The career activities guide in mathematics, part of an Idaho State Department of Vocational Education career exploration series for grades 7, 8, and 9, is designed as supplementary material to enrich the regular curriculum. Any one activity in the guide might be used without involving any other activities. The cross-referenced index indicates grades, subject, career cluster, occupation, and, in most instances, subject concept. Performance objectives, activity situation and steps (mainly situational mathematical problems), materials, and special recommendations are outlined for the various job titles. Career clusters included are: home economics and consumer; industrial arts; arts, crafts, and humanities; business occupations; communications and media; hospitality and recreation; environmental control; personal service; manufacturing; transportation; health occupations; public service; agriculture and natural resources; marine science; marketing and distribution; construction; and miscellaneous activities. Subject concepts involve various aspects of science such as fractions, ratios, decimals, equivalent values, ruler measurements, proportions, metric system, percentages, chart reading, scientific notation, exponents, geometry, cost formulas, graph relations, and weights and heights. (EA)
CAREER ACTIVITIES IN MATHEMATICS

GRADES 7·8·9

BOISE SCHOOLS
IDAHO
PREFACE

The Career Exploration curriculum in this book was developed through a grant from the Idaho State Department of Vocational Education from March 11, 1974 through June 30, 1974. The activities were written by Boise Independent School District personnel.

The activities included are some of the ideas relating to careers which are being used to some degree in many classrooms. It is the purpose of this program to gather and develop many of these ideas and make them available to all seventh, eighth and ninth grade teachers in an integrated format within mathematics, science, language arts and social science.

Any one activity in the book might be used by a teacher or student without involving any other activities. They are designed to enrich the regular curriculum and can be "plugged in" where they seem appropriate. The cross-reference index will indicate grade, subject, career cluster, occupation and, in most instances, subject concept.
ACKNOWLEDGEMENTS

The activities in this guide were developed and written by the following Boise Independent School District personnel:

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Le Anne Carter  Language Arts  South Jr. High
Elaine Chappel  Science  South Jr. High
Christina Cline  Art  South Jr. High
Joe Cobb  Serve Occupations  Career Education
Larry Erickson  Science  South Jr. High
Kathy Erstrom  Language Arts  South Jr. High
Georgia Hansen  Language Arts  South Jr. High
Stanford Harrison  Science  West Jr. High
James Hawkins  Mathematics  South Jr. High
Harvey Hoskins  Social Science  West Jr. High
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Robert Stimpert  Arts and Crafts  South Jr. High
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Peggy Gregory  Counselor  South Jr. High
Lee Fortin  Project Bldg. Coordinator  South Jr. High
Robert Curtis  Principal  South Jr. High

The artwork was done by:
Colleen Maloney  Graphic Artist  Boise School Dist.
Laurel Johnson  Secretary  Career Education

George Washburn  Career Development Consultant  Boise Independent School District
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DIRECTIONS FOR USE OF THIS GUIDE

The purpose of this guide is to help show relationships between school subjects and practical application through simulated activities. These activities are meant to be an enrichment supplement to the regular school curriculum, taught at those times when the instructor determines they are most applicable to that subject's concepts.

The activities were written to be used in four subject areas; mathematics, science, social sciences and language arts; and in grades seven, eight and nine. The intent is to involve all fifteen occupational cluster areas, as designated by the U. S. Office of Education, with these four subject areas in the three grade levels. They can be used as entire class activities, small group assignments or individual study.

The following pages contain cross-referencing of the activities in this guide:

Activity number with cluster, job and concept reference--pages ii through xiii.

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<td></td>
<td>C 1</td>
<td>Fine Artist</td>
<td>using a ruler, angles, construction</td>
</tr>
<tr>
<td></td>
<td>C 2</td>
<td>Potter</td>
<td>percentage</td>
</tr>
<tr>
<td></td>
<td>C 3</td>
<td>Delineator</td>
<td>proportion</td>
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<tr>
<td></td>
<td>C 4</td>
<td>Macrame Artist</td>
<td>proportion, percentage</td>
</tr>
<tr>
<td></td>
<td>C 5</td>
<td>Potter</td>
<td>division of percentage</td>
</tr>
<tr>
<td></td>
<td>D 1</td>
<td>Banker</td>
<td>percentages, multiplication, addition, division</td>
</tr>
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## Career Exploration Project

**June 30, 1974**

<p>| SUBJECT | MATHEMATICS | GRADE | 9 |
|---------|-------------|-------|
| # | CLUSTER | JOB AREA | SUBJECT CONCEPT |
| 9 | E. Communications &amp; Media: | | |
| | F1 Hospitality &amp; Recreation | Hotel Manager | percentage |
| | G. Environmental Control | | |
| | H. Personal Service | | |
| | I1 Manufacturing | Chemist | ratios, rates &amp; flow |
| | I2 Manufacturing | Physicist, Elect. Engineer | exponents, scientific notation |
| | J1 Transportation | Airline Pilot | speed, distance, time, vector additions |
| | J2 Transportation | Astronaut, Physicist, EngIn. | proportion, inverse proportion, power, functions |
| | J3 Transportation | Astronaut | square roots, functions, exponents, ratios |
| | K1 Health Occupations | Doctor | proportions &amp; functions |
| | K2 Health Occupations | Laboratory Technician | ratios, percents |
| | L1 Public Service | License Clerk | percentage |
| | L2 Public Service | Deputy Sheriff | weights &amp; heights |</p>
<table>
<thead>
<tr>
<th>#</th>
<th>CLUSTER</th>
<th>JOB AREA</th>
<th>SUBJECT CONCEPT</th>
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<tr>
<td>N1</td>
<td>Marine Science</td>
<td>Ship's Navigator</td>
<td>analytic geometry</td>
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<td>N2</td>
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<td>Ship's Navigator</td>
<td>geometry, time &amp; angle measures</td>
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<td>01</td>
<td>Marketing &amp; Distribution</td>
<td>Retail Clerk</td>
<td>addition, simple percentage</td>
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<td>02</td>
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<td>P1</td>
<td>Construction</td>
<td>Homeowner</td>
<td>volumes, simple algebra</td>
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<td>P2</td>
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<td>Architect, Civil Engineer</td>
<td>area, volume, scale drawing</td>
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Q. Miscellaneous Activities
### MATHEMATICS CONCEPTS

<table>
<thead>
<tr>
<th>CONCEPT</th>
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<td>8A^1, 8A^5</td>
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<td>2. Algebra</td>
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<td>3. Analytic Geometry</td>
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<td>4. Area</td>
<td>7P</td>
<td>8P^1, 8P^2</td>
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<td>5. Charts</td>
<td>7J^2, 7K^1, 7K^2, 7N</td>
<td>8J</td>
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<td>6. Decimals</td>
<td>7A^4, 7A^5, 7C^5, 7F, 7I^2</td>
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<td>7. Division</td>
<td>7A^4, 7G^1</td>
<td>8A^1, 8B^3, 8B^5</td>
<td>9C^5, 9D</td>
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<td>8. Equivalent Volume &amp; Values</td>
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<td>9. Exponents</td>
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<td>11. Fractional Equivalency</td>
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<tr>
<td>12. Fractions</td>
<td>7A², 7C¹</td>
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<td>13. Geometry</td>
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<td>14. Graphing</td>
<td>7B⁴</td>
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<td>15. Interpolation</td>
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<td>16. inverse Proportion</td>
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<td>17. Metric System</td>
<td>7C⁴</td>
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<td>18. Multiplication</td>
<td>7A², 7A⁴, 7C⁵, 70¹</td>
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<td>19. Percentages</td>
<td>7H</td>
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<td>20. Problem-Solving</td>
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<td>21. Proportions</td>
<td>7C³, 7C⁴, 7M</td>
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<td>22. Ratios</td>
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<td>23. Ruler Measurements</td>
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<tr>
<td>25. Scientific Notation</td>
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<td>26. Square Inch</td>
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<td>27. Square Root</td>
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<td>28. Subtraction</td>
<td>7A³, 7D, 7G²</td>
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<td>29. Volume</td>
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<td>30. Weights &amp; Measures</td>
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The clusters used in this curriculum guide are those designated by the U. S. Office of Education plus one additional in Industrial Arts. The first three; Home Economics and Consumer Education; Industrial Arts; and Arts, Crafts and Humanities; each have five or more activities; whereas, the remaining clusters average one. One of the objectives of the project is to show more practical relationships between school subjects as well as subjects and occupations. This is the reason for the emphasis on the first three clusters which are also subject areas in the junior high years.

The clusters used in this curriculum for all three grade levels are:

a) Home Economics and Consumer Education
b) Industrial Arts
c) Arts, Crafts and Humanities
d) Business Occupations
e) Communications and Media
f) Hospitality and Recreation
g) Environmental Control
h) Personal Services
i) Manufacturing
j) Transportation
k) Health Occupations
l) Public Services
m) Agriculture and Natural Resources
n) Marine Science
o) Marketing and Distribution
p) Construction
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<th>LANGUAGE ARTS</th>
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<td><strong>29</strong></td>
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**APPENDIX A**
ACTIVITY  Page 1 of 2

I. SITUATION

The student is a restaurant cook who must enlarge basic recipes. Once the recipes are enlarged, the measures may be written in simpler terms. For example: four tablespoons is the same as one-fourth cup, four cups is the same as one quart. When measuring amounts of ingredients, it is easier to measure a single large amount than many smaller amounts.

II. STEPS

1) Study the equivalent measures and weights below:
   a) 3 tsp = 1 T
   b) 2 T = 1 fluid ounce
   c) 4 T = 1/2 cup
   d) 8 T = 2 cups
   e) 12 T = 3/4 cup
   f) 16 T = 1 cup
   g) 1 cup = 8 fluid ounces
   h) 2 cups = 1 pint
   i) 4 cups = 1 quart
   j) 4 quarts = 1 gallon
   k) 4 ounces = 1/2 pounds
   l) 16 ounces = 1 pound

2)  Write the measures below in the simplest equivalent amount.
   a) 6 tsp = ______________________
   b) 4 cups = ______________________
   c) 18 T = ______________________
   d) 6 cups = ______________________

RECOMMENDATIONS

Cookbooks should be available for references.

MATERIALS

Measuring spoons
Measuring cups
ACTIVITY

3) Have the students use measuring cups and spoons to see if the equivalency chart above is accurate.
ACTIVITY

I. SITUATION

A common situation many chefs are confronted with is enlarging recipes to serve many people. The recipe below, for Swiss Steak, serves six. If a party of twenty-four people is expected, the chef must enlarge the recipe four times.

Example:

**Swiss Steak**

- 2 1/4 lbs round steak
- 1/4 C. flour
- 1 tsp salt
- 1/4 tsp pepper
- 2 T salad oil
- 1 large onion
- 1 stalk celery
- 2 C cooked tomatoes

Enlarged recipe:

- $4 \times \frac{2\frac{1}{4}}{2} = 10$ lbs steak
- $4 \times \frac{1}{4} = 1$ C flour
- $4 \times \frac{1}{4} = 4$ tsp salt
- $4 \times \frac{1}{4} = 1$ tsp pepper
- $4 \times 2 = 8$ T oil
- $4 \times 1 = 4$ onions
- $4 \times 1 = 4$ stalks celery
- $4 \times 2 = 8$ C tomatoes

II. STEPS

1) Given the following recipe for fudge, (a) double the original recipe (b) halve the original recipe and (c) triple the original recipe.

**MATERIALS**

Example cookbooks
FUDGE

3 C sugar
1/2 tsp salt
1/2 C sifted unsweetened cocoa
1 C milk
2 T corn syrup
3 T butter
1 tsp vanilla
1 C chopped nuts

2) Given the following recipe for macaroni and cheese,
   (a) triple the original recipe  (b) one and a half times
   the original recipe  (c) halve the original recipe.

MACARONI & CHEESE

1/2 C butter
1 8 ounce package macaroni
1 tsp salt
1/2 tsp pepper
1/8 tsp oregano
1/2 tsp dry mustard
2 C water
1 1/2 T flour
14 1/2 ounces canned milk
2 C sharp cheddar cheese
1 T parsley
ACTIVITY

I. SITUATION

The student is a boat owner. He needs to mix gasoline and oil in the proper ratio to keep the motor operating properly. The Owner's Manual states that for normal operation the ratio of gasoline to oil should be 50 to 1. For the 25-hour break-in period, the mixture should be 25 to 1.

II. STEPS

Assume that you will use two standard six-gallon gas tanks and you purchase your outboard motor oil in one-pint containers.

1) Calculate how much oil should be used for a 50/1 ratio to fill a six-gallon tank.
2) Calculate the same for a 25/1 ratio.

On practical operation, most boat owners simply add one pint of oil to a tank of gas for 50/1 ratio and 1 quart of oil to a tank of gas for a 25/1 ratio.

RECOMMENDATIONS

Recommend a three-day field trip to teach class to water-ski.

MATERIALS

Weights and measures table
I. SITUATION

The student is a purchasing agent who is comparing the prices of group item buying to single item prices. He will first determine the price of single item out of a group purchase price and then determine the better buy.

Example: Peas are advertised as 3 cans/82¢

\[
\text{Price per can} = \frac{3 \times 82}{10} = 2.46 \text{ Round off to nearest penny.}
\]

\[
\frac{246}{10} = 2.46 \approx 2.46 \text{ per can}
\]

II. STEPS

1) Study the store advertisements concerning foods. Make a list of at least ten items that are group priced.

2) Figure the price of a single item from the list in (1).

3) Compare the price lists on the next page for the two grocery stores "A" and "B". State which store gives the better buy. How much savings is there?

MATERIALS

Roomset: newspaper ads
<table>
<thead>
<tr>
<th>ITEM</th>
<th>A</th>
<th>B</th>
<th>BEST BUY</th>
<th>SAVINGS</th>
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</thead>
<tbody>
<tr>
<td>Hamburger</td>
<td>$.56</td>
<td>2/$1.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helper</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lettuce</td>
<td>3/$1.00</td>
<td>$.35/head</td>
<td></td>
<td></td>
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<tr>
<td>Eggs (Small)</td>
<td>2/$.89</td>
<td>.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Candy Bars</td>
<td>2/$.25</td>
<td>.17</td>
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</tbody>
</table>
ACTIVITY

I. SITUATION
A butcher purchases a steer at the livestock auction which weighs 1000 pounds for $.51 a pound. He paid $20 to have the steer killed and quick frozen. Weighing the meat after this, he had only 500 pounds of meat. How much does the meat cost him per pound?

II. STEPS
1) How much does the steer originally cost the butcher? (Add in the $20)
2) Divide the amount found in (1) to figure the cost per pound of 500 pounds of meat.
3) A pig weighs 225 pounds before being butchered. A butcher buys it for $.42 a pound plus $15 for killing, freezing and cutting it up. If there is only 140 pounds of cured meat, what is the actual cost per pound?

RECOMMENDATIONS
Field trip to livestock auction or butcher shop.

MATERIALS
ACTIVITY

I. SITUATION

You are an Electronics Technician in an industrial plant. You have a battery, a set of resistors of known resistance, a volt meter and an ammeter. You measure the voltage of the battery and the current through one resistor with an ammeter when your boss tells you that they need your ammeter immediately at Cape Kennedy for the next space shot. You decide that you "can carry on" without this meter because you have confidence in your own ability to predict the current in the resistors. How can you do it?

II. STEPS

1) \[ E = I \times R \] where \( E \) is the voltage, \( I \) = current in amperes and \( R \) = resistance in ohms. For your first resistor, \( R_1 \), measure the voltage across the resistor and the current through it.

2) For the other resistors, \( R_2, R_3, \ldots \), predict the value of current, \( I \), that will result and verify with the ammeter. Keep track of your actual meter readings and predictions (suggested form on the following page).

3) Now use \[ P = I^2R \] where \( P \) = power in watts, to determine how much power is being consumed in the resistor.

