

SOCIAL LIFE IN INSECTS

E-Content for UG

ZOOLOGY; B.Sc.-I; Semester-II; ZOO CC-203

By: **Dr. Shobha Shrivastava**

Associate Professor

Department of Zoology

Patna Women's College (Autonomous)

Patna University, Patna.

E-Mail : shrivastava.shobha07@gmail.com

SOCIAL LIFE IN INSECTS

- Insects of a given species that live together in organized groups or colonies are known as ‘Social Insects.’
- In a social organization many individuals of a species live together in an integrated manner so that each contributes in some specialized way to the welfare of all.
- Only few insect species have been able to develop fully social habits.
- The most highly developed and complex of insect societies are found in the Honey Bees, Ants and Wasps (Order- Hymenoptera) and Termites (Order- Isoptera)

Characteristics of Social Insects :

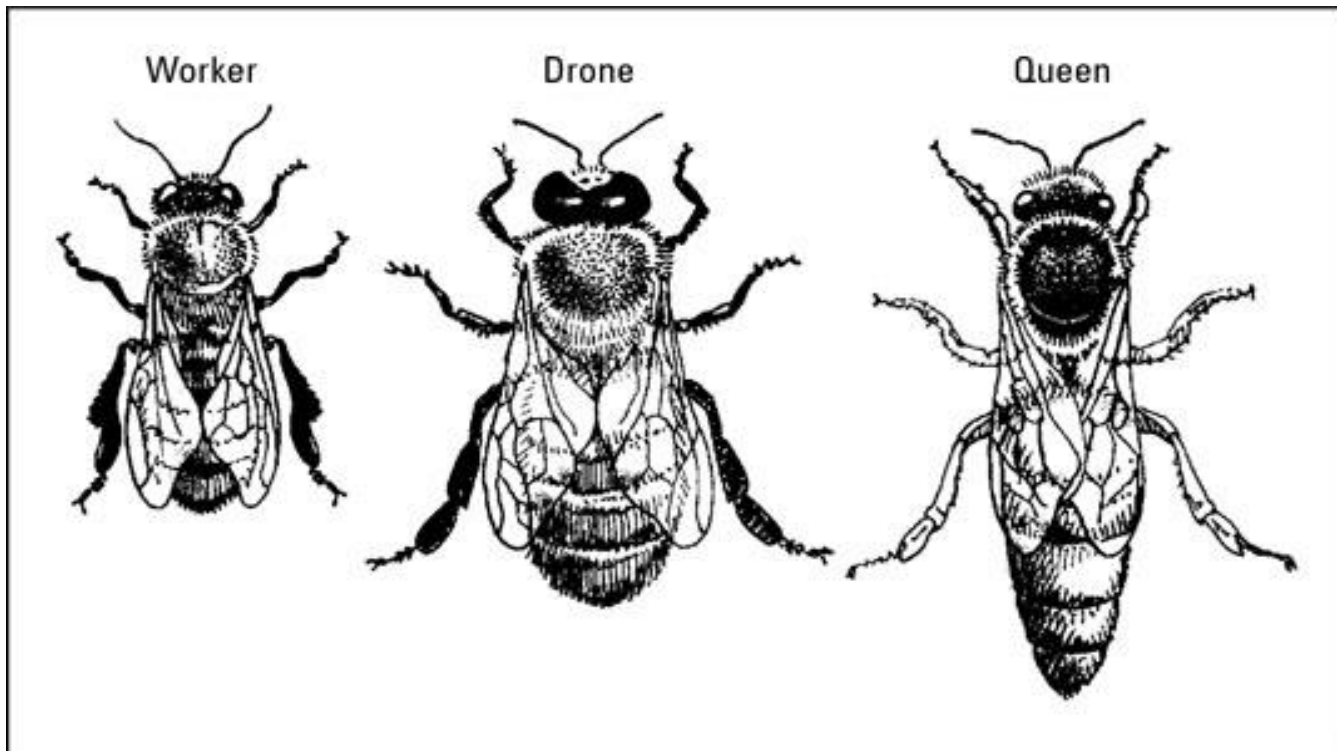
All social insects possess certain characteristics in common, which are as follows:

