

THE HONEY BEES' WORLD

CHAPTER 2, FIRST LESSONS IN BEEKEEPING

OUTLINE FOR CHAPTER 2

1. What are social insects?

2. Biology of the individuals (workers, queens, drones)

3. Biology of the colony (seasonal cycles, foraging)

Photo by: Marlin E. Rice

SOME CHARACTERISTICS OF HONEY BEES

- Social insects
- Can be managed within hives
- Exhibit unique forms of communication

Photo from: http://www.warrenphotographic.co.uk/05497-honey-bee-waggle-dance

WHAT ARE SOCIAL INSECTS?

1. Cooperative brood care

2. Reproductive division of labor

3. Overlapping generations

Species that exhibit all three of the above are termed "**eusocial**" or truly social insects

Photos from bugguide.net

COOPERATIVE BROOD CARE

- Females of the species share the burden of rearing the young
- They assist with brood care, whether it is their offspring or others

Photo from restorationspring.com

REPRODUCTIVE DIVISION OF LABOR

- Some individuals in the society abandon their own efforts at reproduction in favor of helping their sisters reproduce

- Some individuals are responsible for reproduction, while other individuals perform other tasks (brood care, foraging, etc.)

Photo from restorationspring.com

OVERLAPPING GENERATIONS

- Some offspring remain at the nest to help their parents rear more siblings

- Ie. more than one generation is present at any given time

(Photo by Kathy Keatley Garvey, UC Davis)

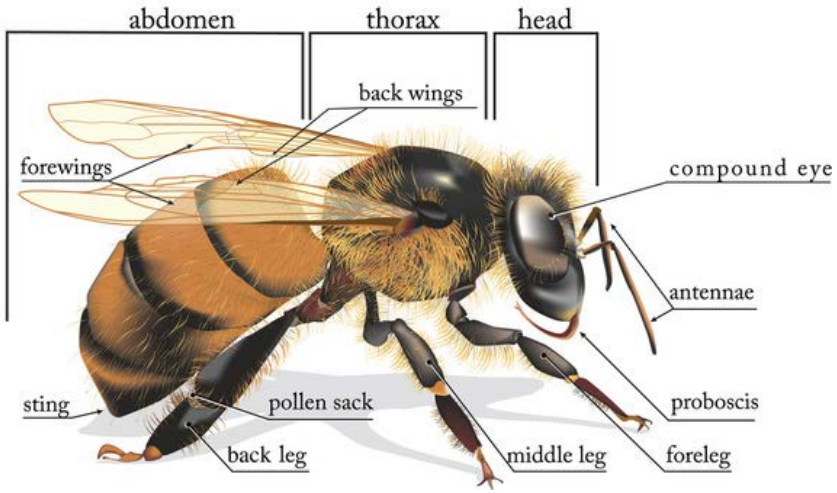
CAN YOU THINK OF SOME EXAMPLES OF OTHER SOCIAL INSECTS?

THE BIOLOGY OF HONEY BEES

- Class: Insecta
  - 3 body segments: (Head, thorax, and abdomen)
  - Pair of antennae
  - Skeleton on outside of body
  - 3 pairs of appendages (6 legs total)

- Undergo complete metamorphosis (*juvenile and adult stages look completely different*)

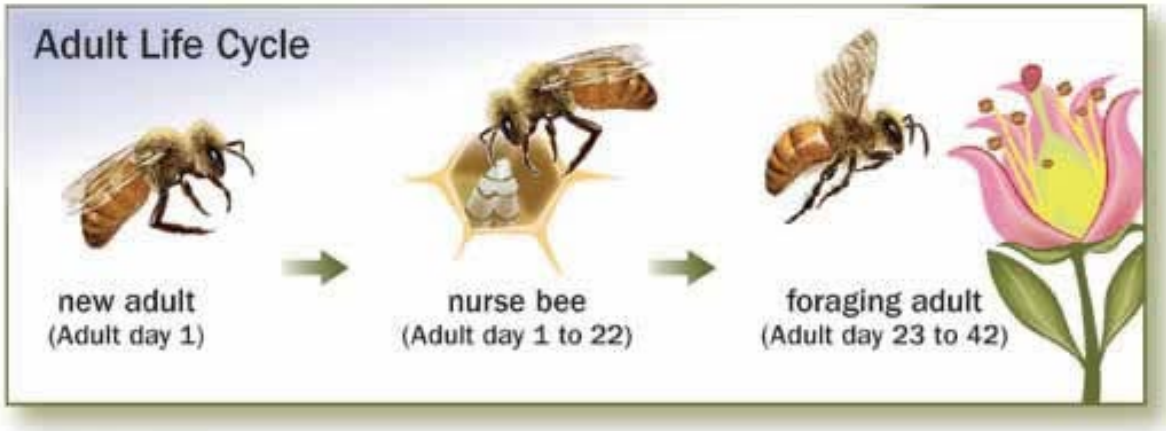
Apis mellifera
Honey Bee Worker



BEE LIFE CYCLE

- Stages include:
  - Egg
  - Larvae
  - Pupae
  - Adult

- Adult stages
  - New adult
  - Nurse bee
  - Foraging adult



Illustrations: Marguerite Meyer

THE EGG STAGE

- Eggs are sausage shaped
- Are about 1/16 inch in size
- They are placed individually inside of a cell
- Will hatch after about 3 days into a larvae

THE LARVA STAGE

- This is the feeding stage of development
- Is fed by worker bees placing food inside their cells
- Usually form a C-shape
- When ready to form pupae, the workers will cap the cell with beeswax