4) Find the resistance of and power consumed by a bell and a light bulb by measuring the current through them. \( R = \frac{E}{I} \)

RECOMMENDATIONS

MATERIALS

Set of 4 or 5 resistors with predetermined resistances, 1 6-volt battery, 1 volt-ammeter, 1 6-volt light bulb, 1 6-volt bell
<table>
<thead>
<tr>
<th>Voltage</th>
<th>Predicted Current</th>
<th>Measured Current</th>
<th>Predicted Power (use measured current)</th>
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</thead>
<tbody>
<tr>
<td>R_1 = ohms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R_2 = ohms</td>
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<td></td>
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<tr>
<td>R_3 = ohms</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Bell</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulb</td>
<td></td>
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</table>
ACTIVITY

I. SITUATION
The student is a carpenter who is renovating an old table. He must be able to measure the length and width of the table to the exact sixteenth of an inch. The degree of accuracy of the measurement depends on the scale used.

II. STEPS
1) Each student will have a three-foot rule.
2) Each student will measure the length, width and height of his/her desk. Measure the distance to the nearest sixteenth of an inch.
3) Next, have the students measure the dimensions of the teacher's desk. Have the students compare their measurements.
4) Have the students measure the length and width of the room's windows. Compare measurements.

MATERIALS
Classroom set of three-foot rulers,
GRADE 7-B
SUBJECT Math
CLUSTER Industrial Arts
JOB TITLE Any trade
Carpenter
Plumber

CONCEPT
In connection with measurement, understanding fractional equivalency.

PERFORMANCE OBJECTIVE
The student will be able to measure an object, then rename the measure in other equivalent terms.

ACTIVITY
I. SITUATION
The student is a homeowner who is replacing a broker window. He must first measure the exact length and width of the window taking into consideration the portion of glass that is putted in. Measurement must be to the closest sixteenth of an inch.

II. STEPS
1) Review activity 7-B-1 on measurement.
2) The students will measure a window in the classroom.
3) Express the length and width of the window in sixteenths and then thirty-seCONDS. Example:
   L = 3' 9/16"; 3' 18/32"  
   W = 2' 8/16"; 2' 16/32"
4) Measure ten things in your room. Give each measure at least two names.
   Example:
   0 1" 2" 2 1/4", 2 2/8", 2 4/16", 2 8/32"
5) Equivalent names for measurements: always take fractions to the simplest or lowest terms. Example:
   8/16" = 1/2"
   20/32" = 10/16" = 5/8"
   a) 12/18" =
   b) 30/64" =
   c) 6/12" =

MATERIALS
Room set 6" rule which measures to 1/16 of an inch
References: Exploring Woodworks, page 29; Metalworks, page 37; General Woodworking page 14

MATERIALS

I. SITUATION

The student is a carpenter renovating an old table (see activity 7-B-1). Once he knows the dimensions of his table, he then develops a "working drawing". The working drawing is used to later figure up the amount of wood needed for the project. The working drawing usually shows the object in a size smaller than it really is.

II. STEPS

1) The teacher will show with the overhead an example working drawing using 1/4" graph paper and a 6" scale or rule (see attached working drawing).

2) The student will make a working drawing of a sample article (stool, cabinet, desk).

3) The teacher can hand out a given working drawing and ask the student to describe the dimensions with a given scale.

MATERIALS

Room set three-foot rules, 1/4" graph paper
References: General Shop, page 63; General Woodworks, page 3; Exploring Woodworks, page 21.
TABLE DIMENSIONS

Width: 6 1/4 feet
Length: 6 1/4 feet
Height: 2 3/8 feet
Width of legs: 1/2 foot

1/4" square = 1/2 foot
ACTIVITY

I. SITUATION

The student is a sheet metal worker who wants to build a fishing gear box. The dimensions of the desired box are 18 inches long, 5 inches deep and 8 inches wide. The question is, "How many square inches of metal is needed?"

II. STEPS

1) Study example problems.
2) Hand out a picture of a metal box or show the class an example metal box. Have the students develop a stretch-out on graph paper and figure the number of square inches.
3) The students can choose the dimensions of a given box and then draw the stretch-out on 1/4" graph paper. Figure the number of square inches of materials in the box. (Examples: book, bookshelves, cabinets, tape deck container.)

MATERIALS

References: Metalworks, page 39-42; General Shop, page 92
FIVE AREAS

\[2(5'' \times 18'') = 180 \text{ sq. inches}\]
\[2(8'' \times 5'') = 80 \text{ sq. inches}\]
\[1(8'' \times 18'') = 144 \text{ sq. inches}\]

\[404 \text{ sq. inches}\]
ACTIVITY

I. SITUATION
Any worker in construction must be able to identify a board foot. By definition, a board foot is one inch thick, twelve inches wide and twelve inches long. Thus a board foot has always 144 cubic inches.

II. STEPS
1) First, the student must learn to recognize equivalent board feet. By definition, a board foot is a unit of wood measurement one inch thick, twelve inches wide and twelve inches long.
   a) A board foot always has 144 cubic inches. Example: 12" X 12" X 1" = 144 cubic inches
   b) An equivalent piece of wood would be a 3" X 4" X 12". 3" X 4" X 12" = 12" X 12" = 144".

2) Name four other pieces of wood equivalent to one board foot.

3) Construct the board foot from exercise #2 using 1/4" graph paper. Let 1/4" square = 1" square.

4) How many board feet are in the following pieces of wood? Example: 6" X 8" X 12"
   a) 6" X 12" X 12"  b) 9" X 4" X 12"  c) 6" X 9" X 24"
   6" X 8" X 12" = 576 cubic inches = 4 board feet
   Divide 144/576
   576

RECOMMENDATIONS
Samples of board feet, overhead work-up of board feet.

MATERIALS
1/4" graph paper
References: Woodworks, page 21; General Woodworking, page 9
With secret agents all the rage these days, it was inevitable that one should find his way into the industrial arts classroom. This time "Agent .007" comes to help the junior high school student work out those sometimes tricky board feet problems.

There are several advantages to using the .007 method, including the following:

* High interest due to student association with popular TV and movie spy heroes.
* Industrial arts instructor can capitalize on student interest.
* Students need only to work with one mathematical process (multiplication) instead of a variety of processes.

Any method or process has its disadvantages, but in this case the advantages heavily outweigh the minor disadvantages. Some criticisms may be that:

* Answers to board feet problems in some cases will be only close approximations due to the use of the constant .007 instead of the true values of 1/144 or 1/12 x 1/12.
* Eventually the instructor will want to teach a more formal version of finding board feet and, if he is not careful, he may confuse his students.
* This method is practical where small sizes are involved. However, the multiplication can become cumbersome in large size pieces.

In actual use the student multiplies the number of pieces times the thickness in inches times the width in inches times the length in inches times .007 to find his answer. Simply stated as a formula: No. Pcs. x T x W x L x .007".

The above information was provided through the courtesy of the "WILCRAFTER", Vol. 1, No. 3.
ACTIVITY

I. SITUATION
An art student wants to mat two pictures on pieces of construction paper.

II. STEPS
1) First, for practice, the student centers a sheet of notebook paper on a piece of construction paper.

2) Center a painting 11 1/2" X 15" on a piece of construction paper 14 3/4" X 19 1/2".

3) Use a piece of construction paper 18" X 20 1/2" as a border for a 15" X 17" picture. The picture is to be centered except for a 1/2" extra bottom border. Therefore, the sides and top will have the same border width.
ACTIVITY

I. SITUATION

An artist needs to draw four three-dimensional perspective objects for a painting he/she is creating.

II. STEPS

The student will construct a three-dimensional drawing of a cube, a rectangular solid, a cylinder and a building:

- Cube
- Rectangular Solid
- Cylinder
- Building

PERFORMANCE OBJECTIVE

This activity will increase the student's ability to construct three-dimensional drawings.

MATERIALS
CONCEPT
Proportion, calculation of basic operations

PERFORMANCE OBJECTIVE
The student will determine the amount of jute needed to make a 30 inch by 36 inch wall hanging, as well as the cost of the project.

ACTIVITY
I. SITUATION
A student wants to make a 30 inch wide wall hanging of natural jute. He/she knows that cotton cord costs 2¢ a foot and natural jute (3 ply) costs 2¢ a yard.

II. STEPS
1) Determine how many cords it will take to make the 30 inch wide wall hanging if it takes 6 cords per inch of hanging.

2) The wall hanging will extend down 3 feet. It takes 8 inches of cord to make 1 inch of hanging. Find the length of each cord needed for the hanging.

3) What is the cost of the jute needed for the project?
ACTIVITY

I. SITUATION

The student will enlarge a 3" X 5" photograph to four times its size.

II. STEPS

1) Determine the enlarged dimensions.
2) Gather the materials.
3) Overlay the small graph paper on the photograph and trace the photograph and squares.
4) Use the large graph paper to transpose the picture onto the 12" X 20" paper.

MATERIALS

1 sheet of 1" graph paper, 1 sheet of ¼" graph paper, 1 sheet of 12" X 20" paper, 1 charcoal pencil, 1 3" X 5" photograph, straight edge
ACTIVITY

I. SITUATION
The student is a potter and has his own pottery shop. He needs to know the cost of the clay needed to make a pot.

II. STEPS
1) Student takes a large handful of wet clay and determines the weight or mass of the clay.
2) Student computes the cost of the clay, with the information that wet clay costs $.11 per pound or $.24 per kilogram.
3) History: A potter's wheel has been found in Northern Iran dating about 4,000 B.C. How old is this wheel?
4) For a related activity, see eighth and ninth grade potter activity.

RECOMMENDATIONS

MATERIALS
Metric balance, clay
ACTIVITY

I. SITUATION

Student "A" is a bank customer who has had difficulty in reconciling his/her checking account. Student "B" is a bank teller in customer service who has been asked by the manager to assist the "customer".

II. STEPS

1) Instructor will provide students A and B with needed forms and information.

2) Instructor will have filled in check register and bank balance sheets and will have built into the checkbook at least three computation errors. (Example: one deposit addition error, one check subtraction error, one overdraft check charge or overlooked service charge or safe deposit box charge, etc.)

3) Role-players will change and situation will change. Suggest at least three situations from step #2 to involve the whole class.

4) Problems will be worked out through reconciliation.

MATERIALS

Bank balance sheets with instruction for balancing, sample cancelled checks, checkbooks and check records and deposit records
ACTIVITY

I. SITUATION
There are blue-collar jobs as well as white-collar jobs in the hospitality and recreation area. Colleges give courses in hotel management while high school graduates might find jobs as bellmen, waitresses, lifeguards, etc. We choose the occupation of a waiter for this activity.

II. STEPS
Bill is a waiter and receives a wage of $2.76 per hour. Determine Bill's gross income for the week of April 8 through April 15.

Check total = total hours X $2.76 + tips.

<table>
<thead>
<tr>
<th></th>
<th>Hours</th>
<th>At $2.76/hour</th>
<th>Tips</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>8</td>
<td>$2.76 = ___</td>
<td>$7.25 = ___</td>
</tr>
<tr>
<td>Apr 10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td>7</td>
<td>$2.76 = ___</td>
<td>$5.76 = ___</td>
</tr>
<tr>
<td>Apr 11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>8</td>
<td>$2.76 = ___</td>
<td>$2.77 = ___</td>
</tr>
<tr>
<td>Apr 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td>5</td>
<td>$2.76 = ___</td>
<td>$.94 = ___</td>
</tr>
<tr>
<td>Apr 13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>9</td>
<td>$2.76 = ___</td>
<td>$10.74 = ___</td>
</tr>
<tr>
<td>Apr 14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturday</td>
<td>10</td>
<td>$2.76 = ___</td>
<td>$25.72 = ___</td>
</tr>
<tr>
<td>Apr 15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MATERIALS
ACTIVITY

I. SITUATION

A teacher gives a 15-problem test and would like to know the percentage for:

a) 15 problems correct
b) 14 problems correct
c) 13 problems correct
d) 12 problems correct
e) 11 problems correct
f) 10 problems correct

II. STEPS

Example: b) \( \frac{14}{15} = \frac{x}{100} \)

\[
\frac{1400}{15} = x \quad \frac{15}{1400.0} \quad \frac{135}{50} \quad \frac{45}{5.0} \\
93.3 = x \\
93.3\% \text{ for 14 problems correct}
\]
ACTIVITY

I. SITUATION

You are a physicist in a university laboratory and you are working on an experiment that has to do with the nature of matter. You know that electrons are electrically charged particles which are part of every atom and you consider them to be small spheres, like BB’s, that spin around atoms. They are very small; you say they have a radius of $2.8 \times 10^{-13}$ cm.

To prove a point to your students, you want them to find out how many of these BB’s you could line up together, touching each other, in a 1 centimeter row. You realize of course, that this is an impossible task since electrons repel each other and would fly apart immediately. If each electron has a mass of $9.1 \times 10^{-28}$ grams, how much mass does this row of electrons have?

Find 1 cm on your rulér and then think about why matter, made up of electrons and heavier particles is no heavier than it is.

$$\text{N} = \text{number of electrons in 1 cm row. If radius} = 2.8 \times 10^{-13}, \text{then diameter} = 5.6 \times 10^{-13}.$$ 

$$\text{N} = \frac{1}{5.6 \times 10^{-13}} = 1.79 \times 10^{12} = 1,790,000,000,000 = 1 \text{ trillion, 790 billion}.$$ 

$$\text{M} = \text{mass of electrons} = 1.70 \times 10^{12} \times 9.1 \times 10^{-28} = 1.63 \times 10^{-15} \text{ grams}.$$
PERFORMANCE OBJECTIVE
1) Students will add a series of decimals in a horizontal format.
2) Upon the satisfactory completion of the decimal activity, the student will measure and record the shaft by using the decimal system to a degree of 98% accuracy.

ACTIVITY
I. SITUATION
A tool and machine operator needs to find the length of two shafts from A to B.

II. STEPS
Add the decimal readings of the shaft parts.

MATERIALS
ACTIVITY

I. SITUATION

You are the chemist in charge of a large industrial laboratory where liquid fuel for space rocket engines is produced. You must make sure that the fuel is mixed in the proper proportions or else the rockets will not operate correctly, endangering the lives of the astronauts aboard the space ship. The two fuels you mix together are called fuel x and fuel y. You know that you must have 15% x and 85% y in the final fuel. You have three problems:

1. You must mix a batch of 7000 gal. of fuel for one space probe. How much of each fuel will you need?

2. At the Florida Space Port there is 42,500 gal. of y on hand and they want you to send them the right amount of x so they can launch the Mars space shuttle. How much x will you send?

3. There is a batch of fuel, 35,000 gal. on hand in Seattle that is 60% y and 40% x. How can you add x or y to it to make it in the right proportion? Which one will you add and how much?
ACTIVITY

I. SITUATION
You are an airline pilot whose route of flight takes you from Boise to Mountain Home Air Force Base, to Pocatello, to McCall and back to Boise. You will draw your route of flight on the chart provided. You will measure the distance between airports on your route and determine the direction of flight on each leg of the journey.

II. STEPS
1) Draw line from airport to airport.
2) Using the compass, mark off 10 nautical mile increments along each leg and measure the remainder accurately. Distance will be determined by the scale on the chart legend.
3) Measure the direction to fly from airport to airport. Set the protractor to measure the angle at which the flight path crosses a meridian (north–south line).
4) Fill out flight log. Suggested form:

<table>
<thead>
<tr>
<th>Leg</th>
<th>Heading</th>
<th>Distance</th>
<th>Ground Speed</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boise - Mountain Home</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mountain Home - Pocatello</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pocatello - McCall</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McCall - Boise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RECOMMENDATIONS

MATERIALS
Aeronautical charts of the Boise area, one per student; rulers; compasses; protractors
ACTIVITY

I. SITUATION

You are a doctor in Boise. You have several children who are running a fever from overwork at school; and you have discovered a wonderful drug that will make them well if you give exactly the right dose, but won't help at all if you give them too much or too little. Your drug works if you give the child exactly 9 milligrams for each pound of his body weight for each degree centigrade his temperature is above normal. Normal temperature is 98.6°F (37°C). And, by the way, your nurse dropped and broke your brand new centigrade thermometer this morning; and all she could find to use was your old-fashioned Fahrenheit model.

