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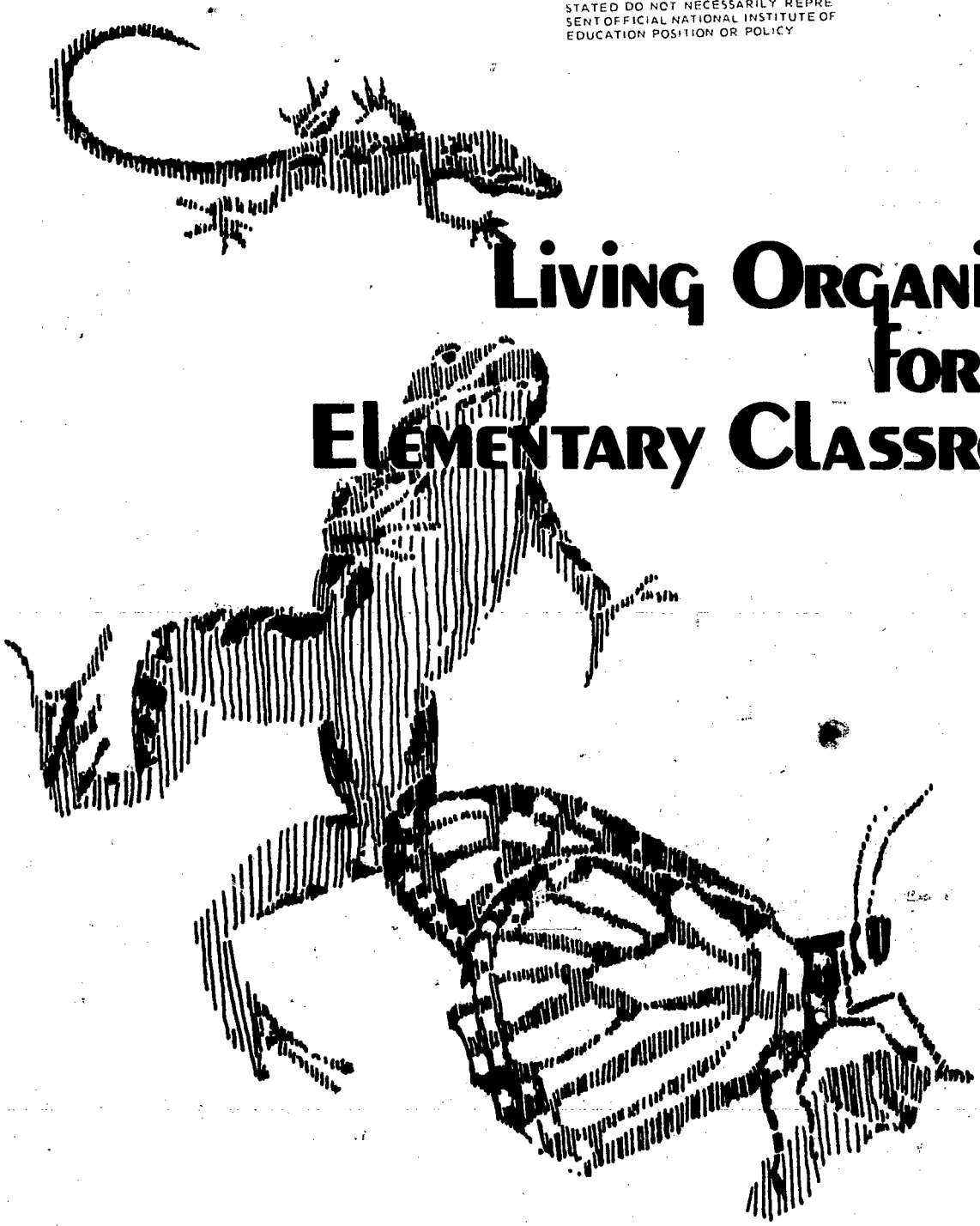
ABSTRACT

This publication was prepared for elementary teachers and other local personnel responsible for providing, maintaining and using living organisms to enhance elementary science programs. The manual contains a foreword, general information, and an appendix. It gives information concerning equipment and supplies, establishing and maintaining an aquarium, and culturing techniques. Techniques are given for culturing the following organisms: guppies and aquatic plants, land snails, chlamydomonas, daphnia, isopods, crickets, mealworm beetles, fruit flies, and wingless pea aphids. The techniques have been researched and developed in the Life Science Center of the Department of Science Education at East Carolina University and have been tried by preservice elementary teachers taking courses in science education. (LS)



Living Organisms for the Elementary Classroom

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Prepared by Department of Science Education, East Carolina University
in conjunction with
Division of Science Education, North Carolina Department of Public Instruction

FOREWORD

Student and teacher involvement is intensified when the study of life science includes ample "hands-on" investigations utilizing live organisms. This publication was prepared for elementary teachers and other local personnel responsible for providing, maintaining, and using living organisms to enhance elementary science programs.

The authors of the content of this publication are Drs. Carolyn H. and Carol D. Hampton of the Department of Science Education, East Carolina University. They were aided in the writing by the research of Mrs. Wende Allen, graduate student, and the trial studies made by Miss Wanda Patton, undergraduate research assistant.

The techniques described here have been researched and developed in the Life Science Culture Center of the Department of Science Education at East Carolina University and have been tried by preservice elementary teachers taking courses in Science Education.

The Division of Science Education of the State Department of Public Instruction joined the authors in this effort by editing the material, establishing the format, getting final art work done, preparing the material for printers, and having the printing done. Final art work was done by Patricia H. Mann, Draftsman-Artist, Division of School Planning, State Department of Public Instruction.

After using this resource, if you can suggest improvements, modifications, or additions, please share your ideas with us. For further information about this publication, inquiries may be sent to either of the addresses below.

