



### Class Goals:

- Decide if beekeeping is for you
- Provide you resources to get started
- Improve your chances of being successful
- Assist in connecting you to area beekeepers and continual education



## About Us:

- Alyssa Piccolomini is the state entomologist with the Montana Department of Agriculture
- Kara Bates Tangedal is the Lewis & Clark County 4-H/Youth Development Agent with Montana State University

## Before We Get Started...

- We are sharing what we've learned from experience, classes, research, and other experts
- As the Beekeepers of the Bitterroot say, "Ask four beekeepers a question and get six confident answers!"



Kingdom : Arthropoda

Phylum: Arachnida

Class: Insecta

Order: Hymenoptera

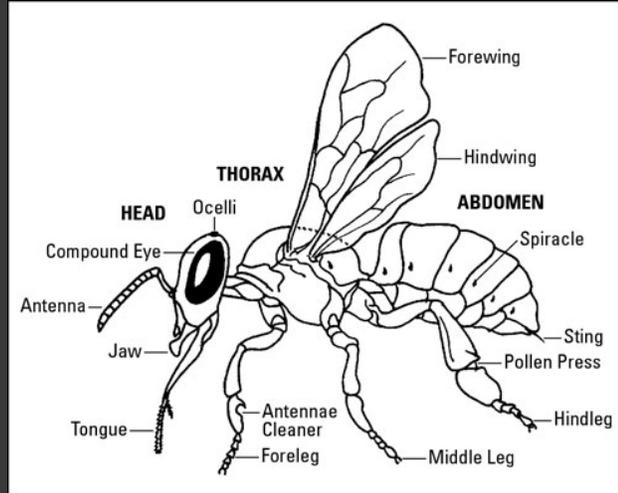
Family: Apidae

Genus: *Apis*

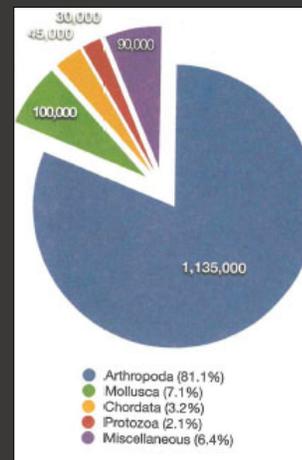
Species: *mellifera*

## General insect anatomy:

- a. Three tagmata (body segments):
  - a. Head
    - a. Sensory perception
    - b. Neural integration
    - c. Food gathering
  - b. Thorax
    - a. Locomotory (wings and legs)
  - c. Abdomen
    - a. Houses visceral organs
      - a. Digestive (tubular alimentary canal)
      - b. Reproductive
      - c. Excretory
- b. Three pairs of legs
- c. One pair of antennae



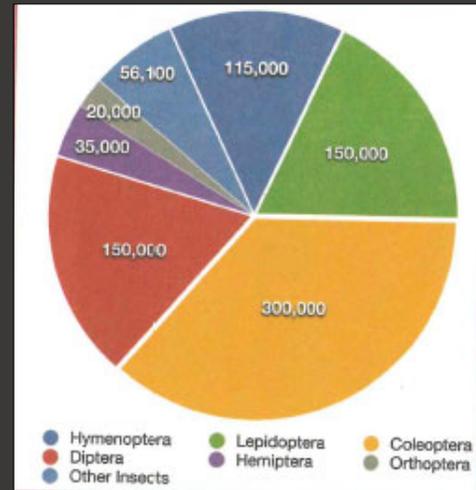
- Arthropods are the most common animal on earth
- $\frac{3}{4}$  of all animals are arthropods
- 1-30 million species estimated
- 26-31 Orders of insects (distinguished by morphology)



