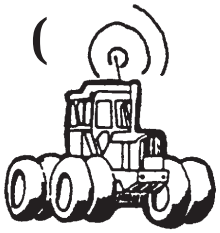
Activity 12



Don't Bug Me

Activity: Students will identify an insect, relate structure to function in terms of insect feeding habits, and propose efficient pest control methods.

Curriculum Fit:

Grade Eight - Science
- Topic 6: Interactions and Environments

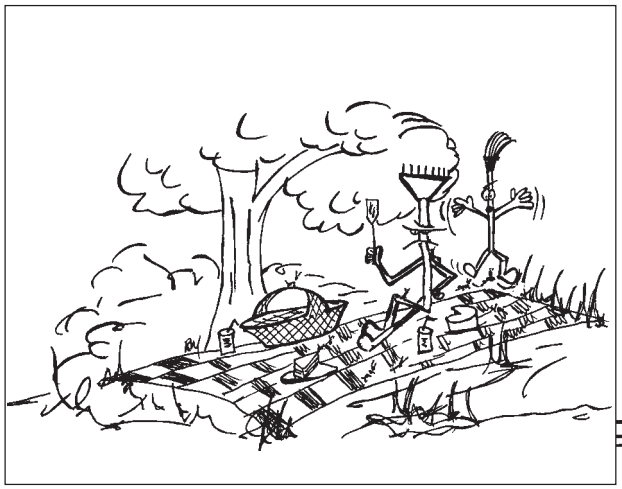
Grade Nine - Science
- Topic 1: Diversity of Living Things
- Food chains and food webs
- Interdependencies of living things
- Adaptation in structure and behaviour
- Systems of classification - dichotomous grouping

Agriculture Concepts: Economic importance of agriculture
Production, processing and marketing systems

Cognitive Level: Comprehension, Evaluation

Materials Required:
- Illustrated insect specimens attached
- Key to insect structure (attached)
- Key to food sources (attached)
- Key to animal hosts (attached)
- Insect information sheets (attached)

Time Required: 2 - 3 periods



Background — For the Teacher

Insects are probably the most successful of all animals. There are more than one million identified species distributed in virtually all freshwater and land regions of Earth. The small size of insects, their high reproductive rates and their ability to exploit suitable food supplies account for much of their success. Individual numbers are so large they defy comprehension. Insects appear in the fossil record from about 350 million years ago. Humans only arrived on the scene in the last several million years. Often, however, the coexistence between man and insect has not been harmonious. Insects play important roles in nature, from helping to decompose organic matter to pollinating plants to providing food for other animals. But some insect species also spread diseases or compete with humans for food.

In this lesson, students will identify 14 common agricultural insect pests of Alberta and their food source. By looking at the type of damage they do to agricultural products, students should infer a connection between structure and function. Students also consider pest control methods both economically and in terms of effectiveness.

Knowledge of insect life cycles and the relationship among pest, host and natural enemies help the pest manager to identify a suitable control method. Students will interpret given information about insect pests in order to come up with the best possible control method. An integrated system of pest management, one involving some or all of the proposed methods, is often best and students may discover this.

NOTE

The two identification keys will give your students experience in identifying unknown things by a process of dividing classes into progressively finer subclasses. This process is important in biology. However, in several instances, we have compromised the basic rule of taxonomy that you must always use permanent structural characteristics as the basis of identification. Most of these compromises occur in the key of food products and involve grouping by use rather than structure.

Procedure

Preparation

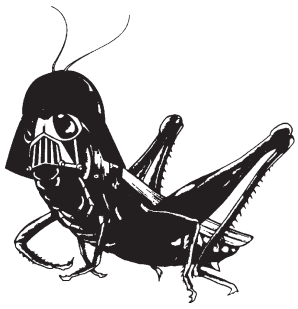
1. Photocopy the illustrated insect specimens (Task Sheets One & Two), cut the cards apart and put them in a box.
2. Make one copy of each Insect Information Sheet (One through Fourteen) and one copy per group of the Insect Structure Key, Food Source Key and Animal Host Key.
3. Make one large class copy of the Insect Structure Key, Food Source Key and Animal Host Key.

Introduction

4. Show your students the box with the insect specimens inside it.
5. Tell them that you have some insect pests in the box and you are going to turn them loose on a farm. Ask students what is meant by "pest" and how an insect gets to be one.
6. Inform them that their job is first to identify the insect, then identify its food source and finally figure out a suitable control method for the pest.
7. Divide your class into groups of 2 or 3 and hand out copies of the Insect Structure Key, the Food Source Key and the Animal Host Key to each group.

Identifying Insects

8. Have each group of students:
   a) draw one insect out of the box;
   b) find the Insect Information Sheet for the insect;
   c) identify the insect by using the Insect Structure Key and the Insect Information Sheet;
   d) find the insect's food source (host) from the Insect Information Sheet;
   e) match the insect to its food source by using the Food Source Key and the Animal Host Key. Use the class copy for this. (There may be more than one line from each insect.)
   f) draw a small picture of the insect and place it on the class copies of the Insect Structure, Food Source and Animal Host Keys.



Choosing Pest Control Methods

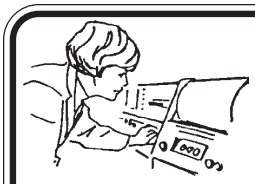
9. Now divide your classroom into three sections - designate one section for the Cultural Control of Insects, one section for the Biological Control of Insects and one section to the Chemical Control of Insects. (See Teacher Resource Sheet Two for an explanation of these control methods.)
10. Have each group go to the section of the classroom that best represents the control method described on their Insect Information Sheet. Groups may discover that a combination of the three control methods is best.
11. Have the groups discuss ways of determining whether a pest control method is economically worthwhile and alternate control methods which might be possible.

Discussion Questions

1. Do the mouth parts of mosquitoes and grasshoppers illustrate a connection between structure and function? Give examples.
2. How do farmers determine whether a pest control method is economically worthwhile?
3. To what degree is damaged food still suitable for human consumption?
4. What seems to be the best approach to pest control?
5. Does it help to know more about an insect pest when determining which control methods to use? Why?

Related Activities

1. Investigate some of the more advanced and interesting pest control methods used on Alberta farms.
2. Find out the cost of various methods for controlling insects in dollars per acre.
3. Identify sources, ordering procedures, import restrictions and other information for biological control agents.
4. Develop a poster advocating one form of insect control.
5. Make a list of all of the pests the class can think of and ask each student to develop a dichotomous key that would allow an extraterrestrial to separate them.
6. The Insect Structure Key and the Food Source Key both break fundamental rules of key construction for life science. Find out what the rules are and evaluate these keys.
7. Have students establish a collection of insects that significantly affect agriculture.



TEACHER RESOURCE

Sheet One

What is a Pest?

A pest is any organism that adversely influences the welfare of humans by affecting their health, food or lodging. This can include anything from the tent caterpillar that consumes ornamental trees and strips the poplar of its leaves to the mosquito that carries equine encephalitis (sleeping sickness) to horses and humans, the warble fly grub that feeds off livestock, the bacterial ring rot that destroys potatoes in storage or the wild oat plant that reduces the yield of wheat.

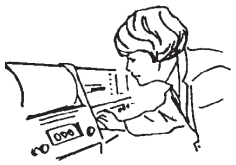
Helpful Insects

Many insects are helpful to man, either directly or indirectly. Insects can be valuable for commercial reasons or for the important roles they play in maintaining the balance of nature. Assistance from beneficial insects could be essential to our survival.

