often used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>Feared diseases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Causes of death</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Life span</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forms of Energy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreation/Entertainment</td>
<td>Forms</td>
<td>Amount of Leisure Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Occupations</td>
<td>Major occupations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Types of skills</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Years in school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Size of grade school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Size of high school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clothing</td>
<td>Type of material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Where produced</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Intro.

Transportation

1. If you wished to travel to Los Angeles, California, how long on an average, would it take in 1886? 1930? 1960? 1986?

2. Put the following in order of their development:
   - rocket engine
   - jet engine
   - steam engine
   - gasoline engine

Homes

1. How is today's home different from the log cabin of 1886 in terms of heating? lighting? appliances? location? construction?

2. Which of the changes listed in question 1 are a result of technology?

Food

How would meal preparation be different today from what it was in 1930 in terms of:
   - time?
   - types of food?
   - method of preparation?

Communication

How quickly would you have been able to contact a relative living in Dallas, Texas in 1886? How long would it take today?
Put the following forms of communication in order of their development:

- satellite communications
- telegraph
- direct communication
- postal service
- telephone

Health
1. What has contributed to increased life span?
2. How is health care different today than it was 25 years ago?
3. What diseases are you afraid of? Has anyone here ever been quarantined?
4. How have causes of death changed since 1900?

Forms of Energy
1. How has modern technology depleted the supply of fossil fuels?
2. List some forms of energy that are alternatives to fossil fuels?
3. Name some advantages and disadvantages of nuclear energy?

Recreation
1. List some types of recreational activities that were not possible 100 years ago.
2. How is car racing a good example of how technology has changed the nature of this form of recreation.

Occupation
1. What kinds of jobs did not exist 50 years ago?
2. How has technology replaced the following occupations of the past:
   - blacksmith
   - iceman
   - chimney sweep
   - cotton picker
   - grape picker

**Education**

1. What kinds of courses were emphasized 50 years ago for the typical student attending school?

2. What kinds of courses are offered today because of our advanced technology?

3. Why are people today staying in school for longer periods of time?

**Clothing**

1. In 1910, a woman might spend hours ironing clothes for her family. Why has this changed today?

2. Classify the following fibers as natural or man-made.
   - silk
   - banlon
   - orlon
   - rayon
   - cotton
   - nylon
   - wool
   - linen
   - acrilon
   - banlon

**General questions:**

1. Pick three categories above and describe how technology has made great strides in that particular area.

2. How has improved technology caused the family to change from 1886 to today?

3. What kinds of technology might be prevalent 50 years from now?
Activity 2. Gift of STS

Objectives: Each student should be able to give several reasons why having good organizing skills is essential for a student in today's society.

Suggested Procedure:

1. Discuss with the students any great gifts (presents) they would like to receive or give at Christmas or birthday.

2. Have the students write down on paper the one best gift and a list of all the components (or things) the gift should have.

Example:

VCR

store- 1 2 3

heads

VHS

remote

on-screen programming

still

no. of events

no. of weeks

front loading

stereo

3. Have the students investigate different stores which sell the items. Students should find out prices, options, other features, distance travelled to store and cost, etc.

4. During a follow-up session, discuss with students the importance of organizing information so that good decisions might be made.

5. Discuss with the students their knowledge of terminology that has been brought up by the students in listing the gifts (examples, overhead cam, fuel injection; frequency modulation, and China Syndrome).

6. Discuss how science and technology have made our lives easier but often more complicated by some of the gifts listed by students.
Activity 3. Picture A Scientist!

Objectives:

Students should be able to:

1. develop an awareness of different peoples concepts of scientists.
2. develop a better understanding and awareness of scientists as individuals.
3. develop an awareness of how personal life experiences effect one's perceptions of scientists (and other things).

Suggested Procedure:

1. Give each student a blank sheet of paper and have them draw his idea of what a scientist looks like.

2. After the students draw their pictures (allow 10-15 minutes), collect/show off the pictures in the classroom. Allow the students to view each others drawings. Have the students individually or in small groups organize the drawings by similarities and differences. Do they find certain similarities? (many males, white, middle-aged, ties, weird hair, pens in pocket, scientific equipment?)

3. Do any of the students suggest a pattern of stereotyping? The teacher might lead a discussion of stereotyping. Where do the students ideas originate from? How might their feelings/attitudes affect future decisions such as career choice and college major. How might their ideas today effect their future ideas concerning science/or becoming a scientist?
Activity 4. Graphing

Objectives:

Students should be able to:

1. identify possible relationships between two variables.

2. create a physical representation of collected data.

3. devise a scale appropriate to the data in order to show direct relationships.

4. interpret prepared graphs.

Teacher Background:

This activity is designed to familiarize the students with the process of graph making.

The following terms should be reviewed to enhance an understanding of the activity.

<table>
<thead>
<tr>
<th>Term</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axis</td>
<td>Coordinate</td>
</tr>
<tr>
<td>Interpolation</td>
<td>Extrapolation</td>
</tr>
<tr>
<td>Data</td>
<td>Data Table</td>
</tr>
<tr>
<td>Best Fit Line</td>
<td>Line Graph</td>
</tr>
<tr>
<td>Bar Graph</td>
<td>Scale</td>
</tr>
</tbody>
</table>

Materials:

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graph Paper</td>
</tr>
<tr>
<td>Rulers</td>
</tr>
<tr>
<td>Pencils</td>
</tr>
<tr>
<td>Erasers</td>
</tr>
</tbody>
</table>

Student Activity Sheets:

SAS 4.1 Graphing
Graphing

A. Grouping Data

1. Five pieces of metal are weighed and are listed in the order that they were measured: 20.0 g., 40.3 g., 30.7 g., 37.1 g., and 28.6 g.

2. Round off the weights to the nearest whole number and include them in the following table in order from lowest (no. 1) to highest (no. 5).

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

B. Constructing A Bar Graph

1. Using a 8 1/2 by 11 inch graph paper with the wholes across the front of you, count in 6 lines from the left margin and 6 lines from the bottom of the paper to locate the origin.

2. Draw the X (horizontal) axis and the Y (vertical) axis from this origin.

3. An easy way to scale your graph is to count the number of available spaces on each axis. If you try this with the X axis, you should get ___ spaces. Find the largest value that you will be graphing. Divide the largest value by the smaller. If the spaces were larger, drop the decimal and this is the value of each space. If the values were larger, then, round the answer off to a whole number and this is the value of each space. You have now constructed a scale that will correctly represent your data and use most of the available space.

4. Label the X axis by counting over 5 lines and labeling it 5 grams. Continue counting and labeling in this manner until the X axis is complete.
B. Constructing a Bar Graph (Continued)

5. Following a similar procedure, let's devise a scale for the Y axis. One unusual thing is that there are 39 spaces available and only 5 items to plot on the Y axis. How many spaces would you eliminate so that the number of items divides evenly into the number of spaces? 35 spaces would be a good answer since 35 / 5 = 7. Therefore, count up 7 lines from the origin and label it number 1. Continue counting and labeling in this manner until the Y axis is complete.

6. Plot the data, making the bars as wide as you wish (but making all bars equal in thickness).

C. Graphing Checklist

A properly constructed graph should include the following items which have been placed in checklist form so that they can be checked as you include each part.

1. ___ a descriptive title  
2. ___ zero point (origin)  
3. ___ x and y axis  
4. ___ each axis properly labeled.  
5. ___ uniformly spaced number on each axis (scaling)  
6. ___ accurately plotted points from the data.  
7. ___ completed lines or bars.
A GENERAL EXPLANATION OF ONE VARIABLE SCALED GRAPHING AND TWO VARIABLE SCALED GRAPHING

After reading through the program ONE VARIABLE and TWO VARIABLE, I came to the realization that, while the programs are rather straight-forward in their solution of the problem, the novice user may have some difficulty in understanding their logic. What follows is a discussion of the steps involved in the programs.

1. The first section of the program asks the user to enter the number of trials and will not let him continue until a number between 10 and 30, inclusive, is entered. The number of trials is assigned the variable name TR.

2. The computer is told to make room for TR number of trials via the DIMension statement (this is called creating a table). Then a loop (called in BASIC a FOR...NEXT loop) is set up to allow input of the results of the TR trials. In ONE VARIABLE only one numeric entry is required for each pass through the loop and those entries are stored in the D(n) table, where n is the number of the pass. In TWO VARIABLE two numeric entries are required and they are stored in two tables "Y(n) and Y(n)."

3. Now that the data has been entered into the computer, we must find the minimum and maximum values for the variables. We do this by setting the minimum and maximum equal to the first variable in our table. Then a loop is established to test each variable to see if it is less than the minimum. If it is less than the minimum, the minimum is lowered to the value of the variable. In a like manner the maximum is tested.

4. To draw the graph we must first turn on the graphics screen (HGR) and choose a color (HCOLOR = 3). Then we draw a box around the screen. It should be noted that the APPLE graphics screen does not confirm to Cartesian rules, i.e., the origin is in the UPPER left hand corner, not the lower left hand corner.

5. A loop is created to plot the points on the screen, but first each point must be scaled to fit on the screen. Since we drew a border around the screen we reduced our screen size from 280 x 160 to 278 x 158 with the upper left corner being 1,1 and the lower right corner being 278,158. The scaling formula is just a version of the two point form for finding the equation of a line.

\[
\frac{Y - Y_1}{Y_2 - Y_1} = \frac{(X - X_1)}{(X_2 - X_1)}
\]

where the values of X1 and X2 are the minimum and maximum values and Y1 and Y2 are the extreme values for the screen.
`PR00)

LIST

10 REM THIS PROGRAM ASKS FOR THE RESULTS OF BETWEEN 10 AND 30 TRIALS, THEN SCALES THE DATA FOR THE APPLE II GRAPHICS SCREEN

20 REM NOTE THAT THE APPLE GRAPHICS SCREEN IS 280 POINTS HORIZONTALLY (0 THRU 279) AND 160 POINTS VERTICALLY (0 THRU 159) WITH (0,0) BEING THE UPPER LEFT HAND CORNER

30 REM *** INPUT THE NUMBER OF TRIALS

40 HOME: REM CLEAR THE SCREEN

50 INPUT "NUMBER OF TRIALS (10-30) ", TR: REM ENTER THE NUMBER OF TRIALS TO BE USED

60 IF TR < 10 OR TR > 30 THEN PRINT "RANGE IS 10 THRU 30 ONLY!!!"; CHR$(7): GOTO 50: REM CHECK THE RANGE OF TRIALS. IF INCORRECT THEN BEEP AND REDO

70 REM *** INPUT TRIAL DATA

80 DIM D(TR): REM MAKE ROOM IN THE COMPUTER FOR THE RESULTS OF TR TRIALS

90 FOR I = 1 TO TR: REM ESTABLISH A LOOP TO ENTER THE DATA

100 PRINT "TRIAL ", I: REM PRINT PROMPT

110 INPUT D(I): REM INPUT THE RESULTS OF THE ITH TRIAL

120 NEXT I: REM CLOSE THE LOOP THAT WAS FORMED IN LINE 90

130 REM *** SCAN FOR MINIMUM AND MAXIMUM VALUES

140 MN = D(1): MX = D(1): REM INITIALIZED THE MINIMUM AND MAXIMUM VALUES TO THE FIRST DATA VALUE

150 FOR I = 1 TO TR: REM SET UP A LOOP

160 IF D(I) < MN THEN MN = D(I): REM IF THE DATA VALUE IS LESS THAN THE MINIMUM, THEN MAKE THE MINIMUM EQUAL THE DATA VALUE

170 IF D(I) > MX THEN MX = D(I): REM IF THE DATA VALUE IS GREATER THAN THE MAXIMUM, THEN MAKE THE MAXIMUM EQUAL THE DATA VALUE

180 NEXT I: REM CLOSE THE LOOP

190 REM *** DRAW THE GRAPH

200 HOME: HGR: HCOLOR = 3: REM CLEAR THE SCREEN, TURN ON THE GRAPHICS SCREEN, AND SET THE COLOR TO WHITE

210 HPLT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0,0: REM DRAW A BOX AROUND THE SCREEN


240 FOR I = 1 TO TR: REM SET UP ANOTHER LOOP

250 Y = 157 * (D(I) - MX) / (MN - MX) + 1: REM SCALING FORMULA FOR THE Y POSITION ON THE SCREEN

260 X = 270 * I / TR: REM SCALING FORMULA FOR THE X POSITION ON THE SCREEN

270 HPLT X,Y: REM PLOT THE POINT

280 NEXT I: REM CLOSE THE LOOP

290 VTAB 23: HTAB 1: PRINT "PRINTOUT OF THE POINTS (Y/N) ": GET X$: IF X$ = "N" OR X$ = "n" THEN 480

300 IF X$ = "Y" OR X$ = "y" THEN 320

310 PRINT CHR$(7): GOTO 290

320 PRN 1

330 PRINT: PRINT

340 PRINT "NUMBER VALUE"

350 PRINT

360 FOR I = 1 TO TR

370 PRINT SPC(3 - (I > 9)); I; SPC(7); D(I)

380 NEXT I

389 PRN 0

390 END`
ACH WITH TWO VARIABLES, AND THEN SCALES THE DATA FOR THE APPLE GRAPHICS SCREEN.

REM NOTE THAT THE APPLE GRAPHICS SCREEN IS 280 POINTS HORIZONTALLY (0 THRU 279) AND 160 POINTS VERTICALLY (0 THRU 159) WITH (0,0) BEING THE UPPER LEFT HAND CORNER.

REM *** INPUT THE NUMBER OF TRIALS
HOME; REM CLEAR THE SCREEN

INPUT "NUMBER OF TRIALS (10-30) "); TR: REM ENTER THE NUMBER OF TRIALS TO BE USED

IF TR < 10 OR TR > 30 THEN PRINT "RANGE IS 10 THRU 30 ONLY!!!"); CHRS(7): GOTO 50: REM CHECK THE RANGE OF TRIALS. IF INCORRECT THEN BEEP AND REDO

REM *** INPUT TRIAL DATA
DIM X(TR), Y(TR): REM MAKE ROOM IN THE COMPUTER FOR THE X,Y RESULTS OF TR TRIALS

PRINT: REM PRINT A BLANK LINE PRIOR TO INPUT
FOR I = 1 TO TR: REM ESTABLISH A LOOP TO ENTER THE DATA
PRINT "TRIAL "; I: REM PRINT X PROMPT
INPUT X(I): REM INPUT THE ITH X VALUE
PRINT "TRIAL "; I: REM PRINT Y PROMPT
INPUT Y(I): REM INPUT THE ITH Y VALUE
NEXT I: REM CLOSE THE LOOP THAT WAS FORMED IN LINE 90

REM *** SCAN FOR MINIMUM AND MAXIMUM VALUES
FOR I = 1 TO TR: REM SET UP A LOOP
IF X(I) < X1 THEN X1 = X(I): REM IF THE X VALUE IS LESS THAN THE X MINIMUM, THEN MAKE THE X MINIMUM EQUAL THE X VALUE
IF Y(I) < Y1 THEN Y1 = Y(I): REM IF THE Y VALUE IS LESS THAN THE Y MINIMUM, THEN MAKE THE Y MINIMUM EQUAL THE Y VALUE
IF X(I) > X2 THEN X2 = X(I): REM IF THE X VALUE IS GREATER THAN THE X MAXIMUM, THEN MAKE THE X MAXIMUM EQUAL THE X VALUE
IF Y(I) > Y2 THEN Y2 = Y(I): REM IF THE Y VALUE IS GREATER THAN THE Y MAXIMUM, THEN MAKE THE Y MAXIMUM EQUAL THE Y VALUE
NEXT I: REM CLOSE THE LOOP

REM *** DRAW THE GRAPH
HOME: HGR: HCOLOR = 3: REM CLEAR THE SCREEN, TURN ON THE GRAPHICS SCREEN, AND SET THE COLOR TO WHITE
HPLOT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0,0: REM DRAW A BOX AROUND THE SCREEN

FOR I = 1 TO TR: REM SET UP ANOTHER LOOP
X = 277 * (X(I) - X1) / (X2 - X1) + 1: REM SCALING FORMULA FOR X
Y = 157 * (Y(I) - Y2) / (Y1 - Y2) + 1: REM SCALING FORMULA FOR Y
HPLOT X,Y: REM PLOT THE POINT
NEXT I: REM CLOSE THE LOOP

REM *** SCANNER FOR PRINTOUT OF THE POINTS (Y/N) "; GET X$: IF X$ = "N" OR X$ = "n" THEN 460
IF X$ = "Y" OR X$ = "y" THEN 380
PRINT CHRS(7): GOTO 350
PRINT CHR$(7): GOTO 350
PRINT "NUMBER "; X$ VALU E; Y$ VALUE"
Activity 5 Intro Cards

Objectives:

Students will be able to:

1. organize random data.
2. define operationally the concepts interpolation and extrapolation.
3. explain the importance of organizing data as a scientific process.

Teacher Background:

Making the Intro Cards: You can choose any number of combinations of numbers (from the master card p.16 Intro Card). Using a master sheet, ditto off (copy) enough sets of cards for each group of students. You might choose to glue the sheets to cardboard for demonstration purposes (back of pad Fs work fine). Make sure you glue the whole sheet.

