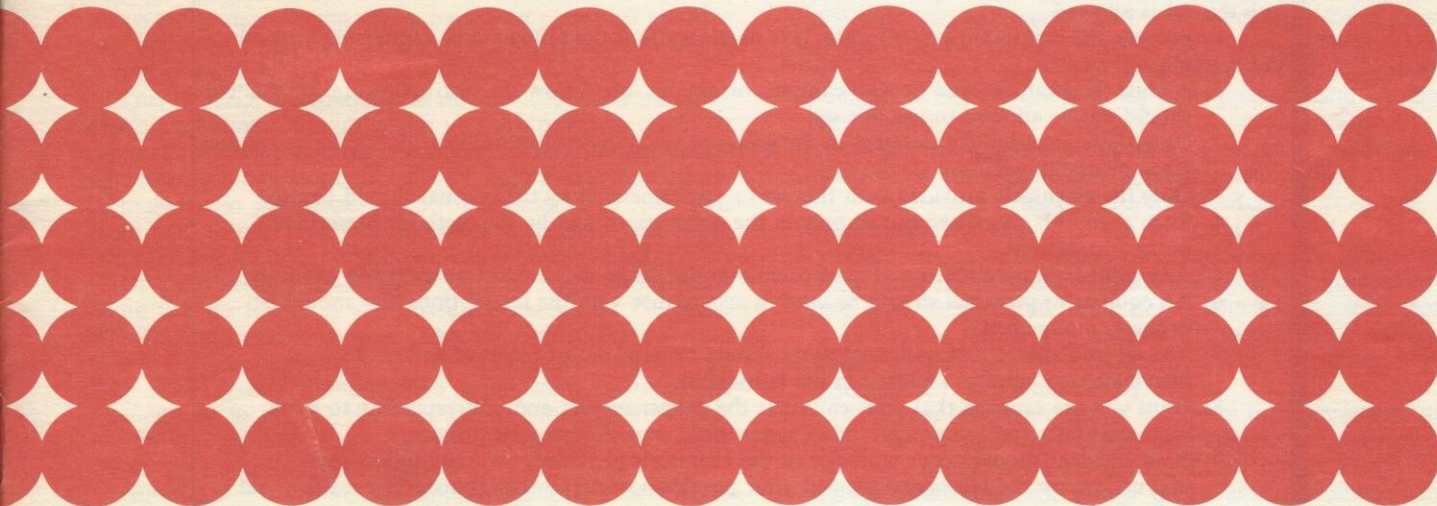




Scanned + Archived
By:
FindMyManual.org

microscope

MANUAL



WARNING—This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

SKIL-CRAFT CORPORATION • a division of WESTERN
PUBLISHING COMPANY, INC. • RACINE, WISCONSIN 53404
© 1976 WESTERN PUBLISHING COMPANY, INC.

TO ALL PARENTS:

ALL SKILCRAFT® SCIENCE LABS have been designed to provide stimulating experiments and useful learning experiences when used in the proper manner. Misuse or careless handling of contents can introduce hazards, which can be avoided by careful adherence to all instructions. Safety and caution should become a habit with every young scientist.

Government regulations require specific labeling of chemicals that are to be used in or around the home. All chemicals supplied in these sets are labeled as required, with the proper cautionary statements for their use and potential misuse. Please review carefully these labels and the instructions in the manual provided, making certain they are understood by your child before any experimentation with this set is allowed.

To provide the maximum safety in use, it is necessary that the following be clearly understood and carefully adhered to:

1. A child who cannot read or who cannot, for any reason, follow the instructions in the manual should not be allowed to use this set.
2. Only those experiments included in the accompanying instruction manual should be attempted when using this set.
3. Only the chemicals provided with this set or recommended by the manual should be used.
4. Such chemicals should be mixed only in the proportions and by the methods prescribed in the instructions.
5. Any spilled, contaminated and used chemicals should be disposed of quickly and carefully.
6. All equipment provided should be used in accordance with the instructions and should be properly maintained.
7. The set and any of its component parts should be kept out of reach of and made unavailable to younger children in the household.
8. Until you are satisfied that your child has the proper respect and understanding to work with chemicals and use this set, adult supervision should always be provided.
9. If an accident should occur with any of the chemicals provided, carefully follow the instructions on the labels and contact your physician or seek other appropriate medical aid immediately.

Information about this set and any chemical included in a SKILCRAFT® SCIENCE LAB can be obtained by contacting

SKIL-CRAFT CORPORATION
1220 MOUND AVENUE
RACINE, WISCONSIN 53404
Telephone: (414) 633-2431

YOUR MICROSCOPE—WINDOW TO A WORLD OF TINY THINGS

All your life you have learned by looking. Now you have a Skilcraft microscope—a fascinating window through which you may look into an entirely new world of knowledge!

With your Skilcraft microscope, you will be able to see things far too small to see with your eyes alone. For instance, you will be able to see the tiny, colorless plants used to make bread rise . . . the sticky pads and claws on the foot of a housefly . . . plants and animals small enough to live in a drop of water.

This Skilcraft microscope is not a toy. It is a carefully made instrument through which you are going to begin to understand the world around you and to see, through magnification, some of its wonders—both natural and man made.

Included in this book are 50 experiments to help you learn how to use your microscope and to teach you what you may expect to see under various magnifications.

Of the materials listed as needed for each experiment, some will be found in your Skilcraft set. Other materials you will find in your home or outdoors. Some you will want to buy from a drugstore or a laboratory supply house. You may want to use the enclosed order form to replenish materials or to add to your set. Doing the experiments is easier, you will find, if you have an extra supply of slides, cover slips, and Redi-Mount labels.

None of the materials are dangerous to use and none of the experiments are dangerous if you use normal care and follow directions carefully. Pay close attention to any warning given about the use of a tool or chemical—and never taste or drink any of the things used or produced in an experiment. When working with staining solutions, be careful not to spill them. Staining solutions are difficult to remove from clothing, tabletops, and floor coverings.

Before you start a new experiment, be sure your micro-

scope, slides, cover slips, and other equipment are clean and ready to use. When you finish working with your microscope, put it and other pieces of equipment away and pick up all waste material.

CARE AND USE OF A MICROSCOPE

On the following pages are diagrams of three Skilcraft microscopes. Yours is like one of the three. As you read this page, you will need to turn now and then to the diagram of your microscope and study it. Whichever Skilcraft microscope you have, you can be sure that it is a carefully made instrument that deserves to be used properly and handled with care.

Lift and carry your microscope by its arm. Avoid jarring or bumping the microscope, and put it down gently.

Protect the microscope from dust. Keep it in its box or in its dust cover when you are not using it.

Keep the lenses of the microscope clean. The lenses are in the objectives and eyepieces. If the top lens of an eyepiece gets dusty or smeared, rub it gently with a soft, clean cloth or lens tissue. It may help to blow on the lens, because your breath is moist. Dry the lens gently. Clean the bottom of an objective lens in the same way.

If the microscope gives a choice of magnifications, set it for the lowest magnification possible. This lowest magnification is called *low power*. For many of the things you will be examining, low power gives all the magnification you need. To get high-power magnification, the eyepiece or nosepiece has to be adjusted. If your microscope is one that can be changed from one power to another, directions for doing this are on the page that shows the microscope. Low power is easier to use than high power and gives a clearer picture. *Always start your viewing with low power!*

To use your microscope, place it on a table and sit facing a window (on a sunny day, a north window will provide an

ideal light source). Look through the eyepiece or eyepieces, and as you look, move the reflector until you see a round, bright area.

WARNING! NEVER POINT THE REFLECTOR DIRECTLY AT THE SUN OR BRIGHT SUNSHINE! DOING SO WILL DAMAGE YOUR EYES!

Instead of daylight, you can use the electric stage illuminator that comes with every Skilcraft microscope. This illuminator easily slips under the microscope stage and will provide all the light you need for viewing. It can be used during the day or at night. Additional directions will be found on page 4.

Slip a slide under the clips on the stage, placing it so that the mounted object is above the stage opening.

Put your eye at the level of the stage and slowly turn either focusing knob until the bottom of the objective almost touches the slide.

WARNING! NEVER PUT OBJECTIVE LENS AND SLIDE ON A COLLISION COURSE WHILE YOU ARE LOOKING INTO THE EYEPIECE! IF THEY SHOULD COLLIDE, THE SLIDE AND OBJECT ON IT WOULD BE CRUSHED AND THE OBJECTIVE LENS DAMAGED!

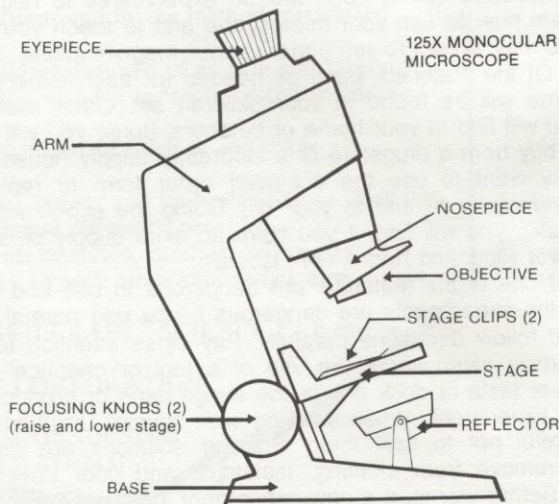
Now look into the eyepiece or eyepieces. If yours has only one, look into it with one eye and leave the other eye open. This takes a little practice, but doing so will cause less eye fatigue and make your viewing more enjoyable. The eye you view with should be about half an inch from the lens. Turn the focusing knob very, very slowly to gradually move the stage down. Stop when you can see the object on the slide clearly. When you can, it is in focus.

If your microscope has only one eyepiece, what you see will be upside down and reversed. As you move a slide in any direction to see more of the object, the slide seems to move in the opposite direction. This effect takes a little getting used to. If you have the binocular microscope, what you see will be reversed but not upside down.

SLIDE TEST

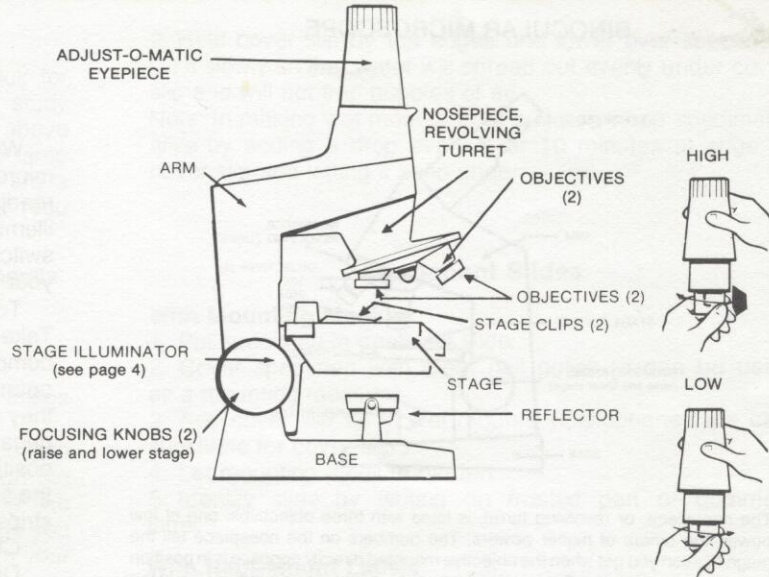
Before you begin doing the experiments in this manual, make yourself a practice slide. Ask your mother for an old pair of nylon hose that you may cut up. Cut out about a 1/4-inch section, place it on a clean slide, and put a self-adhesive Redi-Mount label over it. Redi-Mount labels are provided with each set. Simply peel one off the backing (the center portion must be open). View this practice slide under low power and then under higher powers if your microscope has them. Using the practice slide will help you become familiar with your microscope.