1. Large population or colonies
2. Polymorphism or Caste system
3. Elaborate Nest
4. Cohesiveness of Colony
5. Parental care
6. Progressive provisioning of food
7. Trophallaxis
8. Protective devices
9. Swarming
10. Communication

Social life in *Apis* (Honey Bee)

- *Apis* (Honey bee) of Class - Insecta, Order - Hymenoptera, is a social insect living in colonies of 35,000 to 50,000 or more individuals of the same species in an integrated manner.
- The honey bees live in a highly organized colony wherein a perfect corporate life under strict discipline is exhibited.
- Excellent division of labour with the common aim of keeping the good of the society in view, makes the life very harmonious and extremely busy.
- The colonies of honey bees are perennial and show **polymorphism**.

- A good colony of bees has about fifty thousand individuals consisting mainly of three **castes** :
 - Queen or fertile female
 - Drones or fertile male and
 - Workers or sterile females



Castes of Honey Bee

Queen –

- The queen is the only fertile female in a colony or hive, having immensely developed ovaries, shorter mouth parts and sting.
- She is elongated, 15-20 mm long and is easily distinguished by her longer, tapering abdomen, short legs and wings.
- The queen arises from a fertilized egg and larva specially fed on royal jelly.
- She alone lays about 1,000 or more eggs per day and up to about 15,00,000 eggs during her life time of about five years.
- She is the mother of almost all the members of the hive.

Drones –

- These develop parthenogenetically from the unfertilized eggs laid by the queen.
- There are usually 200 drones in a typical colony, about 10%, depending upon the season of the year.
- They are intermediate in size, 15-17 mm long, but considerably stouter and broader.
- They possess very large compound eyes, small mandibles and lack wax producing glands, pollen-collecting apparatus and sting.
- They exist only to mate with the queen of their own hive or some other colony.
- If not fed by the workers, they will die.
- They live for about 5 weeks only.

Workers –

- Workers are diploid, sterile females.
- Their number in a colony exceeds 90% of the total population.
- The body of a worker bee is densely covered with bristles having lateral barbs.
- Un-branched bristles are found on compound eyes and legs.
- It is the smallest member of the colony. It is about 12-15 mm in size.
- They live for only 4-6 weeks and perform almost all functions.
- They have chewing and lapping type of mouth parts, modified for collecting nectar and pollen.
- All the three pairs of legs are densely covered with bristles and variously modified to collect pollen.

- The modifications of the legs are as follows:
 - (i) Each prothoracic leg bears eye brush, antenna comb and pollen brush.
 - (ii) Each mesothoracic leg bears spur for removing wax and pollen brush.
 - (iii) Each metathoracic leg bears pollen basket, wax pincher, pollen brush and pollen comb.
- Wax glands are present on the ventral surface of the last four abdominal segments. The wax is secreted in the form of scales and is masticated by the mandibles, before it is used for building the cells of the combs.
- The ovipositor is modified to form a **sting**, which can be used only once for its protection and defense.

Functions of Worker Bees:

The worker bees are sterile or neuter females arising from fertile eggs laid by the queen, the larvae are fed bee bread.

Their functions are as follows:

- They are incapable of sexual reproduction. Occasionally, in certain varieties, a worker may lay eggs normally producing drones and very exceptionally producing new workers or even queen.
- The industrious workers look after all the duties, indoor as well as outdoor, of the hive.
- The outdoor workers, the **foragers**, bring loads of nectar, pollen, gum and water, which are received and stored properly by the house bees.