At least fifty of our important food crops depend on pollinating insects, such as bees, for setting of fruit and resultant seed. Insect pests would ruin crops and vegetation but for predatory insects that capture and feed on them. Parasitic species also help to check insect pests. Scavenger insects aid in the decomposition of organic matter while some insects help to aerate, fertilize and condition the soil. There are insects that make shellac, dyes or pigments. The silkworm produces silk and bees make honey and beeswax. Insects also provide food for fish and animals, produce certain medicinal substances and aid in scientific research.

Knowing man's friends in the insect world can be important in controlling his enemies. Entomologists study the life cycles of the beneficial insects, learning how to use them to our fullest advantage.

TEACHER RESOURCE



Sheet Two

Insect Management Strategies

Certain weeds, insects and microorganisms exploit the agricultural environment, using a significant portion of our yearly harvest if they are not controlled. Farmers use many methods to control them.

Chemical Methods of Pest Control

Chemical methods mainly include the use of pesticides such as herbicides, insecticides and fungicides. Pesticide-resistant organisms and examples of harmful side effects from chemicals make it desirable to explore additional methods of controlling pests. The alternatives include cultural and biological control and integrated pest management.

Cultural Methods of Pest Control

Cultural methods of pest control include using physical or mechanical means to prevent pests from getting established. Foremost among these are tillage, crop rotation, summerfallow and the use of weed-free seed.

Biological Control

Biological control of pests depends on the use of living organisms to keep pests from multiplying out of control. These control organisms may act on the pest through predation, parasitism or infection.

Integrated Pest Management

If all the available methods of controlling pests are used in combination, rather than individually, more effective pest control can be achieved. Cultural, biological and chemical methods can be integrated into a total package of pest control called integrated pest management. This strategy depends on a detailed knowledge of the life cycle and natural history of each pest species.

TEACHER RESOURCE

Sheet Three -- Insect Life Cycles

Metamorphosis

Newly hatched insects often do not resemble the adult form. These immature insects must undergo changes in form. All young insects undergo metamorphosis whether this be simply increasing in size or acquiring new adult structure. The two common types of metamorphosis are incomplete (simple) and complete.

Incomplete (Simple) Metamorphosis

This form of metamorphosis includes three developmental stages: egg, nymph and adult. The nymph closely resembles the adult except in size, color, shape and/or presence of wings and sex organs. As the nymphs mature, they gradually become more similar to the adult. As the nymphs grow, they must undergo a series of molts at which time they shed their rigid exo-skeleton or "skin". With few exceptions, both adults and nymphs display similar habits, and live and feed on the same host. Some insects showing this life cycle are grasshoppers, aphids, thrips and lice.

Complete Metamorphosis

This life cycle includes a metamorphosis through four developmental stages: egg, larva, pupa, adult. In this type of development, the young or larvae (e.g. maggots, caterpillar, grubs) do not resemble the adults. Larvae, like nymphs, require periodic shedding of the "skin" in order to grow before transforming into inactive pupae. Pupae are usually covered by a cocoon or some other protective coating. During this stage of development, extensive tissue reorganization occurs in which adult structures replace larval structures. Insects with this life cycle pattern include flies, beetles, moths, and keds.

TEACHER RESOURCE

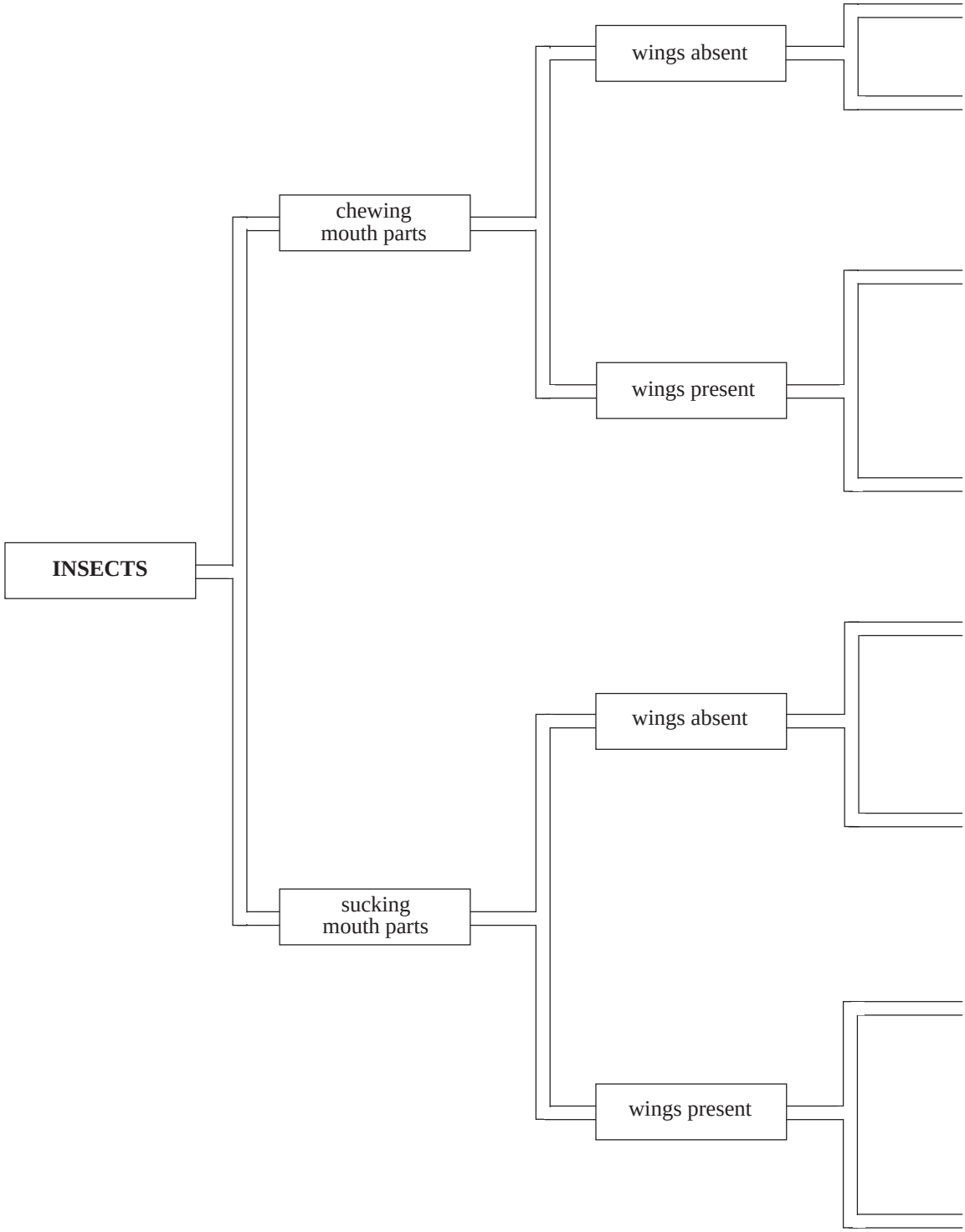
Sheet Four --

Developmental Stages When Insect is an Agricultural Pest

Insect in Key	Type of Metamorphosis	Pest Stage(s)
grasshopper	simple	nymph/adult
sawfly	complete	larva
wireworm	complete	larva
plant bug	simple	nymph/adult
alfalfa looper	complete	larva
red turnip beetle	complete	larva/adult
weevil	complete	adult
thrips	intermediate *	adult
aphid	simple	nymph/adult (female)
warble fly grub	complete	larva/adult
mosquito	complete	adult (female)
biting louse	simple	nymph/adult
ked	complete	adult
horse bot fly	complete	adult