Photo by Laura Mulshine and Alice Runckel

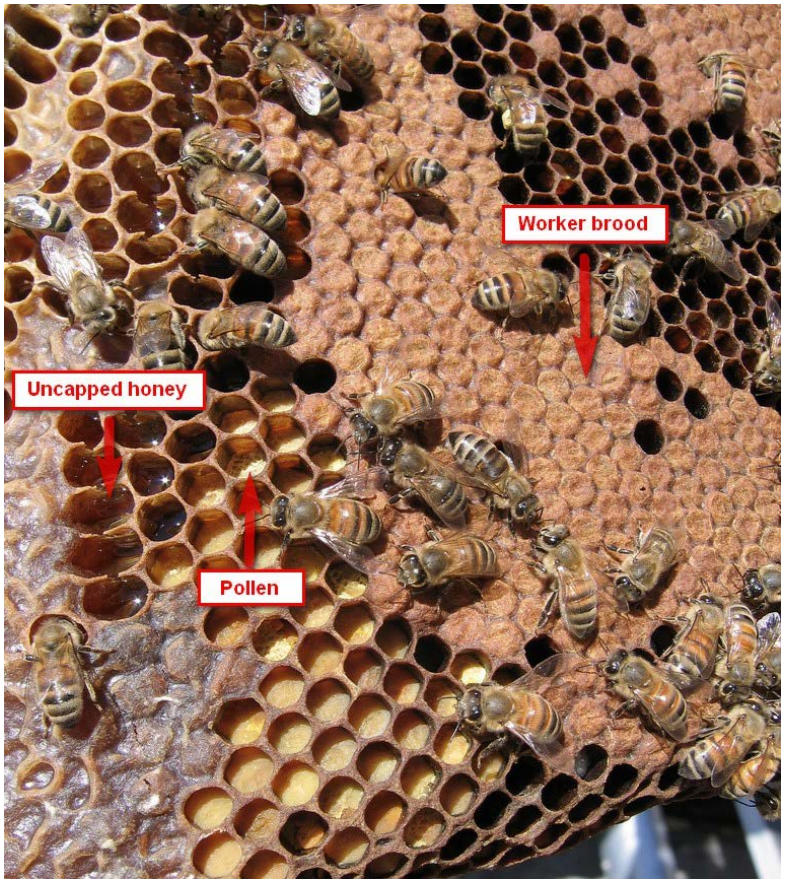
THE PUPA STAGE

- Non-feeding stage
- Is transitioning into an adult bee
- Will emerge as an adult after a few days (the adult will chew through its cell capping when ready to emerge)

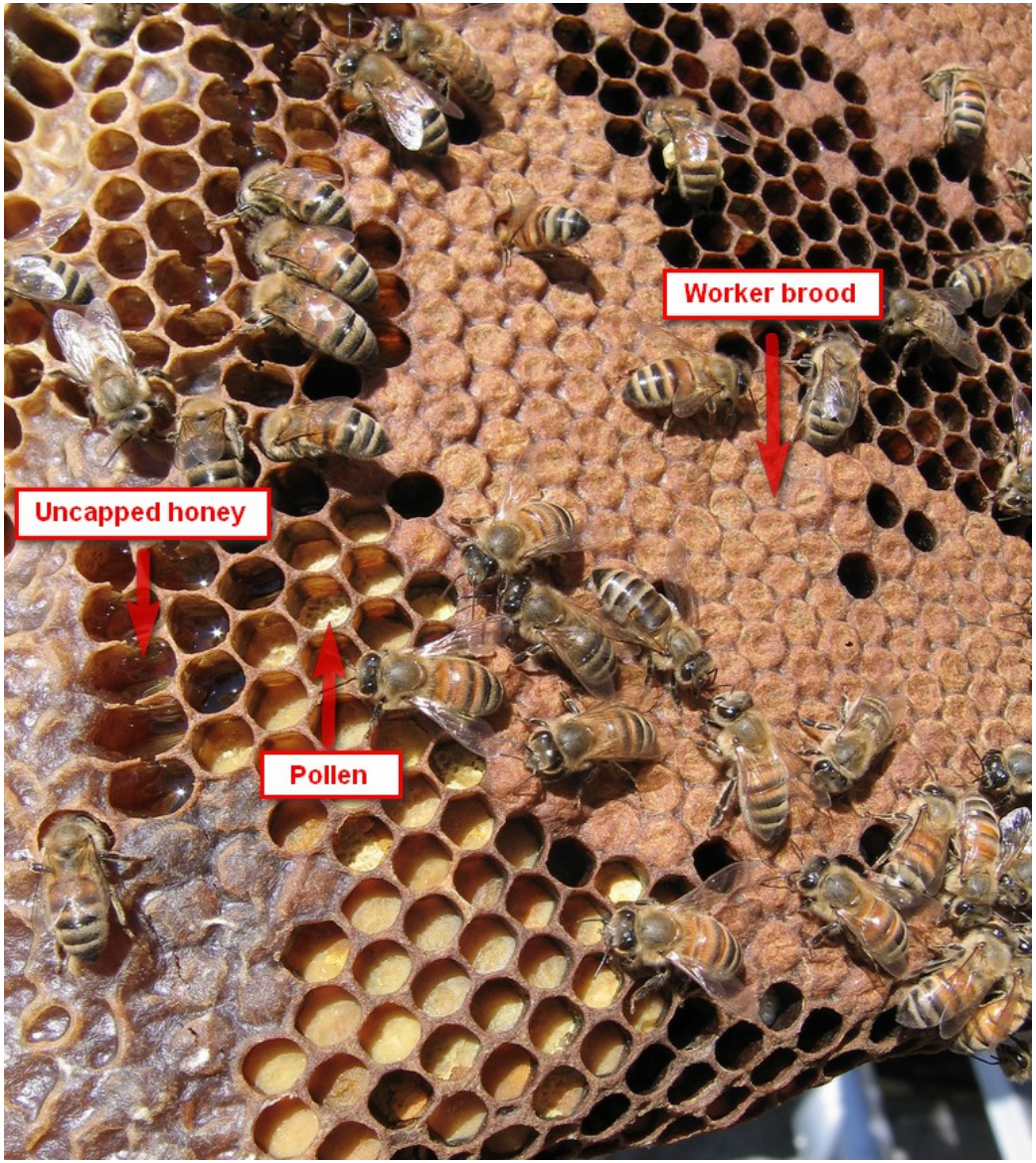
Photos from thehoneygatherers.com

TIME FRAME FROM EGG TO ADULT

- Depends on the type of bee:
  - Workers – 21 days (most numerous, flat cappings)
  - Drone – 24 days (larger in diameter, cappings are more rounded or bullet shaped)
  - Queen – 16 days (least numerous, usually peanut shaped cappings that are oriented in a vertical position relative to the comb face)

