

# The Honey Bee Colony

## Behavior & Organization

**BBE-Tech Apiary Services**

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*Should you be interested in becoming certified through BBE-Tech Apiary Services in Organic Beekeeping (after obtaining the Apiarist Certification) the written exams will be focused primarily on the material presented in this study guide.*

If you are taking a Honey Bee Colony; Behavior & Organization class offered by Tony Sandoval, you will have the advantage of being able to ask questions, verify information, clarify information and extrapolate ideas as they may apply to your specific apiarist endeavors.

If you downloaded this study guide from the BBE-Tech website, I hope that this provides you with information to help you be successful. You may arrange a private consulting/coaching session with Tony or arrange for a private class to be offered individually or for a group.

This manual assumes that you have already had some familiarity, education and/or experience with honey bee physiology and behaviors. If you have not, you may want to consider a private coaching session with Tony to become familiarized with this type of equipment.

To really understand bees, well, as much as we actually *can* understand bees, we have to understand the colony as a super-organism and the behavior of the colony as a whole as well as the individual bees that the colony is comprised of.

As in with learning as much about honey bee biology as possible allows us to better anticipate, assess and diagnose what we see with our bees, it is also so with understanding colony organization and natural bee behavior.

## Table of Contents

What It Is.....	3
Queen(s).....	3
Workers.....	3
Drones.....	3
What Does It Do.....	3
Nests.....	3
Reproduces.....	3
Foraging.....	3
Pollination.....	4
How Does it Do What It Does.....	4
Reproduction.....	4
Nesting.....	7
Foraging.....	7
Traits and Behaviors.....	8
Traits.....	8
Behaviors.....	8
Inherited.....	8
Adaptive.....	8
Individual Behaviors/Activities.....	10
Queens.....	10
Workers.....	10
Drones.....	11

Perhaps the best way to begin is by focusing on the colony as a Super-Organism and what makes it what it is , what it does and how it does those things.

## **What It Is**

A colony made up of three castes, Queen (s) - Reproductive female(s), Workers - Non-reproductive females, and Drones – Reproductive males. The three Castes of bees all working together within a nest that is protected (usually) within a warm, dry and defensible voidspace called a Hive. Working together to achieve a solitary goal as if of one mind as a single entity known as a Super-Organism.

## **What Does It Do**

### **Nests**

The colony builds and lives entirely within a nest made of a wax substance excreted from the bodies of the Workers and chewed and otherwise worked to become the combs made of 6 sides (hexagonal) cells. In the combs eggs are laid, brood is raised and forage is stored. The nest is everything to them. It's been said on occasion that we could think of the nest as the exoskeleton of the colony as an individual entity.

The nest is usually built within a void-space within a structure such as a tree, a fallen log to even the inside of a house wall, roof or even the empty motor block of an engine in a junk yard. As long as it is defensible, warm and dry, it is sufficient to their nesting needs.

### **Reproduces**

Queens mate with Drones from other colonies in the area in order to be able to lay fertilized eggs. After going through the mating period, they are the solitary egg layers responsible for establishing the colony population and laying eggs to compensate for natural mortality rate as well as growth over the natural mortality rate. Drones mate with Queens from other colonies carrying the genetic material of the Queen that they came from and distributing it to other honey bee colonies. The Workers have the task of providing food and care of the brood, “directing” the Queen as to which types of eggs to lay and traveling with the Queen to begin a new colony after leaving the original colony to the effect of reproducing the Colony as a second and sometimes a third or fourth Colony will be split off from the originating Colony to start life as a separate and distinct new colony.

### **Foraging**

One of the primary functions of adult Worker bees is to forage. To bring in the resources such as water, Nectar, Pollen and Propolis that the bees will use as food and environmental treatment. Foraging takes up almost the last half of a bee's individual life and is done in coordination with the other workers in

the hive who either are acting as Scouts to locate resources, foragers to collect them or the “House” Workers who communicate the needs of the colony to the Foragers.

Foragers communicate with each other in order to recruit foragers for resources they have found for the Colony. Primarily they use one of two “Dances” the “Waggle” Dance and the “Circle” Dance.

The Circle Dance is performed to communicate the location and quality of resources found within about 100 meters of the hive. The more vigorously and longer in duration it is, the greater the value as a resource it is.

The Waggle Dance accomplishes largely the same information but in a circular figure 8 movement. The difference is that it indicates resources further than about 100 meters from the hive. Like the Circle Dance, the more vigorous and longer in duration the dance is, the better the quality of the resource being recruited for.