II. STEPS

Here is a list of your patients, their weights and their temperatures. The first dose is worked out for you so you can get the idea.

<table>
<thead>
<tr>
<th>Name</th>
<th>Weight</th>
<th>Temp.(°F)</th>
<th>Temp.(°C)</th>
<th>Degree Above Normal</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Janie</td>
<td>80</td>
<td>99.5</td>
<td>37.5</td>
<td>.5</td>
<td>360 mg</td>
</tr>
<tr>
<td>Susie</td>
<td>85</td>
<td>98.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tom</td>
<td>160</td>
<td>102.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sam</td>
<td>115</td>
<td>100.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Einstein</td>
<td>170</td>
<td>104</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Janet</td>
<td>77</td>
<td>101.3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Janie weighs 80 pounds, and her temperature is .5°C above normal. Her recommended dose of medicine is then .5 X 80 X 9 = 360 mg.

RECOMMENDATIONS

MATERIALS
ACTIVITY

I. SITUATION
In your job as operating room supervisor, you must insure that the equipment used by the doctors and nurses during operations is sterile. The device you use to heat the equipment to kill germs is called a sterilizer. The sterilizer is a kind of pressure cooker. It not only heats but increases the pressure on the instruments. The time required for sterilizing equipment depends on how hot the sterilizer gets. You have helpers working for you who actually do the sterilizing, but you must prepare the chart showing how long to sterilize each bundle of instruments.

II. STEPS
1) Fill out chart #1 to give your helpers their orders.
2) Use the chart #2 to make your decisions. (Chart #1 and #2 on the next page.)
### Sterilizer Worksheet

<table>
<thead>
<tr>
<th>Bundle</th>
<th>Time</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruments in padded tray</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dressings in paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubber gloves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sutures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brushes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubber tubing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syringes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Chart #1**

### Minimum Sterilization Exposure Periods for Manually Operated Cycles

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Temperature</th>
<th>Minutes</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brushes, in dispensers, in cans or individually wrapped</td>
<td>250-254 F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dressings, wrapped in paper or muslin</td>
<td>250-254 F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dressings, in canisters (on sides)</td>
<td>270 F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glassware, empty, inverted</td>
<td>270 F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instruments, metal only, any number (unwrapped)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instruments, metal, combined with suture, tubing or other porous materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instruments, metal only, in covered and or padded tray</td>
<td></td>
<td>15</td>
<td>0.5</td>
</tr>
<tr>
<td>Instruments, metal, combined with other materials (in covered and/or padded tray)</td>
<td></td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td>Instruments, wrapped in double-thickness muslin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linen, packs, (maximal size: 12 x 12 x 20&quot;) (maximal weight: 12 pounds)</td>
<td></td>
<td>15</td>
<td>0.5</td>
</tr>
<tr>
<td>Needles, individually packaged in glass tubes or paper (lumen moist)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Needles, unwrapped (lumen moist)</td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Rubber gloves, wrapped in muslin or paper</td>
<td></td>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>Rubber catheters, drains, tubing, etc. (lumen moist), unwrapped</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rubber catheters, drains, tubing, etc., individually packaged in muslin or paper</td>
<td></td>
<td>10</td>
<td>0.67</td>
</tr>
<tr>
<td>Treatment trays, wrapped in muslin or paper (lumen moist)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teeth, unwrapped</td>
<td></td>
<td>15</td>
<td>1.25</td>
</tr>
<tr>
<td>Teeth, wrapped in muslin or paper</td>
<td></td>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>Syringes, unassembled, individually packaged in muslin or paper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Syringes, unassembled, unwrapped</td>
<td></td>
<td>30</td>
<td>1.5</td>
</tr>
<tr>
<td>Sutures, silk, cotton or nylon, wrapped in paper or muslin</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Chart #2**
ACTIVITY

I. SITUATION

The Forest Service is planting trees and, due to the specific soil and climate conditions of the area, expects five of every eight trees which are planted to survive.

II. STEPS

The forester determines that the hillside (planting area) can support 850 trees. How many trees will the forester plant to get 850 surviving trees?
ACTIVITY

I. SITUATION

You are the navigator of an ocean liner. You are approaching a point of land where there is a 100' lighthouse. The captain asks you when he should be able to see it. Because of the curvature of the earth, the lighthouse is not visible to you until you get within 11.5 miles if you are looking from very close to the surface of the water. If you climb to the bridge of your ship, however, you can see much further, much in the same way you would climb a tree to see further down the block from your house. The higher up on your ship you stand, the farther away you should be able to see the lighthouse.

II. STEPS

1) The chart gives the distance to the horizon for various heights. You figure that 65 feet above the water level you can see 9.2 miles to the horizon. That makes a total of 20.7 miles out from the lighthouse when the tip of it should first begin to show above the horizon. Now the passengers below on the main deck want to know when they will first get to see the lighthouse from the main deck, which is 30 feet above the waterline. They also want to know when they will first get to see the torch in the hand of the Statue of Liberty, which is about 305 feet above sea level. You can now tell them both answers.

2) The statue's head is about 40 feet below the torch. When would it be visible to the passengers? How close would you have to be if you were standing up in a small boat?

(chart is on next page)

MATERIALS

Reference: Dutton's Navigation and Piloting, United States Naval Institute, Annapolis, Maryland.
## HORIZON DISTANCES

<table>
<thead>
<tr>
<th>Height in Feet</th>
<th>Distance in Miles</th>
<th>Height in Feet</th>
<th>Distance in Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2.5</td>
<td>115</td>
<td>12.3</td>
</tr>
<tr>
<td>10</td>
<td>3.6</td>
<td>120</td>
<td>12.6</td>
</tr>
<tr>
<td>15</td>
<td>4.4</td>
<td>125</td>
<td>12.9</td>
</tr>
<tr>
<td>20</td>
<td>5.1</td>
<td>130</td>
<td>13.1</td>
</tr>
<tr>
<td>25</td>
<td>5.7</td>
<td>135</td>
<td>13.3</td>
</tr>
<tr>
<td>30</td>
<td>6.3</td>
<td>140</td>
<td>13.6</td>
</tr>
<tr>
<td>35</td>
<td>6.8</td>
<td>145</td>
<td>13.8</td>
</tr>
<tr>
<td>40</td>
<td>7.2</td>
<td>150</td>
<td>14.1</td>
</tr>
<tr>
<td>45</td>
<td>7.7</td>
<td>155</td>
<td>14.3</td>
</tr>
<tr>
<td>50</td>
<td>8.1</td>
<td>160</td>
<td>14.5</td>
</tr>
<tr>
<td>55</td>
<td>8.5</td>
<td>165</td>
<td>14.7</td>
</tr>
<tr>
<td>60</td>
<td>8.9</td>
<td>170</td>
<td>14.9</td>
</tr>
<tr>
<td>65</td>
<td>9.2</td>
<td>175</td>
<td>15.2</td>
</tr>
<tr>
<td>70</td>
<td>9.6</td>
<td>180</td>
<td>15.4</td>
</tr>
<tr>
<td>75</td>
<td>9.9</td>
<td>185</td>
<td>15.6</td>
</tr>
<tr>
<td>80</td>
<td>10.3</td>
<td>190</td>
<td>15.8</td>
</tr>
<tr>
<td>85</td>
<td>10.6</td>
<td>195</td>
<td>16.0</td>
</tr>
<tr>
<td>90</td>
<td>10.9</td>
<td>200</td>
<td>16.2</td>
</tr>
<tr>
<td>95</td>
<td>11.2</td>
<td>260</td>
<td>18.5</td>
</tr>
<tr>
<td>100</td>
<td>11.5</td>
<td>270</td>
<td>18.9</td>
</tr>
<tr>
<td>105</td>
<td>11.7</td>
<td>300</td>
<td>19.9</td>
</tr>
<tr>
<td>110</td>
<td>12.0</td>
<td>310</td>
<td>20.1</td>
</tr>
</tbody>
</table>
ACTIVITY

I. SITUATION
Student is a checker in a local grocery store. Customer comes to checkstand with a basket of groceries containing fifteen items, ten of which are split-priced.

II. STEPS
1) Present an introduction to retail grocery careers. Give a background description of each of the following:
   a) Manager
   b) Assistant Manager
   c) Department Head
   d) Checker

2) Present an introduction to the capitalist system and profit motive.
   a) Lecture students regarding profit being the businessman's reward for the risk taken; therefore, the business is entitled to the next highest cent on a split-priced item.

3) Check single-priced items first.
   a) Ring on keys
   b) Call prices

4) Group multiple items by price and labels:
   a) Determine amount purchased versus sale price.
   b) Divide mentally to the next highest whole number to determine quantity price.
   Example: If the price for Hunts Tomatoes is 3/89¢ and the customer has one can, \[ \frac{29.66}{3/89¢} = 30¢ \] as the price to the customer for one can.

MATERIALS
1 NCR cash register (schedule two weeks ahead of time from Career Education Dept.), split-pricing test, background handout regarding retail grocery careers
ACTIVITY

I. SITUATION
Student is a checker in a local grocery store. Customer comes to checkstand with a basket of groceries containing fifteen items, ten of which are split-priced.

II. STEPS
1) Present an introduction to retail grocery careers. Give a background description of each of the following:
   a) Manager
   b) Assistant Manager
   c) Department Head
   d) Checker

2) Present an introduction to the capitalist system and profit motive.
   a) Lecture students regarding profit being the businessman's reward for the risk taken; therefore, the business is entitled to the next highest cent on a split-priced item.

3) Upon completion of cash register operation of checking and totalling tax chart:
   a) student will be tendered money to surpass amount owed,
   b) student will make change using least amount of money items (bills, coins) to arrive at proper change for customer.

4) Whole class will be tested with attached chart.

MATERIALS
1 NCR cash register, play money, change-making test, sales tax charts
**MAKING CHANGE**

**REGULAR METHOD**

**USE AS FEW COINS AS POSSIBLE**

<table>
<thead>
<tr>
<th></th>
<th>01¢</th>
<th>05¢</th>
<th>10¢</th>
<th>25¢</th>
<th>50¢</th>
<th>$1.00</th>
<th>$5.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>17¢</td>
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</tbody>
</table>
ACTIVITY

I. SITUATION
You are an architect. You are planning to build a concrete patio for a customer. He wants the patio to be 10' wide and 15' long. You think the concrete should be 6" thick. You need to present your customer a scale drawing (1"=1') and with an estimate of the area of the patio, the volume of concrete needed to complete the patio and the cost of concrete at $ .85/cu. ft.

II. STEPS
1) Prepare the scale drawing - at ¼"=1', 15' converts to 7½"; 10' converts to 5" - A half inch grid can be drawn over the entire surface, if desired, so the students can count the number of square feet.
2) Compute the area, A=LxW = 150 sq ft. Does this agree with the count?
3) Discuss the concept of volume. Each square on the scale drawing represents ¼ cu. ft. Compute the volume V = LxWxH = 10x15x½ = 75 cubic feet. See if this agrees with the count of squares.
4) Now determine the cost of the concrete. At $ .85 per cubic foot, the material will cost $63.75. That is the cost of concrete only and does not take into consideration the cost of excavation, forms or labor.
ACTIVITY

I. SITUATION

Whether a home economics teacher or a homemaker, one of the first decisions one must make is to decide on a recipe and then judge if it will cost more to make it from scratch than already prepared. The hardest part of the decision comes when one calculates his/her own time involved in making an item.

II. STEPS

1) Study the newspapers for current prices of milk, flour, eggs, shortening, sugar. List the current prices.

   Example: Milk, ½ gal. = $ .76
   Flour, 5 lbs. = $1.10
   Sugar, 5 lbs. = $1.25
   Eggs, 1 doz. = $ .60
   Shortening, 5 lbs. = $1.15

2) What would be the price of the following quantities of the above ingredients?

   Note: 1 C = 8 ounces
   2 C = 16 ounces = 1 lb
   2 C = 1 pint
   2 pints = 1 quart
   4 quarts = 1 gallon

   (a) 1 C milk = ____________________
   (b) 1½ C sugar = ____________________

RECOMMENDATIONS

Go step by step in figuring the cost of, say, 1 C sugar.

MATERIALS

Room set of newspapers
Cookbooks—Reference: The World of Foods, Medoed, pg 509
ACTIVITY Page 2 of 2

(c) 3 C flour = ________________
(d) 3/4 C shortening = __________
(e) 2 eggs = ________________

3) The following is a recipe for chocolate pudding:

(a) Estimate the cost of preparing it.
(b) If, when fixed, this serves six people, what would be the cost per serving?
(c) If it cost $ .35 to buy a can of instant pudding, does it cost more or less to make it? How much? (The can serves one person.)
(d) A pudding mix, which serves six, cost $ .27, but you must add three cups of milk. How much does this totally cost? How much does it cost per person? Does it cost more or less to make it from scratch? How much?

**Chocolate Pudding**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 C milk</td>
<td></td>
</tr>
<tr>
<td>2 sq chocolate</td>
<td></td>
</tr>
<tr>
<td>Note: 6 sq cost $ .48</td>
<td></td>
</tr>
<tr>
<td>1/2 c cornstarch</td>
<td></td>
</tr>
<tr>
<td>1 C sugar</td>
<td></td>
</tr>
<tr>
<td>1/8 tsp salt</td>
<td></td>
</tr>
<tr>
<td>2 tsp vanilla</td>
<td></td>
</tr>
<tr>
<td>2 tsp shortening</td>
<td></td>
</tr>
</tbody>
</table>

(Just approximate cost of salt, cornstarch and vanilla.)
ACTIVITY

I. SITUATION

A purchasing agent just bought $15.36 worth of merchandise. In the state of Idaho, there is a 3% sales tax. He/she must compute the amount of sales tax.

Example: 3% of $15.36

\[
15.36 \times 0.03 = (3\% = \frac{3}{100} = 0.03) \\
0.4608 \\
\text{Sales tax} = 0.46
\]

II. STEPS

1) Understanding the meaning of percents.

Example: 4% means 4 cents out of every 100

4/100 or 0.04

Write the percents as decimals:

(a) 5% 
(b) 3% 
(c) 20% 
(d) 75% 
(e) 105% 
(f) 12\frac{1}{2}%

2) Figuring the amount of sales tax for merchandise purchased.

Example: $27.57 worth of groceries
Sales tax is 3%. How much sales tax does one pay? What will be the total bill?

\[
27.57 \times 0.03 = 0.8271 = 0.83 \text{ (rounded off)}
\]
ACTIVITY

Page 2 of 2

Total Paid = $27.57

\[
\frac{.83}{\$28.40}\\
\]

Figure the sales tax and total bill for the following totals.

(a) $5.06
(b) $12.98
(c) $1.45
(d) $33.57
(e) $125.61
ACTIVITY

I. SITUATION

The student is a homemaker who has just purchased her weekly supply of groceries. To compute the price of various items, it is necessary to study the group buying activity and also to understand the logic behind rounding off prices.

II. STEPS

1) Compute the individual cost of the grocery list below and then the total cost of the list.

- 5 lbs of oranges - - - - - - 8 lbs/$1.00
- 3.7 lbs ground beef - - - - - $ .85/lb
- 8 lbs carrots - - - - - $ .12/lb
- 4 cans of soup - - - - - 5 cans/$1.00
- 10 lbs sugar - - - - - $1.56/5lbs
- 15 cans pop - - - - - 7 can/$1.00
- 1 gallon of milk - - - - - $ .76/half gallon

2) Compute the individual cost per type of item and then the total bill.

