

INSECTS

Background Information

The world's most abundant creatures are insects. Yet most people know little about them. Those most noticed are usually the destructive or harmful ones. But, without insects there would be no orchid fruits or berries, no cotton or linen. The interrelationships between insects and man are critical.

The word **insect** means to "cut into" or segmented. The identifying characteristics of an insect are:

- 3 body parts
- 3 pair of legs
- 1 or 2 pair of wings
- external skeleton

It should be noted that when identifying immature insects, problems may occur because distinct characteristics may not all appear as a result of the differences in the growth stages.

The **head** bears the antenna which acts as sensory receptors, one of the various sets of mouth parts and the eyes.

The **thorax** is the locomotion center packed with powerful muscles which operate the legs and wings.

The heart, reproductive organs and a large part of the digestive system is located in the **abdomen**.

Covering the entire body is a hard shell called the exoskeleton which is made up of a material called chiten. It acts as the foundation or framework of the creature.

1. **Mouth parts:** An insect does not have a mouth with two lips on the outside and jaws, teeth, and tongue located on the inside. The jaws or **mandibles** are found on the outside of the mouth. They operate by moving sideways. The insect has an upper lip in front of the mandibles and the lower lip behind. Because the jaws are so different from most other animals, they are called **mouth parts**.

Some insects chew their food using these strong jaws and eat mostly solid foods. Examples include grasshoppers, crickets, dragonflies, and beetles. Other insects siphon liquid through a long, tubular tongue called a **coiled probiscus**. This is how moths and butterflies suck the nectar of flowers. When finished feeding, the tongue is coiled in the underside of the head. Insects such as flies have a tongue with two soft pads located at the base. These insects feed on juicy, semi-soft foods, like fruit and garbage. The insect secretes saliva to break down the food into a liquid state and then laps or "sponges" it up.

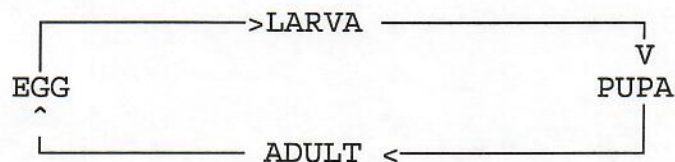
The mouth parts of mosquitoes are long, slender stingers. The female eats by piercing the skin and sucking blood.

2. **Internal:** Insects have the same life systems (i.e., respiration, circulation, digestion) as do other animals. The differences, however, that makes them characteristic of insects are:
- Digestion - This system begins with food intake through the mouth. Most insects mix saliva with their food before it is eaten because of the inability of their bodies to digest solids. After the food enters the body it passes through a system of foregut (food breakdown), midgut (absorption), and the hindgut (waste removal).
 - Respiration - Air enters the body through small openings called spiracles which are located on the sides of the body. It then passes into a system of branching trachea. The oxygen diffuses through the fluid that partly fills the trachea and enters the body cells.
 - Circulation - The blood of an insect circulates through the entire body cavity in what is called an "open" system. It is pumped through the heart located in the abdomen through a single blood vessel to the head region and out into the body cavity. Because insects are cold-blooded, the heart operates faster or slower according to the temperature. An insect's blood is usually green, yellow, or colorless. This is due to the lack of hemoglobins in the insect's blood. The pigment is caused by the various components which make up the blood.

3. **Growth:** The exoskeleton of a young insect does not grow. The old one falls off when the new one forms beneath the old. This is called **molting**.

The change in state and shape of an insect as it grows is called **metamorphosis**.

- Without metamorphosis - The growth of an insect to maturity with little change in appearance except for size. Examples: silverfish, springtails.
- Incomplete metamorphosis - The growth pattern of a young insect which often looks much like the adult, but with certain important differences. Examples: winged insect's nymphs are wingless such as grasshoppers and praying mantis. Nymphs may remain in water (where the eggs were hatched) through this entire stage. While in the water, nymphs may breathe through gills. Examples: dragonflies.
- Complete metamorphosis - This has been called the most advanced growth type. The diagram below outlines this pattern. The most common examples are butterflies and moths.



The egg hatches into a **larva**, commonly referred to as a caterpillar. Many resemble worms even though they usually have chewing mouth parts. Preceding adulthood, there exists a "resting" stage called the **pupa**. The word is derived from Latin meaning doll, which describes the resemblance a pupa has to an infant or doll wrapped in swaddling clothes.

The resting stage is really a misnomer, for the pupa wrapped in silken cover as in what we call the cocoon, or in its own heavy skin such as the **chrysalis**, is undergoing many changes. For example, the extra legs along the caterpillar's abdomen are lost and the long slender legs of the adult butterfly develop; the mouth parts change from chewing to sucking; wings develop as do the reproductive organs.

ADULT INSECTS: Most adult insects live only a short time. This can vary from a few days to a few weeks. Many of these insects do not feed during the adult stage.

4. **Friend or Foe:**

Friend - pollinate plants (bee, butterflies)
- predators (ladybugs, praying mantis)
- food for fish, birds, and animals
- decomposers, waste removal and forest clean-up
(ants, termites)
- study of heredity (fruit flies)
- human food (bees)
- human clothes (silk)

Foe: - eat crops (grasshoppers, Japanese beetles)
- annoy people (mosquito, flies)
- spread disease (tsetse fly, house fly)
- bother cattle and other livestock (hot and warble flies)
- attack structures (termites, moths)



Insects

I. Grade Level(s): K - 3rd

II. Objective:

The students will discover which flowers are most attractive to bees.

III. Materials & Supplies

cardboard flower shapes, crayons or markers, honey, jars, pipe cleaners

IV. Pre-Planning

The pistil from one flower needs to be pollinated with pollen from another flower in order to produce a seed. Bees help spread the pollen from one flower to another. Flowers attract bees with their sweet smell and bright colors. While bees sit on the flowers and suck up the nectar, grains of pollen stick to their bodies. When the bees fly off, they carry the pollen with them, which pollinates the next flower. Some flowers have colored stripes, dotted lines, or a cluster of dots called honey guides that help lead insects toward the nectar in a flower.

Before beginning the activity, punch a hole in the center of each cardboard flower shape.

V. Estimated Time for Activity: 30 - 45 minutes

VI. Procedures:

Give each child a cardboard flower shape. Invite children to color flowers with a color they think will attract a bee. Some children may want to draw honey guides on their flowers. After coloring, have children attach a stem to their cardboard flowers by sticking a pipe cleaner through the center hole. Bend the end of the pipe cleaner so they stay in place. Arrange cardboard flowers in the jars filled with dirt and place the jars where the children can observe the action. Add a touch of honey to the center of the flowers. Be sure to add a few uncolored flowers to the jar arrangement as well. Have the children observe the insect activity and draw some conclusions about a bee's flower choice.

VII. Follow-Up Activity

Ask children to think of characteristics of the perfect "superflower". What would this superflower look like? What color would it be? What size would it be? What designs or markings would it have? What would it smell like?

Submitted by: Sarah Jane Baxter



Insects

I. **Grade Levels:** 3 - 12

II. **Objectives:**

1. The students will be able to list the identifying characteristics of an insect.
2. The students will be able to explain the term **metamorphosis** and relate it to the growth stages of an insect.

III. **Materials and Supplies**

A. **Gathered by the teacher**

- styrofoam meat trays (1 per student)
- straight pins (6-8/per student)

B. **Included in "Insects" kit**

- insect collection nets
- magnifiers
- lenses
- field guides
- magnifier bug boxes
- lighter fluid

IV. **Pre-Planning**

1. Discuss the anatomy of an insect. Distinguish between an insect and other "bugs", such as spiders.
2. Cover background information (your classroom references plus the background sheets provided in this binder) and appropriate vocabulary for your level of students.
3. Ask students to start bringing in Styrofoam meat trays that have been washed in hot soapy water (**CAUTION:** meat trays that have the residue of fresh meat may contain harmful bacteria -- BE SURE the students know to wash them thoroughly before bringing to school).

V. **Estimated Time of Activity:**

30 - 45 minutes

VI. **Procedures:**

1. Demonstrate proper procedures for collecting insects. Stress caution when looking around logs, rocks, and other natural debris in the outdoors where some unfriendly creatures may be lurking!
2. Divide into small groups and let groups use the collection nets and lighter fluid to begin catching insects.
3. Have students mount insects on Styrofoam trays using straight pins. They can use the field guides and insect charts to try and identify their catches. Use a pen to write the names below the insects.



A NATURALIST'S JOURNAL

- I. Grade Levels: Can be modified for K - 12
- II. Concept: People can enjoy wildlife and nature through observation, writing and sketching.
Children can become naturalists, creating their own journals and using them to record observations in out-of-door settings.

III. Materials and Supplies

1. Gathered by teacher
xerox and construction paper
2. Kits from Env. Learning Center
possibly the insect kit; others could be easily integrated into this

IV. Pre-Planning

1. Discuss naturalists. The Project Wild guide has great background for this and here is part of it: " A naturalist is a person who studies nature, especially by direct observation. Naturalists often spend a lot of time in the out-of-doors, and they record their observations in some form-- from sketches, drawings, paintings and photos, to poetry and prose. They usually carry with them a small journal. We benefit today from the insights and observations of naturalists of the past, Henry Thoreau, Walt Whitman, James Audubon, John Muir and today's Annic Dillard, Gwen Frostic, Tom Brown and Edward Abbey. "
2. Let children make their own journals. Fold 3-5 pieces of xerox paper in half, put construction paper on outside, and staple down the inside crease. They can create their own cover for it.
3. Share writings and sketches of naturalists.
4. Give a general description of the setting in which their out of door experience will take place. Let children hypothesize about what they might encounter there.
5. Introduce field guides on wildflowers, butterflies, etc.

V. Procedures

Choose from 2-5 activities for children to participate in at the Environmental Learning Center. You could rotate small groups through several centers or larger groups through a couple of centers. Following are some ideas that will give your students an opportunity to use their journals as naturalists.

1. Use field guides to identify and sketch trees, wildflowers, etc. or just sketch what you see.
2. Make a map of what you hear.
3. Use the insect kit to capture and sketch insects.
4. Observe and describe or sketch everything you see in a one-square-foot plot.
5. Share Shel Silverstein's book, The Giving Tree and let children discuss and/or write about all the things the natural world shares with them.
6. Let pairs of children choose a tree. Children explore and observe their tree in many ways - measure it, draw it, take rubbings, sketch leaves, identify it.
7. Collect leaves, etc. from ground. Let children count, categorize, etc. and glue sample of categories into journal.
8. Share and write poetry.
9. Explore the five senses at a center.



Title: Insects: Moths and Butterflies

I. Grade Level Kind-1st

II. Concepts:

1. The students will be able to identify insects as either moths or butterflies
2. The students will learn how to use an insect net.
3. The students will observe the wings of a butterfly or a moth under a magnifying glass.

III. Materials and Supplies

A. Gathered by the Teacher

Styrofoam meat trays(1 per student), straight pins, large critter jars (5 per class), art paper, pencils and crayons.

B. Kit to use from the Env. Learning Center
Insect kit

V. Estimated Time for Activity 2 hours

VI. Procedures:

1. Pass out insect nets. Demonstrate correct procedure for using nets.(swooping motion)
2. Divide into small groups and give each group a critter jar that has lighter fluid on a cotton ball in the bottom of the jar. Each group is to hunt for moths and butterflies to place them in the critter jar. Tell each group they have 30 minutes and that you will ring the bell when the time is up.
3. Ring the bell after 30 minutes. Check collections of insects, and have children tell if the insect is a moth or a butterfly. Pass out the sheet that tells the differences between moths and butterflies(in binder).
4. Attach dead insects to meat trays.
5. Have microscopes set up and have children take a wing of either a butterfly or a moth and place on the slide under the microscope. Have the children to notice the scale formation.
6. Go to the pavilion and pair up students to trace their partner's feet(see drawing below) to make butterfly or moth wings. After partners trace "wings", then have students to color their wings.

