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ABSTRACT

The publication contains descriptive outlines or graphic designs representing how different aspects of science could be taught. All representative "models" follow the same format: general purpose, behavioral objectives, background information, materials, the lesson plan, evaluation, suggested activities, references and resources. The six "models" are: A Self-Motivating Evaluative Technique in Science for the Primary Grades; An Introductory Unit on Living Things for the Primary Grades; A Discovery Approach in Teaching Aerodynamics to the Intermediate Grades; The Game as a Technique for Introducing Science Systems to the Intermediate Grades; An Open-ended Approach for Teaching the Meaning of Science to the Intermediate Grades; and An Integrated Science Lesson for the Intermediate Grades. (CP)

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N-H

MODELS FOR TEACHING SCIENCE

IN

ELEMENTARY EDUCATION

A PROJECT OF

GROUP B

PHILADELPHIA SUBURBAN SCHOOL STUDY COUNCIL

CHAIRMAN - Herbert Pless, Ridley School District

ADVISER - J. Leonard Halderman, University of Pennsylvania

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According to the United States Office of Education-- and almost anyone studying teacher education--elementary teacher training programs need improvement and updating. To this end, in May 1971, a science committee of the Philadelphia Suburban School Study Council Group B completed a project entitled, "Models for Teaching Science in Elementary Education." Highly prescriptive outlines for five lessons were included in their project report.

It is recommended that the models be used in the following ways:

1. To provide teachers having little or no background with guidelines for designing lessons;
2. To provide teacher training institutions with a resource for use in courses in the methodology of elementary science education;
3. To provide principals or elementary supervisors with a resource upon which they might draw for the development of in-service programs;
4. To provide teachers with insights into the anatomy of a science lesson with particular concern as to:
   a. The introduction of concepts;
   b. The reinforcement of concepts;
   c. The evaluation of conceptual learnings;
5. To provide teachers with techniques for developing child-centered activities.

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PREFACE

During the school year 1968-69, a committee representing participating members of the Philadelphia Suburban School Study Council Group B was formed to determine the status of existing science programs in their districts.

After several evaluation meetings, the committee, composed of science supervisors and science teachers from the secondary levels, identified a need for improving the methods of teaching elementary science. Toward this end, it was recommended that a "model" or "models" be developed to aid teachers in grades K-6. The term "model" was defined as a descriptive outline or graphic design representing how an aspect of science could be taught.

It is interesting to note that at the same time the committee was discussing a course of action, an article appeared in the October edition of the Phi Delta Kappan in which the urgency for the development of teaching models was clearly supported as witnessed by the following statement:

> The USOE issued a request for proposals which would develop educational specifications for a comprehensive undergraduate and in-service teacher education program for elementary teachers (defined as teachers of pre-school through grade eight). These proposals were Phase I of a new two- or three-phase "Elementary Teacher Education Project." Nine proposals were chosen from among 80 submitted by universities and colleges across the nation for the design of conceptual models in elementary teacher education.[1]

To insure both its universal appeal and practicability, it was decided that in developing models, pilot schools would be used for evaluating purposes. The committee recognized the need for suitable vehicles through which models could be demonstrated. Accordingly, an interest inventory was constructed to determine suitable content areas, conceptual schemes and behavioral skills. (See Appendix) An opinionnaire was administered to a representative sampling of both teachers and students from each of the participating school districts. Although the results in themselves might generally prove helpful to teachers in planning lessons, the committee was looking specifically for extreme opinions. It was felt that particularly in the case of negative reactions, a source for direction in structuring the model could be found. In the case of primary grades, a significantly higher number of children seemed to "like" all items listed. With a few exceptions, their teachers showed the same preferences. Perhaps the only significant difference was shown in the teachers' reaction to the study of atoms and molecules with more than three-fourths expressing a "dislike." Children and teachers of the intermediate grades were given a

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1. Monson, Jay A., "The New Models in Elementary Teacher Education," Phi Delta Kappan, October 1969, p. 101.

slightly more discriminating scale with which to voice their opinions. Perhaps the only items that are worthy of note in the case of these pupils deal generally with machines, specific energies and, interestingly enough, the study of atoms and molecules ... again. Almost half of the intermediate teachers expressed the fact that ... "never think about" the cell as the smallest part of all living things. ...ally, it should be noted that a high enough number of students expressed the fact that they did not enjoy making "guesses based on information collected" or explaining "what happened" to justify concern.

With the results of the survey in mind, the committee addressed itself to the task of developing a format for a model lesson. They agreed upon the following outline to serve as a guide:

I. General Purpose

II. Behavioral Objectives

III. Background Information

IV. Materials

V. The Lesson

VI. Evaluation

VII. Suggested Activities

VIII. References and Resources

At this stage, the immediacy for elementary teacher involvement was clearly recognized. Accordingly, the committee was expanded to include teachers representing both the primary and intermediate levels. Since the newest members were to be used mainly in a resource capacity, selections were based upon outstanding qualities already displayed by each in the instruction of elementary science programs.

Following an orientation, during which time the committee's goals were reviewed, the elementary teachers were given the responsibility of presenting a brief lesson which in their opinion displayed innovative teaching techniques. In doing so, they were asked, where possible, to use the findings of the opinionnaire as criteria for their selections. The following are synopses of six presentations made:

1. A Self- Motivating Evaluative Technique in Science for the Primary Grades

Upon completing a unit on plants, a teacher wanted to evaluate what the children had or had not learned about plants.

An evaluative technique was devised that used creativity, as well as a knowledge of the subject. Each child made a flower of his choice, as well as a flower pot. The stem of the flower was made a spiral or a long, equally folded green paper. The stem was attached to the flower and on the back side of the flower pot. All was concealed behind the pot. Each time a child answered a question, his flower grew.

The object: How high could your flower grow?

Prepared by Barbara Faust
Boyertown

2. <u>An Introductory Unit on Living Things for the Primary Grades</u>

Children, under the guidance of teacher teams, observed the stages in the development of a fertilized chicken egg. An evaluation program followed, including drawings by children and oral questioning periods. Each group was responsible for its own egg, to add personal incentive.

Prepared by Betty Bishop
Kennett

3. <u>A Discovery Approach in Teaching Aerodynamics to the Intermediate Grades</u>

To develop general principles, inductive and deductive methods of reasoning are used in the teaching of science. Misconceptions are occasionally used to develop particular concepts.

The concepts are taught in a specific-to-general way. For instance, when teaching the forces acting upon an airplane, a thumb tack is put through a 3 x 5 card and the point inserted into the hole of a thread spool. Children hypothesize what will happen to the card when air is blown into the hole. From there, they proceed to support or refute the hypotheses. Reformulating hypotheses as to why the card stays in place would follow, with investigations to solve the "mystery" eventually. This study of the behavior of air currents eventually leads to "Bernoulli's Principle," which, of course, leads to the reason for the shape of an airfoil, producing lift.

Prepared by William D. Bartman
Pottstown

4. <u>The Game as a Technique for Introducing Science Systems to the Intermediate Grades</u>

Abstract figures are used to construct rules governing science systems. A model used was the atomic system. In a game atmosphere, different colored shapes were used to represent particular members of the atomic system. Once observable rules or properties were recommended by student teams, information was supplied in tabular form to give meaning to the abstract figures.

Prepared by Richard Crouthamel
and
Herbert Pless
Ridley

5. An Open-ended Approach for Teaching the Meaning of Science to the Intermediate Grades

The teacher uses the child as a resource person and draws from the background of the child. Dignity is given to the student's opinions and thoughts. Subject material becomes secondary and the "feeling for science" is given more attention. The organization of science is accented as it applies to the rest of the world.

Prepared by Bernadette George
Sharon Hill

6. An Integrated Science Lesson for the Intermediate Grades

The practical applications of heat and electrical energy were taught in conjunction with the on-going social studies program on a team basis. Other subject areas integrated were arithmetic, art, language arts, and physical education. Student committees were formed to first initiate the project and then to identify specific problems. A Planning Committee submitted to the class several choices. The class chose the project which they called, "The House That Great Grandfather Built." Members of this committee worked to design a house that would be authentic to the time of the Industrial Revolution. The finished project was given to the special education classes, and it is still being used as a valuable learning tool.

Prepared by Herbert Doemling
Springfield

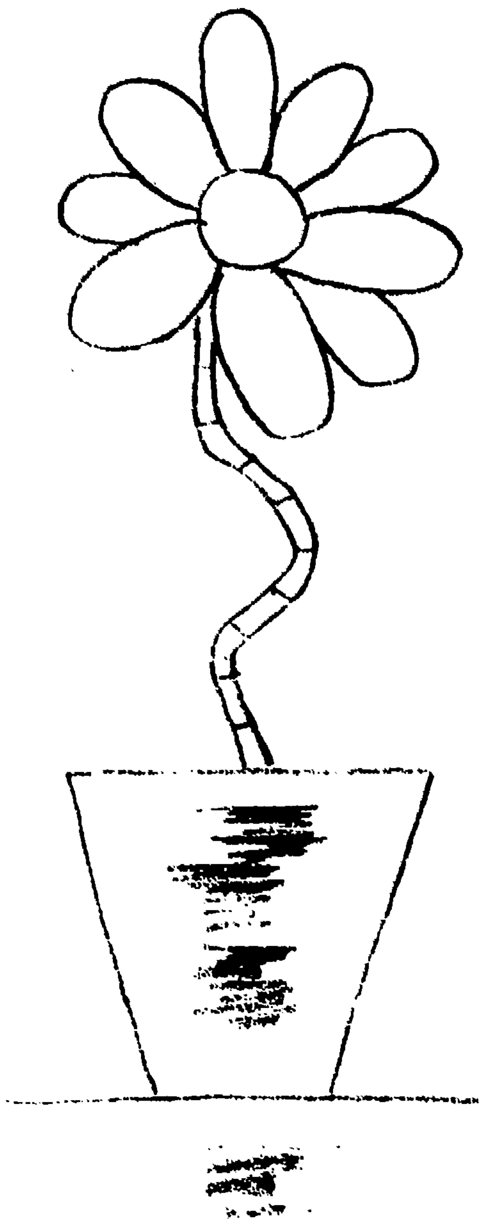
After careful consideration, the first five lessons, briefly described above, were selected to serve as model prototypes. The only criticism of the last lesson, if it can be considered as such, was its extensiveness. It was felt by the committee that in the time allotted to complete its task, lessons of shorter duration could be more successfully be developed into models.

Following an initial critique by the committee, each model prototype was refined and then piloted in selected schools of the representative districts. Results of the trials were discussed at subsequent meetings and a second critique was conducted. This procedure produced the finalized copies of the models included in the remaining sections, with one exception. The lesson dealing with the game technique was used to exemplify the versatility of the model. Therefore, the content which had originally stressed atomic and molecular systems was replaced with subject matter dealing with cellular genetics and is reported here.

In concluding, a special commendation should be given to the members of the committee for their tireless efforts in helping to assemble this report. Hopefully, they have provided teaching models that, with minimal change, can be used to encourage young students to find rewarding educational experiences in the field of science.

Herbert Pless, Project Chairman
J. Leonard Halderman, Adviser

A SELF-MOTIVATING EVALUATIVE TECHNIQUE
IN SCIENCE FOR THE PRIMARY GRADES



Prepared by Barbara Faust
Boyertown Area School Distict

I. General Purpose

A. To develop an informal evaluative technique for students of primary grades.

II. Behavioral Objectives

A. Each student will create a flower, a spiral stem and a flower pot.

B. Each student will answer written and oral questions pertaining to the concepts developed on plants.

C. Each student will manipulate his flower so that the flower can grow when his written and oral questions are answered correctly.

III. Background Information

A. Concepts that have been developed in this unit on plants:

1. There are many kinds of soil.

2. Most plants grow better in good garden soil than in sandy soil.

3. Plants need water, air, light, and the proper temperature.

4. A plant has many parts: flower, leaves, stem, and roots.

5. People take care of some plants.

6. Some plants grow without the care of people

a. The plant makes seeds.

b. All seeds travel.

7. Proper procedure to plant a seed.

IV. Materials

A. Flower and flower pot.

1. 9" x 12" construction paper, tissue paper, or oaktag

2. Scissors

3. Tape

4. Paste

IV. (Continued)

B. Stem

1. Used prepared template of stem- see Sheet I at end of unit.

a. Make on paper heavier than construction paper.

b. Have equally marked sections according to total number of questions each student will be given.

2. Crayons or paint

C. Leaves can be added to stem at the completion of the tests-(optional.)

V. The Lesson

A. Initiating the lesson

1. A week following the beginning of the unit, the flowers were made. Each flower was an original creation. It can be two or three dimensional. Perhaps they can be made with help of an art teacher.

2. The children were told- "You are going to use these flowers to see how much you have learned at the end of the unit. The more you learn, the more your flower will grow."

3. The teacher put the flowers on a shelf until the end of the unit when the tests were given.

B. General Procedure

1. A written test is administered (See Sheet II at the end of the unit.)

a. Reading may be a problem. Have students read silently while the teacher reads aloud.

b. The test is evaluated immediately following its completion.

c. Each child now has his own flower on his desk.

d. For each correct answer, the flower grows one section. The child holds flower pot and stem in one hand and makes it grow with the other hand. (See visual below.)

V. (Continued)

B.

1. e. Each flower is taped at the right height.

   f. Flowers are put around the room -- on lockers, bulletin boards, etc.

2. An oral test is administered. (See Sheet III at the end of the unit.)

   a. Test is given one or two days after the written test.

   b. Test-two days to administer. This is based on a large class (30) and a limited time for science class.

   c. Make it clear to the students that you are not comparing students -- it's strictly "the self."

   d. Use no more than five (5) questions per child.

   e. To meet individual differences questions are ranked above average, average and easy.

   f. Each child again has his own flower at his desk.

   g. Add oral question results to written result.

   h. As an oral question is answered, the flower grows one section. Repeat growing process as explained above.

3. Time

   a. The time involved is up to the teacher's discretion.

   b. Factors to consider:

      (1) size of class

      (2) Amount of class science time

      (3) Enthusiasm of the students

4. Final Grading

   a. According to teacher's grading procedure

   b. Individual ability should be considered.

