Bee School 2020

Honeybee Anatomy

Placing Bees in the Animal Kingdom

Phylum	Arthropod	External Skeleton, Chitinous, Segmented, Invertebrates
Class	Insecta Hexapoda	Six legged 3 major body parts, head, thorax, abdomen
Order	Hymenoptera	2 sets of joined wings connected by hooks, young develop through metamorphosis, ovipositor modified to stinger
SubOrder	Apocrita	Ants, Bees, and Wasps
SuperFamily	Apoidea	Bees
Family	Apidae	Food exchange, pollen baskets, storage of honey & pollen Over 20,000 species
SubFamily Tribe	Apini	Perennial, social colonies, highly eusocial
Genus	Apis	Honeybees 5 Species
Species		Apis florea, Apsi dorsata, Apis ceranna, Apis mellifera and Apis laboriosa (Nepal))

Races of species Apis mellifera

- A mellifera mellifera – German
- A mellifera ligustica – Italian
- A mellifera carnica – Carniolan - Yugoslavia
- A mellifera caucasca – Caucasian – Caucasus
- A mellifera scutellata – African
- A mellifera caucasica - Russian
- Hybrids
  - Buckfast
  - Starline

Genetic Traits of Races

- Color
- Temperament
- Handling Ease
- Production
- Swarming Tendency
- Winter Hardiness
- Propolizing
- Disease Resistance
- Reproductive Rate
- Cleanliness
- Population of Hive
- Pollen Hoarding
- Honey Hoarding
- Conservation of stores
- Plant preference
- Tongue Length
- Whiteness of Cappings

Honeybees are social insects

- They live in large, well-organized family groups
- In nature, they nest in trees, caves, walls of barns, homes, etc.
- They build multiple comb layers hanging vertically with just enough space between the layers for them to move around. Combs are a collection of cells made of beeswax.
- Cells are used to store nectar/honey, pollen and to raise brood.
- They have one queen (normally)
- They make and store honey to survive the winter

Lesson Objectives

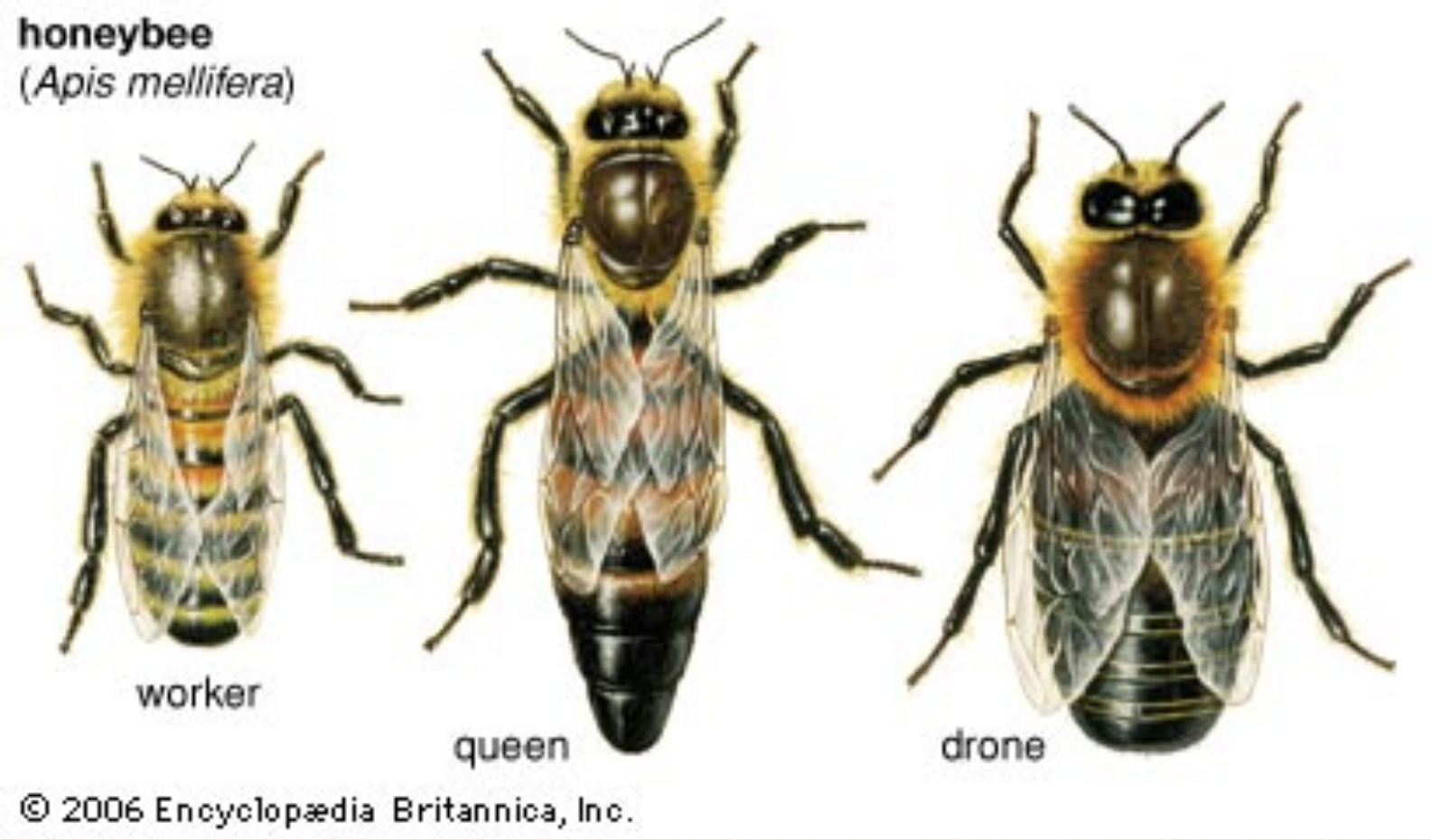
After successful completion of this lesson you will be able to describe:

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

2. Development timeline of a Honeybee and their lifetime functions
   a) Egg (Eggs)
   b) Larva (Larvae)
   c) Pupa (Pupae)
   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

The Caste Members



METRIC
1
2

The Queen

The Queen

- One queen (normally)
- Function: laying eggs
- Can live 2 – 5 years
- Can lay 1500 – 2000 eggs a day at height of season
- Produces air-borne pheromones that keep the colony functioning orderly
- Stinger does not have barbs – only uses it to kill rival queens

The Queen

- Before an old queen dies, or departs to start another hive (swarm), the hive will create a new queen by turning a larvae less than 3 days old into a queen.
- The nurse bees feed the larva a diet of only royal jelly made from a gland on their heads.
- In only 16 days a new queen emerges. She seeks out and destroys any rival queens, because there can be only one queen per colony.

The Queen

- When just a few days old, a new queen takes a maiden flight to the DCA (drone congregation area), she then mates with up to 50 drones, storing their sperm for the rest of her life of 2-5 years.
- She produces chemical scents which regulate hive activity.

The Queen

- Why about 1500 eggs per day, 200,000 per season?
- Worker bees live 6 weeks most of year; a colony needs to have 40 - 60 thousand bees at its peak.
- Is cared for by worker bees. This queen is marked with a green dot.

WHAT TYPE OF EGGS DO BEES LAY?

Worker (Female)

Queen (Female)

Drone (Male)

Fertilization

NO Fertilization

Drone (Male)

NO Fertilization

Drone (Male)

Worker (Female)

OR (depending on diet)

Queen (Female)