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April 1975

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GENERAL INFORMATION

The following organisms can be maintained with a minimum of time, space, and expense:

Invertebrates

- Pond Snails
- Land Snails
- Daphnia
- Isopods
- Crickets
- Mealworm Beetles
- Fruit Flies
- Wingless Pea Aphids

Algae

- Chlamydomonas

Vertebrates

- Guppies

Plants

- Elodea (Anacharis)
- Eelgrass
- Duckweed

Since all organisms living in a very limited space use their food supply, overpopulate, and accumulate toxic wastes fairly rapidly, all cultures must be routinely fed, cleaned, and transferred. Students can learn very quickly, with a little assistance from the teacher, to maintain the cultures.

Initial cultures of living organisms may be obtained from commercial supply houses. Refer to the *RESOURCES* for more information.

EQUIPMENT AND SUPPLIES

WATER

Always use spring or rainwater. Tap water may contain harmful chemicals. In most instances, tap water can be used if allowed to "stand" for 3 days before being used.

GLASSWARE

All glassware must be thoroughly cleaned and rinsed. Gallon jars can be obtained from cafeterias and restaurants. Students can usually supply baby food jars from home.

TOPS

Unless otherwise specified, maintain a loose cover over all cultures to prevent loss of organisms and moisture and to prevent contamination with dust and microorganisms.

PHYSICAL SPACE

Maintain cultures in an area where each receives proper lighting. Plants need to be placed near a window exposed to full sunlight at least part of each day. Small animals can be placed in minimal light. Keep cultures well labeled and in full view without having to be moved and thus disturbed. Provide storage space for cleaning, subculturing equipment, and food supplies. Labeled shoe boxes, one or more for each kind of organism, can help keep equipment organized. Ideally, there should be a work area nearby for setting up new cultures. If you have no extra table space, ask the Maintenance Department to build you a simple table or window shelf.

SUGGESTED ITEMS FOR MAINTAINING CULTURES

Culture vessels

Glass gallon jars - pond snails, daphnia, mealworm beetles, chlamydomonas, elodea, eelgrass, duckweed, guppies

Glass aquariums - pond snails, elodea, eelgrass, duckweed, guppies

Tall baby food jars - fruit flies

Plastic sweater boxes - isopods

Plastic tumblers, metal cans, clay or plastic pots, or milk cartons - pea plants

Maintenance

Basters - to transfer organisms, clean out debris

Sprinkler bottles - to water plants, maintain moisture in terrariums (Empty spray bottles of household products such as windex bottles may be used, if carefully washed.)

Paper towels or rags - for cleanup and protecting surfaces

ESTABLISHING AND MAINTAINING AN AQUARIUM

EQUIPMENT

1. Aquarium or gallon glass jar (A 5-gallon tank will accommodate several adult guppies and many young. A glass shop or Maintenance Department can make an aquarium.)
2. Aquarium cover (A glass shop or Maintenance Department can cut this to fit.
3. Thermometer (for measuring water temperature)
4. Guppy food (May be purchased at a pet store or crushed earthworms, scraped beef and liver, chopped clams, small pieces of shrimp and oatmeal, and daphnia may be used. A varied diet is recommended.)

5. Course white sand (Grains about as large as the head of a dressmaker's pin are best; enough to form a layer 1½".)
6. Pebbles (enough to cover the bottom ½" deep)
7. Soil from woods (enough to form a layer ¼" deep)
8. Two copper pennies (to retard the growth of algae)
9. Tap water (aged 3 days)
10. Baster or dip tube
11. Dip net
12. Pail (plastic)
13. Organisms (include with the guppies, snails, and water plants)

ESTABLISHING THE AQUARIUM

1. Wash and rinse the aquarium thoroughly.
2. Wash the sand and the pebbles separately in a pail by stirring them in water, allowing the sand to settle, and pouring off the water. Repeat until water remains clear.
3. Fill the bottom of the aquarium to a depth of ¼" with soil from woods.
4. Add the washed pebbles to a depth of ½". Lay 2 copper pennies over the pebbles.
5. Add the washed sand, sloping the layer so it is 2" deep at the back and 1" deep at the front. This allows most of the refuse to gather at the front where it can be siphoned off.
6. Wash the plants thoroughly. Make a hole in the sand and set the plant in it. Pack the sand around the roots:

Do not heap the sand above the crown.

Right

Wrong

Leave the front and center of the tank free of plants.

7. To fill the tank, lay a saucer or large piece of paper over the sand and slowly pour the water in over the saucer or paper.
8. Do not introduce any guppies for 1 week.

ADDING THE GUPPIES

1. Check the temperature of the water. It should be 65°-80°F or 18°-27°C (75°F or 23°C is ideal).

2. Have the fish in a small glass jar in the water in which they arrived.
3. Float this jar in the tank for about 30 minutes, allowing the water temperature to become the same as that in the aquarium.
4. Carefully tilt the jar to allow the fish to swim into the tank.
5. Add a few pond snails and floating plants.
6. Sprinkle a small amount of food onto the water.

MAINTAINING THE AQUARIUM

1. Feeding:
   a. Add a small amount of food every day.
   b. Excess food will decay and foul the water so do not overfeed.
   c. Vary the diet as much as you can.
2. Cleaning:
   a. The snails will help keep the water clean but check the tank every day for dead snails and remove them immediately. (Any snail that lays on the bottom several hours without moving is dead.) One snail/gallon of water is enough. If you have too many snails, some may starve.
   b. Keep plants pruned so they do not fill the tank. Remove yellowed leaves and stems.
   c. Suck up any debris that collects in the bottom using the baster or dip tube.
   d. Fish swimming at the surface with their mouths out of the water is an indication of lack of oxygen. It may be caused by overcrowding, not enough plants, or something decaying. (Check for dead organisms or uneaten food and remove.) If the cause was decaying matter, remove some of the old water and add fresh, aged tap water. Do not feed the fish until the water clears up (even for several days).