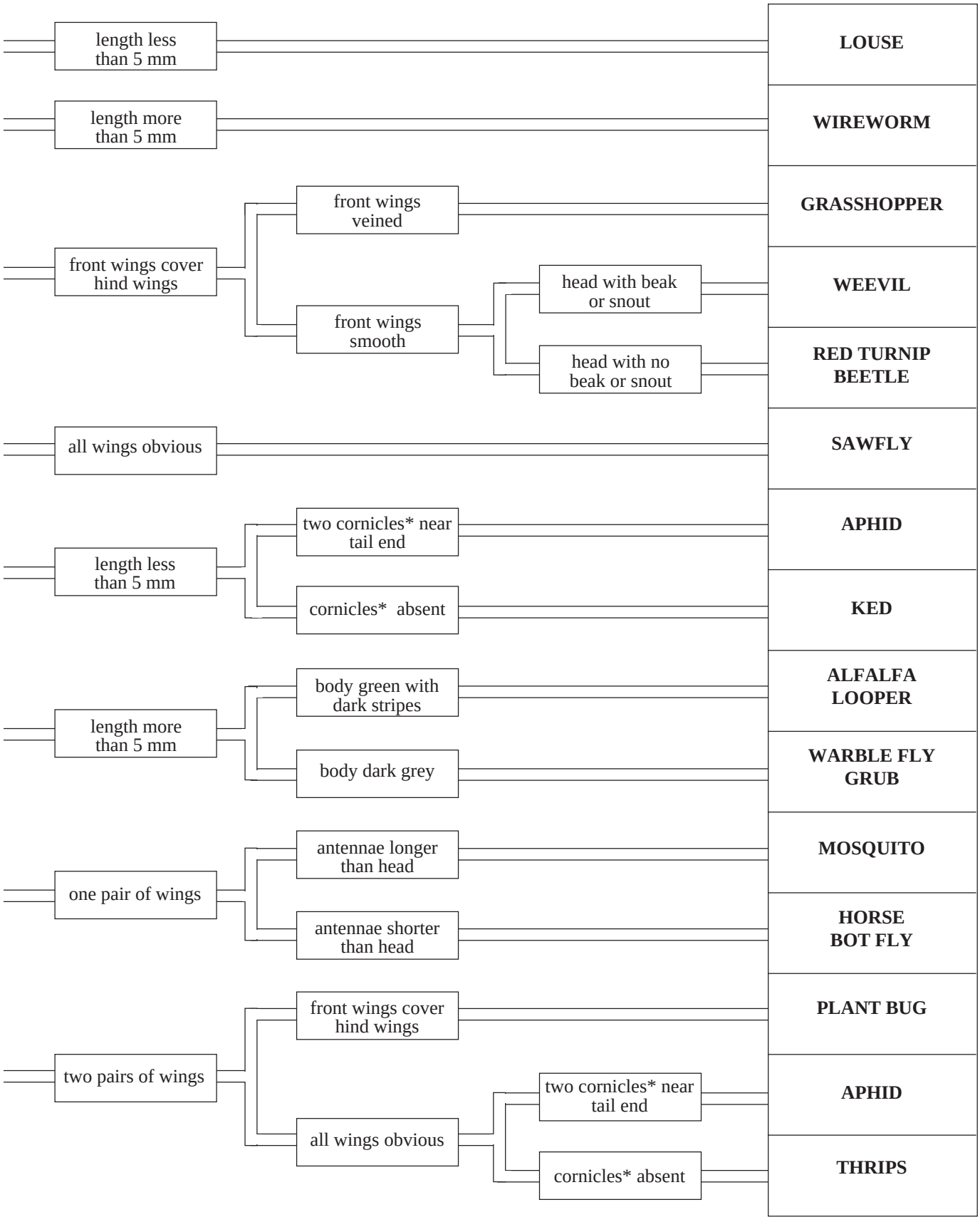
*** thrips -** 4 development stages (egg, larva, pupa, adult) but larva resemble adults except for smaller size, lack of wings and paler color.

KEY TO INSECT STRUCTURE, PART A
**(continues into PART B)



****cornicle:** a small horn-like organ

KEY TO INSECT STRUCTURE, PART B



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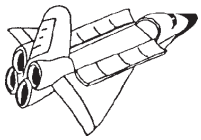

