Honey Bee Anatomy and Function

How Honey Bees are Built and How the Function

Similar but Different

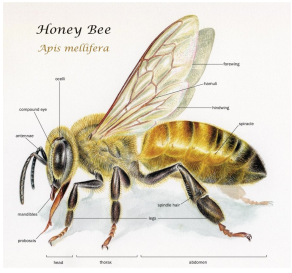
People	Honey Bees

• **Eat:** Everything - Meat and Potatoes
  • Omnivores – Meat and Vegetables
	• **Eat:** Pollen and Honey
	  • Herbivores – Plant origins only

• **Digest:** Stomach & Intestines	• **Digest:** Crop, Stomach, Intestines
• **Excrete:** Feces and Urine	• **Excrete:** Feces only – while flying
• **Circulation** Closed: Blood moves through arteries and veins	• Circulation Open: Hemolymph moves freely about inner body
• **Breathe:** Mouth and Lungs • Blood Carries O_2 and CO_2 around	• **Breathe:** 20 openings in chest and abdomen + branching tubes

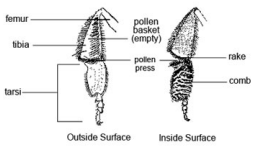
• **Vision:** One pair of eyes
  • Colors: Red to Violet (ROYGBIV)
	• **Vision:** 5 eyes: 2 Compound eyes front/side and 3 Simple eyes on top
	  • Colors: No Red – Best: Blue, Green, UV

Honey Bee External Anatomy



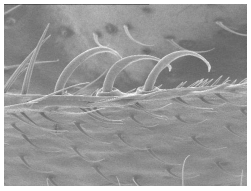
Thorax (Human Chest): 4 Wings & 6 Legs

- Point of Attachment for:
  - 3 Pairs of Legs: Six legs
  - Two Pairs of Joined Wings: 4 wings
  - MANY Setae ("Hairs")



Four Wings Act as Two Wings

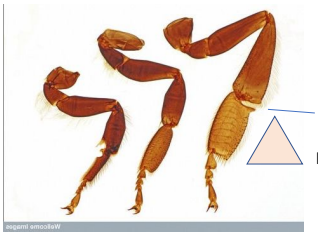
Hooked Together "Tongue and Groove"



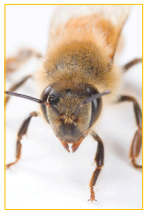
Legs – A Quick Look

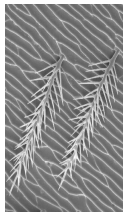
Front

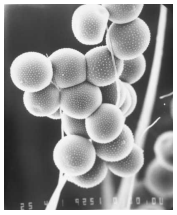
Rear



Setae (Body "Hairs") Attract Pollen & Sensory Touch

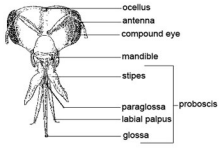




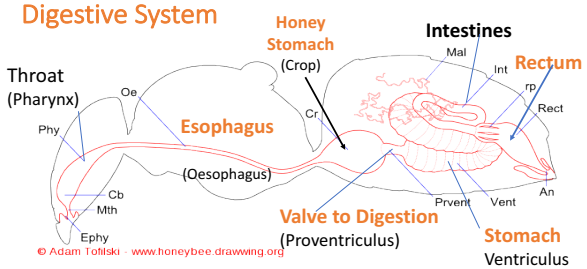


Head

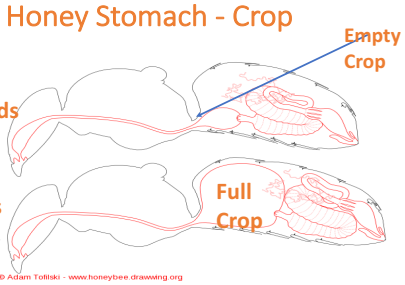
- Compound Eyes
- Three Ocelli
  - Simple Eyes
- Antennae
  - Touch & Smell
- Mandibles
  - Bite and Carry
- Tongue
  - (Proboscis)
  - Hollow tube
  - Sucking up Liquids



Digestive System



The Honey Stomach - Crop

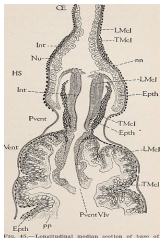


Functions

- **Carrying Liquids**
  - Nectar
  - Honey
  - Water
- **Adds Enzymes**
  - Plant sugars
  - Change to Honey Sugars

