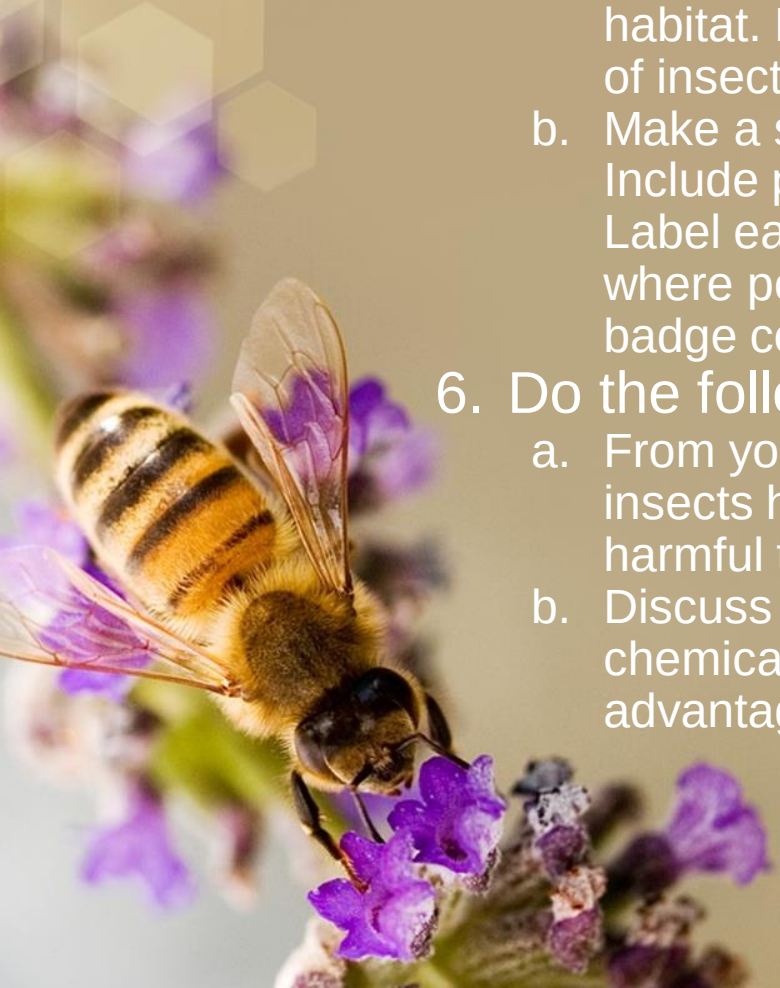
Troop 344/9344
Pemberville, OH

Insect Study Merit Badge

Requirements

1. Do the following:
    a. Explain to your counselor the most likely hazards associated with exposure to ants and bees and what you should do to anticipate, help prevent, mitigate, and respond to these hazards.
    b. Discuss the prevention of and treatment for health concerns that could occur while working with ants and bees, including insect bites and anaphylactic shock.
2. Tell how insects are different from all other animals. Show how insects are different from centipedes and spiders.
3. Point out and name the main parts of an insect.
4. Describe the characteristics that distinguish the principal families and orders of insects.

Requirements



5. Do the following:
   a. Observe 20 different live species of insects in their habitat. In your observations, include at least four orders of insects.
   b. Make a scrapbook of the 20 insects you observe in 5a. Include photographs, sketches, illustrations, and articles. Label each insect with its common and scientific names, where possible. Share your scrapbook with your merit badge counselor.
6. Do the following:
   a. From your scrapbook collection, identify three species of insects helpful to humans and five species of insects harmful to humans.
   b. Discuss the use of integrated pest management vs. chemical methods of insect control. What are the advantages and disadvantages of each?

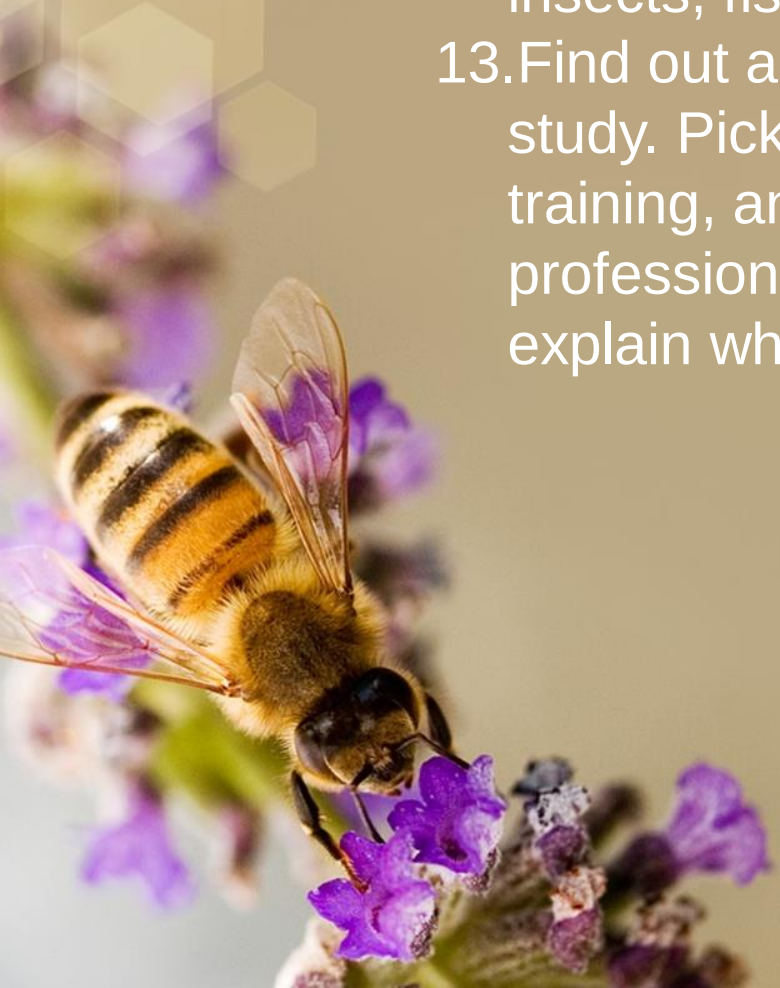
Requirements

7. Explain the symbiotic relationship between bees and humankind. Explain what colony collapse disorder (CCD) is and some of the possible causes. Discuss how CCD affects our food supply.
8. Compare the life histories of a butterfly and a grasshopper. Tell how they are different.
9. Raise an insect through the complete metamorphosis from its larval stage to its adult stage (e.g. raise a butterfly or moth from a caterpillar.

Requirements

10. Do ONE of the following:
    a. Observe an ant colony in a formicarium (ant farm). Find the queen and worker ants. Explain to your counselor the different chambers found within an ant colony.
    b. Study a hive of bees. Remove the combs and find the queen. Estimate the amount of brood and count the number of queen cells. Explain how to determine the amount of honey in the hive.
11. Tell the things that make social insects different from solitary insects.

Requirements



12. Tell how insects fit in the food chains of other insects, fish, birds, and mammals.
13. Find out about three career opportunities in insect study. Pick one and find out about the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.

Requirement 1

Do the following:

a. Explain to your counselor the most likely hazards associated with exposure to ants and bees and what you should do to anticipate, help prevent, mitigate, and respond to these hazards.
b. Discuss the prevention of and treatment for health concerns that could occur while working with ants and bees, including insect bites and anaphylactic shock.

Hazards with Ants and Bees

- Learn to identify flying and crawling creatures.
- Take extra precautions when working outdoors and in places typically inhabited by ants and bees.
- People with a history of severe allergic reaction should consult a medical professional about carrying an epinephrine auto-injector and wearing an allergy identification band.
- Wear light-colored, smooth-finish long-sleeved shirts and long pants and enclosed footwear. Some outdoor stores sell clothing and gear pre-treated with repellent.
- Keep your body clean and odor-free; avoid wearing perfumed lotions and deodorant, aftershave or scented hair products.

Anticipate and Prevent Ant and Bee Hazards

- Manage your environment by checking the area before starting work, closing windows, using screens and nets, and removing any food or other attractive items.
- Insects and ants may be hidden in dark corners, or under wood piles, fallen logs or animal carcasses.
- Areas with abundant flowers attract bugs and bees.
- Do not disturb hives, mounds or nests.
- Be aware of swarming bees and insects, stay calm and leave the area if they become agitated.

Mitigate and Respond to Ant and Bee Hazards

- If you are attacked by several stinging insects at once, run to get away from them.
  - Bees release a chemical when they sting, which may attract other bees.
- Go indoors.
- A shaded area is better than an open area to get away from the insects.
- If you are able to, physically move out of the area.
- Do not to attempt to jump into water.
  - Some insects (particularly Africanized Honey Bees) are known to hover above the water, continuing to sting once you surface for air.

Bee and Ant Stings

- Insect stings can cause life-threatening allergic reactions in sensitive victims.
- These stings cause immediate painful red bumps.
- Remove stinger if still in skin.
- While the pain is usually better in 2 hours, the swelling may increase for up to 24 hours.

Treatment of Stings

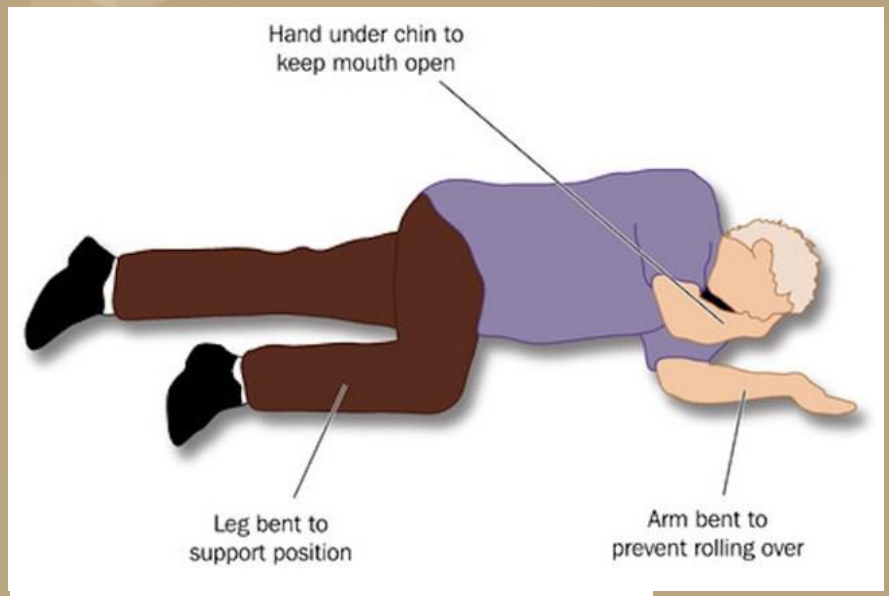
- If you see a little black dot in the bite, the stinger is still present (this only occurs with honey bee stings).
- Remove it by scraping it off with a credit card or something similar.
- For persistent pain, massage with an ice cube for 10 minutes.
- Give acetaminophen immediately for relief of pain and burning.
- For itching, apply hydrocortisone cream.
- Watch victim for any signs or symptoms of allergic reactions.
- If symptoms occur, call 911 and treat for shock.

Symptoms of Allergic Reactions

- Difficulty breathing, wheezing.
- Tightness in throat or chest.
- Swelling of the face and neck, puffy eyes.

First Aid for Anaphylaxis

- Call 911.
- Lay person flat – do not allow them to stand or walk.
  - If unconscious, place in recovery position.
  - If breathing is difficult allow them to sit up.
- Give adrenaline autoinjector (EpiPen).
- Monitor the victim's breathing and be prepared to give CPR.

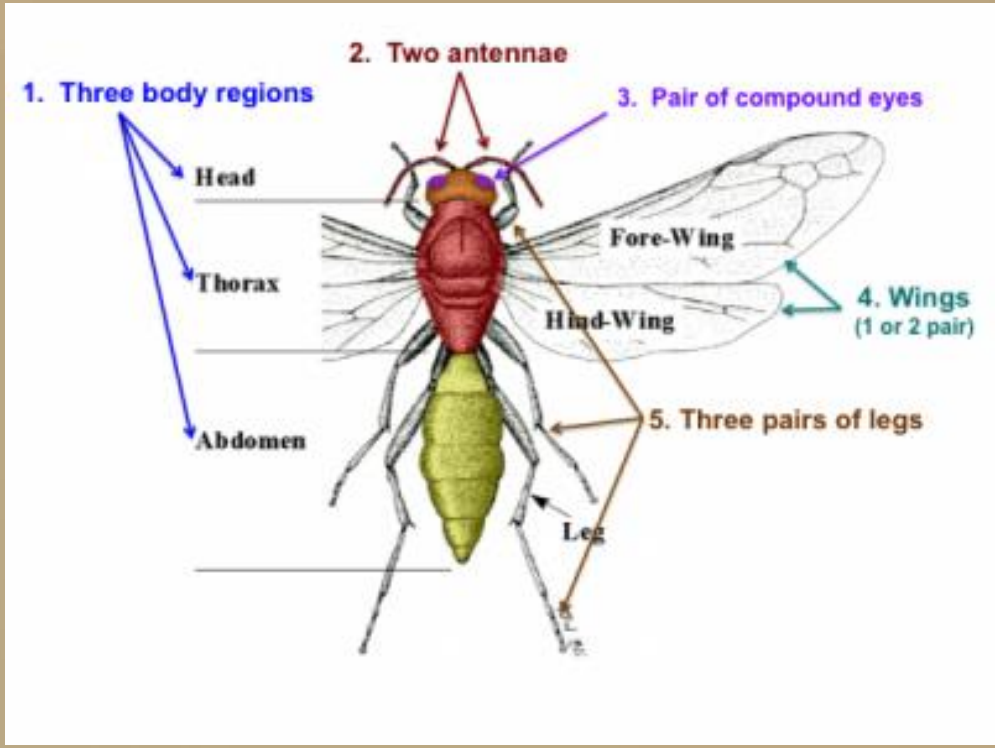


First Aid for Anaphylaxis

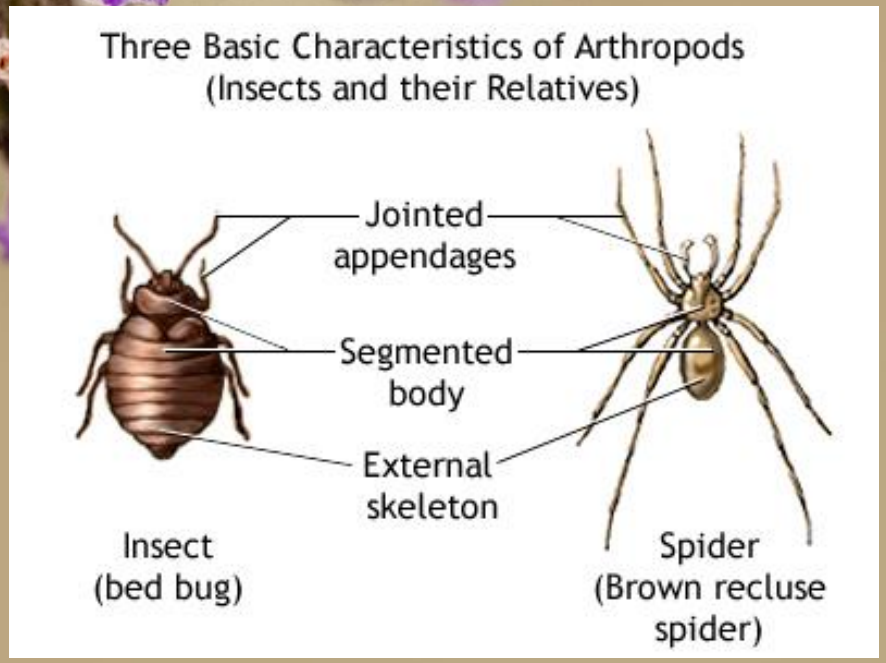
- Emergency Epinephrine Kit (EpiPen)
- May be carried by people with severe allergies.
- Help the victim open and use the kit as needed.

