Norfolk County Bee Keepers Association

Bee School, second night.

- 1st Hr – Bee Biology and Anatomy

- 2nd Hr – Hive Manipulation

Bee Biology and Anatomy

Honey Bees are social insects

- They live together in large, well-organized family groups
- Under natural conditions they nest in cavities of trees, caves, your home, etc.
- They build multiple ____ in layers hanging vertically with just enough space between the layers for them to move around. Combs are a collection of ____ made of _____
- Cells are used to store _____ and raise _____
- They have one _____ (normally) and live to serve her
- They make and store honey to survive the winter.

Lesson Objectives

After successful completion of this lesson you will be able to describe:

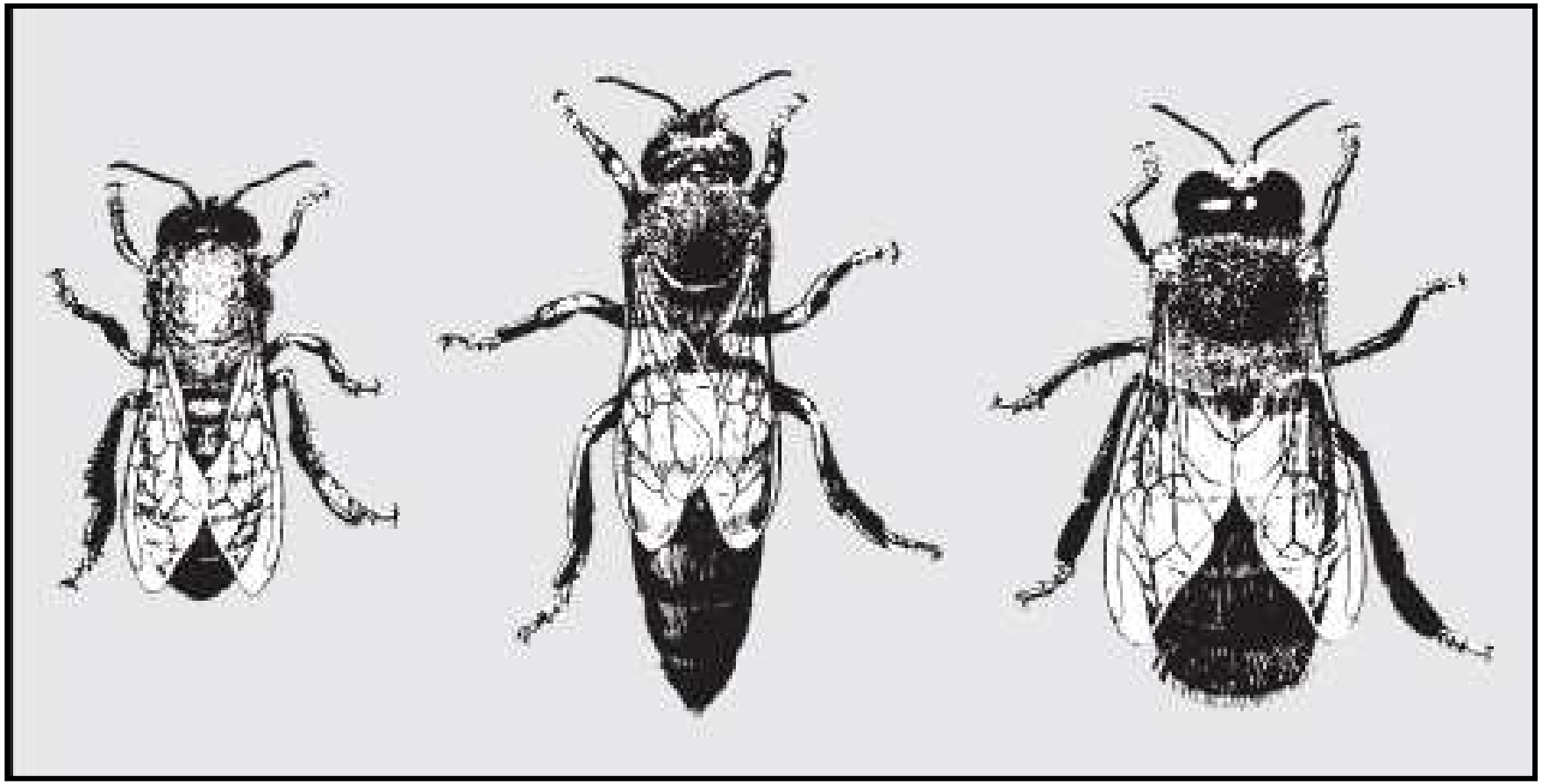
1. Three members of the colony
   a) Worker
   b) Queen
   c) Drone

2. Development timeline of a Honey Bee and their lifetime functions
   a) Egg (Eggs)
   b) Larva (Larvae – “lar-vee” or “lar-vie”)
   c) Pupa (Pupae – “pew-pee” or “pew-pie”)
   d) Adult (Adults)
   e) Job responsibilities

3. Anatomy: Three major sections of the bee and several parts of each
   a) Head
   b) Thorax
   c) Abdomen

Bee Biology and Anatomy

1) Three members of the colony



Worker Queen Drone

Bee Biology and Anatomy

1a) The Worker Bee

- Female but not fertile
  a. Normally does not lay eggs
  b. If she does, they will be drones
- About 20,000 to 60,000 in a colony
- Has several functions throughout her life
- Lives about 4 – 6 weeks in the summer
- Lives about 4 – 5 months in the winter
- Stinger has barbs and stays in your skin – used to defend the hive and herself

1b) The Queen

- One queen (normally)
- Function: laying eggs
- Can live 2 – 5 years
- Can lay 1500 eggs a day at height of season
- Produces air-borne pheromones ("queen substance") that keep the colony functioning orderly, loyal and protective to that queen
- Stinger does not have barbs – only uses it to kill rival queens

1c) The Drone

- Develops from unfertilized egg
- Larger than workers
- Big eyes
- Male (leads the good life)
- Sexually mature at 2 weeks
- One function in life – mate with virgin queens
- Mates once in drone congregation areas at about 300 feet above ground, then dies (maybe not such a good life)
- No stinger (remember, he only has one function)
- Survivors are forced out of hive in the Fall and die
(definitely not the good life. Maybe if he had another function???)

