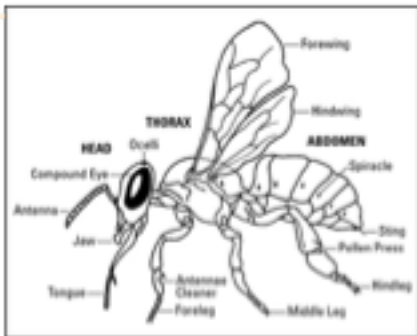


## BEGINNING BEEKEEPING

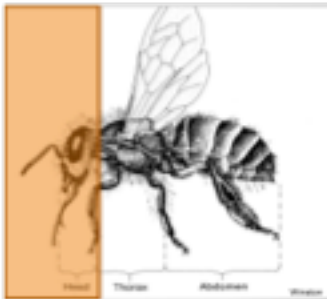
### CLASS 4: BEE BIOLOGY & PHEROMONES

#### BEE BIOLOGY



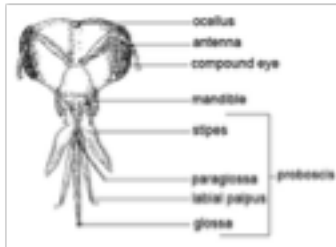
Major parts of the bee

#### BEE BIOLOGY - HEAD

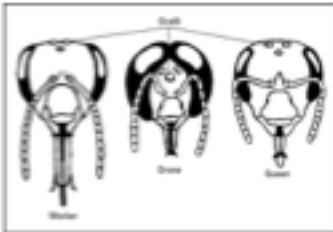


#### BEE BIOLOGY - HEAD

- Ocellus or Simple Eyes (3)
- Compound Eyes (2)
- Antenna (2)
- Mandibles (2)
- Proboscis



## BEE BIOLOGY – HEAD :: SIMPLE EYES



- ✦ Placement of Ocelli or Simple Eyes on types of bees
- ✦ Used in the poor light conditions within hive. On/off switch telling bees when the sun is shining.

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## BEE BIOLOGY – HEAD :: COMPOUND EYES



- ✦ **Compound eyes** are used to detect colors, position of the sun, and recognize landmarks

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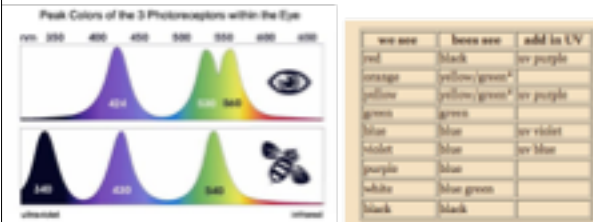
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## COMPOUND EYES – VISION :: COLOR

- ✦ Honeybees don't see colors as we do. Red appears gray or black to them and they can see UV.




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## COMPOUND EYES – VISION :: COLOR

- ✦ If you look at flowers under a blacklight, you'll see a closer representation to what a honeybee sees




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## COMPOUND EYES – VISION :: NAVIGATION

- Bees also use ultraviolet light as a navigational tool. Bees navigate their surroundings by tracking the sun's position and movement. The ultraviolet light passes through clouds, so that even on cloudy days, the bees are able to use the sun as a marker in their flight patterns.

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## COMPOUND EYES – VISION :: LANDMARKS

- The compound eyes of bees are also able to recognize and distinguish between landmarks, which they use to locate their nests or quality sources of food. Trees, utility poles, rock formations, etc., can serve as landmarks for honey bee flights.

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## COMPOUND EYES – VISION :: APIARY

- Compound eyes are also used to tell the difference between different hives if many are located side-by-side. Hive height, color, and other characteristics help bees distinguish between their colony and an adjacent hive.



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## ANTENNAE

- Antennae:** Bees do not have noses, but they can smell a wide variety of odors with their antennae. Smell and tactile sensations are how bees move around and conduct their duties inside the hive.



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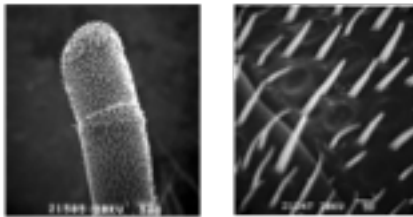
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## ANTENNA TIP AND SCENT GLANDS



Chemoreceptors: on each segment of the antenna are many dozens if not hundreds of specialized cells called chemoreceptors. Each receptor is able to detect various specific odors. For example, bees can smell certain flowers and can quickly locate the nectar and pollen with their vision and sense of smell.

