

JOURNEYMAN LEVEL MASTER BEEKEEPING COURSE

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Session No. 2

Honey Bee Anatomy and Physiology

Anatomy-Structure

Physiology-Functions

(Fig.4) Hive and Honey Bee External Structure. Let's start with an overall view of the honey bee. a. Hairs are all over the body –setae (plural-multiple hair), seta (singular-single). Hair must carry pollen. Acts like a sponge. Legs scrape off pollen to rear of Legs where the corbicula or pollen basket is located.

The Exterior of the honey bee is called the exoskeleton. Bee does not have bones or skeleton. The exoskeleton acts as 1. A barrier to reduce loss of water in the body, and 2. As protection for the bee.

The exoskeleton is made up of three layers. This is important to remember.

- Epicuticle - Outer layer
- Endocuticle - Middle layer
- Epidermis - Inner layer

On the exoskeleton there is hair. The hair is mobile. The other projections are immobile. Plate 3, pg 110 Branched body hairs that help hold pollen.

Three regions-Head, Thorax, Abdomen

Head-Eyes, Antennae, Organs of feeding, Brain

A. HEAD REGION

1. PROBOSCIS-Plate 8, pg 119, Fig 6, pg 121, Fig 7, pg 123

Mouth Part- This is the tongue. This tongue protrudes out and coils back up underneath the head.

2. ANTENNAE-Plate 6, pg 117 & plate 7, pg 118

Two Antenna-**main function is smell or pick up odors**. They need to be able to sense different odors. There are a lot of sensory organs on the antenna. Another function of the antenna is *feel*, to pick up the pheromone of the queen.

On the 2nd section of the antenna, you will find the **Johnston's organ**. This is for wind speed calculations that tells them the wind speed and not to go outside when windy. Bee flies 15 miles per hour.

Another function of the antenna is FEEL. They are feeling the queen and pick up the pheromone and move it around. Also pick up taste.

- d. Antenna cleaner-plate 12, pg. 137 located on first two legs.
- e. The drone has a longer antenna and more sensor organs than the worker bee. Used to find the queen in flight for mating.
- f. Plate 7, pg 118 of the Drone antenna a. b. c. e. (check out plate organs in antenna)

3. Eyes

a. **Two compound, very large, eyes for vision**. Their vision is made up of an mosaic. Each part picks up a different segment that makes a whole. They can pick up movement very easily. Compound eyes have hair on them. Each of the mosaic is an eye.

Close up of the surface of the compound eye with its numerous facets and hairs. The compound eyes are very large eyes. They can see some colors. Blue green, yellow. They cannot see red.

b. **Three simple eyes known as ocelli-in the very top of the bees head. These are light sensor organs, not for vision?**

c. Close up of the three ocelli-light sensor.

4. Brain

B. THORAX- Region of locomotion

1. Leg Region- 6 Legs

On the fore leg of all three castes, there is located an **antenna cleaner**

Legs of the worker honey bee.

Pollen Press - It is found on the exterior of the last leg pivot

The corbicula is on the hind legs of the honey bee. It is found on the exterior of the tibia. Right below the **corbicula** is found the **pollen press** and makes it into a little ball.

Hairs are all over the body –setae (plural-multiple hair), seta (singular-single

2. Wings-Two sets of wings
Fore wing larger than the hind wing
Fore wing hooks into the hind wing. Fig. 12, pg 136, plate 14, pg 139 (*hamuli*-hook mech) when the bee flies.

All honey bees have two pair of wings and a corbicula (pollen basket)

C. ABDOMEN-Region of Reproduction and Digestion

1. The abdomen of the honey bee
 - a. Spiracles on the abdomen for Breathing- The spiracle is the opening to allow air to enter the body.
2. The wax Glands
3. The Scent Gland
 - a. The last abdominal segment contains the “scent” gland known as the NASONOV. The first bees in the hive release this scent. Caused by the Queens’ presence.
4. The Stinger
Stinger of a honey bee. Fig. 16, pg 146, Plate 21, pg 157. The stinger has paired lances that
Work their way into your body. It is important to get the stinger out as soon as possible. The worker bee Pheromone is left from the sting and other will try to sting you in the same place. Honey bees when they sting each other, they do not leave their stinger. The stinger cannot get through hard tissue that is why they cannot get rid of the small hive beetle. There is a poison gland where the venom is stored. It will also leave a sting pheromone, which is another gland.
5. The Structure of the Body Wall- Exoskeleton is made up of the Following cells: Proteins and hydrocarbon that make it hard. Can change Odors after a period of time (days).
 - a. epicuticle
 - b. endocuticle
 - c. epidermis