Requirement 2

Tell how insects are different from all other animals. Show how insects are different from centipedes and spiders.

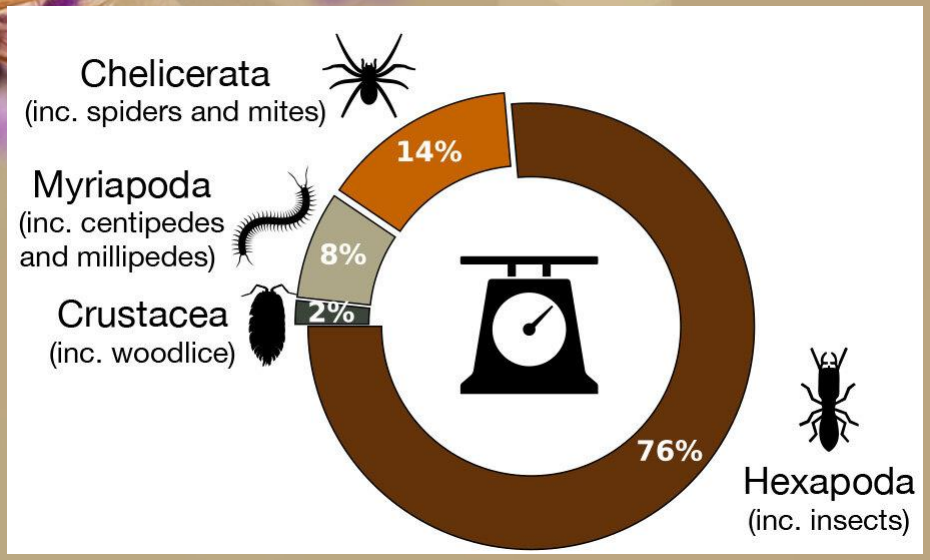


Arthropod Characteristics



- How insects and their kin are different from all other animals.
  - All insects belong to a larger animal group known as arthropods, which also includes spiders, mites, ticks, scorpions, harvestmen (daddy longlegs), crabs, shrimp, crayfish, sow bugs, barnacles, centipedes, and millipedes.
  - All of these related animals share unique characteristics that distinguish them from all other animal groups.
    - Jointed legs
    - Segmented body
    - External skeleton

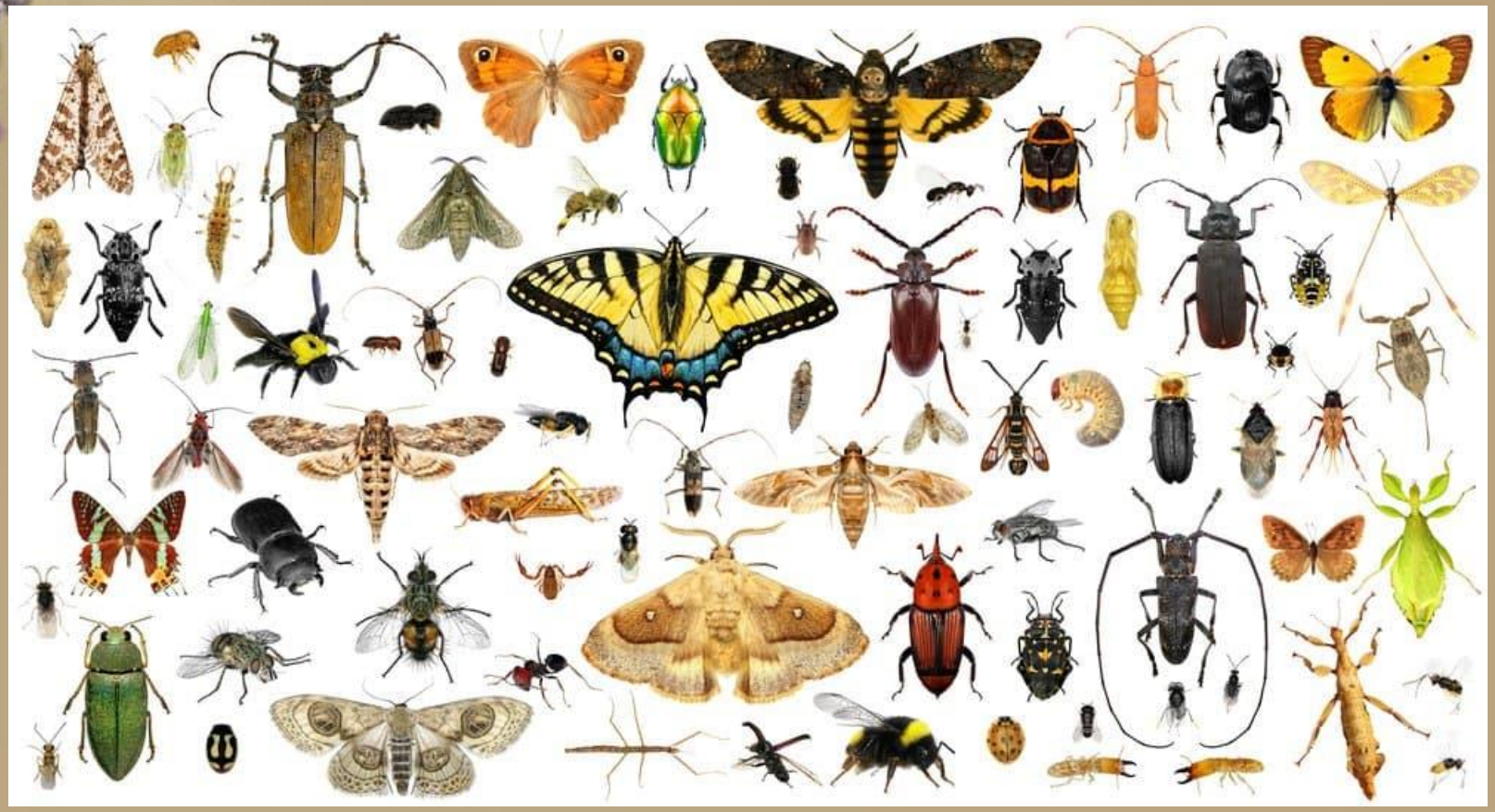
Insect Body Structure



- How insects are different from other arthropods:
  - Insects have six jointed legs (three pairs); all other arthropods have four or more pairs of legs.
  - Insect bodies are divided into three distinct regions—head, thorax, and abdomen; most other arthropods have only two body regions—head and trunk.
  - Insects have one pair of antennae or “feelers”; spiders and their relatives have no antennae, while crustaceans (crabs, shrimp, crayfish, etc.) have two pairs.
  - Most adult insects have wings; no other arthropod has wings at any stage of life.

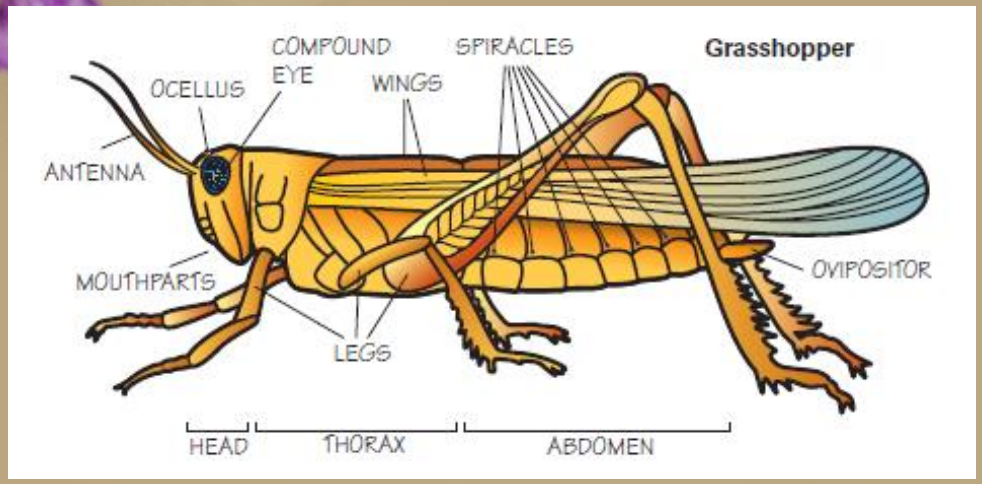
Requirement 3

Point out and name the main parts of an insect.



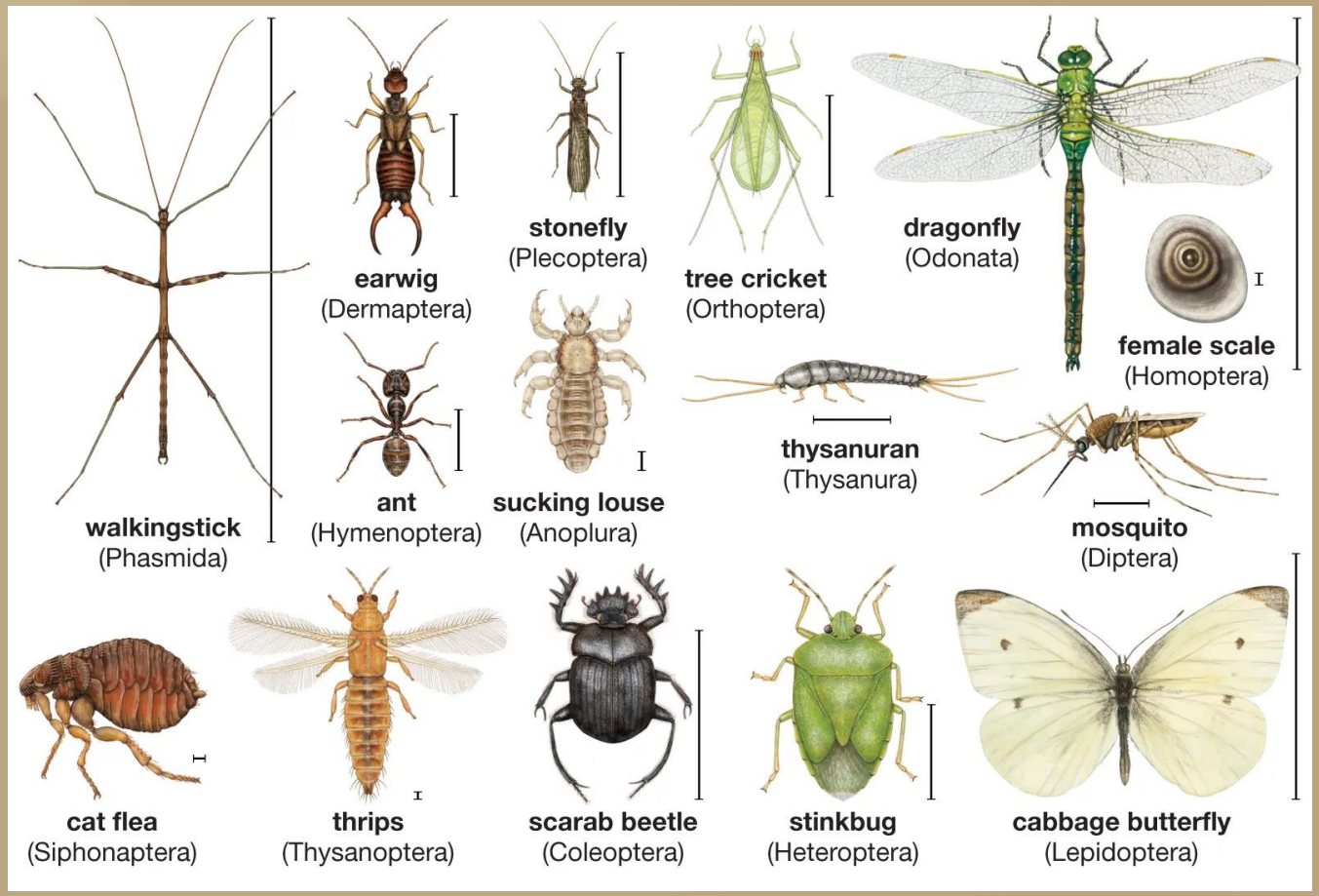
Characteristics of Insects

- The insect body has three distinct regions—head, thorax, and abdomen.
  - The prominent features of the head are the eyes, antennae, and mouthparts.
  - Attached to the thorax are the legs and, when they are present, the wings.
  - The abdomen contains many of the important internal organs, such as the reproductive and digestive systems.

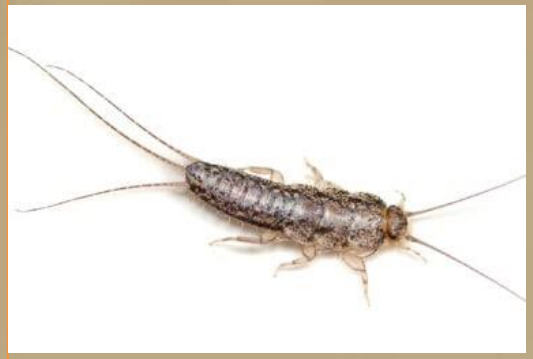


Requirement 4

Describe the characteristics that distinguish the principal families and orders of insects.



