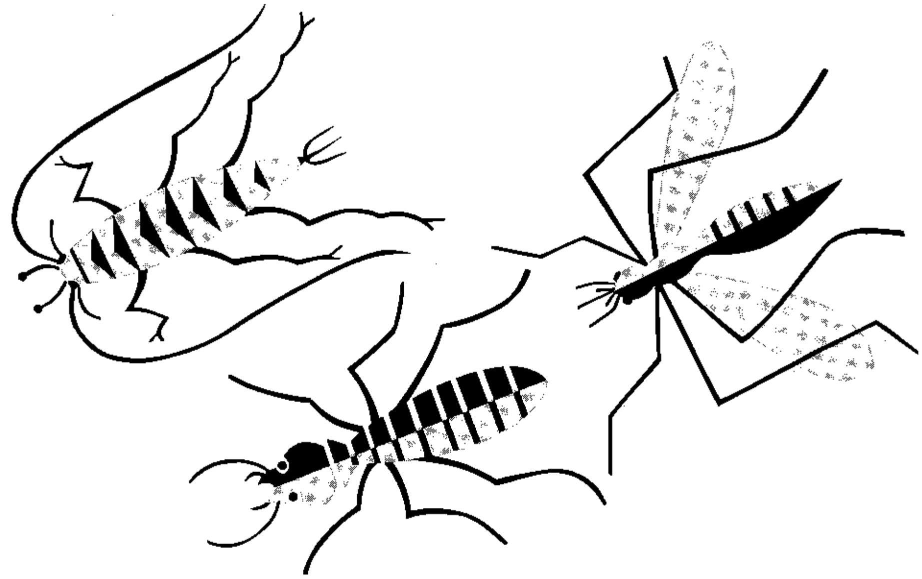
FINDING HIDDEN INSECTS



Student or Classroom Science Project No. 1

OBJECTIVE:

To demonstrate with a "bug betrayer" that (1) insects and other living things, both destructive and beneficial, are frequently present in materials where their presence is unsuspected, and that (2) they can be driven from their hiding places with the heat from a light bulb.

MATERIALS NEEDED:

- 1 sheet of "tag board" or heavy construction paper, approximately 20 inches by 30 inches
- 2 sheets of aluminum foil 10 inches by 30 inches
- 1 half-pint jelly jar or a 1-quart fruit jar
- 2 pieces of window screen approximately 12 inches square
- 1 piece of ¼-inch mesh wire hardware cloth, approximately 12 inches square
- 1 75-watt light bulb and drop cord
- 1 aluminum pie pan, 10 inches in diameter, or a commercially built reflector for the drop cord

SAMPLES:

(to be collected by members of the class)

leaf mold; garden soil; forest litter

decayed plant material from a dump or home compost heaps

grass roots with soil (cut off tops of grass); dried leaves

soil (from grassy areas of school grounds); soil from flower beds

INTRODUCTION:

Living things are often found in places where the untrained observer does not expect them, and in places where they cannot be located by visual inspection alone. This is one reason why many items, such as soil, plant material, etc., are restricted or prohibited from moving internationally or interstate.

In performing this experiment, students will be duplicating a process used by U.S. Department of Agriculture scientists in their inspection work. For example, a modified Berlese funnel made of metal but otherwise similar to the one in this experiment is used by plant quarantine inspectors to locate the khapra beetle—world's worst pest of stored grains—in debris and grain samples taken from ships' holds. A similar arrangement is used with smaller screens to isolate and discover extremely small or sometimes microscopic pests.