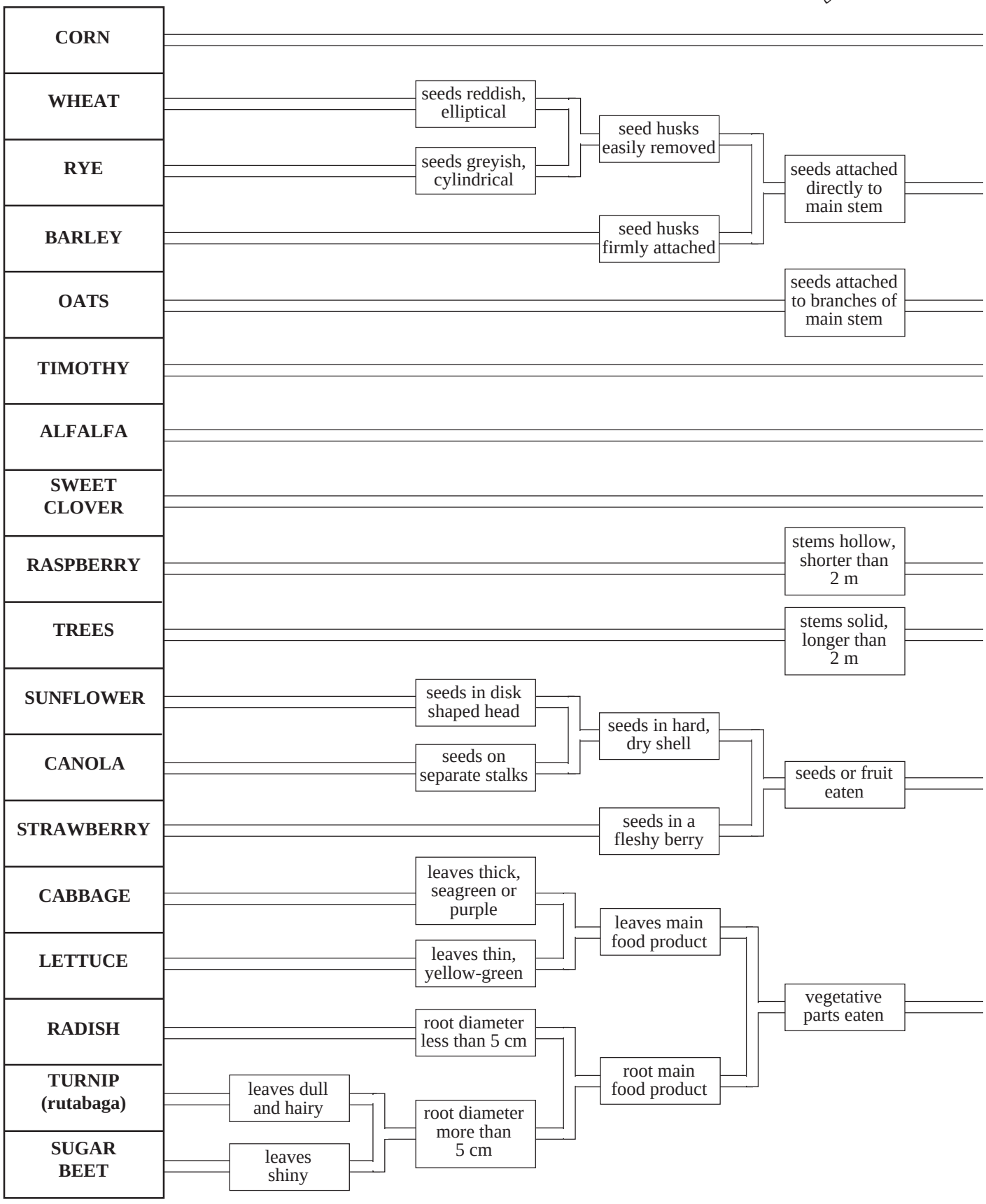

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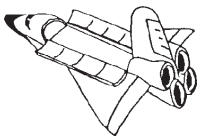
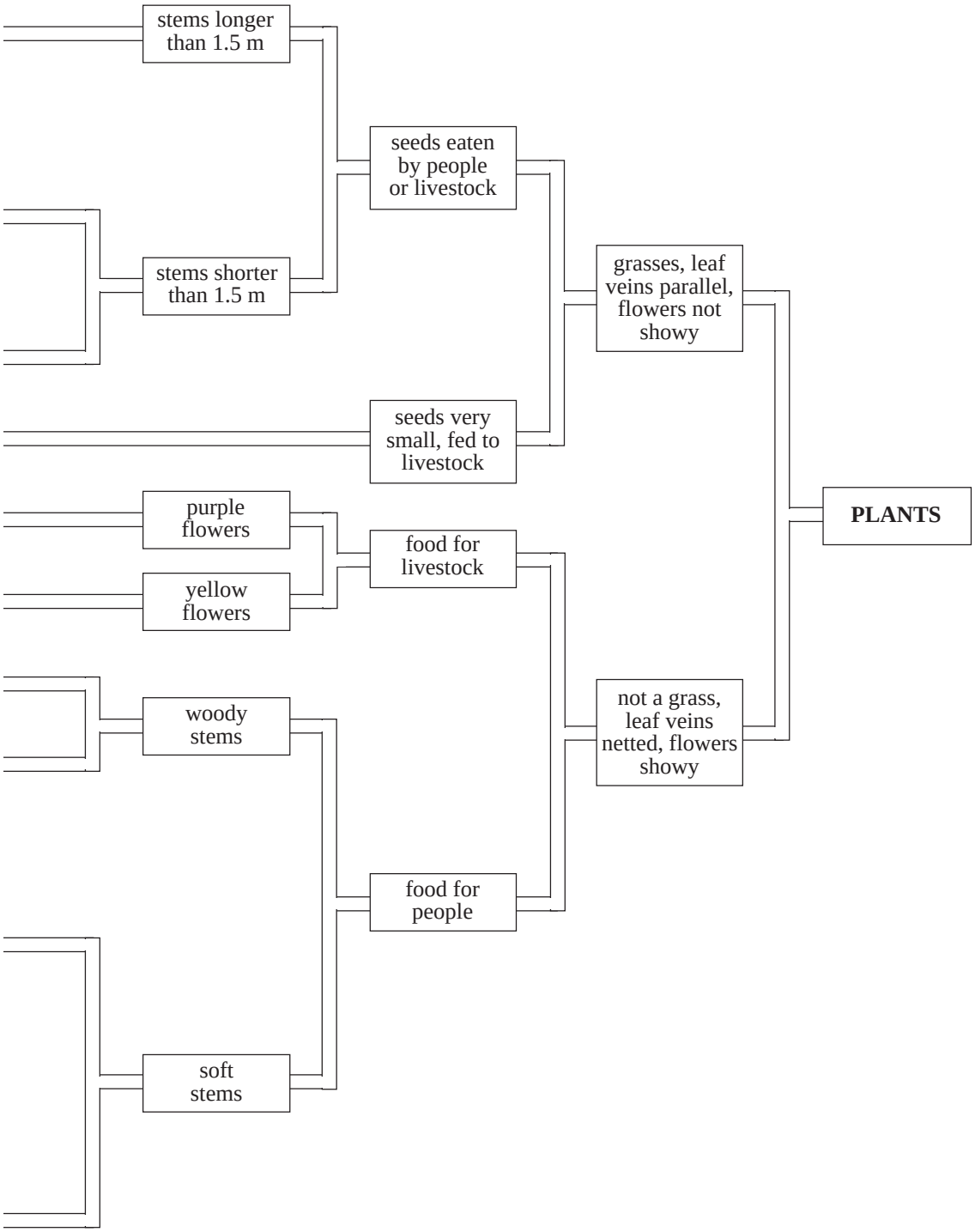
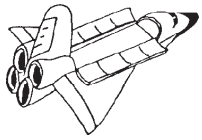
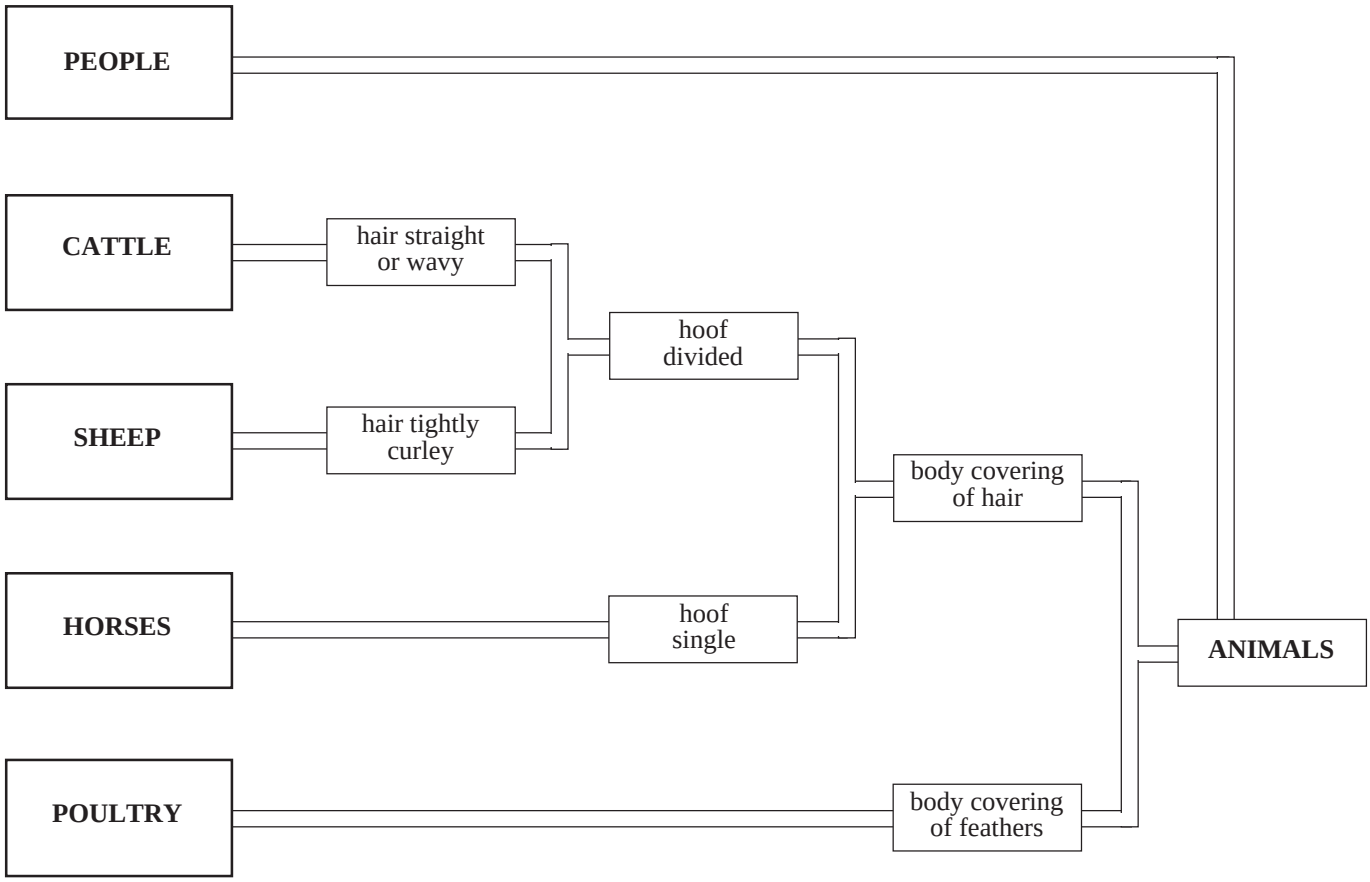