2) The Life Cycle of Honey Bees

Table 1. Developmental stages of the three castes of bees.

DEVELOPMENTAL STAGE	DURATION OF STAGES		
	QUEEN	WORKER	DRONE
	Days		
Egg	3	3	3
Larval stage	5 ½	6	6 ½
Pupal stage	7 ½	12	14 ½
Total developmental time	16	21	24

2a) The Birthing Room – Eggs & Larva(e)

2b) The Birthing Room – Larva(e)

About to pupate

About to be capped

2c) The Birthing Room - Pupa(e)

(cell cut-away showing side view)

2c) Drone & Worker Cells

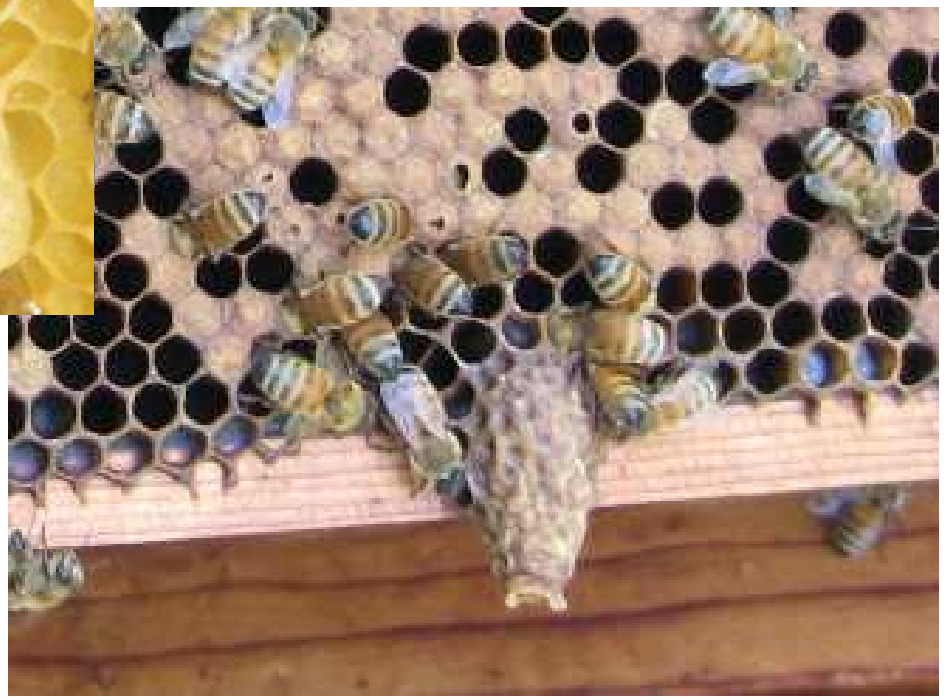
Worker – cap flush with cells

Drone – larger & raised cap, usually found at the outer edges of frames.

2c) Queen Cells

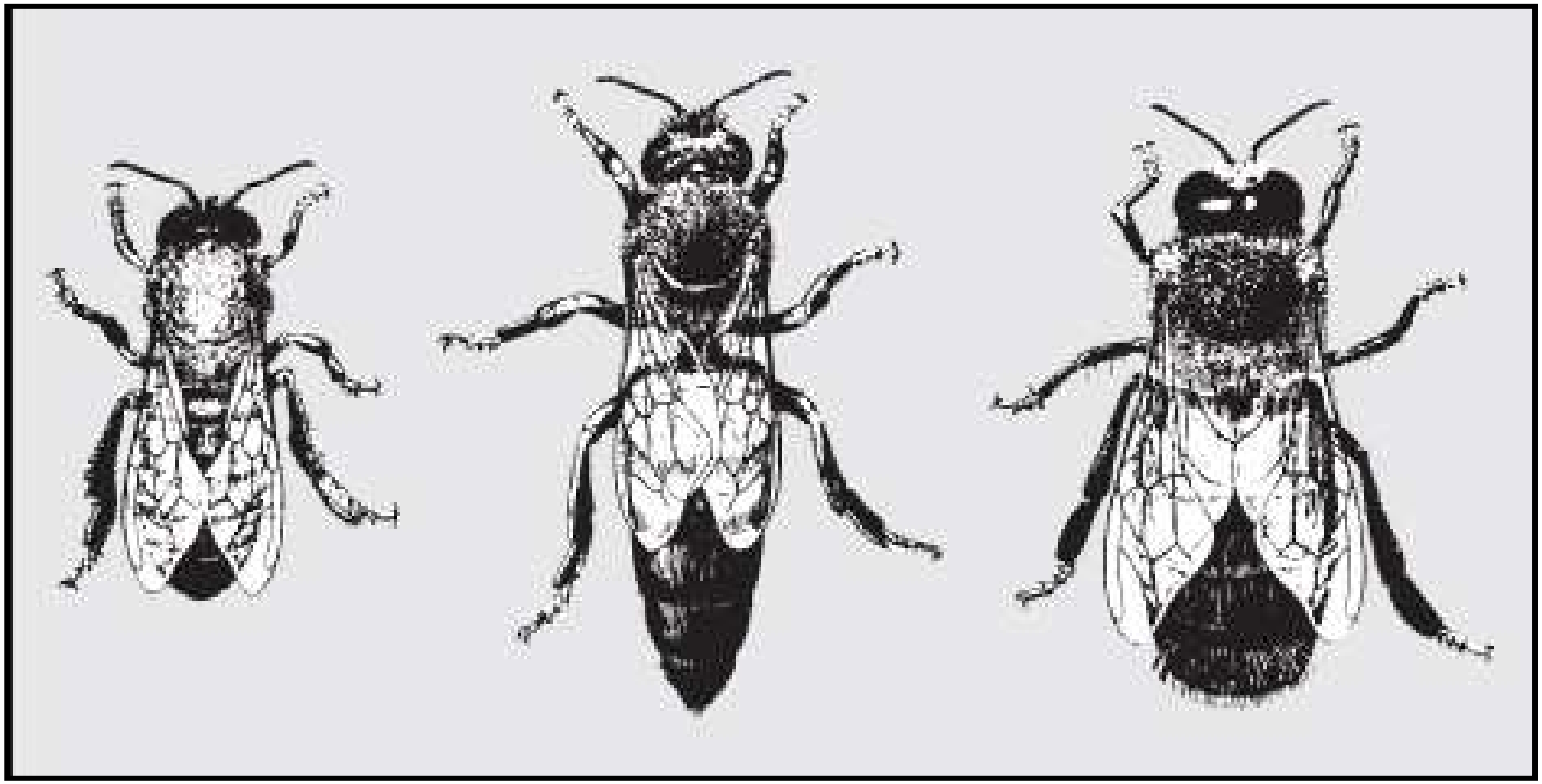
Supersedure Cell

Worker cells are horizontal while queen cells are vertical. As the queen larva grows, the cell enlarges and becomes peanut-shaped when capped for the pupal stage of development.



