

HONEY BEE BIOLOGY

Apprentice Level Training
Texas Master Beekeeper Program



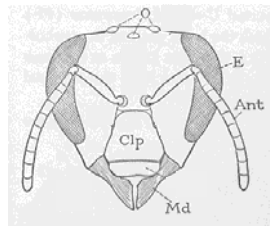
Anatomy Overview

- Three tagmata
 1. Head
 - Sensory
 2. Thorax
 - Locomotion
 3. Abdomen
 - Digestion and reproduction



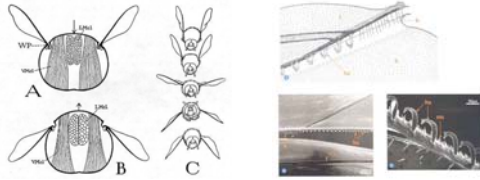
Anatomy Overview

- O = Ocelli – light/dark perception
- E = Compound eye
 - primary vision
- Ant = Antennae
 - chemoreception
- Md = Mandibles
 - chewing
- Johnston organ - A collection of sensory cells that detects movement of the antennae, and helps orientation during flight



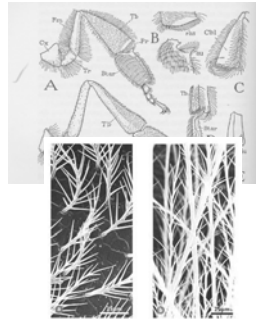
Anatomy Overview

- The fore and hind wings are held together with little hooks called **hamuli**.

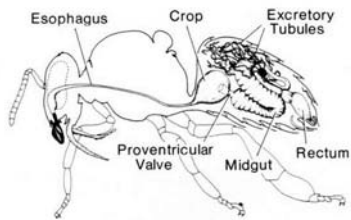


Anatomy Overview

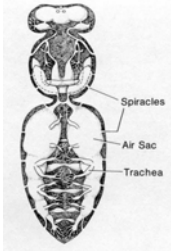
- **Scopa:** any of a number of different modifications on the body of a non-parasitic bee that form a pollen-carrying apparatus. In most bees, the scopa is simply a particularly dense mass of elongated, often branched, hairs (or setae) on the hind leg
- **Corbicula:** A smooth area on the hind tibia of each leg fringed with long hairs and serving to transport pollen.



Anatomy Overview – Digestive System



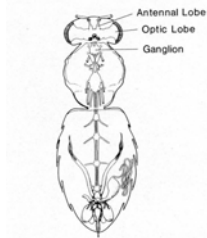
Anatomy Overview – Respiratory System



- Spiracles: pores along the outside of the insect body that lead into the tracheal system.
- Trachea: air tubes that draw air from outside of the insect to the inside and disperse it throughout the body.
- Air sac: expansion of the tracheal system.
 - Similar to lungs.

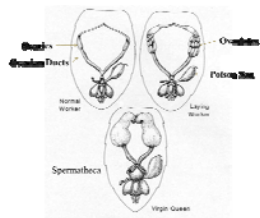
Anatomy Overview – Nervous System

- Two-part brain:
 1. Antennal lobe
 2. Optic lobe
- Ganglion: collection of ganglia located in the thorax and abdomen.
 - Nerves attach to organs throughout the body.



Anatomy Overview – Reproductive System

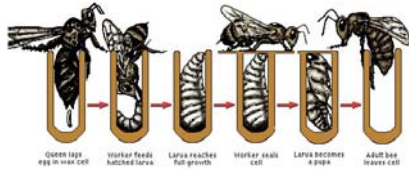
- Ovaries: contains female reproductive cells.
- Ovarioles: mass of densely packed tubes; pear-shaped.
- Spermatheca: houses the sperm cells from all of the drones the queen mated with.
- Poison sac: holds the venom used during stinging.