- 3 shirts - - - - - $3.89 a shirt
- 4 dresses - - - - - 2/$23.00
- 2 pants - - - - - $7.99 a pair
- 4 pairs of socks - - - - - 3 pair/$1.00
- 5 yards of material - - - - - 2 yds/$4.25

3) Figure a 3% sales tax for problems (1) and (2). (See Activity 8-A-2)

RECOMMENDATIONS

Do a class demonstration of unit buying.
Show example grocery sales slips or salesman's slips.

MATERIALS

Roomset of newspapers with adds
GRADE 8-A-4

SUBJECT Math

CLUSTER Home Economics

JOB TITLE Professional Seamstress

CONCEPT
Fractions, multiplication, decimals, addition.

PERFORMANCE OBJECTIVE
The student will be able to compute the cost of making an item, figuring in time, and then compare that price to a similar manufactured item.

ACTIVITY
I. SITUATION
The student is a professional seamstress who is making a dress for a client. Besides figuring the cost for material, thread, zipper, and facing, it is necessary to figure the worth of one's time and charge for that.

II. STEPS
1) Study the pattern requirements below and figure the cost.
   - 2 3/4 yds polyester material -- $2.98/yd
   - 1 spool thread -- $ .39/spool
   - 1 zipper -- $ .79
   - 5 yds facing -- $ .45/3 yds

2) If the seamstress takes 3 1/4 hours to sew the dress and she charges $2.50 per hour, how much does she make?

3) How much does the client pay for the dress?

4) Have the student bring in various clothes patterns. Give approximate prices for the various items needed. Figure the cost of the apparel.

5) Study the local paper and compare the price of a similar apparel if it was bought from a store. Does one save any money?

MATERIALS
Sample patterns

Room set newspapers
ACTIVITY

I. SITUATION

A novelty seamstress makes quilts, often irregular in size, to meet the desires of the buyer. The buyer may also request the size of the individual block, the color scheme and the backing to go with the quilt. After the individual blocks are cut out and embroidered, they are sewn together on all sides. The seams consume 1/2 inch of each block or a total of one inch. To understand the loss of material in the seams, one must accurately determine the total yardage needed for the project.

II. STEPS

1) Determining the finished dimensions of a quilt block whose original size is 8" X 12"; the seam is set at 1/2 inch. See the example to the right.
   a) What would be the finished dimensions of a 6" X 10" block with a 1/2" seam?
   b) What would be the finished dimensions of a 6" X 10" block with 5/8" seams?

2) How many blocks with finished dimensions 6" X 8" would be needed for a quilt that is 6' X 8'?

3) A backing of flannel is needed for the quilt in step #2. How many yards of flannel will be needed if the flannel is 45" wide? How many yards would be needed if the flannel is 36" wide?

Note: 1/2" seam is 1"
Together 1/2" + 1/2" = 1"
Finished block is 7" X 8"

RECOMMENDATIONS

Bring in example quilt blocks and finished quilts.

MATERIALS
ACTIVITY

I. SITUATION

The student is a glass repairman, who is measuring the size of a broken pane. First, measuring the dimensions to the closest thirty-second of an inch, he then renames the dimension in simplified terms.

II. STEPS

1) Study measurement unit 7-B-1.
2) Each student will have a three foot rule or longer tape.
3) The measurement of a given window in the room will be taken. Compare the students measurements for test of accuracy.
4) Have the students find the measure of the outside of their book and then the inside. Is there a difference in the two measurements? How much? Measure the inside and outside measurements of the chalkboard.
5) Once a measurement is known, say to the nearest thirty-second, one should rename the dimensions in lowest terms.

Example: \[
\frac{10}{16} = \frac{5}{8} \\
5' \frac{20}{32} = 5' \frac{10}{16} = 5' \frac{5}{8}\]

(a) \[
\frac{12}{16}
\]

(b) \[
\frac{30}{32}
\]

(c) \[
7' \frac{8}{32}
\]

RECOMMENDATIONS

Show work-up on overhead concerning equivalent points on a scale.

MATERIALS

Reference: Metal Works, pg. 198.
ACTIVITY  Page 1 of 2

I. SITUATION

You are an electronics technician working for the Space Agency. Your boss sends you a box full of resistors marked with their resistance values; three batteries, one 6-volt, one 3-volt, one 1\(\frac{1}{2}\)-volt; and a volt-ammeter. He tells you that he needs to know if there is any connection between the voltage on the resistors and the current through them. Your next pay raise depends on your finding the answer.

II. STEPS--Recommended Approach

1) Measure and record in table form the current through each resistor at each voltage (sample log on next page).

2) Graph the results on Cartesian coordinates and look for patterns. Suggest voltage (E) and current (I) for the coordinates and identify points on graph with color code or some other way to connect the point with its resistor.

3) The graph should show a direct relation between E and I. (E=IR)

4) After discovery of function in step #3, the value of unknown resistance can be calculated from a single set of voltage and current readings.

MATERIALS

Batteries: 6-volt, 3-volt, 1\(\frac{1}{2}\)-volt (any voltage will do); selection of pre-measured resistors; volt-ammeter; graph paper
II. STEPS

<table>
<thead>
<tr>
<th>R (Resistance)</th>
<th>E (Voltage)</th>
<th>I (Current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R₁ = ____ ohms</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>R₁</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>R₁</td>
<td>1\frac{1}{2}</td>
<td></td>
</tr>
<tr>
<td>R₂ = ____ ohms</td>
<td>6</td>
<td></td>
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<tr>
<td>R₂</td>
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<td></td>
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<tr>
<td>R₂</td>
<td>1\frac{1}{2}</td>
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<tr>
<td>etc.</td>
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<td></td>
</tr>
</tbody>
</table>

Plot of E vs I

O = R₁
X = R₂
ACTIVITY

I. SITUATION

The student is a carpenter who is rebuilding an end table. Using the measurements below, he will figure first the board feet needed and then the cost of the project. The formula for board feet is:

\[ \text{Board feet} = N \times L \times W \times T \times 0.007 \]

where
- \( N \) = number of boards
- \( L \) = length of boards in inches
- \( W \) = width of boards in inches
- \( T \) = thickness of boards in inches

Dimensions of end table:
- \( N = 5 \)
- \( L = 42" \)
- \( W = 6" \)
- \( T = 2\frac{1}{2}" \) (2.5"")

\[ \text{Bf} = 5 \times 42" \times 6" \times 2.5" \times 0.007 = 22.19 \text{ cubic inches} \]

If the cost of the wood is $0.78 per board foot, how much would it cost for this project? 22.19

\[
\begin{array}{c}
\times 0.78 \\
\hline
17752 \\
15533 \\
\hline
17.3082 \text{ or } $17.31
\end{array}
\]

II. STEPS

1) Learning to recognize equivalent board feet:

By definition, a board foot is a unit of wood measurement one inch thick, twelve inches wide and twelve inches long.

a) A board foot always has 144 cubic inches.

Example: 1" x 12" x 12" = 144 cubic inches

b) An equivalent piece of wood would be

3" x 4" x 12". So 3" x 4" x 12" = 144 cubic inches.

c) Name four other pieces of wood equivalent to one board foot.

(continued)

MATERIALS

ACTIVITY  Page 2 of 2

II. STEPS

2) The formula for finding the total number of board feet for a project is: 
   \( Bf = N \times L \times W \times T \times 0.007 \). Example: Find the board feet for three 
   pieces of 2" x 10" x 36" board. 
   \[ Bf = 3 \times 36" \times 2" \times 10" \times 0.007 \]
   \[ = 21.60 \times 0.007 \]
   \[ = 15.12 \text{ cubic inches} \]

Find the number of board feet for the following:
   a) 1" x 12" x 30", 5 pieces
   b) 6" x 24" x 48", 3 pieces

3) Figure the cost of the wood above if:
   a) Part 2a is poplar wood which costs $.76 per board foot.
   b) Part 2b is fir plywood and costs $.59 per board foot.
I. SITUATION
A builder is reading the construction prints from the architect. The given scale is 1:4 or 1:4. He/she immediately knows that a wall measuring seven feet on the print would be 28 feet (4x7) in real life. If the scale was 1:25, the length of the wall would be 7x2.5 or 17.5 feet.

II. STEPS
1) A sheet metal box measures 3' x 2' x 1'. Write the following, in terms of inches.
   a) Double the dimensions.
   b) Divide the original dimensions in half.
   c) Triple the original dimensions.
   d) Divide the original dimensions in thirds.
2) Give the actual measurements of the attached house layout. The drawing is a 1:4 or 1:4 scale. Give measures in terms of feet.
3) Draw a 1:4 or 1:4 scale drawing of your home. Use 1/4" graph paper with 1/4" representing one foot.

MATERIALS
1/4" graph paper, room set 6" rule
Reference: General Woodworks, page 6
GRADE 8 - R5

SUBJECT Math

CLUSTER Industrial Arts

JOB TITLE Carpentry, Metal Work

CONCEPT

Division of Fractions

PERFORMANCE OBJECTIVE

The student when given the total length of a board or metal will be able to divide it into equal portions. The portions will not always be whole number parts.

ACTIVITY

I. SITUATION

A carpenter wants to cut a board into four equal parts to build some shelves. If the total length of the board is 18 ft., one must figure the length of each fourth.

Example:  \( P = \frac{1}{4} \) of length
\[ P = 18' \text{ divided by 4} \]
\[ P = 18/1 \times \frac{1}{4} \]
\[ P = 18/4 = 9/2 \text{ or } 4\frac{1}{2}' \]

Note: Carpenters have a trick to the trade of physically figuring out this measurement.

STEPS:

1. The students will study an example of dividing a given length in half, and thirds without use of math.

2. Next, the students will duplicate a length on paper. Showing the diagonal used, they will mark off lengths that are first half the total length and then marks to show thirds of the total length.

3. The students will now measure the exact total length of the line and then use mathematics to find the fractional measures.

4. Observe any differences between the physical and the mathematical measures.

5. Divide the following lengths first in half and then in thirds:
   a. 2 5/8'
   b. 5 3/4'
   c. 4 5/32'

RECOMMENDATIONS

An overhead work-up is needed on the carpenter's physical method for dividing a given length.

Overhead work-up of division.

MATERIALS

Ref: General Woodworks, p. 18
General Shop p. 78
Room set 6" rules

MATERIALS
ACTIVITY
Page 1 of 4

I. SITUATION
To keep up with the changing times, carpenters, etc. must learn to understand the metric system and how it compares with our system. After working with the metric system, one will find that it is much easier to use. It adapts well to division and multiplication.

II. STEPS
1) Learning the metric conversions:
   - 1" = 2.5 centimeters
   - 100 centimeters = 1 meter
   - 1 meter = 39.37 inches
   a) 10" = _____ cm
   b) 5 yards = _____ inches = _____ cm
   c) 5½ yards = _____ cm
   d) 17.78 meters = _____ cm = _____ inches
   e) 144" = _____ yards

2) What would be the metric measurement for the following:
   a) 2' x 4'
   b) 1½" x 3½"
   c) 4" x 8"
   d) 8" x 3'

3) What type of problems would arise for a carpenter using the metric system? What problems would be eliminated?

4) When dividing a piece of wood in sections, would the parts be easier or harder to figure out?
   a) 3 meters divided into 2?
   b) 16 centimeters divided into 4 parts?

RECOMMENDATIONS
Before students start this activity, they must understand the metric system, its prefixes and how the decimal moves.

MATERIALS
Reference: eighth and ninth grade Individualized Math Program, unit XVI, page 454-455 (Attached)
Unit XVI - Level (3)

A. The metric system is the measurement system used in most countries of the world, except the United States. The basic standard units of metric measure are:

- Meter - the standard unit of length
- Gram - the standard unit of weight
- Liter - the standard unit of volume

In the metric system, the prefix of a unit of measure indicates the relationship to a basic unit of measure.

The metric system is based on powers of ten.

If the basic unit was meters the following relationships exist:

- 1 millimeter = 1/1000 meter or 1000 millimeters = 1 meter
- 1 centimeter = 1/100 meter or 100 centimeters = 1 meter
- 1 decimeter = 1/10 meter or 10 decimeters = 1 meter
- 1 decameter = 10 meters or 1/10 decameter = 1 meter
- 1 hectometer = 100 meters or 1/100 hectometer = 1 meter
- 1 kilometer = 1000 meters or 1/1000 kilometer = 1 meter

Another way of writing the same relationships is with decimals:

\[
\begin{align*}
1000 & \text{ millimeters} \\
100 & \text{ centimeters} \\
10 & \text{ decimeters} \\
1 & \text{ meter} \\
.1 & \text{ decameters} \\
.01 & \text{ hectometers} \\
.001 & \text{ kilometers}
\end{align*}
\]

Hence: Conversion from one metric unit to another is accomplished by moving the decimal point.
Examples:

(1) 
\[
\begin{align*}
& 3460 \text{ milligrams} \\
& 346 \text{ centigrams} \\
& 34.6 \text{ decigrams} \\
& 3.46 \text{ grams} \\
& .346 \text{ decagrams} \\
& .0346 \text{ hectograms} \\
& .00346 \text{ kilograms}
\end{align*}
\]

(2) Convert 3000 milligrams to decigrams.

Think: milli to deci, I go down on the metric chart; therefore, I move the decimal to the left. How many units do I go down? 2

Therefore: 3000 mm = 30 decimeters

2 places left

(3) 4.2 decagrams to ____ centigrams.

Think: Deca to centi means going up the chart; therefore, I move the decimal to the right. How many units up? 3

Therefore: 4.200 decagrams = 4200 centigrams


Practice Problems:

Complete the sentences.

(1) 42.7 grams = ____ decigrams.
(2) .4653 kiloliters = ____ liters.
(3) 346 centigrams = ____ decigrams.
(4) 16435 milliliters = ____ dekaliters.
(5) .34 hectograms = ____ decigrams.
(6) 347 dekaliters = ____ milliliters.
(7) 17.58 centimeters = ____ hectometers.
(8) 23.1 grams = ____ kilograms
(9) 34.789 milliliters = ____ deciliters.
(10) 80976 centigrams = ____ hectograms.
B. Addition and subtraction involving metric measures with differing prefixes: change all measures to the same prefix first.

Example:

(1) $100 \text{ decimeters} + 3 \text{ meters} = \underline{\text{______ decameters}}.$
   
   $1 \text{ decameter} + .3 \text{ decameters} = (1.3) \text{ decameters}.$

(2) $432 \text{ hectograms} - 3.6 \text{ decagrams} = \underline{\text{______ decigrams}}.$
   
   $.432 \text{ decigrams} - .036 \text{ decigrams} = (.386) \text{ decigrams}.$

(3) $(12 \text{ grams}) (11.3 \text{ centigrams}) = \underline{\text{______ hectograms}}.$
   
   $(.12 \text{ hectograms}) (.00113 \text{ hectograms}) = (.000156) \text{ hectograms}.$

Practice Problems:

(1) Complete each sentence.

   (a) $.145 \text{ kilometers} + 14 \text{ decimeters} = \underline{\text{______ meters}}.$
   
   (b) $3.5 \text{ decagrams} + 2 \text{ grams} = \underline{\text{______ grams}}.$
   
   (c) $36 \text{ hectoliters} - 3 \text{ decaliters} = \underline{\text{______ liters}}.$
   
   (d) $4365 \text{ centimeters} - 5 \text{ decimeters} = \underline{\text{______ meters}}.$
   
   (e) $(3.5 \text{ decagrams}) (.1 \text{ decigrams}) = \underline{\text{______ grams}}.$
   
   (f) $(5 \text{ kilometers}) (3.8 \text{ meters}) = \underline{\text{______ decameters}}.$
   
   (g) $17 \text{ hectoliters} - 50 \text{ liters} = \underline{\text{______ centiliters}}.$
   
   (h) $.34 \text{ milligrams} - 170 \text{ centigrams} = \underline{\text{______ grams}}.$

(2) Write a mathematical sentence and solve.