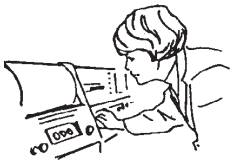




KEY TO ANIMAL HOSTS



Sheet Five -- Key to the Insect Information Sheets



Sheet 1 Alfalfa looper

Sheet 2 Grasshopper

Sheet 3 Plant bug

Sheet 4 Mosquito

Sheet 5 Ked

Sheet 6 Warble fly grub

Sheet 7 Horse Bot Fly

Sheet 8 Thrips

Sheet 9 Aphid

a) winged

b) wingless

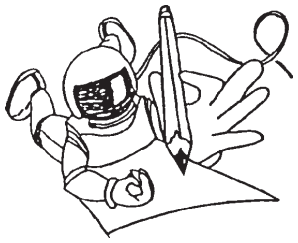
Sheet 10 Weevil

Sheet 11 Sawfly

Sheet 12 Louse

Sheet 13 Red turnip beetle

Sheet 14 Wireworms



Task Sheet One -- Unidentified Insects

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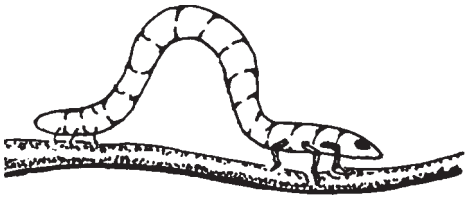

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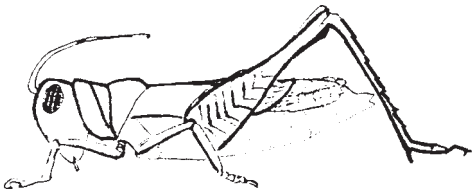

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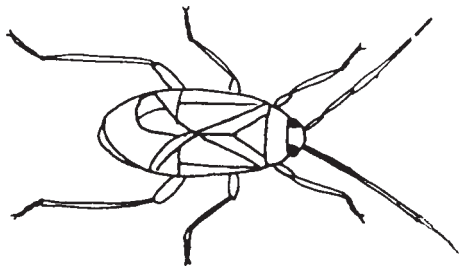

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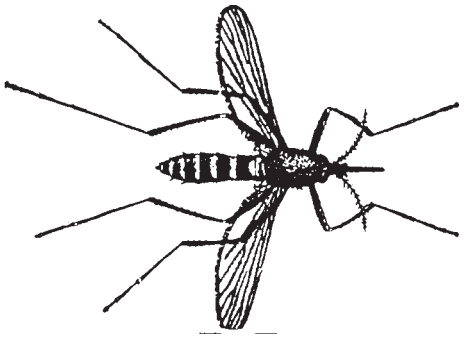

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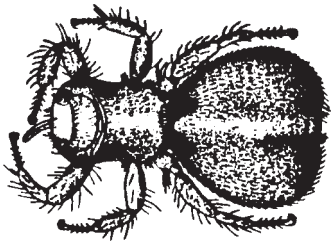

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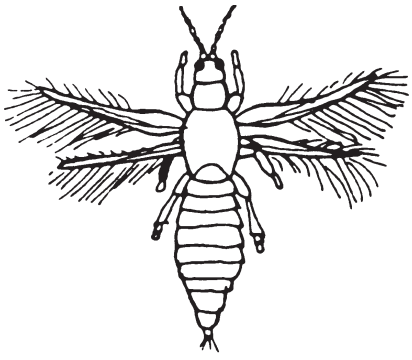
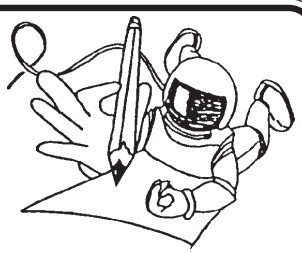


Task Sheet Two --
Unidentified Insects



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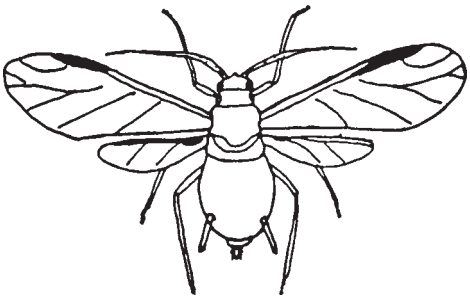

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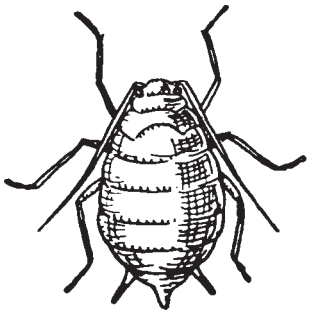

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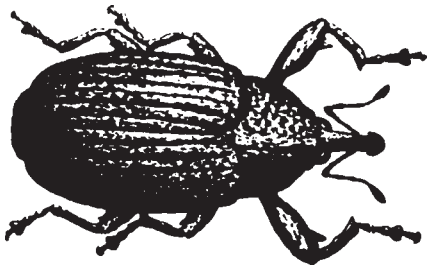

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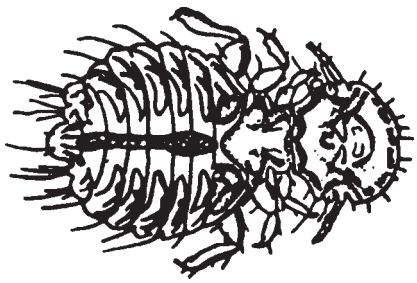

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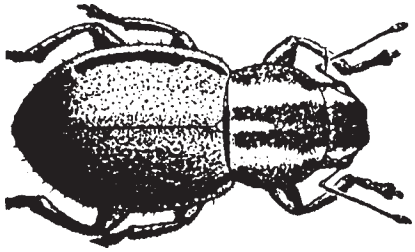