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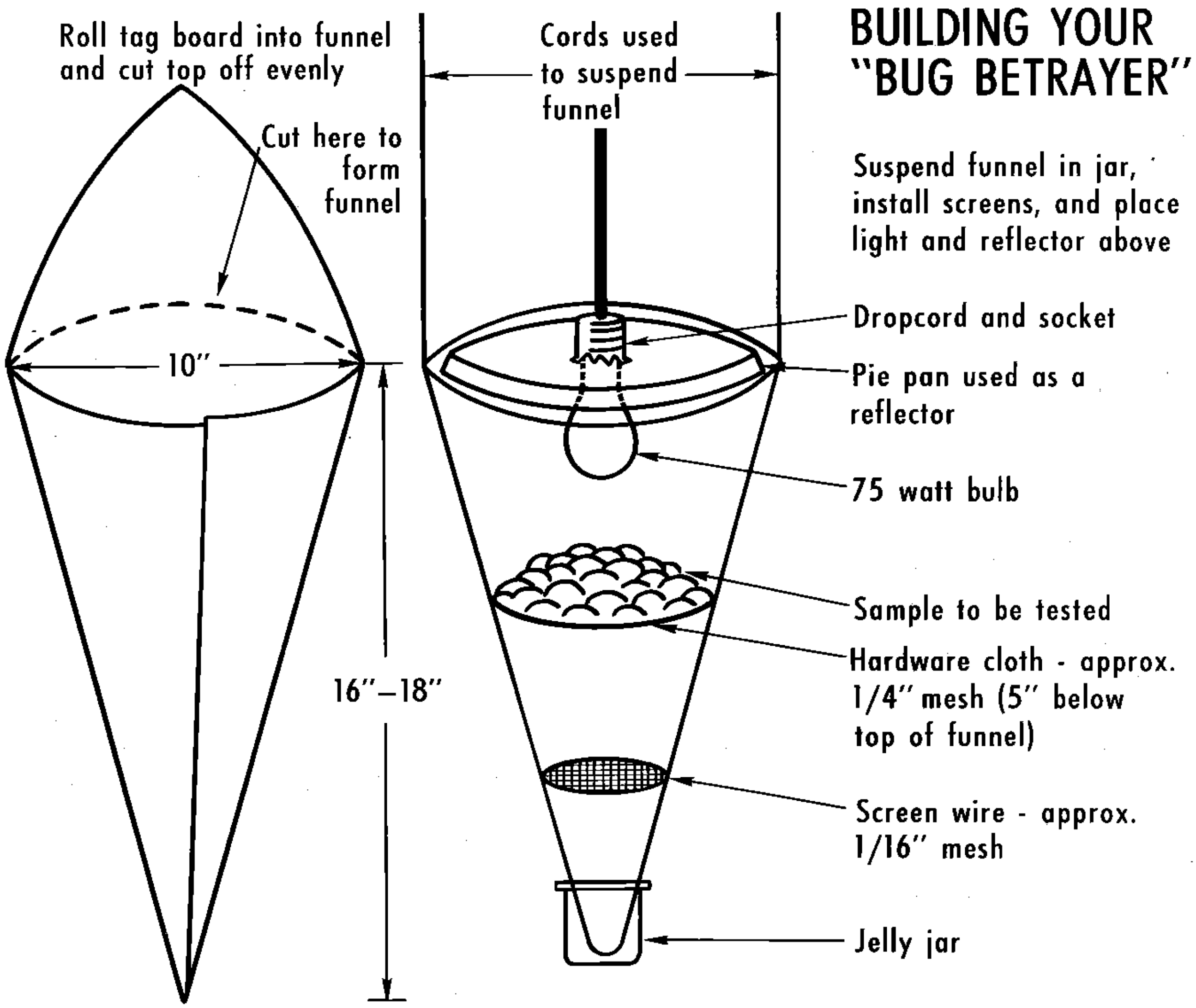
PROCEDURE (see diagrams):

Using masking tape, attach the aluminum foil to one side of the piece of "tag board" or construction paper. The foil should be stretched and smoothed against the tag board or construction paper, depending upon which is used, and then should be taped securely in place at the center seam. Next, roll the tag board or heavy construction paper into a cone with the aluminum foil on the inside. The cone should be constructed so that it will be 10 inches in diameter at the top, 16 to 18 inches high, and have a ½- to 1-inch opening at the bottom after the excess material at the top is cut off. Use masking tape to fasten the cone together and hold the shape, then cut off the extra material at the top to form the finished cone. Place a strip of masking tape down the inside seams of the funnel so that the interior is smooth and free from crevices.