Orders of Insects

Order	Characteristics	Typical Members
Thysanura 	Wingless, usually scaly body; long, slender antennae; two or three bristlelike tails; no metamorphosis	Bristletail Silverfish

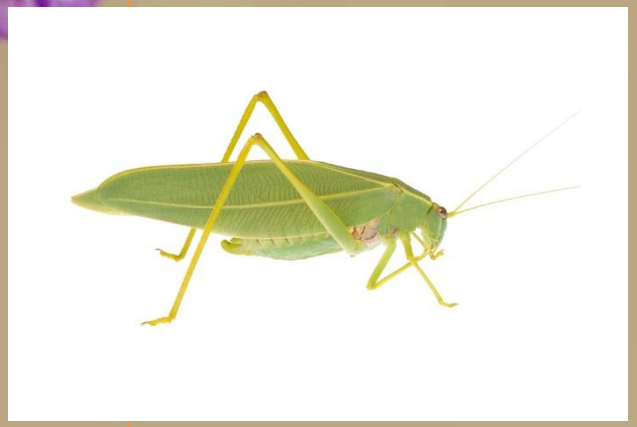
Orders of Insects

Order	Characteristics	Typical Members
Ephemeroptera 	Net-veined wings folding over the back like a butterfly's; two or three long tails; found near water; most live only a few hours as adults; incomplete metamorphosis	Mayfly

Orders of Insects

Order	Characteristics	Typical Members
Odonata 	Two pairs of net-veined wings; very large compound eyes; chewing mouthparts; adults are strong fliers but cannot walk; incomplete metamorphosis	Dragonfly Damselfly

Orders of Insects

Order	Characteristics	Typical Members
Orthoptera 	Chewing mouthparts; two pairs of wings; forewings leathery, hind wings broad and membranous, folded under front wings when at rest; incomplete metamorphosis	Katydids, crickets, grasshoppers, praying mantises, cockroaches

Orders of Insects

Order	Characteristics	Typical Members
Isoptera 	Small, mostly white and soft-bodied; chewing mouthparts; live in large, hidden communities; incomplete metamorphosis	Termite

Orders of Insects

Order	Characteristics	Typical Members
Hemiptera 	True bugs: usually two pairs of wings; forewings leathery at base, membranous at tip; sucking mouthparts; feed on plant or animal juices; many are harmful to crops; incomplete metamorphosis	Box elder bug Squash bug Water strider Giant water bug

Orders of Insects

Order	Characteristics	Typical Members
Homoptera 	Winged or wingless; those with wings (usually four) hold them arched above abdomen; beak usually short; cicada males make loud buzzing sounds; Incomplete metamorphosis	Cicada Aphid Scale Spittlebug Mealybug Leafhopper

Orders of Insects

Order	Characteristics	Typical Members
Neuroptera 	Chewing mouthparts; two pairs of net-veined wings, roofed over body when at rest; long, slender antennae; complete metamorphosis	Lacewing Ant lion

Orders of Insects

Order	Characteristics	Typical Members
Coleoptera 	Hard-shelled front wing covers *(elytra)* under which rear wings fold; chewing mouthparts; largest of the insect orders; complete metamorphosis	Ladybird beetle Boll weevil Rove beetle Colorado potato beetle Tiger beetle Firefly

Orders of Insects

Order	Characteristics	Typical Members
Lepidoptera 	Two pairs of wings covered with scales (the “dust” that rubs off when one is handled); sucking mouthparts (long, coiled proboscis); antennae club-shaped on butterflies and fernlike or threadlike on moths; complete metamorphosis	Monarch butterfly Buckeye butterfly Mourning cloak butterfly Painted lady butterfly Swallowtail butterfly Sphinx moth Cecropia moth Fall webworm

Orders of Insects

Order	Characteristics	Typical Members
Diptera Housefly	Two wings; usually small, often swift and agile fliers; many are nuisances to humans and livestock; some carry disease; complete metamorphosis	Housefly Horsefly Gnat Mosquito Midge

Orders of Insects

Order	Characteristics	Typical Members
Siphonaptera 	Tiny, wingless, jumping insects; adults are bloodsucking parasites of birds and mammals; body flattened side to side like a sunfish; complete metamorphosis; caterpillarlike larvae	Cat flea Dog flea Rat flea

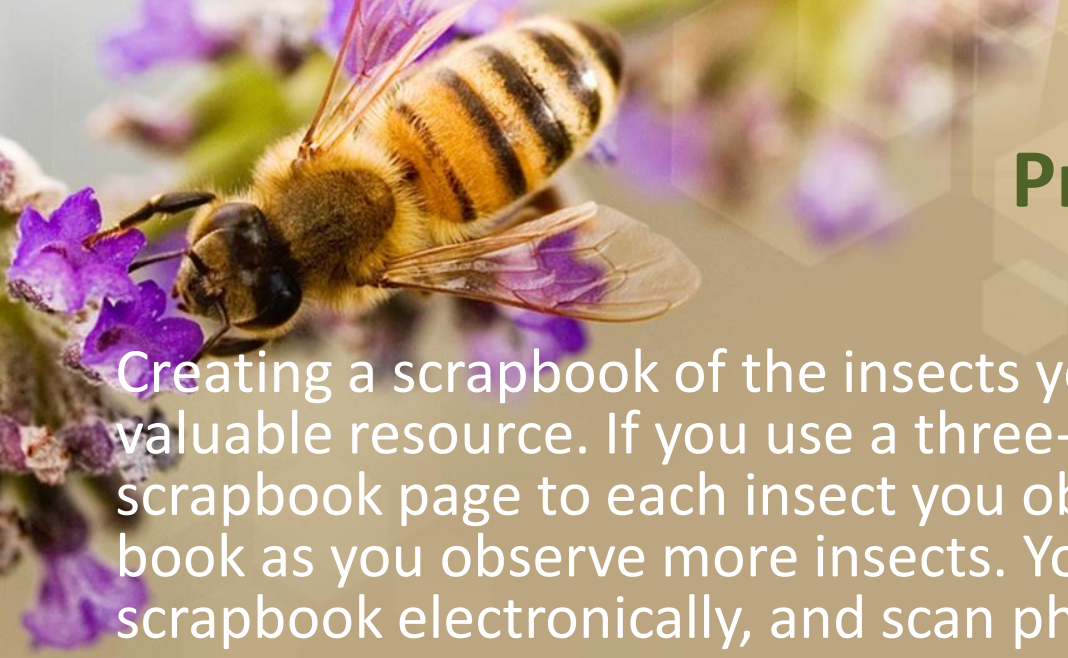
Orders of Insects

Order	Characteristics	Typical Members
Hymenoptera	All have four membranous wings (ant workers are wingless); one of the highest orders of insects, as many are social; complete metamorphosis	Ant Honeybee Sawfly Hornet Ichneumon Wasp

Requirement 5

Do the following:

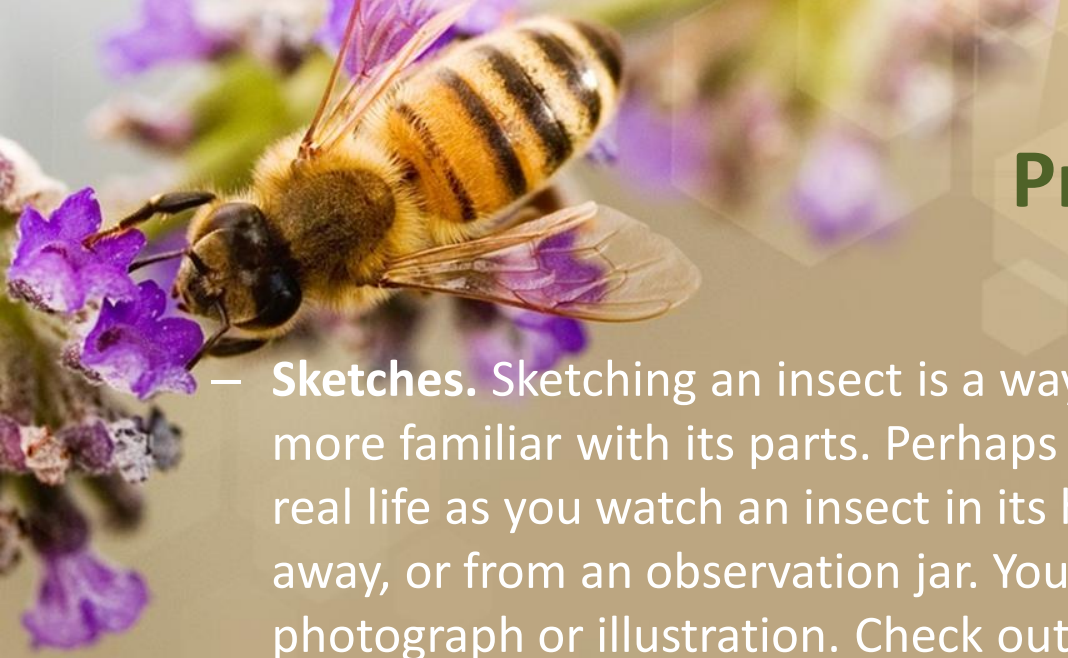
a. Observe 20 different live species of insects in their habitat. In your observations, include at least four orders of insects.
b. Make a scrapbook of the 20 insects you observe in 5a. Include photographs, sketches, illustrations, and articles. Label each insect with its common and scientific names, where possible. Share your scrapbook with your merit badge counselor.



Preparing a Scrapbook

Creating a scrapbook of the insects you observe will give you a valuable resource. If you use a three-ring binder and devote one scrapbook page to each insect you observe, you can add to the book as you observe more insects. You may want to keep your scrapbook electronically, and scan photos or use digital photos.

- **Labels.** Label each insect in your scrapbook with the place and date of observation, and write the insect's scientific and common names (check a reference book for the correct spellings). Some enthusiasts like to record fun facts such as the plant the insect was found feeding upon, or weather conditions.



Preparing a Scrapbook

- **Sketches.** Sketching an insect is a way to learn about and become more familiar with its parts. Perhaps you will have time to sketch from real life as you watch an insect in its habitat, before it hopped or flew away, or from an observation jar. You might enjoy working from a photograph or illustration. Check out the resources in the back of this book from which you can create your own art.
- **Articles.** Another way to learn more about an insect you observe is to research it. Copy or print out articles you find. If the article is short, you may want to write it out by hand. In all cases, be sure to document the author of the article, the place it was published, and the publication date.
- **Photographs and Illustrations.** You may be lucky enough to snap some great shots of insects. If not, you can use a copier to reproduce images found in books and magazines, or redraw yourself.

Preparing a Scrapbook

Photo or Drawing

Notes

Page : 02

Logbook for Bug Identification Date : ___/___/___

Season	
Spring	☐
Summer	☐
Fall	☐
Winter	☐

Weather	
Sunny	☐
Rainy	☐
Foggy	☐
Cloudy	☐

Bug Name :	
Scientific Name :	
Location :	
Colors :	
Number of Legs :	
Does it have wings?	
Behavior :	
Alone or in a group?	

Page : 01

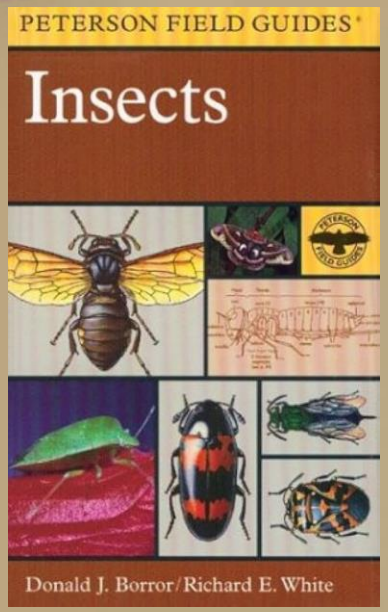
Insect Collecting

As with any trek in the outdoors, there are some basic guidelines to follow when searching for insects.

1. When you embark on your insect safari, prepare a trip plan, or at the very least, tell an adult where you are going. It is also a good idea to take a friend with you.
2. It is a good idea to wear long pants, a long-sleeved shirt, a hat, and closed shoes to keep ticks, chiggers, and insects from biting you or hitching a ride.
3. Check with natural resources authorities in advance to be sure that you will not be collecting any protected or endangered species, or wandering in a habitat where
4. collecting is prohibited.
5. Ask permission before entering private property.
6. If you must handle an insect, be careful and gentle to avoid injuring it. Insects are fragile.
7. Avoid touching an insect's nest.
8. In most cases, specimens should be returned to the location of capture after the requirement has been met. Check with your merit badge counselor for those instances where the return of these specimens would not be appropriate.

Equipment for Insect Collecting

- To observe insects, you must go where they live. Bring along the right equipment so you can properly study and document the creatures you encounter. The basic equipment described here should easily fit into a day pack.
- Some everyday items will be valuable in your search for the most interesting insects:
  - Some **magnifying lenses** can be worn around your neck. Others fold up neatly and fit in a pocket.
  - A good **insect guide** will help you identify the insects you see.
  - Use a **notebook and pencil** for jotting notes and making sketches.
  - A **flashlight** will help you investigate bushes and other nooks and crannies where insects are hiding.
  - Bring a **camera** that can take close-up photos. Your own photos will make a great addition to your scrapbook.

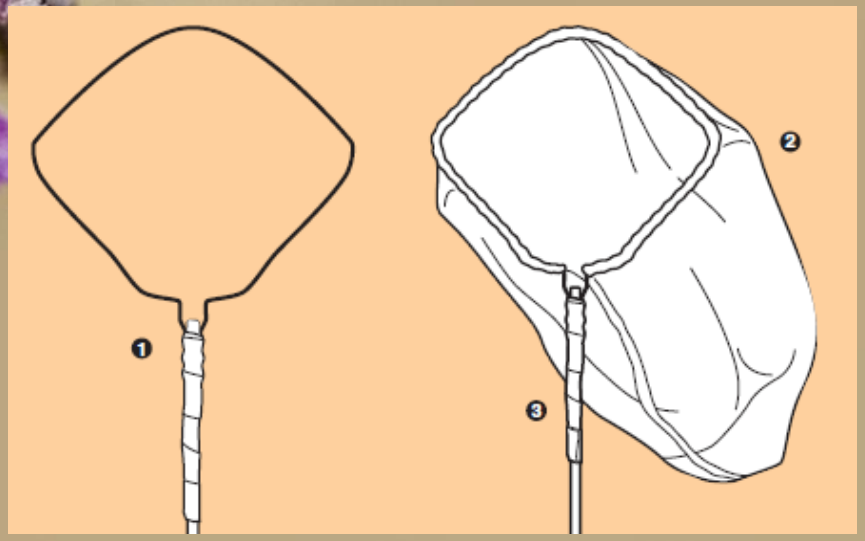


Insect Collecting

Collecting Net

- A good collecting net is an important piece of equipment.
- Collecting nets are lightweight, can be taken apart to be carried, and will last a long time with proper care. College bookstores and biological supply houses are good places to buy a net; some hobby, sport, or department stores stock them.
- You can make a net from a wooden dowel or length of bamboo; a piece of wire or a wire clothes hanger bent into a hoop; some fine-mesh fabric or mosquito netting (preferably green) for the bag; monofilament fishing line; and duct tape.
- The bag should be rounded or blunt-tipped at the closed end and at least one and a half times as deep as it is wide.
- The handle length depends on the material from which the handle is made and the kind of collecting for which the net is intended.
- Do not make the handle too long or heavy.

Insect Collecting

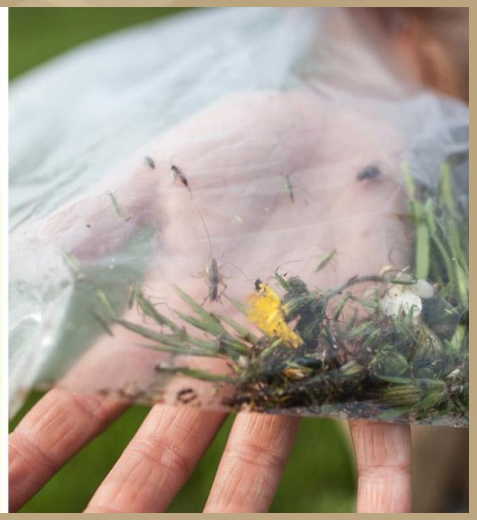


- Make a Collecting Net
  - **Step 1—**Bend the wire coat hanger into a squared hoop, as shown.
  - **Step 2—**Make the bag from fine-mesh fabric, or use a five-gallon nylon paint strainer (available at most paint stores for little cost). Use fishing line to sew the bag to the wire hoop.
  - **Step 3—**Fasten the coat hanger to the handle with duct tape. (Wooden dowels are available at most building supply stores.)

Observation Jar

- You might like to take along an observation jar so you can momentarily watch the insects you collect with a net.
- Remember to keep the insect in the jar for only a few hours, at the very most.
- As soon as possible, return the insect to the place where you collected it.
- To make an observation jar, simply wash and dry a widemouthed glass jar, such as a pickle jar.
- Add a crumpled tissue or blades of grass in the jar to give the insect something to climb on.

Finding Insects



- You will find insects almost everywhere: fields, gardens, beaches, swamps, woods, and roadsides.
- Look under stones, rotting logs, and leaves, and around flowers and grasses.
- The best times of year are summer and early fall, but insects can be found any time of year. In winter, look in protected spots such as under tree bark or stones, and indoors.

Finding Insects

- **Butterflies**
  - Bright, sunny days with little wind are best for butterfly observation.
  - Clover fields and overgrown lots with thistles, asters, milkweed, and similar plants are excellent locations for collecting.

Finding Insects

- **Moths**
  - Moths usually fly at night, so different methods are used to capture them than are helpful in catching their butterfly relatives.
  - Working the lights, sugaring, and mate attraction are some favorite techniques of moth collectors.