Then cut the squares and arrange them in columns (1-7) and rows. Color each column of numbers (1, 8, 15, 22, 29, 36) with a different color.

The extras are colored at random. Place the extras on their corresponding double and remove extra pieces.

Remove 2 or 3 numbers from the pile, shuffle the cards and put a rubber band around them.

Although alot of initial work, the cards last many years.

Materials:

one set of cards per set of students, master sheet for making cards.

Suggested Procedure:

1. Give each student or group a pack of cards and have them spread the cards out on the surface with the numbers facing up.

2. Have the students try to put the cards in some organized fashion (allow time for some work and some frustration).

3. When the students begin to organize them, begin to ask about duplicates and/or missing numbers.

4. Discuss with individual groups how they knew what colored number to keep or throw away.

5. Ask the color of several numbers that are beyond the range of cards.

Discussion:

Bring into your discussions the meaning of interpolation and extrapolation; the importance of organizing data in order to interpret information; the purpose of the data table; scientific methods; and everyday problem-solving.
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</table>
PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ________________________________ Module: Intro A 1 2 3 4 (circle one)

School ________________________________ Activity Title & Number ____________

Grade Level ____________________________

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH
ACTIVITY. Please comment in more detail on separate pages of paper where
appropriate. Circle the most appropriate response.

1. OBJECTIVES

Were the stated objectives clear and accurate? Excellent Good Poor

2. TEACHER BACKGROUND

Was the teacher background accurate? Excellent Good Poor

Was the information provided a sufficient background on the subject? Excellent Good Poor

3. MATERIALS

Was the materials list complete? Excellent Good Poor

Did you have enough of each material required? Excellent Good Poor

*Please indicate any resources, books (teacher or student), equipment, etc. that your recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

Were the Student Activity Sheets (SAS):

Relevant to the objectives? Excellent Good Poor

Clear and logical? Excellent Good Poor

*Which were the most successful activities?

5. EXTENDED ACTIVITIES

*Have newly acquired decision making skills lead to action on personal
problems? Involvement in community organizations? Involvement in
local government issues? Other?
6. **EVALUATION**

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?

7. **PROCEDURE**

Was the suggested procedure clear and complete? 

*Did you follow the suggested procedure? What modifications, if any, did you make?

8. **RATE THE FOLLOWING:** (circle one)

- Student interest: High, Medium, Low
- Appropriateness of material: High, Medium, Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ______________________ Date ______

Date when Activity was completed ________
The PITTS Project

MODULE 1

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

THE AUTO AND ENERGY

25
THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

MODULE I

THE AUTO AND ENERGY

developed by

John Sparvero, David Vause, Steve Schwab,
Sharon Lace, James Metzger, George O'Brien, and Will Korth

with the Inservice Workshop Participants

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh
THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

Supported by a Grant From
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Title Grant Number HO1-6139/33-6825

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Special Thanks To: Cindy Brown, graduate assistant, University of Pittsburgh and Tim Hunsberger, undergraduate assistant, University of Pittsburgh.

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# Module I

**The Auto and Energy**

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MODULE I

The Auto and Energy

COMPETENCIES

A. Processes

1. Observing
2. Classifying
4. Predicting
5. Measuring
6. Communicating
8. Defining Operationally
10. Experimenting
12. Interpreting Data
13. Formulating Models

ACTIVITIES

1. Naming the Energy Form
2. Energy Conversion Box
3. Heat Energy Converted to Mechanical Energy
3A. Heat converted to Mechanical Energy (Modified Procedure)
4. Energy Conversions
   a. Traditional Measurement
   b. Microcomputer Lab Interfacing Procedure

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Demonstrate how stored chemical energy can be converted to heat energy.
2. Describe how heat energy can be converted into mechanical energy.
3. Demonstrate how a steam turbine changes heat energy into mechanical energy.
4. Determine quantitatively an amount of heat energy and relate it to a corresponding amount of mechanical energy.
5. Relate graphically the change in the volume of water used in the turbine apparatus to the amount of mechanical energy it produces.
INSTRUCTIONAL OBJECTIVES (continued)

7. Infer through experimentation that chemical energy is converted to electrical energy in a dry cell.

8. Demonstrate experimentally how electrical energy can be converted to heat and light energy.

9. Construct a data table and graph the results.

10. Describe one form of energy being converted into another form.

11. Label an example of a conversion of one energy form to another.

*12. Construct a thermistor (microcomputer interface techniques).

*13. Calibrate a thermistor.

*14. Collect and interpret data using a microcomputer/thermistor lab interfacing technique.

*Optional objectives
ACTIVITY 1: Naming the Energy Form

Objectives: The student should be able to:

1. demonstrate how stored chemical energy can be converted to heat energy.
2. describe how heat energy can be converted into mechanical energy.

Teacher Background: Ask students when they last used energy. Do they have any idea how energy is used? Is energy heat, light, electricity, magnetism? What is energy anyway? (it is the ability to produce heat, light, or to do work). What has to happen before energy can be used to do work? (It often has to be changed into another form). What is energy? The first step in trying to define energy is to set up two categories. Energy in the form of motion, heat, or light is called KINETIC ENERGY. Energy that is stored in food, gasoline, and the nucleus of atoms and batteries is called POTENTIAL ENERGY. Kinetic is energy on the move. Potential energy is stored energy and it is in this form that we dig it from mines and pump it from wells. To use energy it must be in kinetic form.

We use energy because we want to do something to matter; move it, illuminate it, or warm it. We usually store energy in the potential form. A simple way to store energy is to lift something away from the earth (energy is stored when water is pumped to the top of a water tower, then converted to kinetic energy when it is allowed to run through pipes).

It is possible to convert a certain amount of mechanical energy to heat by, for instance, putting on the brakes of a car. It is possible to convert the chemical energy of coal into heat by burning it. These
conversions cannot go to completion in the other direction, only a limited amount of heat energy is convertible back to other forms. There are many forms of energy but before most energy can be used for work it first must be changed into mechanical energy.

Below are some brief descriptions of basic forms of energy.

Chemical Energy is released when matter changes chemically. When wood burns, it combines chemically with oxygen and gives off heat.

Mechanical Energy is produced by motion.

Electrical Energy is a flow of electrons. It can be changed into many other forms such as heat, light and sound.

Atomic Energy is released when atoms split or combine.

Heat Energy is released as the kinetic energy of the atomic particles increases.

Light Energy is a form of energy which travels by transverse waves (vibrate in all directions).

Sound Energy is produced when matter vibrates.

Student Activity Sheets: SAS 1.1 Naming the Energy Form
THE ENERGY STORY

A. You have all had science classes before this one. In all of those classes you studied energy. Please write as many forms that energy can appear on the lines below.

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  

B. Energy can be stored or used. If we have it stored away, it is called __________ energy. If we are using energy, it is called __________ energy. For each of the above energies, give an example where the stored (potential) energy is changed into moving (kinetic) energy.

1.  
2.  
3.  
4.  
5.  

C. In the following weeks, we will be studying the automobile. Give examples, using the automobile, of changes from potential energy to kinetic energy from the listed energies above.

1.  
2.  
3.  

33
4. In a car, chemical energy is changed to ______ and ______ energy when the gasoline burns. The mechanical energy is changed into ______ energy to light the ______, move the gauges, fire the ______, and recharge the battery. Mechanical energy is also transferred from the up and down motion of the pistons to the turning of the ______. When you push on the brake pedal, mechanical energy is transferred into ______ energy in the brakes. Many changes are taking place in a car when you run it.

Name three forms of energy that are stored when the car is parked in the garage and not running and tell where they are in the car.

<table>
<thead>
<tr>
<th>Energy</th>
<th>Where Stored</th>
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<tbody>
<tr>
<td>1.</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
</tr>
</tbody>
</table>

The person who first made a working automobile must have been both smart and good with their hands. They had to have a picture in their mind of what the engine would look like, how it would fit together and what it would do. This is called a MENTAL MODEL. A ______ is a picture, object or idea that helps us see the real thing even if it is too big or too small to hold easily.

Close your eyes and think of a car. What color is it? What make and model is it? How fast can it go? This is a ______ model.
The car is not really in your head. A map is a model of a section of the earth. List five models below and tell what each represents.

1. __________________________________________
2. __________________________________________
3. __________________________________________
4. __________________________________________
5. __________________________________________

In the car maker’s mind, he (or she) needed to know how big to make the engine and what parts to add to make the car go. List below as many engine parts or parts of a car that make it go.

________________________  ____________________________
________________________  ____________________________
________________________  ____________________________
________________________  ____________________________

The car maker had to know what the fuel (usually gasoline) does inside the engine. He (or she) had to calculate the amount of energy that the gas would release. Boy!! Was he smart.

Besides the size of the engine, what other factors (problems) do you think the car maker would have to consider in making a car?

1. __________________________________________
2. __________________________________________
3. __________________________________________
4. __________________________________________
5. __________________________________________
I.

SAS 1.1

List below some things that you would look for if you were buying a car.

1. ____________________________ 2. ____________________________
3. ____________________________ 4. ____________________________
5. ____________________________ 6. ____________________________

In the next experiment, we will see some of the data that might have been collected in order to figure out how big to make the engine.
ACTIVITY 2. Energy Conversion Box (Evaluation Sheet)

Objectives: The student should be able to:
1. describe one form of energy being converted into another form.
2. label an example of a conversion of one energy form to another.

Lesson Evaluation Activity: Distribute copies of the evaluation matrix (energy conversion box) to the class. Have students fill the blank spaces with examples of energy conversions. Use the responses as a form of evaluation. Challenge the students to fill in the blank blocks within a time limit, counting each correct answer 5 points. Winner would accumulate the highest number of points.

Teacher Background: Energy can be changed from one form to another. Various kinds of energy are often made available by chemical changes. Many times heat and light are given off when other substances combine with oxygen during burning. Physical changes can also produce energy. For example, heat is absorbed when a gas expands inside a pipe. In fact, this is the principle used in refrigeration. Man finds many ways to unleash energy. Electricity that travels for miles along wires can be changed into radio waves which transmit man's ideas. We can make a chemical reaction in an automobile battery provide the electricity for the car. Man can release the energy in fuels by burning and sending airplanes into flight. Coal can be used to turn water into steam and in turn use this steam to run trains and to generate electricity. He can use light energy to regulate the amount of electricity through the photoelectrical cell. Some energy comes from light, other energy from heat. Even sound is a form of energy. Mechanical energy is being used when man uses a stream or
river to turn a water-wheel. All these examples demonstrate that energy can be transformed from one form to another.

Great amounts of energy can be produced from the nucleus of an atom. The nuclei of certain atoms can produce much more energy than can be made by chemical means.
**Evaluation Sheet**

**Directions:** Write in each box examples of one form of energy being converted into another form. Begin with the vertical column on the left. Example: Heat is converted into light energy in a light bulb, so write “light bulb” in the box formed by the intersection of the two energy forms.

<table>
<thead>
<tr>
<th></th>
<th><strong>HEAT</strong></th>
<th><strong>LIGHT</strong></th>
<th><strong>SOUND</strong></th>
<th><strong>MECHANICAL</strong> (Movement)</th>
<th><strong>CHEMICAL</strong></th>
<th><strong>ELECTRIC</strong></th>
<th><strong>NUCLEAR</strong></th>
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<tbody>
<tr>
<td><strong>HEAT</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LIGHT</strong></td>
<td>light bulb</td>
<td>fire</td>
<td>explosions</td>
<td>steam turbine</td>
<td>disassociation of water or other molecules</td>
<td>thermionic effects</td>
<td>nuclear reactions in stars</td>
</tr>
<tr>
<td><strong>SOUND</strong></td>
<td>infra red absorption</td>
<td>sound converted to modification of laser beam</td>
<td>light pressure photoelectric effect</td>
<td>photosynthesis other photo-chemical reactions</td>
<td>solar cell, other photovoltaic effects</td>
<td>microphones, telephones</td>
<td></td>
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<tr>
<td><strong>MECHANICAL</strong> (Movement)</td>
<td>sound eventually dissipates as heat</td>
<td>sound</td>
<td>mechanical motion of molecules</td>
<td>sound</td>
<td>electric generator</td>
<td>cyclotron &amp; other high energy machines</td>
<td></td>
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<tr>
<td><strong>CHEMICAL</strong></td>
<td>rubbing hands, friction in general</td>
<td>non-electrical sparks</td>
<td>vocal cords, musical instruments</td>
<td></td>
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<tr>
<td><strong>ELECTRIC</strong></td>
<td>gas furnaces, fuels in general</td>
<td>fuel burning, fire-fly phosphorescence</td>
<td>firecrackers, other explosives</td>
<td>fuel</td>
<td>cell</td>
<td>battery</td>
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<tr>
<td><strong>NUCLEAR</strong></td>
<td>nuclear reactor, fusion reaction</td>
<td>nuclear bomb</td>
<td>nuclear bomb</td>
<td></td>
<td>nuclear batteries</td>
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39  40
Directions: Write in each box examples of one form of energy being converted into another form. Begin with the vertical column on the left. Example: Heat is converted into light energy in a light bulb, so write "light bulb" in the box formed by the intersection of the two energy forms.

<table>
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<th>SOUND</th>
<th>MECHANICAL (Movement)</th>
<th>CHEMICAL</th>
<th>ELECTRIC</th>
<th>NUCLEAR</th>
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ACTIVITY 3  Heat Energy Converted to Mechanical Energy

Objectives: The students should be able to:

1) demonstrate how a steam turbine changes heat energy into mechanical energy.
2) determine quantitatively an amount of heat energy and to relate it to a corresponding amount of mechanical energy.
3) relate graphically the change in the volume of water used in the turbine apparatus to the amount of mechanical energy it produces.

Teacher Background: Moving people and materials from one-place to another has always been a problem. Many different kinds of transportation have been used. Before this century, most transportation was accomplished by walking, by animal power, or by boat. Now most people walk less than ever before. Today machines move us and our merchandise faster and easier than did the older methods.

However, to support these transportation systems requires a large expenditure of energy. Most of this energy comes from the burning of fossil fuels. The rate at which these fuels are being used today is staggering. This presents somewhat of a problem since fossil fuels are considered to be limited. That is to say that there is only a certain amount in nature and when that is exhausted it will take millions of years for new ones to be formed.

The automobile accounts for about 20 percent of all the energy used in the United States. Thus using the automobile as our primary means of transportation compounds the problem of energy consumption for
several reasons. First of all, the automobile is quite limited in the number of passengers or the amount of cargo it can transport. Secondly, the internal combustion engine used in most automobiles is not very efficient. In scientific terms efficiency can be expressed as:

\[
\text{WORK OUT} \quad 100\% \quad \text{For the average automobile, this figure is about 27\%.}
\]

The low efficiency factor for the internal combustion engine is due to a number of reasons. In general, every time energy is converted from one form to another, energy is usually given up to the environment in some non-useable form. In the automobile, many of these energy conversions take place. For example, the potential energy (chemical) of the gasoline is changed to heat energy from combustion within the cylinders which in turn is converted to mechanical energy. Now the mechanical energy is used to do many different things, some of which involve even further energy charges. For example, some of this mechanical energy is transferred through the drive train to move the car. It is also used to turn the generator to produce electricity. Some is even used to cool the engine (wasted heat) by turning the fan and water pump. At each of these steps along the way, some energy is given up to the environment as heat and cannot be captured and used again.

In this activity the student will observe a similar conversion of energy as it could occur in an electric power plant. Whether nuclear or coal-fired, such a plant is designed to employ a heat source to convert water to steam in order to drive the blades of a turbine and in turn, to produce (induce) an electric current (perhaps the topic of a future discussion or demonstration). By making a few simple
measurements and by using two basic formulas of calorimetry, the student in this activity is able to calculate a total of heat energy in calories transferred from the burning fuel in the alcohol lamp to the water in the test tube. This total heat energy can then be related to an important variable in the conversion to mechanical energy, the revolutions per minute (RPM's) of the pinwheel. The amount of mechanical energy generated is, of course, directly proportional to the RPM's.

One important assumption has been made in the data for the lab. Since its design and operation does not permit a determination of the temperature of the boiling water in the test tube, this temperature has been assumed to be 97°C as a general approximation for most days in Pittsburgh. If you can determine a better value for the day of this activity, feel free to substitute it into the students' data.

The student completes the interpretation of the activity by preparing a bar graph showing the RPM's of the pinwheel as a function of the volume of water in the test tube (really a pressure/volume relationship for the steam generated in the tube). In any case, it should show a general decrease in RPM's as the volume of water in the tube decreases. The data used for the graph is compiled from the individual result of each team of students performing one trial of the experiment over the course of the period.

Instructions are provided for preparing the aluminum pinwheels to be used in the activity. To save time, several students may agree to help to cut out and to prepare these pinwheels in advance of the lab. Needed to make the pinwheels would be the 5"-square piece of aluminum,
a pair of scissors, a ruler, and the pinwheel template.