Swarm Cell

2d) Adults



2e) Jobs - Never unemployment or a layoff

(Well, except for those drones)

- Workers do the work in the bee society. Employment is based on the age of the bee and the needs of the colony. During their life they pass through many job promotions:
- Nurse Bee
  - ✓ 1 – 12 days
  - ✓ Clean own cell and others
  - ✓ Feeding brood (larvae)
- House Bee
  - ✓ 10 – 20 days old
  - ✓ Comb building
  - ✓ House keeping
  - ✓ Undertaker
  - ✓ Ripening honey
  - ✓ Climate control
  - ✓ Secreting/molding wax into cells
  - ✓ Accept and store pollen and nectar from foragers

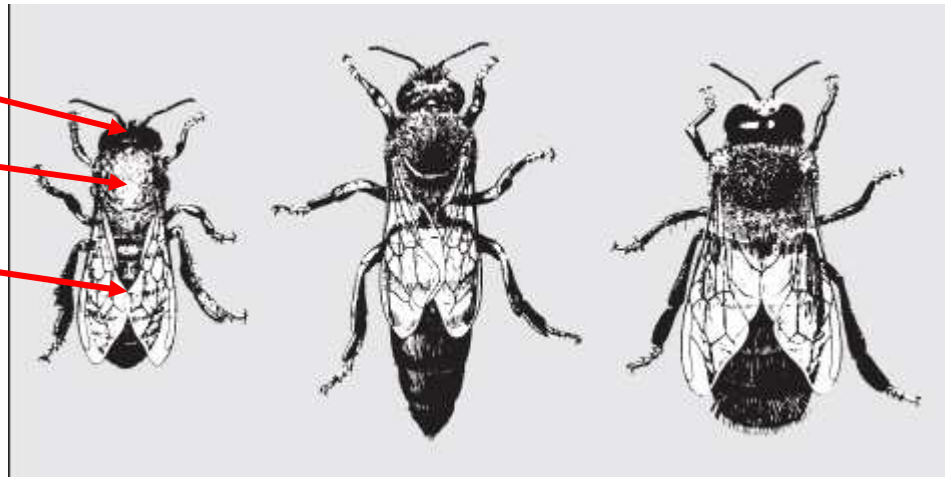
- House Security
  - ✓ Guard hive and its entrance (some say only about 5% of bees perform this job)
  - ✓ Orientation flights to learn surroundings
- Field Agent
  - ✓ After about three weeks the girls are ready to spend the rest of their lives as **foragers** gathering pollen, nectar, tree resin (that they turn into propolis) and water for the hive. During this time they work themselves to death – literally
  - ✓ Worker bees in the summer only live about six weeks. In the winter they live a leisurely life for several months

3) Bee Anatomy

Insects have a hard outer covering called an exoskeleton, rather than an internal skeleton like vertebrates (humans). The exoskeleton, which is made of a material called chitin, helps to protect the internal organs of the insect and helps prevent desiccation (drying out). In order to grow, the insect must shed the exoskeleton.

The three main sections of the Honey Bee's body:

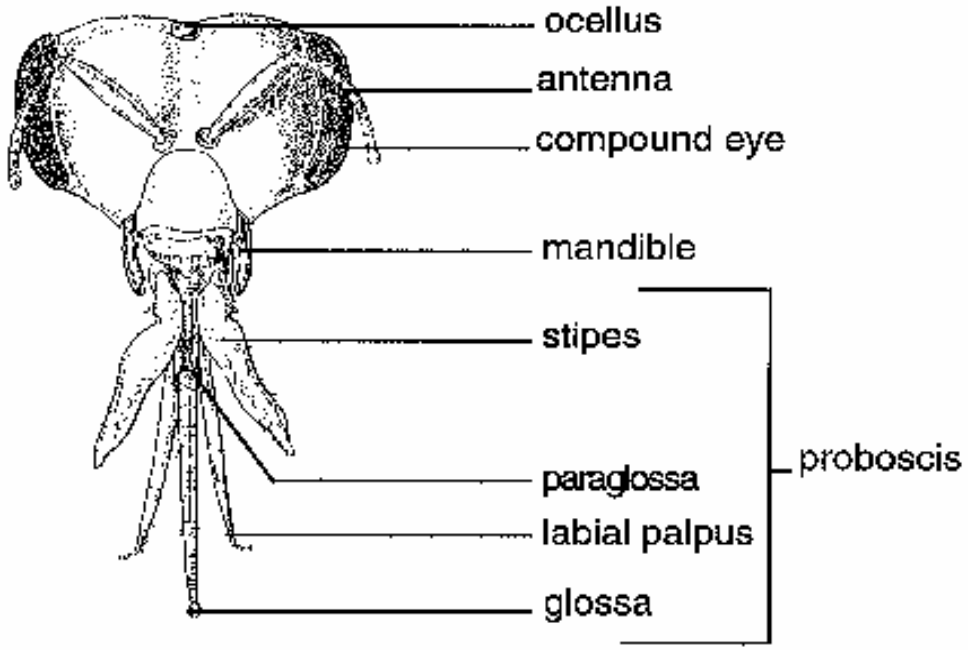
a. Head
b. Thorax
c. Abdomen



Bee Biology and Anatomy

3a) Head

Honey Bee Head and Mouthparts (Hairs not shown)