This microscope has one power of magnification. An object seen through it looks 125 times (125X) as big as it really is. The tilt of the microscope is in a fixed position and makes for easy and comfortable viewing.



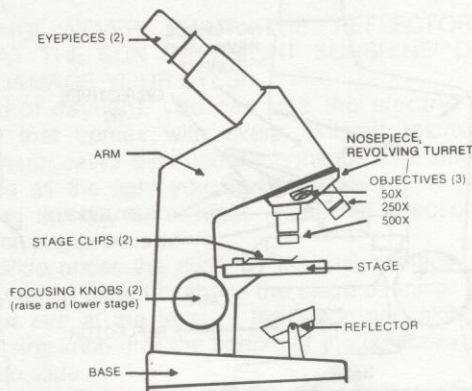
50X-400X MONOCULAR MICROSCOPE ADJUST-O-MATIC EYEPIECE

This microscope has a tiltable arm and stage and an Adjust-O-Matic eyepiece. This exceptional eyepiece provides both low power and high power. To change from one to the other, it must be taken off the microscope. Simply turn eyepiece clockwise from locked position and lift out. (Lock peg on eyepiece travels in groove cut on inside wall of microscope tube.) Eyepiece is set for *low power* when the smaller cylinder in the eyepiece is extended as far as it can be. A slight clockwise twist will unlock this cylinder so that it can be fully extended. To switch eyepiece to *high power*, push cylinder up into upper part of eyepiece. A slight counterclockwise turn will lock it into position. The diagrams show how the eyepiece locks for high power and for low power.



The nosepiece, or revolving turret, is fitted with two objectives, one of *low power*, the other of *high power*. Opposite each objective, you will see a set of numbers on the nosepiece telling the magnifications you can get with the objective. Those opposite the short-tubed objective tell you that it magnifies an object 50 times (50X) used in combination with the eyepiece set for low power, and 75 times (75X) used with the eyepiece set for high power. The numbers opposite the longer objective tell that it magnifies an object 300 times (300X) used with the eyepiece at low power, and 400 times (400X) used with the eyepiece at high power. To change from one objective to the other, turn the eyepiece a half turn. You will hear a click when the objective is in position.

BINOCULAR MICROSCOPE



The nosepiece, or revolving turret, is fitted with three objectives, one of low power, the others of higher powers. The numbers on the nosepiece tell the magnification you get when the objective mounted directly opposite is in position over the stage opening. For low power, turn the nosepiece so that 50X is in the front as you look down the tube of the microscope. The reading means that an object viewed with the objective in position is magnified 50 times. By turning the nosepiece to put the other objectives into position, you get, in turn, magnifications of 250 times (250X) and 500 times (500X). You will hear a click when the objective you are turning to is in position. With this microscope the eyepiece magnification is always the same.

The advantage of the binocular over the monocular microscope is that you use both eyes. With it you get a more realistic picture. Notice that the left eyepiece is movable. It must be set in the right place to make the two eyepieces the same distance apart as your eyes. Look through the right eyepiece with the right eye until you see the bright circle of light sent up from the reflector. Then slide the left eyepiece to where you can see the circle of light with the left eye, also. Move the eyepiece carefully back and forth until the bright areas seen by the two eyes come together into one. Check by covering one eye after the other to be sure you are seeing the bright area with both eyes. Sometimes you will think you are using both eyes when you are really seeing with only one.

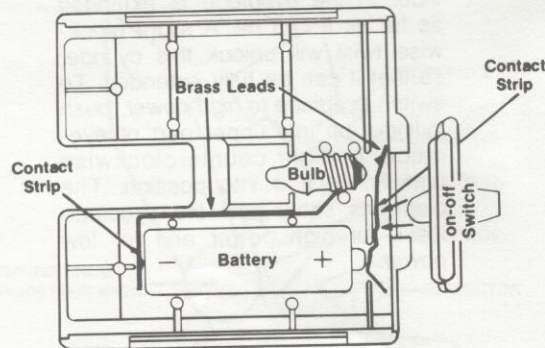
ELECTRIC STAGE ILLUMINATOR

With this device for lighting the stage you can use your microscope whenever you like, without having to adjust and readjust the reflector as light conditions change. The illuminator simply slides under the microscope stage. With the switch turned on, it will provide all the light you need for viewing your specimen.

To set up the stage light, you need only one AA battery. Take off the stage light cover and slip the battery into the compartment fitted with brass contact strips. While cover is still open, be sure contact strips are in position as shown so that they will make contact with bottom of bulb and the positive, negative ends of the battery. Move the switch to the ON position to see whether the bulb makes contact with the strip at the switch. If bottom of bulb does not make contact with metal strips turn bulb counter clockwise until contact is made.

Close cover tightly to hold bulb in proper position.

Do not use batteries that show any signs of corrosion.



VIEWING OPAQUE OBJECTS

Some things you will want to examine are too thick for light to pass through. We say they are *opaque*. To study them with the microscope you must light them from above or from the side. The source of light may be a regular lamp or a high-intensity lamp directed at the stage. Here are a few of many different things that are fun to look at (you will discover many more).

Grooves in a phonograph record	Rocks and minerals
Spices from the kitchen	Sand and soil
Coins and stamps	Insects
Paper money	Shells

You can expect to focus and refocus a good deal for things that vary in thickness.

Another way to magnify opaque objects so that you can examine them is, of course, to use a hand lens. Though the magnification is much lower than with a microscope like yours, a hand lens shows a lot about many of the things you will be experimenting with. The eyepiece removed from your microscope makes a very good hand lens. Take it out carefully and turn it upside down. Hold it close above whatever you want to examine. Look through it and focus by raising or lowering it. Keep the microscope covered while the eyepiece is out.

HOW TO MAKE SLIDES

Temporary Slides

Dry Mounts

1. Put specimen in center of slide.
2. Cover specimen with cover slip or cellophane tape.

Wet Mounts

1. Put specimen in center of slide and add a drop or two of water.

2. Hold cover slip by the edges and lower over specimen. Do it slowly so that water will spread out evenly under cover slip and will not trap bubbles of air.

Note: In making wet mounts from cultures, keep specimens alive by adding a drop every 5 or 10 minutes at edge of cover slip and letting it seep under.

Permanent Slides

With Mounting Medium

1. Put specimen in center of slide.
2. Cover specimen with clear nail polish (it can be used as a mounting medium).
3. Add cover slip as in wet mounts. (Cellophane tape can substitute for cover slip.)
4. Let mounting medium harden.
5. Identify slide by writing on frosted part or gummed label.

With Redi-Mount Labels

1. Place specimen flat against glass in center of slide. Specimen must be somewhat larger across than hole in Redi-Mount.
2. Pull label from backing (center portion must be open). Hold it in spread-out position above specimen, sticky side down and edges parallel to edges of slide.
3. Lower label and press it against glass so that ends or edges of specimen are held tight to glass.
4. Label specimen by writing on Redi-Mount or frosted part of the slide.

Note: Redi-Mount labels provide a quick way of making dry mounts. They make mounting such things as fibers, paper, textiles, hair, feathers, and insect wings easy. You could make a similar label yourself by cutting a window in a small square of masking tape.

Smears

1. Put a drop of fluid containing specimens at one end of slide.
2. Smear drop across 2/3 of slide with edge of another slide or any stiff material.
3. Let smear dry thoroughly before examining uncovered.
4. To make smear permanent, put drop of clear nail polish over a portion of smear and let dry.

How to Stain Specimens

In Wet Mounts

After covering specimen, put a drop of staining solution (if included with your set) at edge of cover slip and let solution seep under, or before covering specimen, add drop of staining solution instead of water.

In Dry Mounts and Smears

Before covering specimen, add drop of staining solution. Wash excess stain away with water from dropper. Blot or let air dry.

Staining solution is absorbed into the specimen and makes it possible to view the internal parts.

50 THINGS TO DO WITH A MICROSCOPE

Experiment 1

PAPER

Materials: samples of different kinds of paper—news-paper, brown wrapping paper, typewriter paper, glossy magazine paper, cleansing tissue, stationery.

Directions: Put a 1/4-inch (6 mm) square of paper in the center of a slide. Add a drop of water, and let the bit of paper soak for a few minutes. Use your dissecting needle to scrape

away a few threads, or fibers, from the paper. Do not bear down as you scrape. Instead, pick the fibers apart gently with the needle. (This process is called teasing. Use two needles if you have them—one for holding and one for teasing. A long florist's pin or a hatpin could take the place of one needle.) When you have separated a few fibers, remove what is left of the paper. Make a wet mount of the fibers. Study the slides under low power as you make them. As a record to keep, draw pictures of what you see, and label the drawings to show what kind of paper the fibers came from.

Paper is made of fibers. The fibers are matted together and rolled out into thin sheets. Much of the fiber used comes from wood. The wood may be ground into pulp or cut into chips and cooked to a pulp with chemicals. Among materials other than wood used to make paper are cotton and linen rags and a number of kinds of straws and grasses. Your microscope will let you see the difference in fibers in the various kinds of paper you have collected.

Look for: crushed, ragged-looking fibers that are a sign of pulp from groundwood . . . more complete fibers, showing the use of chemicals rather than grinding . . . brownish color of unbleached fibers in brown paper . . . cotton and linen fibers (see illustrations on page 8) of good stationery. . . broken, matted fibers of tissue paper.

Experiment 2

COATED PAPER

Materials: sample of glossy white paper from a magazine; test tube or small dish; tincture of iodine (used under adult supervision).

Directions: Make an iodine testing solution by putting a dropperful of water in a test tube or small dish and adding 2 drops of iodine. Soak a small piece of the magazine paper in a drop of water just as you did in the first experiment.

Gently scrape off the top of the paper and throw the rest away. Make a wet mount of the scrapings. Add a drop of the iodine testing solution at the edge of the cover slip. Look at the slide under low power.

Look for: tiny blue particles; particles of starch turn blue when iodine is added. Starch and the minerals talc and gypsum are materials often used to make paper smooth so that it will take ink well. Talc and gypsum by themselves do not turn blue when iodine is added.

Experiment 3

PRINTING

Materials: sample of newspaper with a few words of type, and one with picture in black and white; similar samples from magazine with glossy paper.

Directions: Make dry mounts of the four samples and look at them under low power. Look at them, too, with the eyepiece of the microscope removed and used as a hand lens. Make a permanent slide of one sample by mounting it with a Redi-Mount label.

Look for: ragged, broken look of letters in newspaper, which is cheaper, rougher paper. . . smoother, sharper look of letters on glossy paper . . . tiny smudged-looking dots in newspaper picture . . . finer, more distinct dots in magazine picture.