Queen laying eggs

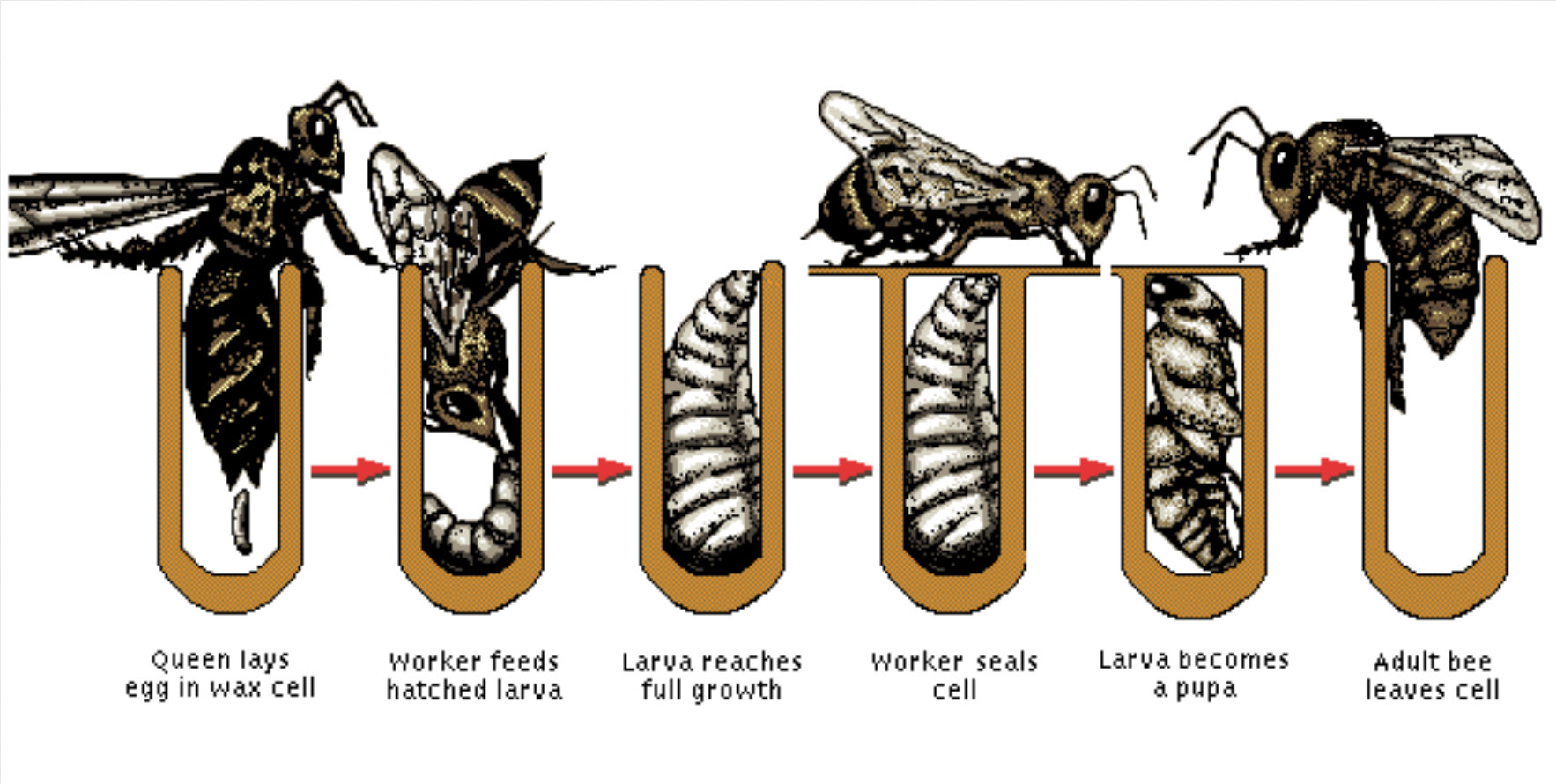
- 12-Queen Queen Laying

The Life Cycle of Honeybees

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

Complete Metamorphosis



Worker Bee & Eggs

Eggs & Larvae

Larvae & Pupae

Pupae

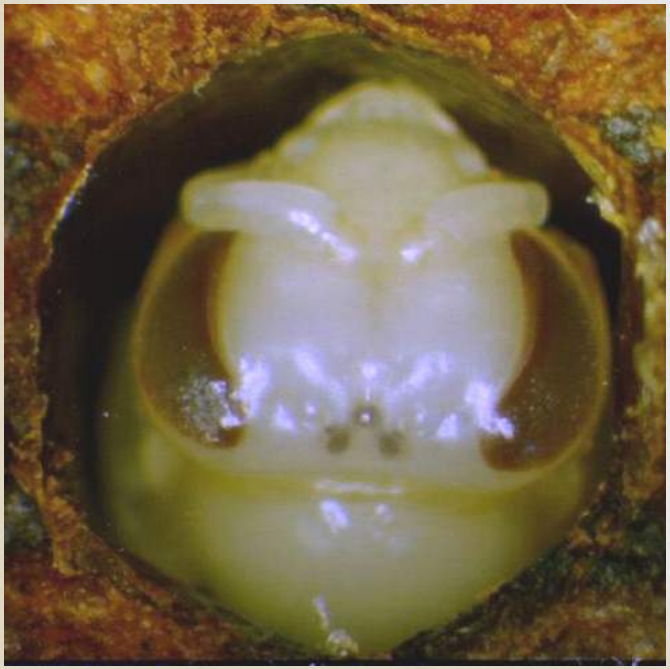
There are 4 Stages of Development

Egg

Larvae

Pupa

And…



Look very closely, can you guess how many eyes a bee has?

Hi There!

She is just emerging.

She must chew her way out.

White larvae in a pool of royal jelly.

Larvae are fed royal jelly for 3 days. After that they are given bee bread (a mixture of honey and pollen).

What makes a Queen?

Feeding a female larva Royal Jelly for the entire larval stage.

Worker Bee

The Worker Bee

- Female but not fertile, has ovaries
- 40,000 to 60,000 in colony
- Structured functions through 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

Worker Bee

- Life starts as an egg, about 1/16” or "," laid in the bottom of a wax cell
- A worker egg hatches after 3 days into a larva.
- Nurse bees feed it royal jelly at first, then bee bread & honey for 6 days.
- Becomes an inactive pupa.
- During its 12 days as a pupa, sealed in a capped cell, it grows into a worker (female) bee, emerging on the 21th day.

Worker Bee Jobs

Never unemployment or a layoff (Well, except for those drones)

Employment is based on the age of the bee and the needs of the colony.
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 Bee Jobs

Drone

The Drone

- Develops from unfertilized egg - Male
- Larger than workers
- Large eyes & Wings
- Sexually mature at 2 weeks

The Drone

- One function in life – mate with virgin queens (the good life)
- Mates once in drone congregation areas, 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???)

