



Honeybee Basic Biology

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While there are 20,000 species of bees in the world, only 7 to 10 produce honey. Most of these species are solitary bees. Of those 7 to 10 that produce honey, only a few produce more honey than they need for their colony. *Apis mellifera* is the most common of the domesticated species which is used around the world for honey production and pollination services. Within this species there are several races. Each race has traits that make them better suited to different situations.

Italian Bees: (*Apis mellifera ligustica*) Are light in color, but the queen is darker, which makes it easier to find her in the hive. They are gentle to work with. They are strong foragers and keep their hives clean but will drift to other nearby hives and rob each other. They have a hard time getting through long cold winters and are slower to stop producing brood in the Fall and slower to build up in the Spring. This trait can mean that they go into winter with too large of a colony and too little stores of honey to get through to Spring. Make sure to supplementally feed during the winter to have a strong colony ready for spring nectar flows.

Carniolan bees: (*Apis mellifera carnica*) Are more grayish brown in color with queens being even darker. They are better at surviving cold winters and are quicker to slow down rearing of brood in the Fall and quicker to start building up in the Spring. They are also very gentle and easy to work with. They are more likely to swarm every year in the Spring so it is important to take steps to manage this early. This can be as simple as making splits or providing extra room in the hive.

Russian bees: Are dark brown to black in color and are slightly more aggressive than European bees but still gentle enough to work with. Their advantage comes from their genetic ability to survive cold winters better. They react quickly to changes in nectar flows, so they will slow down or increase brood production in response to the conditions around them. They do best with a supply of good forage throughout the year and need to be managed to prevent swarming. They will forage in temperatures too cold for European bees so tend to be good producers of honey. They

are less likely to allow robbing. Their queens take a little longer to start laying eggs when introduced to a new hive, and new queens take longer to be accepted by other types of bees. They are naturally more resistant to Varroa mites, tracheal mites, and hive beetles.

Africanized bees: (*Apis mellifera scutellata*) Refers to African bees that were originally brought to Brazil for research and escaped into the wild. They spread quickly and overpower European hives. They produce more drones and easily hybridize with European races introducing their less favorable traits. They swarm far more often and will take up residence just about anywhere. They abscond during nectar dearths or if they are disturbed too often, which could include regular inspections from the beekeeper. They are more protective of their colony so will not only attack intruders quickly but will protect a large radius around the hive. They also send more bees to attack. European bees may send 10 bees and Africanized bees will send 100 to defend their hive and they won't leave you alone if you walk away. They tend to have smaller colonies and produce smaller amounts of honey. They are native to tropical climates so haven't successfully established above 34 degrees North latitude.

Structure of a honeybee

Bees have three main body regions. The Head, Thorax, and Abdomen.

The head is all about sensory information with the antennae and five eyes. Three of these eyes are simple and located in between the larger compound eyes. The compound eyes are made up of 6900 tiny lenses each with a photosensitive cell which are grouped according to their special skill to perceive color, patterns, polarized light and directional information. There are 150 of these groups. Bees can see violet, blue, blue-green, yellow and orange as well as ultraviolet light, so flowers that depend upon bee pollination are in these colors. They are far faster than humans at detecting motion and have tiny hairs where the facets meet which measure wind speed and direction. Their antennae



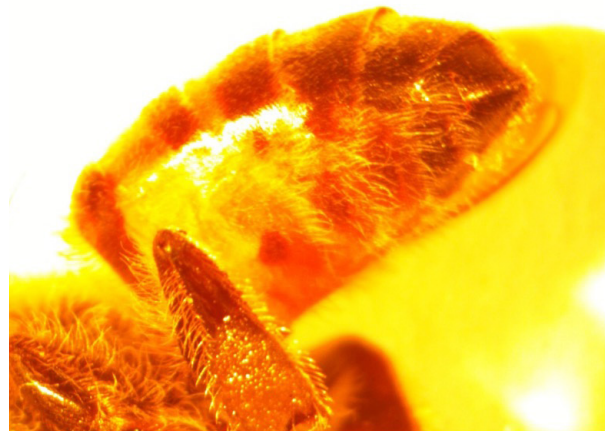
Head of a honeybee with tongue out.



Thorax of honeybee showing wing attachment.

are used for feeling (touch) and smelling. The queen has 3000 plate organs on each antennae, while workers have 3600 to 6000, and drones have 30,000. They are critical for differentiating between smells both in and out of the hive, as well as navigating in and out of the hive. If antennae are damaged or removed the bee will soon die. Honeybees also have a straw-like tongue that can be extended into flowers to extract nectar. Honeybees also have mandibles which act like jaws, but theirs are found on either side of the mouth and move side to side. They are capable of biting and will defend the hive against other insects by biting them. They also use their mandibles to bite their way out of the brood cell, softening and shaping wax for honeycomb, cutting pieces of bee bread, carrying debris, grooming themselves or the queen, working propolis, chewing wood to enlarge a hole, and sometimes biting through the outside of a flower to access pollen or nectar easier.

The Thorax is all about movement so this is where the wings and legs are attached. Bees have three pair of legs. The front legs are often used for grooming, cleaning the antennae and moving collected pollen to the hind legs where there is a depression called the pollen basket. Bees mix a little nectar in with the pollen to make it sticky and then press it into the pollen basket. When the pollen basket is full, they will head back to the hive and deposit the pellet into a cell. Hive bees will add enzymes and bacteria and pack the pellets in tightly. This is then allowed to ferment into bee bread which is more nutritious than raw pollen. When the fermentation process is complete they will cover the cell with a thin protective layer of honey. This food will be used during the winter months to feed all members of the colony. Queens and Drones do not have a pollen basket. Bees have four wings which are designed to fold back over



Abdomen of honeybee.

the abdomen when not in flight. The hindwings have hooks along the front edge which connect them to the forewing during flight. The wings have veins which keep the wings rigid. The wings are quite delicate and are worn out during the repeated flights from the hive to floral resources and are tattered and torn by the end of the bees' life.