VII. Follow-up Activities

1. In the classroom, display insects and discuss each kind, and tell whether the insect is a butterfly or moth by using the list of differences.
2. Have children discuss ways to make our world a better place for the butterflies and moths. You can use this discussion as a springboard to making a book on butterflies and moths, painting a mural, writing an experience story about a moth or butterfly, and planting flowers that will attract butterflies and moths to your school.
3. Make sugar strips to hang out of classroom windows.(recipe is in the binder).



Children put
heels together
Trace around
both feet to
make wings
Glue on body



Insects

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A. Gathered by the teacher

- styrofoam meat trays (1 per student)
- straight pins (6-8/per student)

B. Included in "Insects" kit

- insect collection nets
- magnifiers
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- field guides
- magnifier bug boxes
- lighter fluid

IV. Pre-Planning

1. Discuss the anatomy of an insect. Distinguish between an insect and other "bugs", such as spiders.
2. Cover background information (your classroom references plus the background sheets provided in this binder) and appropriate vocabulary for your level of students.
3. Ask students to start bringing in Styrofoam meat trays that have been washed in hot soapy water (**CAUTION:** meat trays that have the residue of fresh meat may contain harmful bacteria -- BE SURE the students know to wash them thoroughly before bringing to school).

V. Estimated Time of Activity:

30 - 45 minutes

VI. Procedures:

1. Demonstrate proper procedures for collecting insects. Stress caution when looking around logs, rocks, and other natural debris in the outdoors where some unfriendly creatures may be lurking!
2. Divide into small groups and let groups use the collection nets and lighter fluid to begin catching insects.
3. Have students mount insects on Styrofoam trays using straight pins. They can use the field guides and insect charts to try and identify their catches. Use a pen to write the names below the insects.

4. If time allows, take group to edge of field and locate a "gall". A "gall" is a growth or enlargement of some parts of a plant caused by insects, fungi, or mites. Usually, golden rod galls can be found in the meadow during any season. Look at the stem for a ball gall made by tephritid fly larva (related to the fruit fly).

Take a knife and very CAREFULLY open one of these galls or living quarters. They may be difficult to open. Look for the tiny, often white larva. You can tell if the gall is already empty by looking for an exit hole.

5. Insects may also be attracted by using **sugar strips**. Cloths dipped in different baits such as sugar water, honey, or jelly are **sugar strips**. These may be hung out in warm weather to attract insects.

VII. Follow-Up Activity

1. Children may role play complete metamorphosis.
2. Divide children into small groups and let each group form a different insect. In order to be correct, three people may join together to form the three parts of an insect. The insect must have six legs; let the children figure out how to show wings and an antennae.
3. Have the children use drawing paper and crayons to create their own insect. Make sure they have the correct characteristics to be a proper insect.

ORDER OF INSECTS

1. ORTHOPTERA (or-THOP-ter-uh)

These straight-winged, medium to large insects live on land. Their forewings are leathery and hind wings fold fan-like (some have no wings). A large head with strong, biting jaws and long or short antennae.



Grasshoppers, cockroaches, crickets, katydids, praying mantis and walking sticks.

2. LEPIDOPTERA (lep-i-DOP-ter-uh)

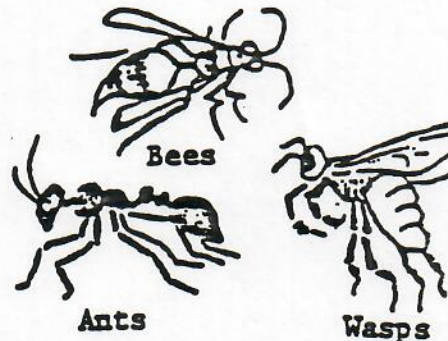
They are medium to large insects with two pairs of scaly wings and sucking mouth parts. Antennae are knob-like or feathery.



Moths and butterflies

3. HYMENOPTERA (hy-meh-NOP-ter-uh)

These are small to medium-sized insects; many are social or colonial. They have two pairs of thin, transparent wings. The hind wings are smaller. Mouth parts are for chewing or sucking. These are the only insects with a "stinger."



4. ODONATA (oh-duh-NAY-tuh)

Usually rather large, abdomen long and slender. Head relatively large, very movable. Large eyes. Antennae are small, 4 to 7 jointed. Has chewing mouthparts. Legs relatively short, usually spined. All live in water until they get wings.



Dragonflies and their kin

5. COLEOPTERA (koh-lih-OP-ter-uh)

Usually hard-bodied. Front wings, if present, are modified to thicken, usually hard. Hind wings are thin and folded. Head usually prominent. Chewing mouth parts, sometimes at the end of a beak-like projection of the head. Antennae usually short and usually about 11 joints.



Beetles

6. HEMIPTERA (he-MIP-ter-uh)

Has two pairs of half wings. The front of the wings is hard and colored and the rest of the wing is a membrane. The forewings are partly thickened. The jointed beak for sucking arises from front of head. Two to five antennae segments. Length varies from 1/15" to 4 1/2". May be long and slender, oval, or roundish. Great numbers are aquatic.



True bugs, stink bugs, water skipper

7. HOMOPTERA (ho-MOP-ter-uh)

Includes a large variety of insects; range in size from more than 2" to minute that are scarcely visible to the human eye. All have sucking mouth parts. Most have two pairs of similar wings that slope over the side of the body. Similar to heteroptera but differ in that their wingfold roof-like over the back and are uniform in texture. Contains many serious agricultural and forest pests.



Locusts, aphids, scale insects, cicad spittle bugs

8. DIPTERA (DIP-ter-uh)

Has one pair of functional wings. Has small knobbed balancers just back of these wings; represent a second pair of wings. Some have thread-like or feathery antennae with only 3 joints. Adult mosquito and gnat are among man's greatest tormentors. Can be carriers of serious disease.



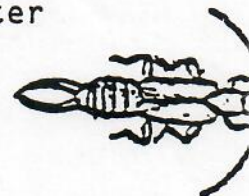
Mosquitoe



Flies & Gnats

9. DERMAPTERA (der-MOP-ter-uh)

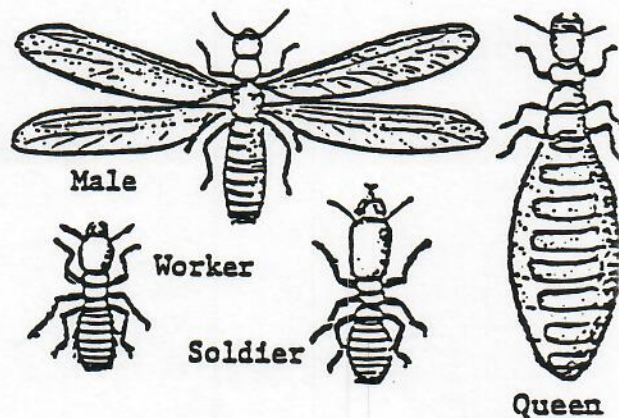
Small insects with pincer-like tail. Has long, narrow body. Chewing mouth parts. If winged, the front wings much shorter than the back and more leathery or even hard. Antennae is thread-like with 10 or more joints.



Earwigs

10. ISOPTERA (eye-SOP-ter-uh)

Are small and soft-bodied, ant-like insects. Have two pairs of equal wings that are narrow. Chewing mouth parts. Antennae is thread-like. Live in colonies and have specialized casts for working and soldiering. Nests in and under old logs and stumps.



Male

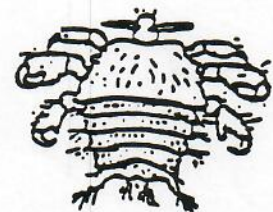
Worker

Soldier

Queen

11. ANOPLURA (ann-o-PLUR-a)

Wingless, small with a rather flat body. Eyes are reduced or absent. Has sucking mouth parts. Have legs with claws for clinging to warm-bodies animals.



Lice

12. EPHEMERIDA (e-FEM-er-i-da)

Adults are short-lived; entire life span of some species being only a few hours. Usually emerge from water near sunset; sometimes their dead bodies are piled along shores of lakes and streams. Are an important food for fishes, some aquatic insects, birds and other animals. Normally have two pairs of delicate wings which are held vertically over body when resting. The hind pair being either reduced or entirely absent. In mayflies, hind wings are smaller. In stoneflies, they are larger. Mayflies have long, 2 or 3 pronged tails.

Mayfly:

Nymph

Adult



13. NEUROPTERA (ner-OP-ter-uh)

Slender with large eyes. Has a network of nerves throughout the wings. Strong biting jaws. Abdomen rather long and slender. Wings are large but flight is slow. Wings at rest usually held at a slope, roof-like. Long Antennae.



Dodson flies

14. MECOPTERA (me-COP-ter-uh)

Wings are long and narrow, with many cross veins. A few are wingless. Generally has spotted wings. Has beak-like chewing mouth parts. Are small insects.