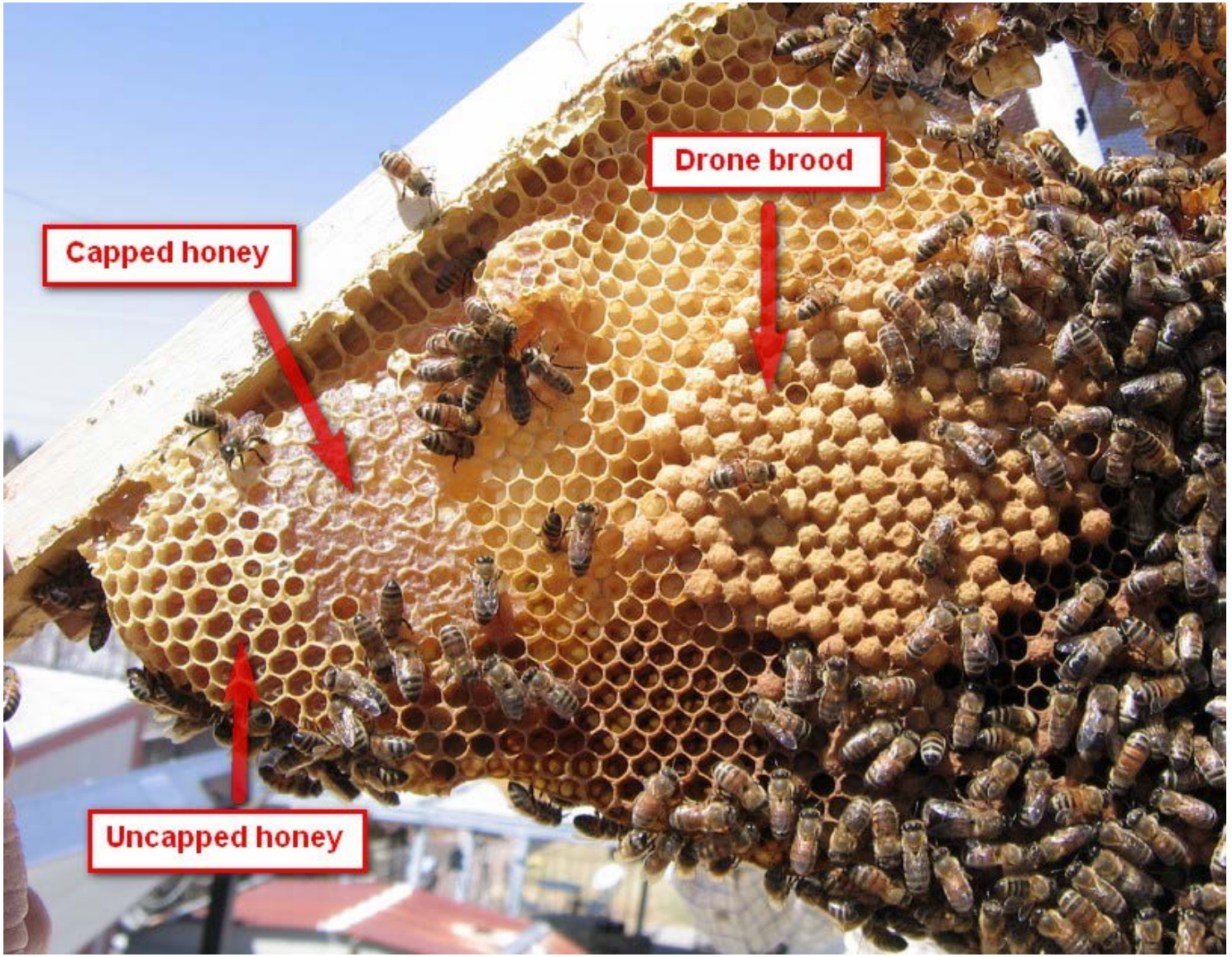


WORKER BROOD (UNIFORMLY FLAT CAPPED)



http://mistressbeek.files.wordpress.com/2008/04/beelesson-workerbrood.jpg

DRONE BROOD (ROUNDED AND BULLET SHAPED)



http://mistressbeek.files.wordpress.com/2008/04/beelesson-dronebrood.jpg

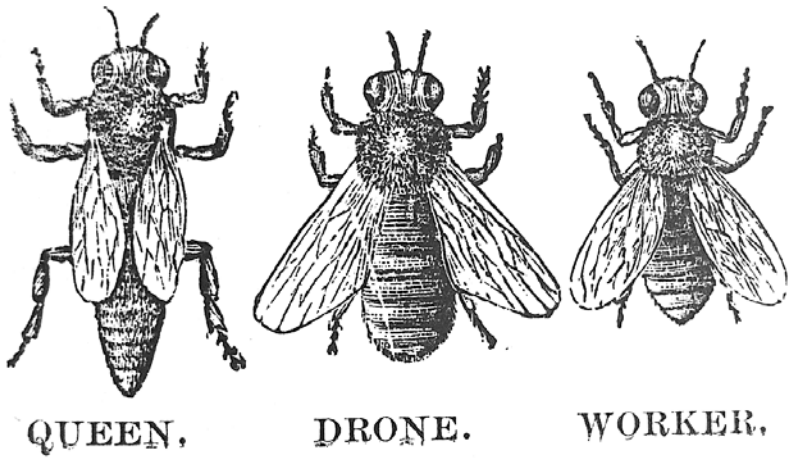
QUEEN CELL (*VERTICAL, PEANUT SHAPED*)

https://danieljmarsh.files.wordpress.com/2012/05/dscf7075.jpg

THE BIOLOGY OF INDIVIDUALS

- Three types of individuals in a honey bee colony:
  - Worker
  - Queen
  - Drone

- **Caste** – a functionally different form of the same sex (ie. females can be either workers or queens)



WORKER BEES

- Most numerous in the colony
- Have many duties throughout life:
  - Care for queen
  - Feed the brood
  - Clean and defend nest
  - Forage for food
  - Recruit nest-mates to food sources
  - Determines resource needs
  - Determines when to swarm