VI. Evaluation

A. Children

1. Flowers of all students were used to decorate the hall and the room.

B. Teacher

1. Observe flower height of each child.

2. Record the height of each flower.

3. Item analyze the written test. You may want to change some questions.

4. Observe student reaction of the lesson; this can be used in an anecdotal record.

VII. Suggested Activities

A. The evaluative technique can be used in other areas. For example,

1. In studying about space and space travel, use rockets blasting off.

2. In studying about weather, use a thermometer -- "How high will the temperature climb?"

VIII. References and Resources

A. Text- Schneider, Herman, and Nina, Science, For Here and Now, D.C. Heath, 1961. Unit XVII.

B. Library Books

1. Darby, Gene, What Is A Plant? Benefic Press, 1960.

2. Haw Kinson, John, Our Wonderful Wayside, Whitman, 1966.

3. Jordan, Helene, How A Seed Grows, Crowell, 1960.

4. Knox, Warren, The Wonderworld of Science, Scribner, 1946.

5. Pondendorf, Illa, Plant Experiments, Armstrong, 1960.

6. Webber, Irma E., Travelers All, Scott, 1944.

7. Zim, Herbert, What's Inside Plants, Morrow, 1952.

VIII. (Continued)

C. Films

1. Gardening (11 minutes), black and white, Encyclopedia Britannica Films.

2. Wonders of Plant Growth, Heath Series.

3. How Does Your Garden Grow?

D. Flannel Board

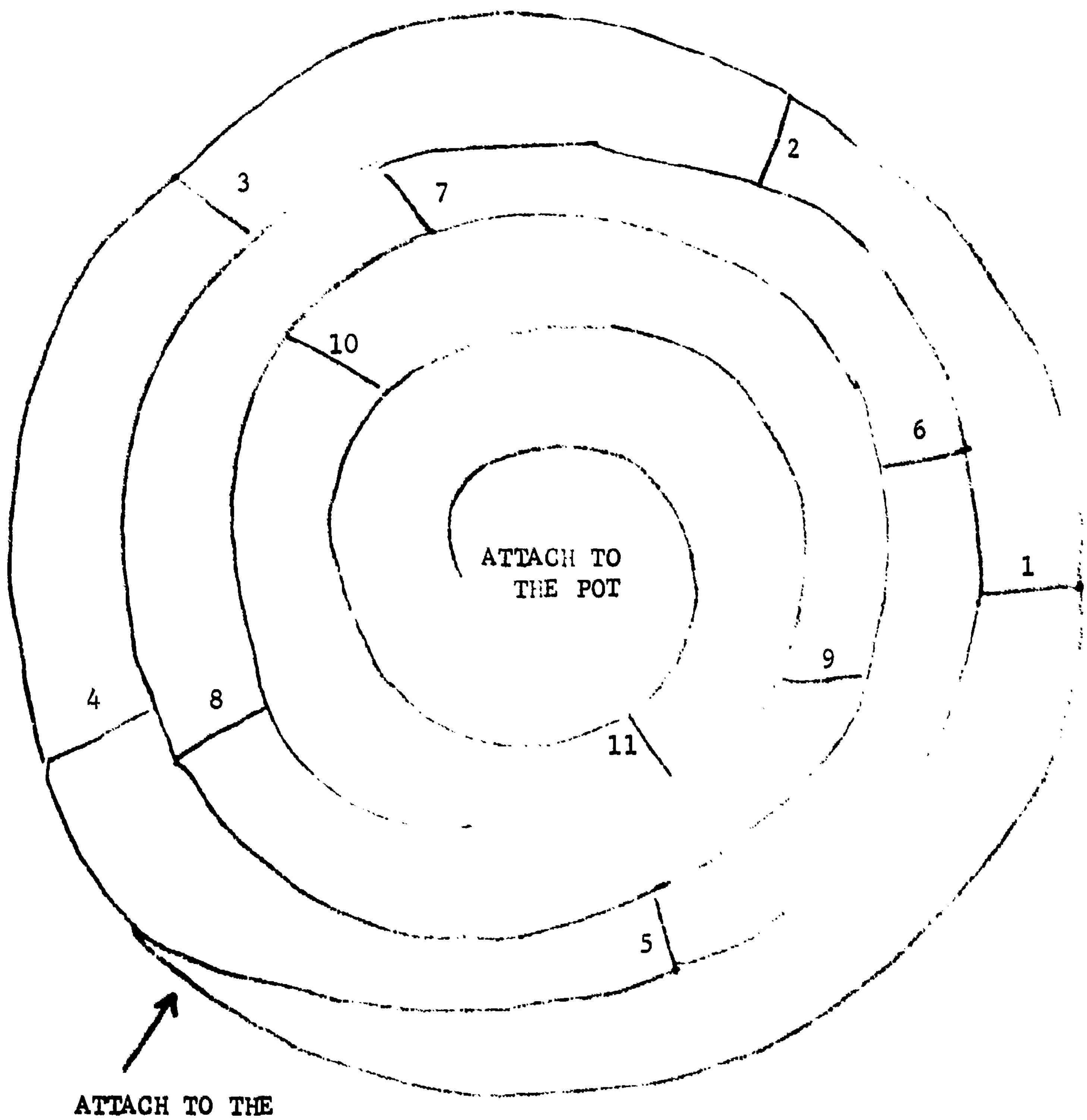
1. Instructo Cut-outs, Plants and Seeds #262-#263

E. Plants and Seeds

1. Children brought in variety

2. Planted seeds

<u>SHEET #1</u> THE STEM----USE GREEN OAKTAG OR COLOR THIS GREEN



NUMBER OF QUESTIONS USED SHOULD EQUAL THE NUMBER OF SECTIONS ON THE STEM.

SHEET #2 (Written Test) NAME_______________

DATE_______________

Circle the best answer.

1. Another name for "the ground" is

PLANT SOIL POT

2. The part of the plant that grows down under the ground is

FLOWER LEAF ROOT

3. Name a seed that we eat.

CARROTS CORN PEACHES

Write yes or no after each sentence.

1. Most plants grow without people to help them. _______________

2. All seeds travel. _______________

3. The stem is the first part of the seed that grows. _______________

SHEET #3 -- ORAL QUESTIONS FOR UNIT ON PLANTS

Listed below are some of the oral questions used in the oral test. According to the pilot study, the questions are ranked above average, average, and easy. Acceptable answers are in parentheses - some being direct quotes of the children tested.

Above Average Questions

1. Describe sandy soil. ("It is light-colored, like in my sand-box.") Why didn't we use sandy soil to plant our seeds? (Sandy soil doesn't hold water; water doesn't stay in sandy soil; it's too dry; it doesn't have the things that garden soil has in it.)

2. How do we know that it was the garden soil that made the plants grow bigger? ("Both groups of plants had water, light and air--the only thing that was different was the soil.")

3. Compare a healthy and an unhealthy plant.

4. How can seeds grow if people did not plant them? ("Seeds travel on the ground, wind or water and they get in the soil and they start growing." Plants make seeds, they grow and become parent plants and then the parent plants make more seeds.)

5. Draw a plant on the board and label its parts.

6. Why did Tom save the pod of seeds?

7. What would happen to a plant that has been watered, but kept in the sun without being turned?

8. Show us how to plant a seed.

Average Questions

1. In planting seeds, why was garden soil used? ("It has the things in it that seeds need to grow.")

2. What are 2 things a plant needs to be healthy? (Water, air, garden soil, light)

3. Where do we find plants growing without the help of people? ("In the woods behind my house, there are lots of plants growing and nobody helps them.")

4. Name 2 ways seeds travel. (Ground, animals, wind, or water.)

5. Name all the parts of a plant.

6. What part of the seed grows first? (Root; "the part that is under the ground.")

7. What did Tom (boy in the movie) save after his flowers died? ("He saved the dried-up flower.")

8. Where did he store the seeds? ("He saved them in a jar that had a lid.")

Easy Questions

1. When planting seeds, what kind of soil should you use? (Garden soil; "the brown ground that holds the water.")

2. How can you tell that a plant is not healthy? ("The leaves are brown and dry.")

3. Can plants grow without people helping them? (Yes)

4. How are you like a plant? ("I need water like a plant.") Other answers could be sunlight or air.

5. Name one way seeds travel. (Ground, wind, water or animals.)

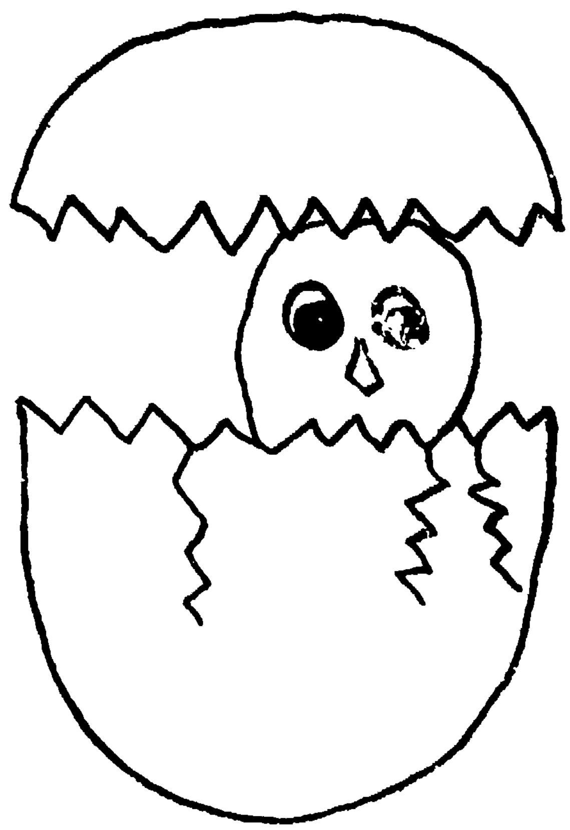
6. Name 1 part of a plant.

7. How did the boy in the movie help his seeds grow? ("He planted them very carefully and then he watered them.")

8. What can Tom do with the seeds that he saved? ("He can use them again.")

-HATCHING CHICKS-

AN INTRODUCTORY UNIT ON LIVING THINGS
FOR THE PRIMARY GRADES



Prepared by Betty Bishop
Kennett Consolidated
School District

I. General Purpose

To develop an interest in animal life at the primary level.

II. **Behavioral Objectives**

At the conclusion of this lesson, the children will be able to:

A. Recite orally how life begins.

B. Name or draw six (6) animals that hatch from eggs.

C. Put in correct order of growth three (3) different embryo stages of a chicken's egg.

D. Name the three (3) conditions - heat, air, moisture - required for an egg to hatch.

E. Name and write the three (3) parts of an egg.

F. Assume some responsibility for life by tending the incubator.

*G. Order five (5) embryo stages.

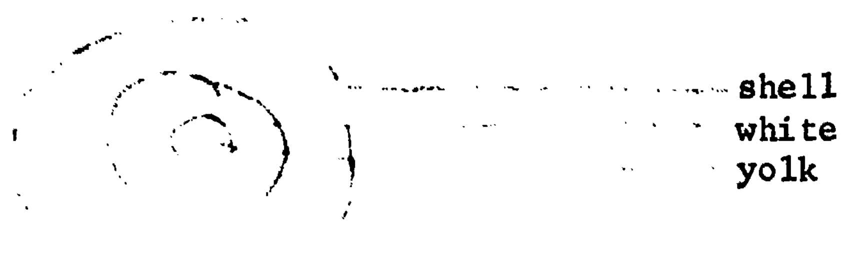
III. Background Information

A. Parts of an egg

1. Shell - protects the white and the yolk. It is thin and oval, because this shape is strong. Big fat hens can sit on the egg, and it will not break... but you can't!

2. White - watery part, named for its color when cooked.

3. Yolk - yellow ball in middle, looks like the sun.



B. Difference between fertilized and sterile egg - a fertilized egg has

*II G is for advanced classes.

III. (Continued)

B. a nucleus that is a tiny, whitish spot - the result of mating a rooster and a hen. The eggs purchased in stores have the three parts of an egg, but they are sterile because they have no embryo inside.

C. Vocabulary

embryo	hen	yolk	white	shell	incubator
sac	cell	hatch	germ-spot	chick(s)	candler
egg	brooder				

D. What to do with the chick(s) after hatching

1. Keep in brooder and observe growth changes:

    a. Size

    b. Color

    c. Feathers

2. Let chicks become class pets for everyone to care for.

3. Give to a nearby farm, or to a child who has written permission.

IV. Materials

6 or more fertile eggs
1 incubator
1 water pan
1 sponge
1 thermometer
tweezers
gloves (to turn eggs so oil won't get on them)
manicure scissors
razor
saran wrap
black paper
1 candler
1 brooder

A. Commercial incubators

1. 50-egg size $26.50 — #65501 Science Kit Inc.
   2299 Military Road
   Tonawanda, N.Y. 14150

2. 4-egg size $4.75 — #147-629 Beckley Cardy Co.
   Chicago, Ill. 60039

B. Construction of incubator and/or Candler and Brooder

1. Incubator - materials needed:

IV. (Continued)

B.

2 heavy cardboard boxes, one 16" x 20" and one 14" x 18", both 12" high
newspaper or other insulating material
masking tape
glue
cloth material
baking tin (moisture pan) with sponge
60-watt bulb
double strength glass
thermometer
1 container for eggs, such as is sold with eggs in stores

Steps:

a. Place smaller box inside larger. Make heights same. Glue bottom of small box to large box.

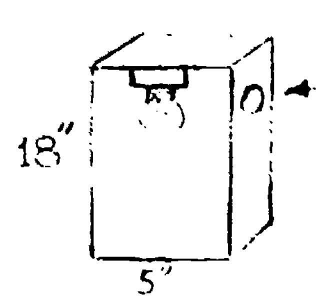
b. Put strips of newspaper between boxes to insulate.

c. Tape edges of box, and place cloth material on bottom of box.

d. Place baking pan with water in box, tack thermometer to box on the side opposite the light, and add egg carton.

e. Use tape to hold cord around inside of box. Plug in bulb, add eggs to container, and cover with glass...Leave a crack for air ventilation and temperature control.

2. Candler



hole (1 1/8"; 4" from top)

egg is held at a 45° angle in a darkened room. Look down on egg - not into light.

3. Brooder

Use a cardboard box, or the incubator without the glass. Place a light (desk lamp works well) in one corner to provide heat. In 2 lids or other small containers, place food and water. Tear up newspaper to line the box.

IV. (Continued)

B.

4. Helpful Hints

a. Make certain incubator is well-ventilated.

b. Vary size of bulb wattage to maintain 102° temperature.

c. Place incubator in part of the room with consistent temperature.

d. Candeling eggs is not harmful, but may slow progress.

e. Except for the 19th, 20th, and 21st days, it is quite safe to take home eggs and incubator. Make certain eggs are well-wrapped and that incubator is wrapped in a blanket.

f. Keep an extra bulb on hand.

g. If eggs do not hatch after 23rd day, discard them.

h. If the chick has a hard time getting out (only a small hole after 4 hours of pecking), you may peel the shell away carefully to help it.

V. The Lesson

A. Initiating the Lesson

1. Show and observe different size, shape, and color of eggs. For example, robin's (blue), dinosaur (need both arms to carry), hummingbird (very small), grouse, snake, turtle, etc.

2. Using hard-boiled eggs, peel off the shell and hold it up to the light. Notice transparency and texture. Cut egg in half to observe color, texture, smell, taste, etc.

3. Use raw eggs. Puncture yolks and cut them. Notice results and compare them to yesterday's hard-boiled egg.

4. Discuss where eggs come from. Read poem, "The Eggs" by Laura E. Richards from <u>The Arbuthnot Anthology of Children's Literature</u>: Chicago: Scott, Foresman and Co., 1952, p. 61. Show pictures of hens and roosters.

5. What is an egg for? To keep the baby safe till born, and to eat. (Humans and animals both do.)

B. General Procedure

V. (Continued)

B.

1. Place 4 or more eggs in the incubator on their sides. Mark one side of each egg with a <u>pencil</u> (magic marker has poisonous fumes) with an X.