Cut out the template and place it on top of the piece of aluminum (or pie pan). Cut along the edge of the circle and produce the large circle. Keeping the template on the aluminum circle, cut the 8 lines into the smaller circle. Then cut along the inner circle at the darkened line (approximately 1/2 inch). Put a small hole through the center spot. Now place a ruler at the end of the 1/2 inch cuts, across the center of the aluminum (where the small hole is), and line the ruler up with the 1/2 inch cut on the other side. The ruler should extend over both edges of the circle. Draw a line along the ruler. This will give you a guide for bending the fins on the wheel. Do this with the other fins.
A diagram of the assembled apparatus is shown in SAS3.1. The suggested distances in centimeters shown on the diagram were determined using the typical alcohol lamp found in most labs and were included to facilitate the set-up of the apparatus and to maximize its performance. However, if you should be using bunsen burners or a different style of lamp, you may need to modify these distances. Try to keep the same basic positions for each part of the apparatus when making any such changes.

**Materials**

- Ring stand
- 50.0 ml graduated cylinder
- Ruler
- Test tube clamps
- Thermometer (°C)
- Marking pen
- 200 x 5 mm test tube
- 1/32" aluminum sheet (5" sq.)
- Graph paper
- Alcohol lamp
- Unsharpened pencil
- Thumb tack
- #4 one-hole stopper
- Styrofoam cup
- Stop watch/wrist watch with sweep hand (one per team)
- Glass tip from medicine dropper

**Student Activity Sheets**


b) SAS 3.2 Student Data and Calculation Sheet.
Procedure for Converting Heat Energy to Mechanical Energy

1. Your teacher will indicate the volume of water that you are to use in your experiment (30, 40, or 50 ml.). Write your volume in the blank called "Initial Volume of Water" (V₁) on your data sheet.

2. Using your graduated cylinder, measure out this volume of water and put it in your test tube.

3. Measure the temperature of this water in your test tube with your Celsius thermometer. Place this temperature measurement in the blank called "Initial Temperature of the Water" (T₁) on your data sheet.

4. Set up the apparatus shown in the diagram below:

   - Notice that the blades of the pinwheel should almost touch and be level with the end of the tip of the medicine dropper, allowing only enough clearance for the pinwheel to spin freely. (This is usually a distance of 7 cm. between the thumb tack and end of the dropper.)
5. using a marking pen, make an "X" on any one blade of your pinwheel.

6. Light your lamp and begin to heat the water in your test tube. After a few minutes, the steam produced in the test tube will make the pinwheel begin to move.

7. Once the pinwheel is moving at a steady rate, begin to time your pinwheel and count the "revolutions" (complete turns) that the pinwheel makes, using the "X" on the blade as a reference as it passes in front of you.

8. Count the revolutions as described and get a total for each minute of timing over a three-minute period. Enter your results for "revolutions per minute" (RPM's) in the blank for each of the minutes on your data sheet.

9. Blow-out your flame. While your water and tube are cooling, figure out an average value for your three results for "RPM's" on your data sheet. You will give your teacher this result when requested along with the rest of the lab teams as part of your class data.

10. When your tube is cool, pour the water as completely as possible into your graduated cylinder. Measure the volume, and put your measurement in the blank on the data table called "Final Volume of Water after Heating" (Vf) on your data sheet.

11. Subtract the two volumes in Section 1 on your data sheet to get the differences, V5, which is the "Volume of Water Changed to Steam" in your activity.

12. Subtract the two temperatures in Section 2 on your data sheet to get the differences called ∆T, the "Change in Temperature of the Water" in your activity.

13. Take your apparatus apart, and check to be sure that you have put all of your measurements on your data sheet. Your teacher will instruct you about the rest of the questions, the problems, and the graph you will do to complete the activity.
I. STUDENT DATA AND CALCULATION SHEET

A. Individual Data:

1. Your initial volume of water in your test tube ($V_I$) = ______ ml.
   Your final volume of water after heating ($V_F$) = ______ ml.
   Volume of water converted to steam ($V_S$) = $V_I - V_F$ = ______ ml.
2. Temperature of boiling water during heating ($T_F$) = ______ ml.
   Temperature of water in test tube at the beginning ($T_I$) = _____ °C
   Change in temperature ($\Delta T$) = ______ °C
3. Revolutions of the Pinwheel

<table>
<thead>
<tr>
<th>Minutes</th>
<th>Number of Revolutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td></td>
</tr>
<tr>
<td>2nd</td>
<td></td>
</tr>
<tr>
<td>3rd</td>
<td></td>
</tr>
</tbody>
</table>

b) Add your results for three minutes and divided by "3" to find your average.

Average = \frac{(total)}{3} = ______ rpm (revolutions per min.)

4. What kind of energy is in the alcohol lamp? _______________
   What kind(s) of energy is the energy in the alcohol lamp being converted to?
   _______________

What change in the water occurs as a result of this conversion of energy?

__50__
***** #5 - #8 are optional or for teacher explanation.

5. Some of the energy change in water causes the water to get hot. It can be found by .

\[ \text{Heat}_1 = (1.0 \text{ cal./ml} \cdot ^\circ \text{C}) \times (\Delta T) \ \circ \text{C} \times (V_1) \ \text{ml}. \]

\[ \Delta T = \text{Change the temperature}. \]

\( (V_1) \ \text{ml} = \text{The volume you started with}. \)

a) Put your results in the blanks and multiply:

\[ \text{Heat}_1 = (1.0 \text{ cal./ml} \cdot ^\circ \text{C}) \times \_\_\_\_ \ ^\circ \text{C} \times \_\_\_\_ \ \text{ml} = \_\_\_\_ \text{cal}. \]

6. The rest of the energy change in the water causes some of the water to boil. It can be found by .

\[ \text{Heat}_2 = (540 \text{ cal./ml}) \times (V_s) \]

\( V_s = \text{Your volume of water converted to steam}. \)

a) Put your result for \( V_s \) in the blank and multiply

\[ \text{Heat}_2 = (540 \text{ cal./ml}) \times \_\_\_\_ \ \text{ml} = \_\_\_\_ \text{cal}. \]

7. The total energy changes in the water = \( \text{Heat}_1 + \text{Heat}_2 \)

a) Put in your results for \( \text{Heat}_1 \) and \( \text{Heat}_2 \) and add

\[ \text{Total energy of water} = \_\_\_\_ \text{cal} + \_\_\_\_ \text{cal} = \_\_\_\_ \text{cal}. \quad \text{(answer #5a)} \]

\[ \text{(answer #6a)} \]

8. It is this total energy of water which causes the pinwheel to spin.

a) Into what form of energy is the heat energy from the boiling water being converted as the pinwheel spins? 

b) The relationship between the conversion of the energy in the water to the energy in the pinwheel is found by .

\[ \text{Energy conversion} = \frac{\text{Total energy of water}}{\_\_\_\_ \text{rpm}} \quad \text{(answer #7)} \]

\[ \text{Average revolutions per minute} \quad \text{(answer #3b)} \]

b) Put in your answers and divide:

\[ \text{Energy conversion} = \_\_\_\_ \text{cal} \div \_\_\_\_ \text{rpm} = \_\_\_\_ \text{cal/rpm} \]
B. Class Data

Do this: Copy from the board the total data from All Teams, then average each group findings in the chart below.

<table>
<thead>
<tr>
<th>Teams</th>
<th>A (30 ml)</th>
<th>B (40 ml)</th>
<th>C (50 ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Calculate Average RPM for Each Group Here...

C. Make Bar Graph from the class averages.

I. Refer to your graph technique checklist.

II. Copy from the blackboard the appropriate titles and numerical scale for completing your graph.
C. Teacher's Graph (Students will copy from)

Title: Pinwheel Turns (RPM) as Related to Volumes of Water

<table>
<thead>
<tr>
<th>RPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
</tr>
<tr>
<td>24</td>
</tr>
<tr>
<td>14</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boilers</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>50</td>
</tr>
</tbody>
</table>

Volumes of Water in Test Tubes (ml)

D. Homework Questions

Using the finished graphs students will complete these questions:

1. What volume of water resulted in the least RPM? __________

2. What boiler would you want to run your pinwheel? _______.
   Explain why.

3. Does all the energy from the burning lamp go to heat the water? ________

4. Does all the energy in the steam go to turn the pinwheel? ______

5. If not, explain where the rest of the energy goes in question (3).
   question (4).
6. Can you think of any way we could improve on the method of measuring energy conversion? 
______, Explain your answer!

7. To what practical application could this steam engine be put?

8. Name the unit of measurement that is used to express the amount of heat in this activity? 
______

9. Do you know the name of other units for measuring energy? 
______. Try to list some. ________________

10. After having done this activity, describe energy?
Activity 3A Heat Energy Converted To
Mechanical Energy (Modified Procedure)

Materials:
2 ring stands, 2 buret clamps, 1 large test tube, 1 one hole stopper to fit test tube, 1 micropipette, 1 each-large (2.5" in diameter) and small styrofoam balls, 6 or 8 plastic spoons, 1 wire coat hanger, 2 glass droppers, thread, paperclips, bunsen burner or good source of heat, 1 small stopper.

Procedures:
1. Fill a large test tube with about 50 ml of water.
2. Place a piece of glass tubing that has been heated and drawn to a fine opening into a one-hole stopper. Place the stopper into the test tube. This is a steam generator.
3. Straighten a wire coat hanger and cut a 30 cm length. Push the hanger through the center of the large styrofoam ball.
4. Remove it from the ball and bend it into a U shape with the bottom of the U wider than the ball.
5. Into the holes made by the hanger, place two glass droppers that have the rubber squeezer removed. Put them in tip first until they are wedged firmly.
6. Cut 6-8 plastic spoons so that only 1" of each handle remains.
7. Insert the cut end of each spoon into the large styrofoam ball. The spoons should all face in the same direction and be evenly distributed around the circumference of the ball. (The spoons will act as turbine blades.) (See diagram on page 26.)
8. Bend the ends of the hanger at the top of the U about 1 cm toward the U. These should fit into the droppers that were inserted into the ball. The ball should now rotate smoothly while you hold the hanger.
9. The hanger can now be clamped to the ring stand by placing a small stopper and the bottom part of the U of the hanger into the buret clamp.
10. Tie one end of a long thread to a paper clip and the other end tightly to one of the eye dropper tubes.
11. Boil the water in the test tube using a burner and direct the jet of steam into the bowls of the spoons in order to spin the turbine.
12. As the turbine spins the paper clip(s) should be lifted.
Questions For Discussion:

1. How does water move a paper clip?

2. How could you redesign your apparatus to be more efficient?

3. How does gasoline move a car?

4. What other types of jobs could a steam turbine do?

5. Why aren't turbine engines used in automobiles?

6. What is meant by energy conversion?

7. How could water help produce electricity?

8. Why do some paper clips move faster than others?

Some Pre/Post Questions:

Pre/Post Test

Fuel is a kind of _______ energy
a) mechanical
b) chemical
c) gravitational

The fuel ________ and produces _________
 a) burns, heat
 b) decomposes, water
 c) distintigrates, air

Water ________ and produces _________
 a) condenses, ice
 b) evaporates, air
 c) boils, steam

The turning ball is a kind of _________ energy
a) chemical
b) potential
c) mechanical

This machine is called a _____________
 a) magnetic wheel
 b) steam turbine
 c) gasoline engine

In this experiment ____________ energy is changed to ________ energy
 a) light, electrical
 b) chemical, mechanical
 c) heat, light
Some Pre/Post Questions:

Pre/Post Test, Continued

Classifying forms of energy:

a) turning turbine  
   f) burning fuel  

b) flame  
   g) methane gas (in burner)  

c) brazil nut  
   h) lifting paper clip  

d) hot plate  
   i) alcohol  

e) winding string  

Put letter by correct energy form

Chemical energy

Heat energy

Mechanical energy

Use terms to complete sentences:

Heat  
Steam turbine  

Steam  
Fuel  

Mechanical energy

A machine called a __________________________ is often used to produce large amounts of electricity.

______________________ is burned to produce ____________________.

Water is changed to ____________________.

The 'blades' of the turbine turn producing ____________________, which can be used to move objects.
Activity 4: Energy Conversions

Objectives: Students should be able to:

1) construct simple circuits.
2) infer through experimentatin that chemical energy is converted to electrical energy in a dry cell.
3) demonstrate experimentally how electrical energy can be converted to heat and light energy.
4) construct a data table and graph the results.

Materials:
2-1.5V dry cells, copper connecting wire, Nichrome wire (2 inches), Styrofoam cups (two sizes), thermometer or thermistor, ceramic light socket, light bulb, knife switch, 1 ring stand, test tube clamp with one hole stopper for thermometer tape to secure cups.

Procedures:
1. Using the copper wire connect the cells in series. To connect in series, see Figure 1.

   **Figure 1**
   ![Copper Wire Connection Diagram]

   **IMPORTANT**
   When connecting cells in series, always connect opposite terminals.

2. Construct a circuit using two cells in series and the light bulb in the ceramic base, and the knife switch. See Figure 2.

   **Figure 2**
   ![Circuit Diagram]
3. Cover the light bulb with a 6 oz. Styrofoam cup containing a thermometer or thermistor. See Figure 3.

Figure 3

4. Complete the data chart.

<table>
<thead>
<tr>
<th>Time (sec)</th>
<th>Temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td></td>
</tr>
<tr>
<td>105</td>
<td></td>
</tr>
<tr>
<td>120</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
</tr>
</tbody>
</table>
5. Open the knife switch and remove the light bulb from the socket. Place a piece of Nichrome wire across the socket and attach to the terminals. See Figure 4

![Figure 4](image)

6. Cover the Nichrome wire/socket arrangement with the previously prepared cup and thermometer/thermistor.

7. Complete the correctly titled data sheet.

8. Open the knife switch and replace the 6 oz. cup with a smaller cup. Repeat data collection and recording.

Calculations

Graph the data using temperature on the vertical axis and time on the horizontal axis. Place all three sets of data on the same pair of axes. Be sure to use the graphing checklist when constructing your graph.

OVERALL PICTURE OF SET-UP

![Diagram of the setup](image)
Factors effecting heat build-up under styrofoam cups

- One large cup
- Two large cups
- One small cup
- Two large dark-lined

Temperature (°C) vs. Time in Seconds
Interfacing with the Thermistor:

TO THE INSTRUCTOR:

Constructing a thermistor may appear to be a difficult activity for 9th graders, please be advised of the following suggestions.

1. Construct and calibrate a thermistor on your own (15 to 20 minutes)
2. Under take the activity in a slow, sequential manner.
3. Increase students self esteem by liberal use of positive reinforcement and one on one interaction.
4. You will find, that your thermistor has the following use:
   a) Weather report, indoor and outdoors
   b) Students temperature, arm, fingertips, armpits, nostral breathing.
   c) Text book use (Merrill General Science, Activity pages 62, 147, 237, 238, 362, 562, and 569.)
Questions

Complete the following questions based on your knowledge of energy conversions.

1. The battery contains _________________ energy.

2. The battery converts ____________ energy to ______________ energy.

3. The light bulb converts ____________ energy to ____________ and ______________ energy.

4. The Nichrome wire converts ____________ energy to ____________ energy.

5. Which experiment produced the most heat as measured by the change in temperature?

6. Which experiment produced the least heat as measured by the change in temperature?

7. Why does the Nichrome wire produce more heat than the light bulb?

8. Why does the temperature increase more with the smaller cup than with the larger cup?

9. Optional - Design an experiment using the same materials that would test a different variable.

10. Optional - Actually run the experiment that you have designed in question #9, setting up your own data chart and graph.
"MAKING A THERMISTOR"

Microcomputer Lab Interface

Objectives: Students should be able to:

1. Construct a thermistor
2. Calibrate a thermistor
3. Collect data using a microcomputer/thermistor interface.

Materials:

- Heat-shrink tubing 12 cm (5/16"), 4 cm (1/8")
- Intercom wire (Z wire)
- Seraphim program - lab module for teacher (directions for making the thermistor probe)
- Wire stripper
- Flax core solder
- Bunsen burners
- Hot plate
- Dropper
- Thermistor 0-100°C

Procedure:

1. Measure to obtain 1.6m intercom wire.
2. Strip 10 cm off each end of the wire (casing).
3. On the exposed wire (black & white) strip off 3 cm.
4. Place 12 cm of 5/16" heat shrink tubing on the intercom wire casing.
5. Place 4 cm of 1/8" heat shrink on the black wire and 4 cm of 1/8" heat shrink on the wire.

Figure 1

b) Loop the bare copper wire from the black and white wire - See Figure 1.

---

\[ \text{heat shrink tubing} \]
\[ \text{heat shrink} \]
\[ \text{intercom wire} \]
\[ \text{exposed wire} \]

\[ \text{black wire} \]
\[ \text{white wire} \]
7) Obtain a thermistor.

CAUTION
1) The thermistor is very fragile.
2) Do not twist the wire near the glass.

8) Hold the thermistor wires at approximately the midpoint, loop the free ends of each thermistor wire (see below).

9) Interloop the 2 loops of the thermistor with the loops of the black and white wire. Pitch the 2 pairs of wires together securely.

10) Carefully pull the 1/8" heat shrink tubing over the connections to the glass part of the thermistor.

CAUTION: When the heat shrink tubing is pulled up be sure that exposed wires do not touch each other.