D. THE ALIMENTARY CANAL

1. Sucking pump
2. Esophagus
3. Honey Stomach
4. Proventriculus

E. THE BLOOD, ORGANS OF CIRCULATION, AND ASSOCIATED TISSUE

1. Body Filled with liquid called blood or hemolymph
2. Heart
Fig 17, Heart, nervous system. Pumps blood to the brain and releases it in the head region, whose purpose is to provide nutrients to the body and also to pick up waste. The blood then flows freely back to the heart. Only one aorta. It has no function of transporting oxygen, like our brain. Insect blood is either brown or green, depending on what the bee has been feeding on. *Hemolymph*-blood

F. THE RESPIRATORY SYSTEM

Tracheal or breathing system of the bee. Fig 19
Spherical is where the tracheal mite goes into the bees. Has nine spherical. Cut across the first spherical. 40 x can pick up tracheal mites. Tracheal is what carries the oxygen to the body.

G. THE SENSORY & NERVOUS SYSTEM

Nervous system of the worker be. Fig 20. Have several of the “ganglion”.
Ganglia where nerves come together into the ganglia where the bee acts

H. THE REPRODUCTIVE SYSTEM

1. The Male Reproductive Organs
2. The Female Reproductive Organs

Reproduction. Fig. 22 a., b. c..

Spermatheca which is the storage for sperm. Single ovary, mature queen and her reproduction system. If she releases a sperm into the egg, then it becomes a female, if not it becomes a drone. Study fig. 22.

3. Insemination of the Queen fertilization of the egg

DIGESTIVE TRACT

Let's start here with the mouth or proboscis that has mandibles and a pump on the front of the head. It can suck nectar up through. Goes through the esophagus into an area known as the foregut or honey stomach.

The Proventriculus is a valve which closes so the bee can regurgitate sand opens into ventricular or large intestine, then to the small intestines. Need to study this figure 17 for clarification. Valve opens and shuts on command. Has kidneys known as malpighian tubules used to remove water.

The feeding components of a bee are: The mandibles which differ based upon bee type, the proboscis which is in three parts and, when brought together, form a 'straw' --(parts: the maxillae and labium), and the esophagus - Malpighian tubules are a spaghetti-like 'sieve' which filters impurities out of the bee's hemolymph. Hemolymph is another way of spelling bee-blood but I always looked at it as more the British English/Latin way.

Regarding the layering of the exoskeleton: The exoskeleton layering is known collectively as the 'integument'. This layering references the cuticular layers and the epidermal cells beneath. The harder layers are the epicuticle, exocuticle, and endocuticle - with the epicuticle being the external layer, the exocuticle is a bit thicker and is the middle layer, and the endocuticle is the internal one. Below those, as mentioned, are the epidermal cells which help generate each new layer above.

Regarding antennae, the drone's antennae are longer than workers or queens. Drones have one

more segment on each antennae than do the females of the species or not. The extra segment seems consistent across the various different stinging insects and in some cases is used to definitively identify male versus female. Pits, pores, and plates are also an interesting point to bring up as those various additions to the antennae are what facilitates the 'sensing'.

Legs -

The legs are divided into segments: the coxa, trochanter, femur, tibia, and tarsus -- with the coxa, where it connects with the thorax, helping control the angle of each leg in relation to the others. The trochanter is responsible for 'up' and 'down', while the next three segments: the femur, tibia, and tarsus, are primarily responsible for forward and backward movement. On each segment of each leg arise specifics related to that particular type of bee. On the hind leg, the pollen brush, pollen press and pollen basket, the third part known as the corbicula (also spelled corbiculae *plural*), as well as the primary hair which holds pollen in place aide in transporting pollen to the hive, and the front leg possesses the antennae cleaner which cleans the antennae.

PESTICIDES AND HONEY BEES.

Pesticides are much more detrimental to bees than herbicides. Herbicides also eliminates forage for bees and can be harmful.

Pollination is essential for food production. Honey bees provides 80 to 90 pollination. The honey bee is our most beneficial insect.

Need to be able to tell between winter kill and a pesticide kill. If bees are in a pile, and if there is regurgitation at mouth parts, it is a good chance it is a pesticide kill. Also if there is massive dead bees outside of hive. They regurgitate their gut content.

Pimcap M, a pesticide labeled for peaches. About the size of a pollen grain. Micro encapsulated size form. They bring it back to the hive.

Safest pesticide is granulated that is placed in the ground and moves up the plant.

PROBLEMS ASSOCIATED WITH PESTICIDE

Due to the lack of bee pastures, Bees cannot find a natural forage where there is no pesticide applied. Have a lack of natural forage.