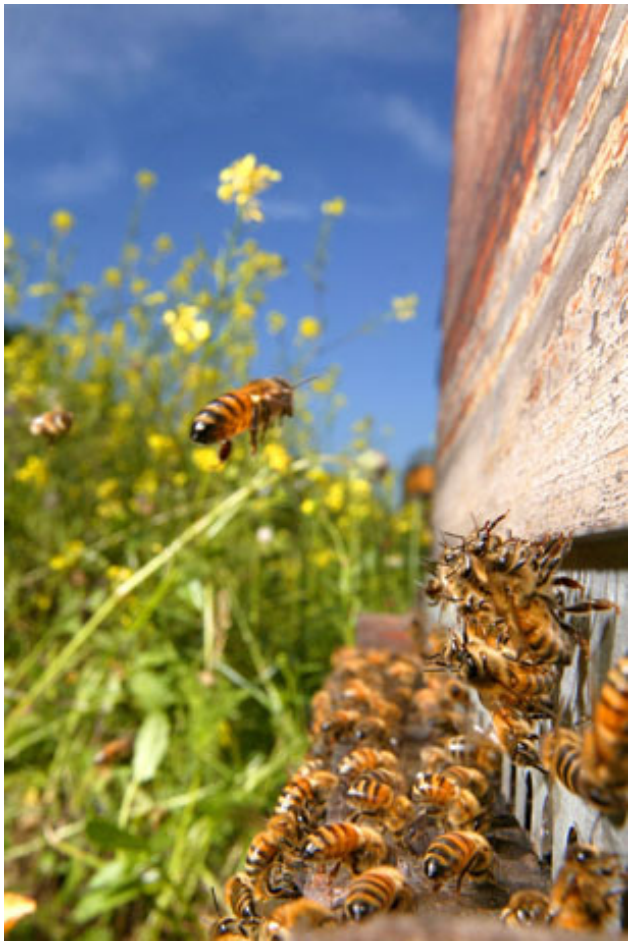


Photo from thehoneygatherers.com

LIFE OF A WORKER BEE

21 days | 42 days | 63 days

Brood | Hive (nurse) Bee | Field (forager) Bee

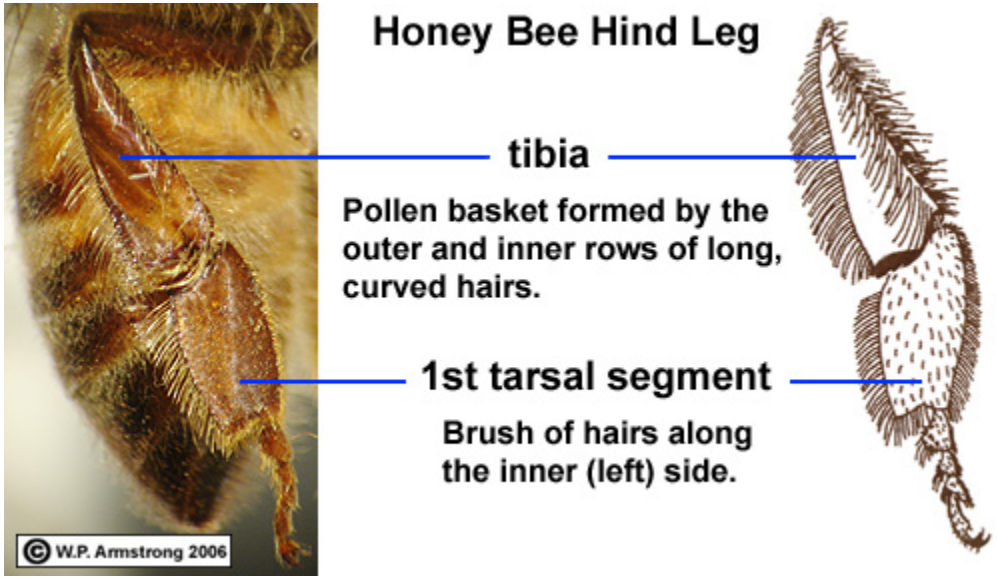
- Develop from egg – larvae – pupae – to adult bee

- Clean cells
- Feed older larvae
- Feed young larvae
- Feed queen
- Build comb
- Clean hive
- Ventilation of hive

- Collect water
- Collect pollen
- Collect nectar
- Collect propolis

DOES ANYONE KNOW HOW HONEY AND POLLEN ARE COLLECTED?

THE POLLEN BASKET



HONEY STOMACH

- The first chamber of a three chambered stomach
- Is used by workers to carry loads of nectar or water
- The load is regurgitated from the honey stomach when the worker returns to the nest

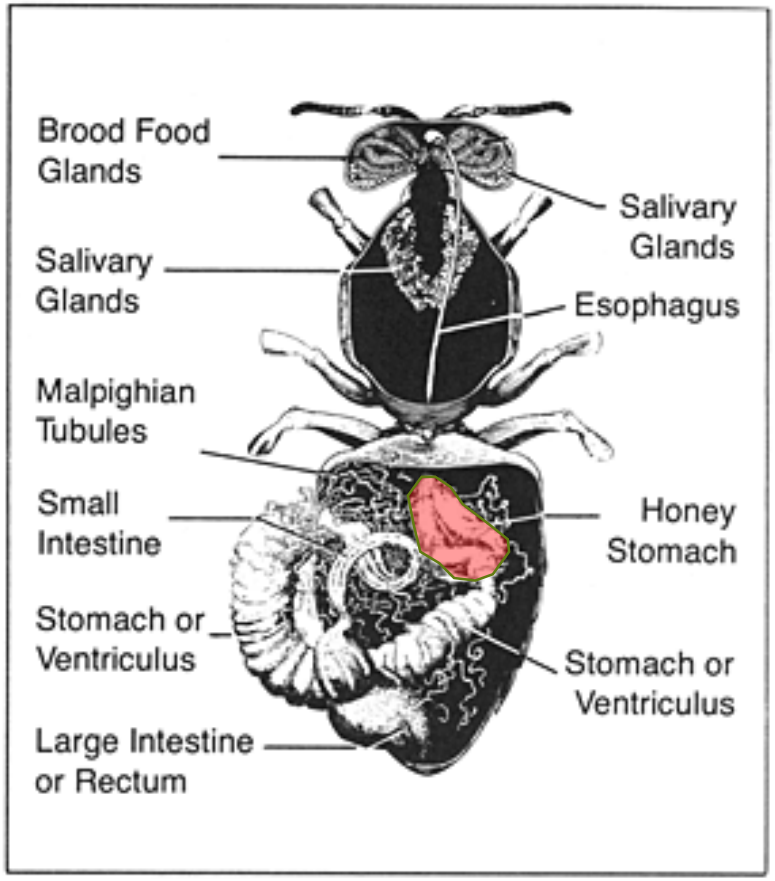
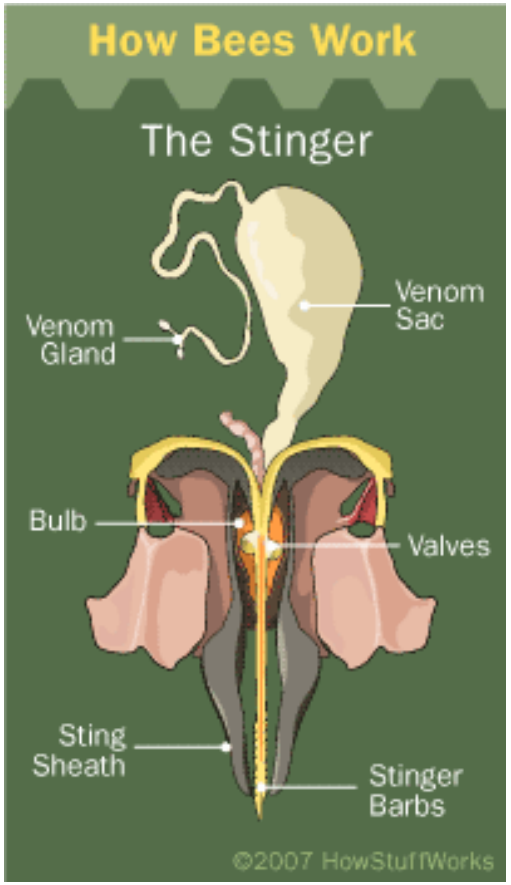