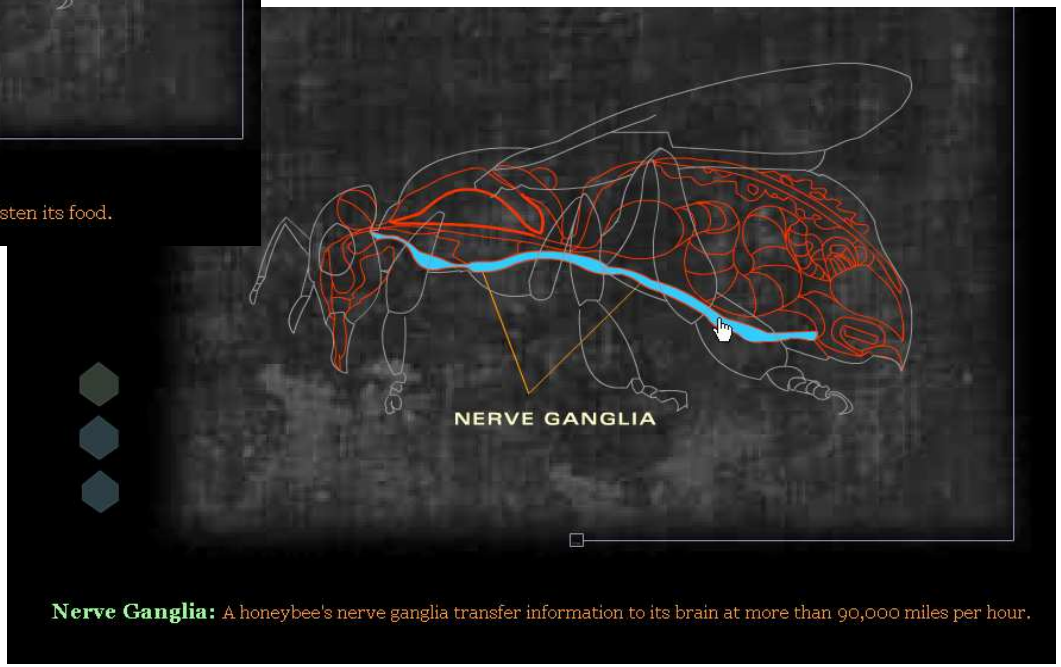


- There are three eyes, called **ocelli**, located at the top of the head between the bee's two larger compound eyes. The ocelli detect light but can't focus or arrange an image like the larger compound eyes
- Honey Bees use their **antennae** to learn about their environment: Tiny sensory hairs on each antenna allow them to smell, taste, feel air movements and to communicate with one another
- The **compound eyes** each have almost 7,000 hexagonal facets. Each facet is like a mini-eye, containing its own lens and sensory cells
- A bee's curved, spoon-shaped jaws, called the **mandible**, are built for many uses: They can be used to ingest food, manipulate wax to build the hive cells, feed the young or queen, and even fight
- The long **proboscis** at the front of the bee's head is used to ingest liquids such as nectar, honey or water. The proboscis is tipped with a spoon-shaped **glossa**

3b) Thorax

The saliva is mixed with bees wax to make it sticky.

The nervous system comprises a small "brain" and 7 ganglia right down the body. The 7th is near the end of the abdomen. This is why the detached body part of the bee sting continues to pump venom. The ganglia control the wings, haemolymph, legs, etc….



3b) Thorax (cont.)

The air sacs (think lungs) are connected to the surface by tracheal tubes, emerging near the wings for breathing.

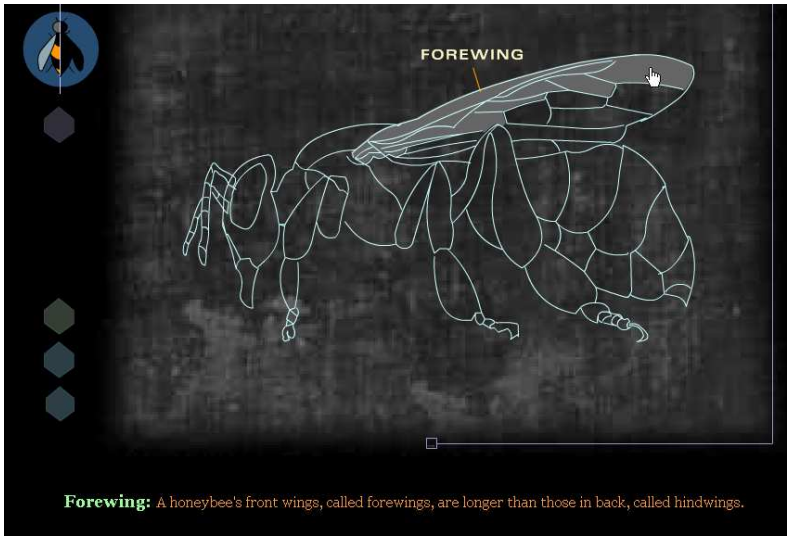
(like having nostrils between your shoulder blades)

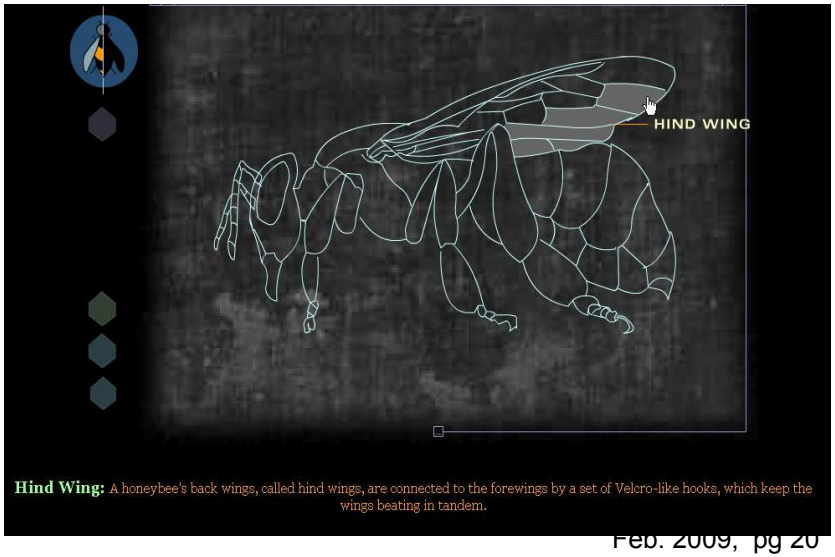
There are also breathing pores (spiracles) along the sides of the abdomen. (refer to the page showing the Dorsal Vessel in the Abdomen section)

Bee Biology and Anatomy

3b) Thorax (cont.)