Desiccation is a problem where bees are collecting any source of water and it may be contaminated. In hot summer, bees need a lot of water and look for it where they can.

THINGS TO CONSIDER BEFORE SPRAYING

1. Time of day-Spray chemicals late in the evening when there are no bees foraging. 2. Formulation-Use a granulated form rather than liquid form of pesticide, and 3. Shortage of residual time pesticide is effective.

Time of day: Spray late in the evening and late in the evening. Sun breaks down most pesticides. Dust can be a problem and is very toxic to honey bees-use liquid form of Sevin where possible. Residual activity of chemical used-remember how long it will be active.

Supersedure - They will blame it on queen and will supersede the queen, thinking the death is due to the queen that is not very good.

You may have a break in brood cycle- The pollen might be brought back to the hive and fed to the brood.

Most of the kills are to the adults.

Mosquito abatement-watch out for the spraying for mosquitos.

Use integrated pest management.

Bush hogging will prevent bees going into the orchard where overdraft collect

Aerial applications is where we get the biggest hit. Very tough on bees.

HONEY BEE POLLINATION

There are some plants that require wind pollination and some that require insect pollination.

1. Insect Pollinated Plants-require some insect to move the pollen around because it is too heavy or sticky. Honeybee and bumble bee are your primary pollinators.

Apple

Pear

Watermelon

Squash

Cantaloupe

Strawberry-80 % wind tolerated. Remaining 20% could be a make or break situation.

Sunflowers

Cucumbers

2. Wind Pollinated Plants

Peach-Bees will forage on flowers unfortunately and collect insecticide.

Oak

Pecan

Pine

Fescue Grass

Dogwood

Strawberry

Corn-Bees collect pollen but not nectar.

What does Proper Pollination Offer?

Fruit Set

Fruit Harvest

Fruit Quality

a. Size

b. Good Taste

Complete Flower Showing General Anatomy and Fertilization

Petal, anther, stigma, pollen tube, ovule

Pollen grain must be wind or insect moved from the anther to the stigma

Quality Check for an Apple: cut apple in two and count number of seeds and look at size of seeds to determine if the apple has been well pollinated. Bees are attracted to the nectar of the flower.

Almond Flower

Some plants are self-sterile. You have to provide pollen to be moved to another tree for the pollen to be transferred to the tree that is self-sterile.

HONEY BEE COLONIES FOR POLLINATION RENTAL

What makes a good pollinating unit?

Need four to six frames of brood. That will be a good indicator your colony to be a good pollinating unit because bees need pollen to feed larvae. On one frame, there are 1200 bees on either side, resulting in a total of 2400 bees.

Pollination Contract Should Include:

Number of colonies

Guaranteed colony strength- 4 to 6 frames of brood.

Timing of colony placement-when bloom first appears. If too early they will collect other nectar.

Distribution of colonies within the crop-best bet is figure out best location with grower. (Try to keep them together rather scatter them out in the field) Do not place near wet areas which will increase chance of getting hive beetles.

Colony rental fee & payment schedule-

Right of Entry-Need to have right of entry into the field to check on the bees.

Advance notice-Need to require advanced notice if you are going to have to remove the bees, if grower is going to spray. Have in the contact how much the bees are worth if he were to spray and kill you bees.

Beekeeper Risks Involved in Rental Pollination

Liability in moving colonies-accident during mobility

Chance of pesticide kill

Bee may starve-need to plan on feeding them.

Crop failure-tornadoes or heavy rain fall. Will you expect full payment?

Time and cost of moving colonies

Weather-may want to have something regards inclement weather in case of moving

Payment schedule

Contract: move on demand

2.3 million Bee colonies in the US (Those beekeepers with 5 or more colonies)

REGULATIONS

We have one beekeeper-Fred Singleton. 10 % of his time regulating bees. We have never been a highly regulated State.

1922 Bee Law-requiring moving of moving from NC to SC. Have to contact beekeeper, NC will write a bee certificate. Checking mail for American foul brood. Once he gets that health certificate, he will send a copy to Fred. Fred will issue an entry permit (must have)

Packages-have their own way of certification. Should have a tag verifying they are free of any disease.

Intra state- movement ok. Must have shipping tags for packages being shipped into or out of state.

Fla is highly regulated. Have 13 or 14 inspectors.

NC is fairly regulated-5 inspectors.

CA is not state regulated but regulate by county.

If you want to take bees to NC, you have to get them inspected and you will get a certificate, then you send that to NC and the NC bee inspector will issue you a permit.