## **Pollination**

Is pollination one of the primary functions of the honey bee colony? Not as a primary function of the colony, no. However, in terms of the honey bee colony’s role in the environment, it could be said that Pollination is their job. Pollination is rather incidental to foraging and yet... Pollination is a matter of a deeply evolved relationship with flowering plants over millions of years. Plants and bees adapting as the needs and behaviors of the other adapted with the surrounding environment. Wasps and Hornets have continued to evolve as predators, keeping other insect “prey” populations in check according to Natural Selection. Honey bees and other bees have evolved as collaborators with flowering plants to aid, even if incidentally, with increasing reproduction of those plants. Think of it as the need in the greater world they have stepped up to fill.

## **How Does it Do What It Does**

### **Reproduction**

The colony reproduces by division. In short, the “old” Queen has laid eggs that are selected by Workers to become Queens and about a day or so before those new Queens emerge, the Queen will take roughly 50% of the existing field force and depart in a Swarm. This leaves the newly emerged and victorious Virgin Queen to get mated and take over the original nest and maintain the continuity of the original nest.

Normally, one might think a Biology class would be the best place to discuss the process of egg laying and building of the colony population. Normally I would agree. However, since Colony and individual bee behaviors are so closely tied to age and timing it tends to work better here.

The bees direct the Queen as to which type of eggs to lay an unfertilized egg which will be a male (Drone) or a fertilized egg, which will be a female. A female could either be a Worker or a Queen, depending on the diet of the larvae as determined by the Workers.

Workers communicate what type of egg to lay by the size they make the wax comb cells. The cells are measured by the Queen using her legs. Small cells are for fertilized (female) eggs and larger cells are for unfertilized (Male/Drone) eggs. Worker bees also direct the Queen's egg laying activity by harrying her or keeping her moving so she cannot stop to lay eggs or letting her go on "normally" so as to continue laying eggs. Harrying behavior is very often associated with preparing for colony reproduction/Swarming.

All bees spend three (3) days as an egg. The larvae hatch and will spend varying amounts of time in the larval, pre-pupae, pupal and finally, emerge in the adult stage.

### **Queens**

Larvae - 5.5 days. Larvae are fed Royal Jelly for the entire time as a larvae.

Pupae – 7.5 days. Pupate in an extended, large "peanut" or conical shaped cell.

Adult – Emerge on day 16

### **Workers**

Larvae – 6 days. Larvae are fed Royal jelly for about the first 3 days or so then are switched to "Bee Bread" for the remainder of their time as a larvae.

Pupae - 12 days. Pupate in flat capped cells.

Adult – Emerge on day 21 by chewing through the wax cap.

### **Drones**

Larvae – 6.5 days

Pupae – 14.5 days. Pupate in dome capped cells.

Adult – Emerge on day 24 by chewing through the wax cap with some assistance from Workers.

An interesting note on Drone production. Because Workers make substantially larger cells to raise drone brood in, bee colonies pretty much have it as a predisposition to have a certain amount of drone comb in a nest. The more Drone comb is removed, the more Workers will make more. The more the comb they make is left alone, the less likely they are to make more than they have decided they need. This information comes into play in relation to IPM and Hive management strategies and control tactics.

**Educational Pictures about Honey Bees** 15 of 15  
 University of Minnesota Instructional Poster #156d - Gary S. Reuter, Department of Entomology  
 WWW.EXTENSION.UMN.EDU/HONEYBEES

### **Jobs Performed By Worker Bees**

Cell cleaning	Handling pollen	Patrolling
Capping brood	Comb building	Resting
Tending Brood	Cleaning debris	Guarding
Queen tending	Cell repairing	Foraging
Receiving nectar	Ventilating	

### **Development times for honey bees (days)**

Caste	Egg	Larva	Pupa	Total
Worker	3	5.5	12.5	21
Drone	3	6.3	14.7	24
Queen	3	4.6	8.4	16

## **Nesting**

The Swarm leaves the original hive and lands at a temporary location to give the Queen time to rest and shrink down a bit to be able to make the flight to the new nest location (Hive). While the Queen rests, Scout bees go out inspecting various void spaces in trees, structures, logs, or anywhere else they may find to build a nest that is dry, warm and defensible. Upon agreeing on a nest location and the Queen is ready for further travel, the Swarm flies to the new Hive and begins to build a nest if one has not already been established. There are situations in which horny bee swarms will locate and choose to move into abandoned nests.

Once in the new Hive, the Workers begin producing wax and drawing out new combs for the Queen to lay eggs in and to begin storing resources in. Brood production is very tied to weather and environmental conditions. With lower temperatures and lack of incoming food sources, Queen egg laying and overall brood production slows down and even might stop in some cases. Winter being a general presence of both conditions in temperate climates like ours is very visible evidence. On the flip side, warmer temperatures and an increase in food availability will have the effect of creating an increase in egg laying and brood production. The more substantial the increase in temperature and food, the greater and more rapid the consequent increase in brood production to take the greatest advantage of it.

## **Foraging**

Foraging includes the “House” Workers in the Colony communicating with the Foraging Workers, building wax combs to store resources and the actual work of foraging which takes up the remaining nearly a third of a Workers bee’s life.