Experiment 4

COLOR PRINTING

Materials: samples of colored pictures from Sunday comics and from magazine with glossy paper.

Directions: Make dry mounts of the two samples. Examine them under low power and with the microscope eyepiece used as a hand lens. Make a permanent slide of one, if desired, by mounting it with a Redi-Mount label.

Look for: overlapping dots of two colors on newsprint . . . dots of four colors (red, yellow, blue, and black) in magazine picture . . . dots of different sizes and shapes in the two samples. The dots that make the pictures are all so small and close together that, with your eyes alone, you see the colors as solid.

Experiment 5

TEXTILE FIBERS

Materials: samples of cotton, linen, silk, and wool cloth; prepared slide of textile fibers (if included with your set).

Directions: Pull a thread from the piece of cotton. Put it on a slide, add a drop of water, and tease some fibers from the thread. Make a wet mount of these fibers. Do the same with each of the other materials. Examine each slide under low power as you make it. If fibers of the same kind are on the prepared slide, examine them also. For your record, make drawings of the fibers on the slides you make, and label the drawings.

Look for: fibers like most of those in the illustrations on page 8. For thousands of years, all textiles were woven of yarns spun from such fibers as these. Nowadays, however, in much of the world, the leading fibers for making cloth are man-made ones, like nylon, orlon, and polyester.

NATURAL TEXTILE FIBERS

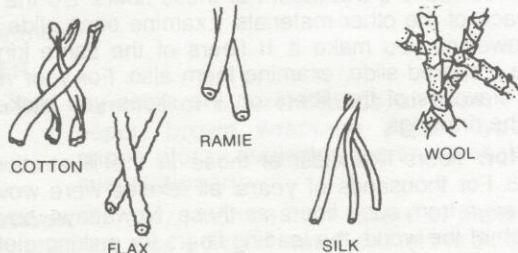
Cotton (plant fibers) Flat, twisted, and ribbon like; thicker and rounder at edges. They are really tubes that have collapsed.

Flax (plant fibers) Round tubes—not flat or twisted like cotton—with frequent small swellings, or knobs, along them; silky luster. Yarn and cloth called linen.

Ramie (plant fibers—a prepared slide is included with some sets) Round tubes, as with flax, but smoother and stronger; may not be completely cleared of other plant material; silky luster. (You probably have never heard of ramie. It is a fiber used since the days of ancient Egypt. Though still common in the Far East, it is rare in the U.S. and Europe.)

Silk (animal fiber) Solid fibers like tiny glass rods; smooth and fairly even in width throughout length; finer than the plant fibers.

Wool (animal fiber) Fibers having a scaly or wavy-looking surface. Wool fibers from different parts of the world are not exactly alike. An expert can tell just by looking at the fibers where a sample of wool has come from.



Experiment 6

MAN-MADE FIBERS

Materials: samples of man-made, or synthetic, yarns, or of cloth woven from such yarns—for instance, rayon, orlon, nylon, polyester, and glass.

Directions: For each yarn or cloth sample make a wet mount of a few fibers the way you did in Experiment 5. Examine them under low power. Make and label a drawing of each kind of fiber.

Look for: there is no easy way of identifying today's many different man-made fibers. Usually the fibers are treated in special ways so that, when spun or twisted into yarn, they give the appearance and texture of cotton, wool, or silk. You may see such signs of "texturing" as crimps, twists, or loops in the fibers.

Experiment 7

SALT AND SUGAR CRYSTALS

Materials: table salt; granulated sugar.

Directions: Sprinkle a few grains of salt on a slide and, without adding a cover slip, look at the grains under low power or with a hand lens. (Remember that you can use the eyepiece of your microscope as a hand lens.) Examine some grains of sugar in the same way.

Look for: cube shape of grains of salt; the grains are tiny crystals. . . Many-sided shape of the grains, or crystals, of sugar.

Experiment 8

MAKING SALT AND SUGAR CRYSTALS

Materials: table salt; granulated sugar; cup; 2 test tubes (or juice glasses); 2 small buttons; white cotton thread; 2 toothpicks.

Directions: Fill a cup half full of hot water. Add salt a little at a time and stir. Keep on adding salt until no more will dissolve. Put a drop of the solution on a slide and set it aside until the water in the solution evaporates. Use low power to examine the residue on the slide. Fill a test tube nearly full of the salt solution in the cup. Tie a button to the end of a short length of thread. Lower the button to the bottom of the test tube, and tie the upper end of the string to a toothpick. Lay the toothpick across the top of the test tube. Set the test tube aside for a time.

Repeat the experiment, using sugar instead of salt.

Look for: larger size of crystals that form on the threads as the water evaporates . . . shapes like those of grains of table salt and granulated sugar.

Experiment 9

EPSOM SALTS CRYSTALS

Materials: Epsom salts; liquid glue; test tube (or juice glass).

Directions: Fill the test tube half full of warm water. Add Epsom salts to it little by little, stirring after each addition, until you are sure no more will dissolve. Mix in a few drops of liquid glue. Put a drop of the mixture on a slide and smear it over the slide with the edge of another slide. Under low power or with a hand lens, look at the crystals that quickly form.

Look for: needlelike shape of crystals.

Experiment 10

ALUM CRYSTALS

Materials: powdered alum; test tube (or juice glass); drinking glass or cup; square of cotton cloth (a handkerchief, for instance).

Directions: Fill the test tube nearly full of very warm water. Dissolve as much of the alum as possible in the water, adding it little by little and stirring after each addition. Set the test tube aside for a time. When you see some crystals in the test tube, pour the solution through the cotton cloth into a clean cup or glass. Pour the solution back into the test tube. Select two or three of the largest crystals on the cloth and, with tweezers, put them back into the solution. Examine some of the crystals left on the cloth with a hand lens or under low power. After several days, examine the crystals put back into the solution.

Look for: double-pyramid shape and greasy look of crystals . . . increase in size of those put back into the solution.

Experiment 11

BORIC ACID CRYSTALS

Materials: powdered boric acid (used under adult supervision); test tube (or juice glass).

Directions: Fill the test tube half full of warm water. Add boric acid little by little to the water, stirring each time, until no more will dissolve. Put several drops of the solution on a slide. Do not add cover. Lay the slide in a warm, not hot, place (out of reach of younger children), and let it stand till the water in the solution evaporates, leaving crystals of boric acid behind. Examine the crystals under low power.

Look for: somewhat lopsided crystals with six sides.

Experiment 12

ICE CRYSTALS

Materials: snowflakes.

Directions: To examine snowflakes with your microscope, you should work in a cold room or out of doors, and your slides must be cold. Snowflakes are made of crystals of ice. Unless they are kept cold, they quickly melt. Catch a few snowflakes on a slide and examine them with your microscope. Do not use a cover glass. A big snowflake is made up of several crystals.

Look for: unbroken crystals with six sides or six points. You may want to make drawings of several different snowflakes. You'll notice that no two of them are exactly alike.

Experiment 13

CELLS

Materials: clean, flat, wooden toothpick; onion; leaf of wandering Jew or snapdragon; sharp paring knife or single-edged safety razor blade (used under adult supervision); staining solution, if included with your set, or iodine solution like that used in Experiment 2.

Directions: Use the blunt end of the toothpick to scrape the skin on the inside of your cheek two or three times. Be careful not to break the skin. Make a wet mount of the scrapings, and stain them with either staining solution or iodine solution. Tear off a layer of the onion and, with tweezers, peel away some of the very, very thin, transparent "skin" on the inner surface. Make a stained wet mount. Use a knife or razor blade to peel off a small section of the undersurface of a leaf of wandering Jew or snapdragon. This peeling, too, will be very, very thin and transparent. Make a stained wet mount of it.

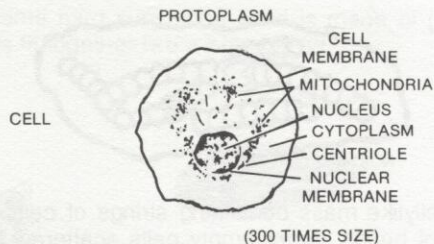
Look for: cells—little blocks of the living material called protoplasm—in both the cheek scrapings and the plant peelings . . . a central round body, the nucleus, in each cell . . . a distinct cell wall around the onion and leaf cells, and a thin membrane around the cheek cells.

GETTING MICROSCOPIC PLANTS AND ANIMALS TO EXAMINE

On a lakeshore or on the edge of a pond, find a place where you see green scum on the top of the water or small green plants below the surface. With a cup, dip up enough water and scum to fill a glass fruit jar almost full. Along with the green plants in the water, you are sure to get some tiny animals. After you take the water home, let it stand. From time to time, add enough water to replace what evaporates. Instead of going back to the pond or lake to get more water, *you can use tap water, but it should first be boiled and cooled.* Tap water may contain chemicals that would kill some of the tiny plants and animals in your culture. The boiling will drive out most such chemicals. The water of an aquarium with fishes, snails, and plants in it is also a source of tiny living things.

Another way to get a supply of microscopic wildlife to examine whenever you like is to make a hay infusion. Boil some tap water and almost fill a pint jar with it. Add a little hay or other dried grasses and let the jar stand in a warm place for several days. You can start a similar culture with a leaf of lettuce instead of hay, but you will not get as many different kinds of plants and animals as you will with hay.

All living things are made of cells. Some tiny living things are single cells. Other plants and animals are many-celled. In a many-celled plant or animal, there are different kinds of cells that do different kinds of work. Cells that are alike and work together form tissues. Tissues working together form organs. Groups of organs working together make up the individual plant or animal.



Experiment 14

ALGAE

Materials: pond culture; prepared slides of any of the common algae listed here (if included with your set).

Directions: Examine the prepared slides of algae. Make several wet mounts of the scum and greenish water from your pond culture and study them under low power. Pond scum is made up of the waterweeds called algae. There are many different kinds of algae. Most of those you will find are green. Some may be blue-green, some brownish. (Since there will be animals, too, along with the plants in your culture, you may want to look ahead at Experiments 25-29 and Experiment 33, all of which are about animals or animal like organisms of pond cultures, and study them along with the algae.)

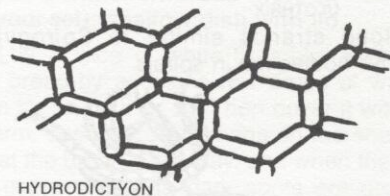
Look for: such common algae as these:

Green Algae

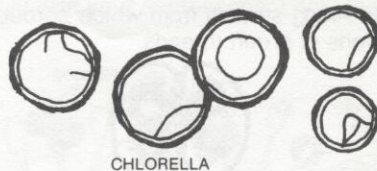


Spirogyra (pond silk)—long, many-celled strands. Inside each cell runs a spiraling ribbon of green (green because of chlorophyll, the coloring matter which enables green

plants to make food for themselves out of carbon dioxide and water). Two threads of Spirogyra may come together and the contents of matching cells fuse to form what is called a zygote. From the zygote a new plant will grow.



Hydrodictyon (water net)—flat sheets of cells linked loosely, as in a net.



Chlorella—single round cells, sometimes in clumps. Common, living inside small animals such as hydras and paramecia. This tiny plant may someday be raised as a food crop for people. It may also furnish food and oxygen for space travelers on voyages to Mars and beyond.