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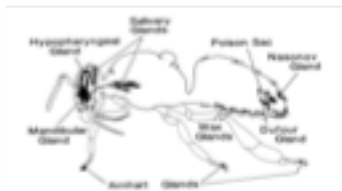
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## SMELL – COMMUNICATION & CONTROL PHEROMONES

- ❖ Queen mandibular pheromone (QMP)
- ❖ Nasanov pheromone
- ❖ Brood recognition pheromone
- ❖ Worker inhibitor
- ❖ Trail or footprint pheromone
- ❖ Warning substance
- ❖ Alarm pheromones
- ❖ Bee decay



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## PHEROMONES – QUEEN PHEROMONE

- ❖ **Queen Pheromone:** "Queen Mandibular Pheromone (QMP)" or "Queen Substance" is produced in the Mandibular Gland and is one of the most important sets of pheromones in the bee hive. Bees can also smell whether or not the queen is present and healthy. A healthy queen secretes an odor called Queen Substance, which, when spread through the hive is responsible for stabilizing the activities and functioning of the colony.

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## PHEROMONES – QUEEN PHEROMONE

- ❖ **Queen Pheromone:** Worker bees can sense the odor of the queen, which subsequently has various effects on workers. Queen substance (1) inhibits the development of worker bee ovaries, (2) inhibits the rearing of new queens, (3) stimulates brood rearing, comb construction, and food collection, (4) is involved in swarm cohesion, and (5) serves as an attractant to drone during mating flights.

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## PHEROMONE – HOME SCENT

- ✦ **Nasanov Gland:** The gland is located near the end of the top-side of the bee's abdomen. Bees release this pheromone to attract other bees. Bees at the hive entrance often release the attractant odor to assist returning bees in finding the colony entrance.



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## PHEROMONE – ALARM PHEROMONE

- ✦ **Guard Bees:** When bees feel threatened or are agitated, they release an odor from their mouth that serves to alert other bees of a possible threat in the area. The first odor does not indicate what the threat is or where it is; it simply is an odor version of sounding an alarm bell. The odor comes from the Mandibular Glands in older bees.

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## GUARD AND SCENTING BEES



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## ONE REASON TO USE SMOKER

- ✦ Anytime a beekeeper opens or otherwise disturbs a beehive, some bees will release the alarm pheromone. That is why we use smokers. The smoke calms the bees down by masking the alarm pheromone, greatly reducing the number of angry bees.

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## PHEROMONE – ATTACK PHEROMONE

- ✦ **Koschevnikov Gland:** Another alarm pheromone that is released by bees when they are stinging something. This chemical serves to mark the threat (or victim) so that other agitated bees can find an attack the intruder. Smells like bananas.

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## MANDIBLES AND PROBOSCIS

- ✦ **Mouth parts:** The bees mandibles (jaws) are used for feeding larvae, collecting pollen, manipulating wax, and carrying things.
- ✦ **Proboscis:** The bee's proboscis is much like a party noise maker that unrolls when you toot it. When the bee is at rest, the organ is retracted. When the bee is feeding or drinking, it unfolds to form a long tube that the bee can use like a straw.

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## BEE BIOLOGY – HEAD :: MOUTH & TONGUE



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## GATHERING NECTAR



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## FEEDING EACH OTHER



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## FEEDING LARVAE



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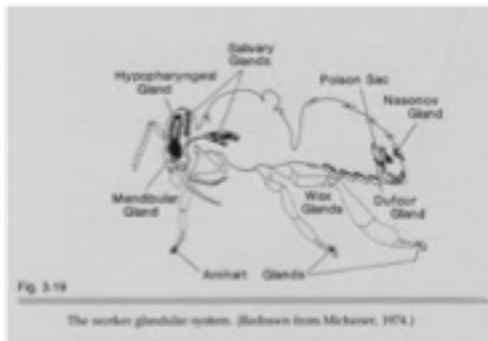
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## MAKING WORKER & ROYAL JELLY



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## MAKING WORKER & ROYAL JELLY

- ✦ Hypopharyngeal glands: Look like cluster of grapes. In young bees, used to produce the protein rich food fed to larvae. Clear.
- ✦ Mandibular Glands: In young bees, used to produce milky fluid that mixes with fluid from Hypopharyngeal glands to feed young larvae.
- ✦ Fed combination 60-80/40-20 for first 2 1/2 to 3 days then just clear unless queen.

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## FEEDING LARVAE

- ✦ After 3 or 4 days, worker larvae fed by other bees that feed them mix of honey and bee bread (pollen).
- ✦ The larvae get fed about every 15 minutes.
- ✦ It takes about 1 cell of honey and 1 cell of pollen to make a new bee.

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## TASTE

- ✦ **Tongue:** Although bees have tongues, they cannot taste with them. Instead, as in smelling, bees can taste materials with their antennae with the same chemoreceptors.
- ✦ **Flower:** With their antennae, bees can tell where nectar is in the flower, and they can also tell how sweet the nectar is and if it is worth collecting.