## 26-31 Orders of insects (distinguished by morphology)

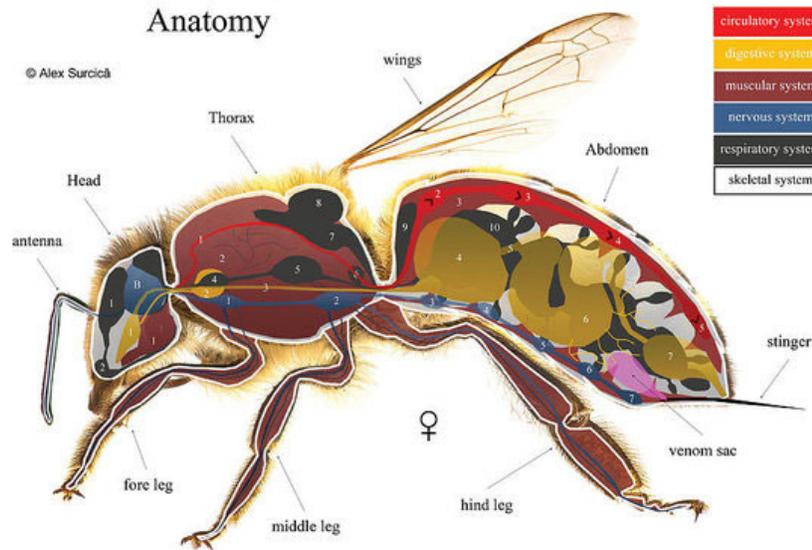
Four largest orders are:

1. **Diptera** – true flies
2. **Coleoptera** – beetles
3. **Lepidoptera** – butterflies and moths
4. **Hymenoptera** – ants, bees, wasps



## European Honey Bee Anatomy

© Alex Surică



Digital Museum of Natural History

## Segments of the Honey Bee: Head

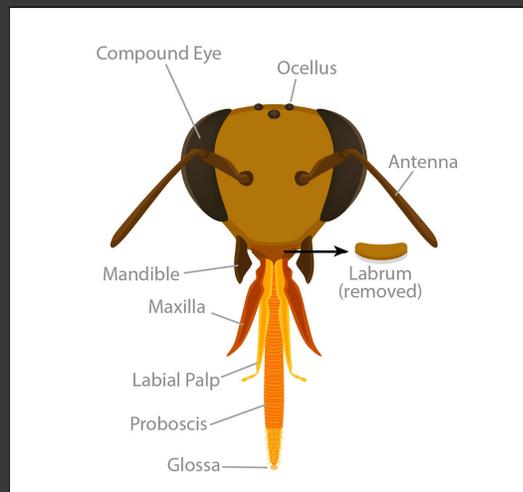
- Contains major sense organs

**Sense organ:** structure that detects some type of stimulus, such as light or a chemical odor. The stimulus detected will be transmitted via the nervous system.

- Major sense organs of the bee head are:
  1. Ocelli
  2. Compound eyes
  3. Antennae
  4. Mouthparts
  5. Body hairs

## Ocelli and Compound Eyes

- Ocelli always arranged in triangle on top of bee head
- Honey bee compound eyes have 6,900 facets
- Bees see in a range of 300-650 nanometers (400-700 in humans)

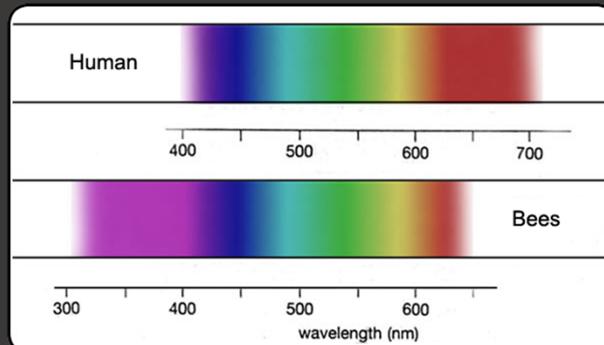


## Ocelli and Compound Eyes



## Ocelli and Compound Eyes

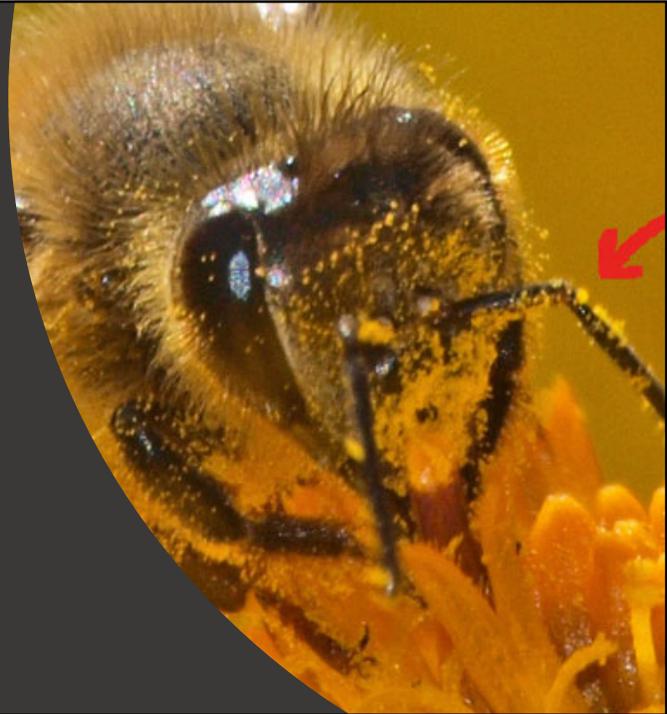
- Bees have **trichromatic vision** (eyes contain 3 types of cone cells)
- Three types are: blue, green, and ultraviolet