BREEDING GUPPIES

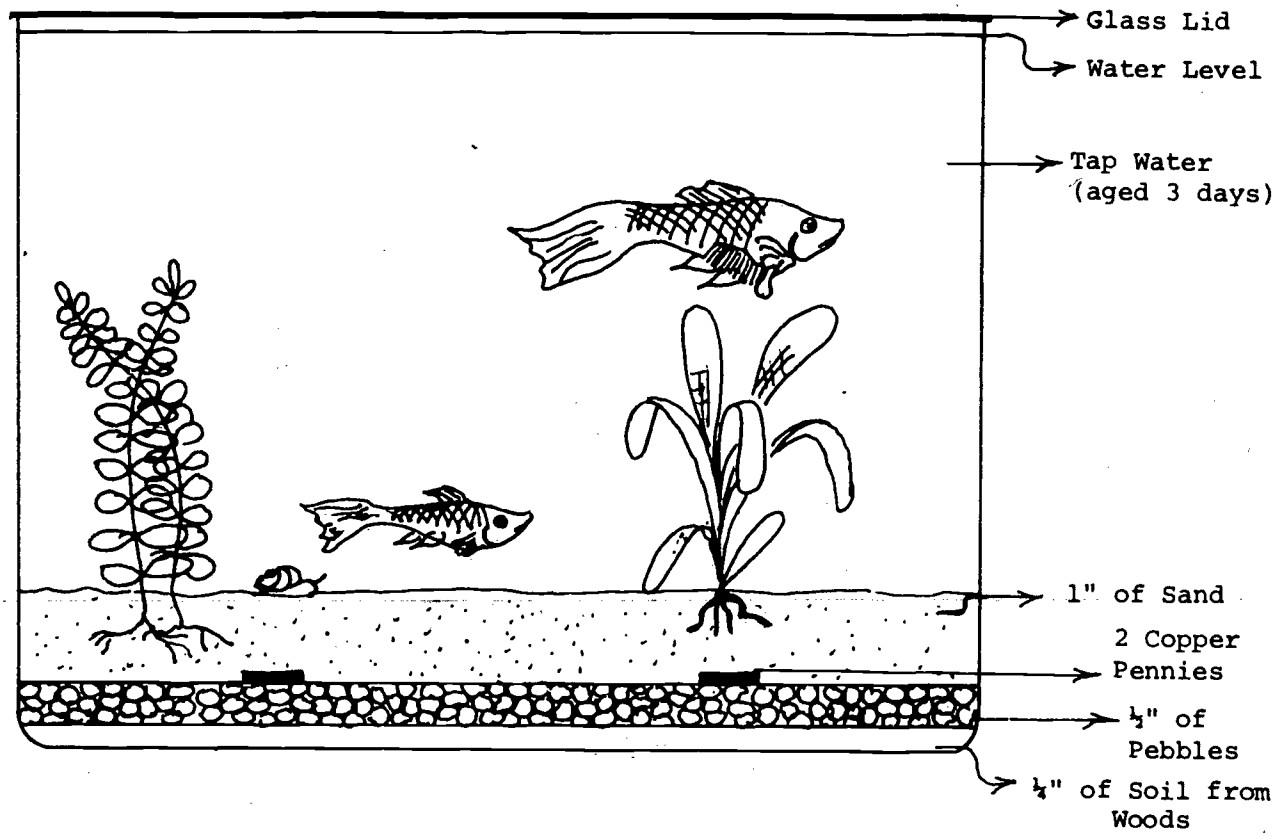
1. A female guppy is twice as long as the male, plain, and silver-gray. The males vary in patterning but are always brightly colored.
2. A female will give birth to 3 to 3 dozen live young every 4 to 6 weeks.
3. The young can eat finely ground food.
4. Be sure to keep floating plants in the aquarium for the baby fish to hide in or they will be eaten by the larger fish. They could also be transferred to a separate aquarium.

DISEASES

1. Observe the aquarium every day for the appearance of unusual spots on the fish or abnormal behavior by any one fish.
2. Remove any fish exhibiting these characteristics immediately and keep in a small jar by itself until the symptoms disappear or the fish dies.