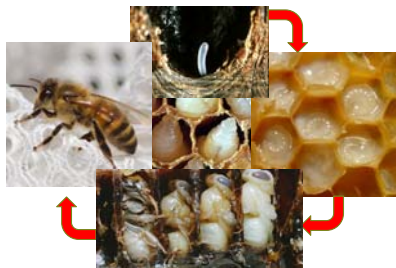
Honey Bee Mating Behaviors



Complete Metamorphosis

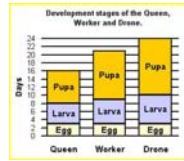


Complete Metamorphosis

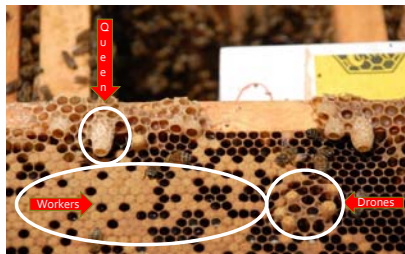


Developmental Timeline

- Worker bees develop in 21 days
- Drones develop in 24 days
- Queens develop in 16 days

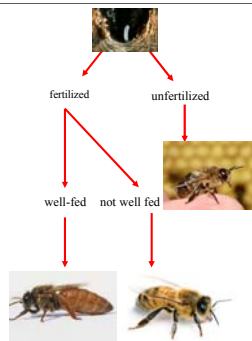


Cell Types



Caste System

- Three castes: queen, drones, and workers.
- Female castes are determined by diet.
- Sex is controlled by haplodiploidy but determined by the queen.
 - Males are haploid (drones)
 - Females are diploid (queens and workers)
- Each caste plays a different role in the function of the colony.



Caste I: Queen Honey Bees

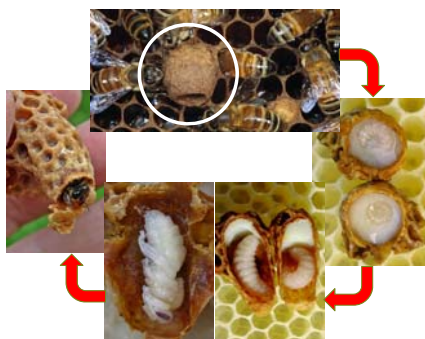
- One queen lays all of the eggs in a hive.
- She may lay 500,000 eggs over her 2-3 year life span.
- She produces "queen substance" from her mandibular glands.
- This pheromone keeps workers from laying eggs and limits supersedure behavior.



Becoming a Queen

- Queens come from fertilized diploid eggs that are laid in special vertical cells called **queen cups**.
- These are "drawn out" and become **queen cells**.
- A queen is fed royal jelly her entire larval life.
- More sugar in royal jelly = higher feeding rate = corpora allata-mediated release of juvenile hormone on day 3 of larvae development = synthesis of queen-specific proteins = **QUEEN!**





Caste II: Drone Honey Bees

- Only job is to mate with virgin queens.
- After emerging they spend a week or two performing orientation flights.
- They begin flying for 2-4 hours each afternoon at drone congregation areas.
- They have large eyes so they can see queens while flying.
- Few mate successfully.
- In hive, drones are tended to by the workers.
- Drones contribute little to the function of the colony.
- They are kicked out of the hive by worker bees when winter arrives.



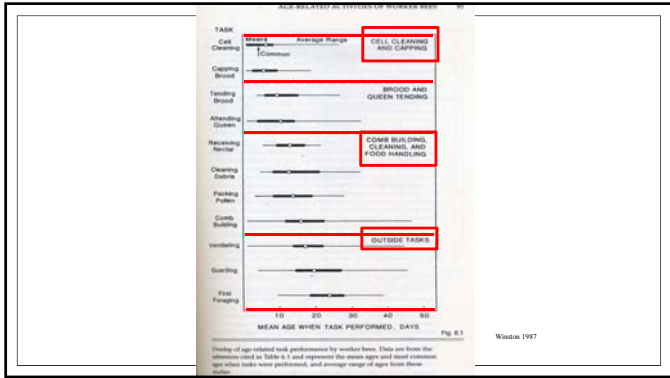
Caste III: Worker Honey Bees

- Workers do not lay eggs when a healthy queen present.
- If queen is failing or absent, workers can lay **unfertilized** eggs (drones).
- Cape honey bee (an African subspecies) workers can lay diploid eggs.
- Instead of reproducing, workers care for the hive, including performing most of the tasks in and outside of the nests.