The abdomen contains their heart, honey stomach, intestines, stinger, wax secreting glands, scent glands and reproductive organs. Worker bees temporarily store nectar, honeydew or water in the honey stomach to transport these liquids back to the hive. The walls of the honey stomach are pleated which allow it to expand with liquid. It also has lactobacillus bacteria living in the stomach which are then transferred to the contents as they are expelled into storage in the hive. This bacteria is very important to the development of honey and bee bread. The sting is only present in female bees and is an adaptation of the egg laying ovipositor. Queens generally only use their stinger to kill other rival queens. The sting is

attached to an acid gland and Dufour gland which allow venom or alarm pheromone to be released when an enemy is stung. The barbs on the sting catch in the victim and as the bee pulls away the entire sting structure is pulled out of the bee's body. The venom sac can continue to pump venom into the wound so it is important to remove the sting promptly by scraping it off. Alarm pheromone marks the area of the sting and invites other bees to attack the same area. Wash thoroughly to remove this scent or smoke to mask the scent to allow continued work.

Three castes in the hive

There are three types of bees in a colony. Two female castes, queens and workers, and one male caste, drones. There is usually one queen, a few hundred drones during the active seasons, and several thousand workers.

The Queen is larger and longer than workers and quite often a darker color and without color bands. Her abdomen is much longer which is to allow room for the spermatheca containing sperm to fertilize eggs and gives her the ability to lay eggs on the bottom of the cells. She has the ability to measure the size of the cell to determine if it is a normal worker or larger drone cell, and will lay an unfertilized egg for drone brood, or a fertilized egg for worker brood. Usually each colony only raises a few hundred drone as potential mates for other nearby colonies. When the queen has run out of sperm she has no choice but to lay unfertilized eggs. This situation will produce far too many drones which don't contribute to the resources of the hive and the hive will soon run out of food and workers and die.

Every fertilized egg has the ability to become a queen. The difference is the diet they are fed. All eggs are fed royal jelly for the first three days. Each larvae is fed between 150 to 800 times a day as needed. On day four, they hatch into larvae and most are switched to a diet of honey and bee



Workers on new honeycomb.

bread. Larvae destined to become queens continue to be fed royal jelly during their entire development. When a hive determines it needs a new queen these eggs are usually laid in a larger cell called a queen cup which are built on the bottom of the frames. If the queen is removed, failing, dies, or is damaged in some way, the hive can use an egg already laid and build a supercedure or emergency queen cell on the side of the frame in the middle of the brood nest. Queen eggs will be fed lavish amounts of royal jelly until her cell is capped on day 8 of her development. The last two days of feeding also contain some honey and juvenile hormone. She then pupates and develops into a virgin queen by day 16. When she emerges her first duty is to call out to any other developing sister queens, find them, and kill them with her stinger. The victorious virgin queen then takes a few days to dry out her wings, eat to gain strength, and then on day 6 she will go on her mating flight if the weather is favorable. She needs to fly far enough away to mate with drones from other neighboring hives. She will emit a virgin queen pheromone that attracts drones from their drone congregation area as she flies by and they begin pursuit. Hundreds of drones will chase the queen until she has narrowed it down to the strongest and fastest drones. She will then allow a drone to mount her in mid air where he inserts his penis and ejaculates with such force that his male parts are separated from his body and he falls to his death. The next drone will then mount her in the same fashion, remove the male parts from the last drone, insert his penis, ejaculate forcefully and fall to his death. This continues until she has successfully mated with 12 to 20 drones. Sometimes she will need to return to the hive for nourishment and then go back out for the remainder of her mating flight. Once she has successfully mated and her spermatheca is full she will spend her days laying eggs inside the hive.



Queen in cage.



Larvae and capped brood.

Even though workers start out as the same fertilized egg and they develop into larvae at the same time, they aren't capped to pupate until day 9 or 10. They then take several days to develop into a worker bee and emerge on day 21. As soon as they emerge they receive a little nourishment from the nurse bees then they turn to start cleaning out their cell for another egg. The tasks of the worker bee depend upon their age and the needs of the colony. Young bees will clean the hive and honeycomb, as well as feed developing larvae. Then they use the wax pellets produced from glands on their abdomen to build honeycomb and cap cells. Later they guard the entrance to the hive, help heat or cool the hive, accept nectar from foragers to help store and cure it, pack pollen for bee bread, and take some orientation flights. The last two weeks of their life is spent foraging for nectar, water and pollen. Foraging takes a heavy toll on the bees and they are soon exhausted, worn out and usually drop dead while working. Their whole life span is around six weeks. During winter months workers may survive for several months since they stay in the hive much more often.

Drones are much larger than worker bees. They don't forage or defend the hive. They don't build honeycomb or clean the hive. They live only to mate with virgin queens from other hives. They also have a very short lifespan and no stinger. When Spring approaches and resources are plentiful the queen will lay some drone egg. Drones eat in the morning then fly out to the drone congregation area for several hours to see if they are lucky enough to mate with a virgin queen and if not, they return to the hive to eat and spend the night. Drones are the first to be kicked out of the



Drone in center surrounded by worker bees

hive if food gets scarce, and they don't overwinter with the workers. Drone larvae are capped on day 11 and the mature bee emerges on day 24.

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