CULTURING TECHNIQUES

GUPPIES AND AQUATIC PLANTS

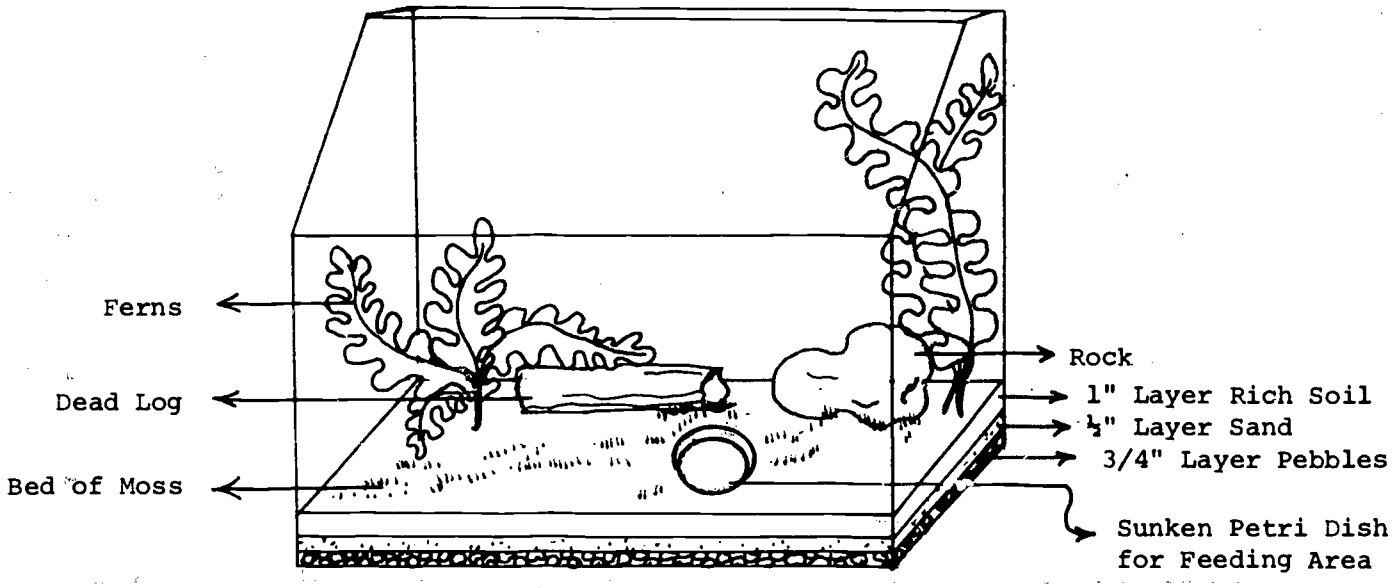


Technique

1. Be sure to plant elodea and eelgrass in sand layer.
2. Keep aquariums near a window; plants need light.
3. Suggested combinations for schools that need to raise guppies and aquatic plants for many classes such as the SCIS program:

Tank #1	Tank #2
Elodea	Eelgrass
Duckweed	Young Guppies
Adult Guppies	Pond Snails
Pond Snails	

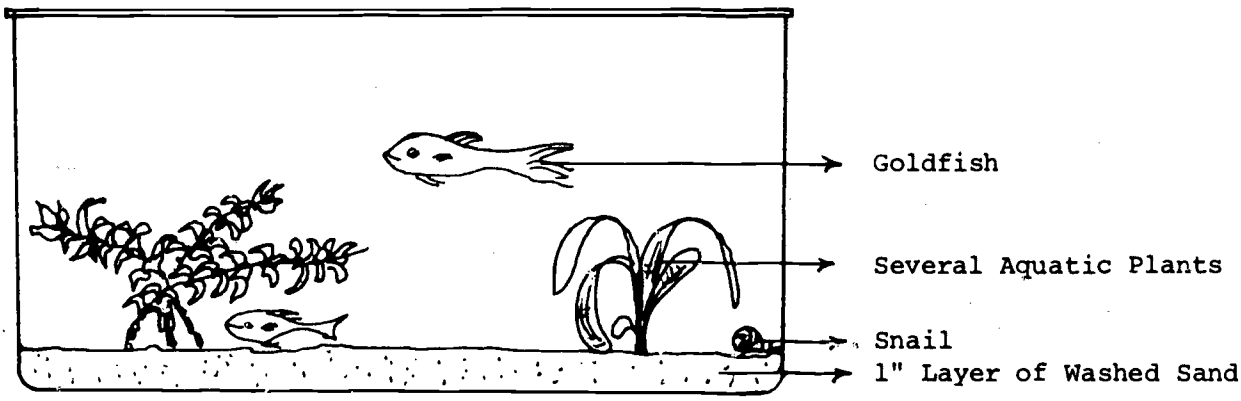
LAND SNAILS



Technique

1. Layer pebbles 3/4" deep in bottom of a terrarium.
2. Add a ½" layer of clean sand.
3. On top of this add a 1" layer of rich soil.
4. Cover most of the soil with healthy green moss (from woods).
5. Plant several clusters of small variety ferns (spleenwort is recommended).
6. Add a piece of rotting log and a large rock.
7. Near the front, depress a shallow dish (or petri dish) in the soil. This will provide an area for adding food that will be easy to clean.
8. Keep plants and soil moist by sprinkling. The pebble and sand layers provide for adequate drainage. If water accumulates in the pebble layer, do not add more water until this evaporates. Do not allow the soil layer to become waterlogged.
9. Add lettuce leaves and small pieces of other vegetables to the shallow dish. When food is gone or decayed, wipe out dish with a damp paper towel and add more food.