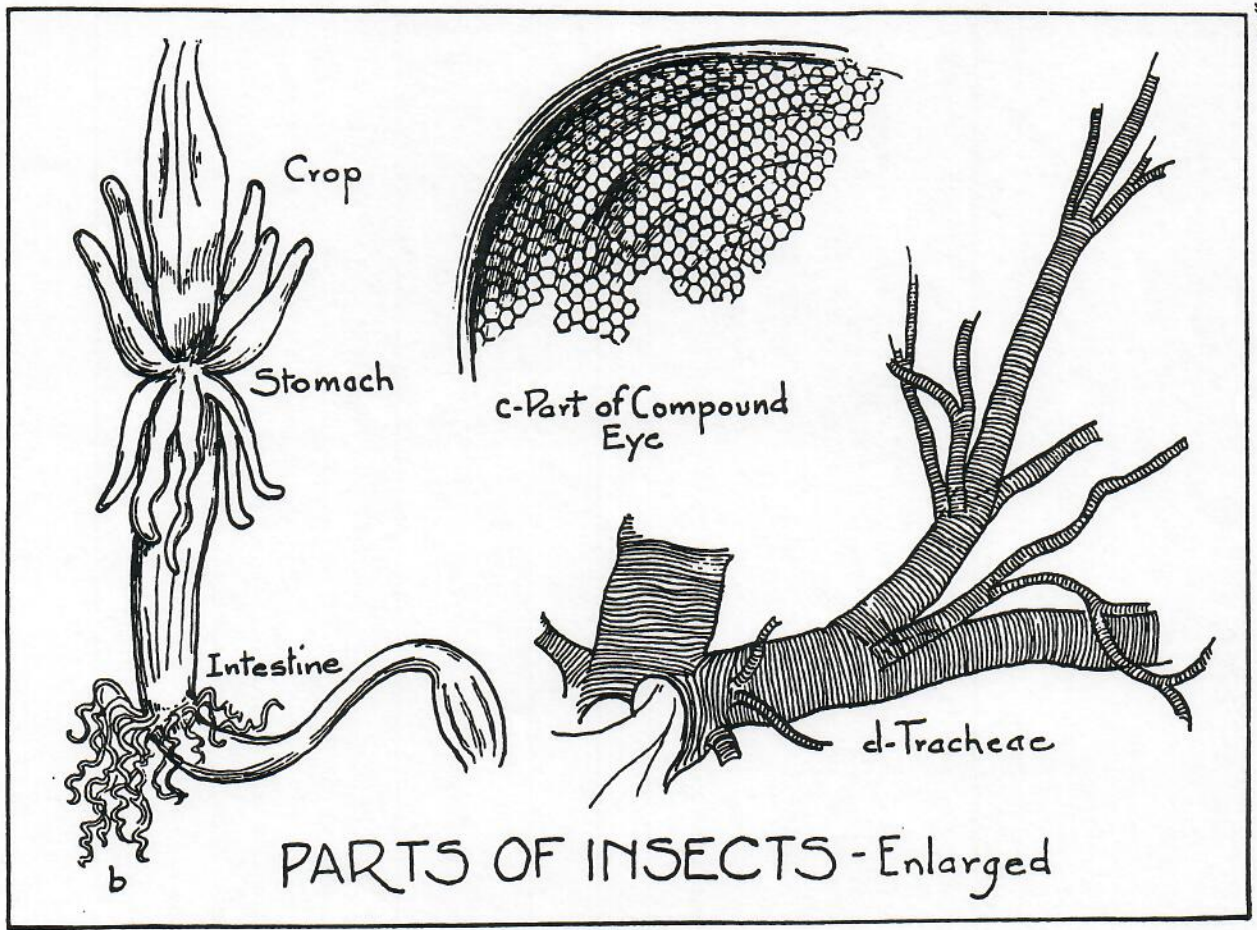
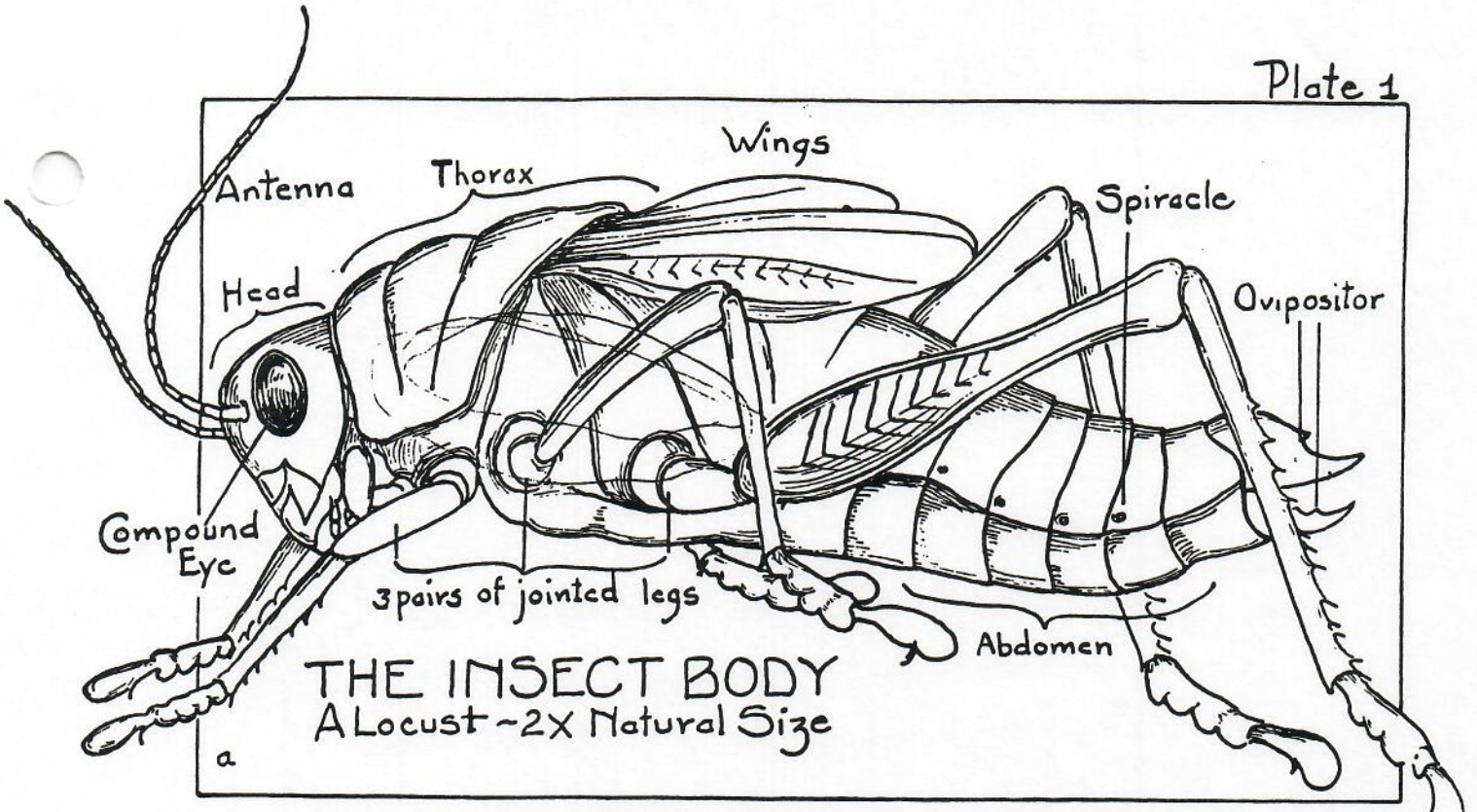
Scorpion flies

15. TRICHOPTERA (trik-OP-ter-uh)

Slender-bodied. Eyes are relatively large. Adults have two pairs of wings that hold them against their body. Have long antennae that are thread-like. Has chewing mouth parts. Are frequently attracted to porch lights.

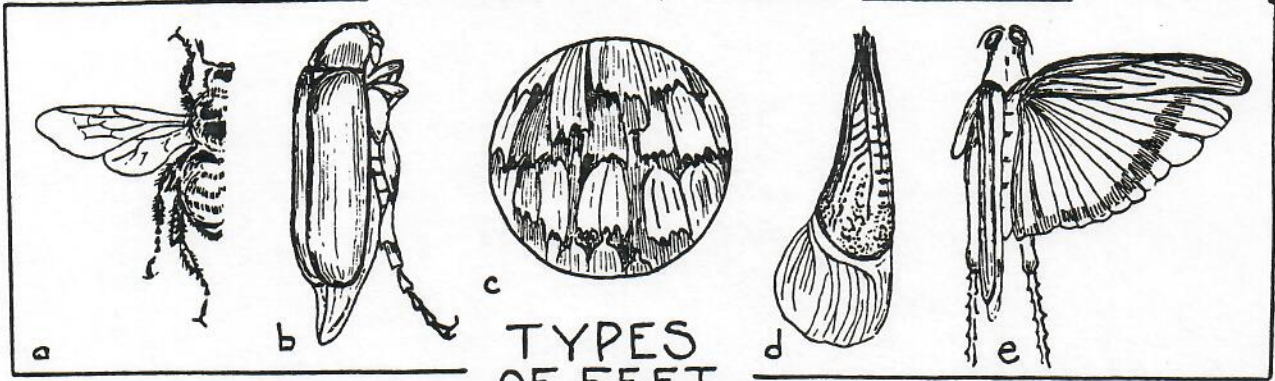


Caddis flies



TYPES OF WINGS

Plate 2

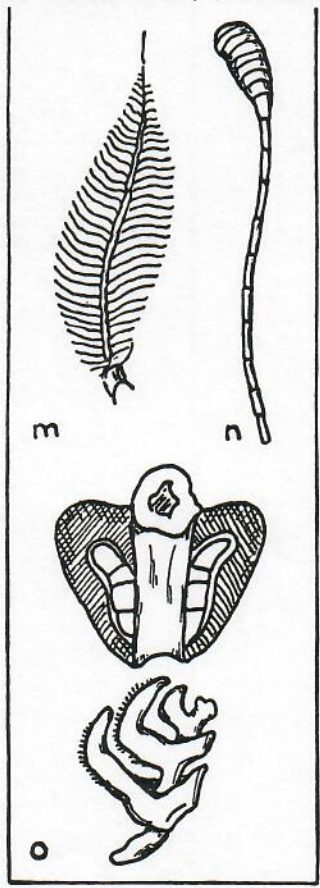
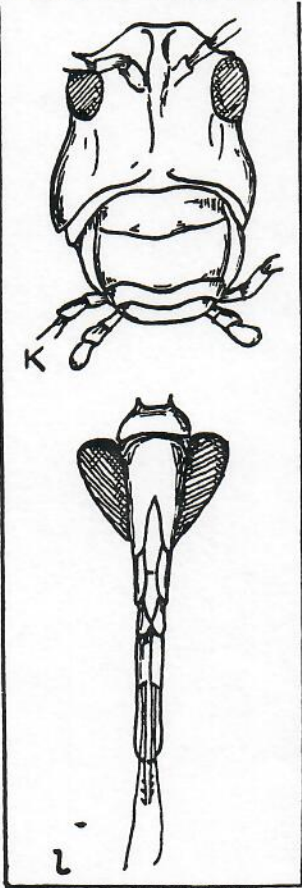