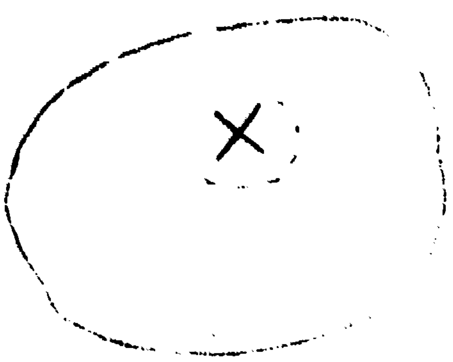
2. Rotate the eggs 1/3 turn, 3 times daily. Make a chart from 1 to 21, and record the turnings. Let the children put on the gloves, and turn the eggs... they love it!

3. Keep eggs away from the light source.

4. Always make sure there is water in the moisture pan, and that the heat remains constant.

5. Any drastic change in the room temperature will cause the embryo to die.... 102° is the right temperature.

6. Optional activity (suggest lots of practice or else have a high school biology student do it)



   a. Cut a window in the egg to observe the growth, by scratching a circle with a razor.

   b. Scratch an X inside the circle, being careful not to break the membrane.

   c. Carefully peel of the shell with tweezers.

   d. Take Saran wrap, and tape a piece to the hole. Cover this with a piece of black paper to shield it from the light.

   e. Peek once a day to watch the embryo.

7. Candle the same egg daily, and notice the changes in the shadow of the embryo.

C. Embryo Development (Big charts can be made from the book, <u>The Wonderful Egg</u>.)

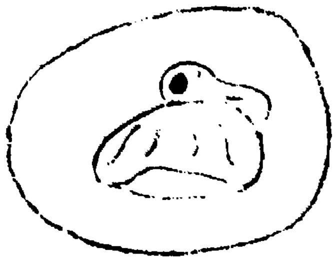
1. After 3 days

   a. Red lines, tubes to carry blood to growing germ-spot.
   b. Yolk and white are food embryo will use.
   c. Beginning of the head.
   d. Heart pumping blood. (140 times a minute)
   e. Sac like skin attached to what will become the stomach.

V. (Continued)

C.

2. After 5 days



a. Blood vessels cover most of the yolk.

b. Embryo is bigger:

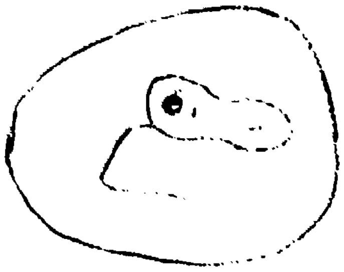
(1) Heart- while candling, watch how the embryo rocks back and forth

(2) Ear- little speck

(3) Eye- open, has lid

(4) Beginning of wing

3. After 7 days



a. Embryo now 1" long.

b. Has all organs, but they are not well-developed.

c. Notice rocking back and forth of the embryo.

4. After 10 days

a. Embryo curled up on yolk.

b. Little bird without feathers.

c. Sac of clear fluid protects embryo.

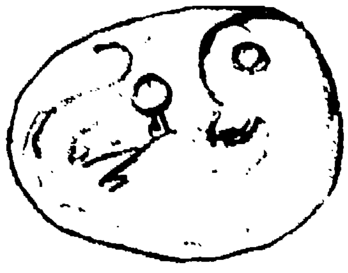
d. Wings, legs and tail appear as blunt projections.

5. After 13 days.

a. Down is visible.

b. White spot on tip of beak to break through the egg.

6. After 18 days

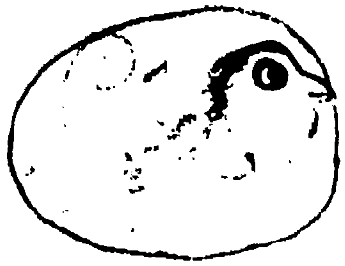


a. Embryo is filling the egg.

b. What is left of the yolk will become part of the chick's body for it to eat when it hatches.

c. Parts are well-developed.

7. After 21 days



a. Chick begins to peck way out of shell (4-12 hrs.)

b. Wet and wobbly when it emerges.

c. Don't have to feed it for 24 hours after it hatches- then feed it oats, oatmeal, small grain and water.

VI. Evaluation (see last two sheets of this unit)

VII. Suggested Activities

A. Observe chick in room for several weeks in the brooder. Keep warm; watch weight, growth, and needs for survival.

B. Go into unit on human growth, as compared to chick's growth.

C. Write reports on other animals.

D. Keep daily pictorial record of the chick's growth.

E. Make giant chick cards- use large pieces of egg shell. Crayon or paint chick. Signs of spring may be added.

F. Cut out or draw pictures of food products that use egg as an ingredient.

G. Take various stages of embryo and place in formaldehyde to preserve.

H. Have children act out embryo development and hatching.

I. Make many decorated eggs as introduction to Easter.

VIII. References and Resources

A. Book materials

1. Who's in the Egg, by Provensen
2. Growing Up, by K. De Schweinitz
3. How Things Grow, by H. S. Zin
4. Human Growth, by L. F. Beck
5. Chickens and How to Raise Them, by L. Darling
6. What Is A Chicken? by Gene Darby
7. The Wonderful Egg, by Warren G. Schloat
8. The Story of a Baby, by Marie Holl Etz
9. When an Animal Grows, by Selsam
10. Your Body and How It Works, by P. Louber
11. The Wonderful Story of How You Were Born, by Gruenbert

VIII. (Continued)

A. 12. <u>Egg to Chick</u>, by Selsam and Wells

13. <u>All About Eggs</u>, by Millicent Selsam

B. Non-print materials

1. Transparencies - Series HE-80 Health Education, 4 trans., 16 overlays $30.00 Aevac Catalogue

2. Elementary Animal Series (growth of animals) Education Supply Co. $26.64

3. Teacher-made transparencies

4. Child-made transparencies

C. Records

1. Do You Know How to Grow? Inside? LCR66-1206 NY 1-10" l.p. $4.15 Scholastic Audio-visual Catalogue

2. Do You Know How to Grow? Outside? LCR66-1205 NY 1-10" l.p. $4.15 Scholastic Audio-visual Catalogue

3. <u>Adventures in Music</u> Grade 1 "Ballet of the Unhatched Chicks" RCA

D. Filmstrips

1. "From Egg to Chick" FOM col. Canadian Book Wholesale Co.

2. "Finding Out How You Grow" SVE 1962 Canadian Book Wholesale Co.

E. Films

1. "Our Wonderful Body: How It Grows" 1 reel, 11 min. Coronet Films $130.00

2. "Life Cycle of the Ant," Bailet Film Association $20.00

F. Cartridges

1. "Life Story of the Herring Gull," Super 8, Dr. W. Jahoda $23.00

2. "Hatching of a Chicken Egg and Growth Inside a Chicken Egg," Super 8 National Instructional Films

3. "Frog Eggs," (Part 3) (Continued Development to Hatching) Super 8 $15.50

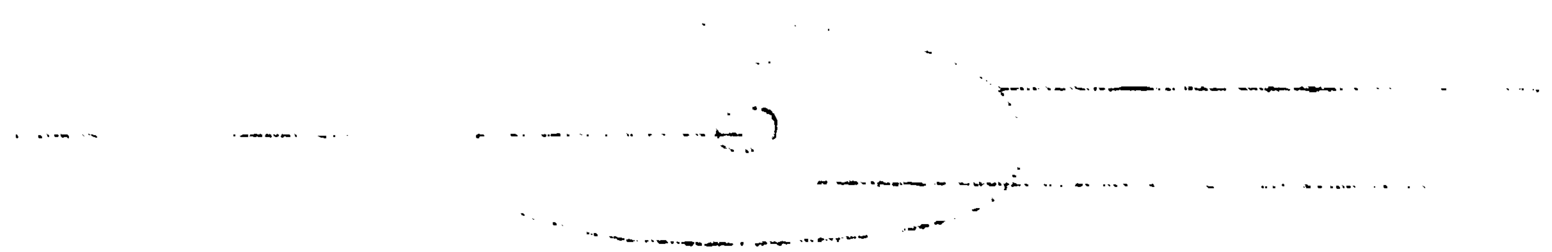
G. Chicken Hatcheries in Chester County, Pennsylvania

EVALUATION________Child's Copy

Name ______________________________

1. Draw and color many kinds of animals and their eggs.

2. Name the parts of an egg.



3. How many days does it take to hatch a chick? ______________

4. Put the pictures in the right order with a 1, 2 or 3.

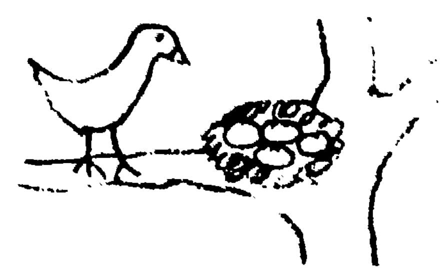
5. Put these pictures in order with a 1, 2, 3, 4 or 5.

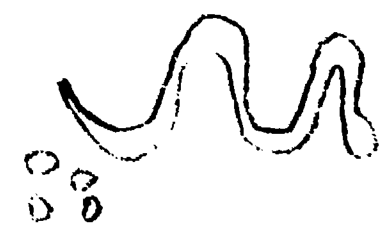
EVALUATION________Teacher's Copy (Suggested Answers Added)

Name________________________________

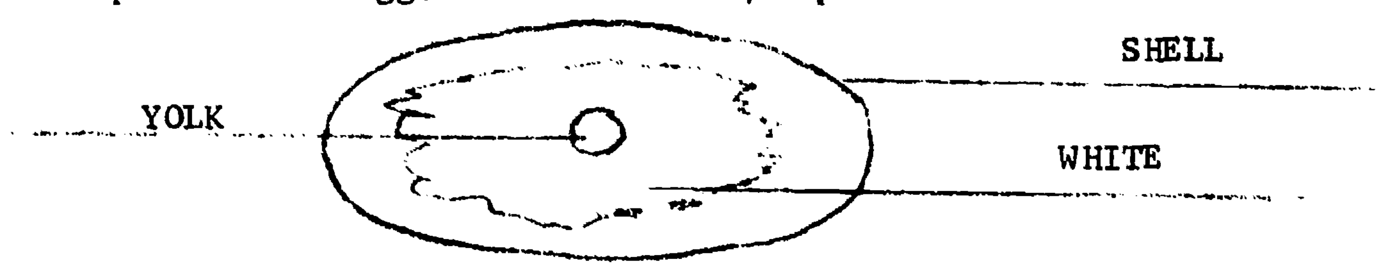
1. Draw and color many kinds of animals and their eggs.

FISH BIRD SNAKE



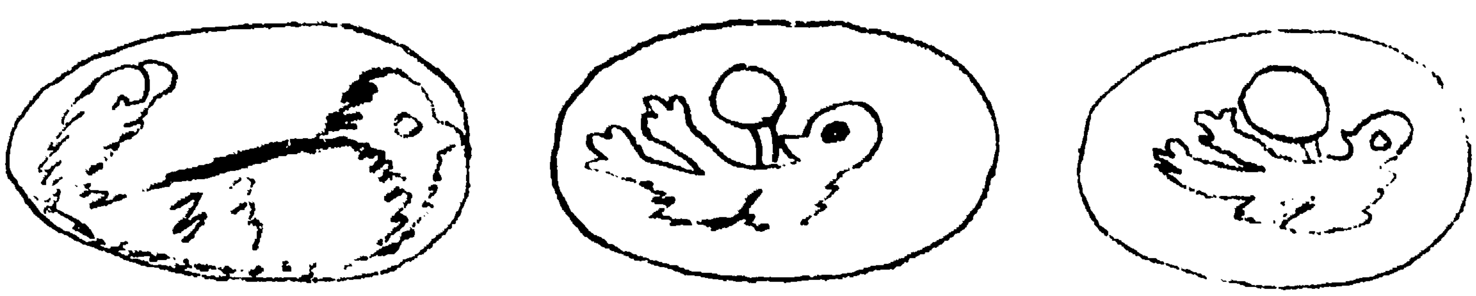


2. Name the parts of an egg.



3. How many days does it take to hatch a chick? 21 DAYS

4. Put the pictures in the right order with a 1, 2 or 3.



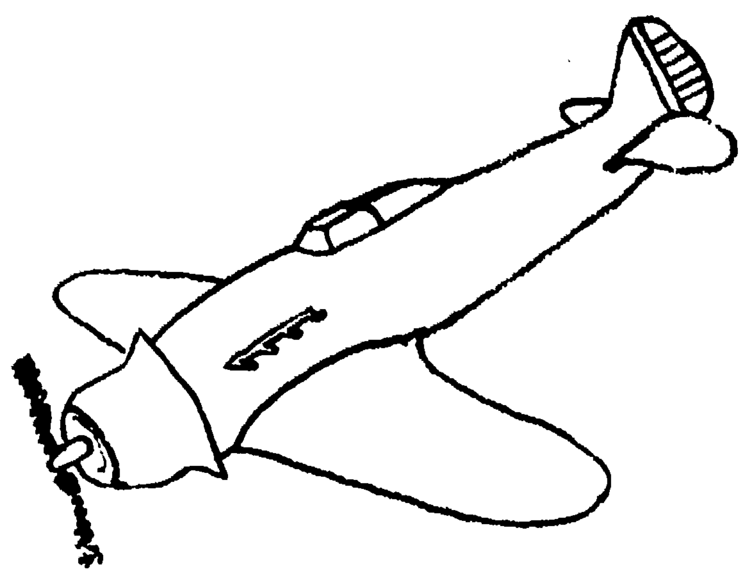
3 2 1

5. Put these pictures in order with a 1, 2, 3, 4 or 5.

4 2 5 1 3

-THE FORCE OF LIFT-

A DISCOVERY APPROACH IN TEACHING AERODYNAMICS
TO THE INTERMEDIATE GRADES



Prepared by William D. Bartman
Pottstown School District

I. General Purpose

To gain an understanding of the behavior of air as it relates to flight.

II. Behavioral Objectives

At the conclusion of the lesson as described below, the student should be able to:

A. Paraphrase, in either written or oral form, "Bernoulli's Principle." (See Part III below.)

B. Identify two airfoils that will produce a maximum amount of lift from a drawing of six various-shaped pbjects.

C. Diagram with arrows and correctly label the four main forces acting upon an airplane: drag, thrust, lift, and gravity.

III. Background Information

Bernoulli's Principle: "As the velocity of a fluid increases, the pressure in the fluid decreases, and conversely, as the velocity of the fluid decreases, the pressure in the fluid increases." (from Above and Beyond: The Encyclopedia of Aviation and Space Sciences, New Horizons Publishers, Inc., Chicago, 1968. Vol. 2, p. 353) Note: accept any reasonable response relating to the idea that velocity and pressure in fluids are inversely related.