There is a total of four wings, two on each side. The forewing and hind wing on each side are joined during flight by a system of hooks (think Velcro). It is the rapid flapping of the wings that causes the distinctive "buzz". At 15MPH you can't out-run a Honey Bee.





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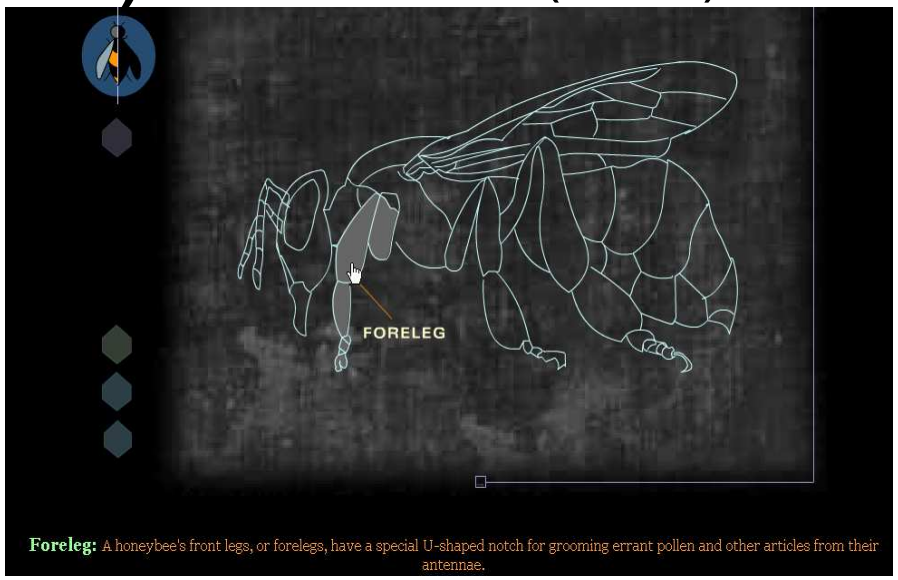
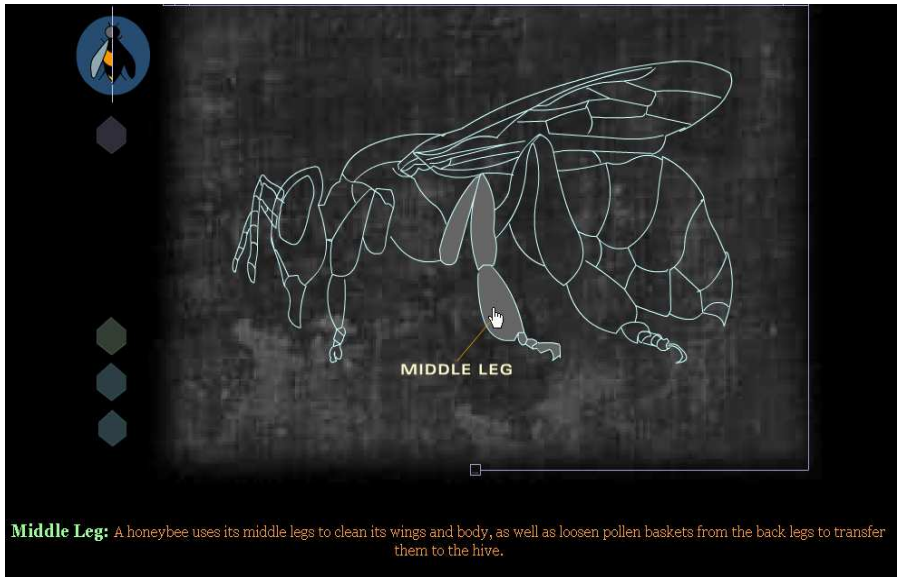
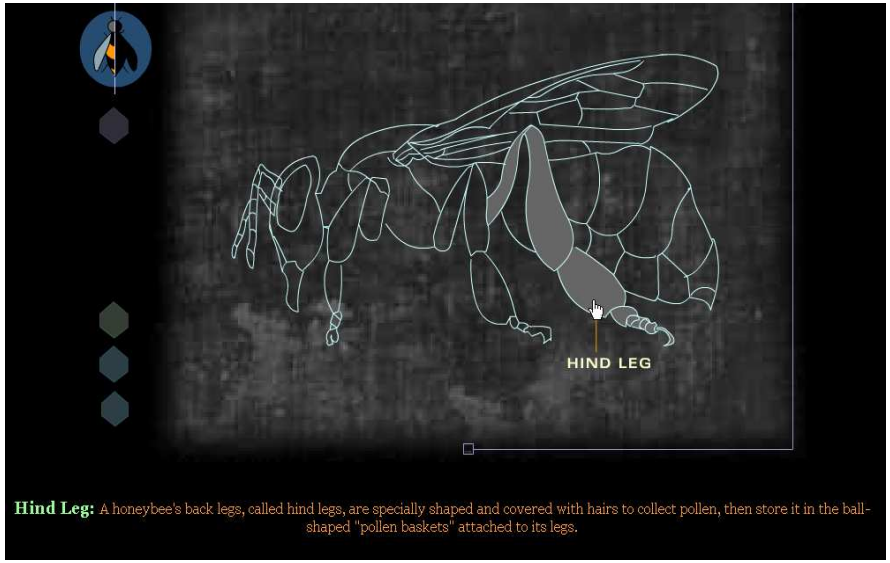
3b) Thorax (cont.)



Foreleg: A honeybee's front legs, or forelegs, have a special U-shaped notch for grooming errant pollen and other articles from their antennae.

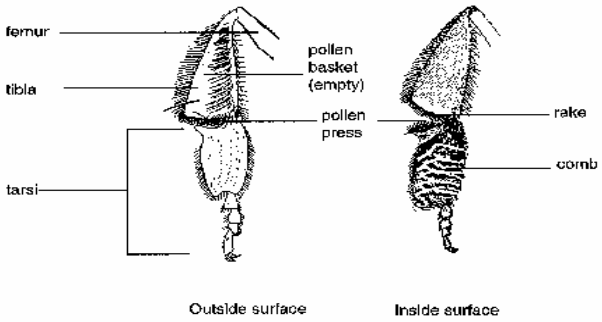


Middle Leg: A honeybee uses its middle legs to clean its wings and body, as well as loosen pollen baskets from the back legs to transfer them to the hive.