TYPES OF FEET



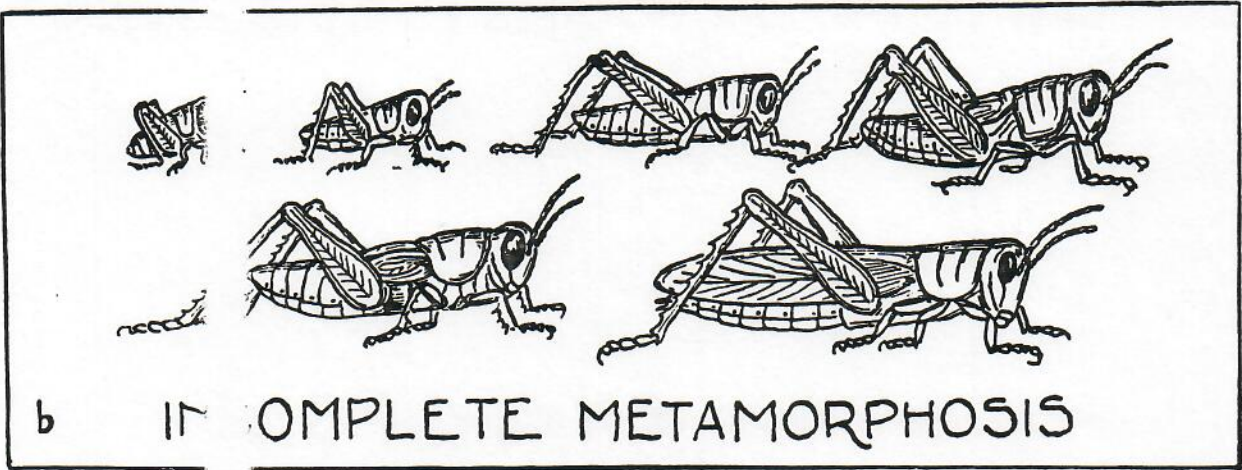
TYPES OF MOUTHS

TYPES OF ANTENNAE

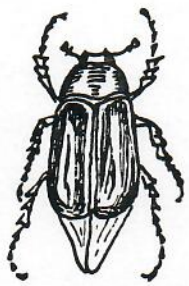




a CC IPLETE
a META MORPHOSIS

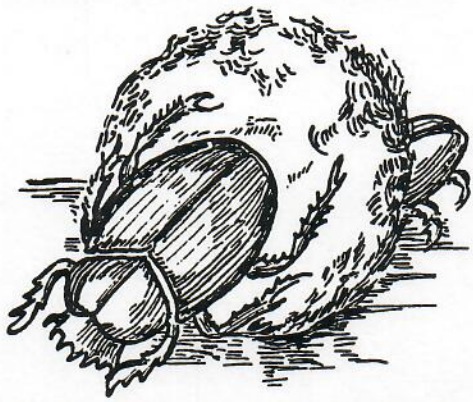


b IN OMPLETE METAMORPHOSIS



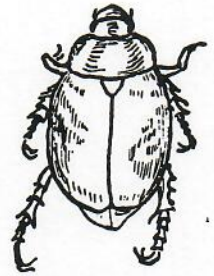
MAY BEETLE

a



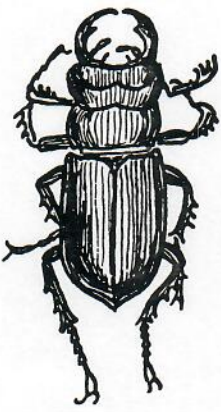
EGYPTIAN SCARAB

b



GOLDSMITH BEETLE

c



STAG BEETLE

d



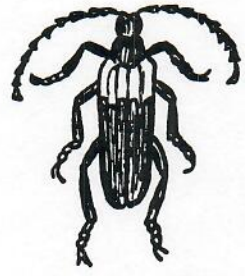
WATER SCAVENGER BEETLE

e



CLICK BEETLE

f



LONGHORN BEETLE

g



WHIRLIGIG BEETLE

h

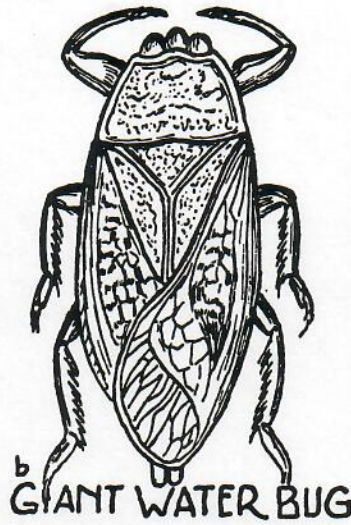


FIRE-FLY

i



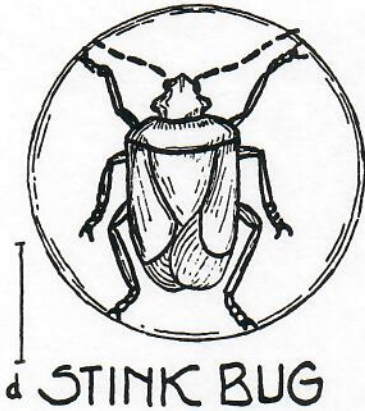
a WATER BOATMAN



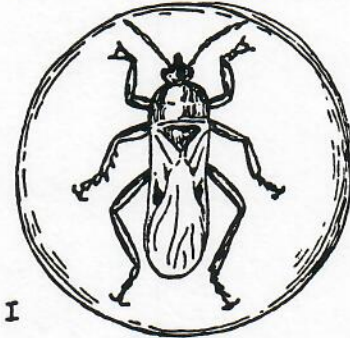
b GIANT WATER BUG



c WATER STRIDER



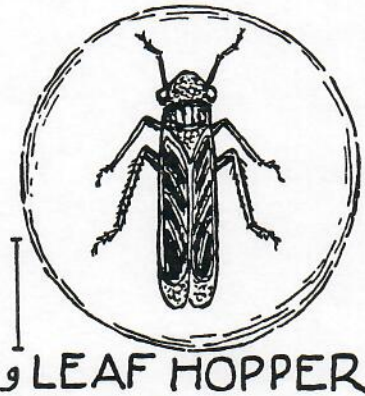
d STINK BUG



e CHINCH BUG



f 17-YEAR CICADA



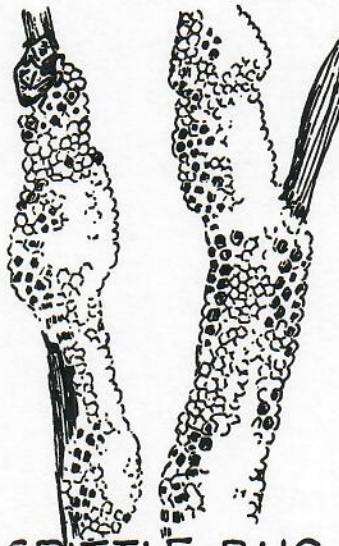
g LEAF HOPPER



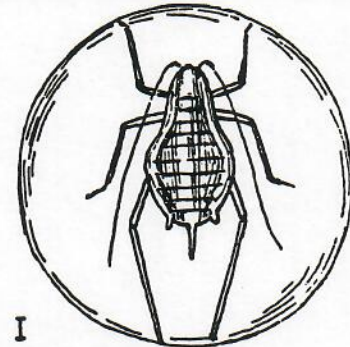
h TREE HOPPER



i OYSTER SHELL SCALE

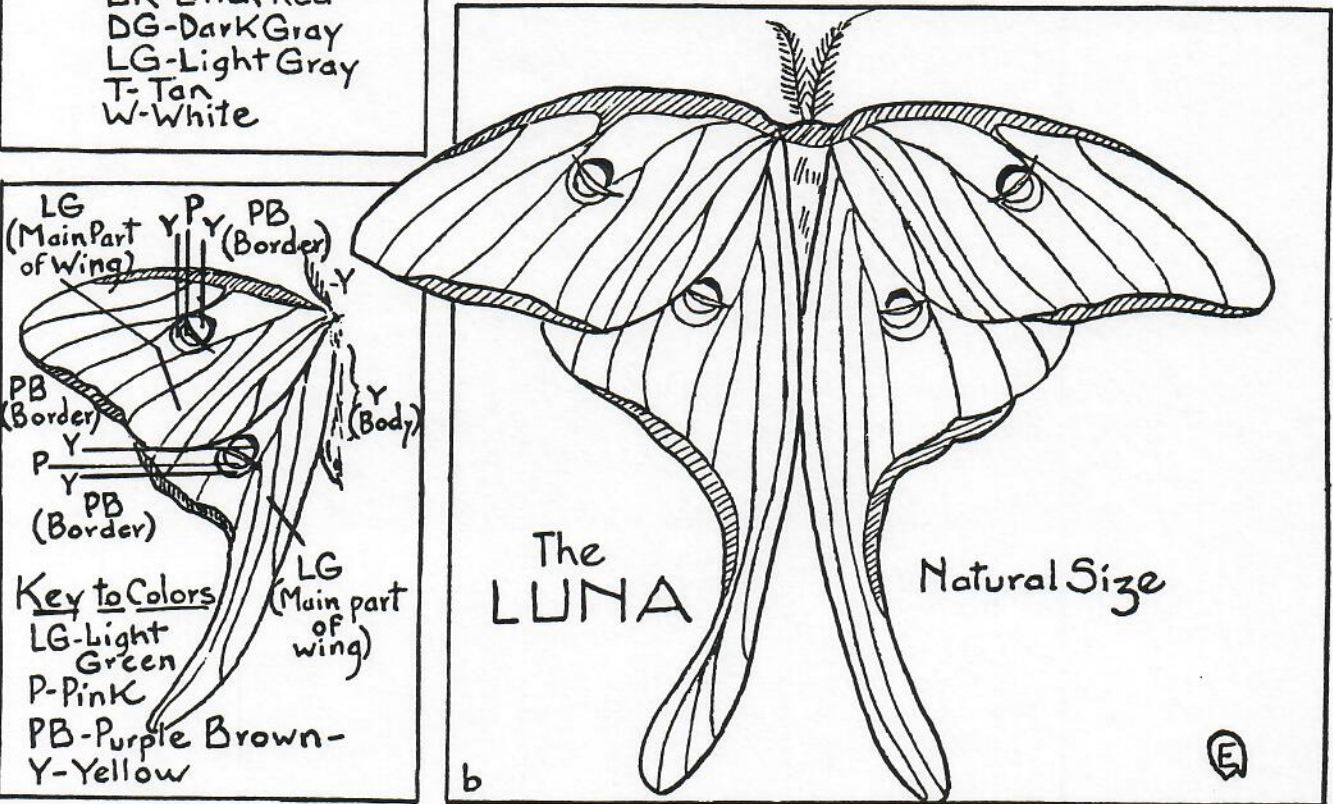
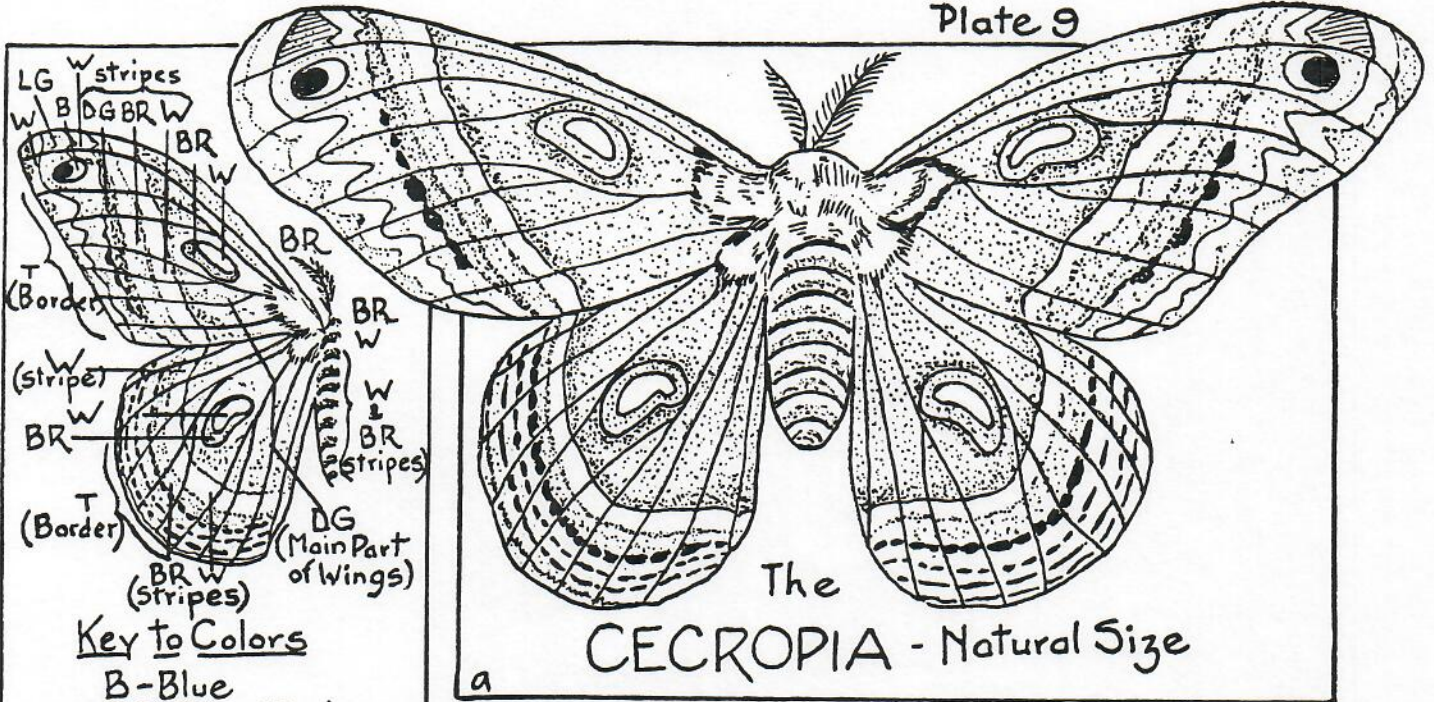