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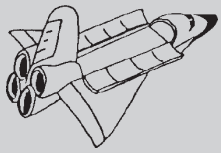


Insect Information
Sheet One

Characteristics

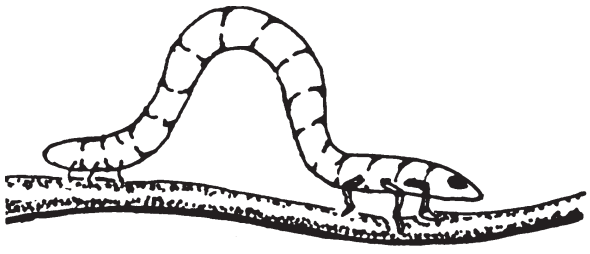
- ❒ This pest is the larva of a gray moth.
- ❒ It is olive green in color with a pale head and dark stripes down sides and back.
- ❒ Larvae feed for about 4 weeks before attaching themselves to a plant and spinning a woolly cocoon in which to pupate.
- ❒ Moves by bringing its hind legs forward, then releasing its front legs and extending its body forward.
- ❒ Mature larvae are about 25 mm long.
- ❒ Commonly 3 broods a year.
- ❒ Over winters as pupa.

Hosts

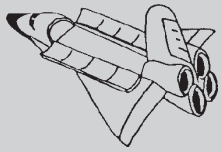
- ❒ They suck the sap from alfalfa and canola.
- ❒ The plants can normally recover unless severe damage occurs due to a large population.

Control

- ❒ Normally numbers are limited by natural parasites and predators.
- ❒ At least one virus species is known to be pathogenic.
- ❒ Insecticides include chlorpyrifos and methomyl. However, these must be applied at least 21 days before harvest.



Insect Information
Sheet Two



Characteristics

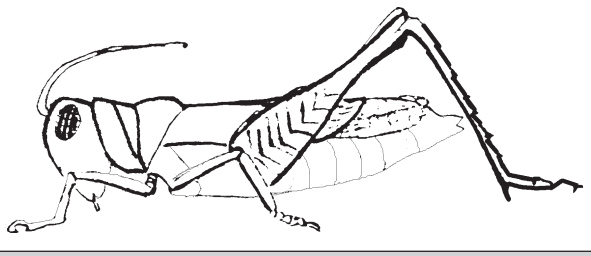
- ❒ Over winter as egg, hatch as a nymph, less than 6 mm long.
- ❒ Adults and nymphs feed on vegetation.
- ❒ Adults 21 - 40 mm long.
- ❒ Two pairs of wings: forewings are veined and cover hindwings; hindwings are transparent.

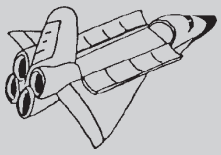
Hosts

- ❒ This pest feeds primarily on native grasses and seeds.
- ❒ Causes damage to cereal crops at the edges of fields (damage to grasslands is more evenly distributed).
- ❒ Damage to cereals include leaf stripping and clipping of heads.
- ❒ Will chew any plant or plant product.

Control

- ❒ Control by cultivating stubble immediately after harvest to destroy eggs.
- ❒ Weed control is important to discourage egg laying.
- ❒ Seed early.
- ❒ Summerfallow in heavily infested areas.
- ❒ Use “trap strips” (rows of cultivated and uncultivated field) in order to concentrate the pest in smaller areas then use insecticide on those areas.
- ❒ Predators include the blister beetle (feeds on eggs).
- ❒ Pathogens include a fungus disease which leaves corpses clinging to stems.
- ❒ Parasites include wasps.
- ❒ Insecticides include carbaryl and methamidophos (do not apply within 10 days of harvest).





Insect Information Sheet Three

Characteristics

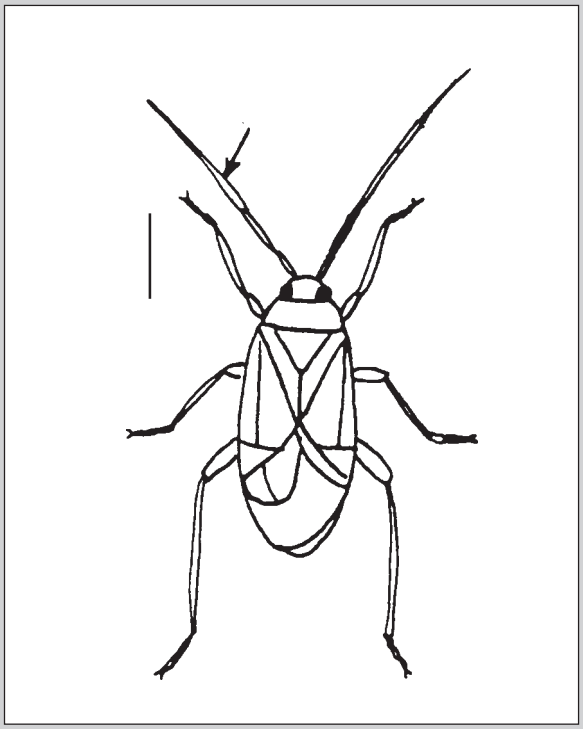
- ❒ This family of pests feeds on blossoms in bud stage, on flowers and on young seedlings by sucking up plant juices with needle like mouthpart.
- ❒ Two pairs of wings, forewings cover hindwings.

Hosts

- ❒ Alfalfa
- ❒ Do not affect feed quality, but, reduce or prevent seed development.

Control

- ❒ Removal of weeds reduces hiding places.
- ❒ Predators include the ladybird beetle.
- ❒ Spring burning of stubble destroys eggs of many species.
- ❒ Chemical control with dimethoate 4E or others.



Insect Information
Sheet Four

Characteristics

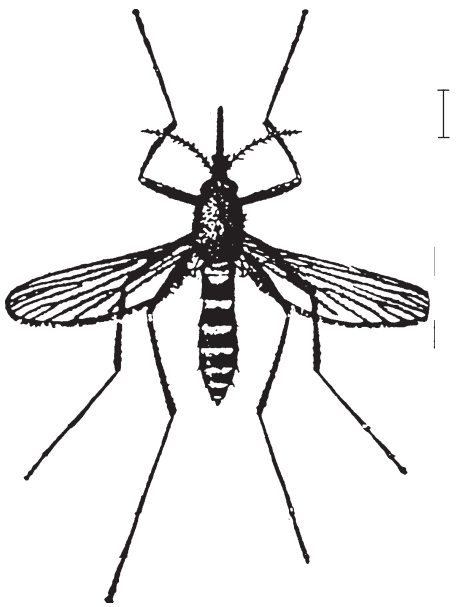
- ❒ This pest lays its eggs around water and eggs are hatched underwater.
- ❒ One pair of wings.
- ❒ Antennae longer than head.

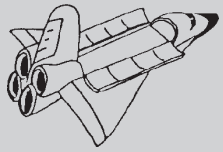
Hosts

- ❒ Larvae feed on organic matter in water.
- ❒ Female adults search for a blood meal after mating in order for egg to develop - sucks blood from all mammals, including humans.
- ❒ Can carry sleeping sickness.

Control

- ❒ Control pest through source reduction - drain stagnant waters around home.
- ❒ Electrocute using heat source and light.
- ❒ Hand killing is also possible, but slow.
- ❒ Chemical control at the larval stage only, by spraying stagnant waters.