Cladophora—branching strings of long, slim cells, often in tangled mats.



ULOTHRIX

Ulothrix—long strands similar to Spirogyra but with chlorophyll bodies not in spirals.



DRAPARNALDIA

Draparnaldia—long strands from which sprout, at intervals, little pompoms of green threads.



COSMARIUM

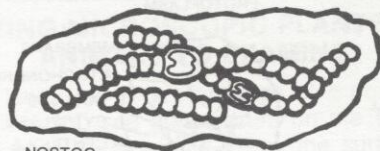
Cosmarium—single rounded cells divided into identical half-cells linked at the center. Belongs to a family of green algae called desmids. Some desmids are long and narrow, some like 6-pointed stars, but all desmids are 2-part single cells.

Blue-Green Algae



GLOEOCAPSA

Gloeocapsa—tiny single cells with jellylike coating.



NOSTOC

Nostoc—jellylike mass containing strings of cells like little strings of beads; larger empty cells scattered along the strings.



ANABAENA

Anabaena—like Nostoc but not in a jellylike mass.

Experiment 15

DIATOMS

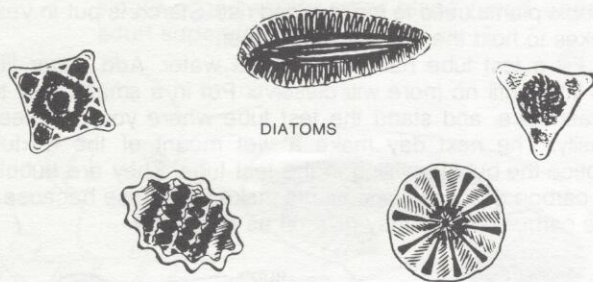
Materials: prepared slides (if included with your set) of any of the diatoms pictured here; mud from bank of pond.

Directions: Examine the prepared slides of diatoms. Make thin smears of pond mud. Examine each smear carefully as you make it.

Look for: tiny one-celled plants of geometric shapes—circles, ovals, diamonds, rectangles, triangles . . . delicate designs of dots, grooves, and knobs on cell walls . . . cells colorless to brown.

Diatoms, like the pond plants you worked with in Experiment 14, are algae. They belong to a group called golden algae. The cell wall of a diatom is a two-part affair made

of the same hard substance sand is made of (silica). The two parts fit together like a box and lid.



Experiment 16

DIATOMACEOUS EARTH

Materials: diatomaceous earth (if included with your set); scouring powder; toothpaste.

Directions: Make wet mounts of diatomaceous earth, scouring powder, and toothpaste. Examine them carefully.

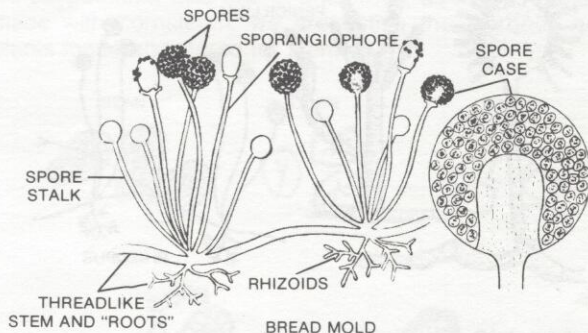
Look for: shapes recognizable as the cell walls of diatoms and broken fragments of such skeletons. When diatoms die and sink to the bottom of the water, their skeletons pile up. In some places, thick deposits of diatom skeletons are found. These deposits, called diatomaceous earth, are useful. Diatomaceous earth is made into scouring powder; it is also put in toothpaste and tooth powder.

Experiment 17

BREAD MOLD

Materials: slice of white bread; prepared slide of *Rhizopus* a common bread mold (if included with your set); shallow dish with lid.

Directions: Lay a slice of white bread in a shallow dish. Dampen the bread by adding a few drops of water. Leave the dish open for an hour or so. Then cover it with a lid, and put it in a warm, dark place—perhaps on the shelf of a cupboard. Look at the bread every day, and when there are dark spots on it, examine it. The dark spots are growing mold plants. Molds are small plants made up of threadlike stems, some of which bear tiny spores. Spores start new mold plants. They are carried about in the air. Look at some of the bread mold with your microscope. Look, too, at the slide of *Rhizopus*.



Look for: threads of the mold . . . black balls that contain the spores . . . tiny specks that are the spores themselves. Molds belong to the big group of plants called fungi. The fungi have no chlorophyll. They cannot manufacture their own food as green plants do.

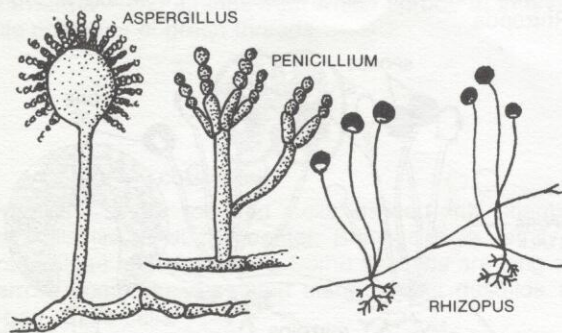
Experiment 18

BLUE-GREEN AND BROWN MOLDS

Materials: moldy orange or lemon; prepared slide of *Aspergillus* (if included with your set).

Directions: Examine the mold from the orange or lemon and the prepared slide of *Aspergillus*. These molds do not bear their spores the way bread mold does. *Aspergillus*, a brown mold, is a close relative of *Penicillium*, the common blue-green mold of citrus fruits. We get the drug penicillin from *Penicillium* mold.

Look for: chains of spores growing from ball-shaped head in *Aspergillus* and on little upside-down "brooms" in *Penicillium*.



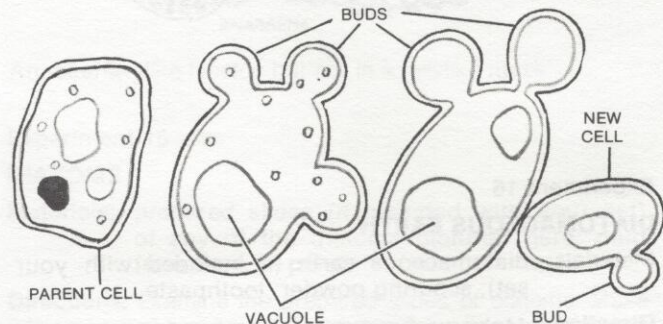
Experiment 19

YEAST PLANTS

Materials: yeast cake; sugar; iodine testing solution like that used in Experiment 2; test tube (or juice glass); small glass dish.

Directions: Make a wet mount of a tiny bit of the yeast cake, using iodine testing solution instead of water. Examine under low power and then high power. The blue grains you see are grains of starch—iodine, you remember, turns starch blue. The tiny colorless bodies are yeast plants—the microscopic plants used to make bread rise. Starch is put in yeast cakes to hold the tiny plants together.

Fill a test tube half full of warm water. Add sugar little by little until no more will dissolve. Put in a small bit of the yeast cake, and stand the test tube where you can see it easily. The next day make a wet mount of the mixture. Notice the bubbles rising in the test tube. They are bubbles of carbon dioxide. Yeast plants make bread rise because of the carbon dioxide they give off as they grow.



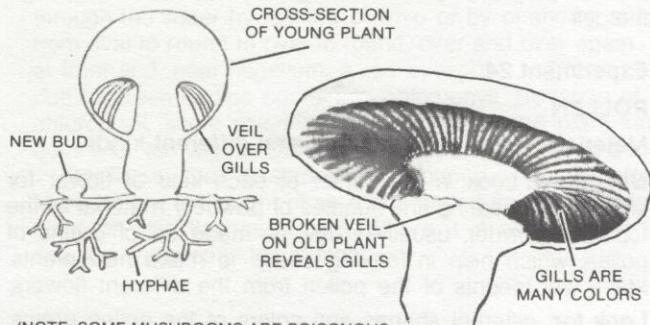
Look for: on first mount—single yeast plants and yeast plants with round buds growing out from them. The buds are young plants.

On second mount—not only budding yeast plants but also chains of several plants. Yeasts need sugar for food and grow rapidly in a sugar solution. Chains break apart into separate plants. Like molds, yeast plants are fungi.

Experiment 20

MUSHROOMS

Materials: 2 fresh mushrooms of same kind; 2 sheets of paper, one white, one dark; 2 glass jars; single-edged safety razor blade (used under adult supervision).



(NOTE: SOME MUSHROOMS ARE POISONOUS. THERE IS NO EASY RULE FOR TELLING WHICH KIND IS EDIBLE.)

Directions: Cut off the caps of the mushrooms and lay one cap, top side up, in the center of a sheet of white paper. Lay the other one on a dark-colored sheet of paper. Turn a glass jar upside down over each cap. The next day, uncover the caps and carefully lift them straight up from the paper. The patterns left on the paper are made by spores. Some mushrooms have dark spores and will show best on the white paper. Some mushrooms have white spores and will show best on the dark paper. The common grocery store mushroom has brownish-black ones. Make a wet mount of some of the spores in your spore prints. Cut thin slices down through one of the spore-bearing parts (gills) of one mushroom cap. Make a dry mount and a wet mount and examine under low power.

Look for: spores hanging from outer layer of gills. Mushrooms are club fungi. Their spore-producing cells are shaped a little like Indian clubs.

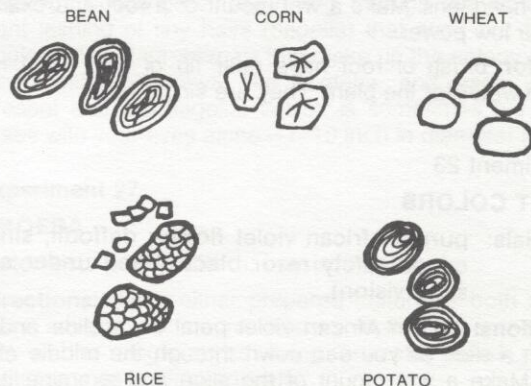
Experiment 21

STARCH GRAINS

Materials: flour, cornstarch, raw potato, rice, navy bean; iodine testing solution prepared as in Experiment 2.

Directions: Take a very small amount of each foodstuff and make wet mounts. With the potato, use fine scrapings. The rice and bean have to be crushed and the insides powdered. Examine each slide as you make it, adding a drop of iodine testing solution at the edge of the cover slip.

Look for: starch grains like those pictured. Much of the food green plants make is stored in the form of starch. When we eat potatoes, rice, beans, and bread, as well as puddings made with cornstarch, we are eating the starches green plants made and stored for themselves.



Experiment 22

ROOT HAIRS

Materials: radish seeds; flat-bottomed bowl and plate to cover; heavy paper towel.



ROOT HAIRS

Directions: Cut a paper towel to fit the bottom of the bowl. Dampen it well. Lay 5 or 6 seeds on it at least half an inch apart. Cover with another layer of well-dampened paper towel. Put a plate over the bowl and set it in a dark place. Each day, add a little water and look to see whether roots have developed. As soon as they have, examine them with a hand lens. Make a wet mount of a root and examine it under low power.

Look for: brush of root hairs near tip of root. Root hairs take in water for the plant. They are single cells.