11) Obtain an alcohol burner

12) Hold the thermistor by the glass. Place the 1/8" heat shrink wire over the burner and shrink the wire.
13) After cooling, pull the 5/16" heat shrink wire over the 1/8" heat shrink wire until you come in contact with the glass part of the thermistor.

14) Place over burners and heat shrink. Caution: Be sure to hold the thermistor by the glass (your fingers will serve as a heat sink to protect the thermistor).

15) Obtain 3/8" diameter heat shrink tube, 7.5 cm long.

16) Place the tubing over the intercome wire.

17) Obtain a sealed dropper and place it over the thermistor.

18) Pull the tubing over the base of the dropper and seal by heat shrinking.

CALIBRATING THE THERMISTOR

It is necessary for the thermistor to be carefully calibrated to establish range, precision, and accuracy.

This simple exercise represents a good illustration of the basic aspects of modern instrument calibration.

Materials:

Thermistor
2 - 250 ml beakers
Hg thermometer
heat source
H2O
ice

Procedure

1. Place 150 ml of water in 1 beaker with ice.

2. Place 200 ml of water in the other beaker and place on heat source. Heat to 80°C.

3. While water is heating and cooling, load #1203 seraphin diskette into the microcomputer, following your teacher's instructions.

Available Computer Enrichment Materials

Software that supplement the four units are available for preview at the University of Pittsburgh Regional Computer Center, 1N10 Forbes Quad. Programs there can be viewed by any teacher. A brief recommended list of such software follows:

   a. Improves student note taking and observational skills.
   b. Helps students analyze and interpret data.
   c. Helps students formulate hypotheses from data selected.
   d. Aids students in testing hypotheses.
   e. Helps students in testing outcomes.

2. "Volcanoes, Blue Book"
   a. Helps students keep records.
   b. Aids students in interpretation of scientific observations.
   c. Helps students understand maps.
   d. Introduces students to Cartesian Coordinates.
   e. Aids students in the interpretation of histograms.

3. "Making Circuits"
   a. Helps students construct both series and parallel electrical circuits.
   b. Uses students to measure, predict, and infer outcomes.
   c. Directs students to conduct simple experiments.
   d. Helps students arrange objects in sequences.

4. "Energy Search"
   a. Helps students stimulate problem solving using various forms of power such as animals, wood, oil, nuclear and solar power. Students are made to solve energy problems.
   b. Introduces to students both independent and dependent variables, helps students answer questions about energy, and helps students infer by grouping.

5. "Relevant Reading Through Science"
   a. Reading paragraphs are presented that have various reading levels - level III, written for grades 5 and 6 and level IV written for grades 7 and 8. The questions that follow the readings are based upon various kinds of comprehension skills.

6. "The voyage of the MIMI," Bank Street Laboratory
   a. Helps students measure, compare, calibrate, and graph temperature, light, sound, loudness, frequency, etc.
   b. Directs students to interpret a sound scope where one and two waves are magnified.
   c. Provides students with experiments in timers, autometers, speed of sound and the use of speakers.
7. "HRM Experiments in Chemistry"
   a. Introduces to students measurement of cooling curves, specific heat of metal, freezing point depression, heat neutralization, along with other basic measurements.

8. "Project Seraphim"
   a. Directs the students to make, calibrate and use of Thermistor Probes.
   b. Helps students make and use pH Probes.
   c. Helps students construct and learn to use a Blocktronics in the measurement of light intensity.
PITTSBURGH,STS PROJECT

TEACHER EVALUATION FORM

Name ___________________________ Module: Intro A 1 2 3 4
School ___________________________ (circle one)
Grade Level ___________________________ Activity Title & Number _____

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES
   Were the stated objectives clear and accurate? Excellent Good Poor

2. TEACHER BACKGROUND
   Was the teacher background accurate? Excellent Good Poor
   Was the information provided a sufficient background on the subject? Excellent Good Poor

3. MATERIALS
   Was the materials list complete? Excellent Good Poor
   Did you have enough of each material required? Excellent Good Poor
   *Please indicate any resources, books (teacher or student), equipment, etc. that you recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS
   Were the Student Activity Sheets (SAS):
   Relevant to the objectives? Excellent Good Poor
   Clear and logical? Excellent Good Poor
   *Which were the most successful activities?

5. EXTENDED ACTIVITIES
   *Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?
6. **EVALUATION**

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?*

7. **PROCEDURE**

Was the suggested procedure clear and complete? ___________ Excellent  ___________ Good  ___________ Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?*

8. **RATE THE FOLLOWING:** (circle one)

Student interest ___________ High  ___________ Medium  ___________ Low

Appropriateness of material ___________ High  ___________ Medium  ___________ Low for students

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ________________________ Date ________

Date when Activity was completed ________
The PITTS Project

MODULE II

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

SELECTING YOUR DREAM CAR
THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

MODULE II

SELECTING YOUR DREAM CAR

developed by

Steve Schwab, Sharon Lace, James Metzger
John Sparvero, David Vause, George O'Brien, and Will Korth

with the Inservice Workshop Participants

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh
THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Rosemary Nulton
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Sister Camille Panich
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Jack Salsi
Edward Schwilm
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Bret Thomas
Zoe Workman

Taylor Allderdice High School
Taylor Allderdice High School
Taylor Allderdice High School
Creative and Performing Arts High School
Carrick High School
Brashear High School
Peabody High School
Schenley High School
Perry High School
Taylor Allderdice High School
Oliver High School
Brashear High School
Wilkinsburg High School
St. Paul Cathedral High School
Wilkinsburg High School
Peabody High School
North Catholic High School
Vincentian High School
Vincentian High School
Peabody High School
Taylor Allderdice High School
Carrick High School
North Catholic High School
Letsche High School

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Module II

Selecting Your Dream Car

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TEACHER EVALUATION FORM
MODULE II

Selecting Your Dream Car

COMPETENCIES

A. Processes
   1. Observing
   2. Classifying
   3. Inferring
   5. Measuring
   6. Communicating
   9. Formulating Hypotheses
   8. Defining Operationally
   12. Interpreting Data
   13. Formulating Models

ACTIVITIES

1. Getting There
2. Selecting a Dream Car
3. Hidden Costs and Cost Per Month
4. Hidden Persuasion

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Label a diagram of an automobile (exterior and interior).
2. Choose options for the dream car.
3. Select her/his dream car.
4. Read a data table (finance charges).
5. Realize hidden costs that she/he will have to pay.
6. Get an indication of monthly costs and unexpected costs of a car.
7. Identify different methods used in advertising.
8. Analyze advertisements in terms of valid information presented.
ACTIVITY 1 - Getting There

Objectives: The student should be able to:
1. Label an automobile (exterior and interior)
2. Begin to choose options for the dream car.

Teacher Background: This activity is designed to familiarize the students with the terminology on the option sheets for Activity 2. Have students bring in pictures of American cars (from magazines, newspapers, etc.) showing both interior and exterior views before class day. During the activity, teachers should circulate around the classroom making sure the students are familiar with terms including rear defroster, cruise control, power steering, and lighting packages.

According to the automobile code, front running lights (outside turn signals) are amber and the rear lights are red.

Materials:
Pictures of cars (inside and out)

Student Activity Sheets:
SAS 1.1 Exterior drawing of the car
SAS 1.2 Interior drawing of the car

Procedure:
1. Pass out pictures of automobiles and parts.
2. Pass out blank student activity sheets.
3. Have students identify and label the blanks, indicate by "*" which are options to be chosen by the buyer.

Extra Activities or Homework
1. SAS 1.3 Scrambled letter sheet - My Dream Car
2. For alternate activity, have the students number the rows and
columns of the scrambled letter sheet. (They can be numbered or letters - your choice).

3. Locate the word, circle the word, list the coordinates of the first letter of the word, and indicate the direction that the word is written in terms of compass headings (N, S, E, W, NW, NE, etc.).
II. CAR INTERIOR

1. What is the function of each of the following part of the dashboard?

1. speedometer 8. radio
2. voltage gauge 9. temperature gauge
3. turn signal indicator 10. glove box
4. odometer 11. horn
5. seat belt light 12. gas gauge
6. wipers 13. radio
7. brake light 14. light switch

2. Place each item listed above on the dashboard below, in the place where you usually see it.

3. Place additional features that you may have seen or know of that are not listed.
II.

MY DREAM CAR

UKYSNOTSIPBSTEKCKBUS
RZRPPOOAGAUNLEADEDROOOF
ETVTEILZHAFIBERGLASSW
ETTTLTSDEIHSNWOFOGGR
LYTBIFCARPOOLBRAKESR
LICAINNLALIGNMENTSGUKT
FIBTIGIACARBURETORYT
LYALEECLOURTGRPOINTSB
WNVLFOIAFLUAXMTVA
HOFNNMENESULDORZVE
ETFOMKFDXYFJRFPIGVLM
EHUCSRAHESALTERNATOR
LAMHORAKDNTGRTFGDLGV
GLASTURKTFSHAIRFROSQ
GFTBSREPMUBEBMBUIIOS
TTEGRDFSEVLAVRIFSNDLR
RCONSOL_EQATYTLMCKFL
NOISSIMSNAARTRADATOR
GPDALTVNGZSIWWUGWSD

WORD LIST

ALIGNMENT
AUTOMATIC
BRAKES
BUMPER
CARBURETOR
CONDENSER
CONVERTIBLE
DEFROSTER
DOOR
FIBERGLASS
FLYWHEEL
HOOD
LIGHTS
MUFFLER
PLUGS
RADIALS
RIMS
STANDARD
TRUNK
VALVES

ALTERNATOR
BATTERY
BUCKETS
CAMSHAFT
CARPOOL
CONSOLE
CRANKSHAFT
DIFFERENTIAL
EXHAUST
FILTER
GRILL
IGNITION
MOLDINGS
PISTONS
POINTS
RADIATOR
ROOF
TRANSMISSION
UNLEADED
WINDSHIELD
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ACTIVITY 2. Selecting a Dream Car

Objectives: The student will choose their own dream car.

Teacher Background: Discuss with the students cars they have seen, cars their parents drive or cars they drive. Have pictures of various cars around the room and available to pass around. Discuss what car they would like to have and play "What if...".

Materials: Pictures of cars and parts.

Student Activity Sheets:
SAS 2.1 Dream Car (options)

Suggested Procedures:
1. Pass out pictures of cars, parts, etc.
2. Pass out dream car option sheet (See SAS 2.1).
3. Have students "pick" their cars, options and accessories and check the options they want.
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<td>Power Seats</td>
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<td>Sports Package (suspension &amp; steering)</td>
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ACTIVITY 3. Hidden Costs and Cost Per Month

Objectives: The student should be able to:
1. Read a data table (finance charges).
2. Realize hidden costs they will have to pay.
3. Get an indication of monthly costs and unexpected costs of a car.

Teacher Background: Using the Dream Car option sheet the students will get a total cost for their car, determine their finance charge, charges for other costs, and monthly charges. With further discussion, salary and types of job needed to afford the car might be determined.

Student Activity Sheets:
SAS 3.1 Retail Price Sheet
SAS 3.2 Finance Charge 9.9% - 48 months
SAS 3.3 Hidden Cost Sheets
SAS 3.4 Dream Car - Option Costs
SAS 3.5 Questions

Suggested Activities:
1. Role playing the scenario of a car theft (see Question #11 of SAS 3.5).
## RETAIL PRICE SHEET

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|                |     |               | 87  |
## II. Finance Charges ($)

### 19.9% for 48 months

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<td>33571.20</td>
<td>592.80</td>
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<td>38736.00</td>
<td>684.00</td>
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<td>42619.60</td>
<td>752.40</td>
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<td>34000.00</td>
<td>914.60</td>
<td>43900.89</td>
<td>775.20</td>
<td>46512.00</td>
</tr>
</tbody>
</table>
II.

HIDDEN COSTS

TOTAL COST OF CAR

FINANCING: Rate ______ Year: ______

COSTS PER MONTH

FINANCING

GAS (ASSUME 250 MILES TRAVELED A WEEK.
AT $1.00 A GALLON.
FIND MILEAGE AND DIVIDE INTO 250. THIS GIVES GALLONS USED X $1.00= “

OIL CHANGE

TUNE-UP

INSPECTION AND EMISSION (TOTAL DIVIDED BY 12)

INSURANCE (RATE DIVIDED BY 12)

REGISTRATION, LICENSE AND CAT

TOTAL COST PER MONTH
II.

DREAM CAR - OPTIONS COSTS

<table>
<thead>
<tr>
<th>Option</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automatic or Stick</td>
<td>275</td>
</tr>
<tr>
<td>Power Brakes and Steering</td>
<td>125</td>
</tr>
<tr>
<td>AM/FM Radio</td>
<td>150</td>
</tr>
<tr>
<td>Power Seats</td>
<td>100</td>
</tr>
<tr>
<td>Air Conditioning (Tinted Glass)</td>
<td>650</td>
</tr>
<tr>
<td>Sports Package (Suspens &amp; Steering)</td>
<td>1,275</td>
</tr>
<tr>
<td>Special Paint</td>
<td>100</td>
</tr>
<tr>
<td>Rear Defrostering</td>
<td>75</td>
</tr>
<tr>
<td>Cruise Control</td>
<td>75</td>
</tr>
<tr>
<td>Standard or Special Engine</td>
<td>150</td>
</tr>
<tr>
<td>Sunroof/Convertible</td>
<td>150/525</td>
</tr>
<tr>
<td>Cloth/Vinyl Seats</td>
<td>0/175</td>
</tr>
<tr>
<td>Lighting Package</td>
<td>125</td>
</tr>
<tr>
<td>Other Options</td>
<td></td>
</tr>
</tbody>
</table>
II. QUESTIONS

1. List as many other costs, not mentioned on the data table, on the hidden cost sheet.

2. Place an approximate cost per month next to each item on the sheet.

3. What would you have to earn each month in order to afford the car you chose and for other expenses?

4. What is this salary for a year?

5. What types of jobs would allow you to have your automobile?

6. Having answered Questions 1 - 5, do you still believe you can purchase the same dream car with the same options?

7. Are there any changes you could make in your lives to help obtain your dream car?

8. If not, would you change your choice of cars? If so, to what car?

9. Are there any options that you chose that you could or should do without?

10. Are there any ways that you can reduce the maintenance costs of your car?

11. You have just paid off your car, and it is stolen. What happens now? What procedures do you have to follow and how is your personal life affected?
II. SUPERFLITE

It is the year 2020. SUPERFLITE CARS MFG. have developed an automobile that flies. How will this invention impact our society? What if you are the designer of a SUPERFLITE car? What would the vehicle look like? Your major objective in this assignment is to set up guidelines that relate to the question: How will this auto impact the development of our society? You will work in teams of three.

Possible avenues to explore include:

1. design of the car—number of passengers, speed, necessary safety features, etc.?
2. where could it go—houses, airports, where?
3. rules and regulations?
   a. impact on recreation—where can you go in one day?
4. impact on the environment?
5. conflicts with existing rules of society?
6. legal implications—where to take off from, littering, etc.?
7. where to put (service) stations—how far apart, zoning laws, planning committee?
8. interior of the car?
9. safety items?
10. international travel customs, smuggling, etc.?
11. advertising—design of car?
12. effects on dating and other social recreational activities?
13. law enforcement—where would police pull you over?
14. bathrooms, emergencies?
15. vocabulary for this new invention?
16. impact on railroads, airlines, businesses?
17. discuss the possible technical aspects of the power train, lift, shape, etc.?
This can be assigned as an inclass project (for example over 5 class periods), or as an independent take home assignment. Each person or group might give an oral presentation of their report. The report should include guidelines to the company, customer, legal system, and the public (innocent bystander).

**Extension:**

Build your SUPERFLITE vehicle. Design as a competition with a prize or prizes for the most imaginative, creative, technical, practical, etc. design.
ACTIVITY 4. Hidden Persuasion

Objectives: The students should be able to:

1. Identify different methods used in advertising.
2. Analyze advertisements in terms of valid information presented.

Teacher Background:

The major portion of the financing of television and radio programs comes from commercial advertising. But some commercials tell very little about the product that they advertise. Terms like softer, lighter, smoother may be used to compare a product with that of a competitor. Qualitative adjective, give no clear evidence that one product is better than another. A more accurate presentation would be a quantitative statement of how much softer, lighter, or smoother is product versus another product.

Some commercials use a catchy slogan or song or have famous persons endorsing the product. Frequently, the slogan or song gives no indication of the worth of the product being advertised. People who endorse a product are paid well to say only good things about it. Describe some other selling methods used in commercials that fail to inform the buyer of the true nature of the product.

A questioning mind is one of the characteristics of a scientist. A questioning mind can be important for everyone, when deciding which products to buy. If people carefully examine and question information about a specific product, it is possible that they may buy more wisely. They would be able to distinguish real evidence from meaningless words.

The words used in the student activity are defined on SAS 4.2. Have students bring in 5 advertisements from magazines or other sources.
that are in color for discussion.

Bear in mind techniques such as sexual attitude, color of car, angle of photography, background, dress, age, sex, education and mannerism of presentor, promotional devices, and time shown during the day.