<https://www.bee-culture.com/bees-see-matters/>

## Antennae

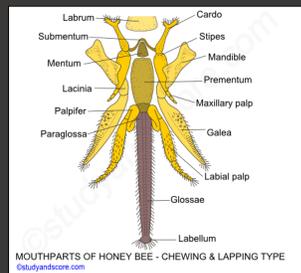
- Each antenna consists of 12 segments (13 on drones)
  - Antennae are completely covered with hairs, pore plates, pits, pegs, and other sensory structures
- 
- Antennae of bees are very mobile and are in constant movement! They are responsible for:
    - Smell
    - Taste
    - Humidity perception
    - Temperature
    - Feel
    - Gravity monitoring
    - Flight speed
    - Vibrations



## Mouthparts

Bees have chewing-lapping mouth parts which consist of four distinct parts

1. Labrum – comparable to an upper lip on humans. Protects the other mouth parts
  2. Mandibles – (pair) act like jaws and can be used for chewing but are mainly used for manipulating wax
  3. Maxilla –
  4. Labium –
- Both assemble to form the proboscis which is used to draw up liquids like water, honey, and nectar. When the proboscis is not in use, the labium and maxilla fold back up inside of the head.



## Segments of the Honey Bee: Thorax

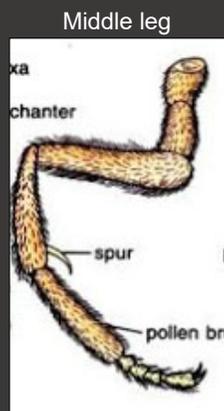
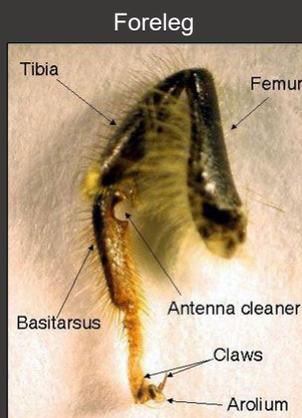
The thorax is the locomotor region of the honey bee body as it contains all leg and wing pairs

The thorax consists of 3 body segments:

1. Prothorax – one pair of legs
2. Mesothorax – one pair of legs, wings
3. Metathorax – one pair of legs, wings

The exoskeletons of the thorax consist of many plates or sclerites that overlap and serve as attachment points for several internal muscles.

## Segments of the Honey Bee: Thorax

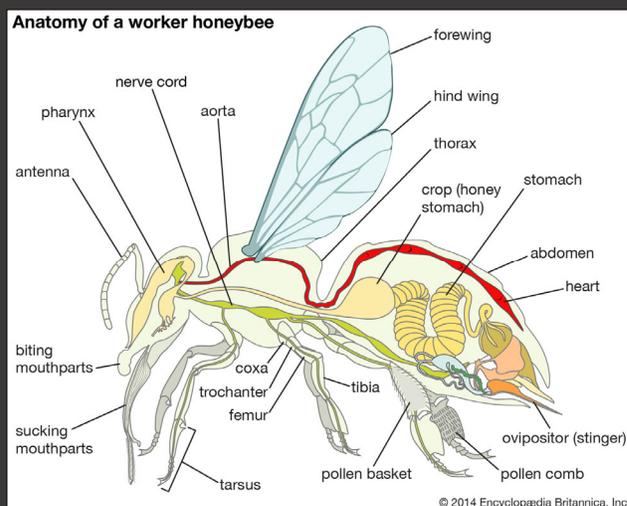


Corbicula = Pollen Basket

## Segments of the Honey Bee: Abdomen

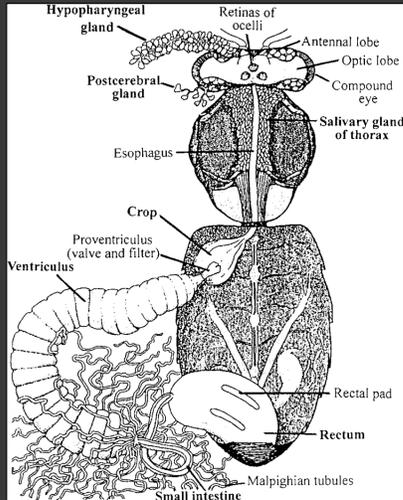


## Digestive and Excretory Systems



- After food passes through the mouth, it is pulled inward by the muscular pharynx
- It then passes through the thorax and wasp waist within the esophagus
- The first section of the stomach is called the **honey crop**
  - Used to store nectar/food
  - Not a true stomach
- When a bee eats, food is digested in the **ventriculus** (or stomach)