Experiment 23

PLANT COLORS

Materials: purple African violet flower; daffodil; single-edged safety razor blade (used under adult supervision).

Directions: Lay an African violet petal on a slide and cut as thin a slice as you can down through the middle of the petal. Make a wet mount of the slice and examine it. Do

the same with a daffodil petal.

Look for: even distribution of color in African violet cells . . . presence of yellow in only small bodies in cells of daffodil petal. The yellow coloring matter found in many plants is in small bodies. So is the green coloring matter, chlorophyll. But the coloring matter found in many red or blue or purple flowers and fruits is dissolved all through the cell.

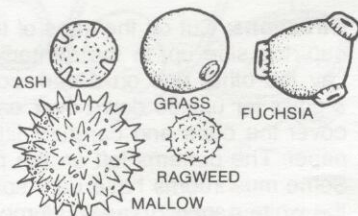
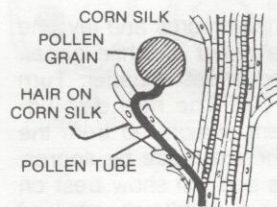
Experiment 24

POLLEN

Materials: fresh flowers of several different kinds.

Directions: Look in the center of each kind of flower for small stalks bearing tiny bundles of powdery material at the top. The powder, usually yellow, is made up of grains of pollen, which help in forming seeds to make new plants. Make wet mounts of the pollen from the different flowers.

Look for: different shapes and colors of the pollen grains. A flower's pollen is one of its identification cards.



Experiment 25

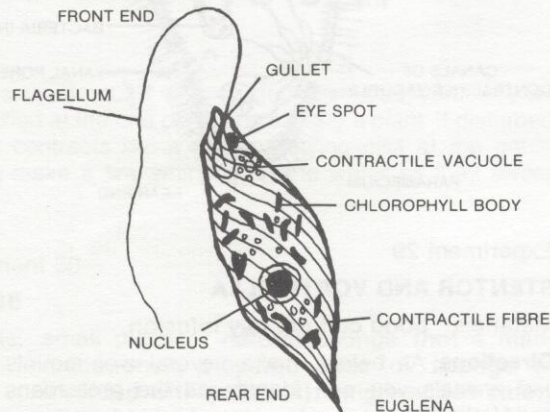
EUGLENA

Materials: pond culture; hay infusion; prepared slides of Euglena and Noctiluca (if included with your set).

Directions: Find *Euglena* and *Noctiluca* on the prepared slides. The diagrams will help identify them. Then, using either of your cultures or both of them, make several wet mounts and hunt for a live *Euglena*. (Don't expect to find *Noctiluca*. It lives in the sea.)

Look for: single cell, usually oval in shape, with a long whiplike hair, called a flagellum, at front end . . . movement through the water by lashing of whip or by changing shape from oval to round to oval to round, over and over again . . . at front end, near flagellum, a red eyespot . . . green color due to green bodies containing chlorophyll. Because of its chlorophyll, some scientists put *Euglena* in the plant kingdom with the algae. Others put it in the animal kingdom.

Noctiluca, too, is sometimes grouped with the algae. More often it is thought of as a one-celled animal. *Noctiluca* gives off little flashes of light. Where it is abundant in the sea, the water sparkles at night.

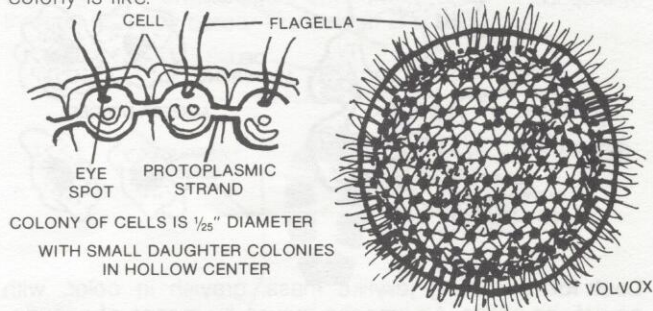


Experiment 26

VOLVOX

Materials: pond culture.

Directions: Make wet mounts of green pond scum and examine them for *Volvox*, a colony of plant-animals also often argued about by scientists (some say it is a plant, others say it is an animal). The illustration shows what a colony is like.



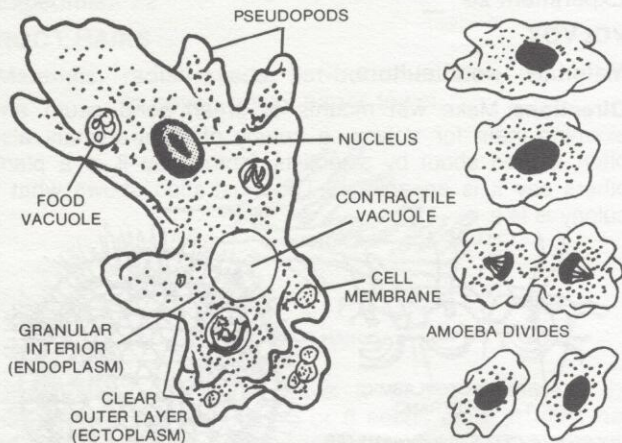
Look for: hollow green ball rolling through the water. Constant lashing of tiny hairs (flagella) that stick out from the single-celled plant-animals that make up the colony . . . cells green with chlorophyll, like *Euglena*, and each with red eyespot and two flagella. *Volvox* is sometimes big enough to see with your eyes alone—1/10 inch in diameter (2.5mm).

Experiment 27

AMOEBA

Materials: pond culture; hay infusion.

Directions: Using either prepared culture or both of them, make several wet mounts and try to find an amoeba. It is one of the single-celled living animals called protozoa. Protozoa means "first animals."



Look for: a moving jellylike mass, grayish in color, with no definite shape. An amoeba moves by means of pseudopods, or "false feet," which are simply part of the cell protoplasm thrust out in whatever direction the amoeba is moving. There is no front. There is no rear. Look for specks inside the amoeba, which are particles of food in little drops of water, and a larger, clear drop of water.

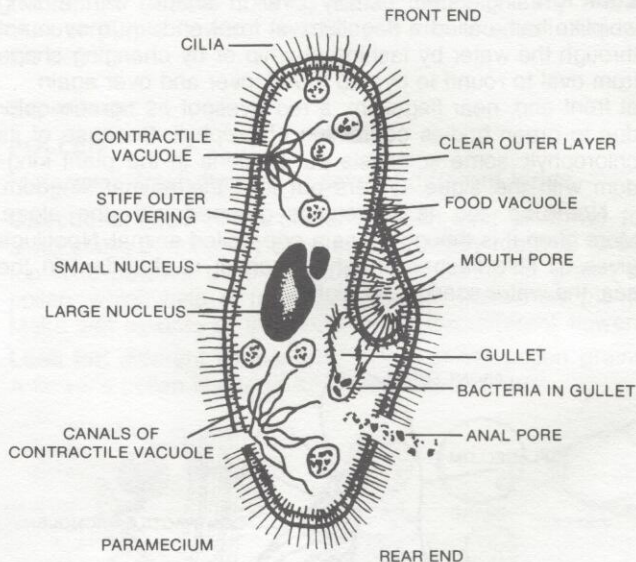
Experiment 28

PARAMECIUM

Materials: pond culture; hay infusion.

Directions: Using your prepared cultures, make several wet mounts. Be sure to include plant material. Try to find a paramecium, a tiny, single-cell animal trapped among the plants. A paramecium is also a protozoan.

Look for: a tiny protozoan shaped like a slipper. The parts are labeled in the diagram. To make these out, study a trapped paramecium. (One that is free to move is hardly still long enough.) Paramecia are fast swimmers. They swim by means of tiny hairs (cilia).



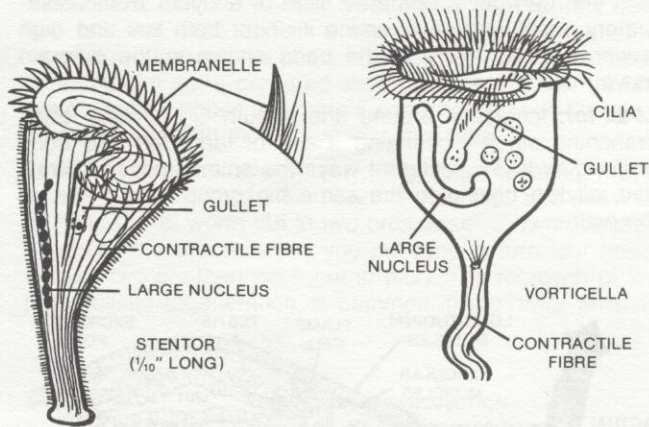
Experiment 29

STENTOR AND VORTICELLA

Materials: pond culture; hay infusion.

Directions: As before, make several wet mounts. Try to find animals you can identify as the protozoans Stentor and Vorticella.

Look for: a large trumpet-shaped protozoan fastened at its lower end to a plant or to the bottom of the slide. This will be Stentor, a giant among protozoa. At the top will be a circle, or wheel, of fast-moving cilia, and inside the trumpet, a nucleus like a string of beads.



The stalked, much smaller, goblet-shaped Vorticella will be attached at the end of its long stalk to a plant. If disturbed, its stalk contracts like a spring. Moving cilia at the goblet opening make a tiny whirlpool in the water as they sweep in food.

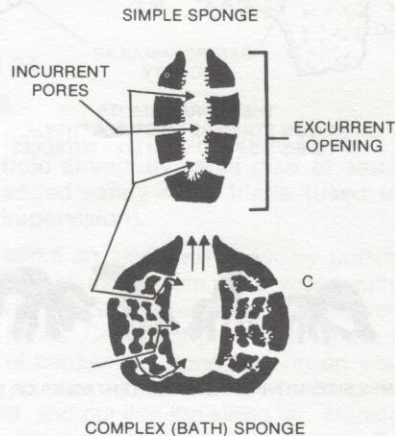
Experiment 30

Sponge

Materials: small piece of natural sponge (not a man-made one); prepared slide of sponge (if included with your set); single-edged safety razor blade (used under adult supervision).

Directions: Soak the sponge in water for a few minutes. With a razor blade, slice off the thinnest of slivers and make a wet mount. Look at it under both low and high power. Compare what you see with the prepared slide.

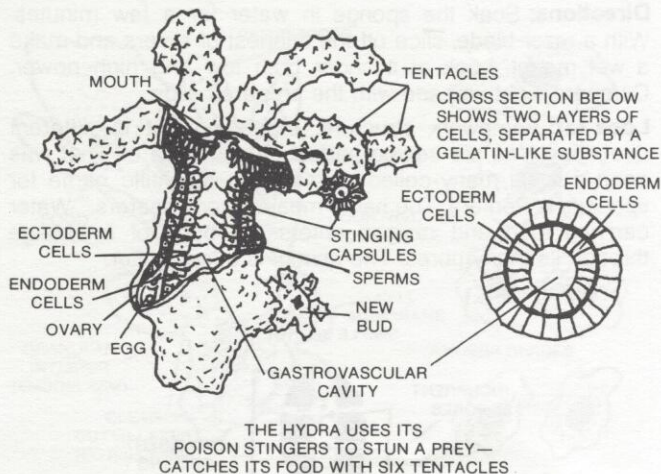
Look for: framework structure, branching out in different directions. You are seeing part of the skeleton of what was once a living many-celled animal. The scientific name for sponges is Porifera. The name means "pore-bearers." Water carrying food and oxygen enters the body of a sponge through its many pores. The animal is a living filter.