Trophallaxis: Exchanging Liquids and Food

Poventriculus: Valve Between Crop and Stomach

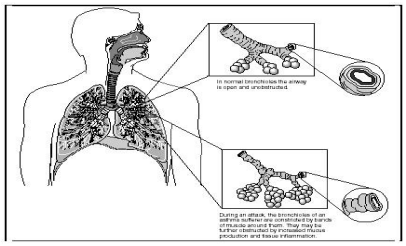


Important Functions

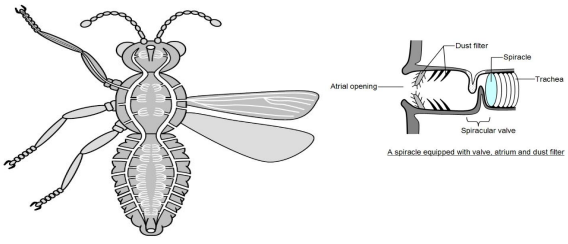
- Gatekeeper to stomach
- Separates Crop contents from digestion enzymes
- Does let some pollen through to stomach

Honey Bee
Respiration – "Breathing"

Human Respiratory System

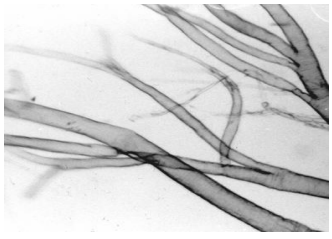


Breathing Using
Spiracles & Branching Tracheoles



A spiracle equipped with valve, atrium and dust filter

Branching Inner Respiratory Tracheoles

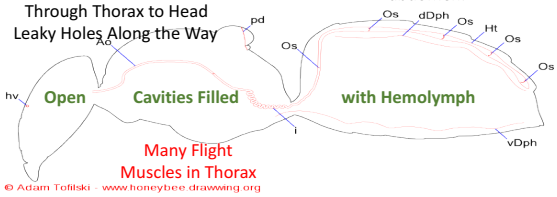


Honey Bee Hearts
&
Fluid Circulation

Circulation - Hearts & Aorta

Five Hearts
along top of abdomen.

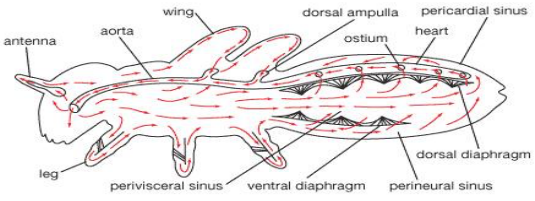
One Aorta
Through Thorax to Head
Leaky Holes Along the Way



Open **Cavities Filled** **with Hemolymph**

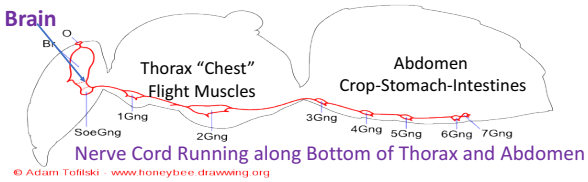
Many Flight
Muscles in Thorax

Insect General Circulation
Round and Round it Goes



Honey Bee Sensory Systems

Honey Bee Nervous System



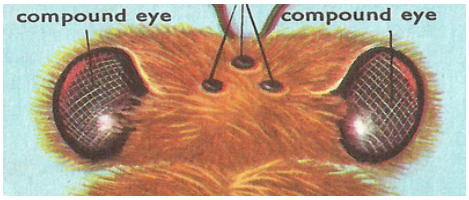
Many Types of Sensory Receptors

- Mechanoreceptors – Touch and joint movement
- Auditory receptors - Sounds
- Stretch receptors – In Muscles – Movement Feedback
- Chemoreceptors – Taste
- Olfactory receptors – Odors and Pheromones
- Gustatory receptors – Sense contents in Crop & Digestion
- Thermoreceptors - Temperature
- Photo receptors – Vision and Ultraviolet Light

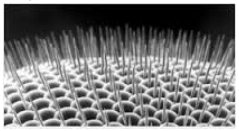
Honey Bee Vision

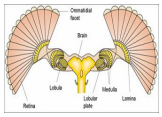
3 Ocelli and 2 Compound Eyes

3 Ocelli



Honey Bee Compound Eyes Have Hair!





Compound Eyes Detect Motion

Flicker effect

Excellent at detecting motion.

Move Slowly & Deliberately Around Your Bees!

26

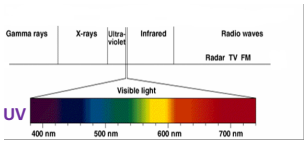
Compound Eyes Have Color Vision

- Honey Bees Can Distinguish Colors
  - Preferences for **Blue** and yellow.
  - Cannot See Red
    - Some beekeepers work in the dark using a red light source
- Color Vision is important in foraging and in courtship behaviors

27

Honey Bees Can Detect Ultraviolet Light

- UV is High Energy: Hard on our skin and eyes
- Can penetrate moderate cloud cover
- Bees can fly on cloudy days



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28

Ultraviolet Vision Examples

Human's view.