   (a) Tom has a rope that is 92.56 meters long. If he divides the rope into four equal parts, how long is each part?
   
   (b) What is the total length, in meters, of three parts of the rope in the above problem?

(3) Joe swims 500 meters. If the width of the pool is 250 decimeters, how many laps did he swim?

(4) The Olympic record for weight lifting was 143.01 kilograms. This was broken when someone lifted 1520.90 hectograms. How many more grams did the second person lift?
GRADE 8-C

SUBJECT Math

CLUSTER Arts and Humanities

JOB TITLE Macrame Artist

CONCEPT
1) Proportions
2) Basic operation
3) Percentage

PERFORMANCE OBJECTIVE
The student will determine the amount of cotton cord needed to make a 40 inch by 48 inch wall hanging, as well as the cost of the project plus the sales tax.

ACTIVITY

I. SITUATION

The student is to make a 40 inch wide wall hanging of cotton cord. Cotton cord costs 2c a foot.

II. STEPS

1) Determine how many cords it will take to make a 40 inch wide hanging if it takes 8 cords per inch of hanging.

2) The wall hanging will extend down 4 feet. It takes 10 inches of cord to make 1 inch of hanging. Find the length of each cord needed for the hanging.

3) Determine the cost of the cotton cord for the project.

4) Determine the total cost with a 3% sales tax.

MATERIALS

MATERIALS
ACTIVITY

I. SITUATION

1) The student has a 12" X 16" picture to be matted under a piece of 14" X 18" construction paper. The student is to cut a hole in the construction paper which will provide a 1 1/2" border on the sides and top and a 1 3/4" border on the bottom.

2) The student has a 14" X 18" picture to be matted under a sheet of construction paper. The picture is to overlap the hole in the construction paper by 1/4" on each side. The border is 1 1/2" on the side and top and 2" on the bottom.

II. STEPS

1) Determine the size of the construction paper to be used.

2) Determine the size of hole to be cut.
ACTIVITY

I. SITUATION

You want to construct a circle with a diameter of 10 inches, and you only have a piece of paper, a ruler and a pencil for materials.

II. STEPS

1) Construct a square with sides of 10 inches.

2) Find the center by constructing the diagonals of the square.

3) From the center, use the ruler and pencil to measure 5-inch dash marks around. These dash marks will make a circle.

MATERIALS

Paper, pencil, ruler
ACTIVITY

I. SITUATION

An advertising designer is asked to take a 6" X 9" layout and make a billboard.

II. STEPS

1) If the billboard is to be 8 feet high, determine the length of the board.

2) A circle on the layout has a 4-inch diameter. Determine the diameter on the billboard.

3) A large K has a height of 5 inches on the layout, determine its height on the billboard.
ACTIVITY

I. SITUATION

When a potter throws a pot, the clay is very wet; and he can expect a 5% shrinkage in weight as it dries in the air. He can expect a 7% shrinkage in weight during the firings. The student is to determine the amount of shrinkage in weight from his clay.

II. STEPS

A student weighs out a handful of clay to be 3.8 kg.
1) Determine the amount of weight loss when it dries in the air.
2) Determine the amount of weight loss during the firings.
3) Determine the total weight loss during both operations.

RECOMMENDATIONS

MATERIALS
PERFORMANCE OBJECTIVE

The student will demonstrate comprehension of percentage computation as measured by the completion of the attached activity with a minimum of 70% accuracy.

ACTIVITY

I. SITUATION

Student "A" is a rancher who raises hereford cattle. Student "B" is a livestock saleyard manager. Student "C" is a professional auctioneer.

The rancher has brought "X" head of calves to the saleyard to consign for immediate sale. The going average price of calves is $110 per head. The saleyard manager agrees to sell the cattle for 5% of the sale price. The auctioneer works for the saleyard for 10% of the manager's income.

II. STEPS

1) Given a hypothetical number of beef and the above situation information, the role-playing students will compute:

   a) Total dollars involved in the sale
   b) Dollars to rancher
   c) Dollars to saleyard manager
   d) Dollars to auctioneer

2) For a whole class activity, each student could role-play a buyer who is allotted a given amount of money to spend. The auctioneer could offer calves one at a time for sale to the group, using pictures of animals.

3) For a secondary activity, students could note beef prices on a daily basis from local newspapers over a week's time to invest money in beef on Monday and sell during the week. Groups could work in competition to see who could create the greatest profit in the shortest time.
ACTIVITY

I. SITUATION

A city recreation director wants to develop a men's basketball program. His research shows that six school courts are available five nights a week at no cost. Three games can be played each night and each team has ten players. A team only plays once a week. The program starts in November and ends in February, lasting for sixteen weeks.

II. STEPS

1) Determine how many teams can participate.
2) Determine how many players can participate. Program costs:
   A referee costs $5.00/game
   A gym supervisor costs $5.00/game
   A scorer costs $2.50/game
   Trophies cost $275
3) Determine the cost of the program.
4) Determine the cost per player.
ACTIVITY

I. SITUATION
Bill owns his own two-chair barber shop. He has an apprentice working with him. The apprentice receives 72% of the amount he collects from haircuts, shaves, etc. On Tuesday he cut 23 heads at $2.75 each, gave 5 shaves for $1.25 each and one shampoo for $2.25.

II. STFPS
1) Determine the apprentice's gross income for Tuesday.
2) Determine the amount he receives (72% of step #1).
3) Because of taxes, social security and retirement; a person's take-home pay is about 60% of his earnings. Determine the take-home pay of the apprentice (60% of step #2).

III. ANSWERS
1) $71.75
2) $51.67
3) $31.00

RECOMMENDATIONS

MATERIALS
ACTIVITY

I. SITUATION

Many beauty operators are paid a percentage of what they earn. Jane receives 72% of what she earns.

II. STEPS

1) Determine Jane's daily salary:
   a) Monday she earns $55.40
   b) Tuesday she earns $52.40
   c) Wednesday she earns $64.75
   d) Thursday she earns $57.00
   e) Friday she earns $68.25

2) Check by adding the earnings and taking 72%.

MATERIALS
ACTIVITY

I. SITUATION

You are the supervisor of a chemical manufacturing plant. You have 1000 liter container that is fed by two pipes. Pipe No. 1 comes from a tank that contains a solution that is 25% water and 75% chemical z. Pipe number 2 comes from a tank that is 75% water and 25% chemical z. You have learned through trial and error and over the years that you can obtain any concentration you need, from 25% z to 75% z simply by figuring out how much liquid to draw from each storage tank.

How much of each do you need to make 1000 liters with the following concentrations:

1. 25% z
2. 30% z
3. 50% z
4. 60% z
5. 70% z
6. 75% z

(You should be able to do three parts of this in your head.)
ACTIVITY

I. SITUATION

(See 7th Grade exercise, same subject)

Continue the BB analogy one step further. Suppose you could make a square pattern 1 cm on a side. How many electrons would you need and what would be their mass?

Let N be number of electrons in a 1 cm row.
\[ N = 1.79 \times 10^{12} \]

then \[ N^2 \] = number needed to fill the square.
\[ N^2 = 3.20 \times 10^{24} \]

\[ M_2 = \text{mass of square of electrons} \]
\[ M_2 = 3.20 \times 10^{24} \times 9.1 \times 10^{-28} = 2.91 \times 10^{-3} \text{ grams} = .0000064 \text{ lb.} \]

What would be the mass of a 1 cm cube of electrons?
\[ N^3 = \text{number required} = 5.74 \times 10^{36} \]

\[ M_3 = \text{mass of cube} \]
\[ M_3 = 5.74 \times 10^{36} \times 9.1 \times 10^{-28} = 5.22 \times 10^9 \text{ g} = 1.148 \times 10^7 \text{ lb} = 5,740 \text{ tons} \]

It is important to note that it is not possible to pack electrons together in a 1 cm cube like this. This problem is simply an exercise in using scientific notation for computations and can be used to stress the density of electrons and therefore the vast spaces supposed to be empty within the atom.
ACTIVITY

I. SITUATION
You are an airline pilot whose route of flight takes you from Boise to Mountain Home Air Force Base to Pocatello to McCall and back to Boise. You will draw your route of flight on the chart provided. You will measure the distance between airports on your route and determine the direction of flight on each leg of the journey. Your aircraft flies at 360 nautical miles per hour. In addition to distance and direction, you must calculate the time in minutes required on each leg, rounded off to the nearest minute.

II. STEPS
1) Draw a course line from airport to airport.
2) Using the compass, mark off any convenient length increments (10 miles is recommended as determined from scale on legend). Measure left-over distance.
3) Measure direction of flight path.
4) Fill out log. Suggested form:

<table>
<thead>
<tr>
<th>Leg</th>
<th>Heading</th>
<th>Distance</th>
<th>Ground Speed</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boise - Mountain Home</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mountain Home - Pocatello</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pocatello - McCall</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>McCall - Boise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5) Compute time required on each leg of the flight. Convert time to minutes.

\[
\text{Time in hours} = \frac{\text{Distance}}{360 \text{mph}}
\]

\[
\text{Time in minutes} = \text{Time in hours} \times 60 = \frac{\text{Distance}}{360} \times 60
\]

MATERIALS
1 aeronautical chart, 1 protractor, 1 ruler, 1 compass per student
ACTIVITY

I. SITUATION

You are the doctor on duty at St. Al's Hospital emergency room. Most of the patients you see in the emergency room have cuts that you believe are serious enough to require an injection of a particular drug. Although you don't give the patient the injection yourself, you must decide how much serum to use.

II. STEPS

You compute the dosage based on 3 milligrams of medication per kilogram of patient's weight. The medicine you use comes in a concentration of 50 milligrams per milliliter of solution. You must make several computations in order to get the correct dosage. It is extremely important that the dosage be correct. This is the list of your patients and their weights. One dosage has been calculated as an example. Complete the list.

<table>
<thead>
<tr>
<th>Name</th>
<th>Weight</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs</td>
<td>kg</td>
</tr>
<tr>
<td>Alien</td>
<td>144</td>
<td>65.45</td>
</tr>
<tr>
<td>Beth</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Carla</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Dave</td>
<td>165</td>
<td></td>
</tr>
<tr>
<td>Fred</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>

Example:

Weight: $Kg = \frac{144}{2.2} = 65.45$

Dosage: $D mg = 3 \times Wt. = 3 \times 65.45 = 196.35$ mg

$D mg = \frac{50}{1} mg$

$D ml = D mg + 50 = 196.35 + 50 = 3.927$ ml = 3.9 ml
ACTIVITY

I. SITUATION

You are the director of laboratory services for a large city hospital. Many medicines come to you in concentrated form, and you must mix and dilute them as required by the doctors who treat the patients in your hospital. You have two concentrated solutions, red and blue, and you must measure and mix them with water to form 500 ml each of three different medicines:

1) 500 ml of 10% red
2) 500 ml of 4% blue
3) 500 ml of 3% red and 14% blue

II. STEPS

1) You must calculate the quantity of each concentrate required in each solution.
2) You must measure and mix the required amount of concentrate and water.
3) The percentages and total volumes can be varied for other problems.

MATERIALS

Metric graduated cylinders, food coloring to make up the concentrates
ACTIVITY

I. SITUATION
A nurseryman makes out a bill for a landscape contractor who receives a 20% discount in price for nursery stock. The contractor buys:

3 upright yews at $12.50 each
2 Colorado blue spruce at $28 each

II. STEPS
Determine the:
1) total cost of the yews and spruces before discount
2) amount of discount in price (20% times step #1)
3) total cost after discount (step #1 minus step #2)
4) actual amount paid including 3% sales tax (C + 3% x C)
ACTIVITY

I. SITUATION

You have heard that primitive navigators sailing in canoes and modern supersonic aircraft navigators can determine their location by observing stars. You can determine your latitude very easily by a simple observation you can make on any clear night if you know where to find Polaris, the north star.

II. STEPS

1) First, you need to know what latitude means. Your latitude is your distance from the equator measured in degrees. The equator is 0° latitude. The north pole is 90° north latitude and the south pole is 90° south latitude.

2) Second, you need an angle measuring device which you can convert to something similar to a navigator’s sextant. Figure 1 shows how to make your sextant and how to measure star altitudes. When you read the angle on your protractor, you will notice that you must subtract the angle you read from 90° to get your latitude no matter where you are in the northern hemisphere. At the north pole, Polaris is straight overhead, so your string should fall across 0°. Thus 90° - 0° = 90° latitude. At the equator (0° latitude) the protractor would be horizontal for a 90° reading at the string.

3) Polaris is one of the easiest stars to locate. It is within one degree of north of every place on earth at all times. See if you can memorize figure 2 and locate it. Hold the chart with the month at the top at midnight for a look at how the northern sky should appear.

(Figure 1 and figure 2 on the next page)

MATERIALS

Protractor and string
Reference: Dutton’s Navigation and Piloting, United States Naval Institute, Annapolis, Maryland.
Sight along edge of protractor toward star. Hold string against protractor and take it into light to read angle.

FIGURE 1

String

Weight

FIGURE 2

Polaris

Big Dipper

Cassiopeia
ACTIVITY

I. SITUATION

Student is an outside salesperson representing a local radio station selling advertising time to businesses. Student is paid a guaranteed salary every month of $600; however, if student sells over a total of $1,000 worth of advertising, he/she will be paid 10% of all sales.

II. STEPS

Over a three-month period, the salesperson has the following record of sales. Determine his/her paycheck for the month.

Month of May:

<table>
<thead>
<tr>
<th>Client</th>
<th>Minutes Sold</th>
<th>Rate per Minute</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Pants Co.</td>
<td>200 (remote spot)</td>
<td>6.80</td>
<td>$1,360</td>
</tr>
<tr>
<td>Spectra Productions</td>
<td>10</td>
<td>5.40</td>
<td>54</td>
</tr>
<tr>
<td>Bon Marche</td>
<td>10</td>
<td>6.80</td>
<td>68</td>
</tr>
<tr>
<td>Brookovers</td>
<td>20</td>
<td>5.40</td>
<td>108</td>
</tr>
<tr>
<td>Gary's Stereo</td>
<td>20</td>
<td>5.00</td>
<td>100</td>
</tr>
<tr>
<td>Monthly Totals</td>
<td>260</td>
<td></td>
<td>$1,690</td>
</tr>
</tbody>
</table>

RECOMMENDATIONS
ACTIVITY

I. SITUATION
You are an architect and you are planning a patio for a customer. The customer has decided that he wants a patio in the shape outlined in figure 1. The flower bed and tree require that you leave those spaces without concrete bottoms. (They are not concrete boxes filled with dirt, but are holes in the concrete.) You decide that the concrete slab should be 6" thick. You must prepare a scale drawing to present to your customer with an estimate of material cost. Concrete (ready mixed and delivered) costs $22 per cubic yard, with a $10 delivery charge if you buy less than 5 cubic yards.

II. STEPS
1) Prepare a scale drawing. (Suggestion: \( \frac{1}{2}'' = 1' \))
2) Compute surface area and volume.
   Area = 12 X 21 - 2 X 8 - \( \pi \times 4 \) = 252 - 16 - 12.56
   = 223.44 square feet
   Volume = area X thickness = 223.44 X \( \frac{1}{2}'' \)
   = 111.72 cubic feet
3) Convert to cubic yards. (1 cubic yard = 27 cubic feet)
   Volume \( \approx 111.72 + 27 \approx 4.14 \) cubic yards
4) If you need 4.14 cubic yards, you will actually buy 5. Decide whether to decrease the size of the patio to 4 cubic yards (costing $88 + $10 = $98 total) or accept 5 cubic yards ($110 and no delivery charge) and use the extra concrete for some other job.

Note: Students should try other designs that they find pleasing. Check on current concrete costs.