IV. Materials

A. Teacher

1. 3" x 5" index card
2. Thumb tack
3. Wooden thread spool
4. Chalkboard

B. Pupil

1. Foot ruler
2. Pencil
3. Work sheets
   a. #1, "Forces Acting Upon an Airplane"
   b. #2, "Properties of an Airfoil"

V. The Lesson

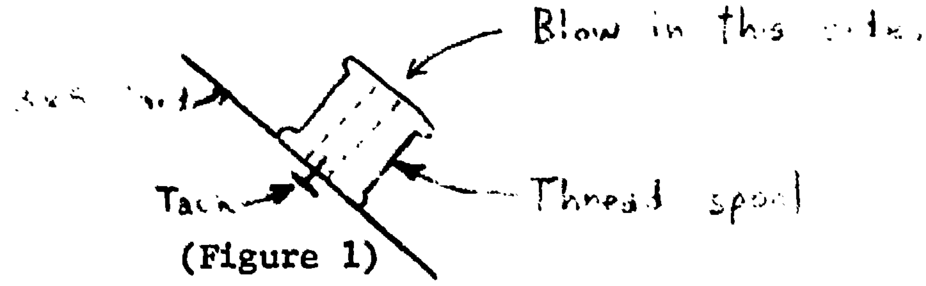
A. Initiating the lesson

V. (Continued)

A.

1. Administer the pretest (Sheet #3) as per instructions on teacher copy.

2. Stick a thumb tack through the center of a 3" x 5" index card. Holding the card and the thread spool ask, "What will happen if I insert the point of the thumb tack into the hole of the thread spool and blow down through the hole real hard?" Set down the various answers on the chalkboard. If the children hypothesize that the card will be blown away, elicit various distances. Hold the card against the spool, begin blowing through the spool hole, and remove the hand that was holding the card against the spool (see Figure 1). The card will stay in place. At this point, several of the children may try the same experiment. Have the children list in their personal notes several reasons why they think the card stayed in place.



(Figure 1)

B. General Procedure

1. Distribute copies of the work sheet #1, which show the forces acting upon an airplane. Elicit acceptable answers for filling in the blanks - drag, thrust, lift, and gravity are given on the teacher's copy. Acceptable answers are at the teacher's discretion. For example, drag may be given as "pull," "hold-back," "wind resistance," etc. Thrust may be given as "push," "drive," etc.
Discuss, "What causes each of these forces?" (Drag--wind resistance to the aircraft itself; thrust--propeller and engine; lift-- mostly the airplane's wings; gravity-- mutual attraction between the earth and the aircraft, gravity to be studied in a later lesson). Ask, "How can the wing make the airplane go up into the air when the airplane is so much heavier than air?" Write the various responses on the board.

2. Distribute the work sheet #2 that shows airplane wing cross-sections A and B. Using foot rulers, connect the point farthest front to the point farthest back (connecting the leading and the trailing edges) on each wing. Label this line the "chord". Now connect the front of the wing with the back using a dotted line that is at all times equidistant from the top and the bottom surfaces of the wing. Call this line the center line. Note that the chord and center line coincide on Wing A, but not on Wing B, the space between the chord and the center line being called the camber. Note also that the camber is on top of the chord, or is positive (see Teacher Copy, Sheet 2).

V. (Continued)

C. Concluding the lesson

1. Return to the reasons that the students listed as to why the index card remained in place against the thread spool. Make a diagram of what happened on the chalkboard. Ask, "Where could the air go that came down through the spool hole?" Elicit that it had to escape by flowing across the upper surface of the card. Ask, "What would be the difference between the flow of the air on the top surface of the card, and the flow of the air under the bottom surface?" Elicit that it was moving more rapidly, or had a greater velocity. Ask, "How, then, could it have stayed in place against the spool?" Elicit the idea that there has to be less pressure on the top surface than on the bottom surface. Formulate a "theory" as a class, and write it on the chalkboard (similar to Bernoulli's Principle--see Background Information) concerning the flow of air and its relationship to pressure. Analogy may be made to a garden hose with a hole in it. Most children know that if the water is flowing very rapidly, very little water will leak out of the hole. However, when one starts closing the nozzle on the end of the hose, the water sprays out the hole with considerable force.

2. Return to the diagrams of the airplane wings on sheet #2 and ask, "Would there be any difference in the speed of the air going over the top of the wing compared to that going under the wing?" Elicit a "no" for wing A, and a "yes" for wing B. Elicit the concept that air traveling over the top of wing B has a greater distance to travel than that flowing under, and therefore it must move faster. The wing "cuts" through the air, forcing it to open and close -- air currents stay in the same relative position from the time they are spread apart by the leading edge of the wing, and are reunited at the trailing edge.

VI. Evaluation

A. Pretest-- Teacher will administer this test (sheet #3) at the beginning of the lesson as per instructions on the Teacher Copy.

B. Post-test-- Teacher will administer this test (sheet #4) at the conclusion of the lesson as per instructions on the Teacher Copy.
Note: As mentioned under Part III, Behavioral Objectives, the teacher may request certain pupils to give their own concept of a "theory" similar to Bernoulli's Principle orally. For those pupils, it would not be necessary to complete Part III of the Post-test, since they would be giving it <u>orally</u> to the teacher.

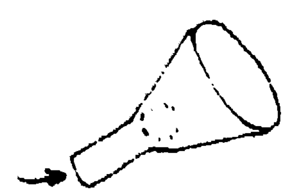
VII. Suggested Activities

A. Written reports may done on the following:

1. Daniel Bernoulli
2. Bernoulli's Principle
3. G. B. Venturi (1746-1822)
4. Venturi tube

(Note: retain these last two for future reference about jet engines.)

B. Using a ping-pong ball and a plastic funnel, let someone try to blow the ball out of the funnel. Ask, "Who thinks that they can blow this ball up to the ceiling?" (See Figure 2) Ball will stay in the funnel, again due to Bernoulli's Principle.



(Figure 2)

C. Several committees may be established to construct models of airfoils using balsa wood, cardboard, etc.

D. Committees may build smoke chambers or wind tunnels in which they can visually observe the behavior of wind currents.

VIII. References and Resources

A. Above and Beyond: The Encyclopedia of Aviation and Space Sciences. Chicago, Ill.: New Horizons Publishers, Inc., 1968.

B. Blough, Glenn O., et al. Science Is Adventuring. (The Basic Science Program Series, Book Six) Chicago, Ill.: Scott-Foresman Co., 1965. pp. 195-225.

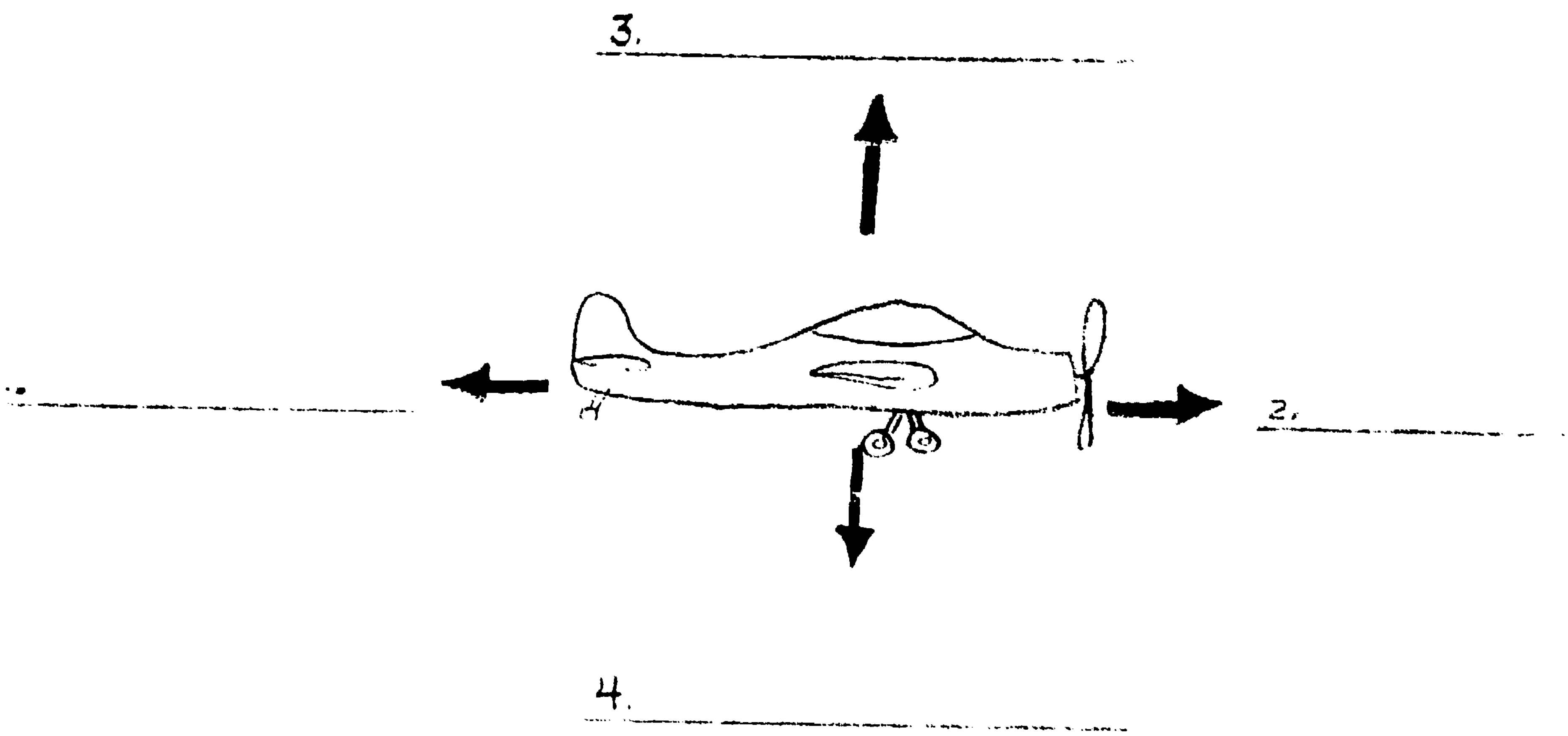
C. Compton's Pictured Encyclopedia, 1967 edition. Chicago, Ill.: F. E. Compton Co., Division of Encyclopaedia Britannica, Inc., 1967.

Sheet #1- Student Copy

"Forces Acting Upon An Airplane"

NAME________________________

DATE________________________



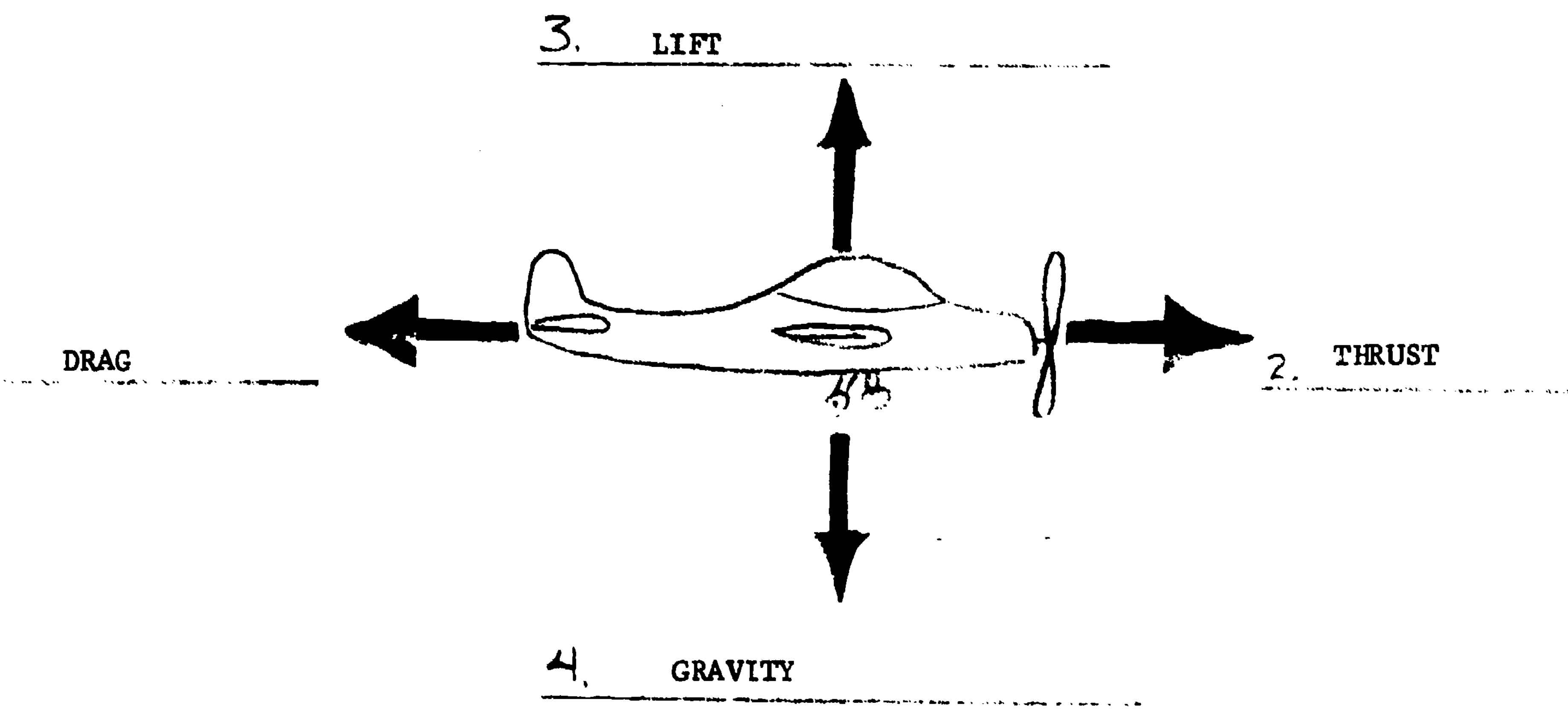
Sheet #1- Teacher Copy

"Forces Acting Upon An Airplane"

(Suggested Answers Added)

NAME____________________

DATE____________________



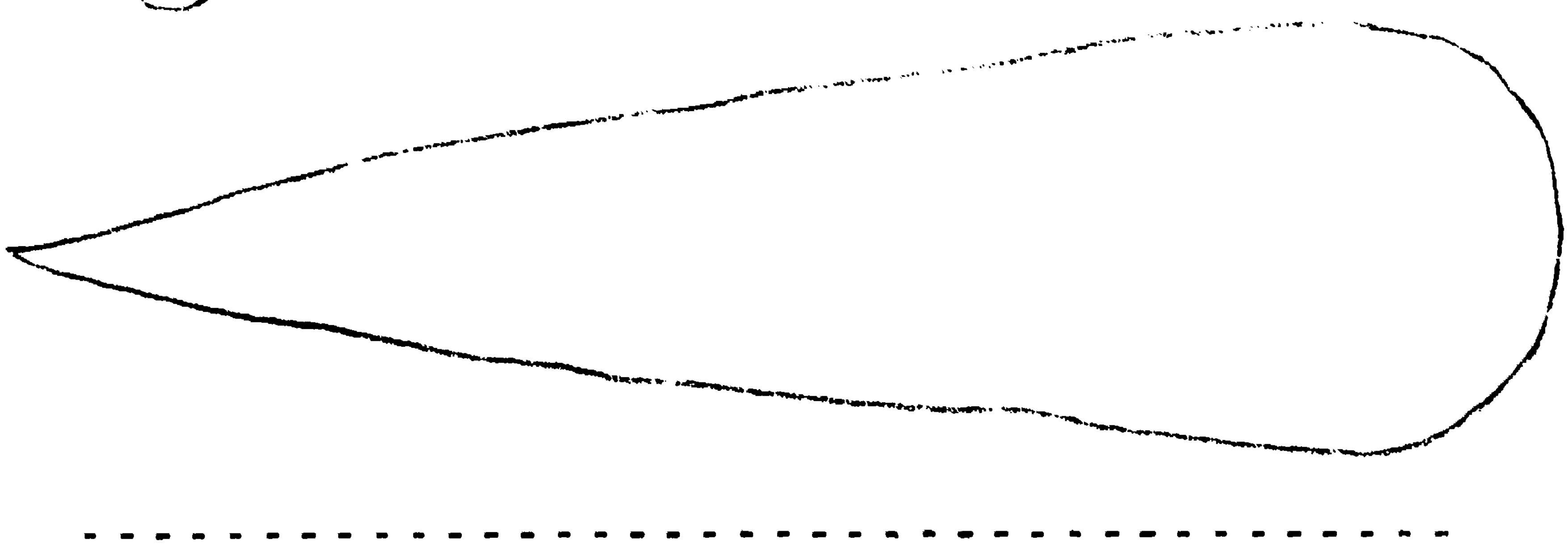
Sheet #2- Student Copy

"Properties of an Airfoil"