Image from Bee Source

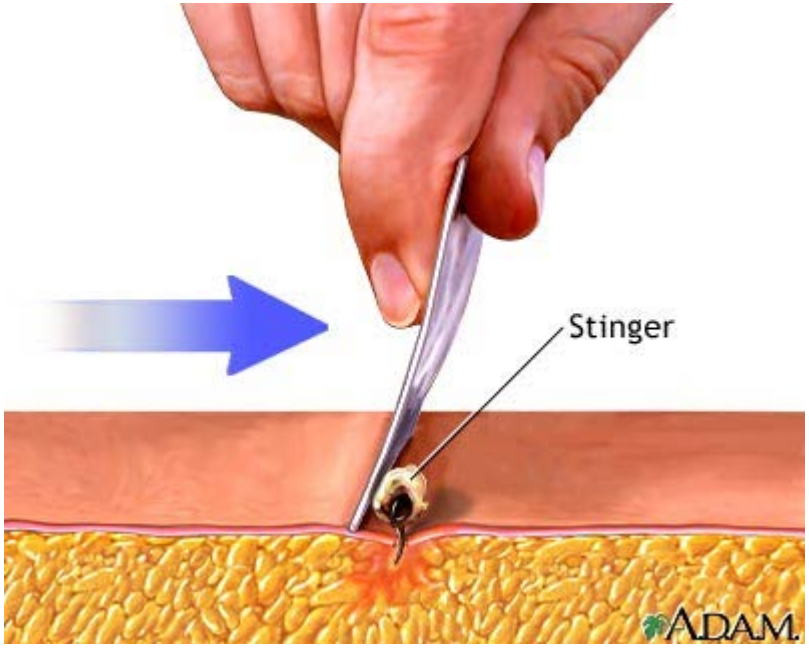
BEE STINGS

- **Stinger –** a modified ovipositor used for defense (males do not have a stinger)
- **Venom Gland** – contains proteins and enzymes that can be used in defense against attack
- **Barbed stinger** – makes removal of stinger difficult, and ensures venom sac will continue to inject venom once the bee detaches



STINGER REMOVAL

- Be calm, and don't squeeze!
- Squeezing the bee could squeeze the contents of the venom sac into you all at once
- You should scrape off the stinger as close to the skin as possible
- The quicker the stinger is removed, the less venom that will get injected

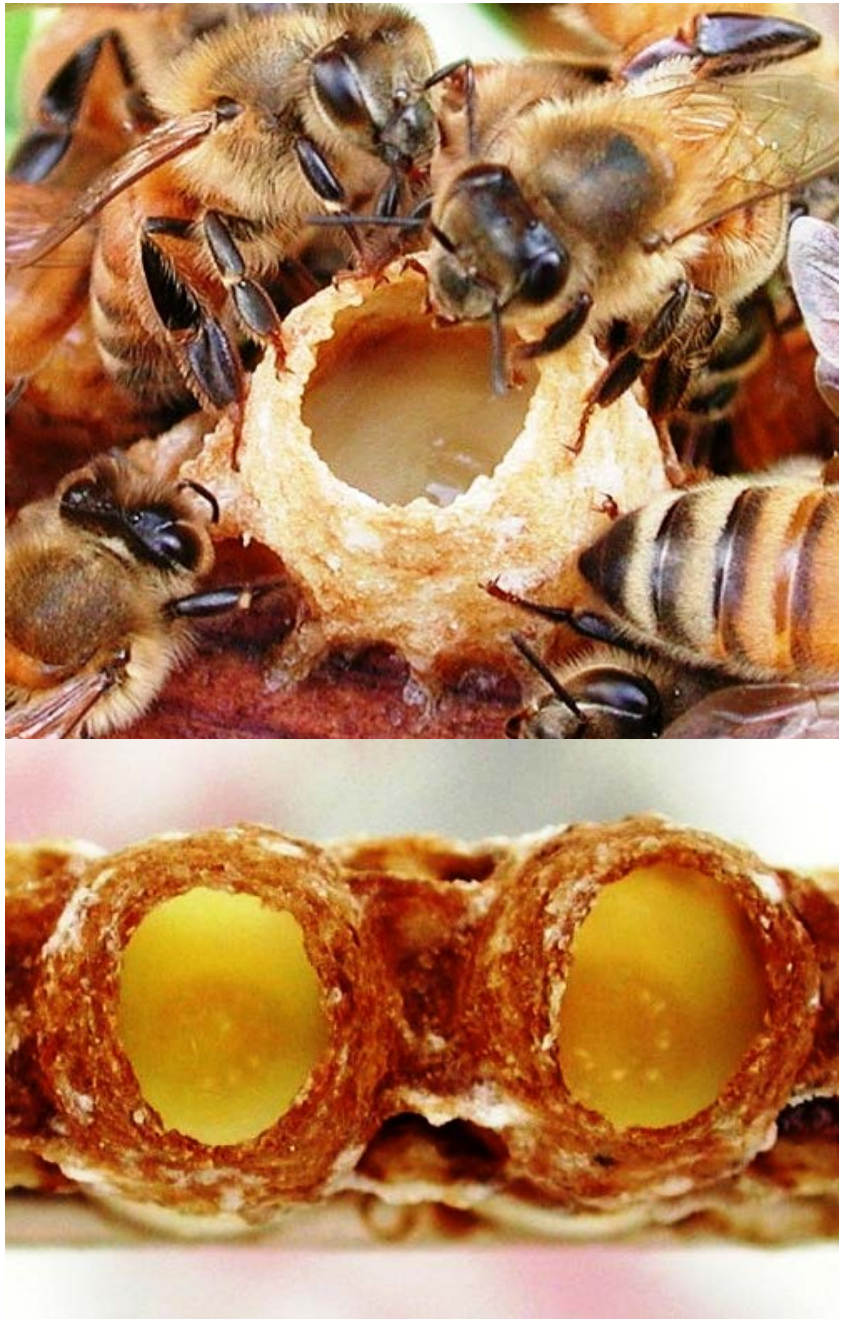


QUEEN BEES

- Differ in worker bees in that they are fed "**Royal Jelly**" throughout their larval life