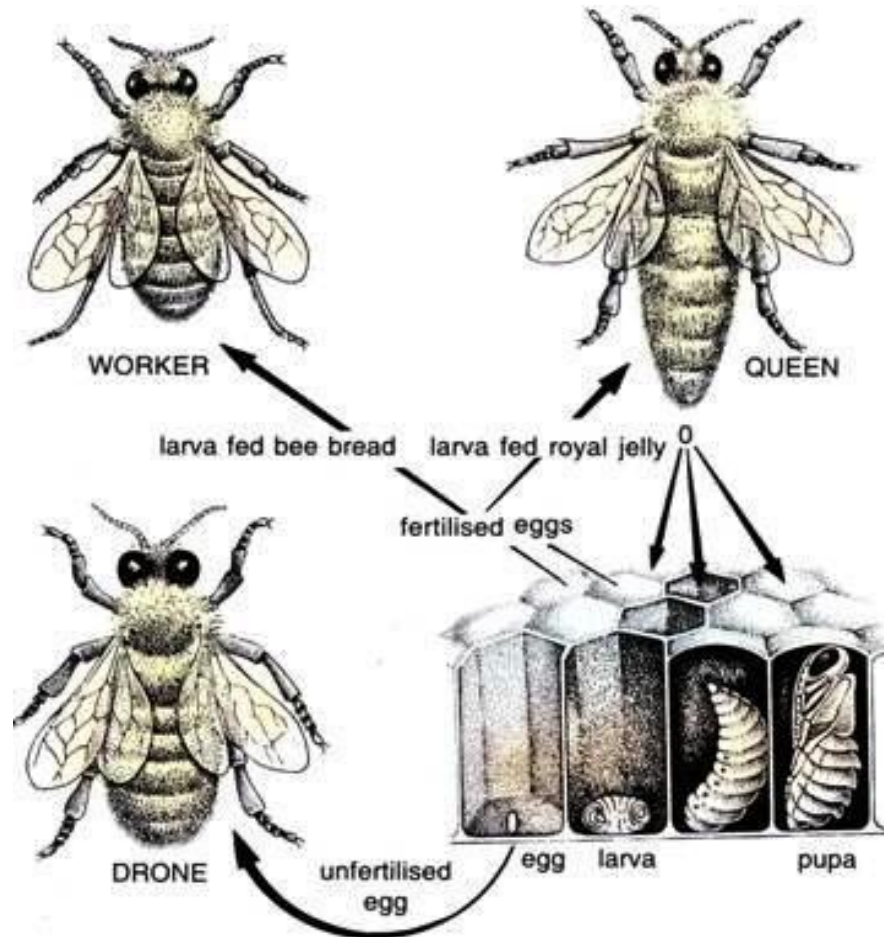
- Among the **indoor workers** some attend the queen and feed her, while others look after the nurseries feeding the young ones.
- The **builders** manufacture wax and build new combs.
- The **repairers** cover up small crevices in the hive.
- The **cleaners** remove the dead bodies and other wastes materials.
- Rows of **fanners** stand motionless except beating the wings to ventilate the comb.
- There are **honey brewers** and **store keepers**.
- There are **guard bees** watching at the gateway of the well-ordered city. Intruders, such as slug, too big to carry out , are covered by wax.

Caste Determination-

- In honey bees **caste determination** depends on genetics and nutrition.
- Males are haploid and develop parthenogenetically from unfertilized eggs. Their larvae are fed bee bread only.
- Queen and Workers are diploid females.
- The larvae which are fed on royal jelly only, develop into Queens
- Those fed on bee bread develop into Workers.

Life cycle –

The life cycle of honey bees has complete metamorphosis, having four stages in their life- egg, larva, pupa and adult.



