BEEKEEPING-Level-I

Learning Guide-08

Unit of Competence: Identify the Biology of Honeybee

Module Title: Identifying the Biology of Honeybee

LO 1: Identifying species and races of honey bee.

Learning Guide-08

Unit of Competence: Identify the Biology of Honeybee

Module Title: Identifying the Biology of Honeybee

LG Code: AGR BKGIM08 LO1-LG-02 TTLM Code: AGR BKGIM08TTLM 0819v1

LO 1: Identifying species and races of honey bee.

Instruction Sheet-1	Learning Guide #1

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- **Describing the history, advantages and *species of honey bees*.**
- **Describing Races *of honey bees.***

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

- **Described History, advantages and *species of honey bees***
- ***Races of honey bees* are described.**

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 2
3. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the "Self-check 1" in page 5.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to "Information Sheet 2". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Submit your accomplished Self-check. This will form part of your training portfolio.
8. Read the information written in the "Information Sheet 2". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
9. Accomplish the "Self-check 2" in page **10.**
10. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).
11. Finished answering the Self-check 2).

formation Sheet-1	Describing the history, advantages and *species of honey.*

1.1. Describing the history, advantages and *species of honey bees* and the

The history of honey bees (or honeybees) and humans is a very old one. Honey bees **Apis mellifera**) are an insect that has not exactly been domesticated: but humans have learned how to manage them, by providing them with hives so we can more easily steal the honey and wax from them. . Plants pollinated by insects are called "**entomophilous,"** and insects are generally the most important pollinators. The history of the bee. These range from the giant leaf eating bee, which is over 3cm long to the tiny dwarf bee which is just 2mm long. The honeybee is just one of these species. Most other bees do not live in colonies preferring a more solitary existence. Bumblebees for example live in burrows in the ground.

The honey bee (Apis mellifera) is an insect species which lives in colonies usually consisting of one queen, thousands of workers and a variable number of drones. New colonies are produced by swarming. The colony lives in a nest which in nature is usually located inside a hollow tree. The nest, or hive, is a series of vertical, two sided wax combs made up of hexagonal cells. The cells hold developing larvea, honey, pollen and/or bee bread which is a mixture.

The main food of honey bees is pollen and nectar collected from flowers. Honey bees are native to Africa, Europe (except northern part) and Near East. They were introduced to Asia, both American continents and Australia. Domesticated honey bees are kept in hives. They are important economically as pollinators of crops and producers of honey.

1.1.2. The history of honey bees:- (or honeybees) and humans is a very old one. Honey bees (Apis mellifera) are an insect that has not exactly been domesticated: but humans have learned how to manage them, by providing them with hives so we can more easily steal the honey and wax from them. . Plants pollinated by insects are called "entomophilous," and insects are generally the most important pollinators. The history of the bee. These range from the giant leaf eating bee, which is over 3cm long to the tiny dwarf bee which is just 2mm long. The honeybee is just one of these species. Most other bees do not live in colonies preferring a more solitary existence. Bumblebees for example live in burrows in the groun

1.1.3. The importance of honeybees:- They have nectar guides (patterns to direct the bee towards the nectar) and often a landing place for bees. Bees are especially attracted to white, blue and yellow flowers

Apart from the importance of honeybees as the basis of Agriculture in the pollination of seed, fruit, Vegetable and legume crops, they are also of immense importance to the beekeepers in production of honey, beeswax, pollen, royal jelly, propolis and bee venom. What ever found in the hive, which have direct or indirect contact with bees are called hive products.

Natural products carried into the hive by honeybees and subsequently processed within the hive are: nectar, honeydew, pollen, propolis and water. Some of them have potential economic value to farmers and others.

Another hive product, which are manufactured by bees within the hive, are: beeswax, royal jelly, bee venom and brood (bees). All of them have potential value in bringing economic return to the owners and they have very essential role in human medicine, human diet and in economy building.

Pollinators strongly influence ecological relationships, ecosystem conservation and stability, genetic variation in the plant community, floral diversity, specialization and evolution. Bees play an important, but little recognized role in most terrestrial ecosystems where there is green vegetation cover for at least 3 to 4 months each year. In tropical forests, savannah woodlands, mangrove, and in temperate deciduous forests, many species of plants and animals would not survive if bees were missing. This is because the production of seeds, nuts, berries and fruits are highly dependent on insect pollination, and among the pollinating insects, bees are the major pollinators. In rain forests, especially in high mountain forests where it is too cold for most bees, other pollinators like bats and birds play a greater role in plant pollination. In farmed areas, bees are needed for the pollination of many cultivated And for maintaining biodiversity in 'islands' of non-cultivated areas. The main role of bees in the different ecosystems is their pollination work. Other animal species are connected with bees: either because they eat the brood or honey, pollen or wax, because they are parasitic to the bees, or simply because they live within the bees nest.