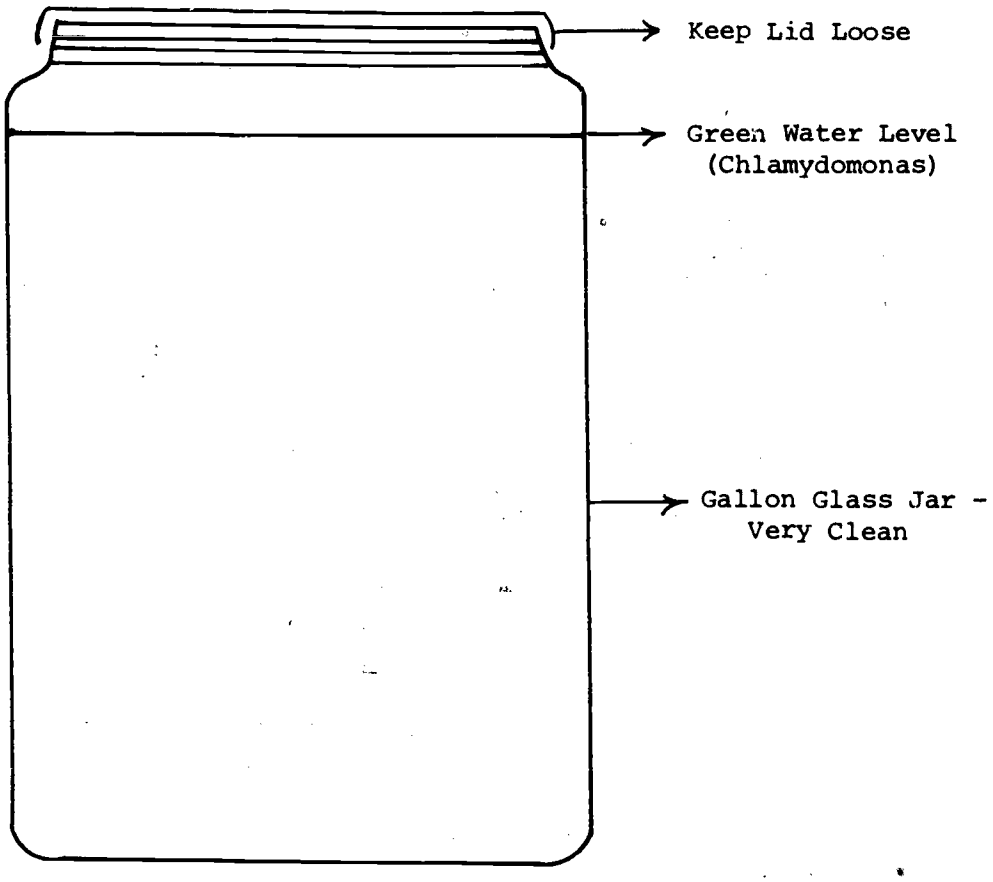
CHLAMYDOMONAS



Technique

1. For growing a large quantity of chlamydomonas, you may choose to use one 10-gallon tank with 2 goldfish or to set up five 1-gallon glass jars with 1 goldfish per jar.
2. Construct an aquarium using a layer of sand, aged tap water, several aquatic plants and 3 snails. After 24 hours add the goldfish.
3. Be sure to cover the tank or jar with a loose lid to prevent evaporation.
4. Be sure to set the tank near a window.
5. After the goldfish are established and detritus (dead organic matter--black stuff) begins to appear on the sand layer, introduce the chlamydomonas. The detritus supplies the nutrients necessary for growth of chlamydomonas. Sunlight from the window supplies the energy for photosynthesis.
6. When the water in the tank turns green with chlamydomonas, remove a gallon of "green" water for daphnia cultures.
7. Replace the gallon of "green" water taken from the tank with a gallon of "aged" tap water.

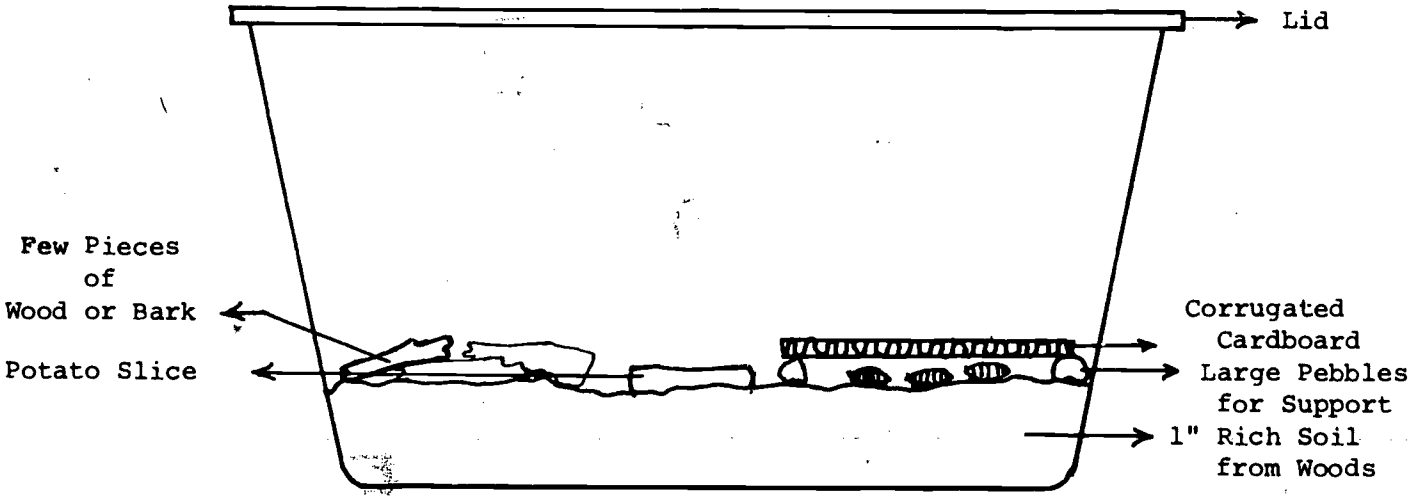
DAPHNIA



Technique

1. Large quantities of chlamydomonas are needed to feed daphnia.
2. Fill a clean gallon glass jar with a chlamydomonas culture (green water). See technique for chlamydomonas on page 8.
3. Add daphnia from an old culture.
4. Cover containers with a loose-fitting lid and place near a window.
5. When the algae water clears, pour the water through a dip net (or a piece of nylon stocking or petticoat stretched over an embroidery hoop) to trap the daphnia.
6. Place the daphnia in a fresh container of chlamydomonas.
7. If the algae water clears before you have more algae to replace it, add a pinch of Brewer's yeast to culture jar. Yeast will support the daphnia cultures for several days. Add more yeast only when water clears.
8. Water temperature should be between 54°-76°F or 12°-24°C.