Insect Information Sheet Five

Characteristics

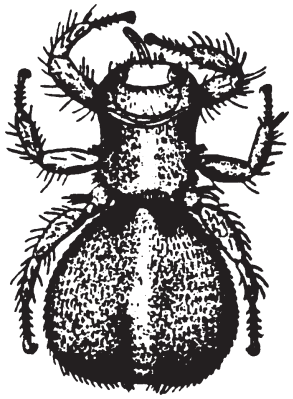
- ❒ This pest is a small wingless fly (less than 5 mm in length) which has become adapted to a tick-like existence.
- ❒ Adult feeds by piercing skin of the host and sucking its blood.
- ❒ Unique in that eggs hatch within uterus of female and the young larvae develop to maturity on food secreted by the nutritive glands of the mother.
- ❒ Mature larvae born after eight days of feeding and growing in the uterus.
- ❒ Pupae become cemented to the sheep's wool for 22 days then adults emerge.
- ❒ Entire life of adult is spent in the fleece of host.

Hosts

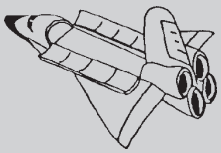
- ❒ Goats, sheep, especially the young.
- ❒ Insect bites result in a defect in sheepskins known as cockle. Quick recovery occurs if parasite is removed.

Control

- ❒ Farmer should feed sheep well, as well-fed lambs usually do not support as many pests as underfed lambs.
- ❒ Insecticides include diazinon which should be applied in spring after shearing when temperatures are at least 10°C.



Insect Information
Sheet Six



Characteristics

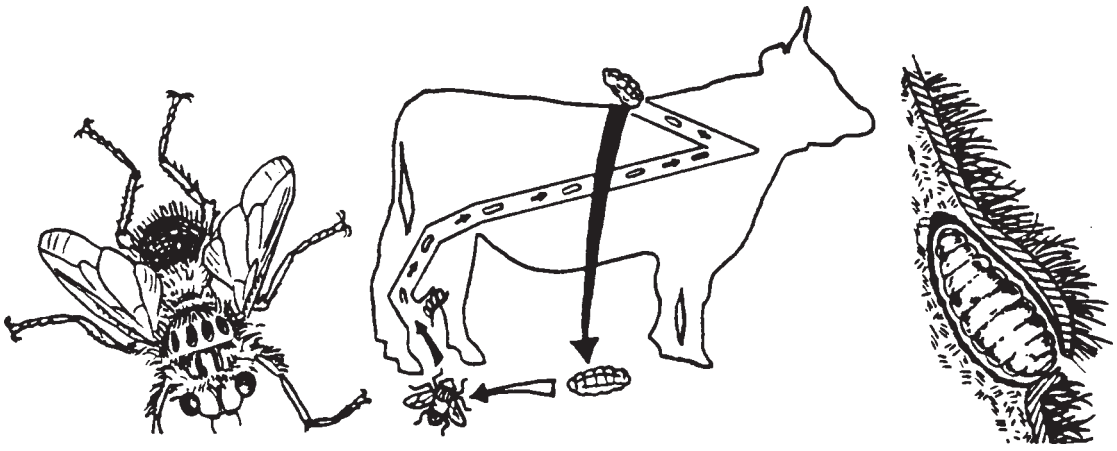
- ❒ This pest is the larva of a warble fly.
- ❒ It is dark grey in color with sucking mouth parts.

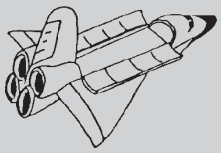
Hosts

- ❒ The adult lays eggs on cattle hairs.
- ❒ The larva hatches and burrows through the skin, wandering through the body until it reaches the back where it cuts a breathing hole.
- ❒ Remains in cow's body 7 - 9 months.
- ❒ Larva is dark gray, longer than 5 mm.
- ❒ When mature, it squeezes through the hole, falling to the soil where it pupates to eventually become the adult fly.

Control

- ❒ The insecticide rotenone can be rubbed onto warble openings in hide during the spring.
- ❒ Systemic insecticides can be applied to calves and adults in the autumn. Cannot treat calves smaller than 62 kg or milking cows or cattle to be slaughtered within 28 days.





Insect Information Sheet Seven

Characteristics

- ❒ Can be a serious pest where excess waste materials build up.
- ❒ Reproduce in manure and are capable of transmitting the stomach worm.
- ❒ Feed by sucking blood, especially during summer months.
- ❒ Antennae shorter than head.
- ❒ One pair of wings.
- ❒ External parasite

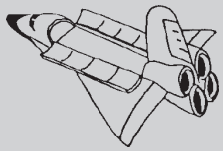
Hosts

- ❒ Horses, cattle, sheep

Control

- ❒ Keep stalls clean and freshly bedded.
- ❒ Good drainage from corrals.
- ❒ Remove dead animals to burying ground.
- ❒ Treat horse wounds.
- ❒ Prevent weed overgrowth to avoid hiding places.

Insect Information
Sheet Eight



Characteristics

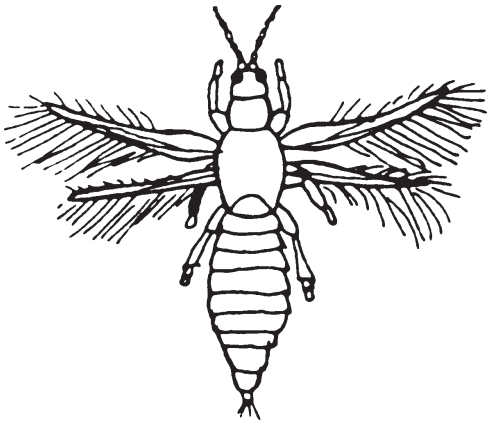
- ❒ This pest is small and slender.
- ❒ It feeds by rasping or piercing outer plant tissue, and sucking up the juices which escape.
- ❒ Damage appears as whitish blotches or streaks on leaves, flower buds and petals.
- ❒ Larva resembles adult even though it undergoes four developmental stages including pupal stage.

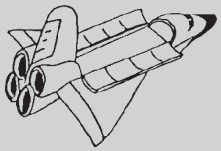
Hosts

- ❒ All plants, especially alfalfa and barley.

Control

- ❒ Under investigation
- ❒ Insecticides should not be used when clover crop is in bloom.
- ❒ Predators include the flower bug.