MATERIALS
ACTIVITY

I. SITUATION

The four walls of the room are to be painted.

II. STEPS

1) Have students determine the wall area to be painted.

2) Have students determine the number of gallons of paint to be used.

3) Have students determine the cost of the paint if a gallon of paint covers 425 square feet and costs $7.25.
ACTIVITY  Page 1 of 2

I. SITUATION

The United States is slowly converting its measurements to the metric system. Every consumer should be made aware of the different metric equivalencies. Quite often a U.S. unit of measure can be written in two different terms in the metric system. They are either grains or liters (weight or volume).

II. STEPS

1) Study both systems of measurement below:

   - 1 teaspoon (tsp) = 5 grams (g) or 5 milliliters (ml)
   - 1 Tablespoon (Tbsp) = 15 g or 15 ml
   - 1 Cup (C) = 240 g or 240 ml
   - 2 C = 480 g or 480 ml
   - 4 C (2 pints, 1 quart (qt)) = 960 g or 960 ml
   - 4 qts = 1 gallon = 4 l
   - 1 pound (1 lb) = 5 Kg

2) Write the U.S. measures to metric measures and then the metric to the U.S.

   (a) 3 tsp = ml
   (b) \( \frac{1}{2} \) C = g
   (c) \( \frac{1}{2} \) gal = ml
   (d) 1\( \frac{1}{2} \) Tbsp = g
   (c) 2\( \frac{1}{2} \) C = g
   (f) 720 g = C

MATERIALS

Reference: Focus on Food, pg. 460.
(g) 45 g = _________________ Tbsp
(h) .25 Kg = _________________ lbs
(i) 960 ml = _________________ pints
(j) 7.5 g = _________________ tsp

3) Knowing the following:
1000 g = 1 Kilogram (Kg)
500 g = .5 Kg
250 g = .250 Kg

Write the following measures from Cups to grams to Kilograms.

Example: 1 C = 240 g = .240 Kg
(a) 2 C = ___________ = ___________
(b) 2½ C = ___________ = ___________
(c) 4 C = ___________ = ___________
(d) 3½ C = ___________ = ___________
ACTIVITY

I. SITUATION
A home economics teacher has a metric cake recipe. For a class demonstration, she compares the metric recipe to an equivalent U.S. recipe.

II. STEPS
1) Study the metric activity.
2) Write metric cake recipe, using U.S. measures. (Approximate when necessary.)

   Example: 500 g flour = 2 C + 1 T flour
   500 g flour -----
   250 g sugar -----
   10 g baking powder -----
   5 g salt -----
   120 g shortening -----
   5 ml vanilla -----
   5 egg yolks
   120 ml milk -----
   45 ml milk -----

3) Which types of measurements use liters? Which use grams?
4) Rewrite the U.S. measured recipe below in terms of the metric.

   Quick Cocoa Cupcakes
   \( \frac{1}{2} \) C shortening -----
   \( \frac{1}{2} \) C sifted cocoa -----
   1 C milk -----

MATERIALS

Reference: Focus on Food, pg 400. Metric measuring cups and spoons.

RECOMMENDATIONS

Review metric equivalents on overhead. Give examples of approximations.
ACTIVITY

1 1/2 C flour
1 tsp baking soda
1 tsp salt
1 1/3 C sugar
2 eggs
1 tsp vanilla
ACTIVITY

I. SITUATION

The student is a homemaker who is baking brownies. The homemaker discovers that he has no unsweetened chocolate. Instead of running to the store for the item, he looks up in a cookbook under substitution and finds that one ounce square of chocolate equals three tablespoons of cocoa plus one tablespoon of shortening. If the recipe calls for three squares of chocolate, what amounts will he substitute in?

3 sq = 3(3T) cocoa + 3(1T) shortening
3 sq = 9 T cocoa + 3 T shortening

According to cookbook substitutions 8 T = \( \frac{1}{4} \) C, so

3 sq = \( \frac{1}{2} \) C + 1 T cocoa + 3 T shortening

II. STEPS

1) Study the list below of common cooking substitution values:

- Baking powder: 1 tsp = \( \frac{1}{4} \) tsp baking soda + \( \frac{1}{4} \) tsp cream tartar
- Chocolate: 1 ounce sq = 3 T cocoa + 1 T shortening
- Cornstarch: 1 T = 2 T flour
- Honey: 1 C = \( \frac{3}{4} \) C sugar = \( \frac{1}{4} \) C liquid
- Eggs: 1 egg = \( \frac{1}{4} \) t baking powder

2) Change the asked-for ingredients to the substituted values above:

Example: 3 t baking powder = 3(\( \frac{4}{4} \)) + 3(\( \frac{1}{2} \) tsp c.t)
= 3/4 T + 3/2 tsp cream tartar

MATERIALS

Have cookbooks available for student references.
ACTIVITY

(a) 2 C honey
(b) 3 1/2 T cornstarch
(c) 3 ounces chocolate
(d) 2 1/2 tsp baking powder
(e) 2 eggs
(f) 1 1/2 C honey
I. SITUATION
Any consumer purchasing hamburger can figure the quantity of fat within the package by reading the percentage on the label. It may read 10%, 15%, 20%, 30% or 40%. Once he knows the quantity of fat in the package it is possible to figure the true amount of meat and then the best price.

II. STEPS
1) Study current newspaper ads to find the prices of various types of ground beef (hamburger).

2) Figure the quantity of fat in the given labels below.
   - Example: 1 lb at $ .88 -- 20% fat
     - 1 lb = 16 ounces
     - 20% = .20
     - 16 ounces
     - x .20
     - 3.20 ounces of fat

   - (a) 1 lb at $1.09/lb -- 15% fat
   - (b) 1 lb at $ .79/lb -- 30% fat
   - (c) 1 lb at $ .95/lb -- 20% fat
   - (d) 1 lb at $1.29/lb -- 10% fat

3) How many ounces of meat are in the packages of meat in problem (2)?
   - Example: 1 lb at $ .88/lb -- 20% fat
     - fat = 3.2 ounces
     - meat = 16.0 ounces
     - 3.2
     - 12.8 ounces of meat

RECOMMENDATIONS
Bring in guest lecturer who is a butcher.

MATERIALS
Room set of papers
ACTIVITY Page 2 of 2

4) What was the actual price per ounce of meat in problem (3)?

   Example: Actual Price = price per pound
            + ounces of meat
            Actual price = \(\frac{0.68}{12.8} \div \frac{768}{1120}\) = 0.068 or 0.07 per ounce

5) Which pound of meat in problem (2) was the best buy?
ACTIVITY

I. SITUATION

The student is a consumer about to buy a new couch. The decision which faces the consumer is which credit plan to use in purchasing the couch. Two options are available: Bank Americard, charging $\frac{1}{2}\%$ per month of the declining balance or the furniture company's plan which is figured at $1\frac{1}{2}\%$ per month. The problem is below.

II. STEPS

The furniture store salesman wants the consumer to use the handy "Carl's Cozy Couches Credit Card" plan. He explains to the consumer that $1\frac{1}{2}\%$ is $1\frac{1}{2}\%$; so why not use the Carl's Plan to save the Bank Americard for other things?

What he does not tell the student is that "Carl's Cozy Couches Credit Card" charges $1\frac{1}{2}\%$ per month of the purchase price, not the declining balance.

The student will compute the total cost of the couch (original price $1,000.00) over a twelve-month period of time using the Carl's Plan and the Bank Americard Plan.
ACTIVITY

I. SITUATION

The student is buying a new home and wants to make draperies for the windows. Given a house plan, the student will determine window dimensions and decide on what kind of draperies to use based on costs.

II. STEPS

For each window, the student will:

1) Determine window dimensions.

2) Decide on length of material required (L).
   a) Normally, length will be 84".
   b) Add 15" for hems to compute material length. Since L = total material length and D = desired drapery length, L = D + 15.

3) Decide on drapery width (W).
   a) Add 20" to width. Since W = total width of draperies and R = width of the window, W = R + 20.
   b) Normal drapery material width is 45" to 48". To determine how many widths of material are needed, divide width by 20. N = W + 20. This will allow enough material for pleats, returns, and overlaps.

4) Determine cost of material (C).
   a) Multiply length (L) in step #2b by the number of widths (N) in #3b to find the total length required. T = L x N when T = total material length in inches.
   b) Convert total length to yards. When Y = total length in yards, Y = T + 36.
   c) Compute cost of material from price list provided by teacher. C = P x Y when C = cost of material and Y = price per yard.

RECOMMENDATIONS

Suggested additional activity: measure the window in the classroom and compute material required and cost of drapes.

MATERIALS

Sample price list, house plan showing window sizes
ACTIVITY Page 1 of 2

I. SITUATION

The diesel engine is the most economical engine to operate in terms of the energy that can be put to use from a given quantity of fuel. That is, it can extract more energy from a pound of fuel than can a steam engine or a gasoline engine. There are drawbacks, however. In a gasoline engine, the pressure in the cylinders is quite a bit lower than in the diesel because the gasoline engine uses spark plugs to ignite the fuel-air mixture. In the diesel, the heat for ignition is supplied by very highly compressing the air. The pressures in the diesel are nearly twice that for a gasoline engine and, therefore, the engine must be stronger to withstand the higher pressures. Some other advantages of the diesel engine over the gasoline engine are that there is no carburetor, no spark plugs, no timing or tune-up problems. You are a diesel mechanic, and you are checking the compression on an engine.

II. STEPS

1) You know that the compression ratio for old gasoline engines was about 4:1 and that for modern gasoline engines is 6.5:1 to 9:1; but diesel engine compression ratio is about 19:1. Compression ratio is illustrated in figure 1 a and b. Assuming that the temperature stays constant during the compression cycle, knowing the four compression ratios given above and that normal atmosphere pressure is 14.7 pounds per square inch (P₁), complete the chart in figure 2 (figure 1 and 2 on next page).

(continued)
ACTIVITY

Page 2 of 2

II. STEPS

2) Find $P_2$ (the pressure of air in the cylinder before ignition of the fuel) if $P_1V_1 = P_2V_2$.

![Diagram of cylinder with piston positions]

**FIGURE 1**

<table>
<thead>
<tr>
<th>$P_1$</th>
<th>$\frac{V_1}{V_2}$ (compression ratio)</th>
<th>$P_2$ (ANS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.7</td>
<td>$\frac{4}{1}$ (model T Ford)</td>
<td>(58.8)</td>
</tr>
<tr>
<td>14.7</td>
<td>$\frac{6.5}{1}$ (regular gasoline)</td>
<td>(95.55)</td>
</tr>
<tr>
<td>14.7</td>
<td>$\frac{9}{1}$ (premium gasoline)</td>
<td>(132.3)</td>
</tr>
<tr>
<td>14.7</td>
<td>$\frac{19}{1}$ (diesel)</td>
<td>(279.3)</td>
</tr>
</tbody>
</table>

**FIGURE 2**

$P_2 = \frac{P_1V_1}{V_2}$

Compression ratio: $\frac{V_1}{V_2}$ or $\frac{V_1}{V_2}$
GRADE 9-B 2

SUBJECT Math

CLUSTER Industrial Arts

JOB TITLE Electronics Technician

CONCEPT
Graph relations, functions.

PERFORMANCE OBJECTIVE
The student will be able to find the relationship between current and voltage in a simple electric circuit with one active element.

ACTIVITY
Page 1 of 2

I. SITUATION
You are a scientist employed by a national research laboratory. You have invented a device that seems to operate in a new, interesting manner. You are now making measurements to help you explain the operation of your device to your boss.

II. STEPS—Recommended Approach
1) Hook up the circuit as shown:

```
BATTERY  DIODE
       V
       A
```

Make voltage and current readings with all available battery voltages.

2) Reverse polarity of the batteries and make a second complete set of voltage and current readings. Record test results on the form on the following page and plot the voltage and current on Cartesian coordinates.

3) Remove the diode from your circuit and repeat the entire experiment.

4) Construct what you believe is a good explanation of what happened in the circuit element.

5) Tell in your own words how you would describe this wonderful device to your boss as you ask for a raise.

MATERIALS
4 1/2-volt batteries, 6-volt bulb, solid state diode, volt meter, ammeter
II. STEPS

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Current</th>
<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>With Batteries Reversed</td>
<td></td>
</tr>
<tr>
<td>1 1/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**GRAPH**

- Plot 1 with device
- Plot 2 without device
Grade: 9-B3
Subject: Math
Cluster: Industrial Arts
Job Title: Power Mechanics

Concept:
Geometry: study of the volume of a cylinder.

Performance Objective:
The student will be able to figure the cubic inch displacement of an engine. To do this, he will apply geometric concepts of measuring diameters (bore) and height (stroke) and applying these in the formula for the volume of a cylinder.

Activity

I. Situation
The student is a power mechanic who is figuring the cubic inch displacement of a lawn mower motor. First, the mechanic must measure carefully the diameter of the piston (bore) using a micrometer or scale. Next, he will measure the distance that the piston moves up and down in the cylinder (stroke). Lastly, he will substitute these figures into the formula: displacement = \( \pi R^2 h \). This displacement figure is the key value needed by a mechanic to evaluate the efficiency of any engine.

II. Steps
1) Present in the classroom should be some old motors (lawn, boat, etc.). The student will first measure the diameter of the piston to either the nearest thousandth if the class has a micrometer or to the nearest thirty-second if they have scales. This measure is called the \textit{bore}.

2) Measure next the distance the piston moves up and down the cylinder. Again, use the type of scale available and be as careful as possible. This measure is called the \textit{stroke}.

3) Substitute the two measures into the formula: displacement = \( \pi R^2 (1/2 \text{ bore measure}) \times h \text{ (stroke)} \).

4) What would be the displacement of a motor if:
   a) bore = 2''
      stroke = 2.5''
   b) bore = 3 1/4''
      stroke = 3 1/8''

\[ \text{Displacement} = \pi R^2 h \]  
\[ R = \text{radius} = 1/2 \text{ bore} \]
\[ D = 24.7275 \text{ cubic inches} \]

Recommendations:
Obtain old lawn motors. Take off the head and let the student do the measurements.

Materials
Room set 6'' scale, micrometer (if possible)
ACTIVITY

I. SITUATION

The student is a car mechanic who is figuring the horsepower of an engine. After measuring the bore of the piston (see activity 9-B-1) and counting the number of cylinders the engine has, he substitutes the figures into this formula: 

\[ \text{horsepower} = \frac{D^2N}{2.5} \]

- \(D\) = measure of bore
- \(N\) = number of cylinders
- 2.5 = mathematical constant

II. STEPS

1) Example: What is the horsepower of a Chevrolet V-8 327 with a 3 1/4" bore?

\[ \text{Hp} = \frac{(3 \, 1/4") (3 \, 1/4") (8)}{2.5} \]

\[ \text{Hp} = 33.8 \text{ square inches} \]

2) Using the same motor and information available in activity 9-B-1, what will be the horsepower of the motor?

3) What will be the horsepower of the following motors?

   a) bore = 2 1/2"
      cylinders = 2
   b) bore = 3"
      cylinders = 1
   c) bore = 3 3/8"
      cylinders = 6
   d) bore = 2 3/4"
      cylinders = 7

RECOMMENDATIONS

Use the same motor used in activity 9-B-1. Work up a transparency of an example horsepower problem.

MATERIALS

ACTIVITY

I. SITUATION

A carpenter must compute the amount of wood needed for the slanted portion of a house's roof. He first must measure the width of the house, then the height of the desired roof. After he gets these measurements, he plugs them into the right triangle formula (Pythagorean Theorem). Example:

![Pythagorean Theorem diagram]

Pythagorean Theorem = \( a^2 + b^2 = c^2 \)

Slanted side: \( c^2 = 6^2 + 15^2 \)
\( = 36 + 225 \)
\( = 261 \)

Take the square root of both sides: \( \sqrt{c^2} = \sqrt{261} \); \( c = 16.1 \) feet

II. STEPS

1) A carpenter needs to know the length of the slanted portion of a roof. The house is 28 feet wide and the height of the roof is 5 feet. Find the length of the slanted portion of the roof.