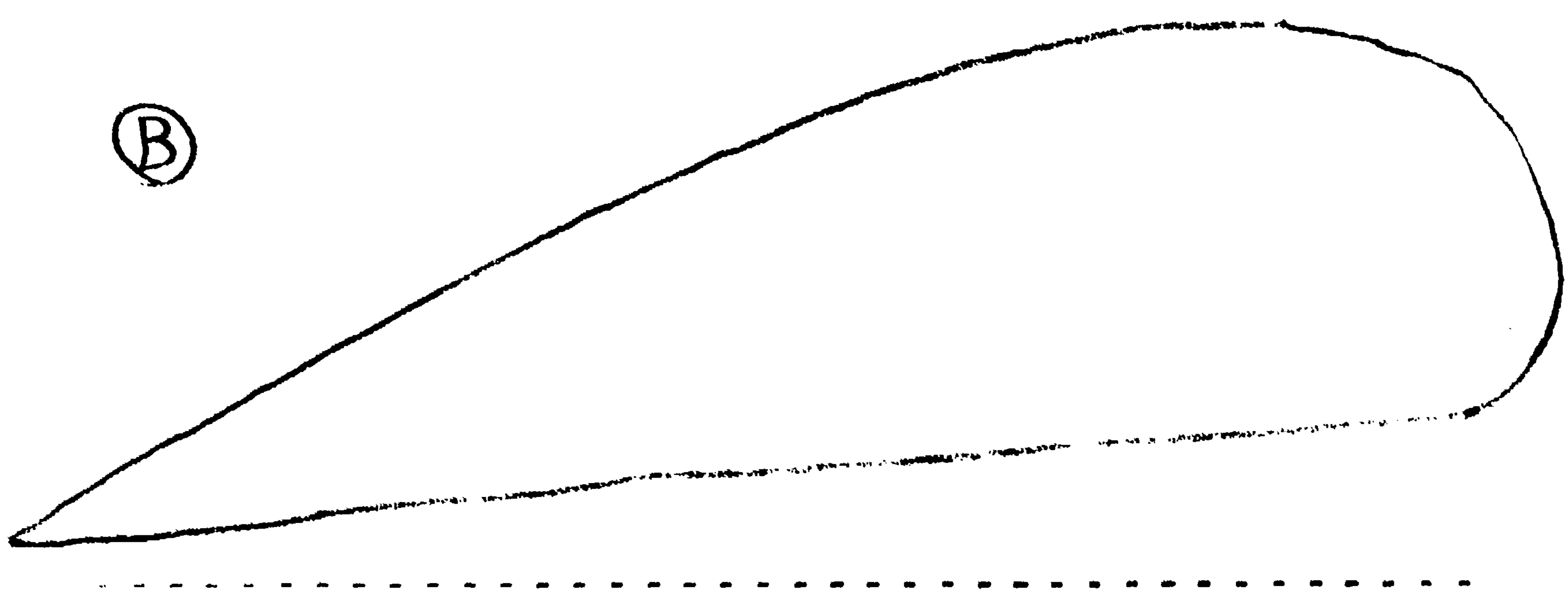
NAME__________________________

DATE__________________________

A



B



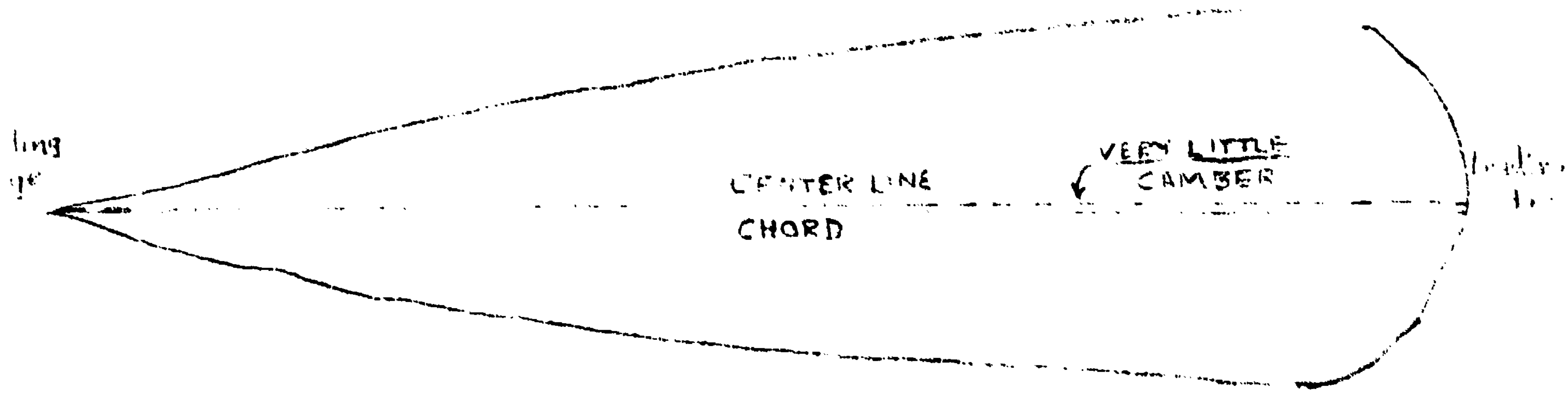
Sheet #2- Teacher Copy

"Properties of an Airfoil"

NAME ______________________

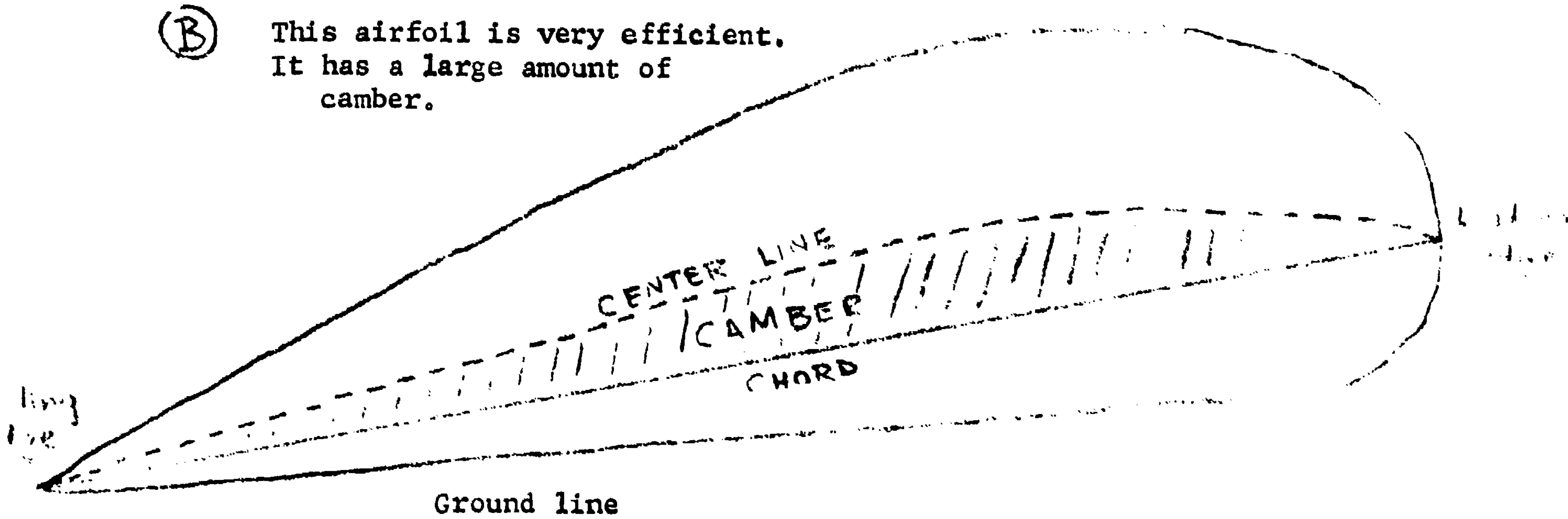
DATE ______________________

(A) This airfoil is very inefficient. It will produce a negligible amount of lift.



Ground line

(B) This airfoil is very efficient. It has a large amount of camber.



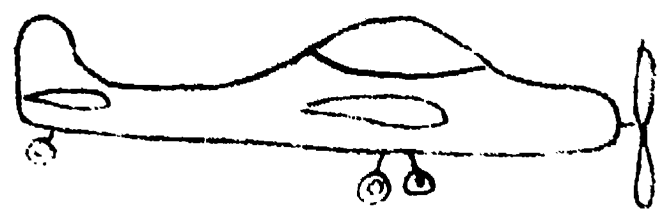
Ground line

Sheet #3 - Student Copy NAME ____________________

Lesson Pretest DATE ____________________

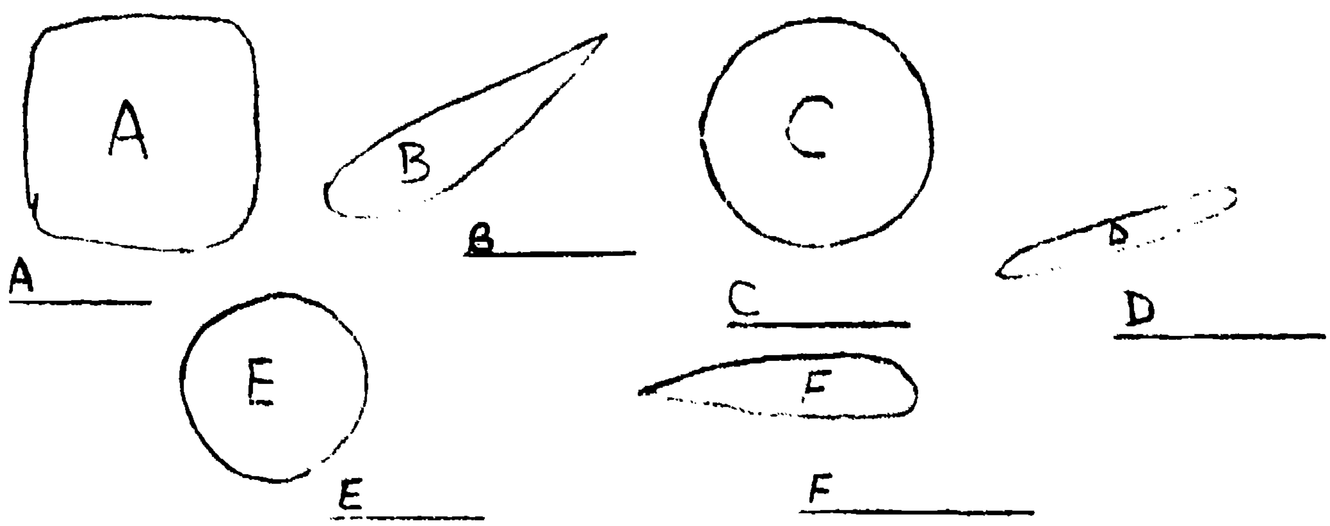
Part I: NAMING AND SHOWING DIRECTION OF THE FORCES ACTING UPON AN AIRPLANE

Directions--Draw arrows to show the direction of each of the main forces acting upon this airplane. Also, write the name of the force next to the arrow showing its direction.



Part II: RECOGNIZING AIRFOILS THAT WILL PRODUCE A MAXIMUM AMOUNT OF LIFT

Directions--Put an X on the blank under the two objects below which you think will produce the greatest amount of lift.



Part III: STATING BERNOULLI'S PRINCIPLE

Directions--On the back of this paper, write (in your own words) Bernoulli's Principle.

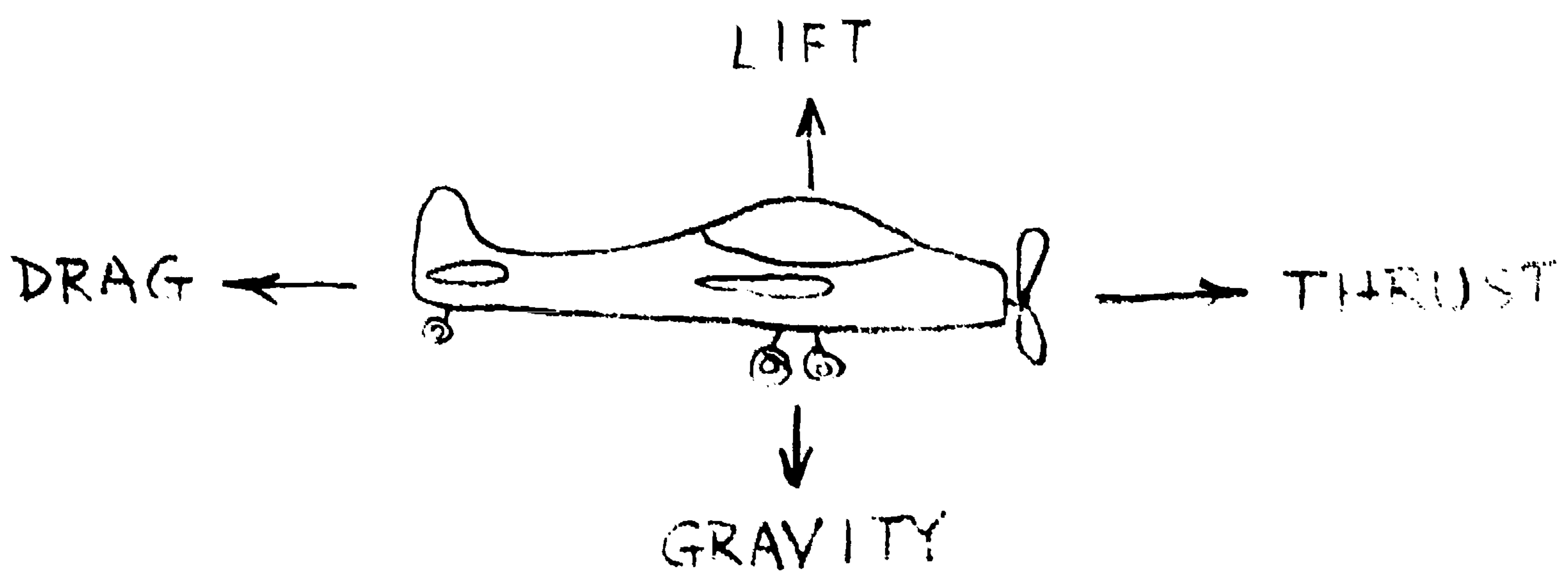
Sheet #3 - Teacher Copy(Answers added) NAME ______________

Lesson Pretest DATE ______________

Note: Administer this test with no additional directions, guidance, or clarification other than what is given to the student on his paper as "Directions."