Experiment 31

HYDRA

Materials: glass jars for collecting living hydras; drinking tube or straw; saucer.



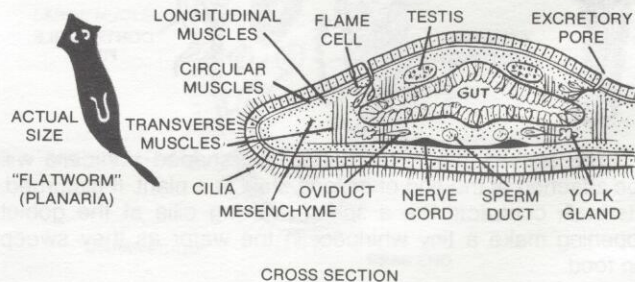
HYDRA ($1\frac{1}{2}$ TIMES SIZE) MOVES BY WAVING TENTACLES OR SOMERSAULTING

Directions: Collect samples of pond water in glass jars. Include some water plants. Let the jars stand in a warm, light place for several hours. With luck, you may find a hydra or two attached to a plant or to the side of a jar. Carefully pick up any you find, using a tube or straw as a dip tube. (Keep your finger over the top of the tube and hold the tube in a straight-up position directly over a hydra.

Quickly lift your finger for an instant. The hydra will be pulled up into the tube with a rush of water. Hold the still upright tube over a saucer and lift your finger. The hydra will drop into the saucer along with the water.) Watch the hydra with a hand lens.

If you can get a prepared slide of a hydra from a laboratory supply house, examine it under both low and high power. Find as many of the parts shown in the diagram as you can.

Look for: tentacles around the mouth . . . new buds branching off . . . changing shape of tentacles and body of living hydra . . . different ways the animal moves. Corals and jellyfish belong to the same big group of animals as the hydra.



Experiment 32

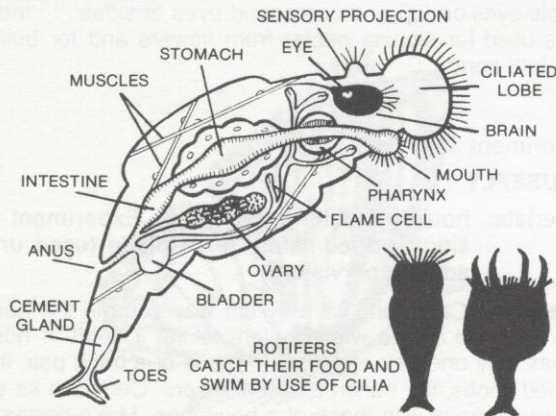
PLANARIA

Materials: liver and string for capturing planarians (flatworms); single-edged safety razor blade (used under adult supervision); several small dishes.

Directions: Leave a piece of fresh liver tied to a string in a clear stream for an hour or two. Tiny worms will attach themselves to the liver. They are planarias, or flatworms. Make a wet mount of one worm and look at it under the microscope. Put others in small dishes and watch them with a hand lens. Cut one worm in half midway between the head and tail. Put each half in a separate dish. Slice another worm down through the head, leaving the head on the body.

If you can get a prepared slide of a planaria from a laboratory supply house, examine it under low power. Compare what you see with the picture included here.

Look for: crossed eyespots . . . gliding, scooting movements . . . growth of new head on tail half and new tail on head half of worm cut in two crosswise . . . two complete heads on the second worm you cut (and in turn four heads if these two are then each cut in half). The regrowth of lost parts, called regeneration, is common in the lower animals.



Experiment 33

ROTIFERS

Materials: pond culture; hay infusion.

Directions: You must already have seen rotifers, for almost any drop of pond water contains some. Make a few wet mounts from your prepared cultures and look for rotifers.

Look for: telescoping body . . . a crown of beating cilia that spins like a wheel . . . constant rapid moving about . . . "toes" on foot end. Though many-celled, rotifers are only about the size of protozoa.

Experiment 34

HONEYBEE

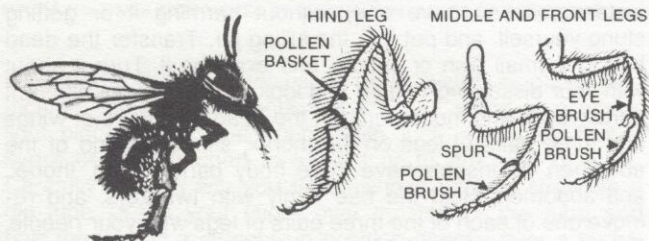
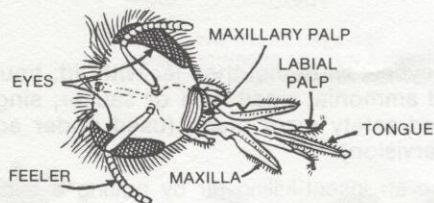
Materials: honeybee; wide-mouthed jar with lid; household ammonia; small dish or saucer; single-edged safety razor blade (used under adult supervision).

Directions: Make an insect-killing jar by putting a folded-up paper towel in the bottom of a widemouthed jar and soaking it with household ammonia. Be careful! *Do not* breathe the fumes. Cover the jar, screwing the lid on tight. Find a way of capturing a honeybee (in an insect net, for instance, if you have one) without harming it or getting stung yourself, and put it in the killing jar. Transfer the dead bee to a small dish or saucer and examine it. Turn it about with your dissecting needle and look at the insect's different parts—eyes and mouthparts on the head; two pairs of wings and three pairs of legs on the thorax; stinger at end of the abdomen. All insects have three body parts—head, thorax, and abdomen. Hold the bee firmly with tweezers, and remove one of each of the three pairs of legs with your needle. Put them on a slide. Make a permanent mount of them, and

label it to show which one is the front, which the middle, and which the hind leg.

Using two dissecting needles, push gently on the lower part of the abdomen to force the stinger partway out. With tweezers, then slowly pull it out the rest of the way. If you are careful, the bee's poison sac and glands will come with the stinger. Make a permanent mount and label it. With tweezers, detach one of each pair of wings. Make and label permanent mounts.

Cut off the bee's head with a razor blade. Put it, uncovered, on a slide and examine it with a hand lens or the low power of your microscope.



Look for: front leg—pollen brush of hairs on large first joint of foot . . . small round notch on inside of same joint, used to comb pollen from antennae . . . short, stiff hairs on leg section nearest foot, for brushing pollen from eyes.

Middle leg—brush of hairs on first foot joint . . . a spike, or spur, for picking up wax from abdomen when making comb.

Hind leg—pollen combs on inside of first foot joint . . . stiff spines at bottom of joint nearest foot. Pollen combed from opposite leg falls on flat area at top of first foot joint. The bee then bends its leg to push the pollen up into the pollen basket, a scooped-out area edged with long hairs on joint above foot.

Stinger—feelers at each side . . . barbs on stinger . . . poison sac and poison glands leading to stinger.

Wings—crisscrossing veins . . . tiny hooks along front edge of back wings . . . grooves on back of front wings (in flight, the two wings hook together and work as one) . . . frayed edges telling of many miles of flying.

Head—parts shown in diagram . . . difference between simple eyes on top and compound eyes at sides . . . mouthparts used for sipping nectar from flowers and for building wax into comb.

Experiment 35

HOUSEFLY

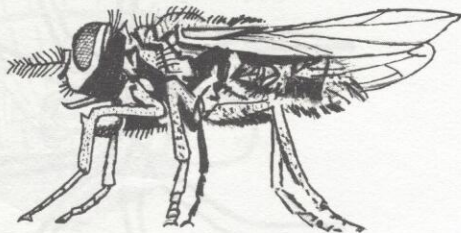
Materials: housefly; killing jar from Experiment 34; single-edged safety razor blade (used under adult supervision).

Directions: Catch and kill a fly the way you did the honeybee. Examine it as a whole before taking it apart. A housefly has only one pair of wings. In place of a back pair, it has stalked knobs, the halteres, or balancers. Compare its eyes and mouthparts with those of a honeybee. Make permanent

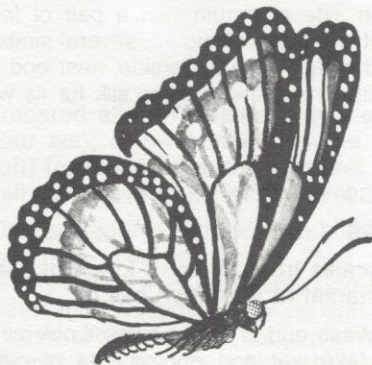
mounts of a wing and a leg. Cut off the head with a razor blade and look at it from all sides.



FOOT
ENLARGED



Look for: short hairs over body . . . powerful thorax and delicate, thin neck . . . halteres . . . large compound eyes . . . short, fleshy antennae . . . club-shaped sucking tube . . . claws on feet, and sticky pads that let fly walk on ceilings and up smooth vertical surfaces such as glass windows . . . lacy structure of wings.



Experiment 36

BUTTERFLY

Materials: butterfly; saucer; camel's hair brush; killing jar from Experiment 34.

Directions: If a butterfly is not furnished in your set, catch and kill one the way you did the honeybee and fly. Put the insect on a slide and look at it with a hand lens. Brush off some specks of wing dust, or scales, and make dry mounts of them. Look at the scales under low power.

Look for: long, delicate antennae, slightly knobbed at the tip . . . large compound eyes . . . long coiled-up thread under head, used as a sipping straw in getting nectar from flowers . . . thin, delicate legs, with front pair in many cases small and almost invisible . . . beautiful colors and scaly look of wings . . . feathery look of scales in dry mounts.

Experiment 37

INSECT EGGS

Materials: ripe and rotting fruit; clear plastic container with lid; table knife.

Directions: Put some pieces of overripe fruit—a few grapes, part of a banana, and a plum, for example—in the container. Let the container stand open for a day or two. When you see that the fruit has attracted several fruit flies, put the lid on the container. Watch for tiny white eggs—specks smaller than a pinhead—that will appear in a few days on the fruit and on the sides of the container. Scoop them up with a knife and put them on slides. Make both a wet and a dry mount. Examine the eggs under low power and then high power.

Go on an insect egg hunt in a park or garden or along a road. Take home any leaves or stems you find that have what you think may be insect eggs on them. The eggs may be single, in rows, or in clusters or masses. Some are on little

INSECT EGGS

BEE

BLACK
ANT

MOSQUITO



stalks. Likely plants to hunt on are sunflower, honeysuckle, milkweed, squash, and such trees as oak, maple, and elm. Make wet and dry mounts to examine.

Look for: oval shape and whiteness of fruit fly eggs. Insect eggs vary greatly in size and shape, and they are not all the same color. Some have smooth shells, some nubby. Many have beautiful designs on them.