**Student Activity Sheets:**

- SAS 4.1 Consumer goods guide
- SAS 4.2 Definition of terms
- SAS 4.3 Commercial study
- SAS 4.4 Questions

**Procedures:**

1. Select 5 commercials from radio or Television.
2. Study each commercial using the consumer goods guide. The four categories of the guide are explained on the definition sheet. You may not need to use all the categories for each commercial. This will depend on the design of the commercials you select.
3. Using the letters A, B, C from the consumer goods guide, record the presentation, situation, theme and facts presented for each commercial on the Commercial study sheet.
4. Study 5 advertisements from the magazines or newspapers that you brought in. Number each advertisement in the upper right hand corner.
5. What items caught your eye from the first advertisement? What moods does the picture give you? Look at the background. What situation is presented? Does it give a hidden message? Are there people in the picture? How are they dressed? What are they doing? Do the colors in the picture give you a feeling? What feeling do you have after
looking at the picture?

6. Write a short paragraph answering the questions above. Also, add any other observations, inferences, or feelings you get from each picture.

Possible Future Activities

1. Have the students make a commercial, trying to use the five elements used in advertising—attention, confidence, desire, urgency, response.

2. Video tape several very good commercials in terms of the four elements on the consumer goods guide.

3. Take several commercials demonstrating the 5 parts of a good commercial in terms of the 5 advertising elements.

4. Use these tapes as a class discussion, and have the students pick out the various elements.

5. Game—"Propaganda"—manufactured by Maple-Packers, Turtle Creek, PA.

Resource Materials

### Consumer Goods Guide

<table>
<thead>
<tr>
<th>Commercial</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Situation</td>
<td>Realistic</td>
<td>Semi-Realistic</td>
<td>Unrealistic</td>
</tr>
<tr>
<td>2. Presentation</td>
<td>Endorsed by famous person</td>
<td>Designed to make viewer/listener laugh</td>
<td>Other</td>
</tr>
<tr>
<td>3. Theme</td>
<td>Slogan</td>
<td>Song</td>
<td>Other</td>
</tr>
<tr>
<td>4. Facts Presented</td>
<td>Sound facts presented</td>
<td>A mixture of facts &amp; nonfacts</td>
<td>No facts presented</td>
</tr>
</tbody>
</table>
II.

Definition of Terms

Situation: Is the situation in the commercial realistic, does it fit our everyday experiences, or unrealistic, with characters such as talking animals, miniature people or dreamlike situations?

Presentation: Is the product endorsed by a famous person? Is the commercial designed only to make people laugh? Neither tells much about the true quality or effectiveness of the product.

Theme: Is there a song or slogan used in the commercial? Neither gives much information about the commercial, but these hooks tend to make us remember the product.

Facts Presented: Does the commercial present factual material such as cost, weight, or other measurable facts to show that the product is better than another? Or are words such as softer, lighter, or smoother used to describe the product?
## Commercial Sheet

<table>
<thead>
<tr>
<th>Product Advertised</th>
<th>Situation</th>
<th>Presentation</th>
<th>Theme</th>
<th>Facts Presented</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
II.

QUESTIONS

1. Based on the commercials that you saw, which products might you decide to buy? What was it about the commercial that convinced you?

2. Which commercial gave the most factual information?

3. Which commercial did you like the most? Why?

4. Were the answers to Questions 2 and 3 the same or different? Explain.

5. Make a general statement about the effectiveness of the commercials that you studied.

6. What adjectives were used to describe the products?

7. What words were used to compare the two products?

8. Does the name of the product bring out certain impressions for you?

9. Advertising usually has 5 parts: 1) attention getting, 2) confidence-building, 3) desire stimulating, 4) urgency-stressing, 5) response-seeking. Look again at your 5 commercials. Can you pick out any of these parts? For each commercial, list or identify those parts and tell what group of people would be most influenced by the ad.

10. Concerning your dream car, did advertising possibly affect your choice? Can you remember what turned your eye towards that particular car?

11. What properties of cars are used by advertising to make a car more appealing?

Optional Questions:

1. What kinds of materials do you not see advertised? Why?

2. Does the name of the product bring out certain impressions for you?
PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ________________________________

School ________________________________

Grade Level ____________________________

Module: Intro A 1 2 3 4

(circle one)

Activity Title & Number __________________

Please answer each of the following questions at the completion of each activity. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES

   Were the stated objectives clear and accurate? Excellent Good Poor

2. TEACHER BACKGROUND

   Was the teacher background accurate? Excellent Good Poor

   Was the information provided a sufficient background on the subject? Excellent Good Poor

3. MATERIALS

   Was the materials list complete? Excellent Good Poor

   Did you have enough of each material required? Excellent Good Poor

   *Please indicate any resources, books (teacher or student), equipment, etc. that you recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

   Were the Student Activity Sheets (SAS):

   Relevant to the objectives? Excellent Good Poor

   Clear and logical? Excellent Good Poor

   *Which were the most successful activities?

5. EXTENDED ACTIVITIES

   *Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?
6. EVALUATION

What method of student evaluation did you use? (SAS sheet, separate test, etc.)?

*How successful were the students?

7. PROCEDURE

Was the suggested procedure clear and complete?  

Excellent  Good  Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?

8. RATE THE FOLLOWING: (circle one)

Student interest  High  Medium  Low

Appropriateness of material for students  High  Medium  Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ________________________________ Date __________

Date when Activity was completed 102
The PITTS Project

MODULE III

THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

TRANSPORTATION AND YOUR COMMUNITY
THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

Supported by a Grant From

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Taylor Allderdice High School
Creative and Performing Arts High School
Carrick High School
Brashear High School
Peabody High School
Schenley High School
Perry High School
Taylor Allderdice High School
Oliver High School
Brashear High School
Wilkinsburg High School
St. Paul Cathedral High School
Wilkinsburg High School
Peabody High School
North Catholic High School
Vincentian High School
Vincentian High School
Peabody High School
Taylor Allderdice High School
Carrick High School
North Catholic High School

Special Thanks To: Cindy Brown, graduate assistant, University of Pittsburgh and Tim Hunsberger, undergraduate assistant, University of Pittsburgh.

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Module III
Transportation and Your Community

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ACTIVITY 2. USING A STANDARD CITY MAP OF PITTSBURGH
   Using a Standard City Map of Pittsburgh
   SAS 2.1
ACTIVITY 3. TRANSPORTATION IN URBAN ENVIRONMENTS
   Transportation in Urban Environments
   SAS 3.1-5
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TEACHER EVALUATION FORM
MODULE III
Transportation and Your Community

COMPETENCIES

A. Processes

1. Observing
3. Inferring
4. Predicting
5. Measuring
6. Communicating
7. Using Space/Time Relations
9. Formulating Hypotheses
10. Experimenting
11. Recognizing Variables
12. Interpreting Data
13. Formulating Models

ACTIVITIES

1. Making Your Own Map
2. Using a Standard City Map of Pittsburgh
3. Transportation in Urban Environments
4. Getting There
5. Cars and Gas

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Make a map depicting the route from his/her home to school.
2. Identify typical routes on a City of Pittsburgh Map.
3. Evaluate identified modes of transportation in terms of energy and environment.
4. Compare different types of transportation in terms of mileage and gas efficiency.
5. Interpret histograms.
6. Recognize the inverse relationship between the mass of a car and the distance traveled.
7. Recognize the direct relationship between mass of a car and fuel consumption.

8. Recognize the direct relationship between fuel consumption and distance traveled.

9. Recognize the direct relationship between force provided and distance traveled.

10. Extrapolate and interpolate a graph.
MODULE III
TRANSPORTATION AND YOUR COMMUNITY

Resources:

The problems concerning transportation on the Ohio River Boulevard is the theme of this article. Dangers on this stretch of road, what causes them, and the fatal results.

A look at a mode of transportation that was essential to the city and its success 70 years ago.


A look at Pittsburgh's 1.2 mile subway costing $70 million. Also, what's ahead for future subway transportation in Pittsburgh.


Pittsburgh, "Trolleys: Still rumbling after all these years," May, 1984.
A look at the area's first mass transit system.

Pittsburgh, "The Yellow Behemoth," August, 1984, pp. 30-40. This article focuses on the problems of taxicab service. The Yellow Cab Co. is profiled and comparisons of fares, services, etc. to other major cities' cab companies is made.
The transportation problems in a city that is dependent on bridges is the theme of this article.

This article features a comparison of 2nd Avenue in Pittsburgh 20 years ago and today. The focus is on economic changes that have come to Pittsburgh and how that is reflected in our driving habits.

Pittsburgh, "Pittsburgh Index," City Guide, SSB.
This is a guide to the city's Public Transportation.

Dilavore, Philip. "Why is it easier to ride a Bicycle than to Run the Same Distance?", The Physics Teacher, March, 1981, p. 194.
This article deals with friction and wasted motion and their effect on energy consumption.

This article gives a broad view of energy and its relation to societal needs. It also suggests an approach of teaching energy issues in the classroom.
Activity 1. Making Your Own Map

Objectives: Students will be able to demonstrate mapping skills by making a map depicting the route from their home to school.

Materials: Pencil, paper (colored pencils, markers - optional) (compass - optional)

Student Activity Sheets: SAS 1.1 Questions

Suggested Procedures:

1. The day before constructing the map, have students make observations on their way to and from school, noting street names, landmarks (for example, stores, cemeteries, churches, etc.), street lights, stop signs, speed signs, etc.

2. In class have students construct maps, including as many of the following as possible: (Teacher may develop symbols and legend with class).
   - street names - indicate N, S, E, W, on map
   - street lights
   - stop signs
   - speed limit and other traffic signs
   - landmarks
   - types of transportation observed along their route (for example bus, car, pedestrian)

3. When maps are completed, have students answer questions in SAS 1.1 relative to their constructed maps.

Optional Activity 1

Objectives: Students will walk for 20 minutes in area around their school, noting street names, speed, stop signs, street lights, landmarks, type of transportation along route, and identify compass directions N, S, E, W.

Students will construct a map of the area, using symbols to enter observed data as above. Teacher should develop symbols/legend with class.
III. SAS 1.1

QUESTIONS

1. Compare your map with your neighbors. Would you be able to find his/her house using his/her map? Would he/she be able to find your house using your map?

2. How is your map the same as your neighbors? Different?

3. What method of transportation do you use following your route? Is it the same as your neighbor uses?

4. List at least 5 methods of transportation that can be used WITHIN the city of Pittsburgh.

5. How does transportation determine when, how and in what mood you get to school?
   How?
NAME: ___________________________ DATE: __________

MAP READING (A)

You and your family are going to Harrisburg Pa. to your cousins wedding. Your parents ask you to get a map of Pa. and find a way to get to Harrisburg. So here is the map, go to it!!!!!!!!!

DIRECTIONS:

1. SELECT THE BEST ROUTE THAT YOUR FAMILY CAN TAKE. WRITE THE ROUTES DOWN THAT YOU ARE GOING TO TAKE.

2. NAME TWO OR THREE CITIES YOU AND YOUR FAMILY MAY HAVE GONE THROUGH. (IF ANY)

3. THE ROUTE THAT YOU AND YOUR FAMILY TOOK HOW MANY MILES WERE THERE?
   ---------------------- MILES/KILO ----------------------

4. IF YOU TRAVEL AT THE AVERAGE SPEED OF 55 MILES AND ONLY TOOK TWO HALF HOUR STOPS. HOW LONG WOULD IT TAKE YOU AND YOUR FAMILY TO TRAVEL FROM PGH TO HARRISBURG.
   ------------------------ HOURS/MINUTES -------------------

5. IF YOUR FOLKS CAR GETS 20 MILES TO A GALLON AND GAS IS 85 CENTS PER GALLON.
   A) HOW MANY GALLONS OF GAS WILL IT TAKE TO GO ROUND TRIP ____________________________

   B) HOW MUCH WOULD IT COST FOR GAS TO GO ROUND TRIP?
      ____________________________ COST.

   C) WOULD $50.00 BE ENOUGH FOR YOUR TRIP?

   D) DID YOU HAVE FUN AT THE WEDDING?
Activity 2. Using a Standard City Map of Pittsburgh

Objectives: Students will be able to identify typical routes on the City of Pittsburgh Map.

Teacher Background: The purpose is for students to transpose their own route as they mapped it out on a standard city map. Students should find their section of the city and their high school on the city map, and trace a route from their home to their school. They will also enter symbols indicating various modes of transportation in their section of the city and in the city at large. This hands-on activity is used as a basis from which the lesson is extended to the concepts of how transportation technology affects people. The SAS worksheets are used in conjunction with the Pittsburgh map to further increase the students awareness of the role that transportation plays in daily life.

PITTSBURGH CITY MAP DIRECTIONS:
1. Map is in 6 numbered sections.
2. Assemble sections 1 to 6 and tape for complete city map. Trim edges.
3. Teacher can use sections needed for their students.
4. Map sections can be xeroxed.

Material: Maps of the City of Pittsburgh

Student Activity Sheets:
SAS 2.1 Using a Standard City Map of Pittsburgh

Suggested Procedures:
1. Distribute maps of the city. Students may work singly or in pairs, groups.
2. Distribute student directions and questions for using maps (see SAS 2.1).
III.

Using a Standard City Map of Pittsburgh

Student Directions:

1. Find your section of the City of Pittsburgh. What area of the city do you live in?

2. What section of the city is your school in?

3. Trace your route from home to school, using your self-constructed map.

4. How is your map the same as the city map? Different?

5. Which map do you find more useful to follow? Why

6. Are there alternate routes to your house from school (other ways of going)? Trace an alternate route. List the names of the streets (in order) on this alternate route.

7. What methods of transportation are available in your section of the city? Check the ones that apply:

   Car
   Bus
   Train
   Plane
   Incline
   Subway
   Other?

   Put symbols where these modes of transportation are found (example draw a bus or write B where a bus route is located; S for subway, etc.)

8. If you lived in Brookline, what is the most direct route to Point State Park in downtown Pittsburgh? Trace your route. List streets. What kind of transportation would you probably take?

9. If you lived in Spring Hill, what is the most direct route to Oakland? Trace your route. List streets. What kinds of transportation would you probably take?
III.

Find these city high schools and give their coordinates.

Westinghouse (Homewood)
Oliver (North Side)
Carrick (South Side)

11. Many modes of transportation are available in the City of Pittsburgh. Mark by symbols (letter or drawings) where the following modes of transportation would be found in the city. Some are only found in certain areas; others you may mark in many places:

- bus
- car
- train
- subway
- incline
- boat
- seaplane (note that there is a seaplane base near Marshall Avenue-Northside)
- boats for transporting other than people
- bicycle
- walking (pedestrian)
- motorcycle
Check each mode, as you mark it off on your map.

12. Teacher transpose subway to their map. Trace the subway routes.
(Use walking map)

13. Trace train route - mark T or symbol

14. Trace a bus route. (Can use bus schedules)
   (a) from home to school
   (b) from home to downtown Pittsburgh

15. Trace a car route:
   (a) from home to downtown Pittsburgh.
   (b) from home to school

16. What are the map coordinates for:
   (a) Your home
   (b) Your school
   (c) The Pittsburgh Zoo
   (d) Frick Park
   (e) Three Rivers Stadium
   (f) Civic Arena
   (g) Monongohela Incline
Activity 3. Transportation to Urban Environments

Objectives: Students to evaluate the identified modes of transportation in terms of energy and environment.

Teacher Background: This activity is designed to look at issues of transportation and evaluate general attitudes.

Student Activity Sheets: 3.1 - 3.6 Transportation in Urban Environments.

TRANSPORTATION IN URBAN ENVIRONMENTS

A. Transportation is the act of carrying things or people (or both) from one place to another place. There are many transportation modes (methods or ways) available to us. Each mode of transportation has advantages and disadvantages. Completing the chart below will help you to reach some conclusions about the role of transportation in the urban environment. Briefly note your answers in the space provided.

<table>
<thead>
<tr>
<th>Mode of Transport</th>
<th>How often do you use this mode?</th>
<th>How do you feel about this mode?</th>
<th>How much does it cost to use?</th>
<th>What effects does it have on the environment?</th>
<th>Type of Fuel Used or Energy</th>
<th>Energy Conversion*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airplane</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>Car</td>
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<tr>
<td>Truck</td>
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<tr>
<td>Bus</td>
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<tr>
<td>Bicycle</td>
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<tr>
<td>Boat</td>
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<tr>
<td>Walking</td>
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<tr>
<td>Subway</td>
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<tr>
<td>Incline</td>
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<tr>
<td>Motorcycle</td>
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<tr>
<td>Train</td>
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<td>Other</td>
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</tbody>
</table>

*fuel is changed from chemical energy to what other form of energy.
III.

After you have completed the chart, use the information to help you evaluate transportation modes.

1. Which mode do you use most frequently? __________________________
   Why?

   Least frequently? __________________________
   Why?

2. Which mode do you enjoy using the most? __________________________
   Why?

   The least? __________________________
   Why?

3. Which mode has the highest costs to the user? __________________________
   Why?

   Which mode has the lowest costs? __________________________
   Why?

4. Which mode has the greatest effects on the environment? ______
   What are some examples of these effects?

   Which mode has the smallest effects on the environment? ______
   Why is there little environmental impact?