Finding Insects

- **Dragonflies**
  - The best place to observe dragonflies is near vegetation where they frequent, but you will need to be patient.
  - These swift aerial insects are skillful at dodging the sweep of a net.
  - During the evening after dragonflies have landed in vegetation, they can sometimes be found clinging quietly to weed stems or leaves.
  - In early autumn they remain quiet for some time after sunrise while the morning chill keeps them inactive.

Finding Insects

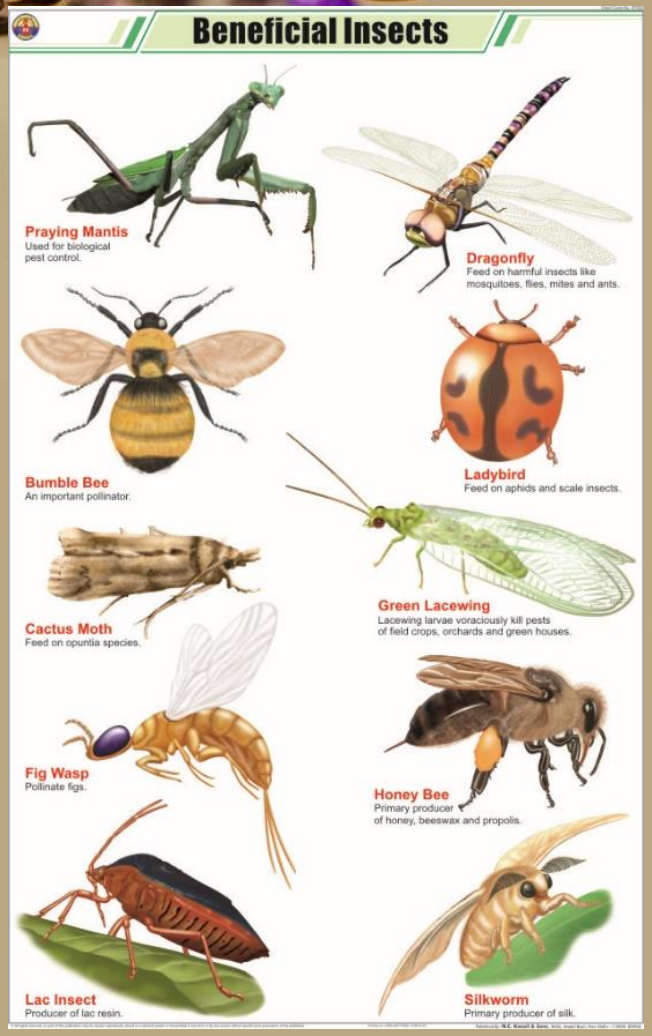
- **Beetles**
  - Beetles are everywhere, and most of them are easy to catch.
  - Look around dead trees, logs that are rotting in shade, clumps of goldenrod, late-summer mushrooms, trees in bloom, and piles of trash left by receding streams or spring runoff.
  - Search along woodland paths and moss banks or under old stones.

Requirement 6

Do the following:

a. From your scrapbook collection, identify three species of insects helpful to humans and five species of insects harmful to humans.
b. Discuss the use of integrated pest management vs. chemical methods of insect control. What are the advantages and disadvantages of each?

Helpful Insects



- Insects are valuable to us in several ways. They help by:
  - Pollinating plants
  - Producing useful materials such as honey, silk, dyes, and beeswax
  - Conserving soil and water
  - Controlling harmful insects and weeds
  - Getting rid of wastes
  - Being subjects of scientific studies
  - Being food for animals and some plants

Helpful Insects

- Honeybees are important because they are responsible for a great deal of pollination. That pollination is what allows our food crops to propagate. This not only allows us to continue to eat fruit and vegetables, but it also provides the feed necessary for the animals that we consume as well. Not to mention they make honey, which is used as food, medicine, and even in beauty products around the world.

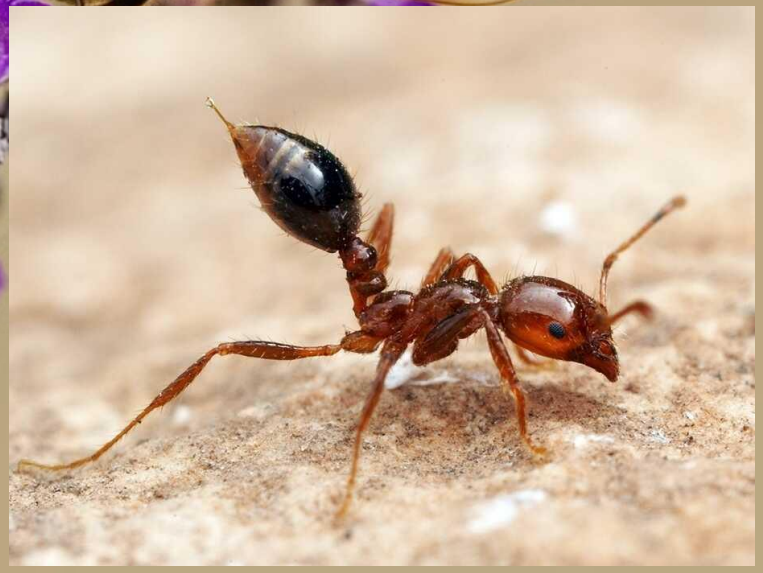
- Ladybugs, or lady beetles in some parts of the country, are extremely efficient at controlling the populations of aphids, mites, lice, mealybugs, and many other small nuisance insects.

Helpful Insects

- The praying mantis is a renowned predator that is useful for keeping other bugs out of your garden. Having a praying mantis around will help to control the population of grubs, aphids, grasshoppers, flies, crickets, and more.

- Dragonflies eat other insects. A single dragonfly can eat 30 mosquitoes in a single day. They also eat moths, fruit flies, houseflies, whiteflies, and a variety of other insects.

Harmful Insects



- A bite from a **fire ant** can be incredibly painful and cause a burning sensation (hence, “fire” ant) before it forms a pustule. For people who are allergic to the venom in fire ants, a bite could be deadly.

- The common **mosquito** is often considered the most dangerous insect because it can transmit diseases like West Nile and (more commonly) malaria to its victims. Each year, this pest kills one million people around the world.

Harmful Insects

- **Cucumber beetle:** These small beetles with yellow strips or spots feed primarily on cucumbers but can also attack squashes and sometimes melons. The insect spreads a bacterial wilt and a mosaic virus that quickly kill entire plants.

- Tomato Hornworms prey on tomato plants, but are also known to destroy potato, pepper, eggplant and tobacco plants. Adults are large moths that are gray or brown with white v-shaped lines on the rear wings and orange or brown spots along the body. They lay eggs on your plants that become the Hornworm caterpillars.

Harmful Insects

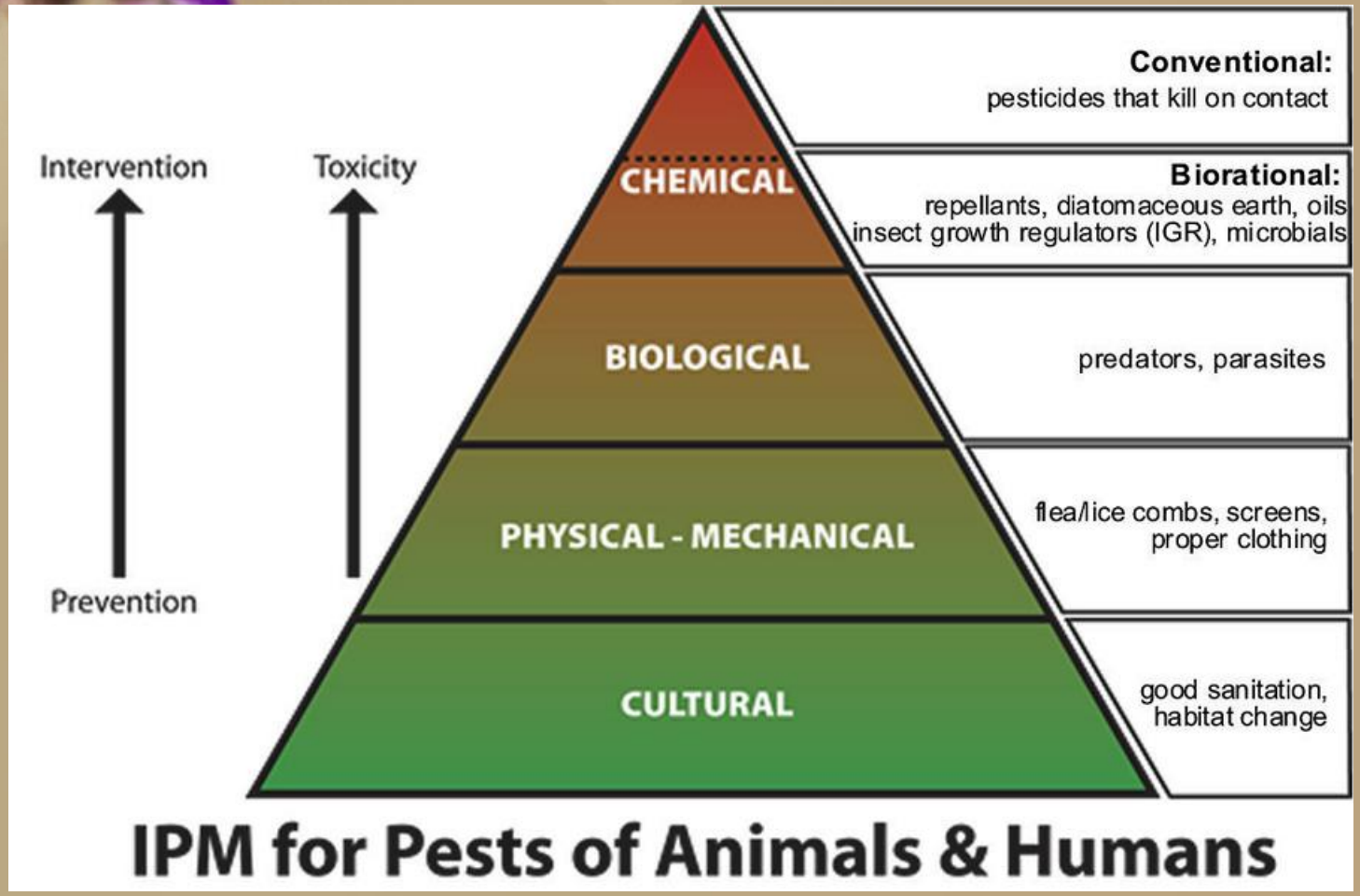
- **Fleas** are external parasites that suck blood from humans, birds, reptiles and wild and domestic animals. Young fleas can consume the volume of blood that is over 15 times their body weight. The flea bites on the human body result in red bumps. They are commonly found around the waist, knees, and elbows. The bite of fleas is very itchy, and it may also lead to infection.

- **Japanese Beetles** are invasive insects that cause extensive damage to your favorite trees and shrubs. They eat the tender tissues between the veins of the leaves of your plants until all that is left are the brown, skeletal remains.

Integrated Pest Management

- Integrated Pest Management (IPM) is an approach to managing pests effectively with the least effect on people, pets and the environment.
- IPM focuses on prevention of pests through several control methods.
- It begins with looking at why the pests are there.

Integrated Pest Management



Integrated Pest Management

Control methods include:

- Cultural – In order to prevent pests, we need to learn what is providing the pests with the habitat they need to thrive. We then modify the habitat so that it no longer provides the pest with a suitable environment in which to live. Habitat modification may involve:
  - Crop rotation
  - Using resistant varieties
  - Tillage practices
  - Regular weeding
  - Fallowing fields - land plowed but not seeded for one or more growing seasons, to kill weeds and make the soil richer.
  - Uprooting and burning infected crops.

Integrated Pest Management

Control methods include:

- Physical/Mechanical – Physical control methods generally involve mechanical or non-chemical ways of killing or removing existing pests.
- Some choices include:
  - Trapping.
  - Vacuuming.
  - Barriers.
  - Removing pests by hand.

Integrated Pest Management

Control methods include:

- Biological – Using natural enemies of the pest is one choice for control.
- Examples of this are ladybugs eating aphids or tiny wasps that lay their eggs on caterpillars.

Integrated Pest Management

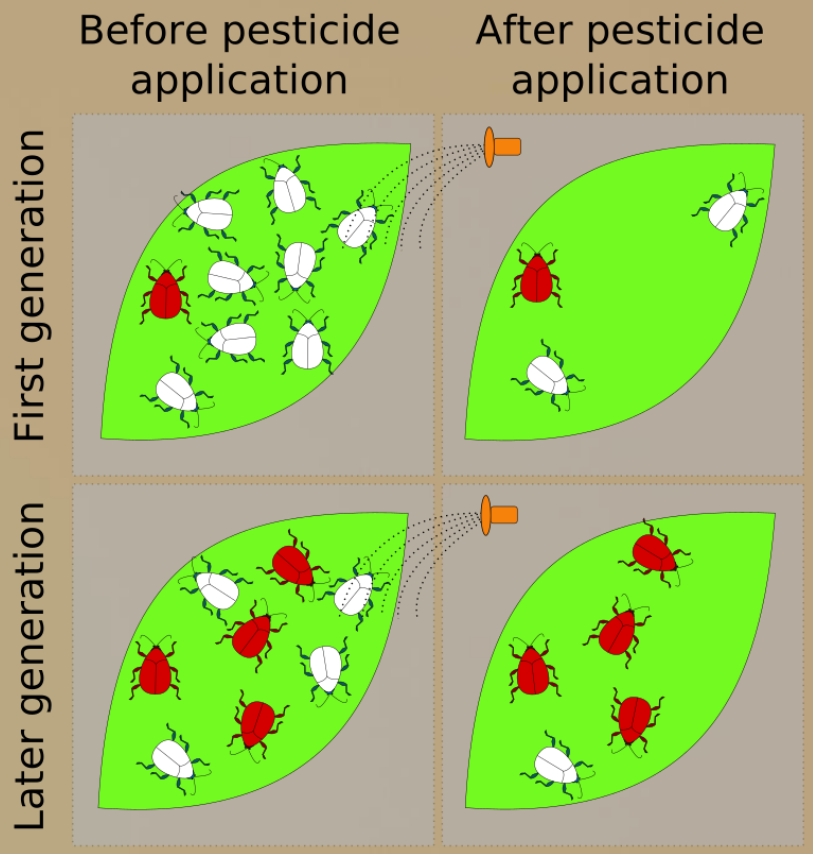
Control methods include:

- Chemical – Pesticides may be used in combination with other control methods. Pesticides chosen for the IPM program are usually used when needed to help eliminate existing populations. Other means such as habitat modification keep the pests from coming back.
  - We choose the least toxic options and target them at where the pests are living and people will not come into contact with them. Fogs and bombs are not used in IPM.
  - If we use pesticides, we choose and use them as they are intended. This means reading and heeding all instructions on the pesticide label.

Integrated Pest Management

Advantages

- #1 Reduced reliance on chemical pesticides in food production systems
- #2 Slower development of resistance to pesticides
- #3 Long-term sustainable method
- #4 Maintaining a balanced ecosystem
- #5 Increased efficiency which can save time, money, and resources in the long term.



Integrated Pest Management

Disadvantages

1. Takes Time to *Learn* IPM
   - People have to be educated about Integrated Pest Management as it has many variables.
2. Time and energy consumption
   - Application of IPM takes time to plan.
   - As IPM strategies differs from region to region, a separate plan is required for each region.
   - The expected results of intervention may take long time to be achieved.