- Royal jelly is a mixture of nectar, protein, and chemicals from worker glands

- The royal jelly triggers development of queen-like characters

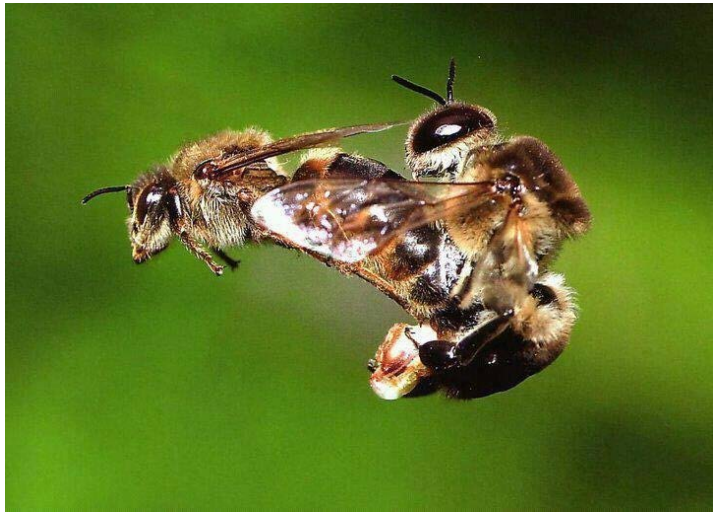


Photos from keepingbee.org

QUEEN MATING

- Newly emerged queens take a succession of mating flights

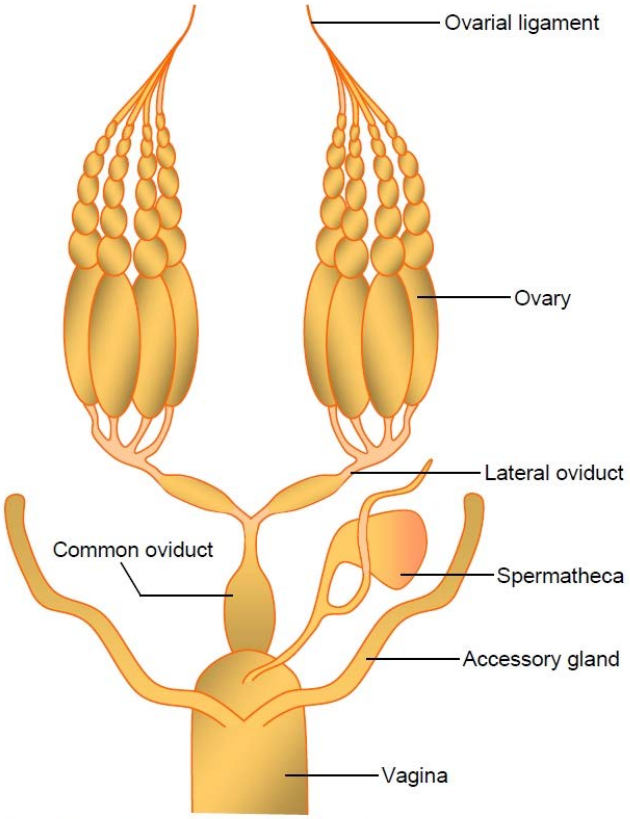
- During mating flights, she mates with about 20 drones



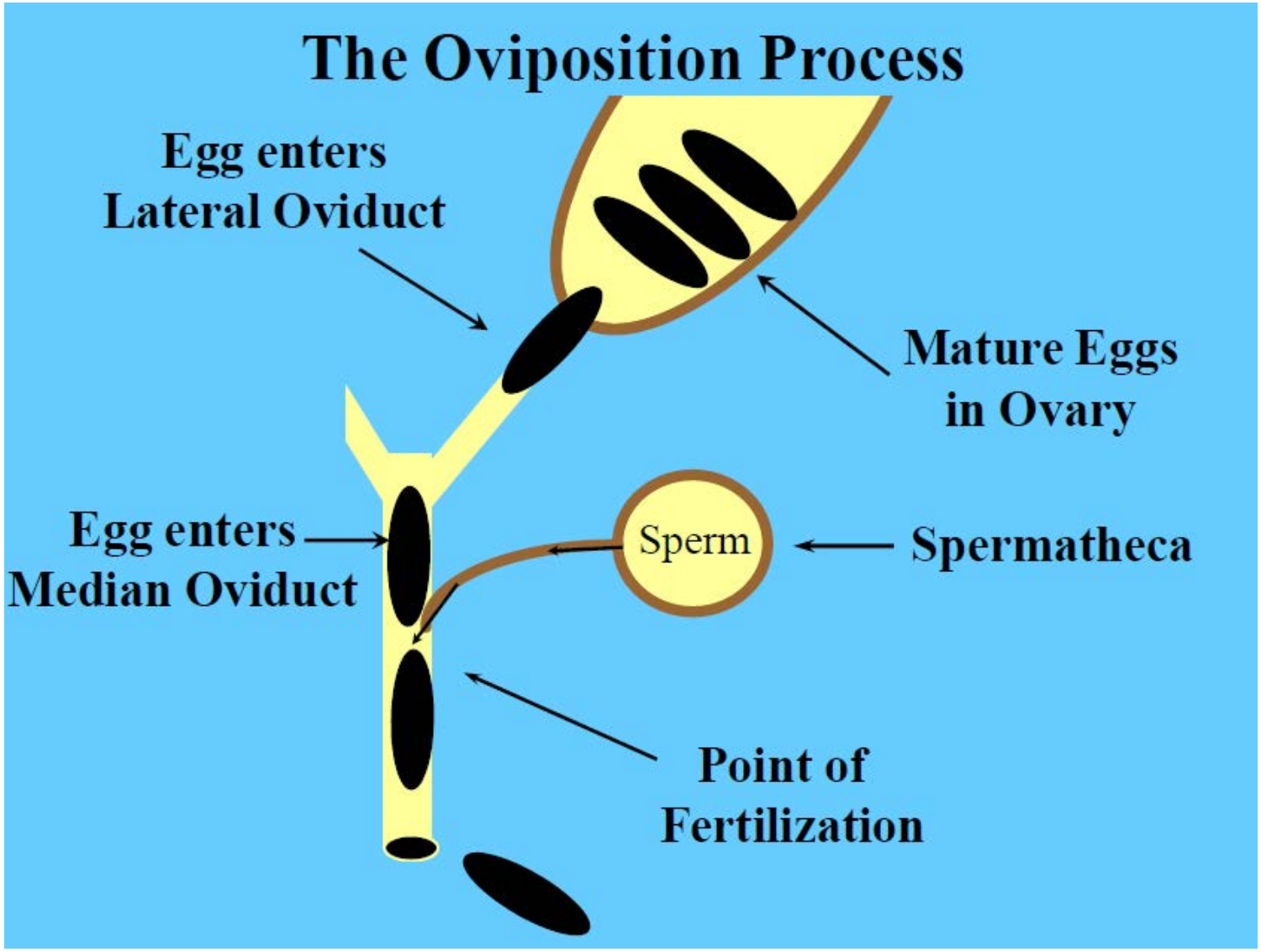
- The queen then stores the sperm from the males in a "**Spermatheca**" (an organ that holds sperm)

EGG LAYING

- As an egg passes down the oviduct it becomes fertilized with sperm (resulting in female)
- In the absence of fertilization, the result will be a male drone
- Most queens can lay up to 1500 eggs per day



Female insect reproductive system


The Oviposition Process
Egg enters
Lateral Oviduct
Mature Eggs
in Ovary
Egg enters
Median Oviduct
Sperm
Spermatheca
Point of
Fertilization

DRONES CAN BE MADE FROM QUEENS OR WORKERS

Worker (Female)

NO Fertilization

Drone (Male)

Queen (Female)

NO Fertilization

Drone (Male)

Drone (Male)