Hind Leg: A honeybee's back legs, called hind legs, are specially shaped and covered with hairs to collect pollen, then store it in the ball-shaped "pollen baskets" attached to its legs.

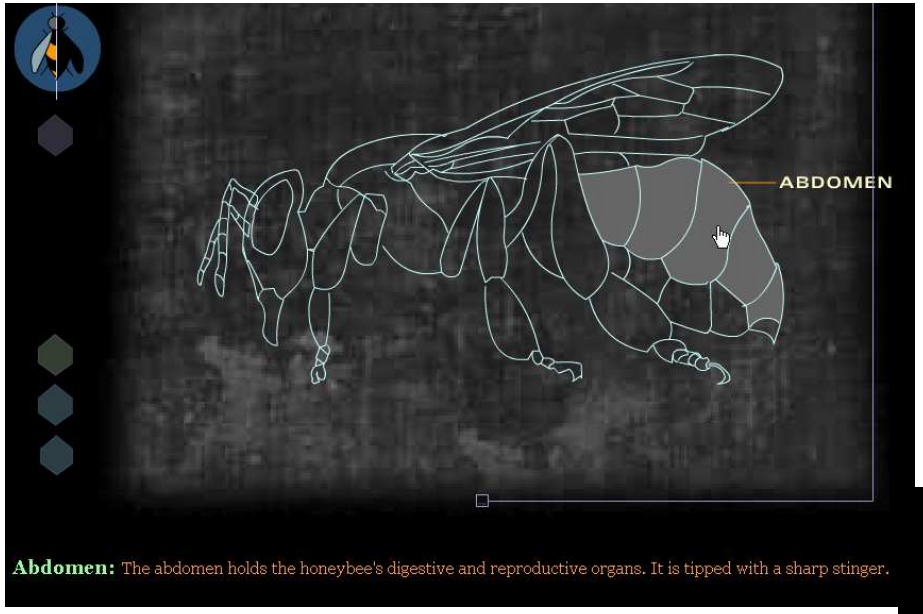
Parts of the Worker Honey Bee Hind Leg



Like all insects, there are 6 legs. The legs of the bee are primarily used for walking. However, honey bee legs have specialized areas such as the antennae cleaners on the forelegs, and the pollen baskets on the hind legs.

Bee Biology and Anatomy

3c) Abdomen

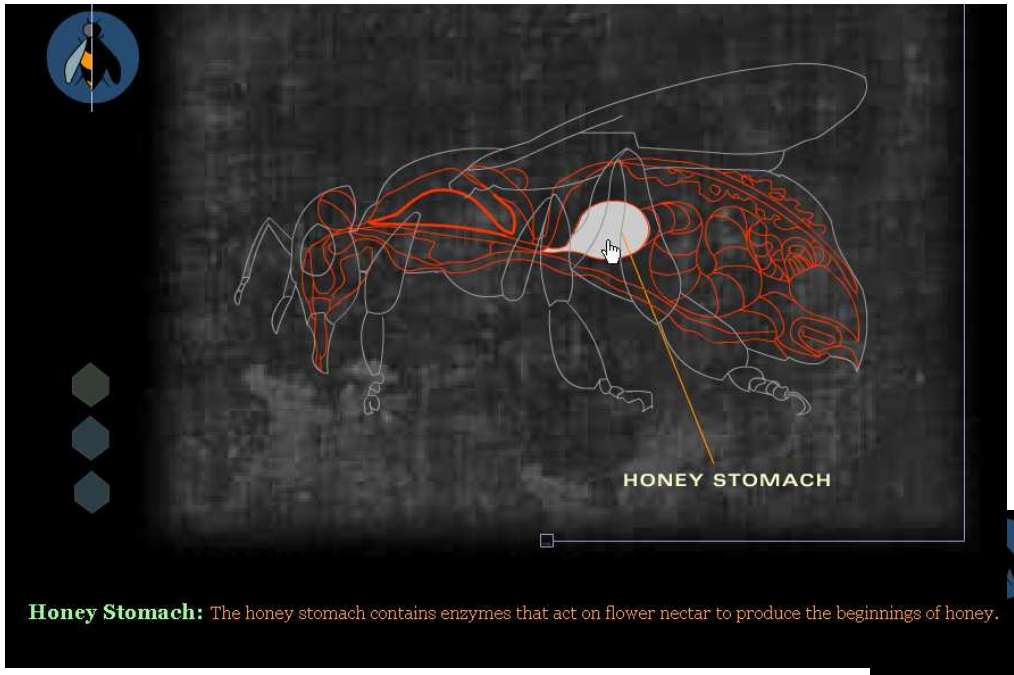


Honey Bees have "six-pack" abs.

Actually, as seen from the outside, only six abdominal segments can be observed, but the adult honeybee has nine, while the larva has ten.

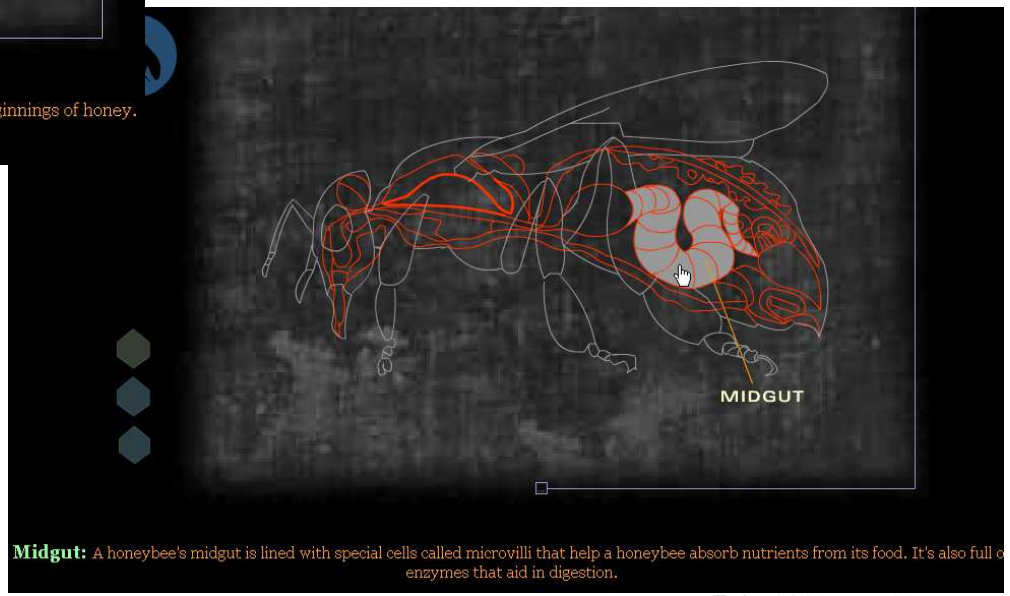
Bee Biology and Anatomy

3c) Abdomen (cont.)