Temporal Polyethism

- This is also called **age-related** division of labor.
- Queens always lay eggs and drones attempt to mate their whole lives, but workers change jobs depending on their age.
- Workers jobs change as different glands develop.
- They gradually move towards the entrance of the hive as their jobs progress.
- There is some flexibility if there are not enough workers doing a job.



Cleaner Bees

- Cleaning is the first job workers do when they emerge as adults.
- They primarily clean cells in the brood area.



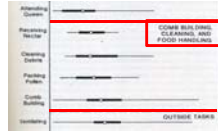
Nurse Bees

- Workers become nurse bees after their hypopharyngeal glands develop (about 6 days).
- Nurse bees feed and care for the brood.



Honey Production (Nectar Ripening)

1. Receive loads of nectar from foragers.
2. Begin active evaporation, the first step in turning nectar to honey.
 - Nectar is mixed with enzymes while bubbles of nectar are blown.
3. After 20 minutes the nectar will be placed in a cell to undergo passive evaporation.
4. Fully ripened honey is consolidated into cells and capped with wax.



Pollen Storage and Cleaning Debris

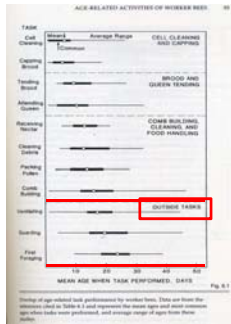


Wax Production

- Wax glands are located on the ventral side of the abdomen
- Wax glands start producing wax ~12 days after emergence.
- Small sheets of wax are excreted and removed by the bee, mixed with saliva, and manipulated with the mandibles.
- Used to build new wax comb or cap cells.



Outside Tasks



Orientation Flights

- Orientation flights begin ~ 18 days after emergence.
- Use visual landmarks.
- Circling flights around a hive are necessary to fix the hive location.
- During this stage bees are prone to drifting- where a bee returns to the wrong hive.



Ventilation



Guards

- Workers begin guarding the hive at 18-24 days after emergence
- Guards assess everything that tries to enter the hive.
- Each hive has a distinct odor which identifies foragers as part of the hive. Intruders will not have this smell.
- Guards are the first line of defense against pests and robbers.



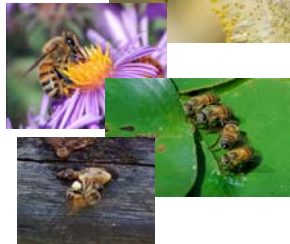
Undertaker Bees

- Most bees die outside of the hive.
- Worker bees usually only live 5-6 weeks, less if there is a very strong nectar flow and much more if they are overwintering.
- When bees die inside the hive, it is the undertaker bees job to remove them.
- This is an important part of a hives sanitation and overall health.



Foragers

- Foragers are the oldest workers, 21 days and older.
- They collect four different things:
 1. Pollen (protein source)
 2. Nectar (carbohydrate source)
 3. Water
 - Used for hydration, diluting honey, and cooling the hive
 4. Propolis
 - Tree resins, used to seal the hive against invaders



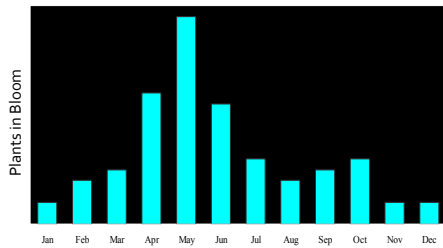
Swarms! – Colony Reproduction

1. Several new queens are reared.
2. The old queen leaves with ~30-70% of the workers in the colony.
3. The cluster of bees looks for a home.



Swarms

Seasonal nectar availability



Swarms



Congestion



Drones??

Swarms



The presence of queen cells

The swarm has occurred



Queen Supersedure

- Queens are replaced when they stop laying well or produce less queen substance.
- In inefficient supersedure, the old queen dies before the new queen emerges, causing a break in brood production.
- In efficient supersedure, the old queen survives until after the new queen emerges, which can briefly result in mother-daughter queen colonies.