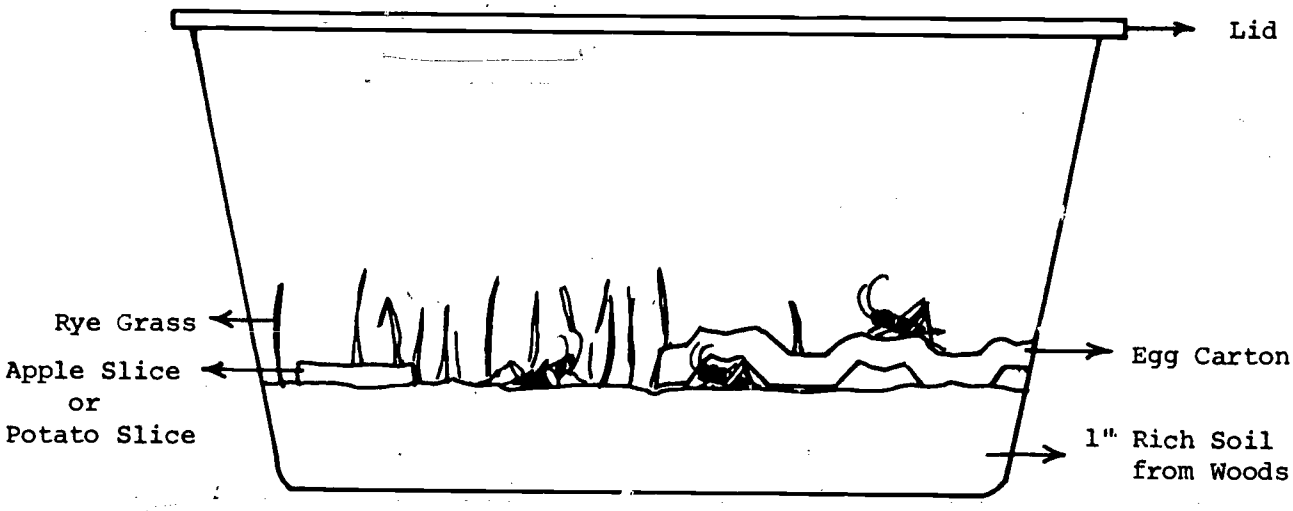
ISOPODS (Pill Bugs)



Technique

1. Layer soil 1" deep in a plastic sweater box or terrarium.
2. Support the cardboard on pebbles.
3. Add bark and a slice of raw potato.
4. Introduce isopods.
5. Bore a few holes in the lid to allow air passage.
6. Keep moist by sprinkling the soil with water on Monday, Wednesday, and Friday.
7. Replace the potato when it dries.

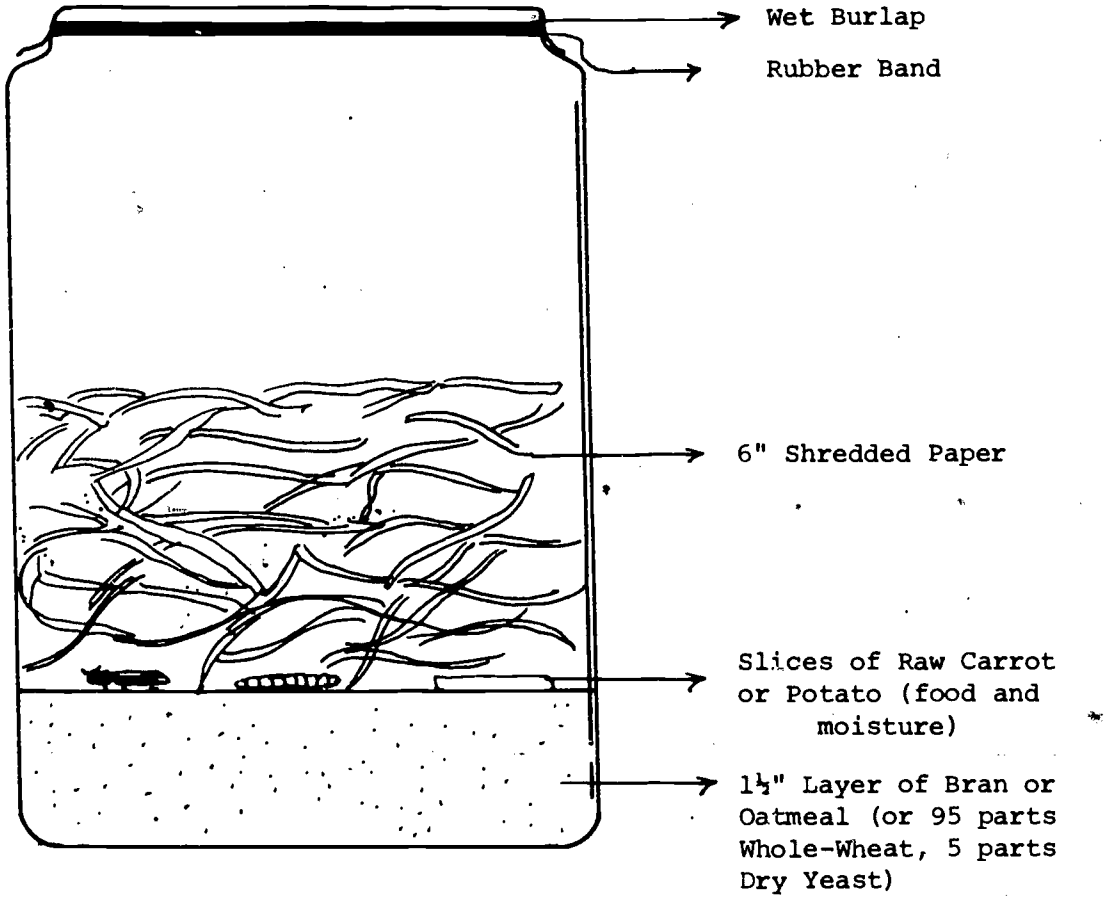
CRICKETS



Technique

1. Layer soil 1" deep in a plastic sweater box or terrarium.
2. Place a piece of cardboard egg carton over one end.
3. Plant rye grass seed over the remaining end. Just barely cover seeds with soil. Moisten soil thoroughly.
4. Keep in a dark place until grass begins to come up; then keep in the light or near a window.
5. When rye grass is 2" to 3" high, introduce crickets.
6. Add a slice of raw apple or Irish potato.
7. Bore a few holes in the lid to allow air passage.
8. Keep moist by sprinkling the soil with water Monday, Wednesday, and Friday.
9. Replace the apple or potato when it dries or decays.