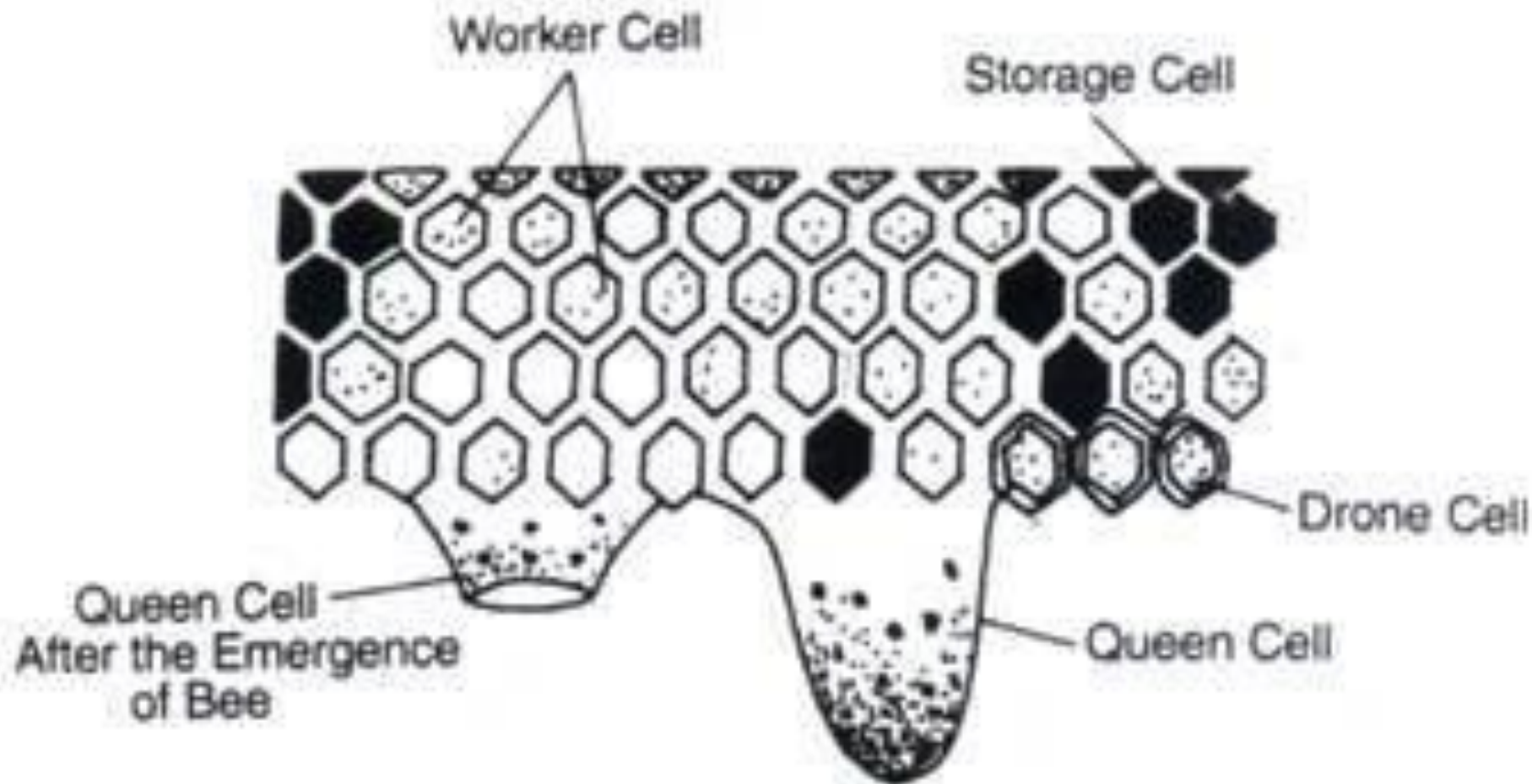
Life Cycle Of Honey Bees

Other Characteristics –

- All the members of the colony live in an **integrated or cohesive manner**, subordinated to the life of the community.
- They work in **cooperation** and with mutual benefits.
- Different castes are bound together by **chemical and physiological mechanisms**.
- **Parental care** is instinctive behavior and provides greater association.
- Honey bees **feed** their young extensively and continuously until they metamorphose into adults.
- Bees feed one another from mouth to mouth (**Trophallaxis**).
- Worker bees have **sting** at the posterior end of their abdomen for their protection.