5. What 2 forms of energy are used in all modes of transportation?
B. Before you come to any conclusions about "good" or "bad" modes of transportation, study the bar graphs below, and answer the questions that follow them. Each graph gives information on the energy use of four modes of transportation. Energy use is expressed in terms of "BTU per passenger mile." A BTU is a British Thermal Unit; it is a measure of heat. A BTU is the amount of heat needed to raise 1 lb. of water 1°F.

**I. ENERGY USE OF VARIOUS FORMS OF INTER-CITY TRANSPORTATION**

**II. ENERGY USE OF VARIOUS FORMS OF URBAN TRANSPORTATION**
III.

1. Graph I provides information about the energy use of four modes of inter-city transportation. What does "inter-city" mean?

Graph II gives the energy use of four modes of urban transportation. What is "urban transportation"?

2. Which mode of inter-city transportation is the least efficient (uses the most energy for every passenger mile)?

Which mode of inter-city transportation is the most efficient (uses the smallest amount of energy for every passenger mile)?

3. Which mode of urban transportation is least efficient?

Which mode of transportation is the most efficient?

4. How might a mode of transportation that uses little energy be inefficient in other ways?
C. More on Energy Use and Transportation

1. Distinguishing Facts from Opinions. Using the information in the previous graphs, read the following statements and place an F in the space beside the facts (statements that can be verified or proved) and an O in the space beside the opinions (statements that some people believe or feel but that cannot be verified).

   a. An aircraft uses more than 8000 BTU per passenger mile.
   b. Walking is better for you than using mass transit.
   c. Walking uses less energy than a bus.
   d. The form of transportation that uses the least energy is bicycling.
   e. In urban transportation, autos use twice as much energy as mass transit.

2. Using the graphs, list the Modes of transportation that use:

   Little Energy = 2000 BTU/passenger mile or less.
   Much Energy = 4000 BTU/passenger mile or more.

   1. 
   2. 
   3. 
   1. 
   2. 
   3.

3. Compare the efficiency of the automobile in Graph I and II. Which one is more efficient? How does that relate to gas mileage on highway vs city driving? Which kind of driving gets better gas mileage?
Activity 4: Getting There

Objectives: The student should be able to:

1. Compare different types of transportation in terms of their mileage and gas efficiency.

2. Determine by interpreting a graph, which form of transportation is the preferred choice for travel.

Materials: Graph paper, rulers

Student Activity Sheets:

SAS 4.1 Tables 1 and 2 - Getting There
SAS 4.2 Questions
SAS 4.3 One More Time

Suggested Procedures:

1. Graph, from the data in Table 1, in bar form, the type of transportation, on the horizontal axis and the fuel efficiency (miles/gallon) on the vertical axis.

2. Graph from Table 2, in bar form, the type of transportation on the horizontal against the people moving efficiency (P,PG) on the vertical axis.
Activity 4. Getting There

Table 1

<table>
<thead>
<tr>
<th>Transportation Type</th>
<th>Fuel Mileage (Average)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(MPG = Miles Per Gallon)</td>
</tr>
<tr>
<td>Automobile</td>
<td>18 MPG</td>
</tr>
<tr>
<td>Van</td>
<td>16 MPG</td>
</tr>
<tr>
<td>Bus</td>
<td>3.3 MPG</td>
</tr>
<tr>
<td>Pass Train</td>
<td>0.1 MPG</td>
</tr>
<tr>
<td>DC Jet</td>
<td>0.25 MPG</td>
</tr>
</tbody>
</table>

Table 2

"Fuel Consumption Per Person"

<table>
<thead>
<tr>
<th>Form of Transportation</th>
<th>Number of People</th>
<th>MPG</th>
<th>Fuel Needed For 200 Mile Trip (in Gallons)</th>
<th>Gallons/Person (200 mile trip)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>1</td>
<td>18</td>
<td>11.1</td>
<td>11.1</td>
</tr>
<tr>
<td>CAR</td>
<td>2</td>
<td>18</td>
<td>11.2</td>
<td>5.6</td>
</tr>
<tr>
<td>CAR</td>
<td>4</td>
<td>18</td>
<td>11.6</td>
<td>2.9</td>
</tr>
<tr>
<td>VAN</td>
<td>1</td>
<td>16</td>
<td>12.5</td>
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<td>16</td>
<td>12.8</td>
<td>3.2</td>
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<td>8</td>
<td>16</td>
<td>13.2</td>
<td>1.65</td>
</tr>
<tr>
<td>BUS</td>
<td>5</td>
<td>3.3</td>
<td>60.0</td>
<td>12.0</td>
</tr>
<tr>
<td>BUS</td>
<td>20</td>
<td>3.3</td>
<td>62.0</td>
<td>3.1</td>
</tr>
<tr>
<td>BUS</td>
<td>40</td>
<td>3.3</td>
<td>64.0</td>
<td>1.6</td>
</tr>
<tr>
<td>TRAIN</td>
<td>1000</td>
<td>.1</td>
<td>2000</td>
<td>2.0</td>
</tr>
<tr>
<td>AIRPLANE</td>
<td>100</td>
<td>.25</td>
<td>800</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Remember: Passenger miles per gallon is arrived by dividing the number of people into the amount of fuel used. Use bar graph to illustrate 200 mile trip/fuel/person.
### GAS MILAGE

<table>
<thead>
<tr>
<th></th>
<th>Automobile</th>
<th>Van</th>
<th>Bus</th>
<th>Train</th>
<th>DC Jet</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
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<td>1</td>
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</tr>
</tbody>
</table>

### TYPES OF TRANSPORTATION
FUEL CONSUMPTION PER PERSON

1.00 2.00 3.00 4.00 5.00 6.00 7.00 8.00 9.00 10.0 11.0 12.0 13.0

FORMS OF TRANSPORTATION

Car Car Car Van Van Van Van Bus Bus Bus Train Plane
(1) (2) (4) (1) (2) (4) (8) (5) (20) (40) (100) (1000) (100)
III.

FUEL CONSUMPTION PER PERSON

MILES PER GALLON PER PERSON ON A 200 MILE TRIP

TEACHER SAMPLE

FORMS OF TRANSPORTATION

129
III. Questions

1. Use Graph #1 to identify which type of transportation is the most efficient in miles/gallon? Why?

   The least efficient. Why?

2. Use Graph #2 to identify which type of transportation is most efficient in terms of fuel used per person. Why?

   The least efficient. Why?

3. Would putting twice the number of people in any of the listed vehicles make it more efficient per person? Explain your answer.

4. If 4 people are going on a 200 mile trip, would it be more fuel efficient per person to go in a van or a car?

5. Use Graph #2 to answer the following. Which is the MORE efficient means of transportation per person?

   (a) a bus with 20 or a car with 2
   (b) a van with 1 or a car with 1
   (c) a bus with 5 or a train with 1000
   (d) a bus with 20 or a train with 1000
   (e) a plane with 100 or a train with 1000
   (f) a bus with 40 or a train with 1000
   (g) a bus with 5 or a car with 4

6. Use Table 2 to compare the TOTAL gallons of gasoline that would be used by 40 people going on a 200 mile trip on the same bus with the TOTAL gallons of gasoline that would be used if those same 40 people each drove their own car 200 miles.
III.

7. In Table 2, the bus appears to be the most efficient in fuel per person. Are there disadvantages in using only buses for transportation? List as many as you can.

8. One way to make a car more efficient is to have more people in the car. List as many advantages and disadvantages as you can for this idea.

9. Is there ever a time when a person might choose a less efficient form of transportation? Explain.

10. Why do you think some people chose to form car pools?

11. Do you think it is important for cars to be fuel efficient? Why or why not?
III.

ONE MORE TIME

1. Would you use the same amount of fuel for 1 person as for 4 people for a 200 mile trip? Explain your answer.

2. Name any factors or variables that would affect the amount of gas used in a 200 mile trip. Explain each of these factors clearly and as best you can.

3. Are mass transit systems, like buses or commuter trains, always more efficient than cars? Explain.

4. Suppose the mayor of your city appointed you as the new director of mass transit systems. He or she wants your ideas on the serious problem of too many cars in the city and the under used public transportation facilities. What would you say in a letter to the mayor?
Newton's second law of motion has a practical application in the design of automobiles. If you want a greater acceleration for your car, you can either install a more powerful engine (increase the force) or decrease the mass of the car. One reason why small cars get good gas mileage is their small mass. Everything else being equal, a 100 horsepower engine will accelerate a 1000 kg car up to 48 km/hr in half the time that the same engine could accelerate a 2000 kg car to the same speed.

(Physical Science, p. 233)
(General Science, pp. 19, 191-192)
Teacher Background: Optional Activity 4

Note: This activity uses the same basic data as Activity 4. And the concepts involved are the same. However, the approach varies: efficiency is determined by people moving capacity rather than miles per person per gallon.
III.

Optional SAS 4.1

Activity 4. Getting There

Table 1

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>Fuel Efficiency (MPG)</th>
<th>Average People/ Vehicle</th>
<th>People Moving (PMPG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automobile</td>
<td>18</td>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>Van</td>
<td>16</td>
<td>4</td>
<td>64</td>
</tr>
<tr>
<td>Bus</td>
<td>3.3</td>
<td>20</td>
<td>66</td>
</tr>
<tr>
<td>Passenger Train</td>
<td>.1</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>DC Jet</td>
<td>.25</td>
<td>100</td>
<td>25</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Type of Vehicle</th>
<th>No. of People</th>
<th>Fuel Needed for 20 mile trip (gallons)</th>
<th>People Moving Capacity (PMPG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAR</td>
<td>1</td>
<td>18</td>
<td>1.11</td>
</tr>
<tr>
<td>CAR</td>
<td>2</td>
<td>18</td>
<td>1.11</td>
</tr>
<tr>
<td>CAR</td>
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<td>16</td>
<td>1.25</td>
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<tr>
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<td>1.25</td>
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<tr>
<td>VAN</td>
<td>10</td>
<td>16</td>
<td>1.25</td>
</tr>
<tr>
<td>BUS</td>
<td>5</td>
<td>3.3</td>
<td>6.1</td>
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<tr>
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<td>6.1</td>
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</tr>
<tr>
<td>PLANE</td>
<td>100</td>
<td>.25</td>
<td>80</td>
</tr>
</tbody>
</table>

Note: People Moving Capacity can be calculated by multiplying number of people carried X fuel efficiency. For example (18 MPG) (2 passenger) = 36 PMPG.
III. Optional SAS 4.2

Activity 4.

Questions

1. Which type of transportation is the most efficient in miles/gallon? The least efficient? (Use Graph 2).

2. Why do you think your choices for question one are true?

3. From graph number one, which type of transportation is most efficient in terms of people moving efficiency? Which was the least efficient?

4. Would putting twice the number of people in the vehicle make it more efficient? Explain your answer (Refer to Table 2).

5. Is the data table or the graph easier to use to determine your answer? Why is your choice easier to use?

6. In Table 2, the bus and the van appear to be the most efficient in people moving. Are there disadvantages in using only buses or vans for transportation? List as many as can.

7. One way to make the car more efficient is to have more people in the car. List as many advantages and disadvantages as you can for this idea.

8. Sometimes you are willing to sacrifice efficiency for some other gain. What are some of the other gains and what vehicles do they apply to?
III. Optional SAS 4.2

9. The PAT train has a capacity of 500 passengers. It usually carries only 125 passengers. Based on your knowledge of efficiencies why is PAT considering dropping this train. Can you apply this same thinking to other modes of transportation?
III.

Activity 4.

People Moving Efficiency Vs. Type of Transportation

Type of Transportation

Car  Van  Bus  Train  Plane

(PMPG)  10

Car  Van  Bus  Train  Plane

Type of Transportation

138
III.

Optional SAS 4.2

Graph 1

Activity 4.

People Moving Efficiency Vs. Type of Transportation

<table>
<thead>
<tr>
<th>Type of Transportation</th>
<th>Efficiency (PMPG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>10</td>
</tr>
<tr>
<td>Van</td>
<td>20</td>
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<tr>
<td>Bus</td>
<td>30</td>
</tr>
<tr>
<td>Train</td>
<td>50</td>
</tr>
<tr>
<td>Plane</td>
<td>60</td>
</tr>
</tbody>
</table>

TEACHER
SAMPLE

139
Activity 4.

Fuel Efficiency Vs. Type of Transportation

Fuel Efficiency (MPG) vs. Type of Transportation

- Car
- Van
- Bus
- Train
- Plane
III.

Activity 4.

Fuel Efficiency Vs. Type of Transportation

<table>
<thead>
<tr>
<th>Type of Transportation</th>
<th>Car</th>
<th>Van</th>
<th>Bus</th>
<th>Train</th>
<th>Plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel Efficiency (MPG)</td>
<td>18</td>
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<td>14</td>
<td>12</td>
<td>10</td>
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<tr>
<td>Car</td>
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<tr>
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<tr>
<td>Plane</td>
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<td></td>
</tr>
</tbody>
</table>
Activity 5
Cars and Gas

Objectives: The student should be able to:

1. recognize the inverse relationship between the mass of a car and the distance traveled.

2. recognize the direct relationship between mass of car and fuel consumption.

3. recognize the direct relationship between fuel consumption and distance traveled.

4. recognize the direct relationship between force provided and distance traveled.

5. extrapolate and interpolate from a graph.

Teacher Background:

The purpose of these activities is to relate automobile gasoline consumption to the size of a car and the distance it is driven.

In doing the activities, students should be introduced to an inversely proportional relationship (mass vs. distance using a constant force in SAS 5.1) and a directly proportional relationship (force vs. distance using a constant mass in SAS 5.3). You may want to ask students which type of prediction would be more accurate - an interpolation or an extrapolation.

In using the car launch board, some hints may be useful. The acceleration pedal should be raised up off the board surface and the lower rubber band loop should be raised to the center of the supporting screw.

The teacher may want to point out that these activities are based on Newton's Second Law of Motion.

Materials:

1. Car launch board with accelerator pedal.
2. Car washers
3. masking tape
4. meter stick
Student Activity Sheets:

5.1 Activity! Constant Force
5.2 Questions
5.3 Activity! Constant Mass
5.4 Questions
Table 5.1
Constant Acceleration

Distance Traveled in CM Trials

<table>
<thead>
<tr>
<th>Number of Washers</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 washer</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 washer</td>
<td></td>
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<tr>
<td>2 washers</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3 washers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 washers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Procedure:
1. Place masking tape along edge of board, starting at 0 cm.
2. Measure off and mark tape in 5 cm increments as in picture.
3. Launch the toy car without washers.
4. Measure and record the distance traveled in centimeters.
5. Run 3 trials from launch point 1.
6. Repeat steps 3-5, using 1, 2, 3, and 4 washers.
7. Average the readings from each trial run.
8. Graph results, placing distance traveled on the vertical axis versus the number of washers on the horizontal axis.
III.

Constant Force
Different Mass

SAS 5.1
Graph 1

Number of Washers

10 20 30 40

10 20 30 40

80

D I S T A N C E (cm)

3

4
III.

Constant Force
Different Mass

SAMPLE
TEACHER COPY

SAS 5.1
Graph 1

Number of Washers

Distance (cm)

0 1 2 3 4

LEVEL

UP

146
III. QUESTIONS

1. Which car went the greatest distance?

2. Which car went the least distance?

3. What is the relationship between the mass of the car and distance traveled?

4. Would a heavy car use the same amount of gas as a light car to go the same distance? Explain.

5. Will the energy in one gallon of gasoline move a heavy car the same distance as a light car? Explain.

6. Use your graph to predict how far a car would go if it had 2 1/2 washers? If it had 5 washers?
III.

Table 5.3
Constant Mass

<table>
<thead>
<tr>
<th>Accelerator Positions</th>
<th>TRIALS</th>
<th></th>
<th></th>
<th></th>
<th>Avg.</th>
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<tr>
<td>1</td>
<td></td>
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<td></td>
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<tr>
<td>2</td>
<td></td>
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<tr>
<td>3</td>
<td></td>
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<td>4</td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>

Procedure:
1. Place 3 washers (constant mass) on car.
2. Launch car 3 times from each of the four peg positions.
3. Measure and record distance traveled in centimeters.
4. Average the readings for each trial run.
5. Graph results, placing distance traveled on the vertical axis versus the number the accelerator positions on the horizontal axis.
Graph 1

Graph
Constant Mass
Different Force

Distance Traveled

60 cm
50 cm
40 cm
30 cm
20 cm
10 cm

Accelerator Positions

0 .1 .2 .3 .4

III.

SAS 5.3
Graph 1
III.

Graph

Constant Mass

Different Force

SAS 5.3
Graph 1

SAMPLE
TEACHER COPY

Distance Traveled

Accelerator Positions
III.

QUESTIONS

1. Which accelerator position caused the car to go the greatest distance?

2. Which accelerator position caused the car to go the least distance?

3. Which accelerator position provides the greatest force? The least force?

4. What is the relationship between force and distance traveled?

5. To provide a greater force in acceleration, would more or less energy (gasoline) be required? Explain.

6. What is the advantage of using the shortest route to a given location?

7. Use your graph to predict the distance a car would travel if the accelerator were released half-way between positions 1 and 2: if the accelerator were released from a fifth accelerator position?