2) You are building a doghouse. The width of the house is 4 feet and the height of the roof is 2 feet. How long will be the slanted portion of the roof?

3) Measure the width of your home; then measure or estimate the height of your roof. Now compute the length of the slanted portion of the roof.
ACTIVITY

I. SITUATION

See 8th grade activity #

Using the perfect gas law $\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$, where $T_1$ & $T_2$ must be expressed in degrees absolute, and knowing that the compression ratio of a diesel engine is approximately 19:1, calculate $P_2$

II. STEPS (pressure in cylinder after compression).

$P_1$ and $T_1$ are standard atmospheric pressure and temperature ($P_1 = 14.7$ psi, $T_1 = 20^\circ C = 293^\circ K$) and that $T_2$ must be at least $450^\circ C (723^\circ K)$. Complete the following chart:

<table>
<thead>
<tr>
<th>$T_1$</th>
<th>$P_1$ psi</th>
<th>$\frac{V_1}{V_2}$</th>
<th>$T_2$</th>
<th>$P_2$ psi (Ans.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$20^\circ C, 293^\circ K$</td>
<td>14.7</td>
<td>$\frac{19}{1}$</td>
<td>$450^\circ C, 723^\circ K$</td>
<td>(689)</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>$500^\circ C, 773^\circ K$</td>
<td>(737)</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>$550^\circ C, 823^\circ K$</td>
<td>(785)</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>$18/1$</td>
<td>$450^\circ C, 723^\circ K$</td>
<td>(653)</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>$500^\circ C, 773^\circ K$</td>
<td>(608)</td>
</tr>
</tbody>
</table>

Compare with pressure ratios if $T$ remains constant ($P_2 = 279$ psi for 19:1 comp. ratio).

RECOMMENDATIONS

MATERIALS
ACTIVITY

I. SITUATION

You have a matted picture which is 18" X 24", and you want to construct a 3" frame with 45° corners and a 1/4" groove to hold the picture.

II. STEPS

1) Determine the length of each side, both outside length and inside length.
   a) Solution to one side:

   ![Diagram of the frame with dimensions]

   2) Determine the cheapest way to cut a 6" board for this frame.

MATERIALS
ACTIVITY

I. SITUATION

A student has the components for P.V.C., a shiny glaze. He/she wants to mix a certain greenish-blue glaze which has the following percentage composition:

- Plastic Vitrox--56.5%
- Colemite--39.2%
- Cobalt Carbonate--2.4%
- Copper Carbonate--1.9%

II. STEPS

Determine the amount of each component needed for 175 grams of the glaze.

a) Plastic Vitrox = ____grams
b) Colemite = ____grams
c) Cobalt Carbonate = ____grams
d) Copper Carbonate = ____grams
The student will build a house accurately on a 1:48 scale (\(\frac{\text{k''}}{\text{to 1'}}\)).

II. STEPS

1) Discuss with the students the jobs of an architect and draftsman; requirements for the positions, benefits, etc. Emphasize the relationships between these jobs and math.
   a) Information can be found in the counselors' offices on these and other occupational areas.

2) Define a delineator (a person who builds three-dimensional model scale homes from blueprint).

3) Build the house.

MATERIALS

Blueprint; drafting paper; building materials (balsa wood from a hobby shop); Exacto tools, such as saws to cut wood.
ACTIVITY

I. SITUATION
A student wishes to make a macrame belt, with a buckle, 30 inches long.

II. STEPS
1) It takes 4 inches of cord to make 1 inch of belt. Determine the length of cord needed.

2) The belt is to be 8 cords wide. Determine the total cord needed for the belt.

3) The cord is nylon and costs 2¢ a foot. Determine the cost of the cord.

4) The state sales tax is 3%. Determine the actual cost of the cord, including tax.

RECOMMENDATIONS

MATERIALS

MATERIALS
ACTIVITY

I. SITUATION
A potter is making a replacement lid for a jar which has a neck diameter of 18 cm. He can expect a 15% shrinkage in size in drying and firing.

II. STEPS
Determine the size of the wet clay lid needed to produce the 18 cm lid.

\[
X = \text{size of the wet clay lid}
\]
\[
X - 15\%X = 18
\]
\[
100\% - 15\%X = 18
\]
\[
85\%X = 18
\]
\[
.85X = 18
\]
\[
\frac{.85X}{.85} = \frac{18}{.85}
\]
\[
X = \frac{18}{.85}
\]
\[
X = \frac{18}{.85}
\]

RECOMMENDATIONS

MATERIALS

MATERIALS
ACTIVITY

Page 1 of 3

I. SITUATION

Each student has $10,000 to invest. He/she goes to the local bank and approaches the teller for information on savings styles and interest rates. The teller explains the three options open to the investor: 1) Timed certificate of deposit--6% annually

2) Premium passbook--5½% compounded quarterly

3) Regular passbook--5% compounded quarterly

II. STEPS

1) The student will compute each style of interest to determine net return on investment of each savings style.

2) Computations will be determined as if no additional deposits or withdrawals were made during the year.

3) Subsequent computations will be based on hypothetical deposits and within a given quarter (90 days) as determined by instructor.

   a) Note: All accounts are computed on the smallest balance in the account during the quarter.

   b) Note: Do not attempt to figure T.C.D. with withdrawals during the quarter.

MATERIALS

Attached interest computations to be copied.
PREMIUM PASSBOOK
INTEREST COMPUTATION

$10,000.00  
\[ \times \ 0.055 = 5\% \]  
$ \ 550.00 \ \text{annual untouched rate}  

$137.50 = \frac{1}{4}\ \text{of annual interest}  
\[ \frac{4}{550.00} \]  

$10,000.00 \ \text{original deposit}  
\[ + \ 137.50 = \frac{1}{4} \ (90 \ \text{days}) \ \text{of annual interest} \]  
$10,137.50 \ \text{after first quarter}  

$10,137.50  
\[ \times \ 0.055 \]  
$ \ 557.56 \ \text{annual untouched rate}  

$139.39 = \frac{1}{4}\ \text{of annual interest}  
\[ \frac{4}{557.56} \]  

\text{added to accrued balance of } $10,137.50  
\[ + 139.39 \]  
$10,276.89  

$10,276.89  
\[ \times \ 0.055 = 5\% \]  
$ \ 565.22 \ \text{annual untouched rate}  

$141.30 = \frac{1}{4}\ \text{of annual interest}  
\[ \frac{4}{565.22} \]  

$10,276.89 = \ \text{accrued balance for previous quarter}  
\[ + 141.30 = \ \text{quarterly annual interest} \]  
$10,418.19 = \ \text{accrued balance}  

$10,418.19  
\[ \times \ 0.055 = \text{annual 5\%} \]  
$ \ 573.00 \ \text{annual untouched rate}  

$143.25 = \frac{1}{4}\ \text{of annual interest}  
\[ \frac{4}{573.00} \]  

$10,418.19 = \ \text{accrued total from previous quarter}  
\[ + 143.25 = \ \text{quarterly annual interest} \]  
$10,561.44 = \ \text{final total}
REGULAR PASSBOOK
INTEREST COMPUTATION

$10,000.00
x .05 = 5% interest
$500.00 ÷ by 4 (number of quarters in a year)

$125.00 = ¼ of annual interest
4/500.00

$10,000.00
+ 125.00 = ¼ of annual interest
$10,125.00 at end of first quarter

$10,125.00
x .05 = 5% interest
$506.25 ÷ by 4 (number of quarters in a year)

$126.56 = ¼ of annual interest
4/506.25

$10,125.00 = accrued balance forward
+ 126.56
$10,251.56

Etc.

$10,509.44 = Final Total

Note: T.C.D. = $10,600.00
ACTIVITY

I. SITUATION
John, the manager at Roll Away Motor Inn, determines that the break-even point is 56.5% of occupancy. If the Roll Away has 120 rooms, determine how many have to be filled to make money.

II. STEPS
Determine the percent occupancy for the following days:
Monday: 70 rooms filled out of 120 rooms
Tuesday: 58 rooms filled out of 120 rooms
Wednesday: 75 rooms filled out of 120 rooms
Thursday: 45 rooms filled out of 120 rooms
Friday: 62 rooms filled out of 120 rooms
ACTIVITY  
Page 1 of 2

I. SITUATION

You are the production chief at a large chemical plant. You are frequently called on to calculate the required amounts of chemicals to be used in the final critical stages of the manufacturing process because of your great experience. You have a large mixing tank with two inlet pipes. One inlet pipe comes from Tank A, which contains 80% ethylene glycol and 20% water (by volume). The other inlet comes from Tank B which contains 10% ethylene glycol and 90% water. You don't have a meter to measure the volume passing through the pipes, but you do know the rate of flow through each pipe. The pipe from Tank A flows at a rate of 10 gal. per minute, and the pipe from Tank B, 15 gal. per minute. You need to prepare a chart showing your assistant how much of A and B to use to obtain various quantities of the mixture and how long to turn on the valves from A & B. Complete the chart following.

(CONTINUED)
<table>
<thead>
<tr>
<th>DESIRED MIX</th>
<th>VOLUME NEEDED</th>
<th>QUANTITY (GAL)</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>A (80%)</td>
<td>B (10%)</td>
</tr>
<tr>
<td>40%</td>
<td>100 gal</td>
<td>42 6/7</td>
<td>57 1/7</td>
</tr>
<tr>
<td>45%</td>
<td>100 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80%</td>
<td>200 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>1500 gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td>300 gal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Example:

For 40% solution, 100 gal.

\[ .4 \times 100 = 40 \text{ gal glycol, 60 gal water} \]

let \( N \) = gal of 80% mixture

then \( 100 - N \) = gal of 10% mixture

\[ .8N + .10(100-N) = 40 \text{ gal glycol} \]

\[ .8N + 10 - .1N = 40 \]

\[ .7N = 30 \]

\[ N = 300/7 = 42 \frac{6}{7} \text{ gal of A} \]

\[ 100 - N = 57 \frac{1}{7} \text{ gal of B} \]

\( T_A = \text{ time of flow from tank A} \)

\[ T_A = 42 \frac{6}{7} \text{ divided by } 10 = 4 \frac{2}{7} \text{ min } = 4 \text{ min } 17 \frac{1}{7} \text{ sec.} \]

\( T_B = \text{ time of flow from tank B} \)

\[ T_B = 67 \frac{1}{7} \text{ divided by } 15 = 3 \frac{17}{21} \text{ min } = 3 \text{ min } 48 \frac{4}{7} \text{ sec.} \]

Could you get a 90% mixture? Why or why not?
ACTIVITY

I. SITUATION

(See 7th Grade and 8th Grade units on same subject)

How were the layers of BB's packed in the previous exercises? They were packed like this:

They could be packed closer by using this plan:

This kind of packing is called "hexagonal close packed" and is found in many crystal structures. It is important to note that the present exercise is not how to pack electrons into a box, but to illustrate how dense matter such as electrons are thought to be. In the previous exercises the space was supposed to be filled as shown in illustration (1). The empty spaces between BB's in illustration (2) seem to be smaller than in (1) and therefore should allow more to be packed into the same 1 cubic centimeter space. You have seen that in the relatively inefficient packing of illustration (1) about 4740 tons would be packed in. Now suppose that all the empty space could be filled, that is, all the electrons mashed like potatoes and packed in solid, how much would the 1 cubic centimeter weigh?

Volume of sphere = \( \frac{4}{3} \pi r^3 \)

R electron = \( 2.8 \times 10^{-13} \) centimeters

M electron = \( 9.1 \times 10^{-28} \) grams

1 gram = \( 2.2 \times 10^{-3} \) lb

Answer: approximately 10,000 tons

MATERIALS
ACTIVITY

I. SITUATION

You are an airline pilot with a route that takes you to several cities in the local area. Your aircraft flies at 360 mph and uses 1,800 gallons of fuel per hour. The wind is from the west at 75 mph. Using distances and directions provided by the teacher and polar coordinate paper, compute the wind-drift, ground speed, time and fuel required for at least one leg of the flight.

II. STEPS

For each leg of your flight:

1) Label graph paper with compass directions and speed rings (see figure 1).

2) Identify the desired ground track of the route of flight and plot on the chart.

3) Plot wind direction and magnitude.

4) Transfer wind direction and magnitude vector so that head of arrow is on desired course line and tail is on airspeed circle (360 mph circle).

5) From tail of wind arrow, estimate drift angle (how far off the desired course you must aim the airplane) and from the intersection of wind arrow (heading) and the desired course line, estimate the ground speed. Put ground speed and heading on log (figure 2).

6) From ground speed and distance, compute time in minutes: Time in minutes = \( \frac{\text{distance}}{\text{grnd spd}} \times 60 \)

Round it off to the nearest minute.

7) Compute fuel required: \( F = \frac{(\text{gal/hr}) \times \text{(time in min)}}{60} \)

(figure 1 and figure 2 on next page)

MATERIALS

Flight log and polar graph paper for overhead projection: demonstrate problem step by step.
### FIGURE 1

<table>
<thead>
<tr>
<th>Leg</th>
<th>Heading</th>
<th>Distance</th>
<th>Ground Speed</th>
<th>Time</th>
<th>Fuel Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boise to</td>
<td>330°</td>
<td>150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desired course:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to</td>
<td>090°</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desired course:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to</td>
<td>180°</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desired course:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to</td>
<td>270°</td>
<td>360</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FIGURE 2
ACTIVITY

I. SITUATION

You are an astronaut planning your next mission in space. The question has come up in the process of manufacturing your spacecraft of how strong will the pull of the earth be when you are out there in space? You know that objects fall toward the earth, even in space, and that the feeling of weightlessness you experienced is because everything about you is falling at the same rate. One of Newton's laws says that the force acting on two bodies is a function of the distance between them. This force of attraction is called gravity and can be expressed by $F = \frac{(k)(m_1)(m_2)}{r^2}$, where $F$ is force, $k$ is a constant, $m_1$ and $m_2$ are the masses of the two bodies, and $r$ is the distance between the two bodies.

You, Joe Astronaut, know that on the surface of the earth, $F$ in this equation is 150 pounds for you because that is what you weighed this morning. And you also know that the earth's center of gravity (CG) is about 4,000 miles below at the center of the earth. And you know that your mass, $m_1$, and the earth's mass, $m_2$, will stay the same.

II. STEPS

1) Can you estimate how far above the earth's surface you will be if $F$ is 1/2 what it is on the surface? 1/4? 1/9? or any other value?

   a) Example: Let $F_s =$ force on surface of earth = 150 pounds and $F_o =$ force in orbit; and if $\frac{F_o}{F_s} = 1$ then $F_o = 75$ pounds.

   Call $r_s$ the radius at the surface (distance from CG); then $r_s = 4,000$ miles.

   (Continued)
II. STEPS

1a) Let $r_o =$ radius in orbit; then
\[
\frac{F_o}{F_s} = \frac{k m_1 m_2}{r_o^2} = \frac{r_s^2}{r_o^2}
\]
but \( \frac{F_o}{F_s} = \frac{1}{2} \) and \( r_s = 4,000 \) miles.

\[
\frac{1}{2} = \frac{(4,000)^2}{r_o^2} \quad r_o^2 = (4,000)^2 \times 2 \quad r_o = 4,000 \times \sqrt{2}
\]

\[
r_o = 4,000 \times 1.414 \quad r_o = 5,656 \text{ miles from center of earth.}
\]

2) How far is this above the surface? Let \( D_o = \) distance above surface = \( r_o - r_s \).
\( D_o = 5,656 - 4,000 = 1,656 \) miles. Complete the following table:

<table>
<thead>
<tr>
<th>( \frac{F_o}{F_s} )</th>
<th>( r_o ) Miles</th>
<th>( D_o ) Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{1}{2} )</td>
<td>5,656</td>
<td>1,656</td>
</tr>
<tr>
<td>( \frac{1}{4} )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \frac{1}{9} )</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3) Can you see that at any given distance above the surface, you can find the force of gravity on your body?