Honey bees have reversible movement of foods from mouthparts to/from a honey stomach. The honey stomach is a crop or storage area to hold freshly collected nectar or water for transport to/from the nest.

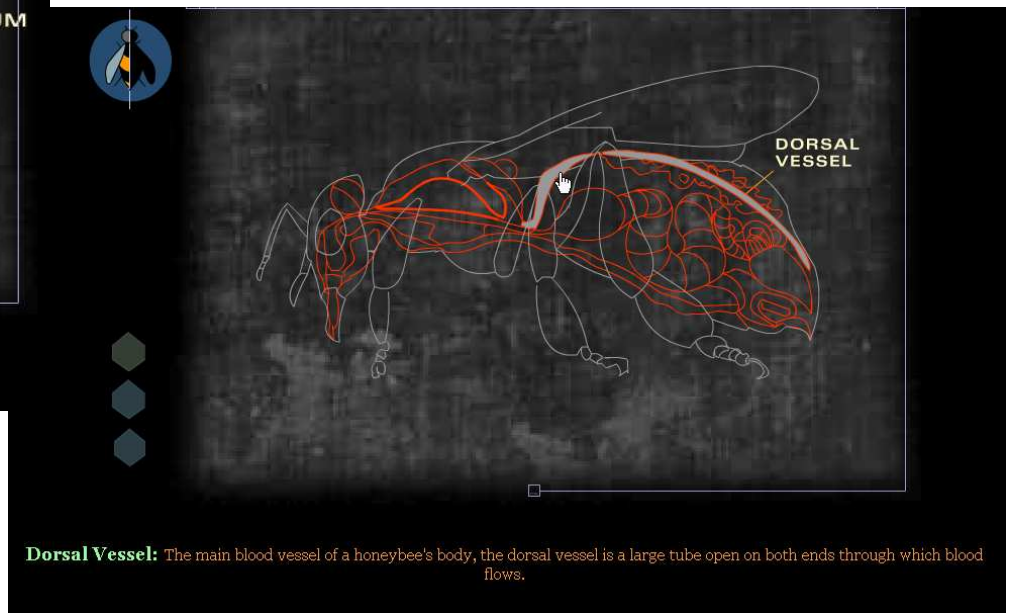
Digestion of foods occurs in the mid-gut. The hind-gut reclaims water and nutrients and passes small amounts of indigestible wastes to the rectum for storage until excretion.



3c) Abdomen (cont.)

In the spring you will find how much waste can be stored when the girls make their cleansing flights over your nice new, clean bee suit or jacket.

(You might want to get the kind with a detachable veil)



The blood (haemolymph) is not carried by arteries and veins but flows loosely around the body, controlled by the dorsal and ventral diaphragms, sometimes called vessels, bellows or heart. Oxygen enters into the bee via spiracles (including two rows of 6 on the abdomen and by trachea connected by 3 spiracles on the upper thorax) then into the bellows in the abdomen which distribute it into the blood.

3c) Abdomen (cont.)

Wax Gland(s): Four pairs of glands, sometimes called mirrors, are specialized parts of the body wall. During the wax forming period in the life of a worker, the glands greatly thicken and take on their glandular structure.

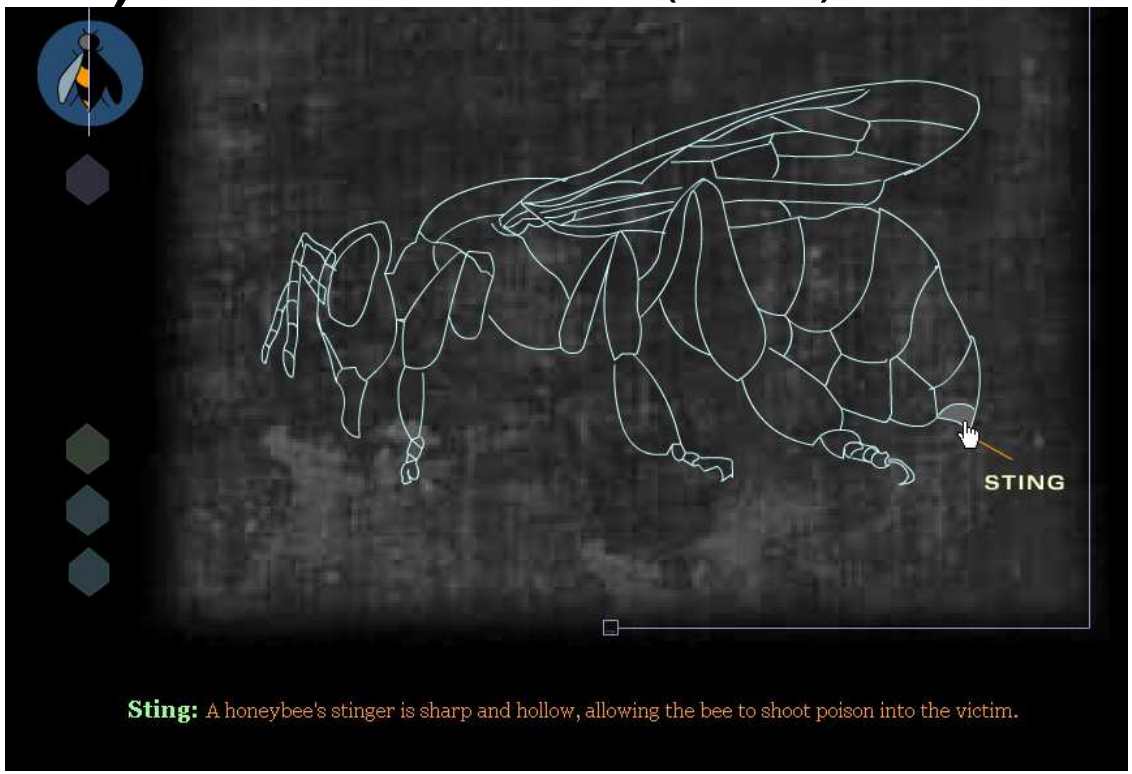
The wax is discharged as a liquid, hardens to small flakes or scales, and sits in wax pockets. The wax scale is then transferred to the mandibles where it is chewed into a compact, pliant mass.
After the worker bee outgrows the wax forming period, the glands degenerate and become a flat layer of cells.