Queen Mating

- Youtube Queen Mating
- Facebook Queen Mating

Worker Cells

Drone Cells

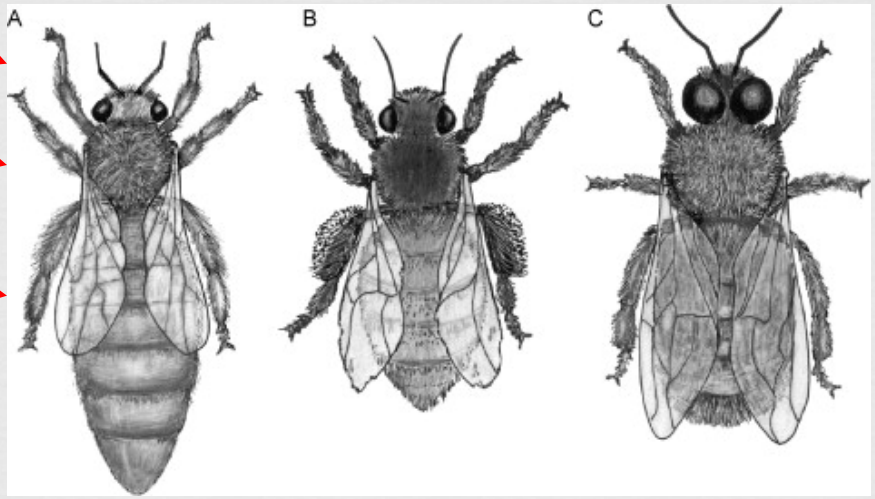
Queen Cells

External Anatomy

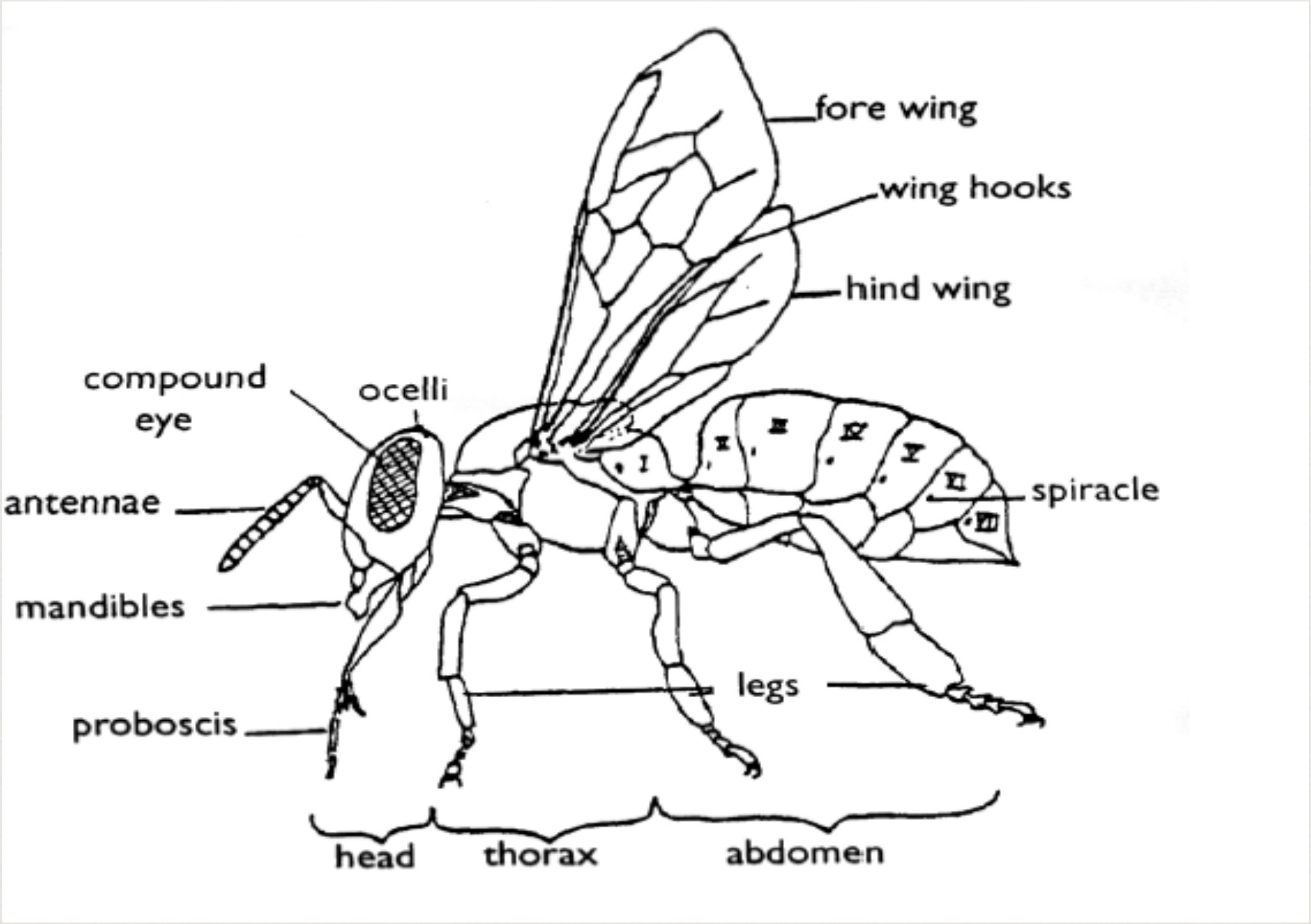
Bee Anatomy

The three main sections of the Honeybee's body:

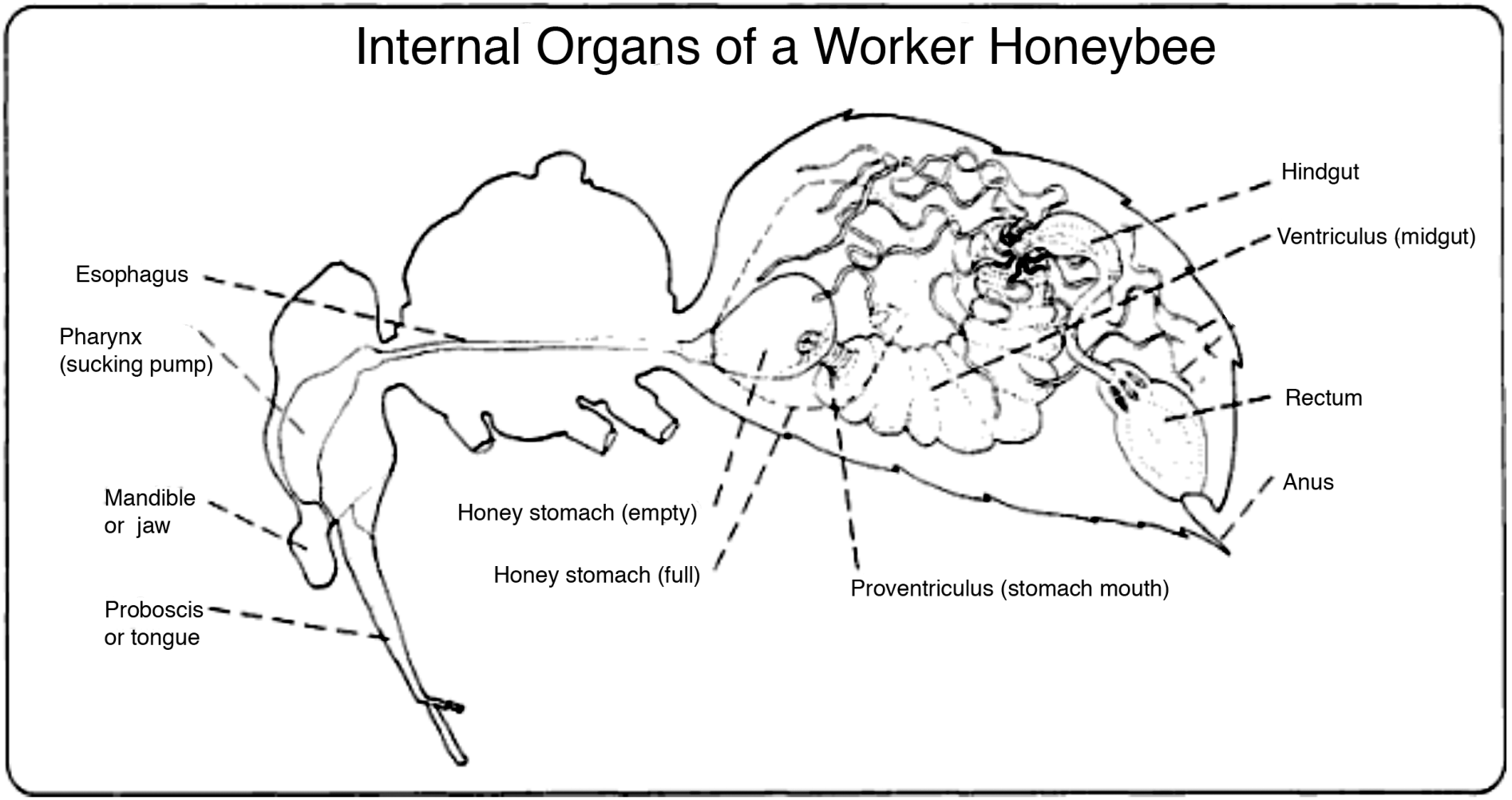
- Head
- Thorax
- Abdomen



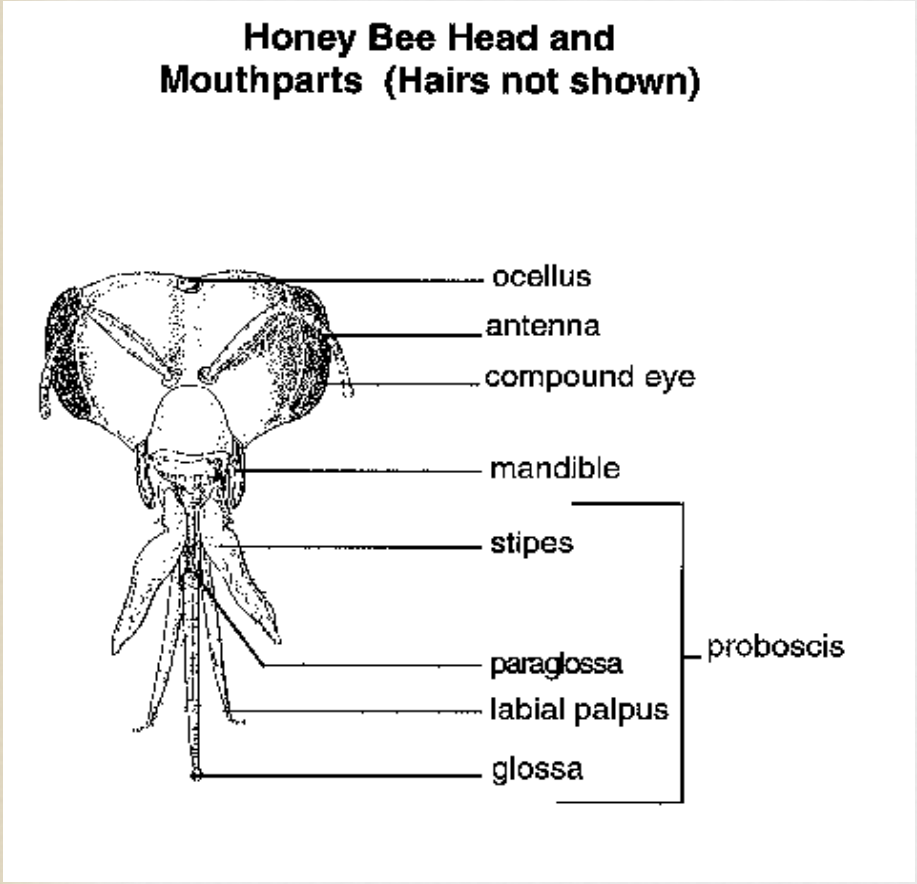
Insects have a hard outer covering called an exoskeleton, rather than an internal skeleton like vertebrates (humans). The exoskeleton, which is made of a material called chitin, helps to protect the internal organs of the insect and helps prevent desiccation (drying out). In order to grow, the insect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


fore wing
wing hooks
hind wing
compound eye
ocelli
antennae
mandibles
proboscis
legs
spiracle
head
thorax
abdomen