MEALWORM BEETLE (Tenebrio)



Technique

1. Layer 1½" of bran or oatmeal (may be mixed with bread crumbs) in the bottom of a large glass jar.
2. Add a thick slice of apple, a scraped raw carrot, or half a potato.
3. Introduce the beetles at any stage of their life cycle. (An artist's brush may be used, or lift the beetles with your fingers.)
4. Cover with 4"-6" of shredded paper.
5. Secure wet burlap over the opening with a rubber band or string.
6. Place in a warm (preferably 85°F), dark location such as a cabinet.
7. Replace the apple, carrot, or potato when it dries. Keep burlap moist.
8. Every 3 months, sift through the entire culture, screening out the beeties. Dispose of the old culture medium.
9. Prepare a fresh habitat and add the beetles.
10. See APPENDIX for notes on *LIFE CYCLES*.

Note: The danger of parasite infestation can be avoided by heating the glass container, including the bran or oatmeal, in an oven at 150°F for 1 hour before using.

FRUIT FLIES (Drosophila)

Equipment

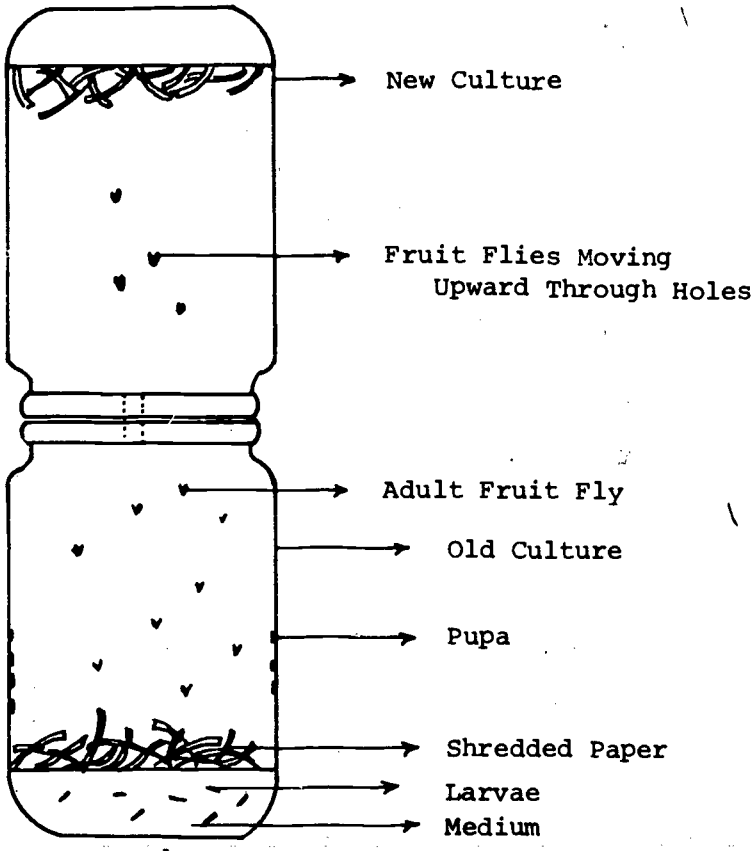
2 baby food or other small jars with lids
masking tape
straight pin
nail
water
dry baker's yeast (available from grocery store)
instant Drosophila medium (available from Carolina Biological Supply Company, Burlington, N. C. 27215)

Procedure

1. Thoroughly wash empty jars.
2. Boil jars in water for 10 minutes.
3. Mix Drosophila medium: Using the cup provided with the Drosophila medium, add 1 cupful of medium and 1 cupful of water to the baby food jar and let stand 5 minutes.
4. Sprinkle a small pinch of dry baker's yeast over surface of the medium.
5. Tap a hole in the jar lid with a nail.
6. Cover the hole with a small square of masking tape and prick small holes in the tape with a pin to allow air to enter the container without losing the flies.
7. Introduce flies by removing the squares of masking tape and aligning the nail holes of the new culture jar and the old.

Note: Mite infestations can destroy your culture. To prevent this, all utensils and the working area should be kept extremely clean. A culture should not be kept longer than a month. If you do notice tiny white, 8-legged, round-bodied arachnids in your culture, remove the culture immediately and destroy mites by boiling for 10-15 minutes. Then sterilize everything which came in contact with the culture.