Insect's view (simulated through UV film.

Production vs. Reproduction

Queens produce more bees for their colonies:

- Proportionate to Nectar Flow

Colonies divide and swarm – Create more colonies.

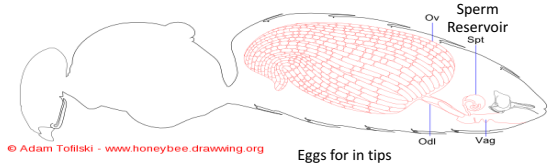
- More colonies are what is important

Honey Bee Sex Determination

- **Number of Chromosomes and Genes**
  - Females have 32 chromosomes (16 pairs) - (Humans have 46; 23 pairs)
  - Males have 16 chromes Only one set – (Human males have 46; 23 pairs
  - Number of genes 10,000 (Humans have about 20,000 genes)
- **The Honey Sex Gene and Sex Determination**
  - Bees not have X and Y sex genes; Only have X and X
  - 1 Gene determines sex. It has at least 19 variations (alleles)
  - Must be 2 different variations, one on each X chromosome
    - If variants are the same – Egg and larvae not develop
  - Males can have only 1 variation --> Drones

Queen Reproductive System

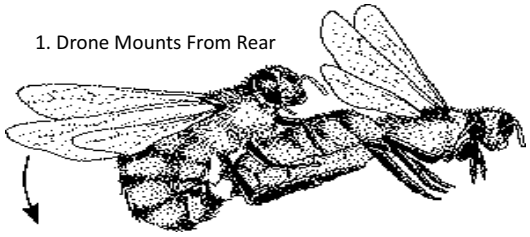
2 Ovaries
130 – 186 Ovarioles



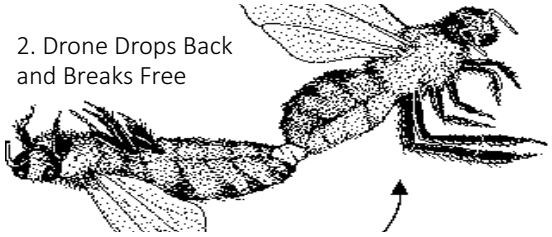
Eggs for in tips
- Migrate toward vagina

Queen and Multiple Drones Mate in Flight

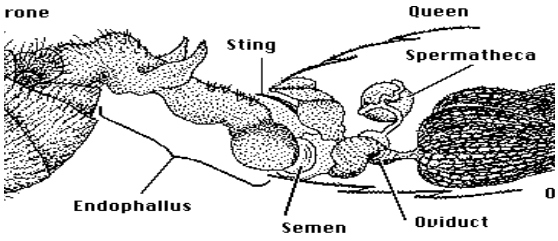
1. Drone Mounts From Rear



2. Drone Drops Back and Breaks Free



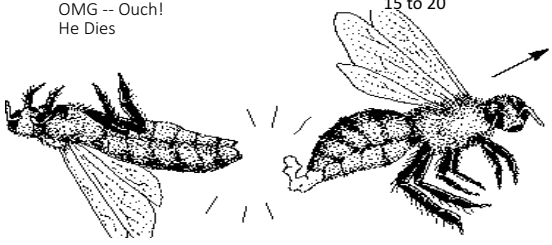
Drone – Queen "Flying United"



3. Drone leaves private parts behind

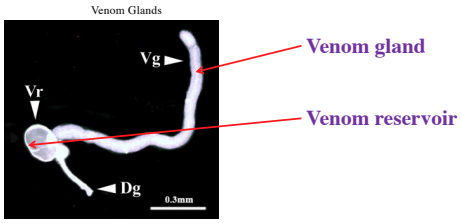
OMG -- Ouch!
He Dies

Queen moves on to next Drone
15 to 20



Honey Bee Sting

Stingers and Venom Glands



Honey Bee Stinger and Sting

Pheromones and Secretions

There are Many Other Pheromones

Worker Pheromones
- Alarm
- Brood Recognition
- Drone
- Dufour's gland
- Egg Marking
- Footprint

Worker Pheromones, cont.
- Forager
- Nasonov

Queen Pheromones
- Queen Mandibular
- Queen Retinue

Many, Many More and Still Being Discovered

Bees Exposing Nasonov Glands

- Orients returning bees to home hive
- Keeps swarming bees together
- Artificial Nasonov used as a swarm lure

Beeswax Production

- Flakes secreted from eight abdominal glands
- Chewed to make workable then deposited on comb
- Contains traces of pollen
- Young bees produce it best
- About 7 lbs. of honey --- 1 lb. waX

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Thank YOU!
☺

What We Will Accomplish

- Basic Honey Bee Anatomy
- How Some of It Works
- Some Comparisons With Ourselves