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## HEARING?

- ✦ **Queen sounds:** Queens can also make high-pitched noises using wing muscles that can be transmitted through the beeswax combs and detected by worker bees.
  - ✦ **Quacking** is likely the same sound but is made by a queen still inside the queen cell and so the sound is muffled.
  - ✦ **Piping** is the sound that a newly emerged queen will make once she is free and walking around the comb. It is thought that the first emerged queen makes the piping sound to inform the workers of their presence and that they don't need another queen. Can also be a way for new virgin queen to call workers to attend her.

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## HEARING

- ✦ **Vibrations:** The closest thing bees have to a sense of hearing is the ability to detect substrate vibrations such as banging on the hive or the passing of heavy machinery close to the hive. Vibrations tend to agitate bees and often encourage stinging behavior. That is why good beekeepers move very deliberately when working the hive and disturb the hive as little as possible.

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## TOUCH

- ✦ **Vibrations:** In addition to substrate sounds, vibrations can also be considered a tactile, or touch sensation.
- ✦ **Food solicitation:** Bees also use sense of touch when they communicate between individuals. For example, bees may tap each other with their antennae to solicit food from another bee.

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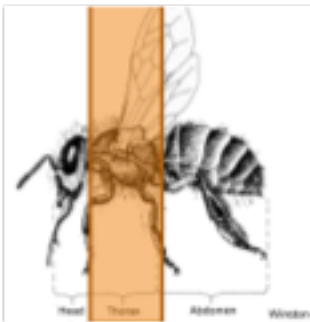
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## BEE BIOLOGY - THORAX



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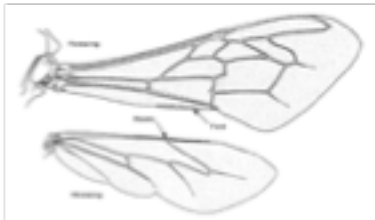
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## BEE BIOLOGY – THORAX :: WINGS

The thorax is the middle part of the bee and includes all muscles, all nerves, and appendages

- ✦ **Wings:** The honeybee has 4 wings, two pairs attached fore and aft to the bee thorax. The wings are hooked together in flight separate when the bee is at rest.



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## BEE BIOLOGY – THORAX :: LEGS

- ✦ **Legs:** The bee has 3 pairs of legs, each different. Each leg has six segments that make them quite flexible. The bees have taste receptors on the tips of their legs.
  - ✦ The **forward legs** are used to clean its antennae.
  - ✦ The **middle legs** help with walking and are used to pack pollen (and sometimes propolis) into the **pollen baskets** that are part of the hind legs. (Propolis is the sticky resinous substance that the bees collect from the buds of trees and use to seal up cracks in the hive.)



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## BEE BIOLOGY – THORAX :: LEGS



- The **hind legs** are specialized on the worker bee. They contain special combs and a pollen press, which are used by the worker bee to brush, collect, pack and carry pollen and propolis back to the hive.

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## BEE BIOLOGY - ABDOMEN

- ✦ The abdomen is the part of the bee's body that contains its digestive organs, reproductive organs, wax and scent glands (workers only) and the stinger (workers and queen only).

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## BEE BIOLOGY – ABDOMEN :: STINGER



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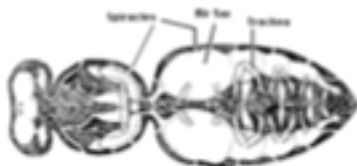
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## BEE BIOLOGY - SPIRACLES

- ✦ **Spiracles:** The tiny holes along the sides of a bee's thorax and abdomen are the means by which a bee breathes.



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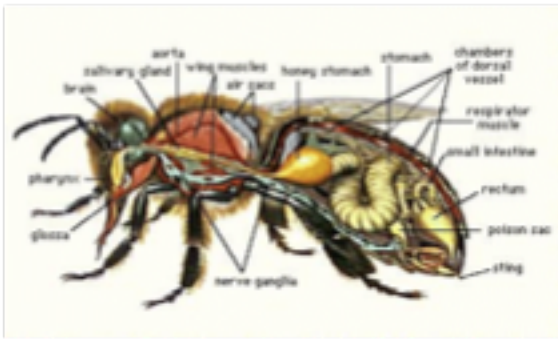
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## BEE BIOLOGY – INTERNAL ANATOMY



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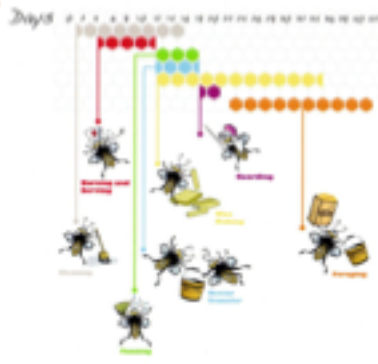
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## A Worker Bee's Life