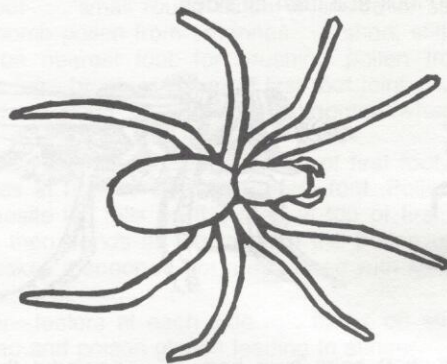
Experiment 38

SPIDER

Materials: harmless variety of spider—a garden, wolf, jumping, or crab spider, for example; saucer; spider web; killing jar from Experiment 34.

Directions: Capture a spider and kill it in the killing jar. Put it on a saucer and examine it with a hand lens. Compare it with the insects you have been working with. Make a permanent mount of any small part you find especially interesting. Find a spider web and make a wet mount of some of the silk.

Look for: body divided into two parts rather than the three parts of an insect's body . . . eight legs instead of six legs as in insects . . . absence of feelers or antennae . . . claws



SPIDER

at end of legs . . . small hairs on body and legs . . . poison fangs at each side of mouth . . . a pair of feeler-legs, or pedipalps, not good for walking . . . several simple eyes and no compound ones . . . on underside, near end of abdomen, spinnerets with which spider spins silk for its web . . . fineness of silk of web.

Experiment 39

FISH SCALES

Materials: scales from different kinds of fish (from fish market or your own catch).

Directions: Wash and dry the scales. Look at them with a hand lens. Make wet and dry mounts of different kinds.

FISH SCALE



4 YEARS

3 YEARS

2 YEARS

1 YEAR

Look for: growth rings that tell a fish's age . . . smoothness or toothiness of edge of scale. The free back edge of scales of some fishes, such as herring and trout, is smooth. Scales from other fishes, such as perch and sunfish, are toothed or comblike. Fish scales grow out of the skin much as our fingernails and toenails do. Sharks have a very different kind of scale. Their scales look like tiny teeth.

Experiment 40

FEATHERS

Materials: prepared slide of feathers (if included with your set); a few feathers (some stiff, some soft) from duck, canary, parakeet, or pigeon; hairs from raw piece of chicken.

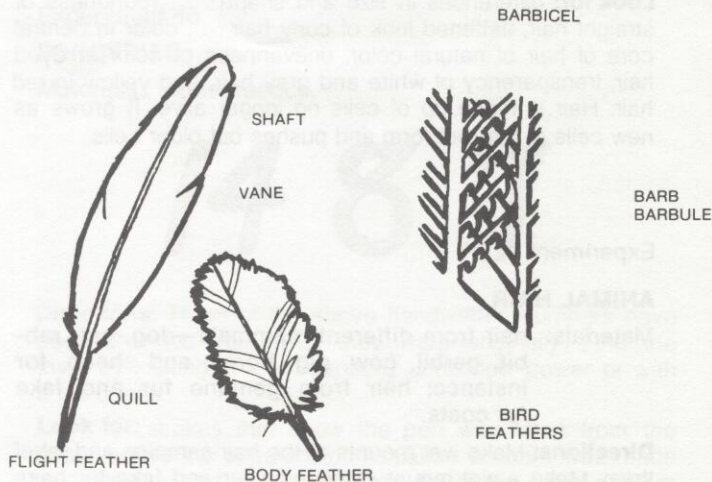
Directions: On the prepared slide, look at both the contour and the down feather under low power. Then, with a hand lens, examine any feathers you can find. Sort the feathers into contour feathers—the familiar-looking outside feathers of a bird, and down feathers—the fluffy, plumelike, underneath feathers that help hold in a bird's body heat. Make

dry mounts of some and look at them under both low and high power. Make a wet mount of chicken hairs. Such hairs are a third type of feather called hair feathers.

Look for: on contour feathers—a webbing of inter-locking branchlets (barbules) held together by tiny hooks. The locking together makes a feather stiff. By pulling down on the main branches, or barbs, of a wing or tail feather, you unhook the barbules, and by stroking them in the opposite direction you hook them up again. A bird, when it preens its feathers, is zipping up any that have come unhooked.

On down feathers—no main shaft or hooking together of branches. Down feathers are limp.

On hair feathers—a few tiny branches (barbs) at end.



Experiment 41

HUMAN HAIR

Materials: prepared slide of human hair (if included with your set); hair samples of different colors, some straight and some curly (include some bleached or dyed hair); eyelash; eyebrow hair; dishwashing detergent; Redi-Mount label.

Directions: Wash each hair by pulling it through detergent suds with tweezers and rinsing it in clear water. Snip off a short section of each one and make wet mounts. Use a Redi-Mount label or cellophane tape to make a permanent dry mount of those you find especially interesting.

Look for: differences in size and shape . . . roundness of straight hair, flattened look of curly hair . . . color in central core of hair of natural color, unevenness of color in dyed hair, transparency of white and gray hair, and yellow in red hair. Hair is made up of cells no longer alive. It grows as new cells at the root form and pushes out older cells.

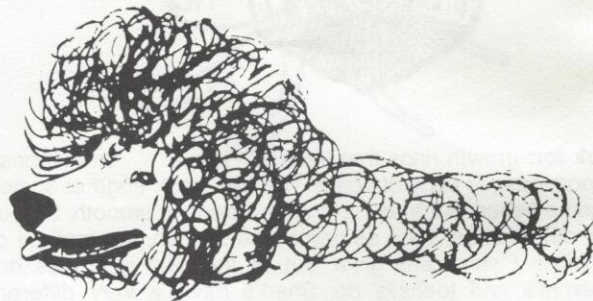
Experiment 42

ANIMAL HAIR

Materials: hair from different mammals—dog, cat, rabbit, gerbil, cow, pig, horse, and sheep, for instance; hair from genuine fur and fake fur coats.

Directions: Make wet mounts of the hair samples and label them. Make a wet mount of genuine fur and fake fur hairs combined so that you can compare them. Use Redi-Mount label or cellophane tape to make permanent mounts.

Look for: scaliness, waviness . . . round or flattened shape . . . thickened, spoon-shaped, flat, or pointed ends. Does the sheep hair look like the wool fiber you examined in Experiment 5? Some fake furs are such good imitations that they can almost pass for the real thing. Could you be fooled?



Experiment 43

BLOOD

Materials: sharp needle; match or candle flame.

Directions: *Do this experiment only under adult supervision.* Sterilize the needle by holding the point in a match or candle flame until it is white-hot. Let it cool for an instant, then jab the end of a finger with a quick, sharp thrust of the needle. Squeeze a drop or two of blood onto a slide and make a smear.

Look for: red and yellow colors . . . tiny discs—the red corpuscles—which carry oxygen through the body.

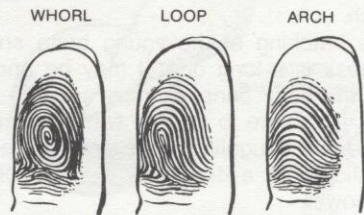
Experiment 44

FINGERPRINTS

Materials: inking pad; clean white paper.

Directions: Ink each of your fingers in turn, beginning with the left little finger and ending with the right one, by pressing it on the inking pad and then on the paper. In both the inking and the printing you must roll the finger from one side to the other so that you will have complete prints.

Make prints at the same time, but in no special order, on freshly polished slides. Afterwards, try to identify the prints on the slides by comparing them with the prints made in order on the paper.



Look for: whorls, loops, and arches more or less like those in the picture. Most fingerprints can be classified according to these three basic patterns, though there are endless variations. No two fingerprints are just alike, and no two people have identical prints. Fingerprints, therefore, can be used for making positive identification of criminals, victims, and missing persons. Files of fingerprints are among the most important records kept by law enforcement agencies.

Experiment 45

SEARCHING FOR CLUES

Materials: pinch of dirt from vacuum cleaner bag.

Directions: With your dissecting needle, transfer a very small amount of vacuum cleaner dirt to a slide. Use it to make dry mounts and wet mounts.

Look for: textile fibers . . . hairs from people and pets . . . sand . . . pollen . . . paper and wood fragments . . . metal filings . . . tobacco dust . . . food crumbs . . . bits of anything else recognizable to you that might be a clue as to which room it came from and who or what put it there. Detectives sometimes use just such unlikely things as these in solving crimes.

Experiment 46

FORGERIES

Materials: none needed.



Directions: Three of the above handwritten numbers have been changed from what they were originally. Find the three by looking at them carefully under low power or with a hand lens.

Look for: strokes that show the pen was lifted from the paper before the apparent continuation of them was made . . . strokes that would normally be made after another that has, in fact, been made later. The number 1, for example, may be changed to a 4, in which case the cross

stroke, instead of crossing under the long stroke of the 4, will cross over it. (The clue is in which stroke is on top.) The changing of amounts and dates on checks and legal documents may have important consequences. The microscope is useful in detecting such forgeries. Play a game with a friend, taking turns making "forgeries" for the other to try to detect.

Experiment 47

BRINE SHRIMP EGGS

Materials: brine shrimp eggs (if included with your set).



Directions: Sprinkle a few brine shrimp eggs on a slide. Examine them under low power, focusing on one egg at a time. Use direct lighting from a high-intensity lamp (see page 5) rather than light from the reflector or stage light. Also look at the eggs with a hand lens.

Look for: bowl shape, brown color, any signs of life. The brine shrimp (*Artemia*), along with its better known but distant relatives, the crayfish, lobster, crab, and shrimp, belongs in a big group of animals called crustaceans. Brine shrimps are all small animals. The gills they breathe with are on their feet. Brine shrimps are found around the world. They flourish in salt lakes and saltwater marshes. Brine shrimp eggs laid in a salt lake or pond can stand drying when the water evaporates and there is nothing else left but

salt. Even after years of drought, the eggs stay alive and will hatch when they are again in salty water.

Experiment 48

HATCHING BRINE SHRIMPS

Materials: brine shrimp eggs (if included with your set); pint jar; table salt (use water from ocean or a salt lake if you can).

Directions: Make a brine solution by adding 1 teaspoonful of salt to a pint jar of tap water. Shake in a few brine shrimp eggs. Let the water stand at room temperature—about 70°F. (20°C.). Put two or three eggs on a slide and wet them with a drop of salt solution from the jar. Watch the eggs under low power. From 4 to 8 hours later, use your dropper to pick up a few eggs from the brine solution in the jar and drop them on a slide. Examine them. The eggs should be ready to hatch.

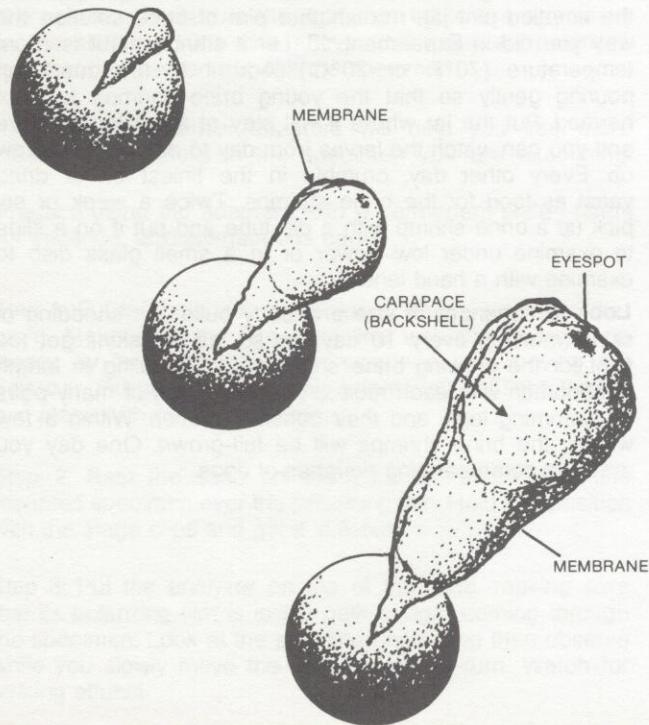
Watch the hatching of the young brine shrimps in the jar. The process is a long one. It may be another 8 to 16 hours before the baby brine shrimps are free of their eggshells. Check from time to time to see how they are doing. When you see one struggling to be entirely free of the egg, put it on a slide with a drop of brine solution and watch it under low power.