4) If you could be at the center of the earth, would you be crushed by your own weight? Why or why not? (No)

5) Can you ever get far enough away from earth so that there is no force from earth's gravity? (No)
ACTIVITY

Page 1 of 2

I. SITUATION

You are an astronaut. You know that from Einstein's Theory of Relativity that the mass of an object increases as its velocity increases. The relationship between the object's mass at rest (mo) and its mass in motion (m) is given by the formula $m = \frac{mo}{\sqrt{1-(\frac{v}{c})^2}}$ where $v$ is the velocity of the object and $c$ is the speed of light. $C = 3 \times 10^8$ meters per second (approximately 186,000 miles per second).

II. STEPS

1) Find the ratio of velocity to speed of light ($\frac{v}{c}$) at which the mass is twice the rest mass.

2) Find the other ratios of $\frac{v}{c}$ and $\frac{m}{m_0}$ in the table on the following page.

   a) Example: $m = \frac{m_0}{\sqrt{1-(\frac{v}{c})^2}}$ $m = 2m_0 = m_0\frac{\sqrt{1-(\frac{v}{c})^2}}{2}

\sqrt{1-(\frac{v}{c})^2} = \frac{1}{2}$ $1-(\frac{v}{c})^2 = \frac{1}{4}$ $(\frac{v}{c})^2 = \frac{3}{4}$ $\frac{v}{c} = \frac{\sqrt{3}}{2}$

$v = \frac{1.732 \times 3 \times 10^8}{2} = 2.598 \times 10^8$ m/sec
### ACTIVITY

#### Page 2 of 2

**II. STEPS**

2) 

<table>
<thead>
<tr>
<th>( \frac{m}{\infty} )</th>
<th>( \frac{\sqrt{3}}{4} )</th>
<th>( v(\text{m/sec}) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>( \frac{\sqrt{3}}{4} )</td>
<td>( 2.598 \times 10^8 )</td>
</tr>
<tr>
<td></td>
<td>( .9 )</td>
<td>( 3 \times 10^7 )</td>
</tr>
<tr>
<td></td>
<td>( 0 )</td>
<td>( 2.85 \times 10^8 )</td>
</tr>
<tr>
<td></td>
<td>( 4 )</td>
<td>( 3.0 \times 10^8 )</td>
</tr>
</tbody>
</table>
ACTIVITY

I. SITUATION

You are a doctor in Boise. You have discovered a way to make students three times as smart as their teachers. If you give the students a dose of your wonderful medicine in proportion to their body weights and temperatures in just the right way, they will get straight A's in school. If you goof and give them the wrong amounts, then you find that all their grades go down one letter each. You discover that for each kilogram of body weight and for each degree centigrade of temperature, your patients should take exactly 6 milligrams of your wonderful medicine. The only trouble is, although you got straight A's in math, your assistant dropped out of math in third grade, and you now have to make all the weight and temperature calculations yourself since he gave you the wrong dosage for the Einstein kid who was immediately found to be flunking all his courses at Southwest Junior High School.

II. STEPS

You know that to change temperature from Fahrenheit to centigrade, you use the formula \( ^\circ C = \frac{5}{9} (^\circ F - 32) \) and to change pounds to kilograms, you use the formula \( \text{kg} = \frac{\text{pounds}}{2.2} \). On the next page is a list of your patients (and the dose that worked for one of them). Complete the calculations.

RECOMMENDATIONS

MATERIALS

MATERIALS
## II. STEPS

<table>
<thead>
<tr>
<th>Name</th>
<th>Temperature</th>
<th>Weight</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>°F</td>
<td>°C</td>
<td>lbs</td>
</tr>
<tr>
<td>Audrey</td>
<td>98.6</td>
<td>37</td>
<td>115</td>
</tr>
<tr>
<td>Bill</td>
<td>99</td>
<td></td>
<td>150</td>
</tr>
<tr>
<td>Charlie</td>
<td>99.4</td>
<td></td>
<td>125</td>
</tr>
<tr>
<td>Doug</td>
<td>98</td>
<td></td>
<td>140</td>
</tr>
<tr>
<td>Emily</td>
<td>98.4</td>
<td></td>
<td>102</td>
</tr>
<tr>
<td>Fran</td>
<td>99</td>
<td></td>
<td>92</td>
</tr>
<tr>
<td>George</td>
<td>100</td>
<td></td>
<td>175</td>
</tr>
</tbody>
</table>

**Example:** for Audrey

\[ ^\circ C = \frac{5}{9} (98.6 - 32) = \frac{5}{9} (66.6) = 37^\circ F \]

\[ K = 115 + 2.2 = 117.2 \]

Dosage = 37 X 52.27 X 6 = 11.60394 mg = 11.60394 gm
ACTIVITY

I. SITUATION

You are a pharmacist. You have prescriptions for several doses of two drugs which you must prepare for a patient. It is necessary for the dosage to be exact since the patient's life depends on it. You must give 5 milligrams of "Wonder Drug" and 7 mg of "Miracle Cure" in a 4 ml injection. You have a bottle of each drug. The Wonder Drug is marked 5 mg/ml and the Miracle Cure concentration is 14 mg/ml. You must determine how much of each drug and how much sterile water to mix to get enough medicine in one injection.

II. STEPS

1) You first decide that the patient will probably need 4 doses of the drugs; so you want to mix 5 to be sure to have enough, since you have noticed how Doctor Welby seems to always squirt a little out of the syringe before he gives a shot, wasting a small amount each time the medicine is given.

2) Determine how much medicine is required for 5 doses. (5 x 4 = 20 ml total volume of final mixture.)

3) 5 doses of Wonder Drug requires 5 x 5 mg = 25 mg total.

4) Determine how many ml of Wonder Drug to use. (25 mg = 5 mg)
   Let N = the number of ml of Wonder Drug to use. (N ml = 1 ml)

5) 5 doses of Miracle Cure requires 5 x 7 mg = 35 mg total.

6) Determine how many ml of Miracle Cure to use. (35 mg = 14 mg)
   Let M = the number of ml of Miracle Cure to use. (M ml = 1 ml)

7) Add Wonder Drug and Miracle Cure volumes together. How much water is needed to bring the total up to 20 ml?

8) Calculate other dosages using the same concentrations of medicines.

MATERIALS
ACTIVITY

I. SITUATION

You and two of your friends want to determine how much it will cost to license your three boats in the state of Idaho. You know that the minimum license fee is $2.50, but you want to know the exact excise tax on each of your three boats. You own a 1967 16-foot boat with a 100 horsepower engine on it. One of your friends owns a 1969 17-foot boat with a 125 horsepower engine. Your other friend has a 1973 18-foot boat with a 125 horsepower engine.

II. STEPS

1) Multiply the length of the boat times the horsepower times .01%.

2) Multiply the above answer times one of the following:
   
   a) New to 3 year-old boat -- 0%
   b) 4 to 6 year-old boat -- 15%
   c) 7 to 10 year-old boat -- 30%
   d) 11 to 15 year-old boat -- 40%
   e) 16 years and older boat -- 50%

3) Subtract the answer to step #2 from that of step #1 to get the total excise tax. Example: a 1959 15-foot boat with a 35 horsepower engine on it.
   
   a) 15 X 35 X .01% = 5.25
   b) 5.25 X 40% = 2.10
   c) 5.25 - 2.10 = 3.15 ($3.15 is the excise tax paid for one year)
GRADE 9 - L

SUBJECT Math

CLUSTER Public Service

JOB TITLE Deputy Sheriff

CONCEPT Sight estimation of weight and height

PERFORMANCE OBJECTIVE

The students will be able to estimate the weight, within a few pounds, and the height, within a couple inches, of people.

ACTIVITY

I. SITUATION

An unknown person steps into the classroom; and upon leaving, the students are asked to describe the person in terms of his/her weight and height.

II. STEPS

1) Arrange for the above situation and then discuss it in class, including why this ability is needed in the field of law enforcement.

2) Have five students line up in front of the class and have their classmates guess the weight of height of each.

MATERIALS

RECOMMENDATIONS

17-0
ACTIVITY

I. SITUATION

A wheat farmer has 2,480 acres in wheat. At the start of the growing season, he expected a yield of 84 bushels per acre; but due to lack of fertilizer (energy crisis), his yield is decreased by 15%. He contracts his wheat for $2.85 a bushel.

II. STEPS

1) Determine the expected yield.
2) Determine the actual yield.
3) Determine the gross profit.
ACTIVITY
Page 1 of 2

I. SITUATION

You are the ship's navigator. You need to have a chart which will explain the principles of LORAN (a Long Range Navigation system which is used throughout the world). LORAN is a system of low frequency radio broadcasts which allows the navigator of ships and aircraft to determine his/her location with a very high level of accuracy. It depends on the navigator's being able to measure the difference in time between the arrival of the radio pulse from two stations in the same LORAN network and checking the difference on a LORAN chart (see figure 1). For any given time difference other than zero, the possible positions of ships with that time difference is a curve called a hyperbola such as the TD = 2 curve or TD = -2 curve.

II. STEPS

1) You can construct a chart like figure 1 by using strips of paper which will represent the time difference of LORAN signals. Plot the stations as in figure 2. Place strips of paper so that the ends meet on the line segment joining and number position 1 on strips next to stations.

Time difference = time of arrival of signal 1 minus time of arrival of signal 2.

TD = 0 on the perpendicular bisector of line connecting stations.

MATERIALS

FIGURE 1

FIGURE 2
ACTIVITY

II. STEPS

2) As in figure 3, place strips side by side and mark other numbers at random distances. By placing the paper strips so that both 2's are on the stations and marking where the ends of the strips meet, repeating for 3's, etc.; a set of hyperbolas can be constructed (figure 4). You should construct at least three curves on your chart.

3) By seeing where one LORAN position line crosses a second, the ship's location can be determined with extremely high accuracy (figure 5).
ACTIVITY

I. SITUATION

You are the navigator of a ship. You know that you can find the ship's latitude if you make a sextant observation of the sun when it is at its highest point in the sky. The sun is highest at noon, if you happen to be on the central meridian of your time zone. If you are east of that meridian, the sun will be at its highest in the sky before noon; if west, then after noon.

II. STEPS

1) Knowing your approximate longitude, you can calculate when the sun should be highest. Figure 1 shows the earth looking toward the south pole from space. The earth is divided into 24 sectors of 15° each. Each 15° sector can be thought of as a time zone. The earth rotates 15° per hour, one complete rotation each 24 hours. So you can see that the sun is at its highest point on some line of longitude at all times. What we want to know is when it will be highest at our position. The reference point for all time and longitude calculations was taken at the Royal Observatory, Greenwich, England. The sun will be over the 0° (prime) meridian at 12:00 noon, Greenwich mean time (GMT), sometimes called "coordinated universal time". It will again cross that meridian 24 hours later. So to find your time of highest sun, called "local apparent noon" (LAN), we just need to work a proportion problem:

\[
\text{Your longitude} = \frac{(\text{LAN}-12)\text{ GMT}}{360°} = \frac{24\text{ hours}}{24\text{ hours}}
\]

(continued)
II. STEPS

2) For example, the longitude of Chicago is \(87^\circ 45'\)W = 87.75°W. So

\[
\frac{87.75}{360^\circ} = \frac{(LAN-12)(Chicago)}{24}; \quad LAN (Chicago) = 17.85 \text{ hours} = 17:51 \text{ GMT.}
\]

Now to convert to local time: Central DST = GMT-5

\[
LAN \text{ CDST} = 17:51-5 = 12:51
\]

3) Boise longitude = 115-50W. Calculate Boise LAN. MDST = GMT-6

MST = GMT-7

Answer: \(LAN \text{ (Boise)} = 19:43 \text{ GMT}

= 13:43 \text{ MDST = 1:43 p.m. daylight savings time}

= 12:43 \text{ MST = 12:43 p.m. standard time}
ACTIVITY

I. SITUATION

Student will assume role of sales clerk in local store of his/her choice. Instructor or other student will assume role of customer, and will request assistance of "salesclerk" in completing the sale.

II. STEPS

1) "Salesclerk" will add purchase items on sales slip.
2) "Salesclerk" will compute sales tax of 3% on purchase.
3) "Salesclerk" will total purchase price of all items, add sales tax and finalize total of cost to customer.

MATERIALS

List of prices of items for sale. Sales slips for each student.
ACTIVITY

I. SITUATION
Student is outside salesperson for a major recording firm. The firm is introducing a new brand of record to local retailers. As a promotional tool, the firm has authorized its salespeople to allow each retailer a discount on each case of records. The percentage of this discount will be determined by the number of displays the retailer will set up and maintain on the following schedule: every four displays equals 5% discount, up to a maximum of 20%.

II. STEPS
1) Student "A" will role-play the salesperson. Student "B" or teacher will role-play the retailer.
2) "Salesperson" student will approach "retailer" with full sales approach, including the mention of the display promotion discount.
3) "Retailer" will agree to put up "X" number of displays for "salesperson" and request "Y" number of cases of merchandise.
   a) Note: "X" and "Y" totals will vary for each salesperson.
4) "Salesperson" will compute discount and total purchase price for sale using the following information:
   a) 20 records in a case
   b) case price: $56
   c) 5% discount per four displays
5) Whole class activity: following each transaction, the whole class will compute the following:
   a) Price per record to retailer before discount. (Note: normal record cost is $4.25 without tax.)

MATERIALS
ACTIVITY

Page 2 of 2

II. STEPS

5b) Gross profit per retailer for retailer before discount. (Note: at this point the instructor could introduce such ideas as gross versus net profit and how to figure cost of goods sold, operating expenses, etc.)

c) Price per record to retailer after discount.

d) Gross profit per record for retailer after discount.

e) Total difference (excess profit) of retailer who takes advantage of discount promotion.
ACTIVITY

I. SITUATION

A homeowner wishes to build a patio which will be 10 feet wide, 20 feet long and 6 inches deep. He would like to compute the cost of the concrete needed for such a structure.

II. STEPS

1) Compute the volume in cubic yards of concrete needed.

2) How many bags of cement are needed if there are 6 bags to 1 yard of concrete?

3) If the ratio of sand, gravel and cement is 5:10:3, then determine how many yards of sand and gravel are needed.

4) Determine the cost of cement, the cost of sand and the cost of gravel if 1 bag of cement is $2.15, sand is $2/yard and gravel is $2/yard.

5) Determine the total cost of concrete.

MATERIALS
ACTIVITY

I. SITUATION
You are an architect working on a modern home for the richest man in town. He wants a concrete patio with some unusual features. He wants flower beds, a shade tree, and a fish pond in the shape shown in figure 1. You decide that with a good scale drawing, some good calculations and maybe an educated guess or two, you can come up with a good estimate of how much concrete the job will require. Concrete costs $22 per cubic yard plus $10 delivery charge if you buy less than 5 yards. You decide to use a 6" thick slab of concrete.

II. STEPS
1) Prepare scale drawing and 1' X 1' overlay grid. (Suggestion: ¼" = 1' scale)

2) With curved corners and flower beds, compute the area of the patio minus cutout areas for tree, fish pond and flower bed. You may want to guess at areas to be deducted in curves of the flower bed rather than computing them. If so, a large-scale detail drawing and finer grid is recommended so you can guess more accurately. Compute volume of material by multiplying area by thickness.

3) Compute volume of material to construct a fish pond. You must consider thickness of walls. A good detailed drawing is a must. Label all dimensions carefully.

4) Convert volume in cubic feet to cubic yards and determine cost. You must buy the next higher whole yard of concrete. You should also get the current cost of concrete.