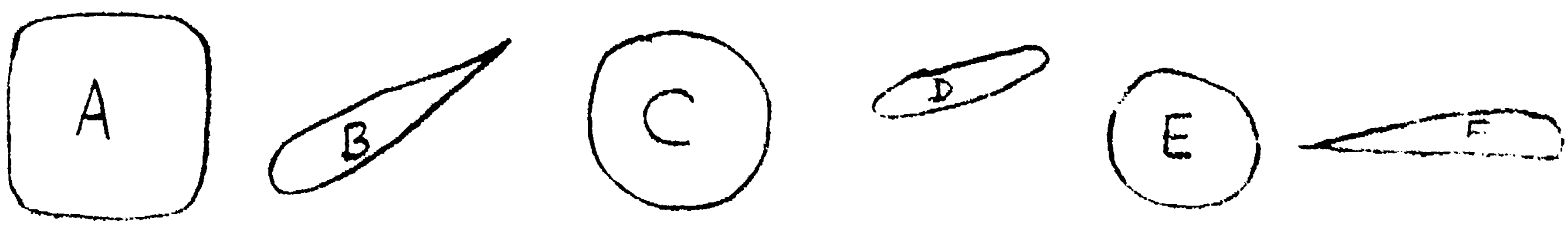
Part I: NAMING AND SHOWING DIRECTION OF THE FORCES ACTING UPON AN AIRPLANE

Directions--Draw arrows to show the direction of each of the main forces acting upon this airplane. Also, write the name of the force next to the arrow showing its direction.



Part II: RECOGNIZING AIRFOILS THAT WILL PRODUCE A MAXIMUM AMOUNT OF LIFT

Directions--Put an X on the blank under the two objects below which you think will produce the greatest amount of lift.



A ______ B X ______ C ______ D ______ E ______ F X ______

Part III: STATING BERNOULLI'S PRINCIPLE

Directions--On the back of this paper, write (in your own words) Bernoulli's Principle.

Sheet #4--Student Copy NAME ____________________

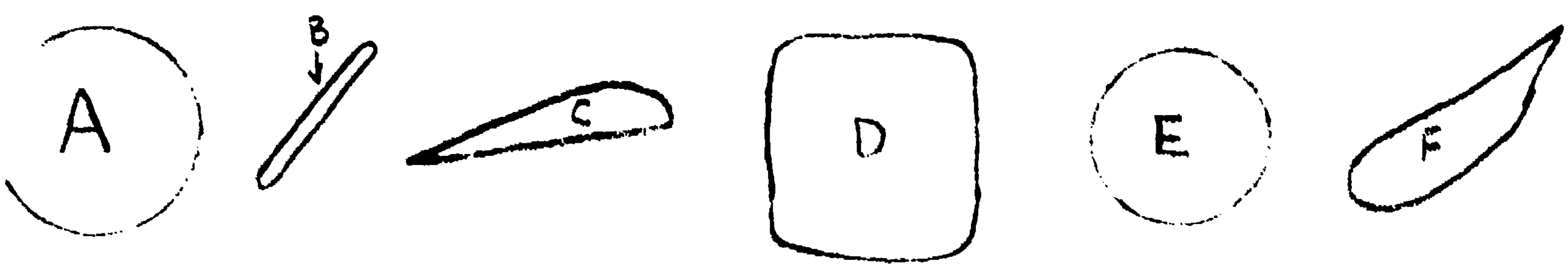
Lesson Post-test DATE ____________________

Part I: NAMING AND SHOWING DIRECTION OF THE FORCES ACTING UPON AN AIRPLANE

Directions--Draw arrows to show the direction of each of the main forces acting upon this airplane. Also, write the name of the force next to the arrow showing its direction.

Part II: RECOGNIZING AIRFOILS THAT WILL PRODUCE A MAXIMUM AMOUNT OF LIFT

Directions--Put an X on the blank under the two objects below which you think will produce the greatest amount of lift.



A ____ B ____ C ____ D ____ E ____ F ____

Part III: STATING BERNOULLI'S PRINCIPLE

Directions--On the back of this paper, write (in your own words) Bernoulli's Principle.

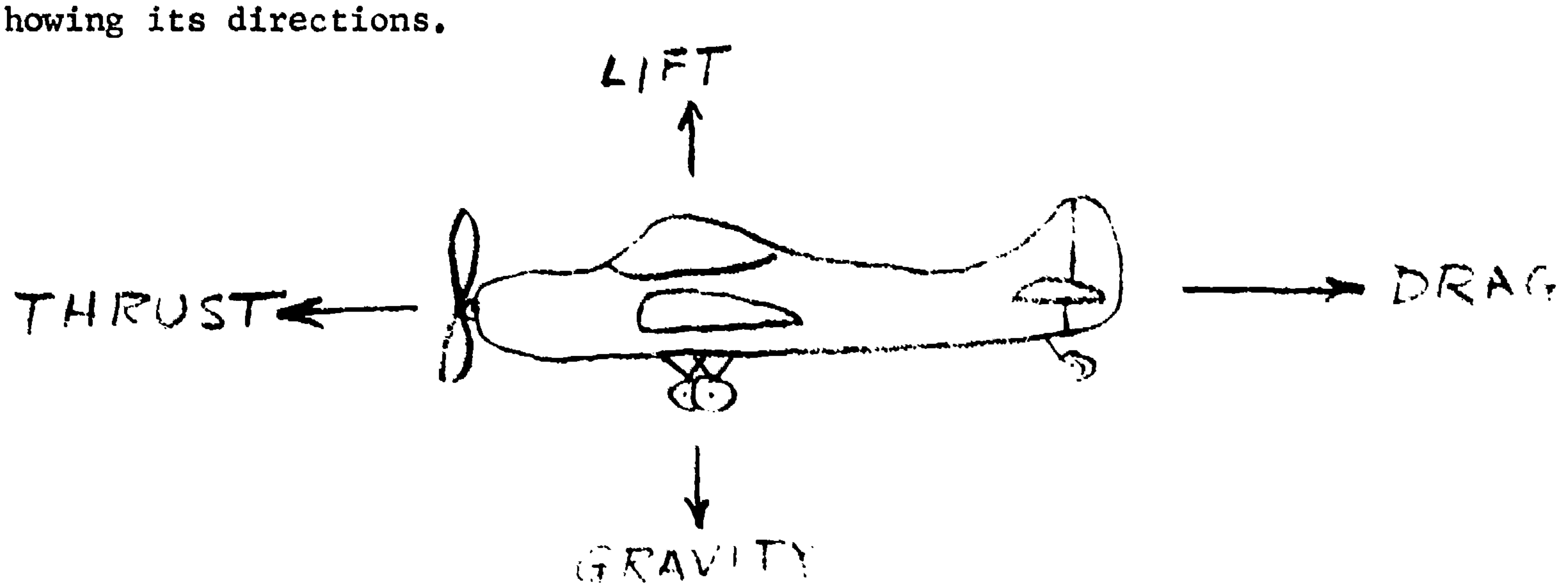
Sheet #4--Teacher Copy (Answers added)　　NAME ________________

Lesson Post-test　　DATE ________________

Note: Administer this test with <u>no</u> <u>additional</u> <u>directions</u>, guidance, or clarification other than what is given to the student on his paper as "Directions."

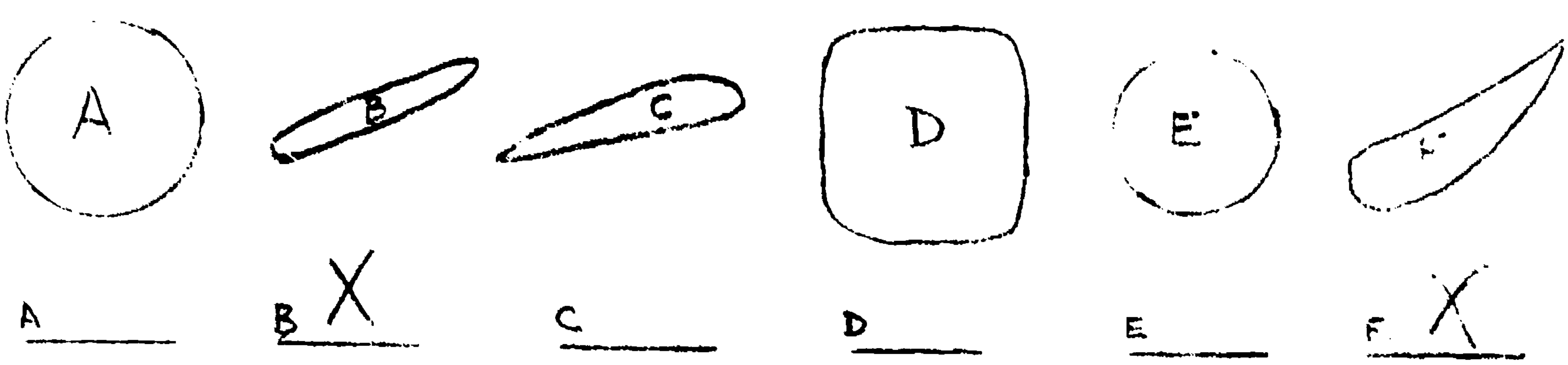
<u>Part I</u>: NAMING AND SHOWING DIRECTION OF THE FORCES ACTING UPON AN AIRPLANE

Directions--Draw arrows to show the direction of each of the main forces acting upon this airplane. Also, write the name of the force next to the arrow showing its directions.



<u>Part II</u>: RECOGNIZING AIRFOILS THAT WILL PRODUCE A MAXIMUM AMOUNT OF LIFT

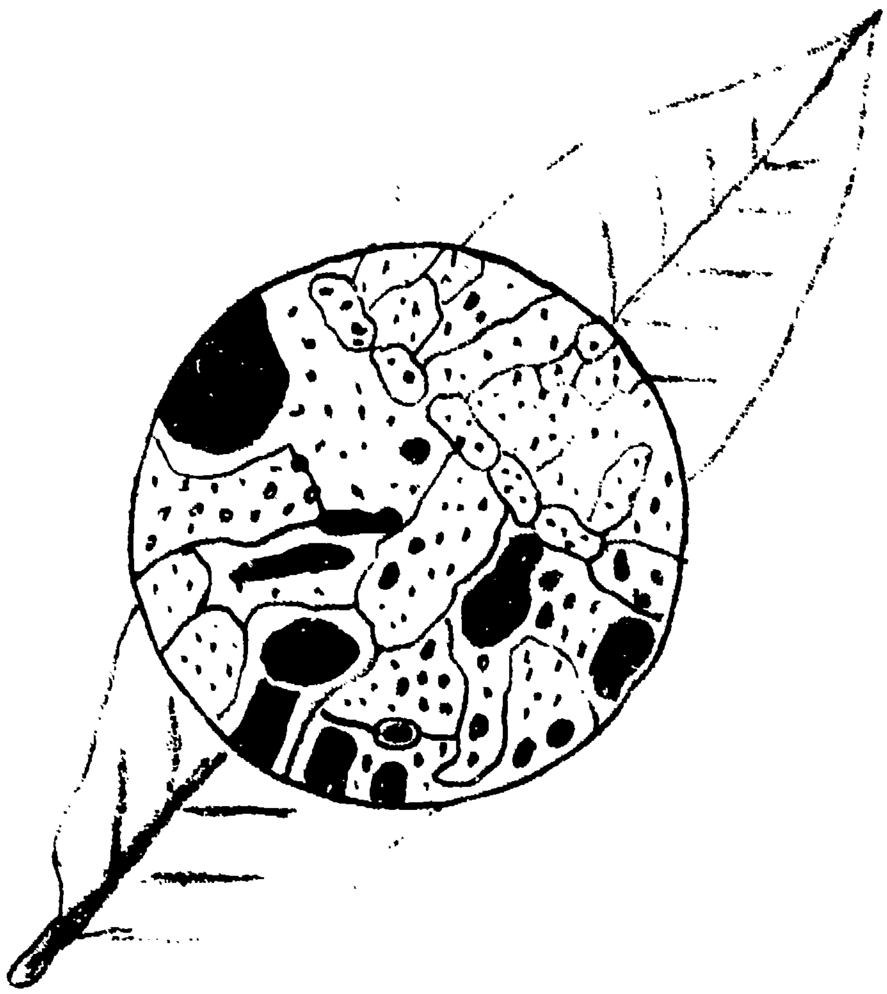
Directions--Put an X on the blank under the <u>two</u> objects below which you think will produce the greatest amount of lift.



<u>Part III</u>: STATING BERNOULLI'S PRINCIPLE

Directions--On the back of this paper, write (in your own words) Bernoulli's Principle.

THE GAME AS A TECHNIQUE FOR INTRODUCING SCIENCE SYSTEMS
TO THE INTERMEDIATE GRADES



Prepared by Herbert Pless
Ridley School District

I. General Purpose

To discover the fundamental principles of the modern theory of heredity.

II. Behavioral Objectives

A. To determine rules common to particular sets of objects.

B. To state general rules governing particular sets of objects and, further, to test the validity of those general rules in all possible combinations of objects.

C. To apply the general rules to fundamental principles of heredity and genetics.

III. Background Information

In 1865, Gregor Mendel, an Austrian monk, punlished the results of a masterful piece work on the laws of heredity. He was not the first to experiment in the field of inheritance, but his findings were the first of any scientific consequence. His paper, representing years of work with garden peas, was published by the Natural History of Brunn, Austria. Mendel had been dead for 16 years when three other scientists discovered his work and began to make use of his findings. It is, however, a great tribute to Mendel that the laws he formulated from his experiments with garden peas stand today, practically unchanged, as the basis of the science of genetics.

There were good reasons why Mendel selected the garden pea for his experiments. Mendel noticed that garden peas differed in certain definite characteristics. Some plants were short and bushy, while others were tall and climbing. Some produced yellow seeds, some green seeds; some had colored flowers and some white ones. Mendel discovered that garden peas differed in seven respects altogether. He also found that the characteristics of any one kind of pea were preserved in generation after generation because the plants normally carried on self-pollination.

IV. Materials

A. Each student group should be given a set of four envelopes. The envelopes should contain items according to the following distribution:

1. Envelope #1

(a) Three purple triangles and one yellow triangle.**

(b) Two smaller envelopes, each with a purple triangle on the front,

**All triangles should be made by diagonally cutting 1½" construction paper squares in half.

IV. (Continued)

A.

1.

(b) and each containing a purple and a yellow triangle.

2. Envelope #2

(a) Two purple and two yellow triangles.

(b) Two smaller envelopes, one with a purple triangle on the front and containing a purple and a yellow triangle, and the other with a yellow triangle on the front and containing two yellow triangles.