Fertilization

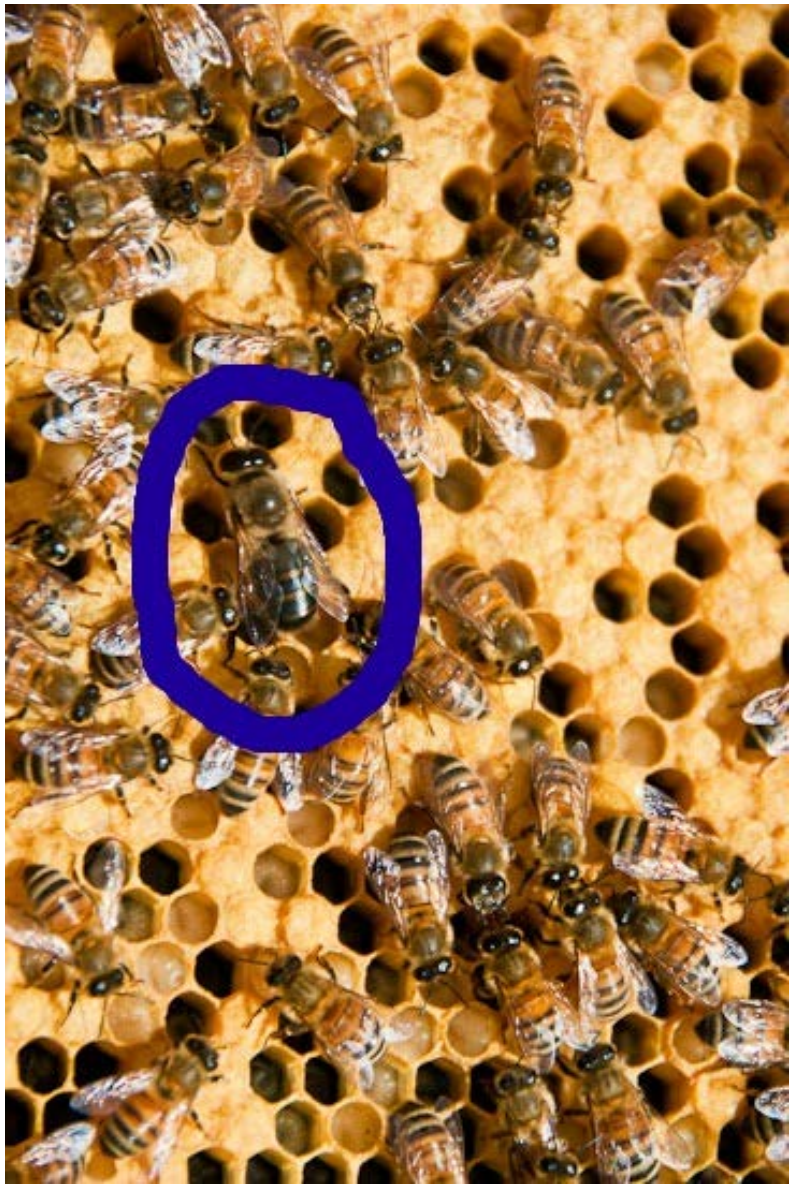
Worker (Female)

OR (depending on diet)

Queen (Female)

DRONES

- Are responsible for mating with queen bees
- When mature, participate in daily afternoon flights
- Flights usual include males from multiple colonies
- Drone flights are often associated with permanent landmarks



ANY QUESTIONS SO FAR ON THE BIOLOGY OF INDIVIDUAL BEES?

THE BIOLOGY OF THE COLONY

- Seasonality
- Swarming and queen supersedure
- Communication
- Foraging

OVERWINTERING

- During the winter, bees cluster in the center of the nest to conserve heat
- In the middle of cluster is the queen and some workers eating honey to shiver their thoracic flight muscles (generates heat)
- We will talk much more on winter hive maintenance later in the course

SPRING AND REPRODUCTIVE CYCLE

- Brood rearing typically begins as the winter solstice passes.
- Colony will start to take advantage of the earliest of nectar sources
- **Swarming** may occur in mid-spring, and **queen succession** will take place

A typical Spring to Fall Season for bees

WHAT IS SWARMING?

- Colony splitting (can occur multiple times within a single colony)
- New queens are produced mid-spring
- Once ready, the old queen and half the workers will form a cloud of bees.
- The queen will alight on an object (ie. tree branch), and her pheromones orient the swarm to her
- Scout bees then look for a new location

QUEEN SUCCESSION

- First emerging daughter queen personally kills each of her rival sisters in their cells
- Once her rivals are eliminated, the queen takes her mating flight
- Queen will then begin laying eggs, and the colony starts to rebuild its winter food supply