Foraging also has a direct impact on in-colony reproduction. That is, the availability of forage-able resources in the larger environment will impact how large and how rapidly the colony grows its population.

The larger the population of the Colony, the greater the efficiency of the Colony in foraging and nest management.

## Traits and Behaviors

Colony organization is essentially the result of coordinated genetic traits as well as inherited and learned or adaptive behaviors.

### Traits

Traits are genetic predispositions of the bees in the colony which essentially form the basis of the “Hive Mind”. For example, foraging is a trait as is wax production as is, to a certain degree, the demeanor or aggressive defensiveness of the colony. All of these are further impacted by specific behaviors learned or adaptive that influence the Hive’s overall “personality” over time.

### Behaviors

Behaviors are both inherited and adaptive or learned. Meaning some behaviors are attained by genetic predisposition and others by acclimating to the local environment.

### Inherited

Defensive behaviors of the colony are often a result of genetic predisposition. Some sub-species and blood-lines of honey bees are naturally inclined to be more aggressive and less tolerant of what they consider threatening or intrusive activity than others. Some sub-species or bloodlines can be extremely docile and very “forgiving”.

There is some cause to believe that foraging or the level of “enthusiasm” to which the colony gives to foraging and storing of foraged resources is at least partly inherited. This affects honey production, wax production and defensiveness of a “stocked” Hive.

Collection and use of Propolis AKA “Bee Glue” to seal cracks and crevices inside the hive and to use as a means of keeping the hive environment healthy is tied to inherited behaviors. Some sub-species and bloodlines of honey bees show a tendency to have more or less propensity to collect and utilize Propolis inside the hive.

Hygienic behaviors will round out the basics of inherited or genetically predisposition behaviors. This is the effort to which honey bee workers patrol the combs seeking out and identifying pests and diseases on or in the comb cells. Some sub-species or bloodlines are more naturally inclined to show high levels of hygienic behavior while others show little or low tendencies of hygienic behaviors.

### Adaptive

Adaptive behaviors are those which the bees learn and teach each other in the course of day to day activity. They learn to modify their defensiveness when a predator or pest threat is persistent near the

hive. They learn when forage resources are more available or are more scarce and when and where to expand or shrink their forage area. Honey bees also learn and teach each other how to access specific flower types that require a “trick” to get to the nectar or pollen such as encountering a field of Alfalfa. Bees can modify their behaviors in response to environmental conditions as well as to availability of resources.

## Individual Behaviors/Activities

### Queens

- Queens are not sexually mature at emergence. They become so at about 5-6 days after emergence at which time she commences mating flights. She will mate with approx 7 to 15 drones and subsequently stop mating flights. Within 2 to 5 days she will start laying eggs.

### Workers

#### Notes:

Job Progression of a Worker Bee		
Age	Role	Description
Days 1-2	Cell cleaning	Right from birth the bee has a job to do: she has to clean out her cell
Days 3-11	Nurse	Nurse bees feed the worker bee larva with a substance called worker jelly
Days 12-17	Wax making	Worker bees produce wax to build and repair old cells to hold either eggs or pollen/nectar
Days 18-21	Honey sealing	Honey must be dried to 17-18% moisture and then sealed
	Drone feeding	Drones (the only male bees) are fed by worker bees
	Queen attendant	
	Egg moving	
	Honeycomb building	Workers take wax from the wax makers to build or repair combs
	Pollen packing	Pollen must be packed tightly to prevent it from going rancid
	Propolizing	Propolis is a waxy substance used to seal unwanted crevasses within the hive
	Mortuary	Dead bees and failed larva must be removed from the hive
	Water carrier	
	Fanning	Worker bees will fan the hive using evaporated water brought by water carriers to keep the hive exactly 95° at all times and seasons
	Guard	Protect the entrance of the hive from enemies
Days 22-42	Soldier	Protect the entrance and attack invaders. They work in concert with entrance guards.
	Entrance Guard	Inspect incoming bees to ensure that they are bringing in food and have the correct hive odor. Other bees will be rejected or attacked with soldier bees.
	Outside Guard	Take short flights around the outside of the hive in response to disturbances.
Days 22-42	Foraging	Travel up to 5 miles from the hive to collect pollen, nectar or propolis

During Nurse activities, Workers feed older larvae (over 3 days old) first until their glands mature and become capable of producing Brood Food (AKA “Worker Jelly”) at which time they begin feeding younger larvae.

## Drones

- Drones are often tolerated to enter any hive besides the one they were born in.
- When Fall begins, Drones become Persona Non Grata, meaning they are no longer needed or desired. They will be excluded by guards and literally chewed on and dragged out of a hive by Workers in order to conserve resources.
- Drones visit almost daily a remote area called a Drone Congregation Area (DCA) where they along with drones from multiple colonies wait for virgin Queens to fly by in order to make the effort to mate with them.