Internal Organs of a Worker Honeybee



Head

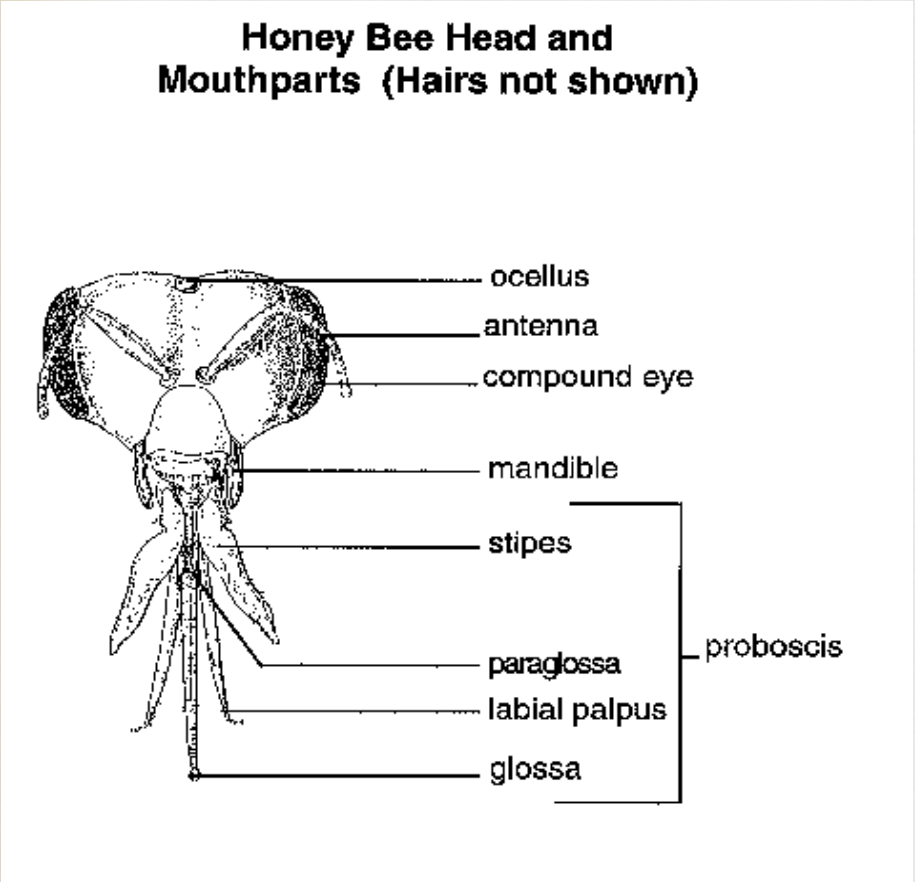


There are three eyes, called **ocelli**, located at the top of the head between the bee's two larger compound eyes. The ocelli detect light but can't focus or arrange an image like the larger compound eyes