Chemical Insect Control

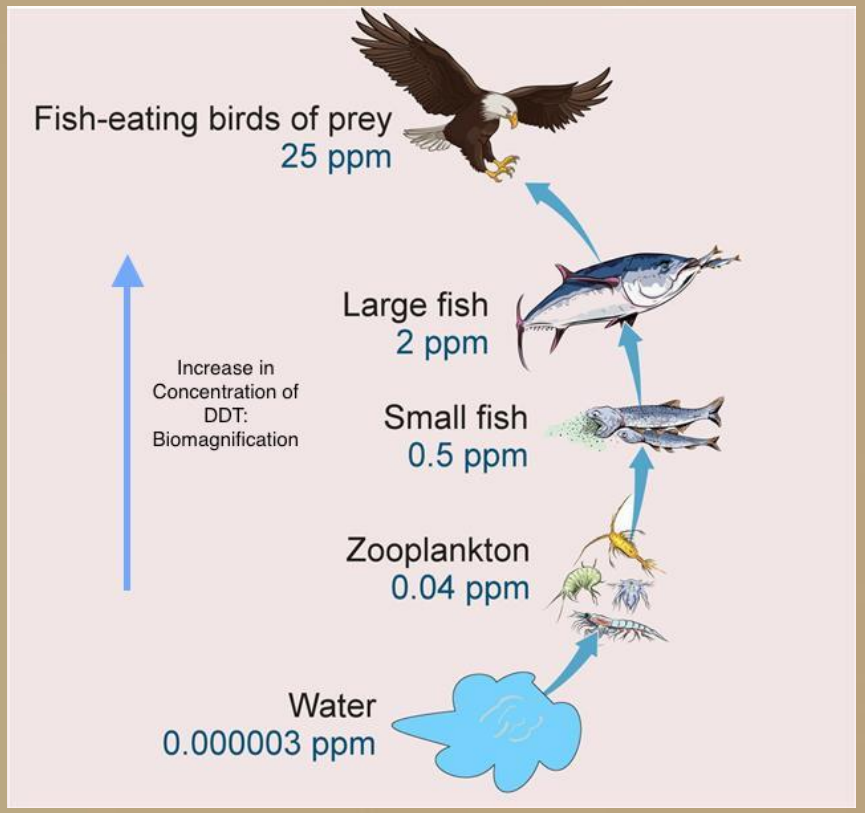
- Pesticides are a class of chemicals designed to kill pests (rodents, insects, or plants) that may affect agricultural crops or carry diseases like malaria and typhus.

Chemical Insect Control

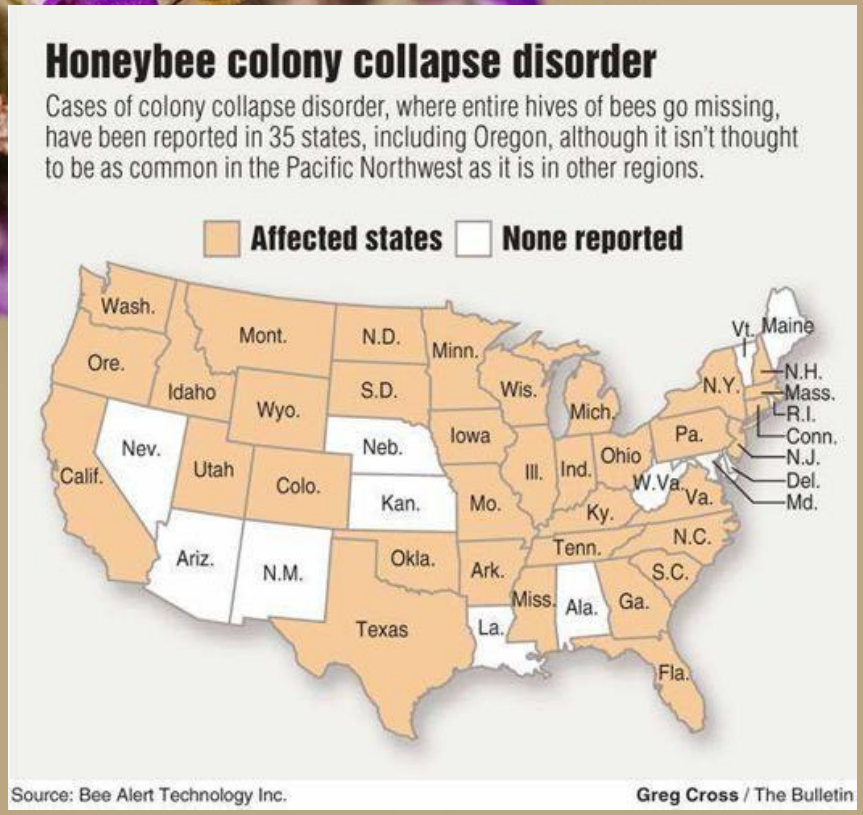
- Advantages:
  - The use of chemical pesticides is widespread due to their relatively low cost.
  - The ease with which they can be applied.
  - Their effectiveness, availability and stability.
  - Chemical pesticides are generally fast-acting, which limits the damage done to crops.

Chemical Insect Control

- There are disadvantages to the overreliance on pesticides. Some problems include:
  - resistance, when the pest is no longer controlled by the pesticide
  - movement away from the site of application
  - contamination of food, water, air , and people
  - exposure to people, pets and wildlife
  - high cost from frequent applications
  - kill beneficial organisms like lady beetles.

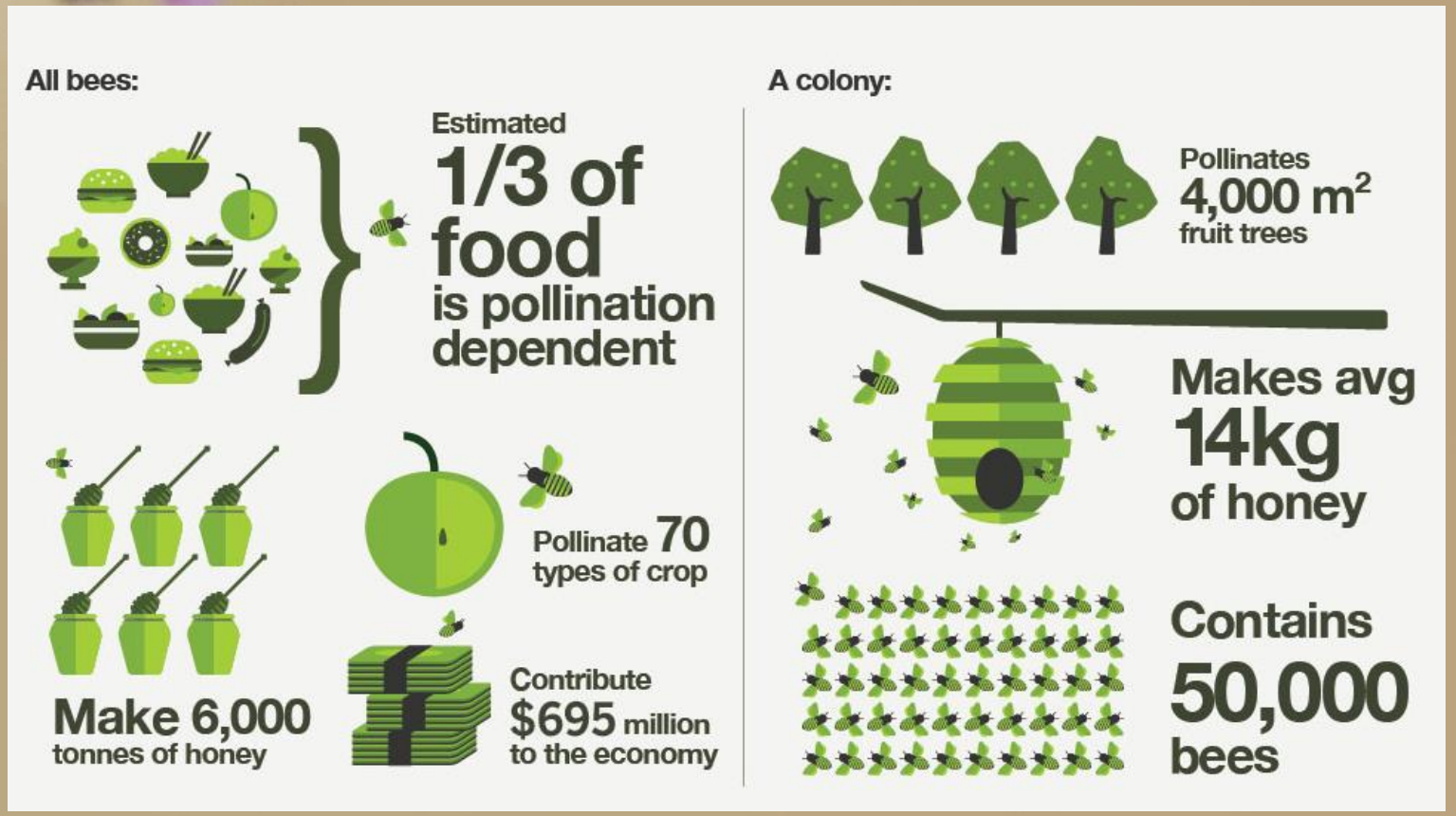


Requirement 7



Explain the symbiotic relationship between bees and humankind. Explain what colony collapse disorder (CCD) is and some of the possible causes. Discuss how CCD affects our food supply.

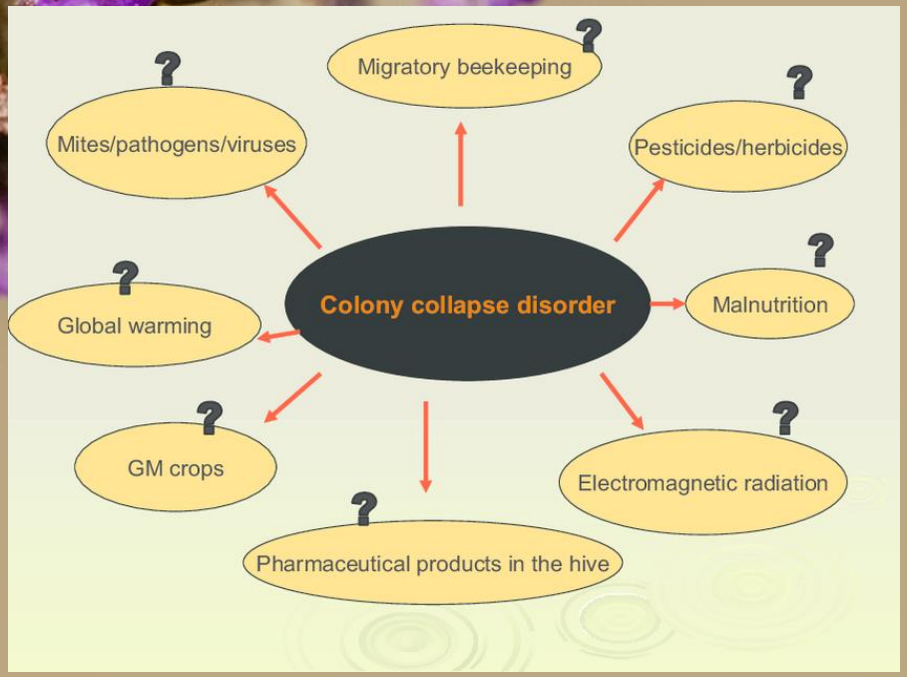
Benefits of Bees



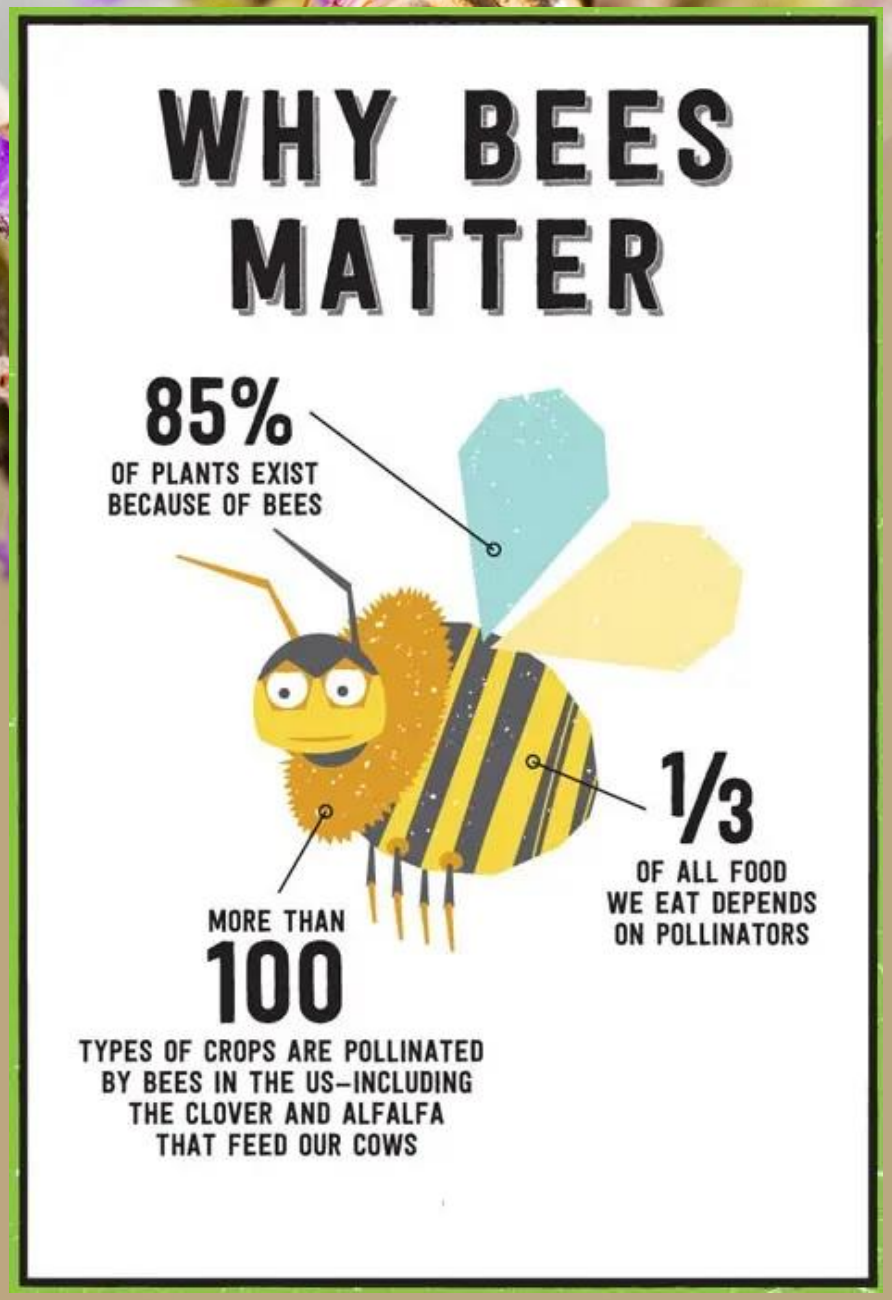
Colony Collapse Disorder

- Colony Collapse Disorder is the phenomenon that occurs when the majority of worker bees in a colony disappear and leave behind a queen, plenty of food and a few nurse bees to care for the remaining immature bees and the queen.
- Bee hives cannot sustain themselves without worker bees and eventually die.

Colony Collapse Disorder



- **Why It's Happening**
- Increased losses due to the invasive varroa mite (a pest of honey bees).
- New or emerging diseases such as Israeli Acute Paralysis virus and the gut parasite Nosema.
- Pesticide poisoning through exposure to pesticides applied to crops or for in-hive insect or mite control.