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## BEESWAX



- ✗ Produced by four pairs of glands on the underside of the worker's abdomen
- ✗ When wax is secreted and exposed to the air, it hardens into flat wax scales
- ✗ Bees remove wax scales from the underside of the abdomen with spines located on their middle legs and pass it to their mouthparts. It is manipulated until pliable and ready to be formed into six-sided cells

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## FESTOONING



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## HONEYCOMB



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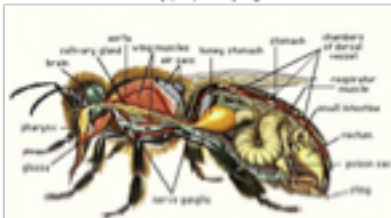
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## NECTAR AND HONEY

- Forager bees draw in nectar through their proboscis (straw-like tongue.) They then add **invertase** while they carry the nectar in their honey stomach.
- This **invertase** begins breaking down the sucrose into glucose and fructose in the **honey** stomach.
- The enzyme invertase comes from Hypopharyngeal Glands of older bees



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## NECTAR AND HONEY

- Delivered to house bees
- Bubbled into cells and fanned to decrease the water content (below 18%)
- Cured honey is then capped with wax



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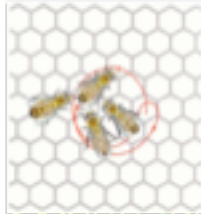
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## DANCE LANGUAGE - THE ROUND DANCE

- ✦ Communicates the food source is near the hive
- ✦ Forager bee moves in a circular motion first right then left
- ✦ Richer the food source, the longer and more vigorous the dance
- ✦ Dance does not indicate any specific direction
- ✦ Forager bee offers flower's scent so others know what to look for.



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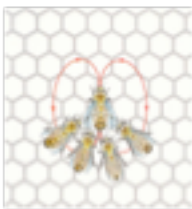
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## DANCE LANGUAGE - WAGGLE DANCE



- ✦ The direction the bee moves in relation to the hive indicates direction;
- ✦ The duration of the waggle part of the dance signifies the distance. More "wagging", further away

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## POLLEN COLLECTION

- ✦ Worker bees are covered with hairs all over their bodies (even their eyes)



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## ATTRACTING POLLEN

- ✦ When the worker bee flies, the hairs get electrostatically charged. When she lands on a plant with pollen, the pollen sticks to her.



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## PACKING POLLEN TO TAKE BACK TO HIVE

- ✦ The worker bee combs the pollen off her body and stores it in her pollen basket on her hind legs.



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## PROPOLIS AND WATER

- ✦ Propolis
  - Sticky sap substance with antimicrobial properties
  - Collected on their pollen baskets
  - Used to:
    - ✦ reinforce loose hive components
    - ✦ plug holes and narrow entrances
    - ✦ cordon off foreign material within the hive
    - ✦ self-medicate
- ✦ Water
  - Collected in late Winter / early Spring
  - Uses:
    - ✦ to dilute honey!
    - ✦ added to bee bread (eaten to produce brood food)
    - ✦ placed on tops of frames and fanned to cool hive

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## QUEEN REPLACEMENT / SWARMS

- ✦ Supersedure
  - Lack of queen substance feedback due to 'failure' / old age, and/or a lack of brood pheromones
  - Old queen balled by workers
- ✦ (Reproductive) swarms
  - Division of successful colonies in Spring
  - The old mated queen leaves w/ ~ 60 % bees
  - A new queen emerges, mates, and takes over hive
- ✦ Emergency queen replacement
  - Begins within 24 hours of queen loss

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## LAYING WORKERS

- ✦ When a colony becomes queenless or the queen is on the decline, the ovaries of several workers develop and workers begin to lay unfertilized eggs.
- ✦ Normally, development of the workers' ovaries is inhibited by the presence of brood and the queen and her chemicals.



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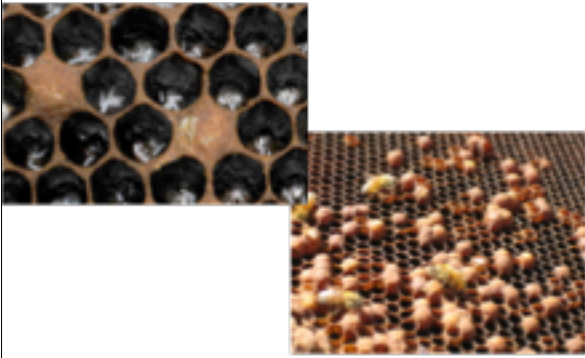
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**LAYING WORKER**

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**NEXT WEEK: PESTS, DISEASES,  
& PESTICIDES**

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