3. Envelope #3

(a) Four yellow triangles.

(b) Two smaller envelopes, each one with a yellow triangle on the front and each containing two yellow triangles.

4. Envelope #4

(a) Four purple triangles.

(b) Two smaller envelopes, one with a purple triangle on the front and containing two purple triangles, and the other with a yellow triangle on the front and containing two yellow triangles.

B. Each group should have a record sheet and pencil.

C. Each group should have access to reading resource material dealing with fundamentals of heredity and genetics.

D. The teacher might use the following items:

1. Transparencies

2. Overhead projector (if not available, the blackboard can be used.)

3. Flannel board or magnetic chalkboard with sixteen purple triangles and sixteen yellow triangles.

E. Question and Answer Sheet (See Part VI on Evaluation)

V. The Lesson

A. Initiating the lesson

1. The teacher should first carefully study "Question and Answer Sheet."

V. (Continued)

A.

2. The teacher may want to read the story below at this point in the lesson. If not, it can be used later as an additional activity.

THE CASE OF THE BLUE-EYED ORPHAN

Some years ago, a boy stood in front of the judge's bench in a Canadian court. This boy was an orphan whose parents had been killed in an automobile crash. Money had been left to him, but he was finding it hard to prove his right to receive it. Another person had put in a complaint that the orphan had no right to the money. It was claimed that he could not have been the son of the two people who had died.

The boy had blue eyes; both parents were brown-eyed. For this reason, the will was challenged. How could brown-eyed parents have a blue-eyed child? To the mind of the person contesting the will, this boy was not their son at all. Even if he was an adopted son, there was no legal proof of it. The judge agreed that, since the boy's eyes were so different from those of his parents, he could not have been their son. He ruled against the boy. Later, after college professors explained the scientific facts to the judge, the case was dropped, and the boy received the money left to him. (Case taken from L. Eisman and C. Tanzer, Biology and Human Progress, Prentice-Hall, Inc., New York, 1953, P. 303)

Did you agree with the judge's first decision? Let us look into the problem.

3. The teacher should divide the class into groups, each having four students. A capable discussion leader and a recorder should be appointed by the teacher for each group. Students left after the formation of groups should assist the teacher.

B. General Procedure

1. The teacher should explain that a set of four envelopes containing certain objects will be distributed to each group and that the combined information gathered from just these objects should enable each group to determine rules common to the the entire set of envelopes.

2. The sets should be distributed to each group and one envelope should be selected by each member. A previously appointed member should be given a recording sheet and a pencil.

3. All students should be told to open their particular envelope, observe the contents, and then share the information supplied with their fellow group members.

V. (Continued)

B.

4. The group leaders should encourage their fellow group members to state provisionally some general rules governing the objects found in the set of envelopes. The recorder should list these rules.

5. Group leaders should report to the teacher when their particular group has "run out of ideas."

6. Recorders from the student groups should read aloud each of the general rules from their particular lists. The feasibility of each general rule should be challenged by members of the entire class. Only those items accepted by the entire class should be recorded by the teacher on a master list with the use of an overhead projector transparency or the blackboard.

7. A quick survey of the master list should tell the teacher whether the class has explored all possible general rules. According to the major ones that might be missing, the teacher should use questions from the "Question and Answer Sheet."

8. If some of the rules developed are still not clear to all of the students, the teacher should demonstrate graphically, particularly the possible color combinations and subsequent color distribution ratios. This can best be done with the use of transparencies, flannel board or magnetic chalkboard.

9. To insure a competitive spirit, the recording sheets can be collected by the teacher and graded with the aid of the "Question and Answer Sheet."

VI. Evaluation

A. The following "Question and Answer Sheet" should be supplied for either the teacher or student group leader.

QUESTION AND ANSWER SHEET

Q1. How many different objects can be found in all the envelopes?

A. Two by color.

Q2. Are any objects alike? How?

A. Yes, by color, shape and size.

Q3. Are the same number of triangles found in each envelope?

A. Yes, always four triangles in the larger envelope and two triangles in each of the smaller envelopes.

VI. (Continued)

A.

Q4. Are the four triangles outside the smaller envelope always the same color?

A. No, they are distributed as follows: 3 purple and 1 yellow in envelope #1; 2 purple and 2 yellow in envelope #2; 4 yellow in envelope #3; and 4 purple in envelope #4.

Q5. Are the triangles on the front of the smaller envelopes in each large envelope always the same?

A. No, they are as follows: 2 purple in envelope #1; 1 yellow and 1 purple in envelope #2; 2 yellow in envelope #3; and 1 yellow and 1 purple in envelope #4.

Q6. Are there any relationships between the colors found in front of the smaller envelopes and the distribution of colors found in the larger envelopes?

A. No. In the only case of similarities (envelopes #2 and #4) where there were yellow and purple triangles in front of the smaller envelopes, the distribution of colors was dissimilar (two purple and two yellow in envelope #2 and four purple in envelope #4).

Q7. Are there any relationships between the colors found in front of the smaller envelopes and the color distribution within the smaller envelopes?

A. Yes. In all cases where a yellow triangle was found in front, the contents were two yellow triangles. In all cases where a purple triangle was found in front, the contents were either two purple or a purple and a yellow triangle.

Q8. Can you now state any general rules governing the objects in the smaller envelopes?

A. Yes. Two yellow triangles within a smaller envelope always yield one yellow triangle. Two purple triangles or a purple and a yellow triangle within a smaller envelope always yield a large purple triangle. In this way, purple appears to be stronger or more dominant than yellow when they are combined or together.

Q9. Are there any relationships between the color distributions found within the smaller envelopes and those found outside the smaller envelopes?

A. Yes. The possible combinations of color pairs between the contents of each smaller envelope (4 possible combinations) determine the color distribution found outside the smaller envelopes (according to rules developed to question #8). For example, in envelope #1 each small envelope contains one yellow and one purple triangle. If all combinations are formed according to the chart below, we would get one pair with two yellow triangles (which yields one yellow triangle) and two pairs with one purple triangle and one yellow triangle (which yields one purple triangle). This 3 to 1 ratio in favor of the purple is the distribution found in envelope #1. This line of

VI. (Continued)

A.

reasoning can be supported in the 2:2 ratio in envelope #2, the 0:4 ratio in envelope #3, and the 4:0 ratio in envelope #4.

First Small Envelope

		purple	yellow
Second			
Small	purple	purple and purple	purple and yellow
Envelope	yellow	purple and yellow	yellow and yellow

Q10. Can you now show all possible combinations and subsequent color distribution ratios?

A. Yes, according to the following chart (P = purple triangle; y = yellow triangle --- Suggest the use of a capital letter for the stronger or dominant color triangle - purple - and a lower case for the weaker or recessive color triangle - yellow.)

First small envelope	Second small envelope	Distribution ratio
PP	PP	4:0
PP	Py	4:0
PP	yy	4:0 (envelope #4)
Py	Py	3:1 (envelope #1)
Py	yy	2:2 (envelope #2)
yy	yy	0:4 (envelope #3)

VII. Suggested Activities

A. If not used earlier to initiate the lesson, the teacher may want to read the story entitled, "The Case of the Blue-eyed Orphan," and have the pupils answer the question posed at the end.

B. The teacher should provide students with reading resource materials that deal with introductory principles of heredity and genetics.

C. The teacher should carefully plan reading assignments so that students will cover material related to the game.

D. The teacher should ask students if any parallels can be drawn between their reading assignments and the game. Hopefully, students will see that yellow purple triangles might very well represent single hereditary characteristics in living organisms, such as hair color or eye color in human beings.

E. Students should be encouraged to study possible genetic relationships in their own class population using representative symbols for hair color, eye color or tallness. Class ratios might uncover dominant characteristics and family studies might show classical ratios of single trait crosses.

VIII. References and Resources

A. Films

1. The Mechanism of Inheritance (14 min.) McGraw-Hill. Like begats like, not by pure chance, but by complex mechanism. Deals with the inheritance of color in plants, crossbreeding of plants, blend of color, and effect of dominant and recessive genes.

2. Heredity (11 min., black-and-white) E.B.F. Explains the transmission of hereditary factors responsible for inherited characteristics of animals.

B. Filmstrips

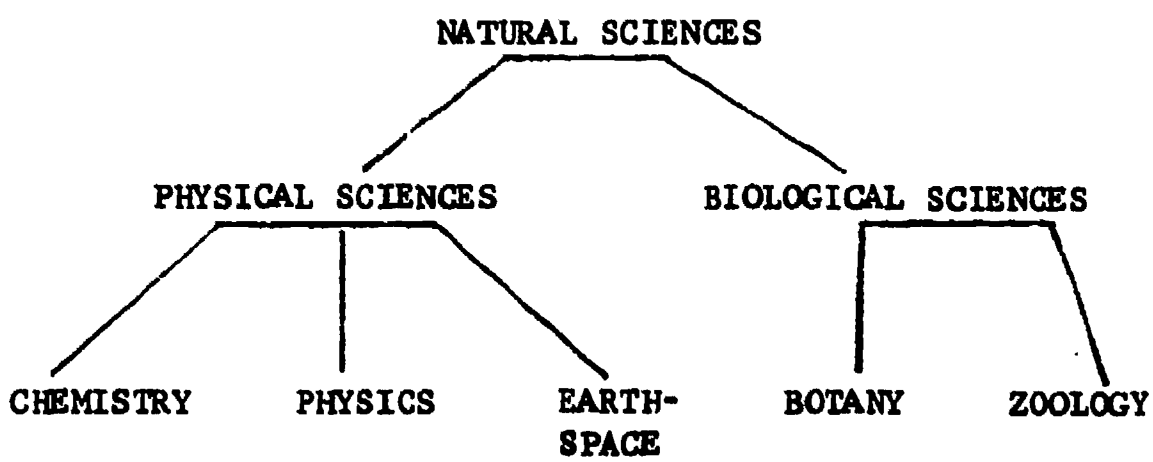
1. Heredity (48 frames) McGraw-Hill. Explains why offspring resemble their parents; also why there can be differences; shows experiments verifying Mendel's law, development of hybrids, causes of mutations.

2. Gregor Mendel (50 frames) E.B.F. Drawings tell of Mendel's experiments with plants to determine how characteristics of parent plants were inherited; shows cross-pollination; development of hybrids; explains Mendel's Law.

C. Readings

1. All About Heredity, by Judith Randal, Random House, 1963. An introduction to the science of genetics, from Gregor Mendel's first experiments with garden peas to the latest discoveries about DNA. Part I is entitled "The Framework of Heredity." Part II, "Revolution in Biology." A list of important dates in genetics summarizes the content of the book. Remarkable photographs supplement the narrative.

AN OPEN-ENDED APPROACH FOR TEACHING THE MEANING OF SCIENCE
TO THE INTERMEDIATE GRADES



Prepared by Bernadette George
Sharon Hill School District

I. General Purpose

To develop in students an awareness of how a body of knowledge is structured.

II. Behavioral Objectives

At the conclusion of the lesson described below, students should be able to:

A. Group items of a collection according to common properties and state the criteria used.

B. Construct a three-level classification system, given a collection of items.

C. Make use of available resource materials to gain information.

III. Background Information

A. Science: a branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws.

B. Natural Science: a science or knowledge of objects or processes observable in nature, as biology, physics, etc., as distinguished from the abstract or theoretical sciences, as mathematics, philosophy, etc.

C. Biology: the science of life or living matter in all its forms and phenomena, often especially with reference to origin, growth, reproduction, structure, etc.

D. Botany: the branch of biology that deals with plant life.

E. Zoology: the branch of biology that deals with animals.

F. Physical Science: the study of natural laws and processes other that those peculiar to living matter, as physics, chemistry, etc.

G. Physics: the branch of science dealing mainly with matter and energy and their interactions. It is subdivided into such areas as mechanics, optics, heat, electricity, magnetism, acoustics, and radiation.

H. Chemistry: the science pertaining to matter, its composition and structure, its change in composition and the related change in energy.

I. Earth Science: the study of the earth, its materials, and the forces acting on them, and the earth's relationships to other bodies in space.

IV. Materials

Dictionary, encyclopedia, general science text.

V. The Lesson (recommended for the beginning of the school year)

A. Initiating the Lesson

1. Give the pretest provided at the end of this lesson (Sheet #1).

2. Write "Science" on the board or overhead.

3. Ask the class the meaning of the word and record their responses on the board or overhead. (If need be, limit each student to one best response he can offer. Responses might be similar to the following: rocks, how magnets work, people who work with chemicals, dinosaurs, geysers, mountains, history of man, snakes, insects, weather, etc.)

4. Ask the class how these words relate to each other or what they have in common or how they are similar. (possible responses: they all tell about nature, our environment, our surroundings.)

B. General Procedure

1. Through a discussion show the class that all the topics they have offered must be arranged in an orderly system and explain that together you will attempt to organize them.

2. The teacher should circle all the words relating to living things.

3. Ask the class to consider the circle words and decide how these words are similar and how they differ from the words not circled.

4. This information provides an introduction to the diagram supplied on the cover of the unit (see p. 43). Show this diagram on the board.

NATURAL SCIENCES

LIVING THINGS NON-LIVING THINGS

5. Ask the class if they know the scientific terms used for the study of living things and non-living things. If not, you might supply the terms biological sciences and physical sciences.

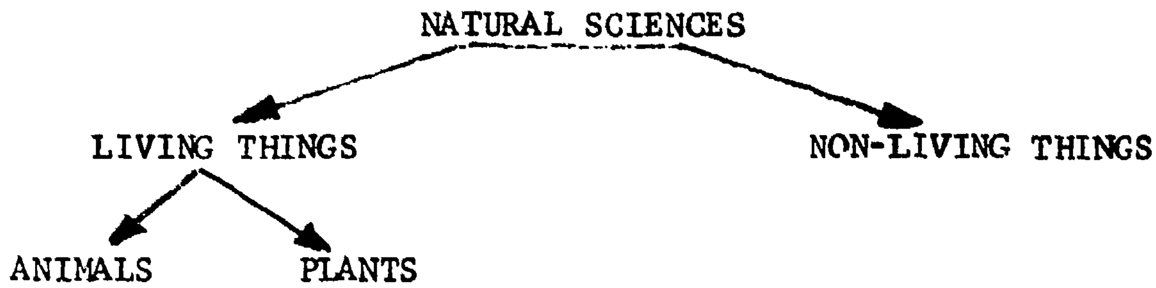
6. Once again ask the class to consider the circled words and ask them if these words can be grouped under other headings. You might put a check mark or some other symbol near the words relating to animals and ask how these words are similar and how they differ from the words that were not circled.

7. Responses to question #6 can be related to the diagram below. (See Page 46).

8. Ask the class if they know the scientific terms used for the study of animals and plants. If not, supply the terms botany and zoology.

V. (Continued)

B.



9. Continue this technique (varying the color of the circle or the geometric object) until all topics have been classified and subsequently arranged on the diagram.