Cut one piece of the screen wire to a size that will allow it to be placed inside the funnel approximately 12 inches below the top. Make sure it fits tightly against the sides of the funnel and cups down slightly in the center. Cut the piece of ¼-inch mesh wire hardware cloth to a size that will allow it to be placed inside the funnel approximately 6 inches below the



top. (It should not be farther down than 7 inches or closer to the top than 5 inches.) Then cut the second piece of screen wire the same size as the hardware cloth and lay it to one side for use later.

Note: An easy way to measure the sizes required for all screens is to place an ordinary compass normally used to draw circles inside the cone at the points where the screens will be located. When opened to touch each side of the cone, the compass will show the inside diameter of the cone at the point, and the radius of the screen required will, of course, be one-half the diameter.

Suspend the funnel in a vertical position, large end up. The funnel may be supported in any one of the following three ways:

1. Hung by four wires attached to small holes in the top;
2. Set inside a wire coat hanger that has been previously bent outward (so that it forms an approximate square) to the correct size to fit around the funnel several inches below the top. The hook of the coat hanger is then placed between books stacked to the proper height to hold the funnel upright; or
3. Set the funnel in the neck of an ordinary 1-quart fruit jar. This is the least desirable method, as the funnel tends to tip and wobble when in use.

Cut a hole in the center of the aluminum pie pan slightly larger than the small end of the 75-watt light bulb. Insert the bulb through the hole with the pie pan turned upside down, and screw the bulb into the socket of the drop cord. The pie pan should touch the glass portion of the bulb *only*, and it acts as a reflector. Position the drop cord over the center of the funnel and lower it to a point where the bottom of the bulb is 4 to 5 inches above the top screen inside the funnel. This completes construction of the "bug betrayer," scientifically known as a modified Berlese funnel.

OPERATION OF THE "BUG BETRAYER":

Have students collect the samples listed above either at home or on the school grounds. Samples may be collected in paper sacks. After a sample is collected, the student should twist the neck of the sack shut securely and tie a piece of string around it to prevent the possible escape of any living organisms in the material. Samples may be collected anytime during the day or evening in fall or spring. In the winter, living organisms generally burrow down too deeply to be detected.

Place an individual sample on the top screen of the funnel. When using soil or other fine material, place the second piece of screen wire on top of the ¼-inch mesh screen so that the material will not drop through. Crumble the soil up finely not more than ½ inch deep.

When using leaf mold, forest litter, and decayed plant material, place it directly on the ¼-inch screen. Loosen the sample with the fingers and make a layer 1½ to 2 inches deep.

After a sample has been placed on the top screen in the funnel, place the half-pint jelly jar under the funnel. Elevate it so that the edges of the jar touch the sides of the funnel. (If a 1-quart jar has been used to support the funnel, let it be the collecting jar instead of using the half-pint jar.) Lower the light bulb and reflector into place and turn on the light. The heat drives living organisms in the sample downward. Most of them will be small enough to drop through the lower screen into the collecting jar. Any larger organisms will be found on the screen wire at the end of the experiment.

Specimens usually begin to drop into the jar within 10 to 15 minutes after the light has been turned on, although soil samples sometimes require a longer time. It requires 1½ to 2 hours to drive all living organisms out of a sample. At least 75 percent of the samples listed for this experiment will yield living organisms if collected and tested in the fall or spring.