What is pollination? Pollination is transfer of pollen from the anther (the male part of the flower) to the stigma (the female part of the flower). Some plants can pollinate themselves: in this case, the pollen passes from the anther to the stigma inside the same flower, and this is called self-pollination. Other plants need pollen to be transferred between different flowers or different individuals of the plant. This is cross-pollination. Many plants can be pollinated both ways. Plants can be pollinated by wind or animals. Some plants have only one method for pollination, others use a combination. The

1.1.4. Honey species" Bees (Apoidae) :- are a super family of about 20,000species in the order of Hymenoptera; other super families in this order include the ants and the wasps. The majority of bee species are solitary, not social i.e. there is no worker caste, and each female makes her own nest and lays her eggs in it; she does not live there and no males do so. But minorities of bee species are social, also so many hundreds of species of wasps and all 12,000 or more species of ants. So are the species of termites, the only social insects outside the Hymenoptera. The term social means that the individual insect lives out its life in a social community, referred to as colony. One characteristics of social bees is that workers produce enzymes (and possibly other secretion) that enable them to make honey, and thus to store a food safe from spoilage, for use in dearth periods. A beekeeper manages his colony so that it produces more honey than it needs and he can then harvest the surplus. Bees that produce enough honey to be worth harvesting belong to the two sub-families of the family **Apidae; Apinae** (honeybees) and **Meliponinae** (sting less bees). **Apinae** has only one genus **Apis,** of which **Apis mellifera** is of much greater economic importance.

Self-Check -1	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. What The history of honey bees (3points)
2. Define *Bees (Apoidae)* (2 points)
3. What are the **importance of honeybees** (4 points)
4. Write the what is pollination (2 points)
5. What are the sub-families of the family **Apidae;** .(4 points)

Note: **Satisfactory rating - 3 and 5 points** **Unsatisfactory - below 3 and 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ____________

Rating: _____________

Name: ___________________________ Date: ________________

Short Answer Questions

1.____

2.____

Reference

1. *Crane, E., Walker, P., & Day, R. (1984). Directory of important world honey sources. International Bee Research Association. ISBN 978-0860981411.*
2. ^ Jump up to:[a] [b] *Crane, Ethel Eva (1999). The World History of Beekeeping and Honey Hunting. Routledge. ISBN 9781136746703.*
3. ^ Jump up to:[a] [b] [c] [d] National Honey Board. "Carbohydrates and the Sweetness of Honey"Archived 1 July 2011 at the Wayback Machine. Last accessed 1 June 2012.
4. **^** Oregon State University "What is the relative sweetness of different sugars and sugar substitutes?". Retrieved 1 June 2012.
5. ^ Jump up to:[a] [b] *Geiling, Natasha (22 August 2013). "The Science Behind Honey's Eternal Shelf*

Information sheet-2	Describing the races of the honey bee

2.1. Describing the races of the honey bee

These classified into various named instances of an informal taxonomic rank of race below that of subspecies—on the basis of shared genetic traits. The term "honey bee" means a bee of the species ***Apis mellifera*** which descend from bees that originated in Africa.

Differences in the colors of bees may be more pronounced in **queens** and **drones; workers** are much less easily differentiated by color. Drones are produced from the unfertilized eggs of queens and therefore their genetic characteristics depend entirely on those of the queen, whereas worker bees are produced from **fertilized eggs.**

1. Honeybee species and races

Race: indicates group under the same species with some common distinct features.

There are a few characters, which can be used to distinguish among races:

Size: Differences in size among races may be observed with the naked eye. By measuring certain individual parts of the body (width of thorax and abdominal segments, length of tongue, legs and wings) smaller differences in size can be objectively determined.

Length of tongue: there is extremely a 1.7 mm difference between the tongues of the two extremes in races.

Hair coverage: some races have wide, dense tomenta; others have only narrow and dispersed bands.

Veins of wings: in taxonomy of honeybees veins (blood vessels) of the wings play a big role.

Honey Bee Races

There are several races of honey bee, each having advantages and disadvantages linked to their original regional background. i.e. climate, topography, resources and predators. Because of differences in background, each race of honey bee has evolved in a slightly different manner than their cousins, allowing them to better take advantage of their specific environment. Today the Italian Honey Bee is the most commonly kept honey bee in the United States. Conversely the Africanized Honey Bee is the most feared, and illegal to keep in may regions. Between these two extremes are the many other races and the Feral Honey Bee. Though technically not its own race, it may be acclimated to the area in which it has been found. The following is a partial listing of the races of honey bee that may be available to a prospective beekeeper. Along side is a brief description of each race and some common advantages and disadvantages of each.

2.3.2 Characteristics of Races of Honey Bees Italian

- probably the most common race of honeybees in this area.
-Colonies are usually large and winter well.
-Very good honey producers.
-Usually gentle and non-aggressive.
-Swarming instinct is not especially strong.
-Minimum propolis.
-Keep a clean hive and are quick to get rid of the wax moth.
-Queens lay all through the summer, so a large amount of stores are used for brood rearing.
-Italian bees have a strong tendency to rob.Yellow coloring with bands on the abdomen.

1. ***Caucasian Bees***

- Very gentle bees.
- Do not swarm excessively.
- Brood buildup is later in the spring.
- A good honey producer, not exceptional.
- Caucasians produce and use a good deal of propolis.
- Brown in color.