Honeybees 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

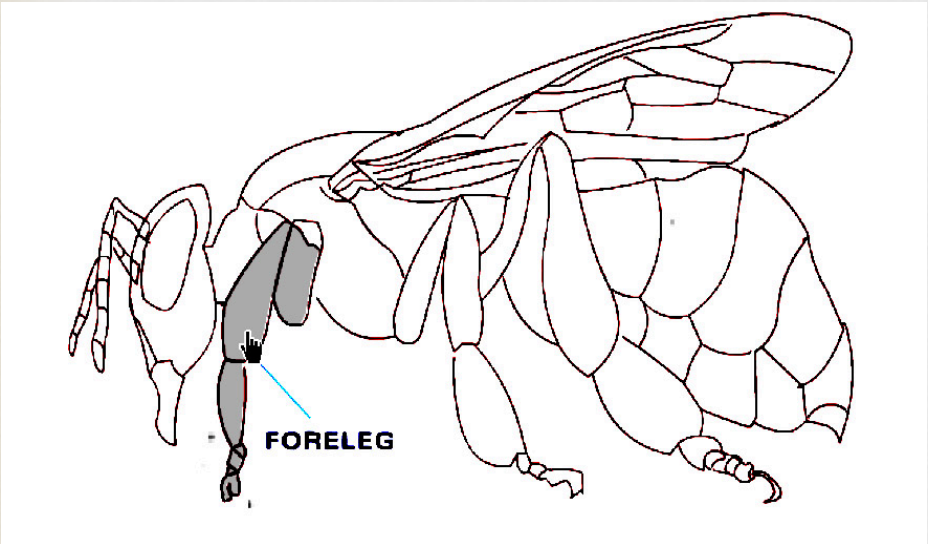
Head

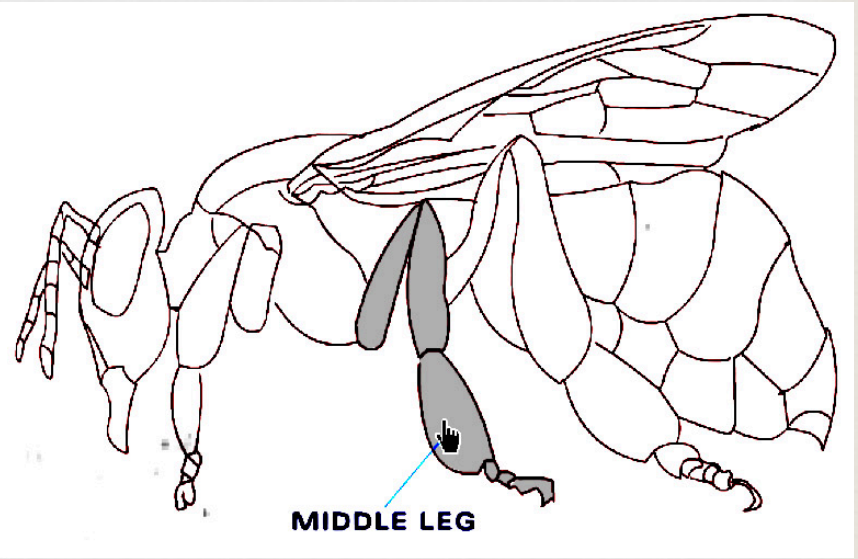


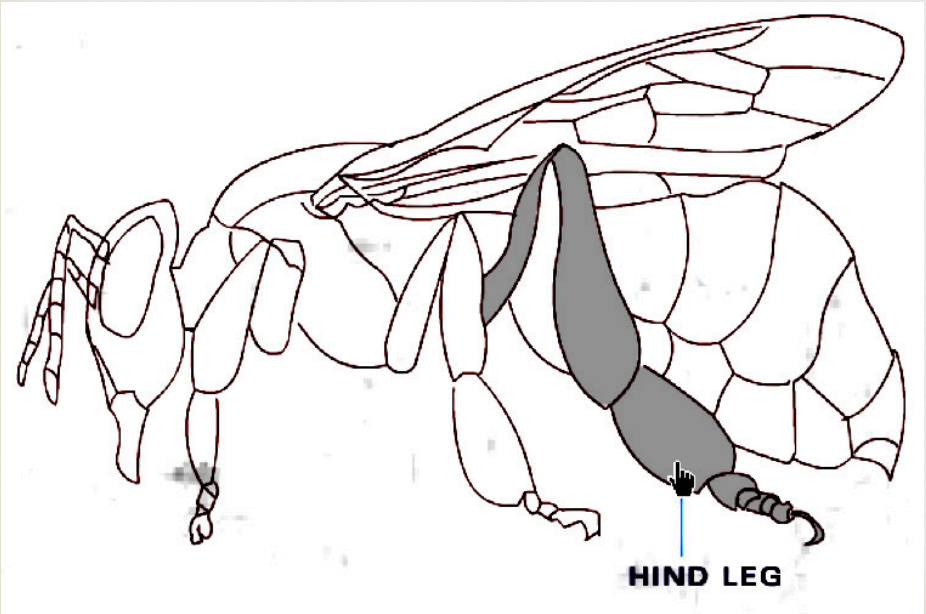
A bee's curved, spoon-shaped jaws, called the **mandible**, are built for many uses: They can be used to ingest food, manipulate wax to build the hive cells, feed the young or queen, and even fight

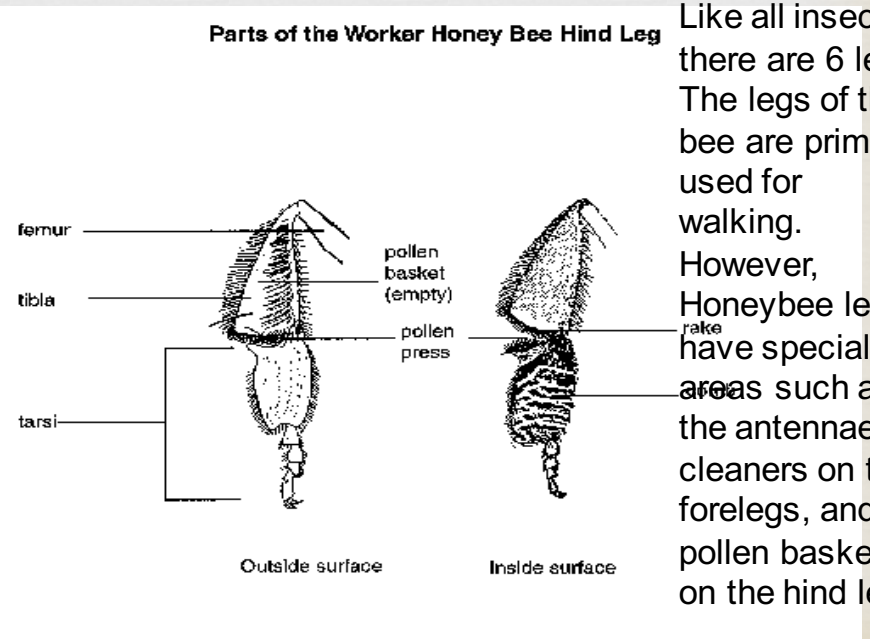
The long **proboscis** at the front of the bee's head is used to ingest liquids such as nectar, honey or water. The proboscis is tipped with a spoon-shaped **glossa**

Thorax









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

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.

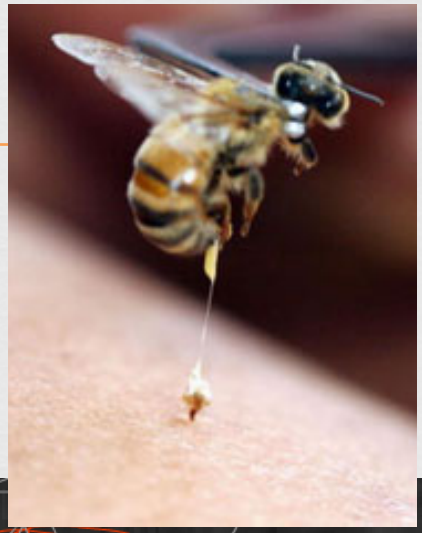
The wax is discharged as a liquid, hardens to small flakes or scales, and sits in wax pockets. The wax scale is then transferred to the mandibles where it is chewed into a compact, pliant mass.
After the worker bee outgrows the wax forming, the glands degenerate and become a flat layer of cells.

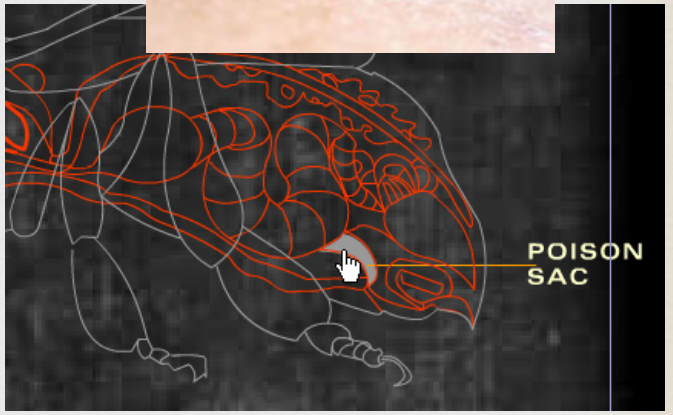
Abdomen (cont.)