## Digestive and Excretory Systems



- The digestive tract expands with the posterior intestine (rectum)
- The rectum reclaims reusable products and reabsorbs water
- Rectal pads aid in reclaiming and recycling water
- Bees usually void wastes outside of the hive or while in flight
- **Malpighian tubules:** main excretory organs
  - Absorb waste matter from the haemolymph
  - Nutrients are absorbed and waste is dumped into the digestive tract as uric acid

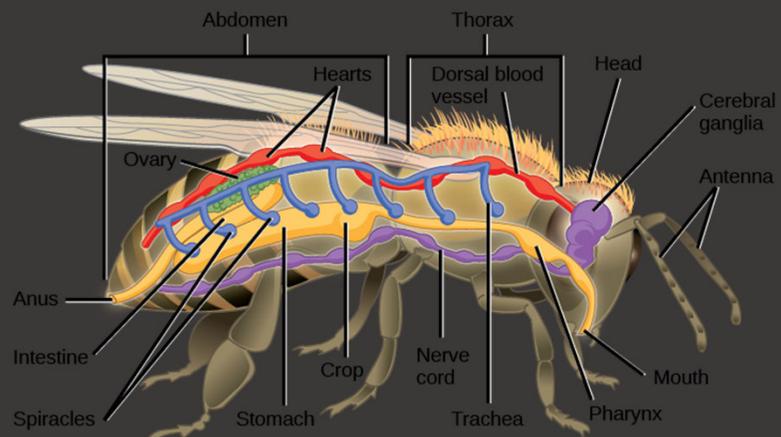
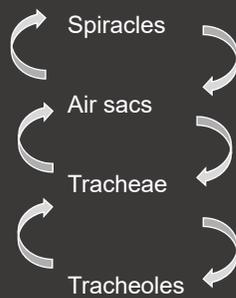
## Nervous System

1. Brain
  - Two-part: optic and antennal lobes
2. Ganglion
  - Seven ventral ganglia
  - Located throughout the thorax and abdomen
  - Extend into major organs to regulate activity
  - Each individual ganglia is capable of coordinating functions of the segment of which it is located
  - Headless bees can still walk and sting!

## Circulation

- Extremely simple in bees (like all insects)
  - Heart – four-chambered
  - Aorta – single tube
- Insect haemolymph carries nutrients to the body cells and removes cellular wastes; hormones, blood cells, and other substances
- Open circulatory system:
  - Does not contain red blood cells (no oxygen)
  - Moves very slowly