j SPITTLE BUG

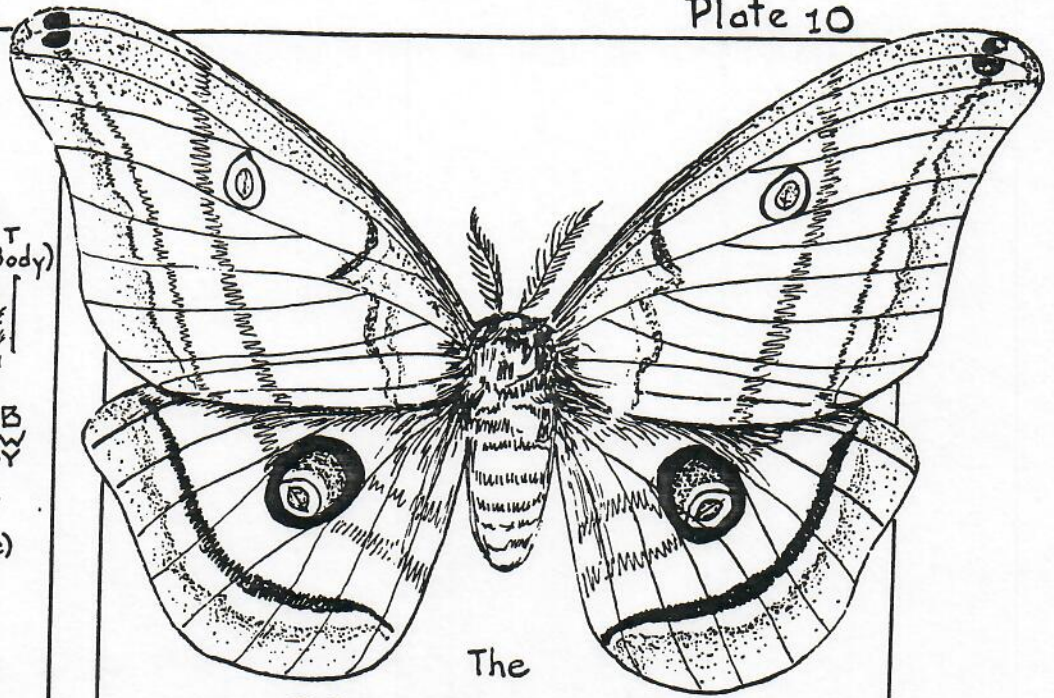
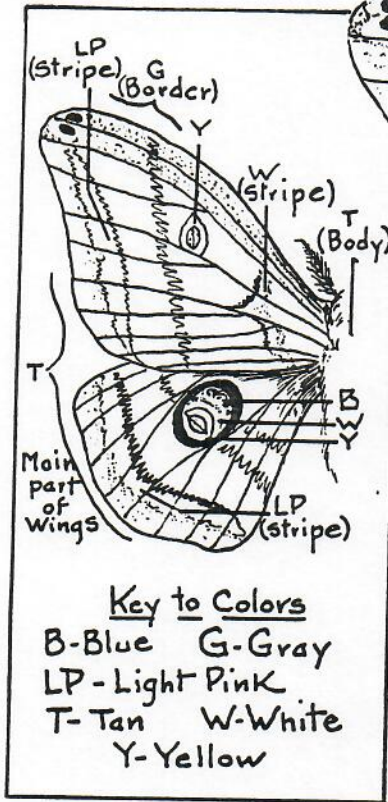


k APHID-

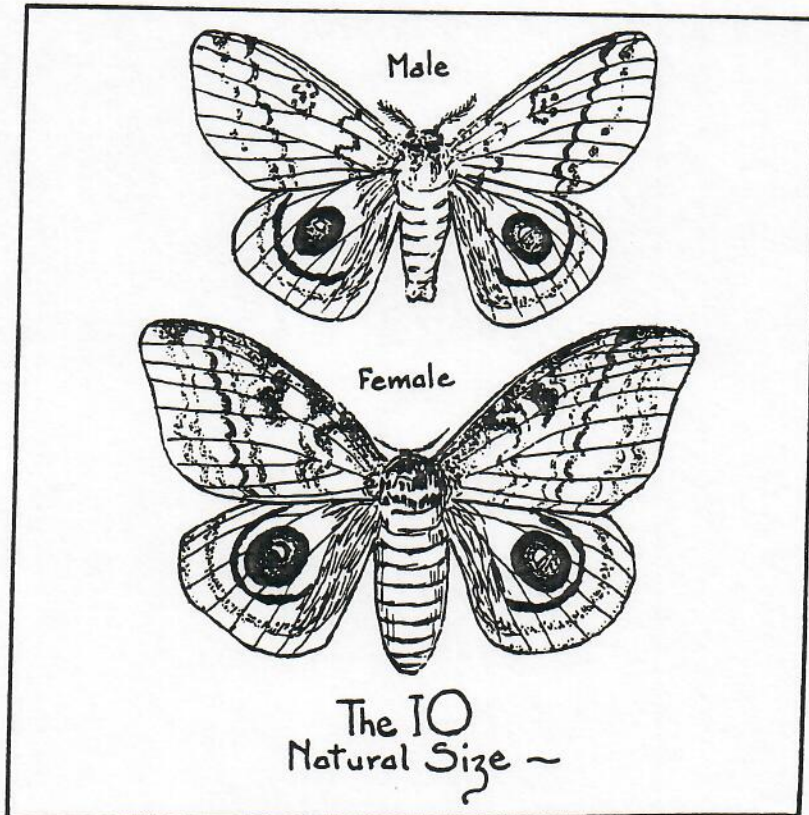
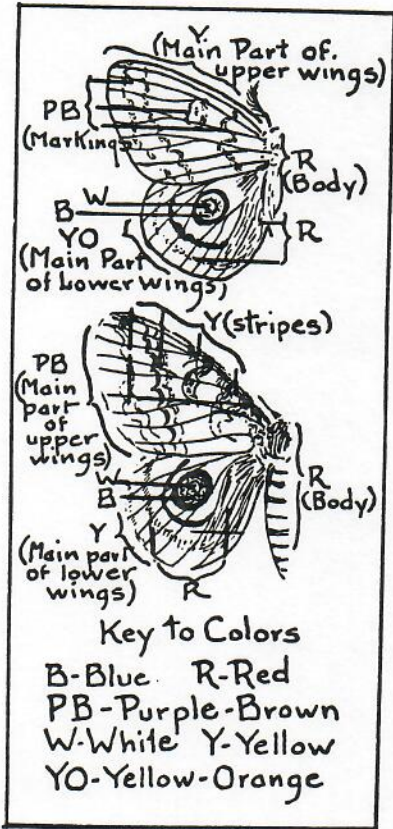
Upright lines to the left of figures show the actual size of the insects

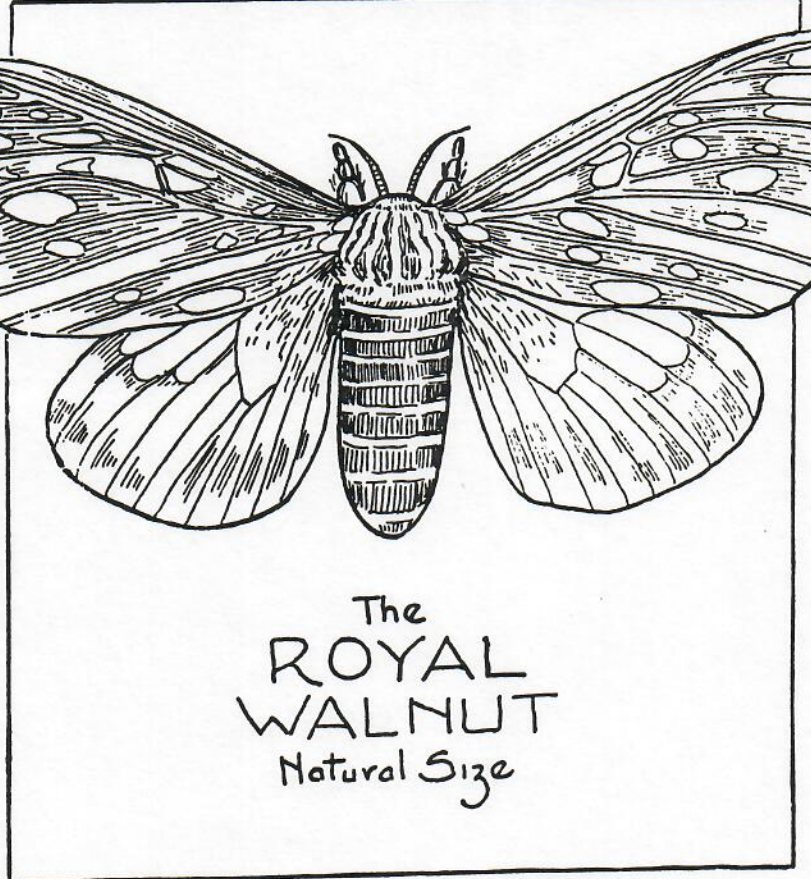
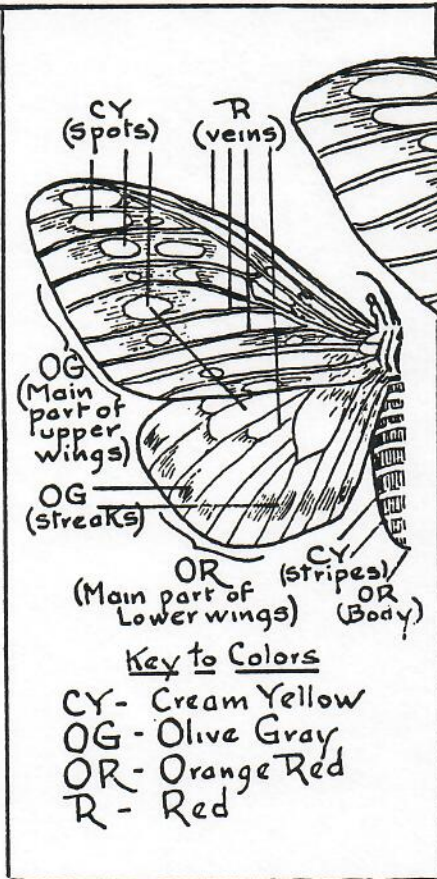
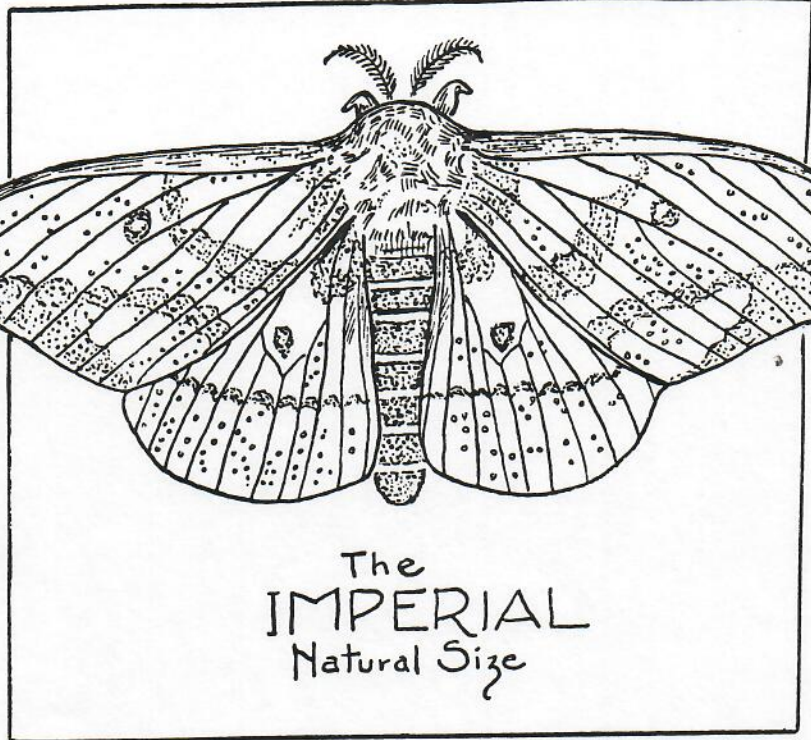
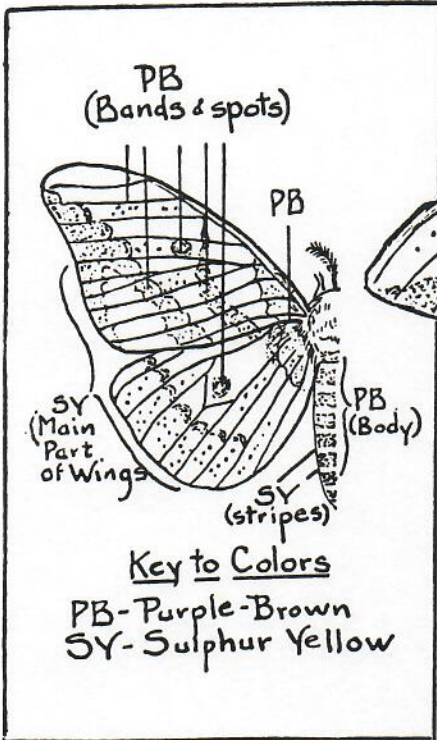