Bee Hive –

- The honey bees live in hives, made of combs, prepared by the workers with the help of the wax secreted by them.
- Resin and gum from plants is also used for repair of the hive.
- Each hive is made of a number of combs generally remaining parallel to each other.
- Each comb has thousands of hexagonal cells arranged in two sets opposite to each other on a common base.
- The cells are thin walled and so arranged that each side-wall serves for two adjacent cells and each cell-base for two opposite cells.
- There are different types of cells in the comb –
 - (i) The Worker cells, where the workers are reared and honey is stored, are about 5mm across.



A portion of Bee Hive

(ii) The Drone cells 6mm across, serve to rear drones and for storage.

(iii) The Queen cells are built along the lower comb margins for queen rearing. These are large , vertical, peanut-like and open below.

- The combs keep a vertical plane, while the cells a horizontal position.
- There are no special cell for the adults which generally keep clustering or moving about on the surface of the comb.
- The cells are mainly intended for storage of honey and pollen specially in the upper portion of the comb.
- Those on the lower part are for brood rearing.

Swarming or Nuptial Flight –

- The behavior of the honey bee to come out of the hive in large numbers is called swarming. It occurs for feeding, migration and mating.
- It takes place during the spring or early summer (May to July).
- With plenty of food available, the population of a hive reaches its highest strength during summer.
- Swarming , therefore, relieves the overcrowding and also provides a means of propagation of colony , i.e., founding new colonies.
- In preparation to a swarm, large numbers of queen and drone cells are constructed.
- Then on one fine forenoon, the old queen leaves the hive to establish a new colony , accompanied by a large number of older workers, about 20,000 and a few drones to a new location previously selected by the scout workers.

- Young workers and several new queens, still in their cells , but approaching the time of emergence, are left in the hive.
- The first one to hatch usually becomes the queen of the parent colony.
- The new queen utters a piping sound and stings to death her other sisters, which emerge or are about to emerge.
- There is only one queen in the colony.
- The **prime swarm** is led by the old queen while the **second swarm** is accompanied by the newly emerged virgin queen.
- About a week after emergence, the new queen takes her first aerial flight followed by a swarm of drones.

- Mating occurs in mid-air , during which the queen receives the spermatophores from a drone.
- The sperms are stored in her spermatheca and fertilize her eggs as long as she lives.
- The genital parts of the male are forced out with such great pressure that he dies after mating.
- The queen returns to the hive and starts laying eggs at once.
- She lays fertilized or unfertilized eggs.
- She remains in the hive until she grows old and leads a prime swarm.

Communication and Bee Language –

- Honey bees utilize **chemical, tactile, visual and auditory signals** as methods of communication with each other.
- Honey bee **Pheromones** provide the ‘glue’ that holds the colony together.
- The Queen bee pheromones, the **Queen substance**, produced by the queen’s mandibular glands, lets the entire colony know her presence.
- The queen pheromones act as a sex attractant for the drones and also regulate the drone population in the hive.

- It stimulates many worker bee activities, such as comb building, brood rearing, foraging and food storage.
- In case of sudden death of the queen bee, the worker bees become at once aware of the lack of queen substance and they start rearing a new queen.
- The worker bees at the hive's entrance produce pheromones that help guide the foraging bees back to their hive.
- Worker bees produce alarm pheromones that can trigger sudden and decisive aggression from the colony.
- The colony's developing bee larvae and the pupae secrete special pheromones that help worker bees recognize the brood's gender, stage of development and feeding needs.

- The most famous and fascinating ‘language’ of the honey bee is communicated through a series of **dances** done by foraging worker bees who return to the hive with news of nectar, pollen or water.
- Brilliant Austrian Zoologist, Karl von Frisch, studied these rhythmic movements or dances and was awarded Nobel Prize in 1973.
- This unique form of communication allows forager bees to share information on the location, distance and direction of food sources with nest-mates that are readily understood by them.
- Two types of dance are performed:
 - (i) Round Dance
 - (ii) Tail Wagging Dance

- **Round Dance** communicates that the food source is near the hive, within about 10 to 80 meters. The informant bee performs round dance, turning in a circle, once to left, then to right and repeating it for about one-half minute in one place.