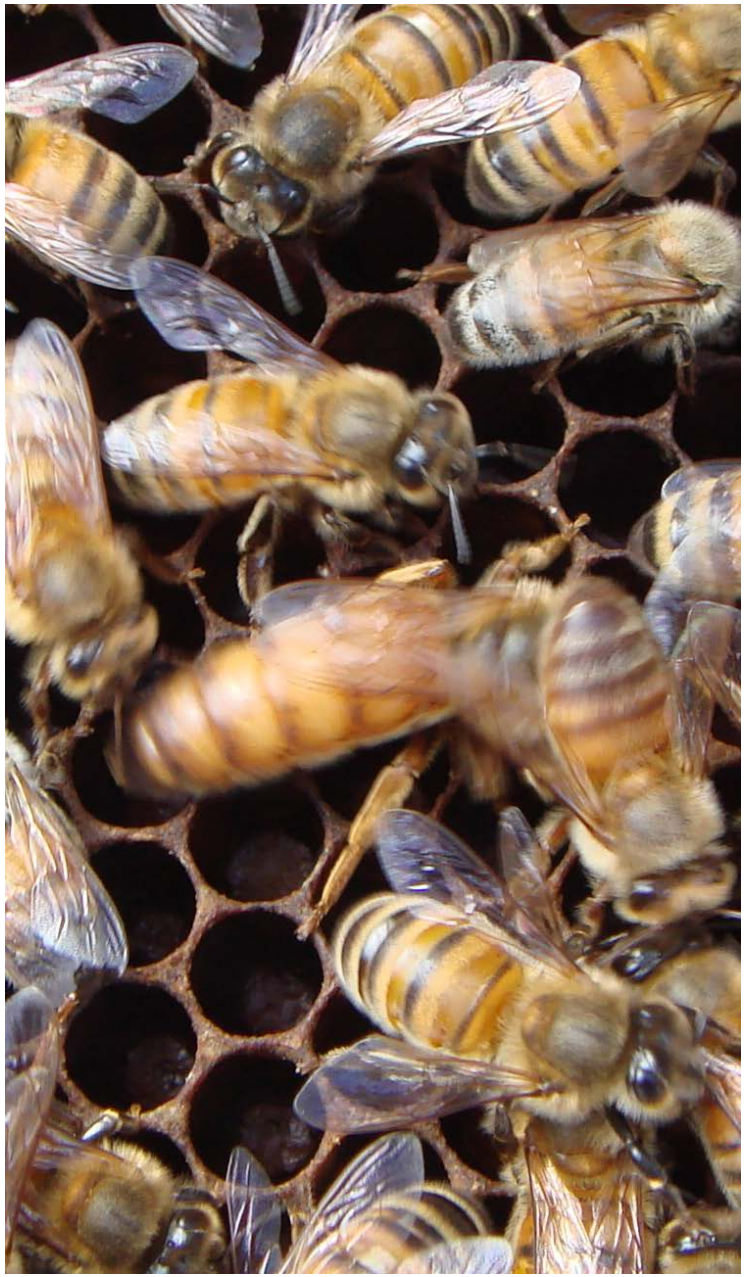


Photo by Tom Cochrun

QUEEN SUPERSEDURE

- Is NOT done under swarm impulse
- Rather, supersedure is done to replace a failing or lost queen
- Supersedure queen cells are usually located on the comb face and not the comb edge
- Usually poorer queens result from supersedure

Photo from: https://nhbees.wordpress.com/tag/supercedure-cells/

HONEY BEE COMMUNICATION

- **Pheromones** – hormones that regulate the behavior of other bees
  - Workers pick up pheromones from queen during grooming and pass it on to other workers
  - In the immediate removal of queen, workers become agitated

- **Dance Language –** We will discuss later on in this lecture

Photo from thehoneygatherers.com

QUEEN PHEROMONES

1. Partially suppress worker ovaries
2. Stimulate foraging
3. Prolong worker life
4. Coordinate swarms during reproduction

FORAGING

- Involves:
  - foraging regulation and
  - Nest-mate recruitment
- Requires about 100 pounds of accumulated honey and pollen to survive the winter
- Bees will forage for:
  - Water, nectar, pollen, and propolis

Photo from thehoneygatherers.com

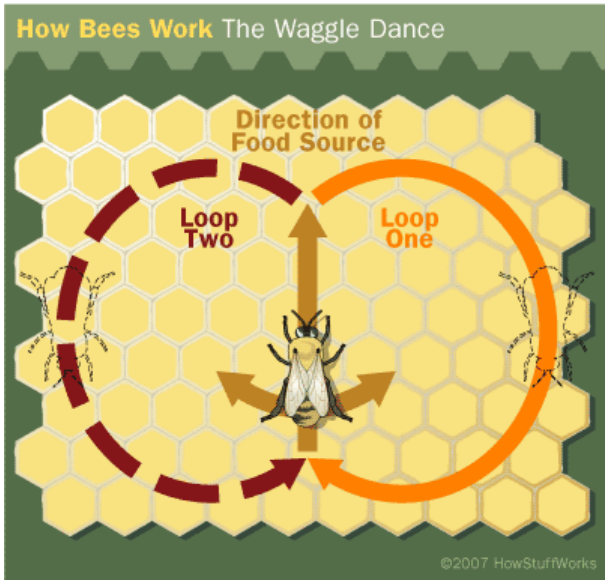
FORAGING REGULATION

- “appraiser” bees can assess the needs of the colony and quality of the resource
- If colony needs energy, then the appraisers will quickly accept nectar loads from foraging bees
- If the greatest need is water, then appraiser bees will quickly assist those returning with water
- Lack of help from appraisers will cause foragers to switch to a different resource

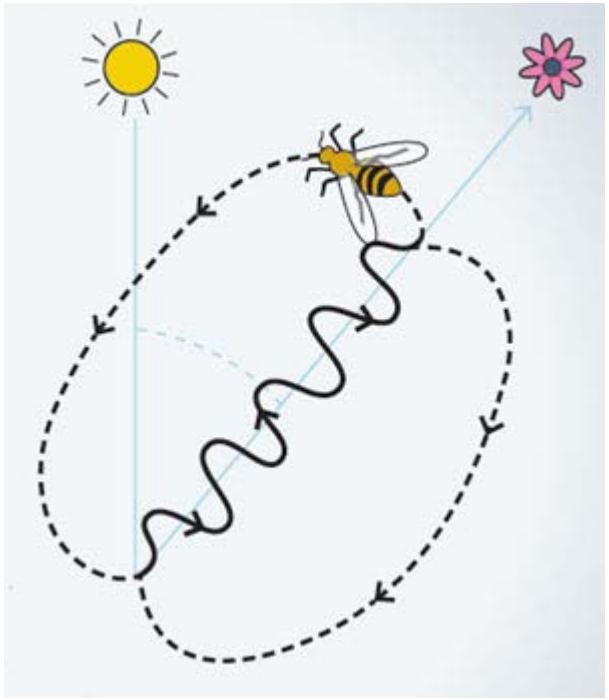
Photo from thehoneygatherers.com

NEST-MATE RECRUITMENT

- Utilizes dance language (Waggle dance) to communicate information about resources



- Dance language includes:
  - Distance to the resource
  - Location of resource
  - Richness of the resource



- Bees can assess multiple dances and resources at the same time and select the most appropriate

POP QUIZ SECTION

WHAT IS BEING DEMONSTRATED IN THIS PHOTO (BE SPECIFIC)?

WHAT IS THE TERM TO DESCRIBE THE FOOD ITEM FED TO FUTURE QUEENS

A. Propolis

B. Royal Jelly

C. Nectar

D. Queen protein

WHICH STAGE OF DEVELOPMENT IS BEING SHOWN IN THE PHOTO BELOW?

WHICH OF THE FOLLOWING IS AN **INCORRECT** STATEMENT

A. Workers perform the waggle dance to demonstrate the location and direction of a rich food source

B. Queen bees release pheromones that stimulate foraging

C. Worker “appraiser” bees assess the needs and the quality of resources for the colony

D. Worker bees release pheromones that stimulate foraging

WHICH STAGE OF A BEE'S LIFE CYCLE IS SPENT FORAGING?

A. During its time within the brood

B. After emerging as an adult

C. When it is older, and has spent time performing tasks within the hive

D. None of the above, foraging is predetermined in the larval stage

WILL THE EMERGING BROOD FROM THESE CELLS BE WORKERS, DRONES, OR QUEENS?

A FERTILIZED EGG WILL RESULT IN WHICH OF THE FOLLOWING

A. A drone only
B. A worker only
C. A queen only
D. A drone or worker
E. A worker or queen
F. Any of the above

DURING WHAT TIME OF YEAR ARE THE NUMBERS OF BEES WITHIN A COLONY AT ITS HIGHEST?

A. Winter
B. Spring
C. Summer
D. Fall

SUMMARY

- Bees are social insects that have cooperative brood care, division of labor, and overlapping generations
- This social system within a hive system has allowed us to manage colonies
- Bees exhibit interesting communication behaviors

QUESTIONS?