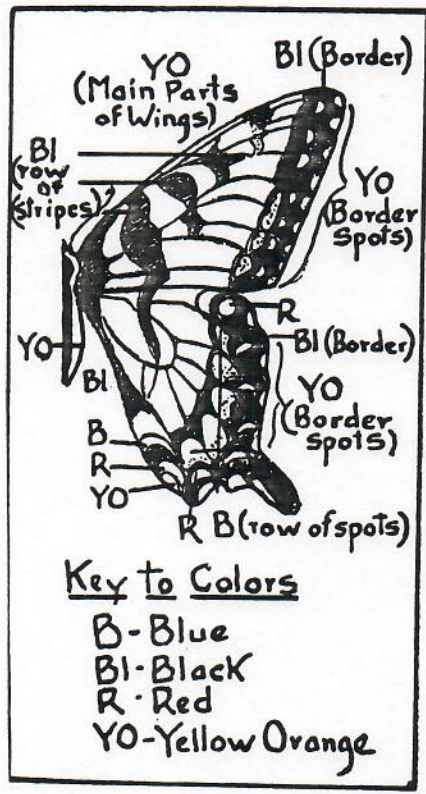
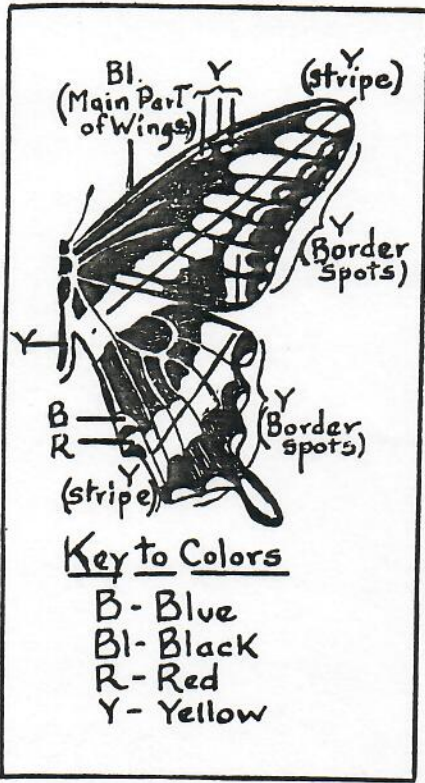
Moths have softer, paler colors than butterflies. Before you put in the different colors, go over the whole moth except the white parts very lightly with brown crayon ~ Then put in the separate colors lightly over the brown. When you color butterflies, do not use a brown back-ground - Make their colors bright and showy. When you have finished a page of moths and one of butterflies, compare the two and notice the difference ~



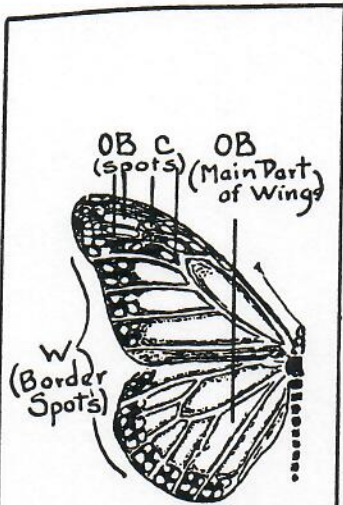
The
POLYPHEMUS
 Natural Size



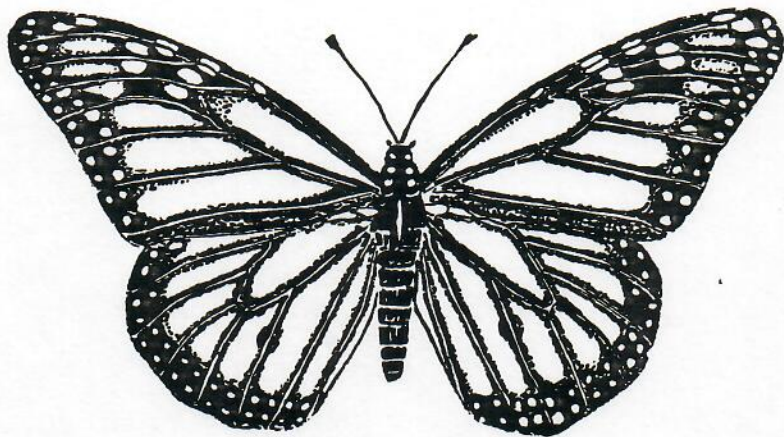




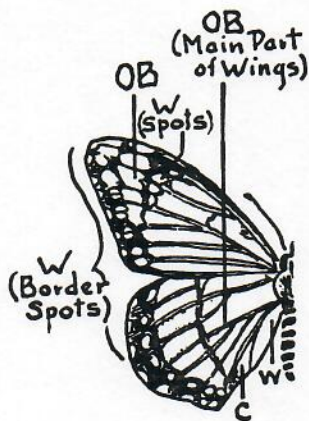
Remember to make the butterfly colors bright and showy.
Do not use any brown background.



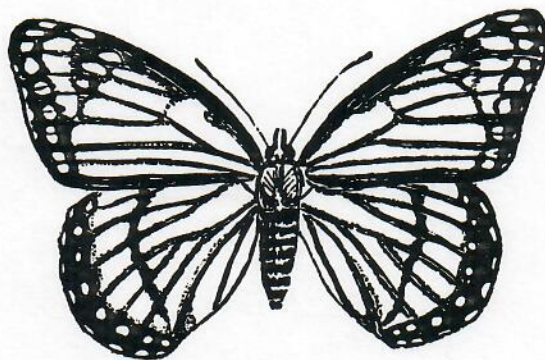
Key to Colors
C-Cream
OB-Orange-Brown
W-White



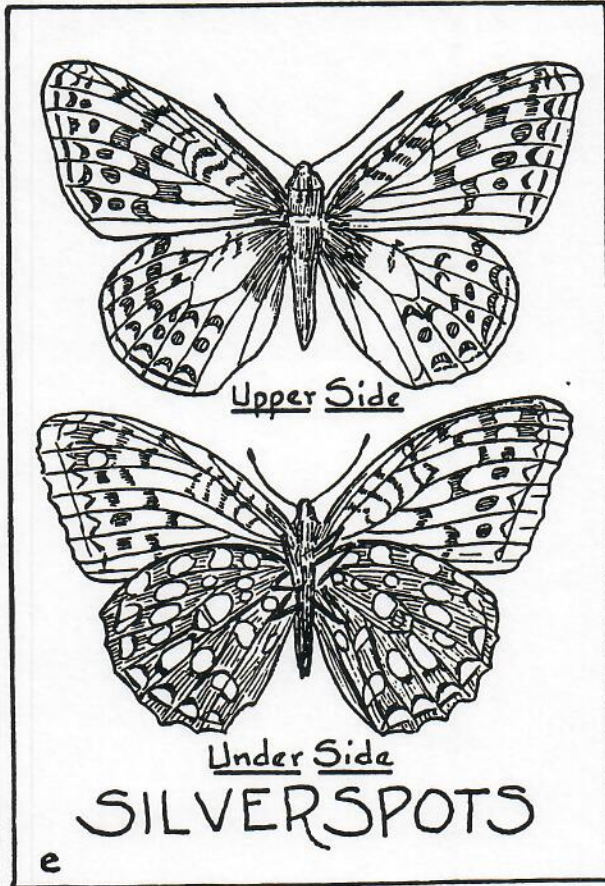
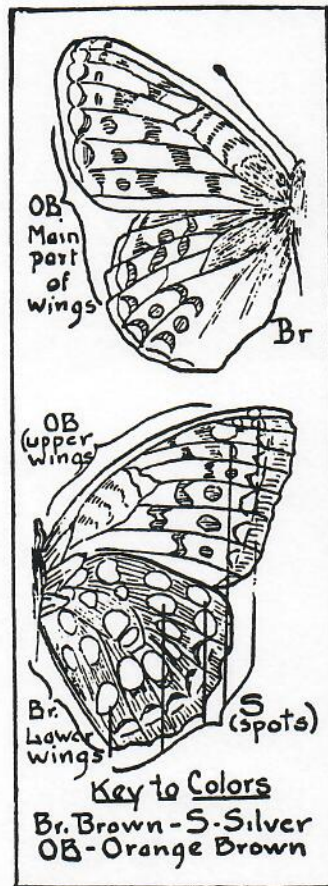
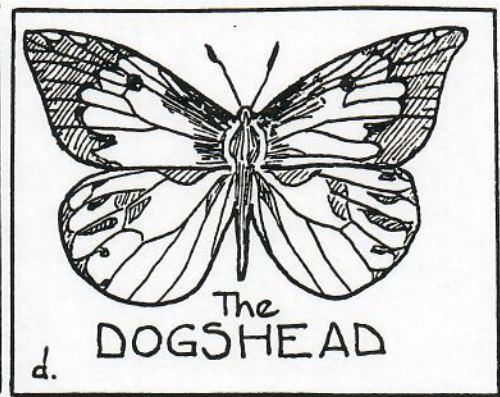
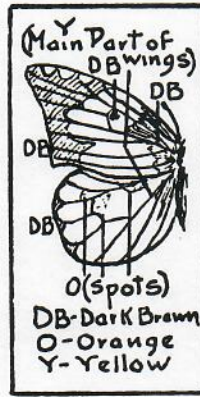
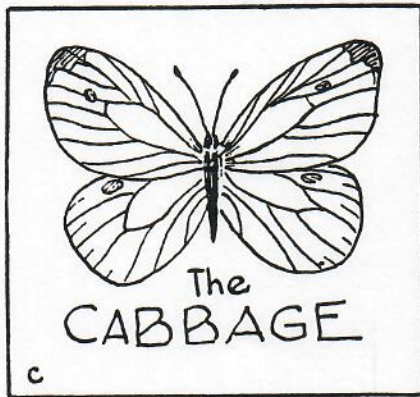
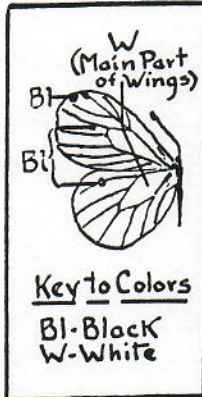
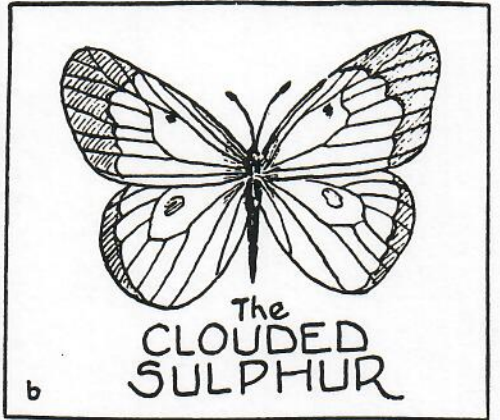
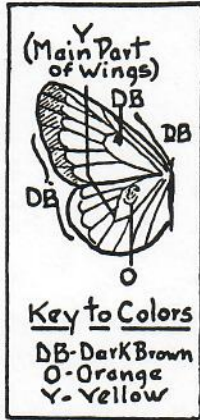
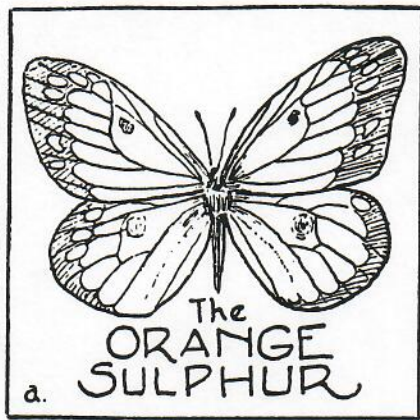
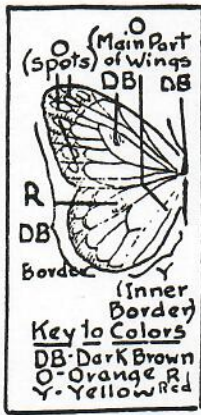
The
MONARCH
Natural Size ~