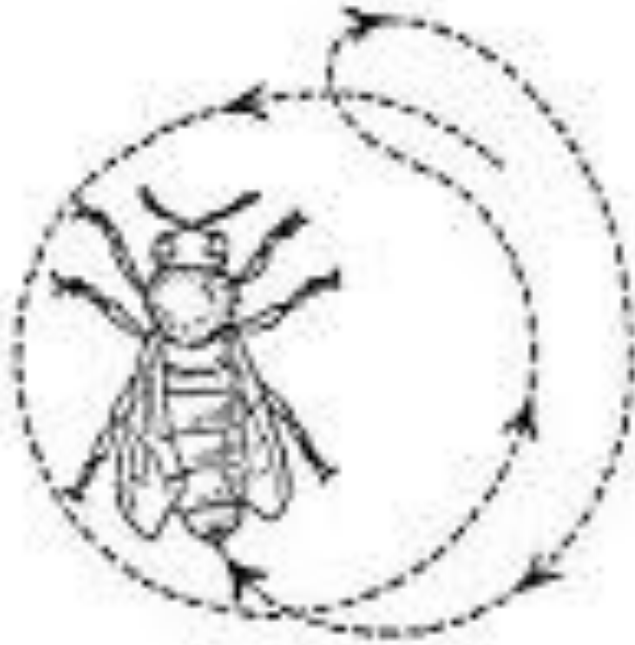


Figure 1.
Round dance

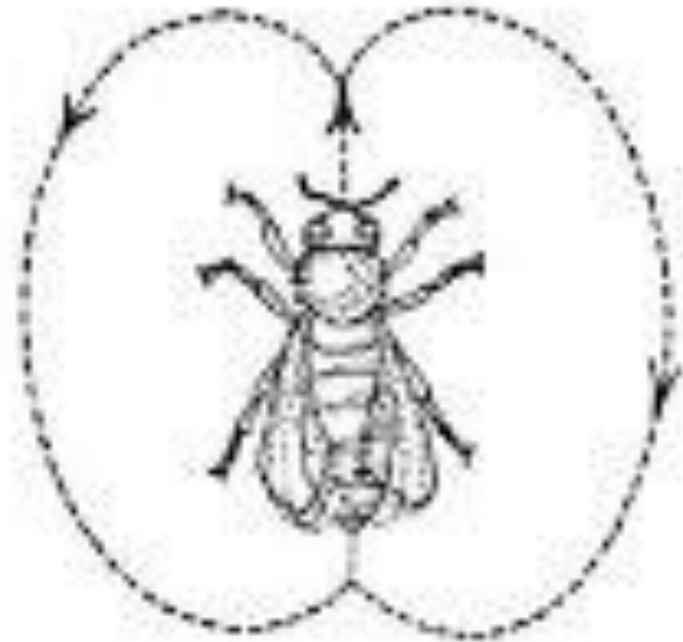
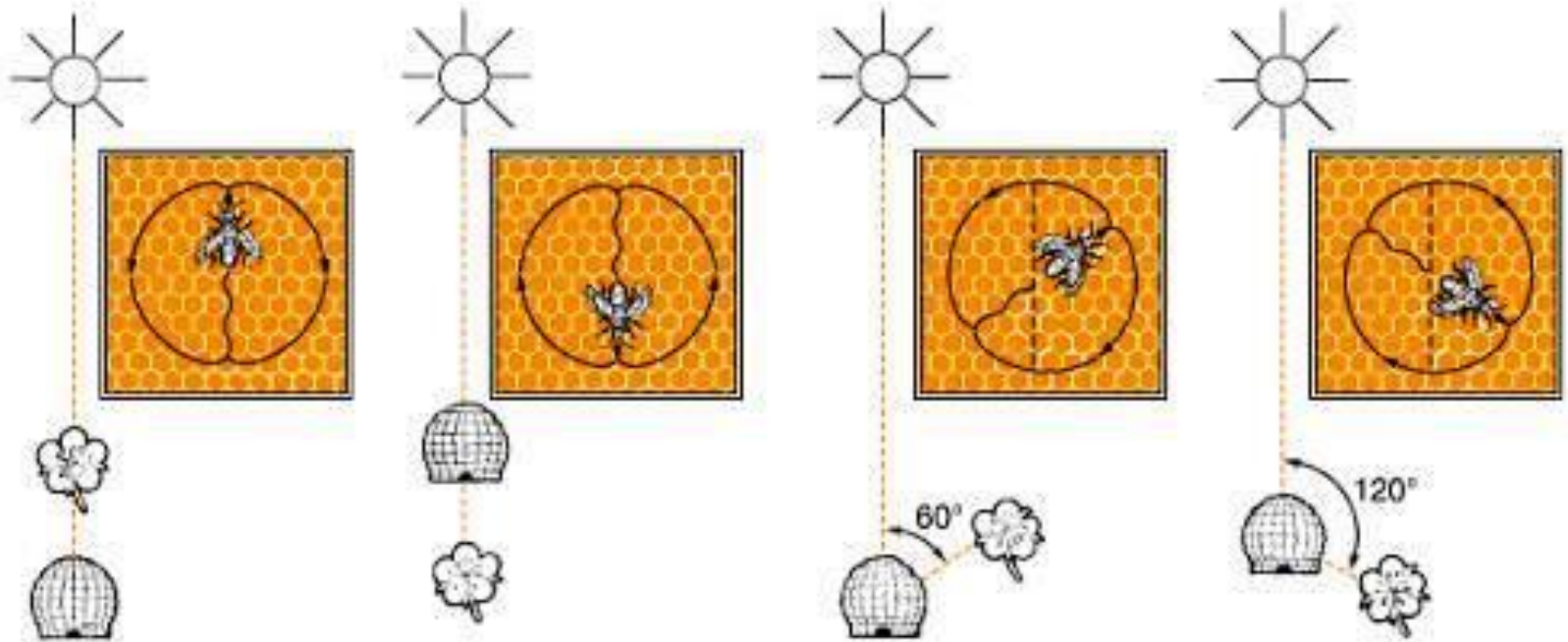


Figure 2.
Waggle dance

- **Tail Wagging Dance** is performed by the informant when the source of food is further away. It runs straight ahead for a short distance wagging the abdomen side-to-side, takes a 360 degree turn towards left, runs ahead once again and turns right.
- This is repeated over and over, the dancing bee forms a figure of 8 (eight).
- In the wag-tail dance, the length of the straight run varies with the distance of food from the hive, hence the number of straight runs per minute also varies. For example, if the source of food is 300 meters away the worker makes 28 runs per minute, but when 3000 meters away, only 9 runs.
- The direction of the food is indicated by the angle of the straight run with the vertical axis of the comb.

- Running vertically upwards means that the food is in the direction of the run. Running vertically down the comb means that the food is in opposite direction.

The language of bees



The bee runs up to tell other workers to fly toward the sun. It runs down to tell them to fly away from the sun. The number of runs in a given time indicates distance.

The angle at which it runs gives the angle of the food source relative to the hive and the sun. The drawings do not show that the scout is surrounded by workers that follow its movements.

- If the straight run is at an angle, the source of food is at the corresponding angle.
- As it is dark in the hive, the other workers touch the dancer with their antennae to determine the direction of its run.
- The dancer also regurgitates a drop of nectar which, together with the scent, indicates the kinds of flowers it has visited.
- These dances are closely watched by other bees in the hive, who immediately go out and discover the source of food.
- The language of bees represent a most revealing method of communication known among the insects.