Transferring

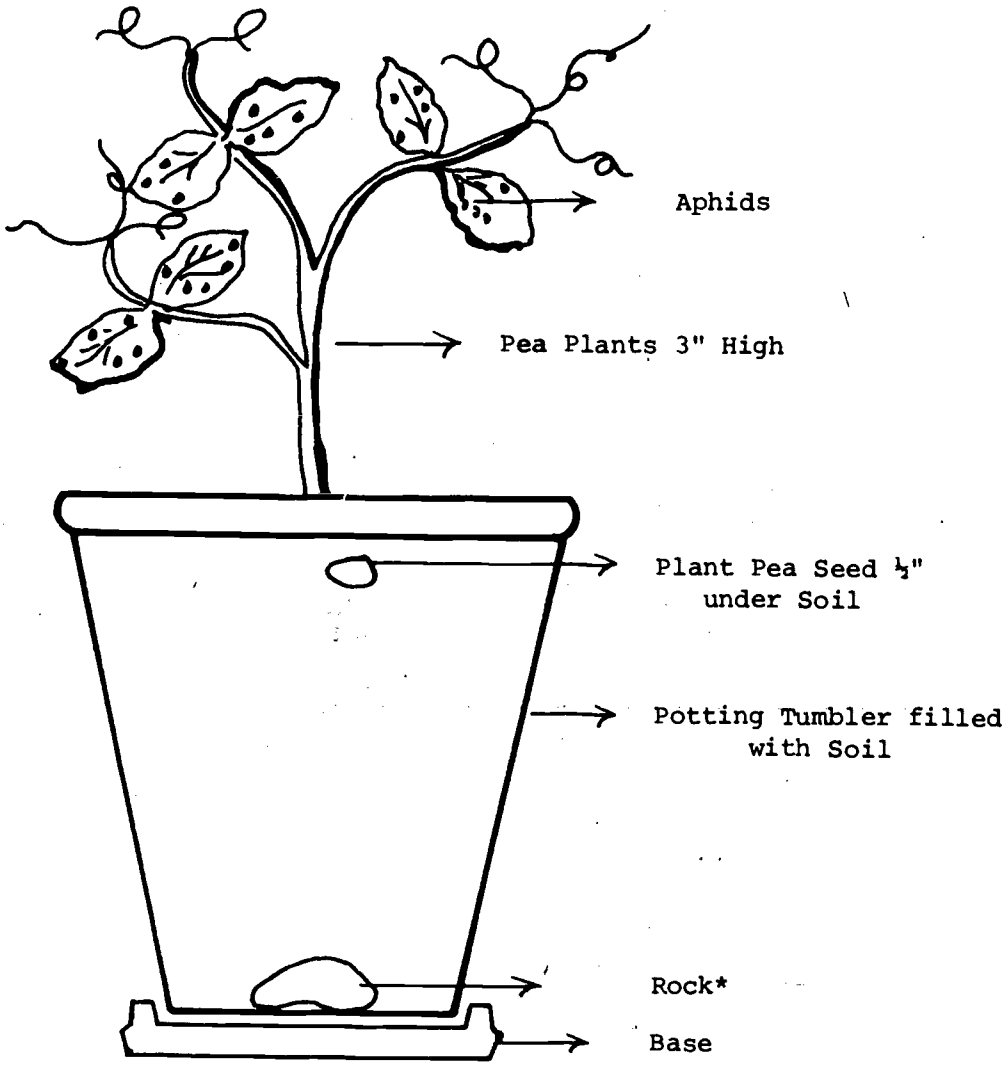


1. Transfer flies every 3 weeks. See APPENDIX for *LIFE CYCLES*.
2. Prepare a jar of fresh medium.
3. Remove tape from the lids of the new and old jars.
4. Quickly align the holes, with the new jar inverted over the old jar; fruit flies have a tendency to move upward.
5. After several fruit flies have entered the new jar, separate the jars and retape the covers.
6. Look for the presence of eggs in the new culture jar before discarding the old culture.
7. If no eggs and larvae are seen within a week, add more flies. You may not have included both sexes in the first transfer.

Note: The sex of the mature adult fly is readily distinguished. Look at the tip of the abdomen. The male is dark and very rounded. The female is narrow and more tapered.

Male Female

WINGLESS PEA APHIDS



Technique

1. *If planter has a large hole in the bottom, place a rock in the bottom to cover hole. Fill planter with soil. Moisten soil completely.
2. Plant 3-4 pea seeds ½" under soil. Keep soil moist.
3. Keep plants in well-lighted area. Water on Mon., Wed., and Fri.
4. When the plants are 3" tall, transfer aphids to plants using an artist's paintbrush.
5. Plant new seeds every 2 weeks. Transfer aphids to the new plants when plants are 3" tall. (Plants are eventually killed by the aphids.)
6. Dispose of old plants and aphids in plastic bags tied securely. Aphids are a potential danger to outside vegetation.
7. See APPENDIX for *LIFE CYCLES*.

APPENDIX

LIFE CYCLES

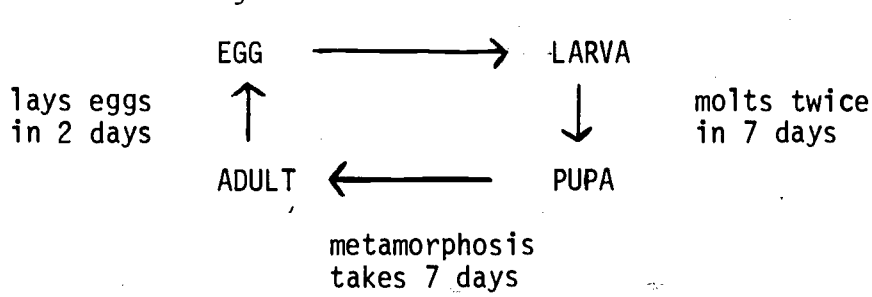
Invertebrates

1. Incomplete Metamorphosis: egg --> nymph --> adult

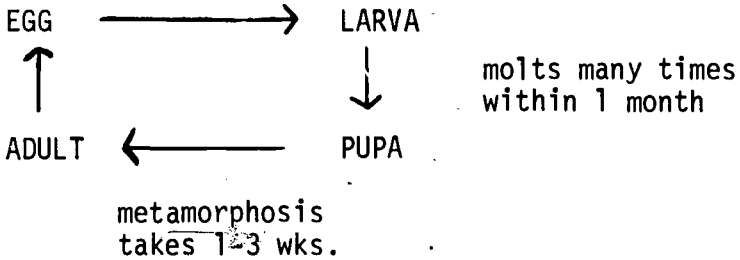
   The young when hatched look like the adults. Successive molting enables the organism to attain adult size. (Examples: crickets, pea aphids)

2. Complete Metamorphosis: egg --> larva --> pupa --> adult

   Examples: *Fruit Fly*



Mealworm Beetle



Vertebrates

Guppies: A female will give birth to young every 4-6 weeks. The young are born alive.

RESOURCES

Additional Reading

Hone, Elizabeth B., Alexander Joseph, Edward Victor, and Paul F. Brandwein. A SOURCEBOOK FOR ELEMENTARY SCIENCE. New York: Harcourt, Brace and World, Inc., 1962.

Morholt, Evelyn, Paul F. Brandwein, and Alexander Joseph. A SOURCEBOOK FOR THE BIOLOGICAL SCIENCES (2nd Ed.). New York: Harcourt, Brace and World, Inc., 1966.

Sources For Living Organisms

Carolina Biological Supply Company
Burlington, N. C. 27215

Delta Education
Box M
Nashua, N. H. 03060

Mrs. Elizabeth Pulley, Consultant
Route 9
Greenville, S. C. 29609

Rand McNally and Company
School Order Department--SCIS
P. O. Box 7600
Chicago, Illinois 60680