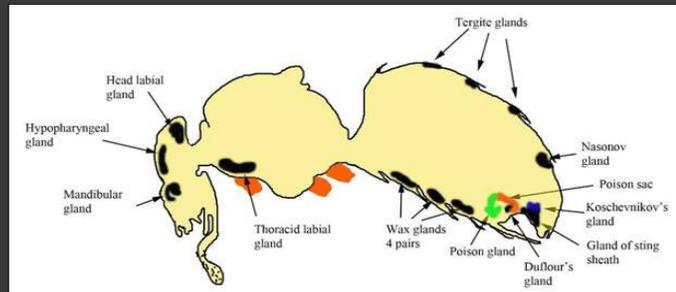
## Respiration



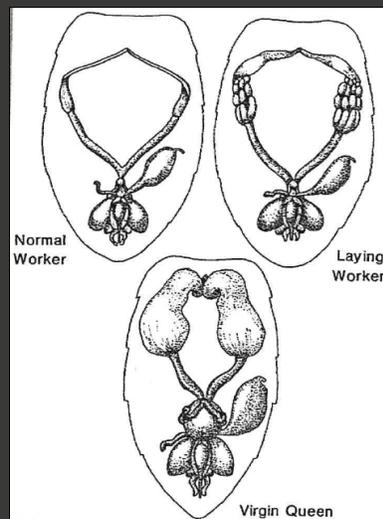
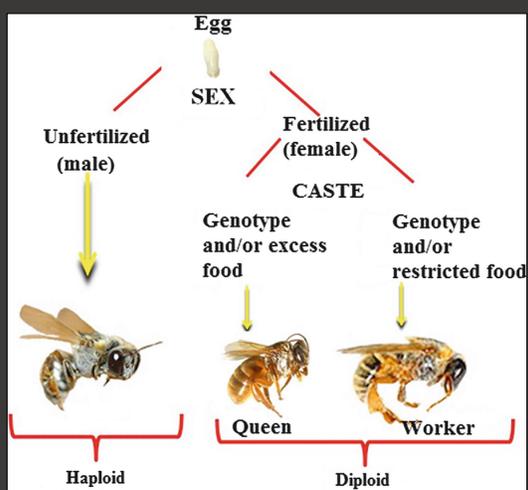
## Gland Systems

- Complex and well developed – extremely important!
- **Endocrine glands:** secrete hormones that key the functioning of chemical processes
- **Exocrine glands:** produce pheromones that strongly influence many aspects of bee behavior

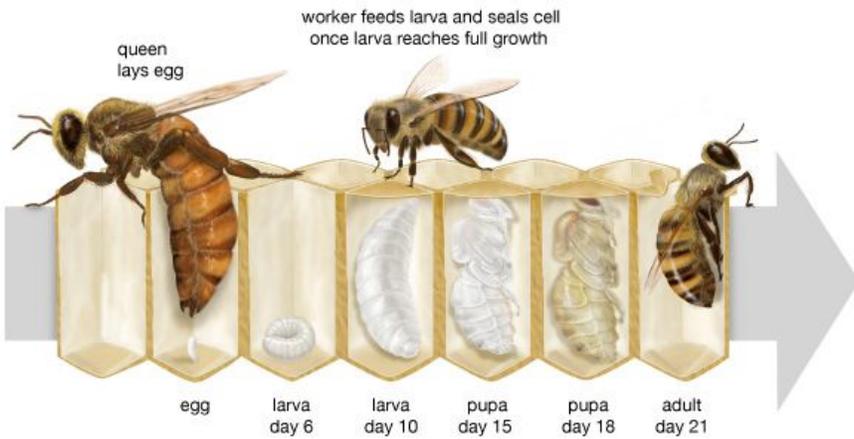
- Royal jelly production
- Bee sociality (queen substance)
- Wax glands
- Defense (alarm) communication
- + many more



## Reproduction



### Life cycle of honeybees



### Life Cycle of a Honey Bee

Total Development Time of Honey Bees (Days)			
	Queen	Worker	Drone
Egg	3	3	3
Larva	5.5	6	7
Pupa	7.5	12	14
Total	16	21	24

## Queen



- Fully developed female
- Primary functions: lay eggs and secrete pheromones that keep colony intact
- Cannot survive alone – must rely on workers to groom and feed her
- Usually lives for about two years if not overly stressed

## Drone



- Fully developed male (haploid = unfertilized egg)
- Primary functions: mate with virgin queens
- Active for about 2-4 hours in the afternoon looking for virgin queen (males that are successful will die while mating)
- Lives for about a month
- Expelled from hive by workers when cooler temperatures arrive

## Worker bees



- Non-fully developed female
- Workers pass through a variety of duties as they age (more complex tasks as they age)
- Can live 21-40 days
- Wintering adult bees can live for up to 6 months

## Worker bees

### House bees (first few days)

- beeswax cleaners in brood area
- clean the hive
- orient themselves to hive
- beg for food



### Nectar ripening (5-11 days)

- retrieves incoming nectar from field bees and stores it
- pollen storing
- feeding queen
- removing dead bees



### Wax secretors (12-18 days)

- build comb and cap honey-filled cells
- produced from specialized glands on underside of abdomen



### Guard bees (18-21 days)

- hormone levels change
- first orientation flights
- guarding hive entrance from other bees/predators (each hive has distinctive odors)



### Field bees (21+ days)

- foraging
- collect pollen, water, nectar, propolis
- highly flexible depending on the needs of the colony

## Seasonality of brood and adult populations

- Population of a beehive fluctuates throughout the year
  - Seasons
  - Food resources
- January-March: 10,000 bees (only workers and queen)
- March-April: increasing population as floral resources and daylight/temperature increase
- June-September: peak population – about 60,000 bees