QUESTION FOR OPTIONAL PROCEDURE

1. How does climbing Pittsburgh's hills affect the amount of gas you use as opposed to driving the same distance on Utah's salt flats?
PITTSBURGH STS PROJECT

TEACHER EVALUATION FORM

Name ____________________________________________ Module: Intro A 1 2 3 4 (circle one)
School __________________________________________ Activity Title & Number ___
Grade Level _____________________________________

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. **OBJECTIVES**

   Were the stated objectives clear and accurate? Excellent  Good  Poor

2. **TEACHER BACKGROUND**

   Was the teacher background accurate? Excellent  Good  Poor

   Was the information provided a sufficient background on the subject? Excellent  Good  Poor

3. **MATERIALS**

   Was the materials list complete? Excellent  Good  Poor

   Did you have enough of each material required? Excellent  Good  Poor

   *Please indicate any resources, books (teacher or student), equipment, etc. that you recommend for inclusion in future modules.

4. **STUDENT ACTIVITY SHEETS**

   Were the Student Activity Sheets (SAS):

   Relevant to the objectives? Excellent  Good  Poor

   Clear and logical? Excellent  Good  Poor

   *Which were the most successful activities?

5. **EXTENDED ACTIVITIES**

   *Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?
6. **EVALUATION**

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?*

7. **PROCEDURE**

Was the suggested procedure clear and complete?  

Excellent  Good  Poor

*Did you follow the suggested procedure? What modifications, if any, did you make?*

8. **RATE THE FOLLOWING:** (circle one)

Student interest  High  Medium  Low

Appropriateness of material  High  Medium  Low for students

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature ___________________________ Date ______

Date when Activity was completed 156
Module IV

The Pittsburgh Science Technology Society Project

AUDC Issues: The Speed Limit, Seat Belts, and You
THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

MODULE IV

AUTO ISSUES: THE SPEED LIMIT, SEAT BELTS, AND YOU

developed by

James Metzger, Sharon Lace, Steve Schwaab,
John Sparvero, David Vause, George O'Brien, and Will Korth

with the Inservice Workshop Participants

June, 1988

George O'Brien, Project Director and Series Editor
University of Pittsburgh

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THE PITTSBURGH SCIENCE TECHNOLOGY SOCIETY PROJECT

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Zoe Workman

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Taylor Allderdice High School
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Brashear High School
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Schenley High School
Perry High School
Taylor Allderdice High School
Oliver High School
Brashear High School
Wilkinsburg High School
St. Paul Cathedral High School
Wilkinsburg High School
Peabody High School
North Catholic High School
Vincentian High School
Vincentian High School
Peabody High School
Taylor Allderdice High School
Carrick High School
North Catholic High School
Lettsche High School

Special Thanks To: Cindy Brown, graduate assistant, University of Pittsburgh and Tim Hunsberger, undergraduate assistant, University of Pittsburgh.

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Module IV

Auto Issues: The Speed Limit, Seat Belts, and You

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MODULE IV

Auto Issues: The Speed Limit, Seat Belts and You

COMPETENCIES

A. Processes

1. Observing
2. Classifying
3. Inferring
4. Predicting
5. Measuring
6. Communicating
7. Using Space/Time Relations
8. Formulating Hypotheses
9. Experimenting
10. Recognizing Variables
11. Interpreting Data

ACTIVITIES

1. The Speed Limit
2. The National Speed Limit
3. Fuel Consumption and the Speed Limit
4. Do Seat Belts and Other Safety Devices Prevent Injury and Death?

INSTRUCTIONAL OBJECTIVES

At the end of these lessons, each student should be able to:

1. Determine why various speed limits are posted in their neighborhood.
2. Determine how effective speed limits really are.
3. Illustrate why the nation has established a national speed limit.
4. Gather and analyze data concerning speed limits and variables.
5. Construct and interpret a graph.
6. Identify the major factors affecting fuel consumption at different speeds.
7. Evaluate positive and negative aspects of the 55 MPH speed limit.

8. Make decisions concerning the effectiveness of seat belts and other safety devices in cars.

9. Analyze data concerning accidental deaths.
ACTIVITY 1. Speed Limit

Objectives: The student should be able to:
1. investigate why various speed limits are posted in our neighborhood.
2. determine how effective the speed limits really are.

Teacher Background Information: Students should be allowed to make observations of signs and landmarks while also completing activities that investigate local speed limits and parking availability.

After these activities are completed, assign students to categorize the observations they made for discussion tomorrow which can be quantitative or qualitative in nature.

Suggested Categories:

<table>
<thead>
<tr>
<th>Living</th>
<th>Not Living</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directional Signs</td>
<td>Safety Signs</td>
</tr>
</tbody>
</table>

Student Activity Sheets: SAS 1.1 Questions

Materials: pen, paper

Optional Activities:
1. Go to the local police station to gather data on frequency of accidents in the school neighborhood.
2. Compare speed limits in the area to speed limits of other areas (suburb, country, parks, etc.).
3. Survey 25 adults on whether they really obey the speed limit.
4. Draw a map of the route you traveled include scale and direction.
5. Calculate how much money you would spend parking at a meter for 4 hours; 8 hours (cost $0.25 per hour).

Suggested Procedures: Walk through the neighborhood surrounding your school, record the street name and the speed limit posted on that street. Record your observations of each street you travel. Construct a table like the following.

<table>
<thead>
<tr>
<th>Street</th>
<th>Speed Limit</th>
<th>Observations of Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cane Ave.</td>
<td>25</td>
<td>Traffic light, no parking signs, two lanes, cobblestone</td>
</tr>
</tbody>
</table>
IV. QUESTIONS

After analyzing the data table, answer the following:

1) Are there different speed limits in the area?

2) What conditions determine a slower or faster speed limit?

3) What would be good speed limits for the following areas?
   School ____ Park ____ Alley ____ Hospital ____
   City Street ____ Parkway ____ Turnpike ____ Suburb ____
   Mall Parking Lot ____

4) Do drivers you know obey the speed limit? Does the speed limit keep people from going too fast?
ACTIVITY 2: The National Speed Limit

Objectives: The student should be able to:

1. investigate and illustrate why the nation has established a national speed limit.
2. gather and analyze data.
3. construct and interpret a graph.

Materials: pencil, paper

Student Activity Sheets:

- SAS 2.1 Motor Vehicle Traffic Deaths by States 1972-73
- SAS 2.2 Motor Vehicle Traffic Deaths by States 1982-83
- SAS 2.3 State Automobile Speed Limits 1973
- SAS 2.4 Population of the States (1980)
- SAS 2.5 Questions
- SAS 2.6 Map of the United States

Suggested Procedures: Using the information above, construct a data table as follows:

<table>
<thead>
<tr>
<th>State</th>
<th>Speed Limit before 1974</th>
<th>Population</th>
<th>Region</th>
<th>Deaths before/after</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA</td>
<td>65</td>
<td>11.5 million</td>
<td>Middle Atlantic</td>
<td>2225/1750</td>
</tr>
</tbody>
</table>

Color your chosen states on the map with the color that matches the speed limit on the following chart:

- 65 MPH: green
- 70 MPH: yellow
- 75 MPH: blue
- 80 MPH or above: red

After constructing the table answer and discuss the student questions.
### Table 4.1

Motor Vehicle Traffic Deaths by States (1973 & 1972)

Source: State traffic authorities

<table>
<thead>
<tr>
<th>Place of Accidents</th>
<th>Number 1973</th>
<th>Number 1972</th>
<th>Mil. death rate* 1973</th>
<th>Mil. death rate* 1972</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total U.S.</strong></td>
<td>55,800</td>
<td>56,600</td>
<td>4.3</td>
<td>4.5</td>
</tr>
<tr>
<td>Alabama</td>
<td>1,235</td>
<td>1,248</td>
<td>6.2</td>
<td>6.0</td>
</tr>
<tr>
<td>Alaska</td>
<td>76</td>
<td>59</td>
<td>4.7</td>
<td>4.0</td>
</tr>
<tr>
<td>Arizona</td>
<td>958</td>
<td>807</td>
<td>5.9</td>
<td>5.5</td>
</tr>
<tr>
<td>Arkansas</td>
<td>67.5</td>
<td>764</td>
<td>5.0</td>
<td>6.0</td>
</tr>
<tr>
<td>California</td>
<td>4,905</td>
<td>4,996</td>
<td>3.8</td>
<td>3.9</td>
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<tr>
<td>Colorado</td>
<td>672</td>
<td>738</td>
<td>4.1</td>
<td>4.6</td>
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<td>Connecticut</td>
<td>516</td>
<td>467</td>
<td>2.8</td>
<td>2.6</td>
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<td>Delaware</td>
<td>129</td>
<td>132</td>
<td>3.6</td>
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<tr>
<td>District of Columbia</td>
<td>76</td>
<td>73</td>
<td>2.5</td>
<td>2.5</td>
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<td>Florida</td>
<td>2,660</td>
<td>2,498</td>
<td>4.5</td>
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<td>1,904</td>
<td>1,885</td>
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<td>146</td>
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<td>Idaho</td>
<td>349</td>
<td>348</td>
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<td>2,367</td>
<td>2,287</td>
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<td>1,605</td>
<td>1,555</td>
<td>4.1</td>
<td>4.2</td>
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<td>Iowa</td>
<td>813</td>
<td>873</td>
<td>4.1</td>
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<tr>
<td>Kansas</td>
<td>623</td>
<td>606</td>
<td>4.1</td>
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<td>Kentucky</td>
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<td>1,181</td>
<td>6.0</td>
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<td>Maine</td>
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<td>1,010</td>
<td>991</td>
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<td>2,213</td>
<td>2,258</td>
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<td>1,024</td>
<td>1,031</td>
<td>4.1</td>
<td>4.1</td>
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<td>883</td>
<td>922</td>
<td>6.4</td>
<td>7.0</td>
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<td>3,082</td>
<td>3,197</td>
<td>4.6</td>
<td>4.3</td>
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<td>267</td>
<td>259</td>
<td>6.4</td>
<td>6.7</td>
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<td>1,355</td>
<td>1,314</td>
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<td>2.8</td>
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<tr>
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<td>636</td>
<td>587</td>
<td>6.8</td>
<td>6.6</td>
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<td>3,197</td>
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<td>1,889</td>
<td>1,976</td>
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<td>122</td>
<td>7.4</td>
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<td>South Carolina</td>
<td>967</td>
<td>1,047</td>
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<td>5.6</td>
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<td>South Dakota</td>
<td>286</td>
<td>294</td>
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<td>5.8</td>
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<td>1,414</td>
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<td>5.1</td>
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<td>Texas</td>
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<td>3,688</td>
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<td>Utah</td>
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<td>382</td>
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<td>151</td>
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<td>1,256</td>
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<td>550</td>
<td>7.5</td>
<td>8.2</td>
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*The mileage death rate is the number of deaths per 100,000 vehicle-miles
<table>
<thead>
<tr>
<th>Place of Accidents</th>
<th>Number 1983</th>
<th>Number 1982</th>
<th>Mil. death rate* 1983</th>
<th>Mil. death rate* 1982</th>
<th>Place of Accidents</th>
<th>Number 1983</th>
<th>Number 1982</th>
<th>Mil. death rate* 1983</th>
<th>Mil. death rate* 1982</th>
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<tr>
<td>Total U.S.*</td>
<td>44,800</td>
<td>48,000</td>
<td>2.7</td>
<td>2.9</td>
<td>Montana</td>
<td>786</td>
<td>254</td>
<td>4.0</td>
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<td>3.2</td>
<td>3.1</td>
<td>Nebraska</td>
<td>255</td>
<td>261</td>
<td>4.4</td>
<td>2.2</td>
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<tr>
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(a) Includes both traffic and nontraffic motor-vehicle deaths. (b) The mileage death rate is deaths per 100,000,000 vehicle miles. 1983 mileage death rates are National Safety Council estimates.
STATE AUTOMOBILE SPEED LIMITS
(except Where Otherwise Posted)


Alabama: Interstate highways 70 mph daytime, 60 mph nighttime; open highways 60 mph daytime, 50 mph nighttime; residential districts 25 mph; business districts, school zones, etc. 15 mph.

Alaska: Divided highways 70 mph, state highways, surfaced 60 mph, unsurfaced 50 mph, city streets 30 mph.

Arizona: All highways 25 mph or as posted, residential areas, business districts 25 mph or as posted, school zones 15 mph.

Arkansas: Interstate and controlled access roads 75 mph, urban districts 30 mph.

California: Statewide limit 55 mph except freeways posted for 70 mph, residential and business districts, school zones 25 mph.

Colorado: 4-lane highways 70 mph, open highways 60 mph, residential districts 30 mph, business districts 25 mph, open mountain highway 40 mph, winding mountain highway 20 mph.

Connecticut: Reasonable and proper for conditions. Posted limits prima facie evidence of reasonable speed, residential and business districts posted locally.

Delaware: Open highways, 4-lane, 60 mph, 2-lane, 30 mph; residential and business districts, 25 mph.

District of Columbia: Expressways 40 mph; school and playground areas 15 mph; other roads 25 mph.

Florida: Interstate highways 70 mph day, 65 mph night; open highway 65 mph day, 50 mph night; residential & business districts 30 mph.

Georgia: Interstate highways 70 mph daytime, 55 mph nighttime; open highway 65 mph daytime, 50 mph nighttime; residential & business and school areas 25 mph.

Hawaii: Open highways 40 mph, or as posted residential and business districts, local ordinances govern.

Idaho: Interstate highways 70 mph; open highway 60 mph daytime, 55 mph nighttime; urban and business districts 35 mph.

Illinois: Expressways 70 mph; open highways 60 mph; urban areas 30 mph; school zones 20 mph.

Montana: Open highways, day, reasonable and prudent unless posted, 55 mph; night except Interstate highways 65 mph nights; residential and business districts 25 mph.

Nebraska: Interstate highways 75 mph; open highways 65 mph; residential districts 25 mph; business districts 20 mph; on non-hard surfaced roads 55 mph.

Nevada: Turnpike 70 mph; open highways 60 mph; rural residential districts 35 mph; urban and business districts 30 mph; school zones 20 mph.

New Hampshire: Turnpike 70 mph; open highways 65 mph; rural residential districts 35 mph; urban and business districts 30 mph; school zones 20 mph.

New Jersey: Turnpike 60 mph; open highways 50 mph; residential and business districts 25 mph.

New Mexico: Open highways 70 mph day, 60 mph nighttime; other highways 65 mph daytime, 50 mph nighttime; residential and business districts 25 mph; school zones 15 mph.

New York: New York State Thruway 55 mph; open highways 55 mph; school zones when children go in and from school as posted.

North Carolina: Interstate 70 mph; open highways 60 or 50 mph, permitted as posted, otherwise 55 mph; residential districts 30 mph; business 20 mph.

Ohio: Turnpike and expressways 70 mph; open highways 60 mph daytime, 30 mph nighttime; within municipal corporations 25 mph; school zones 20 mph.

Oklahoma: Turnpikes and Interstate highways 70 mph; open highways 60 mph daytime, 35 mph nighttime; school zones 20 mph.

Oregon: Open highways 65 mph; freeways up to 75 mph; residential districts 25 mph; business and school zones 20 mph.

Pennsylvania: Turnpike 65 mph; open highways 55 mph; residential and business districts 30 to 40 mph.
IV.

Indiana: Interstate highways 70 mph; open highways 65 mph; residential district 30 mph; school zones as posted.

Iowa: Interstate limited access roads 75 mph daytime, 65 mph nighttime; open highways 70 mph daytime, 60 mph nighttime; suburban 45 mph; residential and school districts 25 mph; business districts 20 mph; secondary roads 60 mph daytime, 50 mph nighttime.

Kansas: Interstate highways 75 mph daytime, 70 mph nighttime; open highways 70 mph daytime, 60 mph nighttime; residential districts 30 mph; business districts 20 mph; Kansas Turnpike 75 mph, 40 mph minimum.

Kentucky: Interstate highways 70 mph; open highways 65 mph daytime, 50 mph nighttime; residential and business districts 35 mph.

Louisiana: Open highways 4-lane, 70 mph; other open highways 60 mph.

Maine: Turnpike 70 mph daytime, 65 mph nighttime; open highways 45 mph; residential and business districts 25 mph.

Maryland: Interstate highways 70 mph; open country expressway 60 mph; dual lane highways 55 mph; other highways 50 mph; residential and business districts 30 mph; thinly settled areas 35 mph; other highways 30 mph.

Massachusetts: Turnpike 65 mph; divided highway 50 mph; other highways 40 mph; residential and business districts 30 mph; school zones 20 mph.

Michigan: Freeways 70 mph; open highways 65 mph daytime; 55 mph nighttime; residential 25 mph.

Minnesota: Open highways 60 mph daytime; 55 mph nighttime; all speeds in urban districts 30 mph.

Mississippi: Interstate highways 70 mph; open highways 65 mph; residential districts 25 mph; business districts 20 mph; school zones 15 mph.

Missouri: Dual lane U.S. routes 70 mph; undivided U.S. routes 70 mph daytime; 65 mph nighttime; other open highways 60 mph daytime; 60 mph nighttime; municipalities 45 mph.