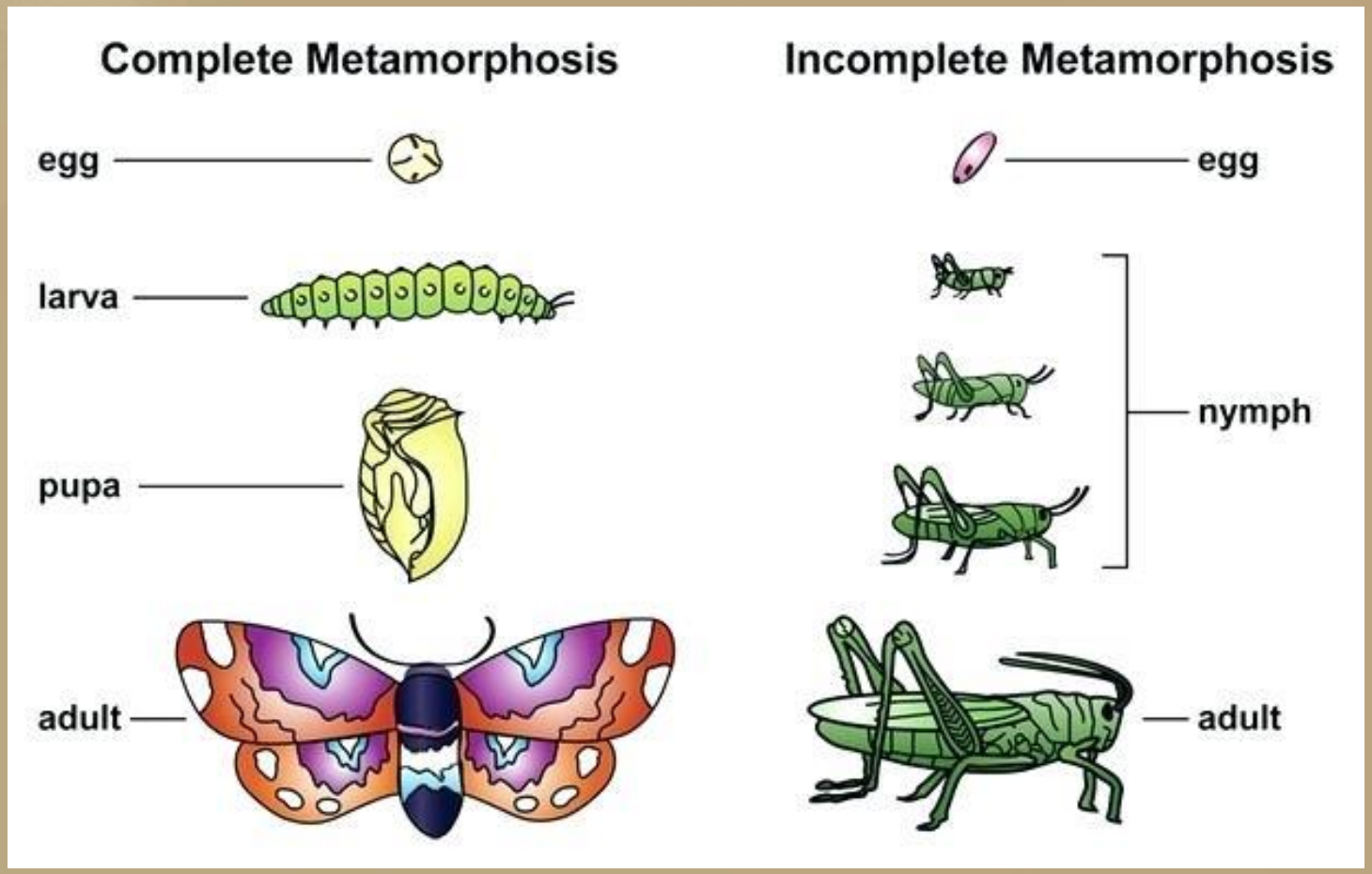


Colony Collapse Disorder

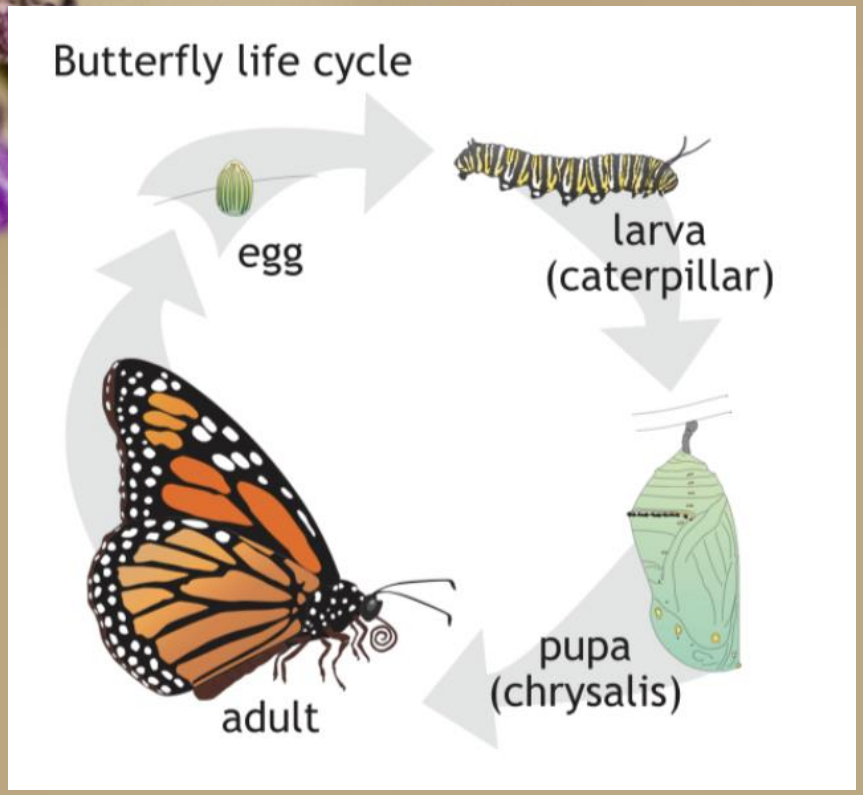
- One-third of our diet comes from insect-pollinated plants, and the honeybee is responsible for 80% of that pollination.
- CCD threatens not only pollination and honey production but, much more, this crisis threatens to **wipe out the production of crops dependent on bees for pollination**.

Requirement 8

Compare the life histories of a butterfly and a grasshopper. Tell how they are different.



Butterfly Life Cycle



- The butterfly and moth develop through a process called **metamorphosis**. This is a Greek word that means **transformation or change in shape**.
- Butterflies, moths, beetles, flies and bees have **complete metamorphosis**. The young (called a larva) is very different from the adults. It also usually eats different types of food.
- There are four stages in the metamorphosis of butterflies and moths: egg, larva, pupa, and adult.

Butterfly Life Cycle

- **Egg**
  - Eggs are laid on plants by the adult female butterfly. These plants will then become the food for the hatching caterpillars.
  - Eggs can be laid from spring, summer or fall. This depends on the species of butterfly. Females lay a lot of eggs at once so that at least some of them survive.
  - Butterfly eggs can be very small.

Butterfly Life Cycle

- **Caterpillar: The Feeding Stage**
  - The next stage is the larva. This is also called a caterpillar if the insect is a butterfly or a moth.
  - The job of the caterpillar is to eat and eat and eat. As the caterpillar grows it splits its skin and sheds it about 4 or 5 times. Food eaten at this time is stored and used later as an adult.
  - Caterpillars can grow 100 times their size during this stage. For example, a monarch butterfly egg is the size of a pinhead and the caterpillar that hatches from this tiny egg isn't much bigger. But it will grow up to 2 inches long in several weeks.

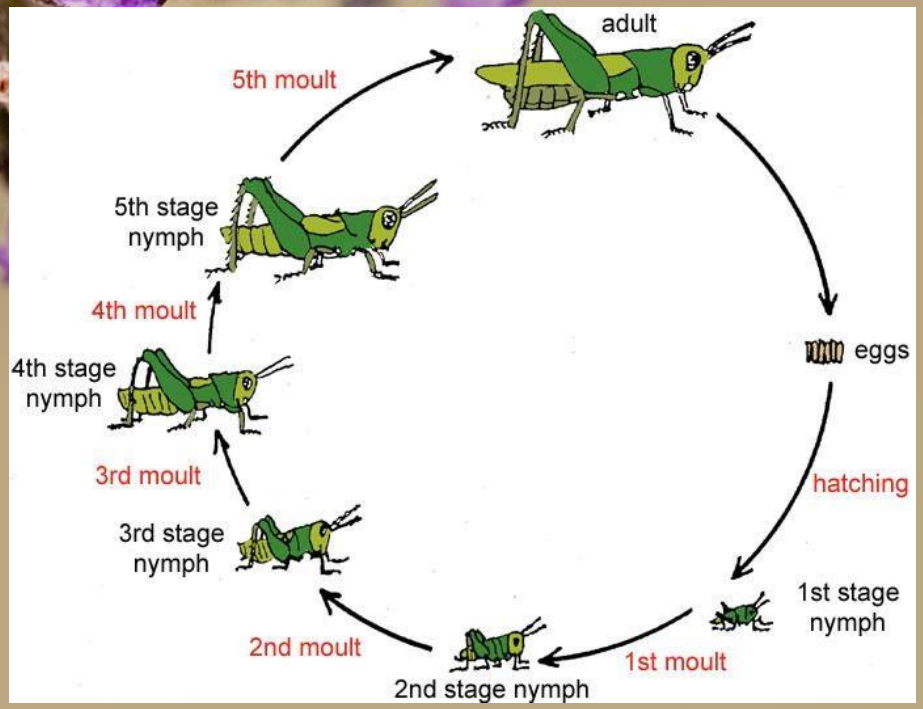
Butterfly Life Cycle

- **Pupa: The Transition Stage**
  - When the caterpillar is full grown and stops eating, it becomes a pupa. The pupa of butterflies is also called a chrysalis.
  - Depending on the species, the pupa may suspended under a branch, hidden in leaves or buried underground. The pupa of many moths is protected inside a cocoon of silk.
  - This stage can last from a few weeks, a month or even longer. Some species have a pupal stage that lasts for two years.
  - It may look like nothing is going on but big changes are happening inside. Special cells that were present in the larva are now growing rapidly. They will become the legs, wings, eyes and other parts of the adult butterfly. Many of the original larva cells will provide energy for these growing adult cells.

Butterfly Life Cycle

- **Adult: The Reproductive Stage**
  - The adult stage is what most people think of when they think of butterflies. They look very different from the larva. The caterpillar has a few tiny eyes, stubby legs and very short antennae. The adults have long legs, long antennae, and compound eyes. They can also fly by using their large and colorful wings. The one thing they can't do is grow.
  - The caterpillar's job was to eat. The adult's job is to mate and lay eggs. Some species of adult butterflies get energy by feeding on nectar from flowers but many species don't feed at all.
  - Flying comes in handy. The adult female can easily fly from place to place to find the right plant for its eggs. This is important because caterpillars can't travel far.
  - Most adult butterflies live only one or two weeks, but some species hibernate during the winter and may live several months.

Grasshopper Life Cycle



- Unlike other insects, the grasshopper's life cycle consists of THREE stages – **the egg, the nymph and the adult.**
- The life cycle of a grasshopper is known as **Incomplete metamorphosis** because it consists of **THREE** stages.
- They go through "I**ncomplete Metamorphosis**," in which each stage looks similar to an adult grasshopper but adds a few changes each time the young grasshopper sheds its skin.

Grasshopper Life Cycle

- Egg
  - The female grasshopper lays fertilized eggs in summer under the sand or in leaf litter. Then she sprays a sticky substance on the egg which hardens and forms a protective waterproof **POD** around the egg.
  - Each POD has 10 – 300 eggs inside it, depending on the species. Normally the female grasshopper can lay up to 25 pods.
  - During autumn and winter season, the eggs remain underneath (under the sand or leaf litters). After TEN months, during summer or spring the eggs hatch and come out as nymph.

Grasshopper Life Cycle

- Nymph
  - **The Nymph, that hatches from the egg is the SECOND stage of the life cycle of the grasshopper.**
  - Nymphs look like a adult grasshopper without wings and reproductive organs.
  - During the Nymph stage, it sheds its skin **FIVE to SIX** times to grow into an adult grasshopper. And this process is known as **MOLTING**.
  - To survive, nymphs start to eat succulent and soft plant foliage just after hatching from the egg. This stage of the life cycle lasts for about five to six weeks until it matures to be an adult grasshopper.

Grasshopper Life Cycle

- Adult
  - **The adult grasshopper is the THIRD and final stage of life cycle of a grasshopper.** It takes about ONE MONTH to develop fully grown wings.
  - The lifespan of Grasshoppers is about 12 months. At this stage the adult female grasshopper is ready to lay eggs. Once she starts laying eggs, the female grasshopper continues to lay eggs at intervals of three to four days until she dies.
  - That means when the grasshopper reaches its adult phase it lives for only one or two months.

Requirement 9

Raise an insect through the complete metamorphosis from its larval stage to its adult stage (e.g. raise a butterfly or moth from a caterpillar.*

*Some insects are endangered species and are protected by federal or state law. Every species is found only in its own special type of habitat. Be sure to check natural resources authorities in advance to be sure that you will not be collecting any species that is known to be protected or endangered, or in any habitat where collecting is prohibited. In most cases, all specimens should be returned at the location of capture after the requirement is met. Check with your merit badge counselor for those instances where the return of these specimens would not be appropriate.

Requirement 9

For video click on image

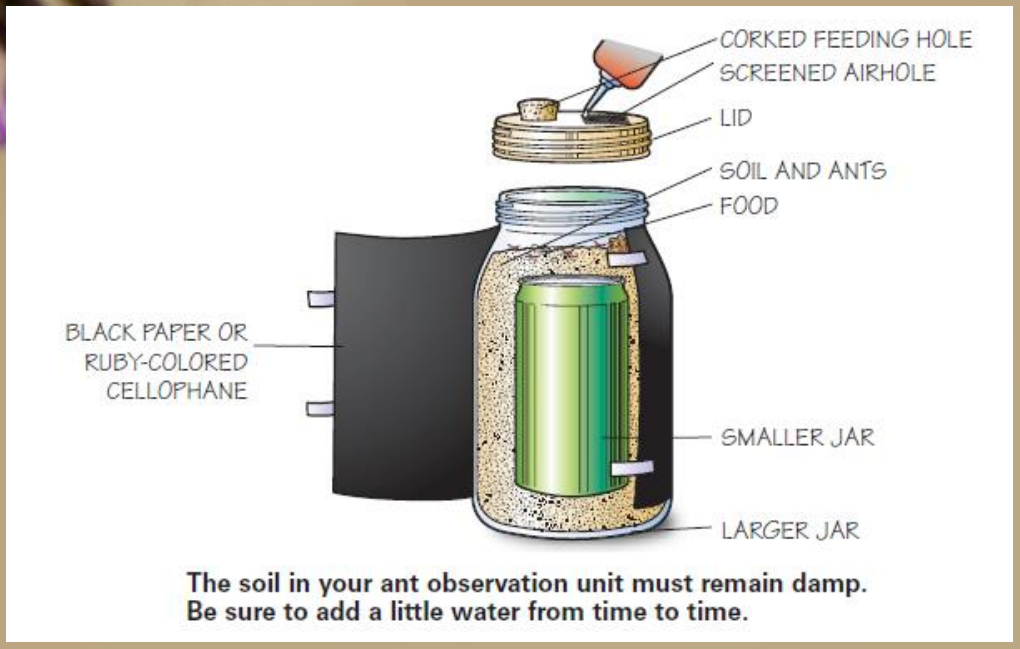
Requirement 10

Do ONE of the following:

a. Observe an ant colony in a formicarium (ant farm). Find the queen and worker ants. Explain to your counselor the different chambers found within an ant colony.
b. Study a hive of bees. Remove the combs and find the queen. Estimate the amount of brood and count the number of queen cells. Explain how to determine the amount of honey in the hive.