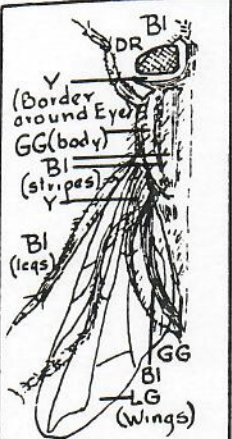


Key to Colors
C-Cream
OB-Orange-Brown
W-White

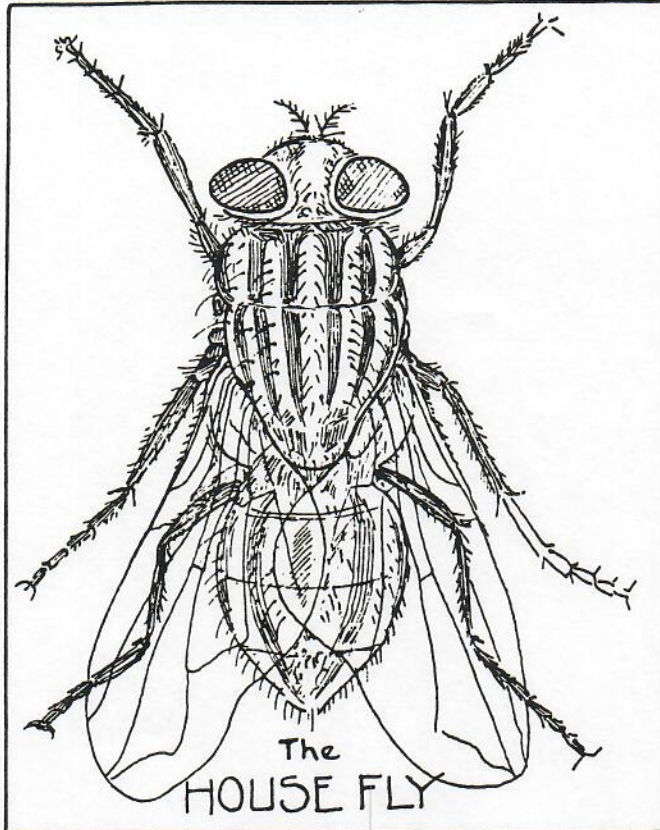


The
VICEROY
Natural Size ~

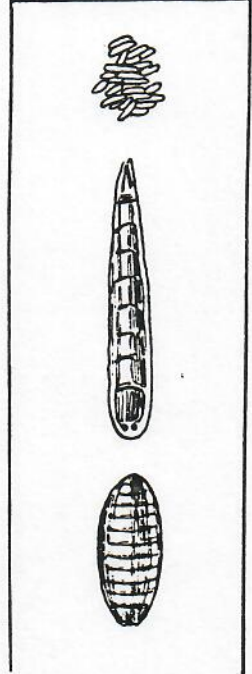




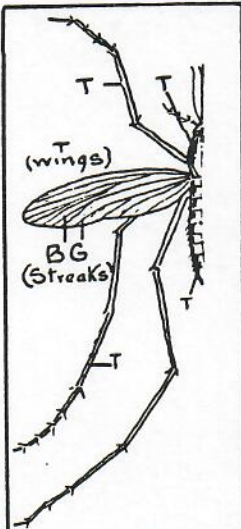
Key to Colors
 BI - Black
 DR - Dark Red
 GG - Gray Green
 LG - Light Gray
 Y - Yellow



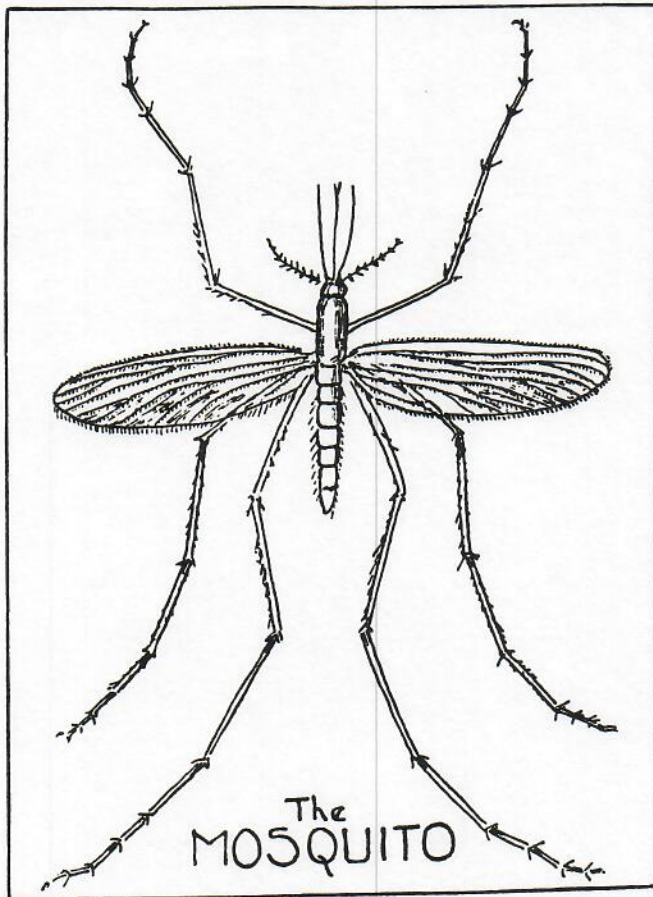
The
HOUSE FLY



Eggs, Larva
and Pupa of
House Fly -
Greatly enlarged.

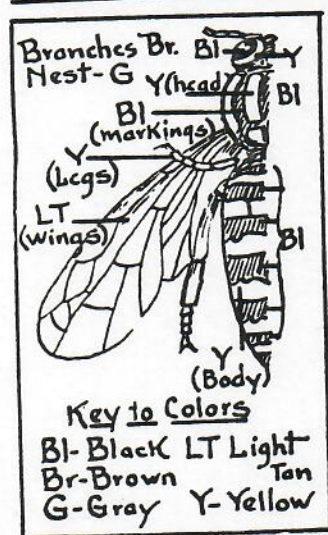
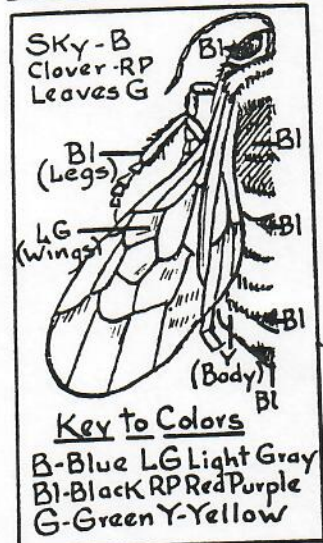


Key to Colors
 BG - Bluish
Gray
 T - Tan -



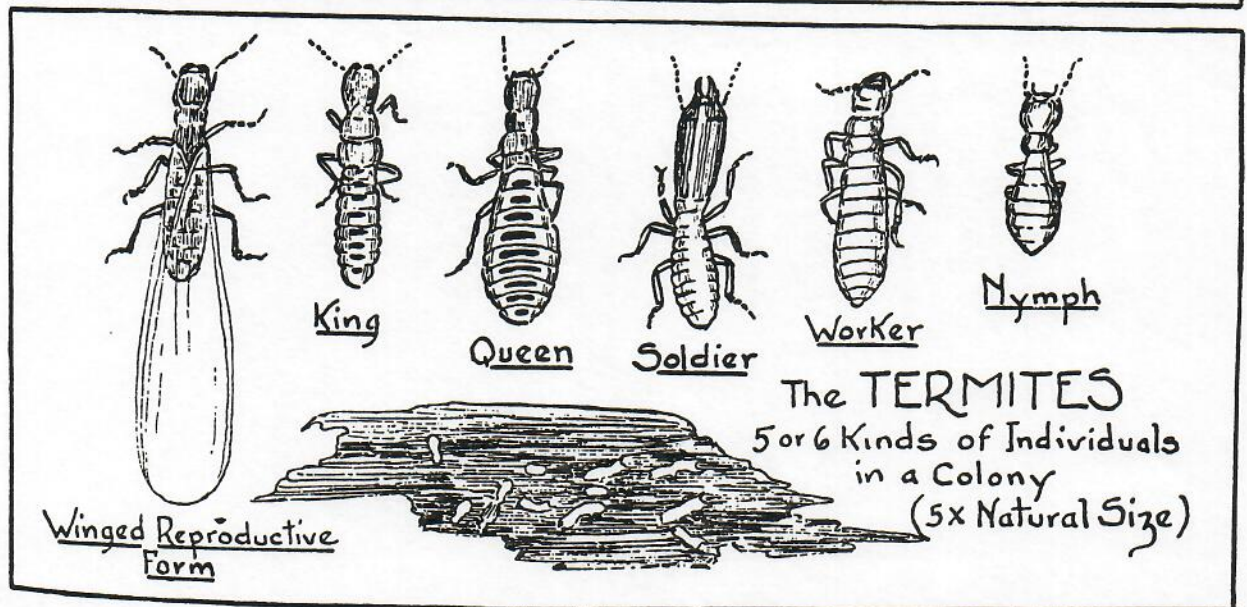
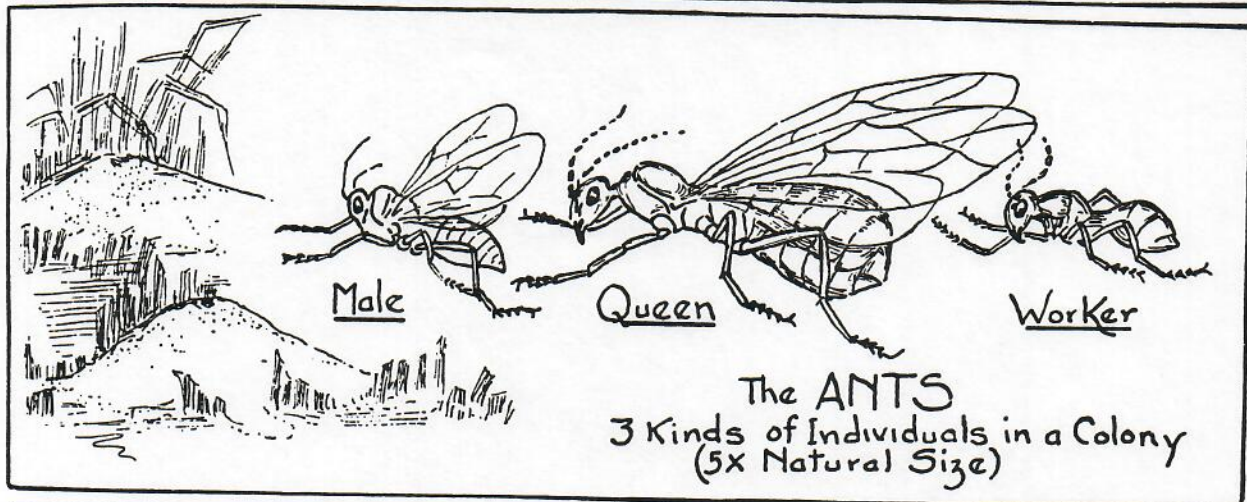
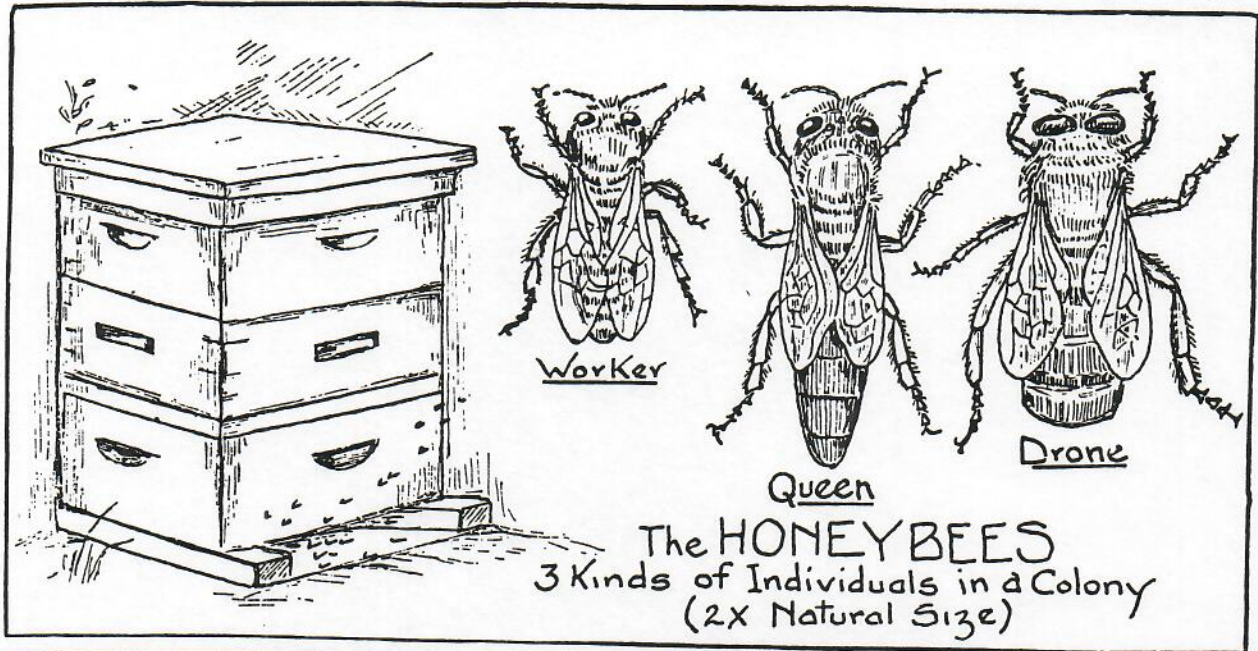
The
MOSQUITO