Rhode Island: Residential and business districts 25 mph; elsewhere 30 mph daytime, 45 mph nighttime.

South Carolina: Interstate System 70 mph daytime, 65 mph night; State highways 00 mph daytime, 55 mph night; urban districts 30 mph.

South Dakota: Interstate highways 75 mph daytime, 70 mph nighttime; open highways 70 mph daytime, 60 mph nighttime; residential and business districts 30 mph; school zones 15 mph.

Tennessee: Open highways 65 mph day, 55 mph night; school zones 15 mph; Interstate highways 75 mph.

Texas: Federal or State roads 70 mph daytime, 65 mph nighttime; other rural roads 60 mph daytime, 55 mph nighttime; in urban districts 30 mph.

Utah: Open highways as posted; residential and business districts 25 mph; school zones 20 mph.

Vermont: Interstate highways 65 mph; open highways 50 mph.

Virginia: Interstate 70 mph; all others 55 mph or as posted; residential, business and school areas 25 mph.

Washington: County roads 50 mph; cities and towns 25 mph; school zones 20 mph; Interstate highways 70 mph; in other locations 60 mph.

West Virginia: Interstate highways, 70 mph; Turnpike 60 mph, open highways 55 mph; residential districts 25 mph; school zones 15 mph.

Wisconsin: Interstate highways 70 mph daytime, 60 mph nighttime; open highways 65 mph daytime, 55 mph nighttime; residential and business districts 25 mph; school zone 15 mph.

Wyoming: Open highways 4-lane divided, 70 mph; open highways 65 mph; residential districts 30 mph; business and school districts 20 mph.

Canal Zone: Outside town limits 40 mph; within town limits 25 mph.

Guam: Roads 45 mph; school zones when children at recess or going to and from school 10 mph.

Puerto Rico: Open highways 45 mph; urban districts and school zones 15 mph.

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<tbody>
<tr>
<td>Mountain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Montana</td>
<td>11,368,330</td>
<td>8,283,590</td>
</tr>
<tr>
<td>Idaho</td>
<td>786,690</td>
<td>694,408</td>
</tr>
<tr>
<td>Wyoming</td>
<td>943,936</td>
<td>713,008</td>
</tr>
<tr>
<td>Colorado</td>
<td>470,816</td>
<td>332,416</td>
</tr>
<tr>
<td>New Mexico</td>
<td>2,888,834</td>
<td>2,207,250</td>
</tr>
<tr>
<td>Arizona</td>
<td>1,299,968</td>
<td>1,016,000</td>
</tr>
<tr>
<td>Utah</td>
<td>2,717,006</td>
<td>1,772,482</td>
</tr>
<tr>
<td>Nevada</td>
<td>1,461,037</td>
<td>1,059,273</td>
</tr>
<tr>
<td>Pacific</td>
<td>798,184</td>
<td>488,730</td>
</tr>
<tr>
<td>Washington</td>
<td>31,796,100</td>
<td>26,525,774</td>
</tr>
<tr>
<td>Oregon</td>
<td>4,130,103</td>
<td>3,409,100</td>
</tr>
<tr>
<td>California</td>
<td>2,632,063</td>
<td>2,091,365</td>
</tr>
<tr>
<td>Alaska</td>
<td>23,068,262</td>
<td>19,903,134</td>
</tr>
<tr>
<td>Hawaii</td>
<td>400,481</td>
<td>302,173</td>
</tr>
<tr>
<td>Puerto Rico</td>
<td>903,000</td>
<td>759,513</td>
</tr>
<tr>
<td></td>
<td>3,198,520</td>
<td>2,712,083</td>
</tr>
</tbody>
</table>
IV. QUESTIONS

1. Before the mandatory 55 m.p.h. speed limit did speed limits vary from state to state? Give examples.

2. What factors influenced the speed limit of each state?

3. Locate the states on the map and determine regions. What is the correlation between region and speed limit?

Construct two graphs, one of a ten year period before mandatory 55 MPH and one of a ten year period after, graph fatalities per year and compare (see Below)

<table>
<thead>
<tr>
<th>Deaths</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td>40,000</td>
<td>40,000</td>
</tr>
<tr>
<td>30,000</td>
<td>30,000</td>
</tr>
<tr>
<td>20,000</td>
<td>20,000</td>
</tr>
<tr>
<td>10,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>

4. Was there a decrease in fatalities from 1973 to 1983 in each state?

5. The 55 m.p.h. speed limit was put into law to save fuel. Has it accomplished anything else?

6. What do you feel about states rather the Federal Government establishing their own speed limits as in the past?
ACTIVITY 3: Fuel Consumption and the Speed Limit

Objectives: The students should be able to:

1. analyze data concerning fuel consumption and speed.
2. identify the major factors affecting fuel consumption at different speeds.
3. evaluate positive and negative aspects of the 55 MPH speed limit.

Teacher Background: No additional information needed.

Materials: Pen and Paper

Student Activity Sheets:

SAS 3.1 History of Cars and Speed
SAS 3.2 Effect of Speed on Fuel Consumption Rates Automobile
SAS 3.3 Questions

Suggested Procedures: Read SAS 3.1 on history of cars and speed. After this take a vote on whether fuel is saved by driving at 55 MPH as opposed to 70 MPH? Put results on board, use data table (see SAS 3.2) to answer the questions on the student activity sheet. Discuss answers with the rest of the class. After discussion take poll again.
History of Cars and Speed

The first automobile in the United States was driven in 1893. Almost immediately, design set out to see how fast he could make it go. By 1894, people were talking about an automobile race. The first race took place one year later in Chicago. It was a 52-mile race with the winner averaging 5.05 MPH.

By 1900, when cars were first produced in any large quantity, 10 MPH was considered a reasonable speed on the open road. In 1901, New York and Connecticut passed the first motor vehicle speed limit laws in the United States. The speed limits were 8 MPH in the cities and 15 MPH on the open road. These laws also contained a provision that a motorist, upon meeting a horse, must pull to the side of the road and, if necessary turn off the motor to allow the horse to pass. These early speed laws were passed mainly to pacify the non-motorists who complained of the noise and dust as opposed to modern day speed limits that are designed to protect the motorist from himself and from other motorists. Now, of course, speed limits are imposed to conserve fuel, too.

From the very early car speeds of 5 MPH, cars quickly became capable of higher speeds. In 1904, Henry Ford set a world's land speed record of over 93 MPH! By this time, highway speeds were about 15 MPH, mostly because the road system was not designed or constructed for automobile traffic. They were more suitable for horse and buggy travel. Very few paved roads existed. However, road construction for automobile traffic began about 1900 and has continued until the present time. Speed and speed limits continued to increase as a network of paved roads grew across the nation.

- Department of Transportation
IV. Effect of Speed on Fuel Consumption Rates

Automobiles

<table>
<thead>
<tr>
<th>Test Car Number and Net Weight (lbs.)</th>
<th>Miles Per Gallon At Selected Speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>35</td>
</tr>
<tr>
<td>1  (4,880)</td>
<td>17.12</td>
</tr>
<tr>
<td>2  (3,500)</td>
<td>19.30</td>
</tr>
<tr>
<td>2A (3,500)</td>
<td>21.33</td>
</tr>
<tr>
<td>3  (3,540)</td>
<td>23.67</td>
</tr>
<tr>
<td>4  (3,975)</td>
<td>18.25</td>
</tr>
<tr>
<td>5  (2,450)</td>
<td>31.45</td>
</tr>
<tr>
<td>6  (3,820)</td>
<td>22.88</td>
</tr>
<tr>
<td>7  (3,990)</td>
<td>15.61</td>
</tr>
<tr>
<td>8 (2,050)</td>
<td>(24.79)</td>
</tr>
<tr>
<td>9  (2,290)</td>
<td>21.55</td>
</tr>
<tr>
<td>10 (2,400)</td>
<td>22.72</td>
</tr>
<tr>
<td>11 (5,250)</td>
<td>18.33</td>
</tr>
<tr>
<td>12 (4,530)</td>
<td>20.33</td>
</tr>
<tr>
<td>Average (Unweighted)</td>
<td>21.05</td>
</tr>
</tbody>
</table>

\(^1\)Since vehicle #8 could not be operated satisfactorily at 75 miles per hour, its miles per gallon performances were omitted from the averages. They are, however, given in parentheses.
IV. Questions

1. Do many cars get more miles per gallon at 35 mph than at other speeds?

2. Do many cars get more miles per gallon at 45 mph than at other speeds (identify the test car number)?

3. Do any cars get their best mileage at 55 mph (identify the test car number)?

4. Do any of these cars get more miles per gallon at speeds of 65 or 75 mph than at other speeds? (Identify the test car number.)

5. Using cars 10, 11 and 12 which car gets the best mileage at 35 mph? 45? 55? 65? 75? Which car get the least mileage at these speeds?

6. Give possible reasons why vehicle #8 could not be operated satisfactorily at 75 mph.

7. List some negative aspects of the 55 mph speed limit.

8. Would it be reasonable to set a speed limit at 35 mph? Why?

9. What effect has the speed limit on natural resources?

10. Of the cars offered which one would you buy?
Activity 4.

Do Seatbelts and Other Safety Devices Prevent Injury and Death?

Objectives: The students should be able to:

1. make their own decisions concerning the effectiveness of seat belts and other safety devices.

2. analyze data concerning accidental deaths.

Materials:

Equipment designated by the lab sheet.

Pencil

Paper

Graph paper

Student Activity Sheets:

SAS 4.1 Lab sheet - Testing Automobile Safety Devices
SAS 4.2 Lab sheet - Questions
SAS 4.3 Accidental Death Data
SAS 4.4 Questions

Suggested Procedures:

1. Lab procedure for determining the effectiveness of seat belts and other safety devices.

2. Using data sheet 4.3, graph and answer questions.

Supplementary Materials:

1. Bureau of Safety Programming and Analysis
   109 Transportation and Safety Building
   Harrisburg, PA 17120

   Booklets
   *Buckle Up Baby
   *Safety Belt Roulette
   *Speed Limits Life

   General Services Division
   400 Seventh ST., S.W.
   Washington, DC 20590

   Booklets
   *Alcohol, Drugs, and Young Drivers
   *55 - Judge for Yourself
   *There are lots of safety belt myths - why not consider the truths
IV.  

Automobile Safety Devices

**Purpose:** To show the effectiveness of various automobile safety devices.

**Apparatus:**
Hall’s carriage modified with wood back and Velcro dots  
Clay figure  
Shoestring seat belt  
Cork head rest,  
Balloon air bag  
ramp for launching cart (Use ramp from Module III, Activity 5)

![Diagrams]

1. Place the clay figure in the cart according to the instructions for each trial in the data table below.
2. Place cart on the ramp at the same starting point for each trial and allow the cart to roll down the ramp and strike the board.
3. Describe the damage done to the clay figure as to head, arms and legs, and trunk.
<table>
<thead>
<tr>
<th>Trial</th>
<th>Description of Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 no safety devices</td>
<td></td>
</tr>
<tr>
<td>2 seat belt only</td>
<td></td>
</tr>
<tr>
<td>3 seat belt and head rest</td>
<td></td>
</tr>
<tr>
<td>4 seat belt, head rest, and air bag</td>
<td></td>
</tr>
</tbody>
</table>
IV. SAS 4.2

Questions relative to lab

1. What was the reason for starting the cart from the same height each trial?

2. In which trial was the passenger most injured. Why?

3. In which trial was the passenger the least injured. Why?

4. Give reasons for making the use of seat belts and air bags mandatory.

5. What are the arguments or NOT making seat belt use and air bags mandatory?
## IV.

**Accidental Death Data Sheet**

### Table 1

Accidental Deaths by Age, Sex, and Type in 1980

*(National Safety Council)*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Total Accidental Deaths</th>
<th>Motor Vehicles</th>
<th>Falls</th>
<th>Drownings</th>
<th>Fires/Burns</th>
<th>Poison</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>4479</td>
<td>1426</td>
<td>155</td>
<td>803</td>
<td>846</td>
<td>73</td>
</tr>
<tr>
<td>5 - 14</td>
<td>5524</td>
<td>2747</td>
<td>89</td>
<td>856</td>
<td>478</td>
<td>33</td>
</tr>
<tr>
<td>15 - 24</td>
<td>26204</td>
<td>19040</td>
<td>515</td>
<td>278</td>
<td>564</td>
<td>522</td>
</tr>
<tr>
<td>25 - 44</td>
<td>26772</td>
<td>16133</td>
<td>1066</td>
<td>1858</td>
<td>1017</td>
<td>1372</td>
</tr>
<tr>
<td>45 - 64</td>
<td>18140</td>
<td>8022</td>
<td>2116</td>
<td>902</td>
<td>1245</td>
<td>650</td>
</tr>
<tr>
<td>65 - 74</td>
<td>8997</td>
<td>2991</td>
<td>18040</td>
<td>307</td>
<td>749</td>
<td>218</td>
</tr>
<tr>
<td>75+</td>
<td>15950</td>
<td>2813</td>
<td>7513</td>
<td>253</td>
<td>923</td>
<td>221</td>
</tr>
</tbody>
</table>
Table 2
Percentage of Accidental Deaths Caused by Motor Vehicles
(National Safety Council)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Motor Vehicles Deaths (total)</th>
<th>Motor Vehicles Deaths (as a % of all accidental deaths)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 4</td>
<td>1426</td>
<td>31.8%</td>
</tr>
<tr>
<td>5 - 14</td>
<td>2747</td>
<td>52.6%</td>
</tr>
<tr>
<td>15 - 24</td>
<td>19040</td>
<td>72.7%</td>
</tr>
<tr>
<td>25 - 44</td>
<td>16133</td>
<td>60.3%</td>
</tr>
<tr>
<td>45 - 64</td>
<td>8022</td>
<td>44.2%</td>
</tr>
<tr>
<td>65 - 74</td>
<td>2991</td>
<td>33.0%</td>
</tr>
<tr>
<td>75+</td>
<td>2813</td>
<td>17.6%</td>
</tr>
</tbody>
</table>

*Note: 150,000 people were permanently disabled in car accidents in 1983. (National Safety Council).

Accidental Death Data Sheet

Procedure:

1. Use Table 1 to make Bar Graph 1 placing Total Accidental Deaths (for each age group) on the vertical axis and Age Group on the horizontal axis.

2. Use Table 1 to make Bar Graph 2 placing Motor Vehicle Deaths (for each age group) on the vertical axis and Age Group on the horizontal axis.

3. Use Table 2 to make Bar Graph 3 placing Motor Vehicle Deaths as a percent of all Accidental Deaths (for each age group) on the vertical axis and Age Group on the horizontal axis.
Accidental Death Questions

1. What age group has the most total accidental deaths? Which has the least? Can you give some possible reasons why?

2. Which age group has the most accidental deaths caused by motor vehicles? Which group has the least? Can you give some possible reasons why?

3. Use Table 1 to determine the type of accident that causes the most deaths for each age group. How does your answer relate to great concern for seat belt use in this country?

4. Seat belts greatly increase your chance of surviving a bad car accident. You are 60% less likely to receive serious or fatal injuries if you wear a seat belt. Why is seat belt use important to your age group? Use Graph 3 to help in forming an answer.

5. Child restraint laws, particularly for those younger than 4 years of age have received much publicity lately. Use Table 1 or Table 2 to explain why this makes sense. How must youngsters less than age 4 be protected while riding in a car in Allegheny County?
PITTSBURGH, STS PROJECT
TEACHER EVALUATION FORM

Name ____________________________ Module: Intro A 1 2 3 4 (circle one)

School ____________________________ Activity Title & Number __________

Grade Level __________ ______

Please ANSWER EACH OF THE FOLLOWING QUESTIONS AT THE COMPLETION OF EACH ACTIVITY. Please comment in more detail on separate pages of paper where appropriate. Circle the most appropriate response.

1. OBJECTIVES

Were the stated objectives clear and accurate? Excellent Good Poor

2. TEACHER BACKGROUND

Was the teacher background accurate? Excellent Good Poor

Was the information provided a sufficient background on the subject? Excellent Good Poor

3. MATERIALS

Was the materials list complete? Excellent Good Poor

Did you have enough of each material required? Excellent Good Poor

*Please indicate any resources, books (teacher or student), equipment, etc. that you recommend for inclusion in future modules.

4. STUDENT ACTIVITY SHEETS

Were the Student Activity Sheets (SAS):

Relevant to the objectives? Excellent Good Poor

Clear and logical? Excellent Good Poor

*Which were the most successful activities?

5. EXTENDED ACTIVITIES

*Have newly acquired decision making skills lead to action on personal problems? Involvement in community organizations? Involvement in local government issues? Other?
6. **EVALUATION**

What method of student evaluation did you use? (SAS sheet, separate test, etc.?)

*How successful were the students?

7. **PROCEDURE**

Was the suggested procedure clear and complete?  

Excellent  Good  Poor

*Did you follow the suggested procedure?  What modifications, if any, did you make?

8. **RATE THE FOLLOWING:** (circle one)

Student interest  High  Medium  Low

Appropriateness of material for students  High  Medium  Low

9. Do you recommend this activity for future use?

10. Other comments/recommendations:

Teacher signature __________________________ Date ________

Date when Activity was completed 186