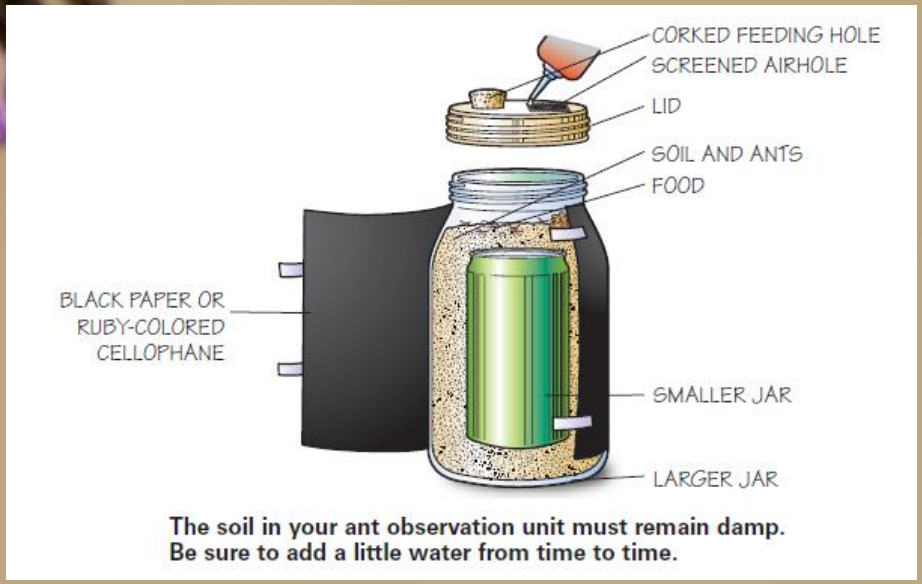
Requirement 10a

- **Ant Observation Unit**
  - The simplest method of preparing an ant observation unit is to use two widemouthed glass jars with lids.
  - One of the jars must be smaller and slightly shorter than the other; when it is placed inside the larger jar, there should be about a half inch of space between the outside of the smaller jar and the inside of the larger one.



The soil in your ant observation unit must remain damp. Be sure to add a little water from time to time.

Ant Observation Unit

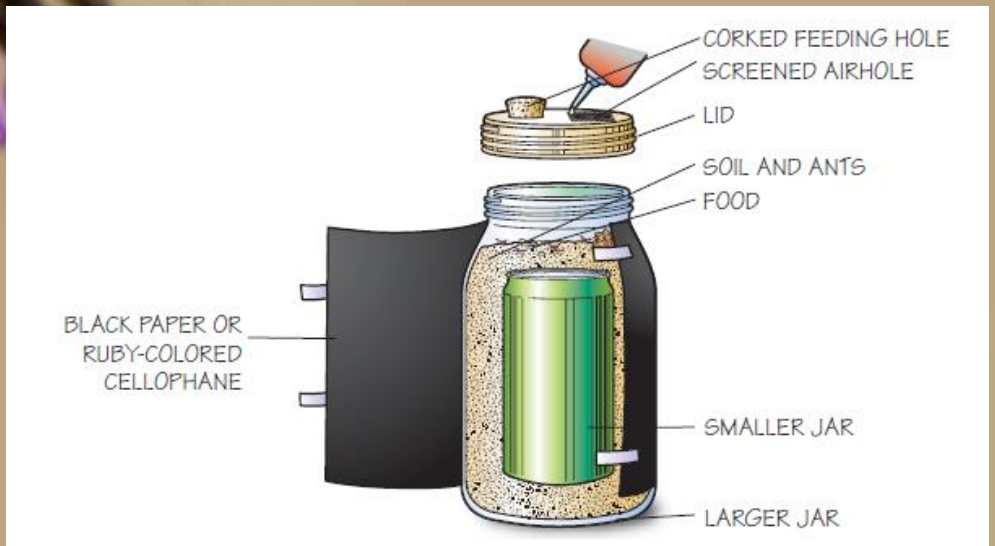


The soil in your ant observation unit must remain damp. Be sure to add a little water from time to time.

- **Step 1**—Securely tighten the lid of the smaller jar, then put that jar into the larger one.
- **Step 2**—Drill two holes approximately 1⁄4 inch in diameter in the lid of the wider jar.
- **Step 3**—Put a tight-fitting cork into one of the holes; this will serve as an opening for feeding the colony.

Ant Observation Unit

- **Step 4—**Use quick-drying rubber cement or a glue gun to fasten a screen of fine cloth or wire mesh over the other hole.
  - A small piece cut from a discarded pair of women's hose will work well as a screen and will let plenty of air into the observation unit. The opening will be small enough to prevent the soil in the unit from drying out rapidly and endangering the ants' lives.



The soil in your ant observation unit must remain damp. Be sure to add a little water from time to time.

Collect an Ant Colony

- The simplest way during summer is to turn over some large flat rocks until you find a full-fledged colony.
  - The center of the nest is often at the surface directly beneath a rock.
  - You may see the workers, soldiers, larvae, cocoons, eggs, and winged males and females (young queens and their mates) in one scrambling mass when you suddenly overturn a rock.
- Quickly scoop up that living mass, along with the surface soil, and pour it into the space between the two jars in your observation unit.
- Do not pack the dirt tightly, but fill the space to within an inch of the top and secure the lid of the larger jar.

1313dbb50d08f1dc974d206e52505f5a.webp

Ant Colony

Maintaining the Ant Colony

- As with any insects you collect and maintain at home, keep the ant colony away from direct sunlight and direct heat.
- Whenever you are not watching the colony, wrap a piece of black paper or ruby-colored cellophane around the outside of the jar and secure it with a rubber band or tape.

Maintaining the Ant Colony

- Feed the colony by pulling the cork and using a medicine dropper to add honey water or sugar water as an energy food.
  - Bits of hard-boiled egg and dry pet food will provide the ants with needed protein.
  - Be sure not to overfeed the colony, because any surplus will decompose and contaminate the nest.
- Keep the soil damp but not wet.
  - Ants must have at least some water to survive.
  - From time to time, add a few drops of water from your finger, a dropper, or a spoon.

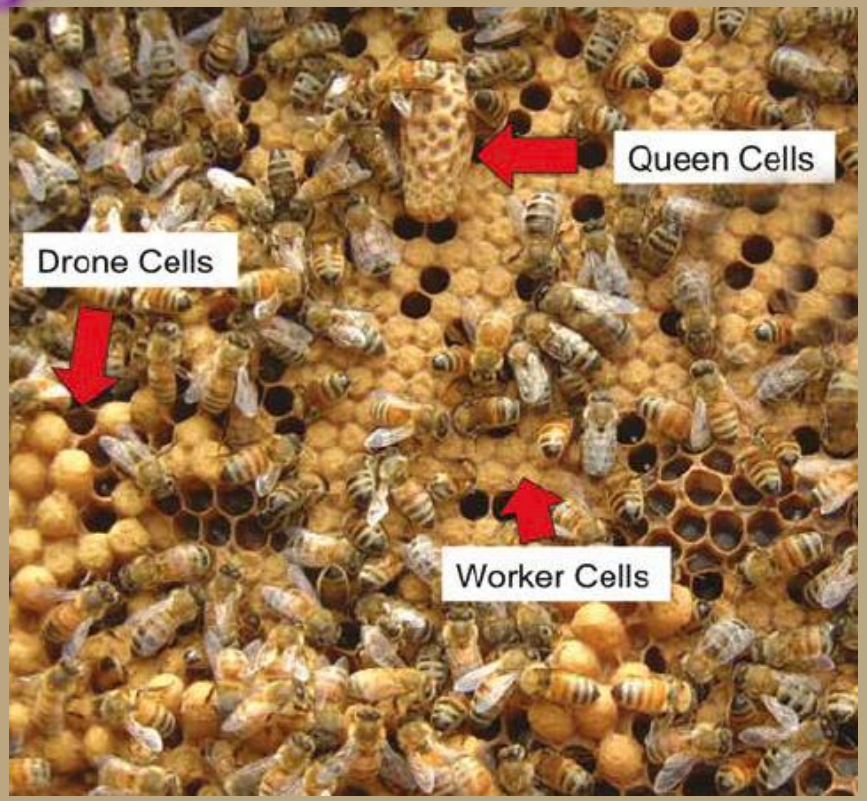
Requirement 10b

Study a hive of bees. Remove the combs and find the queen. Estimate the amount of brood and count the number of queen cells. Explain how to determine the amount of honey in the hive.

Queen Bees

- Distinctive features of a Queen Bee Look for:
  - A long, narrow abdomen with a pointed end – other bees have a rounded abdomen.
  - Shorter wings – while workers' wings reach almost to the end of their bodies, the queen's wings only reach halfway down her abdomen.
  - Splayed legs – most bees tuck their legs under their bodies.

Inside of the Bee Hive



- A honeybee hive is divided into parts, each with its own purpose.
- In one area there are cells full of growing larvae.
  - Nearby are cells with beebread and others with honey for the nurses that tend the larvae.
- In the nursery are larger cells that contain the larvae of drones.
- Near the bottom of the nursery are big peanut-shaped cells where a few queens develop.

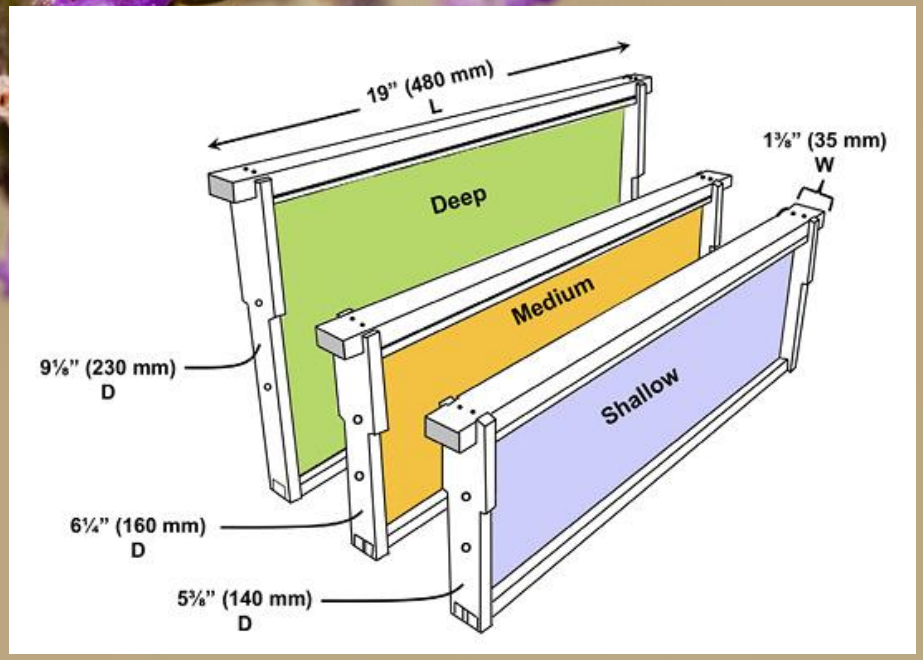
Inside of the Bee Hive

- At the top of the hive is the main storehouse of honey, where most of the inside workers spend their time making and storing the staple food for the colony.

Bee Hive

- How to calculate the amount of brood in a hive.
  - There are about five worker cells to one inch.
  - A square inch of sealed worker brood therefore contains about 25 developing bees.
  - Multiply 25 times the square inches of brood cells will give you an estimate of the number of bees in the sealed stage.

Amount of Honey in a Hive



- Estimating the pounds of honey in a hive will depend on frame size.
  - Deep frames are estimated to yield six pounds of honey.
  - Medium frames yield about four pounds.
  - Shallow frames are estimated to yield three pounds of honey per frame.
- For better accuracy, you can weigh frames with a portable scale.

Requirement 11

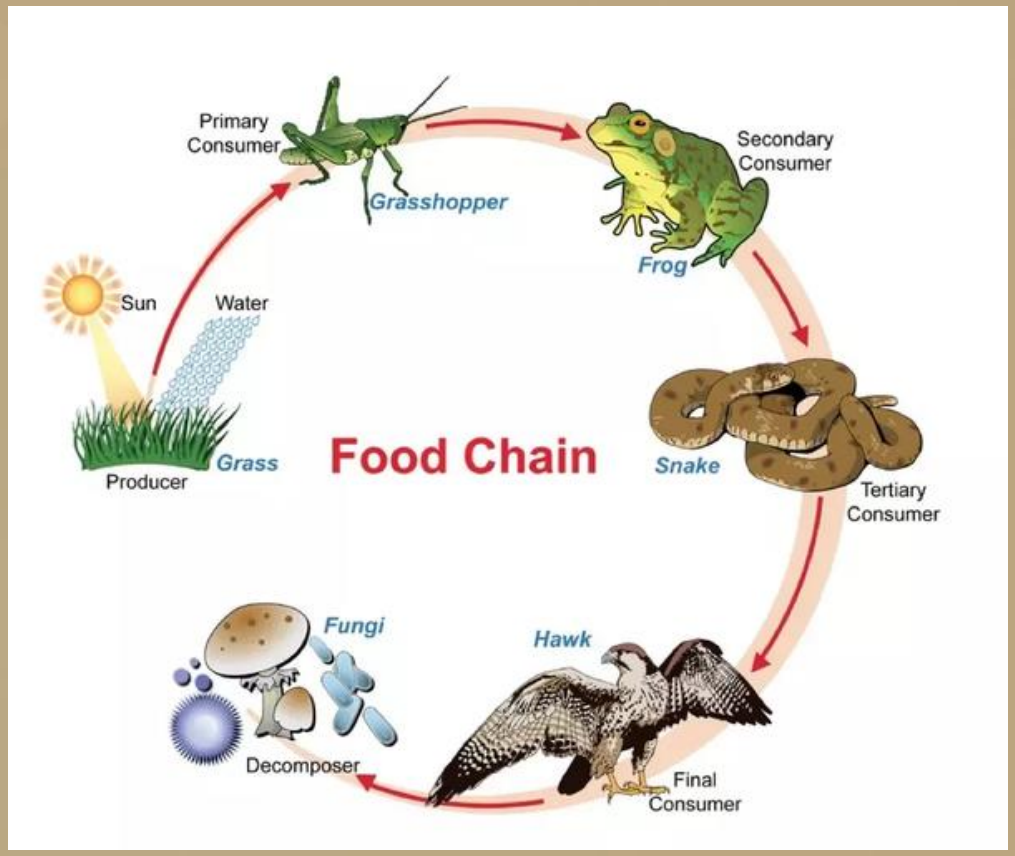
Tell the things that make social insects different from solitary insects.