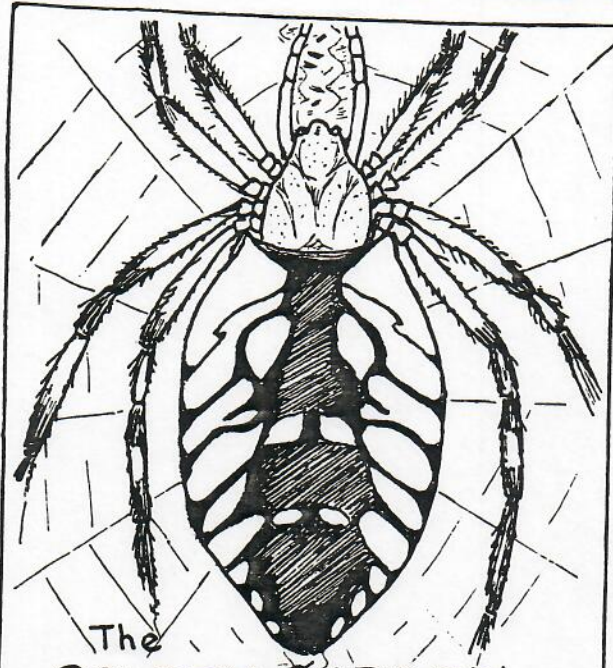
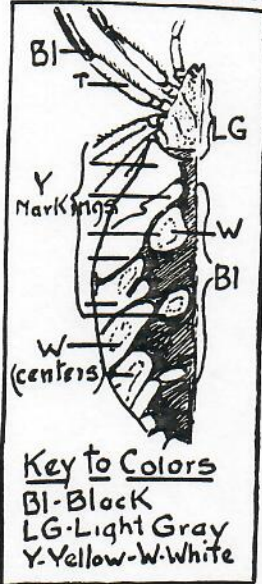
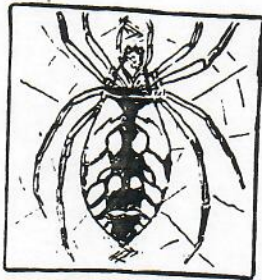


SOCIAL INSECTS

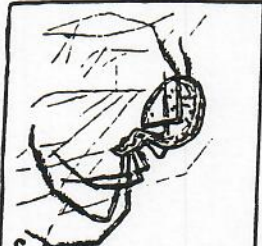
Plate 18



RELATIVES OF THE INSECTS



The GOLDEN GARDEN SPIDER 3X Natural Size



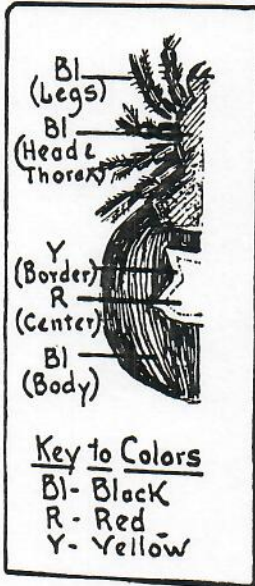
HOUSE SPIDER



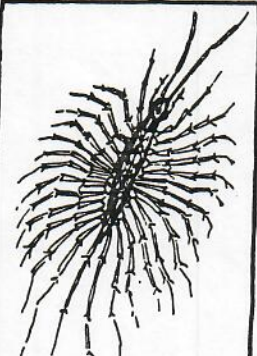
RUNNING SPIDER



JUMPING SPIDER



The BLACK WIDOW SPIDER 4 1/2 X Natural Size



CENTIPEDE



MILLIPEDE



The Mark and Recapture Technique

- I. Grade Level 9-12; Ecology and Math (Statistics)
- II. Objectives:
 1. The students will be able to determine the density of grasshoppers in a given area by utilizing the mark and recapture technique.
 2. The students will be able to use the Lincoln-Peterson Index: $N = Mn/m$ to find the density of each species in the open field.
- III. Materials and Supplies:
 - Insect collection nets
 - Clipboard
 - Markers
 - Pen and paper
 - Jar with lighter fluid
- IV. Pre-Planning:
 1. Discuss the most common grasshoppers found in Alabama.
 2. Discuss the different techniques used to find the population of a species.
 3. Explain the use of mathematics to find the density of grasshoppers in an area.
 4. Discuss the background of grasshoppers including the anatomy and appropriate vocabulary for your level of students.
- V. Procedures:
 1. Demonstrate proper procedures for collecting the grasshoppers using the insect collection nets. (CAUTION: When looking around the pond, stream, logs, and other natural debris in the outdoors, please watch for snakes and other dangerous creatures.) Show the class a designated area to collect the grasshoppers.
 2. Separate the class into groups of four and let them begin catching grasshoppers. When they catch the grasshoppers put a black mark behind their head. The class should capture and mark the grasshoppers for approximately 25 to 30 minutes.
 3. The groups should take a 10 minute break and record the data each group collects. The groups should share their data in order to have an accurate count of grasshoppers.

4. The same groups should now recapture as many grasshoppers as possible. This time they need to place them in the glass jar with lighter fluid.

5. The students should make a table showing the marked grasshoppers in the first capture labeling them (M). The total number of grasshoppers caught in the second capture should be labeled (n). Then, the marked grasshoppers in the second capture should be labeled (m). Example:

	Marked(M)	Second Capture(n)	Marked (m)
Green	68	81	11

With this data, use the Lincoln-Peterson Index ($N = Mn/m$) to calculate the density ($D = (N/Area) 1/x$). By taking the recipricle, it will give the total grasshoppers per square meters. Example:

$$\begin{aligned} N &= Mn/m & D &= (N/Area) \\ N &= 68(81)/11 & D &= 500.72/8600m^2 \\ N &= 500.72 & D &= .058m^2 \quad (\text{take the recipricle} \\ & & & \text{to get (gh) per sq meters)} \\ & & D &= (.058m^2) 1/x \\ & & D &= 17.2 \text{ (gh) per sq meters} \end{aligned}$$

VI. Estimated time of Activity : 70 to 80 minutes

MAKING A CRITTER-JAR LID

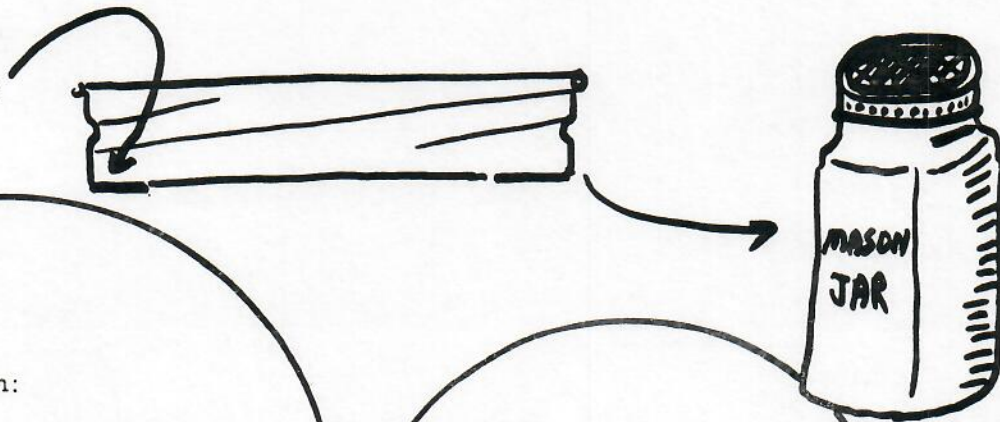
You will need:

- (1) a Mason Jar ring for each jar
- (2) a canning jar or a mayonnaise jar that the ring will fit
- (3) a piece of window screen (aluminum screen is best)
- (4) a pair of scissors
- (5) a tube of "Plastic Metal" or "Liquid Solder"

How to do it:

- (a) cut out the round paper pattern
- (b) using the pattern, cut out as many pieces of screen as you have Mason Jar rings; if you are using aluminum screen, you can use regular scissors but if you're using steel screen use old scissors or tin-snips.
- (c) put a generous but neat amount of the Plastic Metal all around the inside rim of the ring.
- (d) drop the screen circle into the ring and press it neatly down into the Plastic Metal.
- (e) make sure the screen is well "glued" in and wipe out any excess liquid. **BE SURE** not to get any of the Plastic Metal on the threads of the ring or you will not be able to screw it on your jar.
- (f) let the rings dry for several hours before you use them; over-night is best.

Plastic Metal here:



Screen wire pattern:

for wide-mouth
Jars such as
Kraft mayonnaise.

for
Standard
Qt. and Pt.