Be sure never to let the brine solution dry up. Once the baby brine shrimps have started growing, they will die without water. As water evaporates from the jar, replace it with plain tap water, not with salt water. If you added salt water, the solution would soon get too salty even for brine shrimps. Though the water evaporates, the salt does not. There is always the same amount of salt you started with.

Look for: first hour—swelling up of eggs as they absorb water and become round instead of bowl-shaped.

After 4 to 8 hours—splitting open of one end of egg, followed by pushing out of larva (baby brine shrimp). transparent sac around larva, which stays fastened to egg. Until the baby brine shrimp is entirely free, it gets its food from the egg. Eyespot visible through sac.

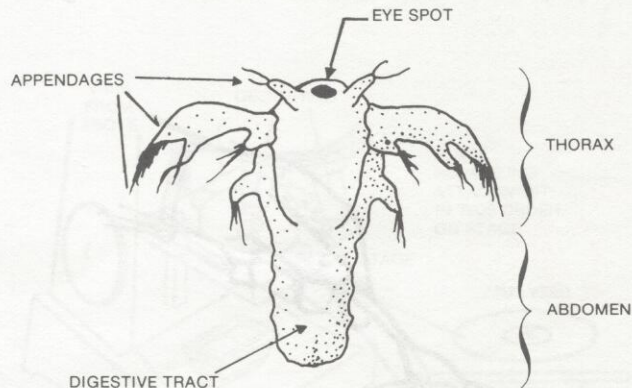
After 12 to 24 hours—larva's struggle to free itself of the sac . . . movement of arms as it wriggles out . . . speed with which the freed larva darts about, using its three pairs of arms as oars . . . empty eggshells floating at top of water.



Experiment 49

YOUNG BRINE SHRIMPS

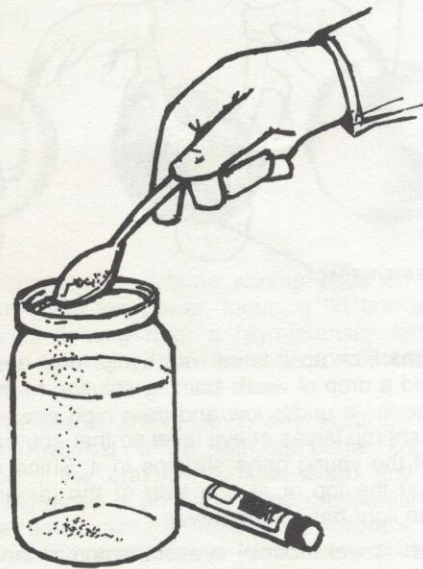
Materials: larval brine shrimps from Experiment 48; brine shrimp incubation cups and staining solution (if included with your set); flashlight; dip tube used in Experiment 31.



Directions: Pick up a larva with a dip tube and put it on a slide. Add a drop of weak staining solution to the specimen. Study the larva under low and then high power. Set the jar of brine shrimp larvas at eye level so that you can watch the antics of the young brine shrimps in it. Shine the flashlight directly at the top or at one side of the jar and see what effect the light has on the larvas.

Look for: in wet mount—eyespot at top of larva . . . three pairs of arms with hairs at the ends, used for swimming and getting food . . . dark-colored digestive tract in abdomen, clearly visible through larva's transparent skin.

In jar with light thrown on it—quick response of larvas . . . collisions of individual animals as they flutter toward light. Like moths around a streetlight, brine shrimps are attracted to light. In the daytime, they are always found swimming at the surface of the saltwater lake or pond they live in. They bump into one another because their eyespots are simply spots sensitive to light, not eyes to see with. All the eyespots do is tell the brine shrimps where light is.



Experiment 50

BRINE SHRIMP COLONY

Materials: larval brine shrimps from Experiment 49; quart jar; table salt (or water from ocean or salt lake); dried yeast; dip tube used in Experiment 31; small glass dish.

Directions: Carefully pour the pint of brine solution and free-swimming brine shrimp larvas into the quart jar. In the emptied pint jar, mix another pint of brine solution the way you did in Experiment 48. Let it stand until it is room temperature (70°F. or 20°C.). Add it to the quart jar, pouring gently so that the young brine shrimps are not harmed. Put the jar where it will stay at room temperature and you can watch the larvas from day to day as they grow up. Every other day, crumble in the tiniest bit of dried yeast as food for the brine shrimps. Twice a week or so, pick up a brine shrimp with a dip tube and put it on a slide to examine under low power or in a small glass dish to examine with a hand lens.

Look for: changes in size and body build . . . shedding of skins (molting) every 10 days or so, as the skins get too tight for the growing brine shrimps . . . doubling in length of abdomen with each molt . . . development of many pairs of swimming legs, and their constant motion. Within a few weeks, the brine shrimps will be full-grown. One day you may see some carrying pouches of eggs.

USE OF THE POLARIZING ADAPTERS

Polarized light, by reducing glare, helps reveal fine details under the microscope. It is particularly useful in the study and identification of things that themselves have some ability to polarize light. With Skilcraft's polarizing adapters (not included with all sets), you can observe polarization effects for yourself. As the diagram shows, one adapter goes on each side of a slide. The one beneath (the polarizer) polarizes the light that lights the specimen on the slide, and the one above (the analyzer) polarizes light that has passed through the specimen.

Using the polarizer adapters will help you see more clearly many details in the specimen you are examining.

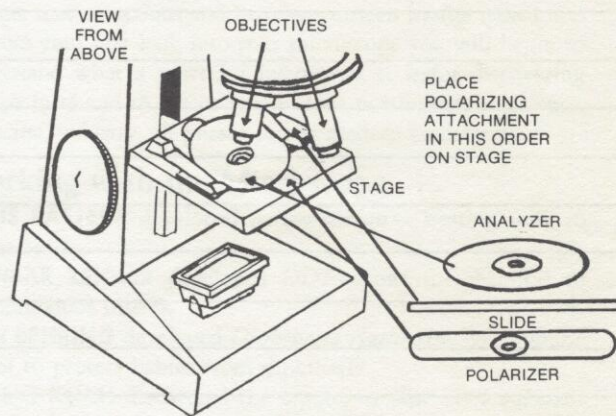
Practice using the adapters with a permanent slide—fibers, for instance, or diatomaceous earth.

Step 1: Put the polarizer on the stage as shown in the diagram. Make sure the film is in line with the microscope lenses by looking through the eyepiece and moving the polarizer until you see an evenly bright circle of light. Fasten it in place with cellophane tape.

Step 2: Rest the slide on the polarizer and center the mounted specimen over the polarizing film. Hold it in position with the stage clips and get it in focus.

Step 3: Put the analyzer on top of the slide, making sure that its polarizing film is in the path of light coming through the specimen. Look at the specimen now, and then observe while you slowly move the analyzer a half-turn. Watch for striking effects.

HOW TO USE YOUR POLARIZING ATTACHMENT



[The page contains horizontal lines for writing.]

HISTORY OF THE MICROSCOPE

Almost everything man made in the world today—the foods we eat, the medicine we take, the preventive shots we took as infants, the car, the toys we own—has been manufactured, developed or discovered with the help of the microscope!

Man has been developing the microscope for more than 350 years but man has known for much longer than that, that any round piece of transparent material magnifies—a drop of water, a piece of quartz.

Many scientists have given their entire working lives to the development of the microscope but credit for developing and perfecting the first usable compound microscope goes to the Dutch lens grinder Van Leeuwenhoek. He called the strange little things moving before his eyes under the microscope his "little beasties!"

A simple microscope is nothing more than a simple magnifying glass. Your Skil-Craft microscope is a compound microscope which is a combination of two simple magnifying glasses. The first, the objective magnifies the specimen, the second or eye lens magnifies the image formed by the objective. This system produces far larger and more perfect images.

The compound microscope has contributed great scientific advancements—the discovery of the cell (smallest functional unit of plants and animals) and millions of minute beings in our world now known to aid or injure mankind.

Without the microscope the organisms causing some of the dread diseases could not have been identified. With the help of the microscope, life saving drugs such as our wonder drugs have been developed and perfected.

Man's progress in probing and conquering nature would have been slowed to a snail's pace without this amazing instrument to identify and study minute plant and animal life, inorganic matter, actions and reactions unseen by the naked eye.

From your first look into your microscope you will begin to understand what a powerful instrument it is for discovering hidden facts and to see its tremendous possibilities in science, medicine, industry, all phases of our modern civilization.

Working with the Microscope . . .

LOUIS PASTEUR developed *pasteurization*—heating milk to kill bacteria.

OTHMAR ZEIDLER developed *DDT*—powerful chemical to kill obnoxious insects.

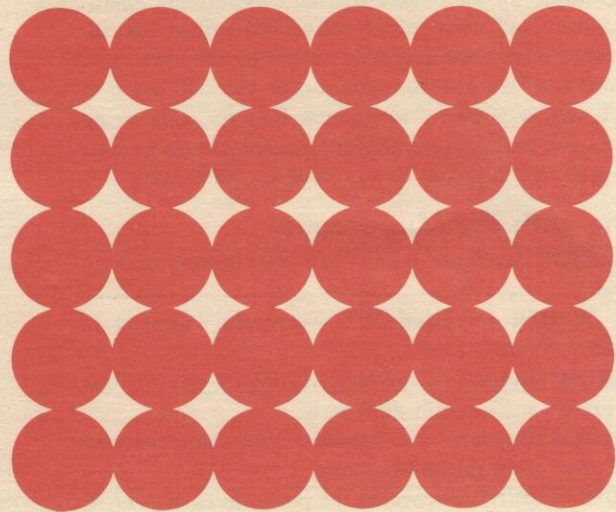
VON BEHRING developed *Diphtheria Antitoxin*—an immune serum to protect babies from diphtheria.

ROBERT KOCH discovered the *organisms that cause tuberculosis*—and grew them in the laboratory.

ALEXANDER FLEMING discovered the possibilities of *penicillin* for stopping certain bacterial growth.

SELMAN A. WAKSMAN discovered fungus—*streptomycin*.

CARL ZERNICHE was given the Nobel Prize for Physics in 1953 for his work as a physicist and microscopist.



Skil-Craft World of Science sets are created and designed by experts in Science Education to give the growing youth of every age some special tools for learning; to help him satisfy his natural curiosity; to help him develop skills and concentration; to inspire him in pursuit of his general knowledge and special interests.

Replacement Apparatus

To assure yourself of fine quality replacement apparatus refer to the parts list included in this set.