Avoid use of sand, gravel, or peat moss as such materials do not normally contain living organisms. When using extremely dry material (such as dead leaves), keep the light bulb at least 2 inches above the top of the material in the funnel and be alert to any possible fire hazard. NEVER operate, or allow the funnel to be operated, unattended. If a pupil has piled the sample too high and smoke is detected, turn off the light immediately. Adjust it higher and sprinkle water on the sample. This reduces the fire hazard without impairing operation of the funnel.

ADDITIONAL ACTIVITIES:

After the class has learned to use the funnel, have several students visually examine a sample before placing it in the funnel. Collect and record the number and types of living organisms detected. Then place the sample in the funnel, using care to include all debris that was separated out during the visual examination. Then record the specimens missed during the visual inspection but detected by the funnel. In at least half of the cases, this will demonstrate man's inability to detect the presence of all living organisms by visual inspection alone.

The "bug betrayer" yields living specimens of the organisms detected. These may be transferred to a larger jar for additional inspection by the class if desired. Have pupils note and catalog the different types of organisms discovered in a sample, recording the type of material, place where it was obtained (location on the school grounds or at home), and environment from which the sample was obtained (such as "compost heap," "dead leaves in fence row," "soil in flower bed," etc.). Teach them to note both the similarities and differences in types of organisms obtained from different environments. For example, dead leaves generally yield tiny spiders, mites, lice, aphids, and bugs but few worms; compost yields many of the above plus worms and larvae; soil generally yields grubs and may or may not yield tiny worms depending on conditions of temperature, moisture, etc.

LEARNING:

Stress to the class that all samples will not contain living organisms. However, the experiment demonstrates that many samples *do* contain them, both beneficial and harmful. This illustrates how man can accidentally spread insects and other organisms to other States, countries, or even continents where the organisms could not have spread without man's help. In many cases, man spreads a destructive pest to another region or continent without taking along its natural enemies, and this often results in great economic damage to our food, forest, and ornamental resources. This is why agricultural quarantines restrict or prohibit movement of many fruits, plants, seeds, bulbs, and all soil and decayed vegetable matter into the United States from abroad or, in some cases, between States within the country.

The class will soon note that the living organisms driven out of their natural habitat run about and quickly attempt to hide under any leaves or soil placed in the jar with them. This is a natural instinct which allows these organisms to escape from their natural enemies and survive.

Advanced students may wish to use this tool to collect specimens. Organisms may be killed when the class is through observing them by pouring ordinary rubbing alcohol into the jar. A better killing and preserving solution is compounded as follows: 80 percent ethyl alcohol; 15 percent formalin; 5 percent glycerine. Killed specimens are then removed with a toothpick and placed on a paper towel to air-dry.

Identification of the organisms discovered may be undertaken if the teacher chooses to do so, as most children want to know what they have discovered. A magnifying glass is needed as most specimens are small. Exact identification is extremely difficult and is further complicated because many specimens are immature stages instead of adults.

However, students can learn to separate spiders from mites (and both from any tiny, 6-legged insects obtained) by using a simple paperback book or textbook showing specimens by orders and families.

From this starting point, teach pupils that all living organisms of the animal kingdom including man are divided into approximately 15 "phyla" (plural for phylum). The phyla are then subdivided into "classes." All insects belong to the class, "hexapoda," but the mites and spiders are in another class. The classes are then divided into "orders" and these are then divided into "families," "genera" (plural for genus) and finally into "species." Have the class learn the meaning, relationship, pronunciation, and spelling of "phylum," "class," "order," "family," "genus," and "species."

Often this is a youngster's first realization of the vastness and many variations found within nature's world, and pupils may better appreciate this vastness by realizing that 75 percent of all known kinds (or species) of living animals in the world are insects!

Advanced students may wish to study insects and other living forms in greater detail and learn to use the various keys to identification provided by simple field guides. In this way, pupils can begin a study of the vast world of nature with its complications, mysteries, and delights. Many of today's world-famous entomologists—and other natural scientists—began learning about the "big world of bugs" in just this manner.

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