C. Concluding the Lesson- use reference materials to evaluate the terms that are on the diagram.

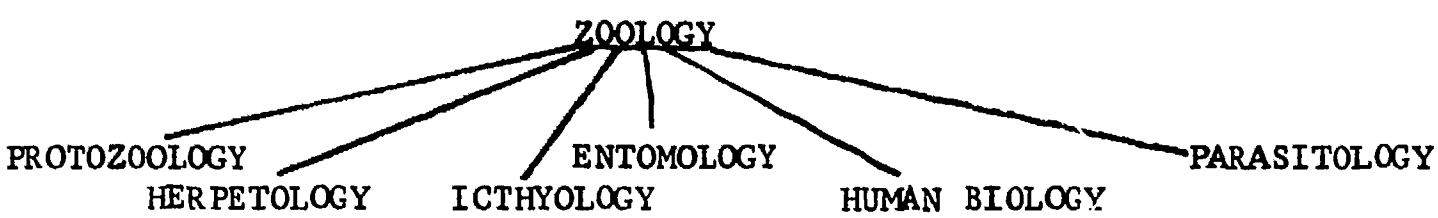
VI. Evaluation

Before and after the lesson administer the test supplied herein. (See Sheet #1)

VII. Suggested Activities

A. Develop an original classification system. Suggestions: children in your school, fingerprints of children in the class.

B. Delineate further the zoology segment of the diagram.



VIII. References and Resources

Craig, Gerald S. and Katherine E. Hill. Adventuring in Science. New York: Ginn and Co., 1954.

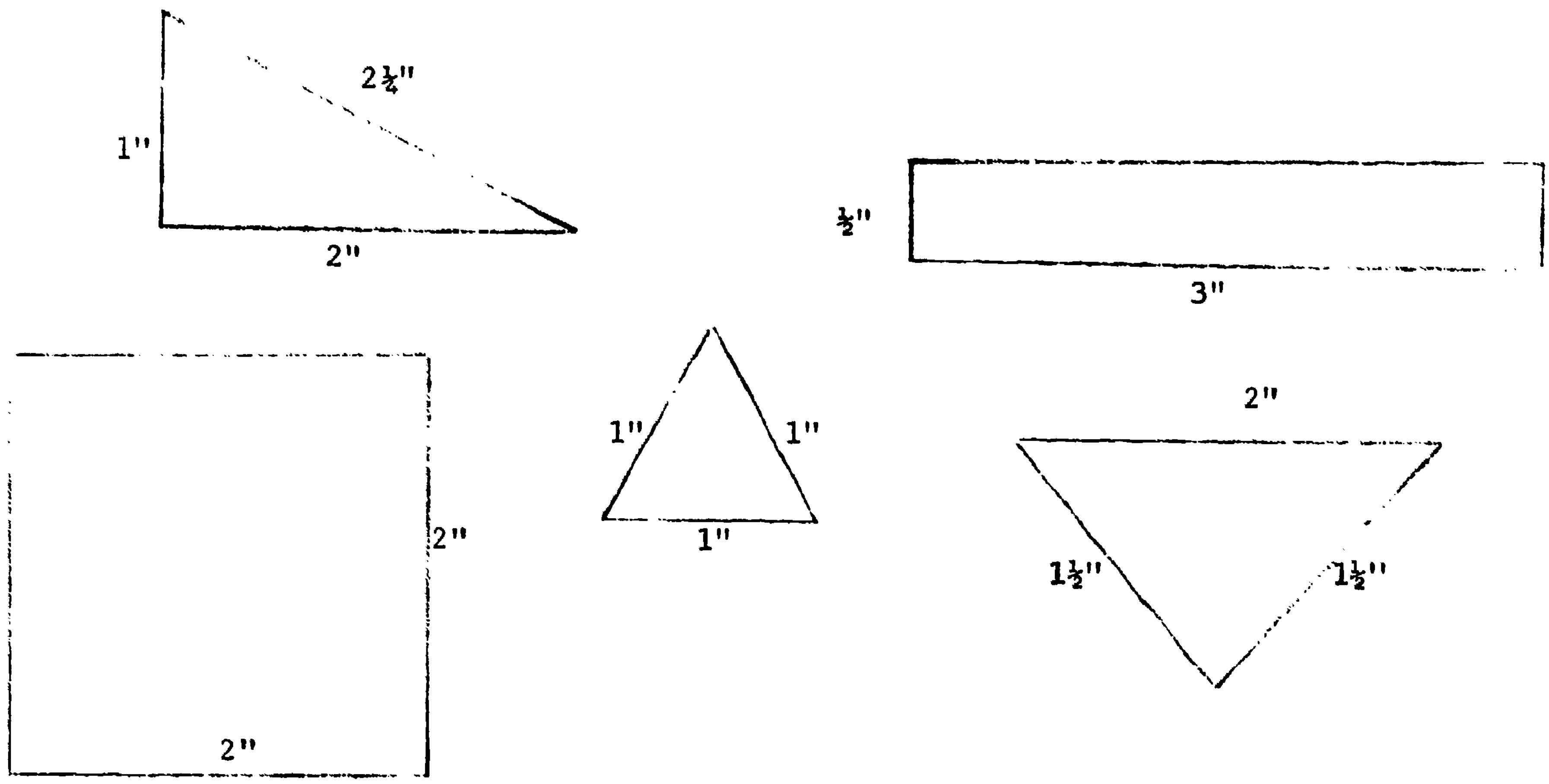
Ford, Charles A. Compton's Illustrated Science Dictionary. Chicago: F. E. Compton Co., 1963.

Schneider, Herman and Nina. Science in Our World. Englewood Cliffs, N.J.: D. C. Heath and Co., 1961.

SHEET #1-- TEST (Teacher's Copy- Suggested Answers Added)

NAME ______________________

DATE ______________________

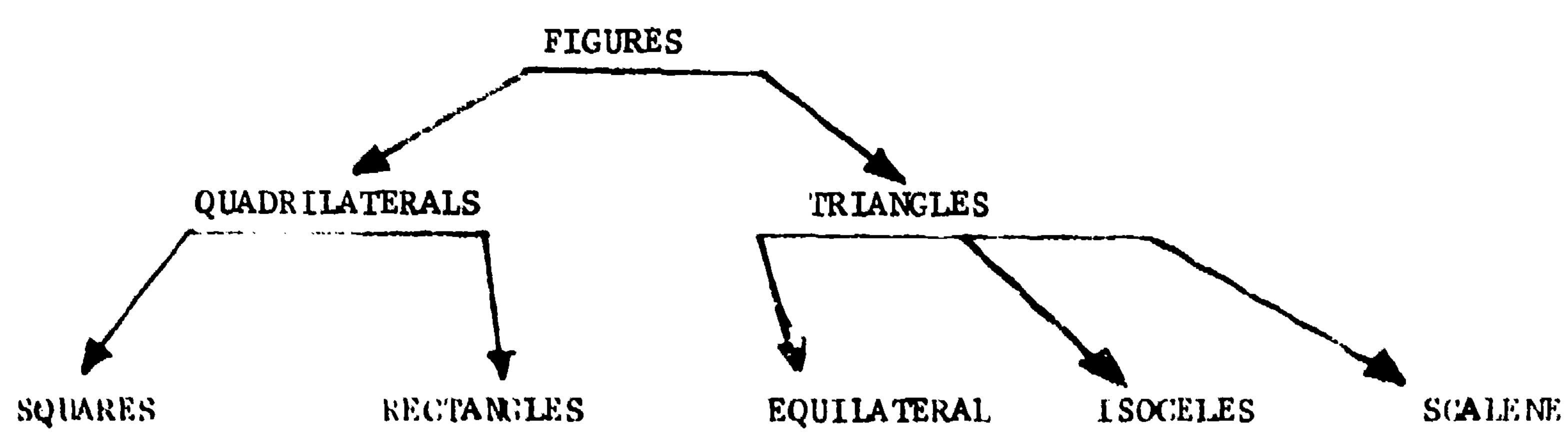


1. Under what title can you group all the objects on this sheet? (Shapes, figures, geometric objects)

2. If you had to divide these objects into two groups, how would you do it? (Four-sided figures or quadrilaterals, and three-sided or triangles.)

3. Consider the two categories that you made in #2. Can you divide those two categories into different groups? If so, what did you name the groups? (square, rectangle, equilateral triangle, scalene triangle, isoceles triangle-- the specific geometric term is not necessary as long as the child is able to describe the differences among the subjects.)

4. You have developed a classification system. Arrange the information on the diagram below. (Note: Any logical classification system is acceptable. The terms used herein are merely suggestions.)



APPENDIX

PHILADELPHIA SUBURBAN SCHOOL STUDY COUNCIL - GROUP B

TO: MEMBERS OF SCIENCE COMMITTEE

FROM: HERBERT PLESS, CHAIRMAN

RE: STUDENT AND TEACHER SURVEY

This mailing should include the following master forms to be duplicated and used in your survey of students and teachers:

1. FOR GRADES 1 - 3

1 Opinionnaire sheet and 1 Answer sheet

Explain the purpose and ultimate goals of the survey to all teachers involved. Review the directions with them. Explain that they are responsible for turning in the following:

a. All completed answer sheets including an additional one on which the class totals for each item should be recorded.

b. One completed answer sheet reflecting the teacher's judgement of what they think their students "like" or "dislike."

2. FOR GRADES 4 - 6

1 Opinionnaire - answer sheet

Explain the purpose and ultimate goals of the survey to all teachers involved. Review the directions with them. They in turn should read the directions to their students and answer questions that might arise. Tell the teachers that they are responsible for turning in the following:

a. All completed opionionnaires including an additional one on which the class totals for each item should be included.

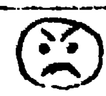
b. One completed opinionnaire - answer sheet reflecting the teacher's judgement of what they think their students "like," "think about" and "enjoy".

OPINIONNAIRE (1-3)

DIRECTIONS:

This is a science interest inventory in basic (1) content area, (2) conceptual schemes and (3) behavioral skills. Each numbered item below should be read aloud to the children. It will be their task to show certain preferences. They should do this by placing an "X" under a particular facial expression as shown on the left. (Place on the blackboard if necessary.) Distribute the student answer sheets and pencils. Make sure that the children understand their responsibilities. Now, introducing each with the introductory phrase indicated, read every numbered item, making sure that the children have sufficient time to mark the appropriate spaces.

TEST A



	Like	Dislike
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Test A - Content Areas

INTRODUCTORY PHRASE: Do you like to study about

1. Machines
2. Light
3. Heat
4. Sound
5. Electricity and magnetism
6. The Earth, Moon and Sun
7. Stars and Space
8. Animals
9. Plants
10. Weather and Air
11. Rocks and Minerals

Test B - Conceptual Schemes

INTRODUCTORY PHRASE: Do you like to learn how

1. Things can move.
2. Everything is made of atoms and molecules.
3. Animals and plants change because of things around them.
4. Animals and plants can make animals and plants like themselves.
5. Animals and plants are different from one another.
6. The earth is always changing.
7. Air is all around us.

Test C - Behavioral Skills

INTRODUCTORY PHRASE: Do you like to

1. See, feel, smell, taste and hear things
2. Guess what happens
3. Use numbers
4. Wonder why
5. Find out how big or small things are
6. Tell about things
7. Name things
8. Put things that are the same together

grade 1 - 3 name 1218 students from 7 districts

a

	like	dislike
1	834	384
2	872	346
3	822	396
4	928	290
5	981	237
6	1062	156
7	1043	175
8	1050	168
9	920	298
10	921	297
11	971	247

b

	like	dislike
1	1055	163
2	857	361
3	1042	176
4	932	286
5	966	252
6	1051	167
7	997	221

c

	like	dislike
1	1038	180
2	946	272
3	916	302
4	929	289
5	1044	174
6	955	263
7	1022	196
8	987	231

grade 1 - 3 name 38 teachers in 7 school districts

a

	like	dislike
1	29	9
2	21	17
3	19	19
4	27	11
5	28	10
6	36	2
7	33	5
8	38	0
9	36	2
10	33	5
11	18	20

b

	like	dislike
1	32	6
2	8	30
3	34	4
4	29	9
5	29	9
6	27	11
7	29	9

c

	like	dislike
1	38	0
2	35	3
3	26	12
4	37	1
5	33	5
6	35	3
7	30	8
8	34	4

GRADE (4 - 6) NAME 1260 children in 7 school districts

SCIENCE OPINIONNAIRE (4-6)

DIRECTIONS: Below you will find many numbered items about which you have studied in science. Place an "X" in the one space that best represents your feeling about each item.

A. SUBJECTS TO STUDY	LIKE VERY MUCH	LIKE	DO NOT LIKE
1. Machines	319	529	412
2. Light	257	602	401
3. Sound	328	584	348
4. Heat	233	576	451
5. Electricity and Magnetism	572	446	242
6. Solar System	607	385	268
7. Stars and Space	704	383	173
8. Animals	872	287	101
9. Plants	483	518	259
10. Weather	410	540	310
11. Chemistry	673	264	223
12. Rocks and Minerals	547	467	246

B. IDEAS TO THINK ABOUT	THINK ABOUT A LOT	THINK ABOUT SOMETIMES	NEVER THINK ABOUT
1. Energy does work.	220	690	350
2. All matter is made of atoms and molecules.	198	559	503
3. Animals and plants are affected by things around them.	556	470	234
4. The smallest part of all living things is the cell.	257	573	430
5. There are different forms of living things.	510	532	218
6. The universe is always changing.	463	449	348
7. Weather is caused by changes in the air around us.	418	566	276

C. THINGS TO DO	ENJOY DOING VERY MUCH	ENJOY DOING	DO NOT ENJOY DOING
1. To make guesses based on information collected	294	563	403
2. To experiment	982	211	67
3. To tell how something works	442	528	290
4. To explain what happened	371	484	405
5. To build models	768	249	243

GRADE (4 - 6)

NAME 33 teachers in 7 school districts

SCIENCE OPINIONNAIRE (4-6)

DIRECTIONS: Below you will find many numbered items about which you have studied in science. Place an "X" in the one space that best represents your feeling about each item.

A. SUBJECTS TO STUDY	LIKE VERY MUCH	LIKE	DO NOT LIKE
1. Machines	6	21	6
2. Light	8	17	8
3. Sound	10	17	8
4. Heat	7	15	11
5. Electricity and Magnetism	19	14	0
6. Solar System	23	9	1
7. Stars and Space	21	12	0
8. Animals	22	9	2
9. Plants	19	12	2
10. Weather	17	14	2
11. Chemistry	16	11	6
12. Rocks and Minerals	14	14	5

B. IDEAS TO THINK ABOUT	THINK ABOUT A LOT	THINK ABOUT SOMETIMES	NEVER THINK ABOUT
1. Energy does work.	9	16	8
2. All matter is made of atoms and molecules.	9	16	8
3. Animals and plants are affected by things around them.	22	11	0
4. The smallest part of all living things is the cell.	5	12	16
5. There are different forms of living things.	18	14	1
6. The universe is always changing.	19	13	1
7. Weather is caused by changes in the air around us.	11	22	0

C. THINGS TO DO	ENJOY DOING VERY MUCH	ENJOY DOING	DO NOT ENJOY DOING
1. To make guesses based on information collected	15	14	4
2. To experiment	28	5	0
3. To tell how something works	15	16	2
4. To explain what happened	9	22	2
5. To build models	20	10	3