Social Insects

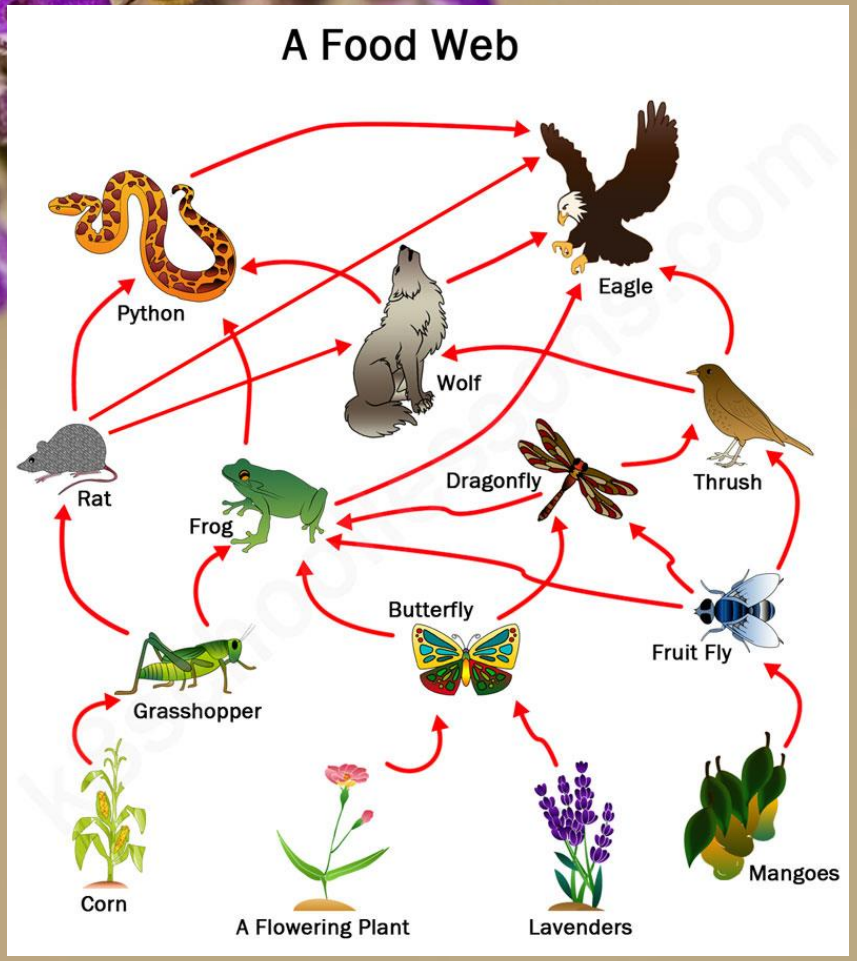
- *Social insects* will swarm and sleep, hibernate, and migrate together.
- Social insects include termites, ants, and certain species of bees, wasps, and hornets.
- These insects live together in groups all their lives.
- By instinct, each individual performs a certain task that is of value to the whole community.
- Social insects care for their young (something most insects do not do), build nests, and sometimes feed each other.

Requirement 12

Tell how insects fit in the food chains of other insects, fish, birds, and mammals.



Requirement 12



- Insects, many of which feed on plants, are the most significant link between plants and other animals in food webs.
- Birds, reptiles and mammals are predators of insects, thus insects connect the energy of the sun absorbed by plants with all other animals.
- The death of insects is suspected to be a leading cause of recent declines in bird populations. Species that are higher up the food chain suffer population losses.

Requirement 13

Find out about three career opportunities in insect study. Pick one and find out about the education, training, and experience required for this profession. Discuss this with your counselor, and explain why this profession might interest you.

How to Become an Entomologist

1. For a career in entomology, you must have a thorough understanding of math and science. Begin now to take all of the biology, zoology, botany, ecology, chemistry, math, statistics, genetics, and physics courses you can. Also develop your writing skills. Study foreign languages if you are interested in traveling abroad.

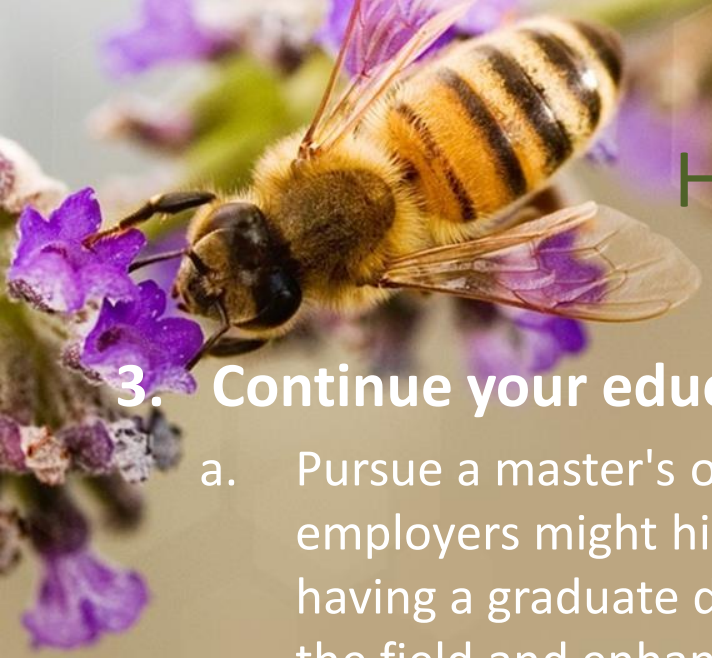
How to Become an Entomologist

2. Earn a bachelor's degree

a. Enroll in an undergraduate program that allows you to study entomology. Some colleges and universities offer the opportunity to major in entomology, but you can also choose a related scientific major like biology or environmental science. Most employers require entomologists to have a bachelor's degree at minimum, and completing an undergraduate program at an accredited college or university can give you the educational foundation you need to succeed in the field. During undergraduate study, entomology students study subjects like anatomy, physiology, reproduction, life cycles, evolution, ecology and more.

b. A bachelor’s degree in entomology should qualify you to work for government agencies, chemical companies, or pest management industries.

c. Advanced degrees are typically required to teach or conduct research.



How to Become an Entomologist

3. **Continue your education**
   a. Pursue a master's or doctoral degree in entomology. While some employers might hire entomologists with only a bachelor's degree, having a graduate degree can give you additional information about the field and enhance your abilities as an entomologist. A master's or doctoral degree in entomology can also qualify candidates for board certification later on, which can increase your chances of being hired professionally. You can find several options for graduate study in entomology by visiting the website for the Entomological Society of America, which lists programs in entomology by state.

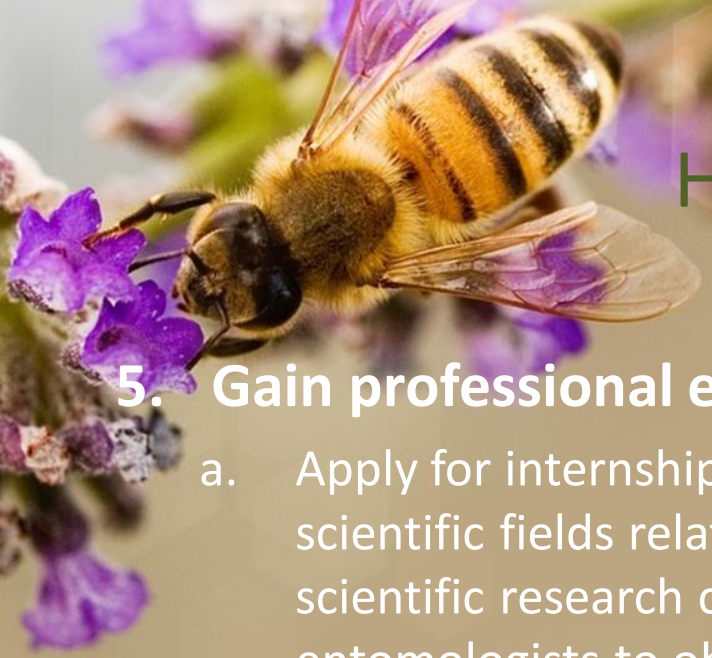
How to Become an Entomologist

4. Earn certification

a. Obtain certification from the Entomological Society of America (ESA). As entomologists perform advanced specialized work, most employers require entomologists to be certified before beginning their work in the field. The Entomological Society of America offers two different certifications for aspiring entomologists, one that results in board certification and another that results in associate certification. Here's some additional information about the certifications available to entomologists:

b. Board Certified Entomologist (BCE): This certification requires candidates to pass two exams and to have already completed graduate-level study.

c. Associate Certified Entomologist (ACE): The ACE certification requires candidates to pass one comprehensive exam.



How to Become an Entomologist

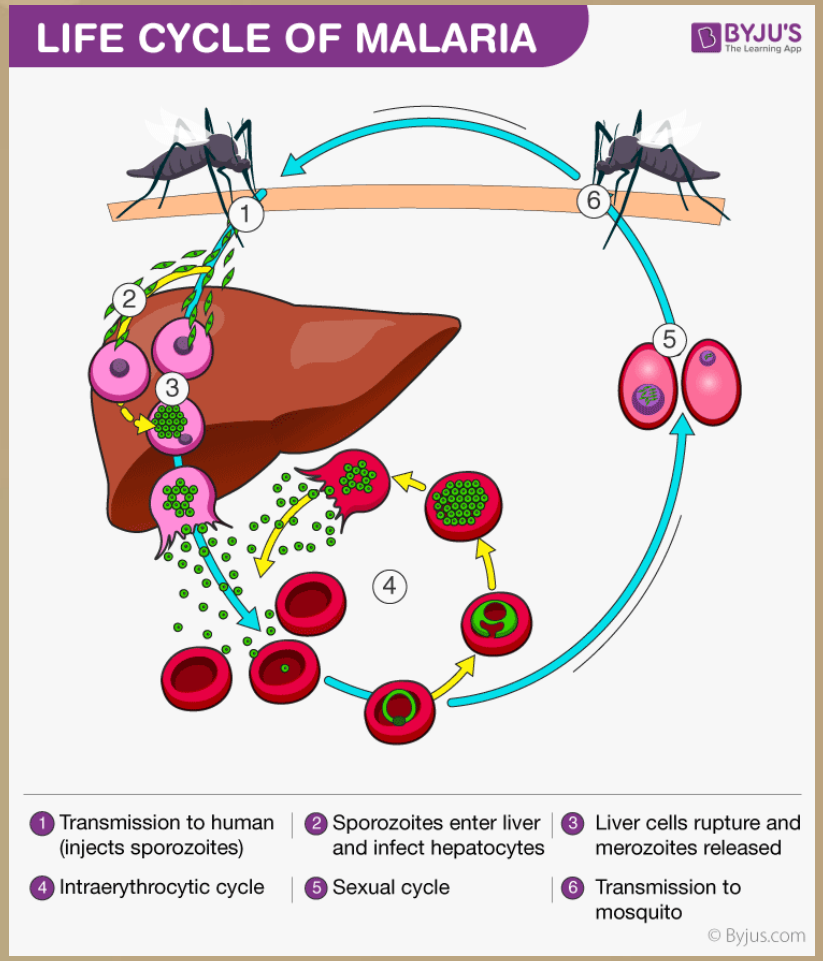
5. **Gain professional experience.**
   a. Apply for internships and entry-level jobs in entomology or in scientific fields related to entomology. Many laboratories and scientific research centers offer internships that allow aspiring entomologists to observe professionals in the field and engage in hands-on learning. Another great option to gain professional experience in entomology is by working at a zoo or wildlife facility that houses insects, as most have opportunities for work as interns or novice zookeepers. Building professional experience in the field can give you further expertise in the duties of an entomologist and help you develop your own entomological skills.

How to Become an Entomologist

6. **Choose a specialization**
   a. Decide if you want to specialize in a certain area of entomology. There are several options to choose from in terms of specialization for entomology, which means you can determine which areas interest you the most and focus on the one you most want to work with. Entomologists can specialize based on behavior or area of study, all of which offer their own opportunities for employment. Here are some common specializations for entomologists:
      - Insect pathology
      - Crop protection entomology
      - Insect taxonomy
      - Industrial entomology
      - Insect physiology
      - Insect morphology
      - Medical entomology
      - Forensic entomology
      - Biological control

Medical Entomologist

- Medical entomologists are concerned with the role of insects in the causation of disease in animals and humans.
- This field includes the study of insects and arachnids that adversely affect the health of humans, domestic vertebrate animals, and wildlife through transmission of disease-causing agents.



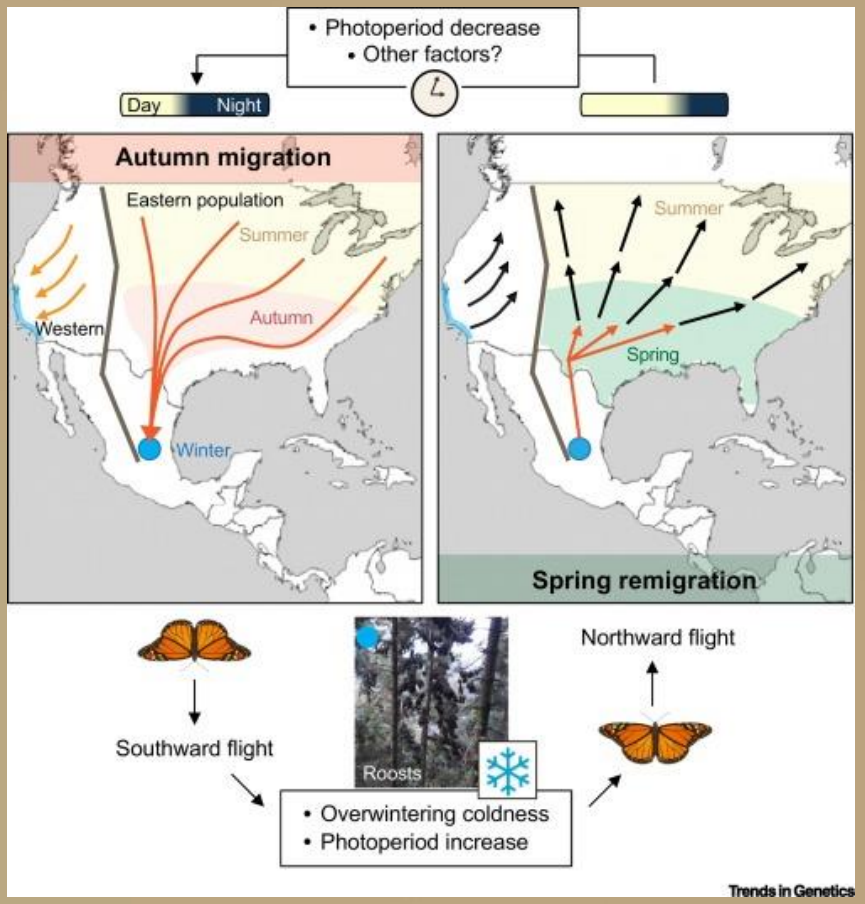
Plant Protection Entomologist

- Entomologists work to reduce the crop losses that insects cause, which can help to relieve some of the food shortages that exist in many parts of the world.
- Entomologists also work with foresters to battle the insect pests that injure trees, destroy timber, and damage the biological riches found in forests.
- Plant protection entomologists study insect pests and figure out ways to protect crops, trees, flowers, and other plants from attack and injury by insects.
- These entomologists work for the Department of Agriculture, the Forest Service, the Department of the Interior, universities, nature centers, conservation agencies, and private industries.

Montana Beetle Kill

Conservation Entomologist

- By identifying endangered insect species and studying their habitats, conservation entomologists can help rebuild threatened ecosystems.
- Many are involved in education and outreach programs at natural history museums, nature centers, zoos, conservation agencies, and extension offices.



Monarch Butterfly Migration

Forensic Entomologist

- Forensic entomology is a field of forensic science which involves application of the study of insects and other arthropods in criminal investigation and legal cases.
- The principles of forensic entomology have been used to resolve crime for thousands of years but they became a part of Western science only in the 19th century.
- Few people are employed full-time as forensic entomologists and most are affiliated with universities and work as consultants to law enforcement.