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.

Abdomen (cont.)

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





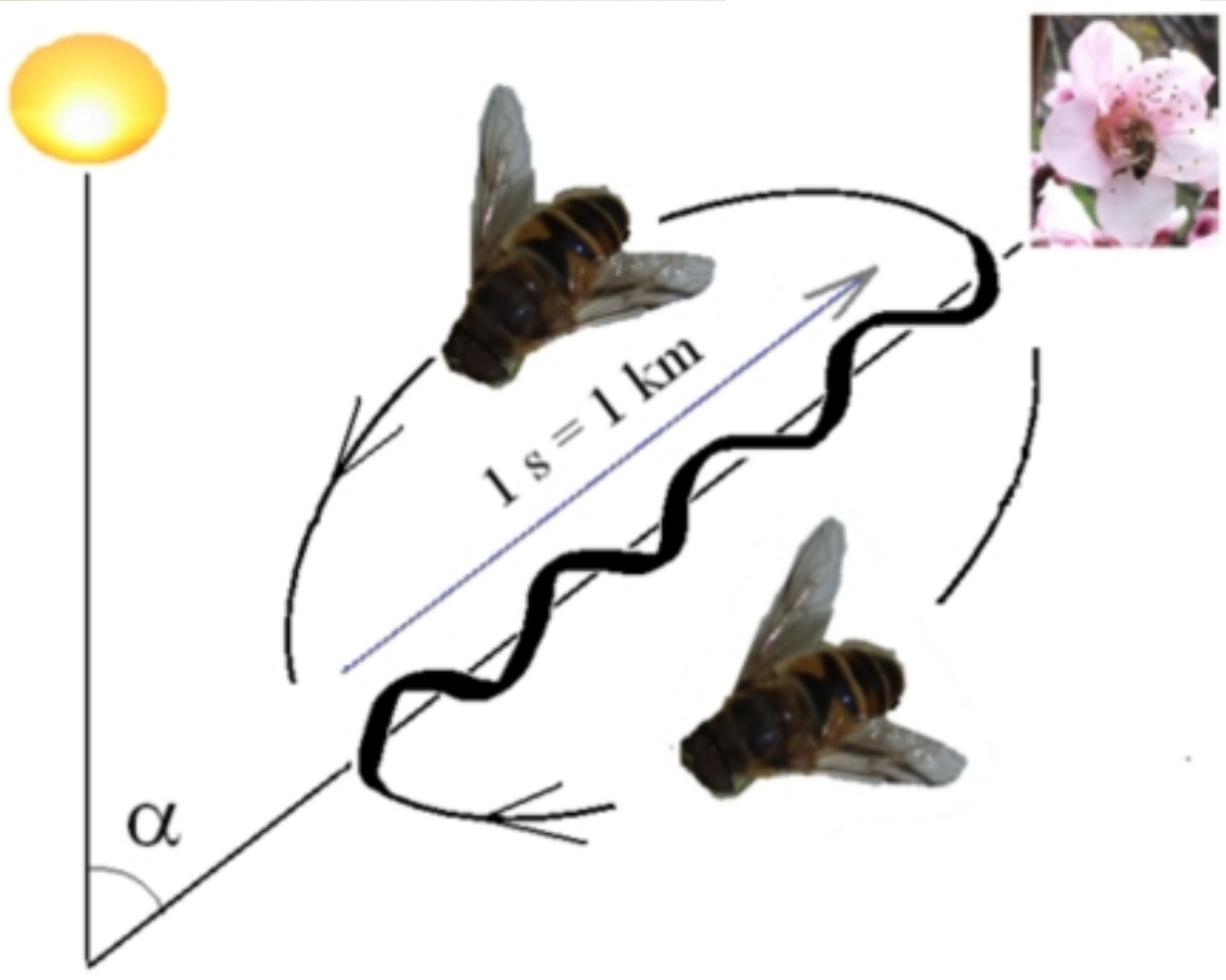
On the end of the female bee's abdomen is the *ovipositor* (stinger). The ovipositor of the worker bee is barbed so that it remains imbedded into whatever the honeybee stings. In its struggle to free itself, a portion of the bee (stinger, venom sac, ganglia) is left behind, which damages her enough to 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.

Sting Rating	Hymenopteran	Comparison Analogy
1.0	Sweat Bee	Like a tiny spark has has singed a hair on your arm.
1.2	Fire Ant	Like walking on a carpet & getting a static electricity shock.
1.8	Bullhorn Acacia Ant	Like someone fired a staple into your cheek or hand.
2.0	Bald-Faced Hornet	Like getting your hand mashed in a revolving door.
2.0	Yellowjacket	Like extinguishing a cigar on your tongue.
2.0+	Honey Bee	Like a burning matchhead that lands on your skin.
3.0	Red Harvester Ant	Like using a drill to excavate your ingrown toenail.
3.0	Paper Wasp	Like spilling a beaker of hydrochloric acid on a paper cut.
4.0	Pepsis Wasp	Like dropping a running hair drier into your bubble bath.
4.0+	Bullet Ant	Walking on hot charcoals with 3 inch rusty nail in your heel.

How *Do* Bees Communicate with each Other?

They Do a Dance !

Communication - Waggle



Lesson Objectives

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

2. Development timeline of a Honeybee and their lifetime functions
   a) Egg (Eggs)
   b) Larva (Larvae)
   c) Pupa (Pupae)
   d) Adult (Adults)
   e) Job responsibilities

3. What is the total development time for eggs to hatch – Queen, Worker, Drone?
   a) 16 - Queen
   b) 21 - worker
   c) 24 - drone

What can you do for Pollinators?