3c) Abdomen (cont.)

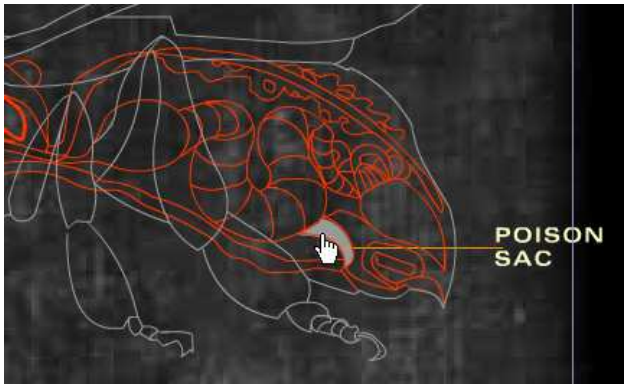
Workers have a Nasanoff gland at the end of their abdomen. This Nasanoff gland is used by the guard bees at the hive entrance to disseminate a scent that guides young bees back to the entrance during early flights.

Bee Biology and Anatomy

3c) Abdomen (cont.)



And finally – the part you're most interested in...



On the end of the female bee's abdomen is the *ovipositor* (stinger). The ovipositor of the worker bee is barbed so that it remains imbedded into whatever the honeybee stings. In its struggle to free itself, a portion of the bee (stinger, venom sac, ganglia) is left behind, which damages her enough to kill her. The venom sac continues to contract by reflex action, continuously pumping venom into the wound for several seconds. The queen's ovipositor is slightly barbed and is "reusable": It's used to kill rival queens.

Anatomy Review

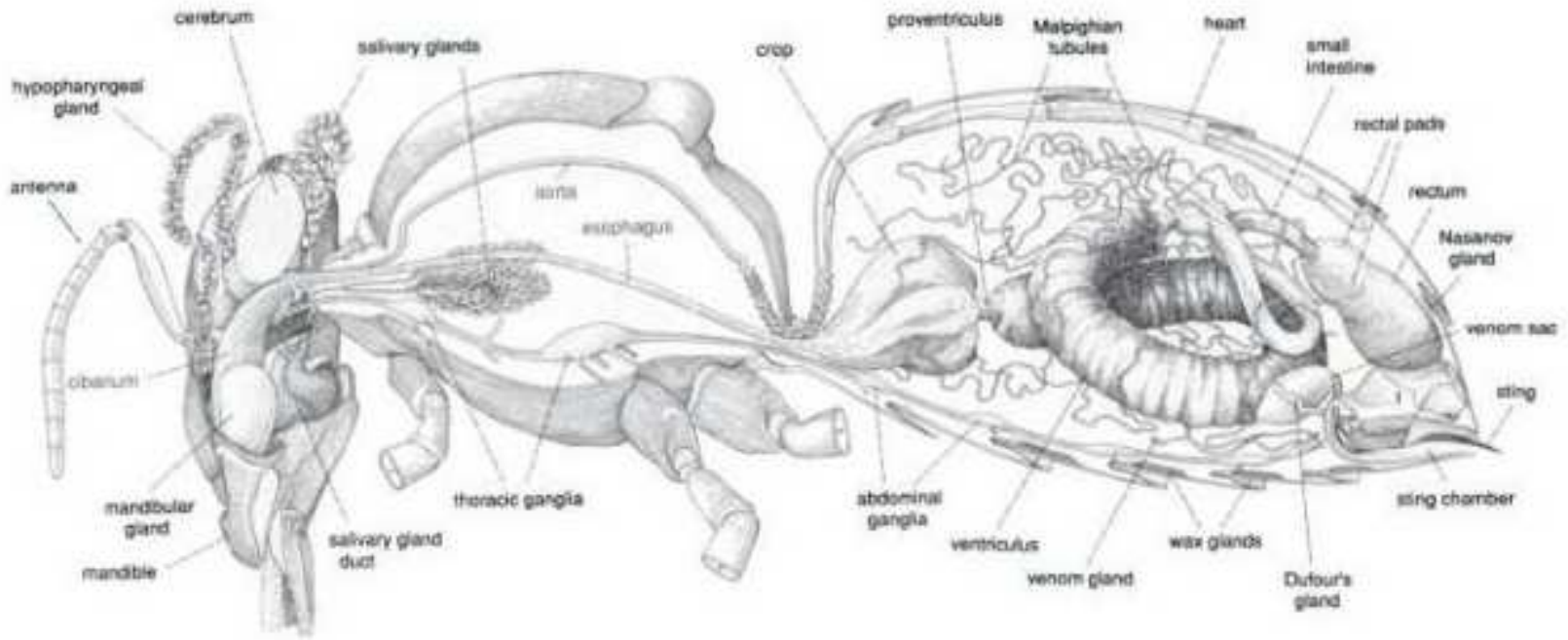


Figure 3.15. Internal anatomy of a bee showing the locations of exocrine gland systems. A worker *Apis mellifera* is depicted (Camargo 1972). Original drawing provided by J. M. F. Camargo.

Credits & Reference URLs

http://photo.bees.net/biology/ch5/

http://www.rothamsted.ac.uk/pie/DeBug/Anatomy.html

http://ag.arizona.edu/pubs/insects/ahb/inf2.html

http://www.pbs.org/wnet/nature/alienempire/multimedia/bee.html

http://maarec.cas.psu.edu/diseasesPests.html

http://www.ent.iastate.edu/zoo/lessonplans/honeybee.html

The .pdf files sent to each student