Insect Information Sheet Nine

Characteristics

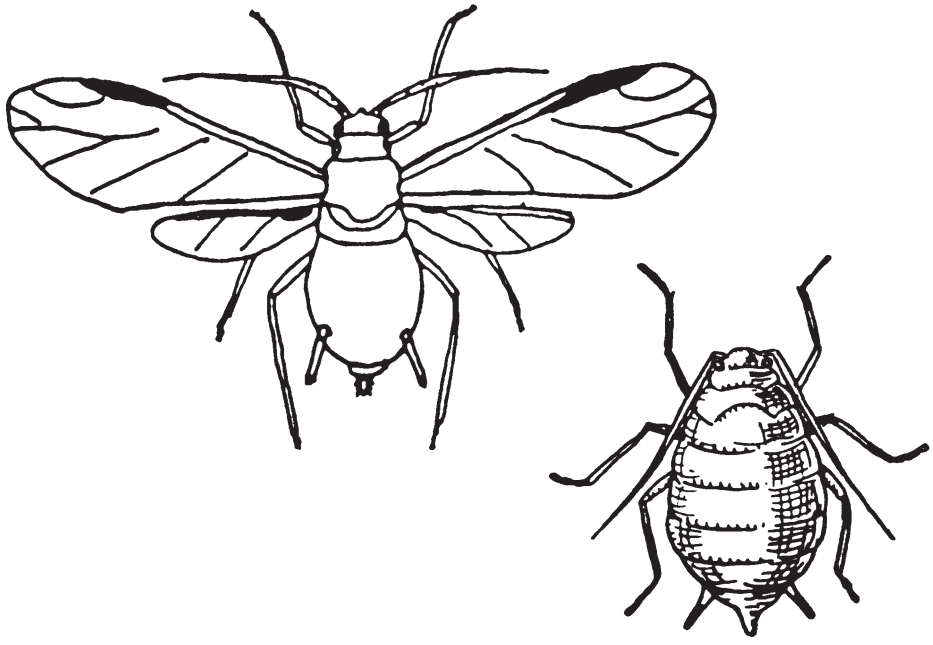
- ❒ This pest is small (less than 5 mm long), oval and fragile.
- ❒ Adults may be either winged or wingless.
- ❒ It has piercing and sucking mouthparts.
- ❒ It reproduces both sexually (mating required) or partheno-genetically (mating not required).
- ❒ Males are not produced until early fall.

Hosts

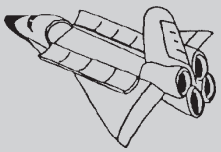
- ❒ Injurious to all forms of plant life and may be found on tree bark, stems, leaves, blossoms, fruit and roots.

Control

- ❒ Predators include the lacewing.
- ❒ Parasites include the braconid wasp.
- ❒ The insecticide diazinon can be used on crops and trichlorfon on trees.
- ❒ Do not apply diazinon just before harvest.



Insect Information
Sheet Ten



Characteristics

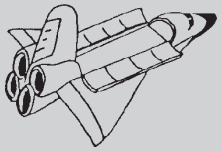
- ❒ 4 mm long.
- ❒ Dark grey in color.
- ❒ Prominent beak.
- ❒ 2 pairs of wings; forewings are smooth and cover hindwings when at rest.

Hosts

- ❒ This pest causes defoliation of plants, especially legumes and fruit.
- ❒ Chews on alfalfa if no sweet clover is present.

Control

- ❒ Control by arranging crop rotations so that new clover fields are as far as possible from old ones.
- ❒ Sow clover early (before grain crops) and at proper depth to promote hardy vigorous seedlings.
- ❒ Cultivate clover silage and hay fields as soon as crop is removed in order to kill larvae.
- ❒ Predators include toads and grubs.
- ❒ Pathogens include a fungus disease.
- ❒ Insecticides include malathion, diazinon, methoxychlor. Do not use in houses - rather keep doors and windows closed, seal all cracks, and use broom or vacuum cleaner if pest is found in house.
- ❒ Insecticides not recommended for tree infestations.



Insect Information
Sheet Eleven

Characteristics

- ❒ This pest is wasp-like in appearance.
- ❒ Adults do not feed.
- ❒ Females lay eggs using saw-like ovipositor.
- ❒ Cannibalism occurs among newly hatched larvae.

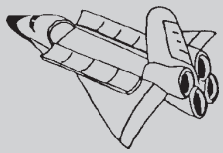
Hosts

- ❒ Larvae chew on inside of wheat and rye stems - stem is weakened at a point just above ground level resulting in breakage by wind or rain.
- ❒ Fallen stems are difficult to harvest.

Control

- ❒ Control by swathing infested wheat after kernel moisture drops.
- ❒ Rotate crops to barley, oats, alfalfa, etc.
- ❒ Delay seeding in spring.
- ❒ Summerfallow infested stubble (burning also reduces numbers, but it reduces parasite numbers as well).
- ❒ Solid-stemmed resistant varieties of wheat can be tried.
- ❒ No insecticides are recommended.
- ❒ For infested trees, either hand pick the larvae or use acephate.

Insect Information
Sheet Twelve



Characteristics

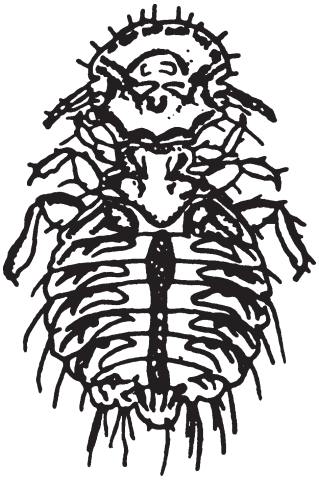
- ❒ This pest is small (less than 5 mm long), wingless and flattened.
- ❒ It spends its entire life and development on host.

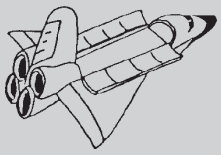
Hosts

- ❒ Major pest of poultry - chews primarily on bits of hair, feather, flakes of skin and other debris on hosts.
- ❒ Heavily infested hens appear dopey and listless; egg production decreases significantly.

Control

- ❒ Insecticides include malathion dust applied directly on birds, nicotine sulphate paint on roosts and lindane spray on litter. Do not apply within 7 days of slaughter.





Insect Information
Sheet Thirteen

Characteristics

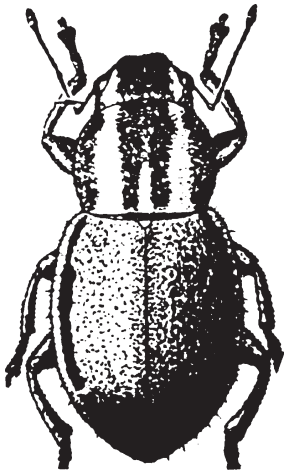
- ❒ 7 mm long.
- ❒ Adults bright red with black patches on head and 3 distinct black lines on the back.
- ❒ Over winter as eggs.
- ❒ Larvae black, slow moving, feed at night.
- ❒ Pupae bright orange.
- ❒ One generation per year.
- ❒ Two pairs of wings; forewings are smooth and act as covers for the hindwings when the insect is at rest.

Hosts

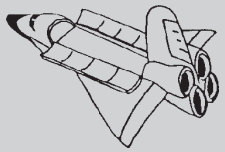
- ❒ This pest feeds on potato, cabbage, radish, turnip, canola, and other cruciferous plants.
- ❒ The larvae and adults chew on the flowers, seed pods and foliage.
- ❒ Adults are responsible for the greatest damage, especially in seedling canola.

Control

- ❒ Cultivate fields after harvest.
- ❒ Rotate crops.
- ❒ Predators include the fiery hunter.
- ❒ Pathogens include microsporidians.
- ❒ Insecticides include oziniphos-methyl, carbonfuranete (do not apply within 30 days of harvest).



Insect Information
Sheet Fourteen



Characteristics

- ❒ Slender, hard bodies, usually yellow, up to 25 mm long.
- ❒ May live 5 - 10 years before pupating.
- ❒ Always found in soil.
- ❒ Chewing mouth parts.

Host

- ❒ Roots or germinating seeds of cereal crops and roots of potatoes, sugar beets, corn, lettuce and sunflower seeds.
- ❒ Can go for 2 years without food if they survive first winter.

Control

- ❒ Control by rotating grass with cereal crop.
- ❒ Insecticide called lindane can be used as a seed dressing.