2. ***Carniolan Bees***

- A very gentle raceofbees.
  Probably the best wintering bees.
- Little use of propolis.
- Builds up very rapidly in the spring.
- Summer brood rearing depends on pollen and nectar flow.
- Usually not inclined to rob.
- These bees tend to swarm more, probably due to rapid spring build up.
  Not as productive as Italians.

3. ***Buck fast Bees***

- Developed by Brother Adam at Buckfast Abbey, Devon, England.
- Very rapid spring build up.
- Very gentle bees.
- Low tendency to swarm.
- Low consumption of winter stores.
- Well adapted to areas with damp cold winters.
- Excellent honey producers.
- Inclined to rob.

4. ***Midnight Bees***

- ❖ Hybrid bee.
- ❖ Very gentle.
- ❖ Developed for hobbyist beekeepers.
- ❖ Not as productive as the Italian or Sterling races.

5. ***Starline Bees***

- ☞ Hybrid bee based on Italian stock.
- ☞ Rapid spring build up.
- ☞ Gentle.
- ☞ Winter well.
- ☞ Good honey producers.

6. ***Russian Bees***

- ❖ Not actually a race but they are actually a hybrid between Italian, Carniolan, Caucasian.
- ❖ Mite resistant.
  Frugal - Winter with small population.
  Explosive growth in Spring.

7. Russian vs Italian Honey Bees

Italian honey bees are susceptible to two deadly parasitic mites, the tracheal mite (Acarapis woodi) and the varroa mite (Varroa destructor), which were introduced into the U.S. in 1984 and 1987, respectively. Colonies contract these mites through equipment sharing and overcrowding, and, once infested, entire colonies can succumb within one or two years. Beekeepers have relied largely on pesticides to control the mites, but many of these chemicals can contaminate the honey and beeswax in a hive. The mites also are becoming increasingly resistant to the pesticides, making the chemicals less reliable and, eventually, ineffective. The high colony mortality that accompanies these two mites is a serious concern of the bee industry today, and various types of bees are continually being examined with an eye toward ?nding a hardy, productive stock that can resist them.

2.2.4. Russian Bee Project

Efforts to find a honey bee that is genetically resistant to the varroa and tracheal mites led researchers at the USDA Honey Bee Research Laboratory in Baton Rouge, Louisiana, to Russia. There, on the far eastern side of that vast nation, in the coastal Primorski region around Vladivostok, they found what they sought?a promising strain of Apis mellifera. These Russian bees had been exposed to varroa mites for approximately 150 years, much longer than other Apis mellifera strains had, and the researchers surmised that the Russian bees could have developed a resistance to the mites. Indeed, subsequent research has shown that these Russian bees are more than twice as resistant to varroa mites than other honey bees. Moreover, they are highly resistant to tracheal mites, the other mortal enemy of bees. Russian bees also tend to produce as much honey as standard bee stocks, if not more.

A number of American queen breeders now produce Russian queens for sale. These breeders are located all across the country, but most are concentrated in the South and in California. Many of the Russian queens on the market are hybrid daughters of a breeder queen openly mated to any drone, which may come from a variety of stocks within two miles of a particular mating yard. The resulting colonies are genetic hybrids. Recent research has suggested the hybrids are only partially resistant to mites, but studies at North Carolina State University show that partial resistance is statistically signi?cant when the hybrids are compared to Italian bees. Production of pure Russian queens can be guaranteed only by truly isolating the breeding grounds, as has been done at the USDA?s bee laboratory on Grand Terre Island, 25 miles off the coast of Louisiana. Here the drone stock is also controlled.

2.2.5. Management of Russian bees

Russian bees are quite different from standard Italian bees in several ways:

Russian bees do not build their colony populations until pollen is available, and they shut down brood rearing when pollen is scarce. This characteristic makes them suitable in areas where the main honey and pollen ?ows occur later in the year, such as the mountains of North Carolina. By contrast, Italian bees maintain a large brood area and worker population regardless of environmental conditions. This trait can result in more bees than the hive can feed and may lead Italian colonies to early winter starvation. It also explains the Italian bee?s tendency to rob other colonies of their honey stores

Russian colonies maintain active queen cells through out the brood-rearing season. In Italian colonies, the presence of queen cells is interpreted by beekeepers as an attempt to swarm (reduce overcrowding by establishing a new colony) or to supersede (kill and replace) the resident queen. This is not the case with Russian colonies, as the workers often destroy the extra queen cells before they fully develop.

Russian bees can vary in color, but they are generally darker than the Italians. Requeening Italian hives with Russian queens can be difficult, and many beekeepers lose their newly introduced Russian queens. Russian queens have a different odor than Italians, and parent colonies must become acclimated to this odor before they will accept the newcomers. Beekeepers who intend to go from Italian to Russian bees should re-queen a colony in the fall by splitting the hive in two with the use of a double screen. This will permit the odors to mix but, at the same time, prevent the workers from interacting with the new queen. The old Italian queen should be kept in the lower half, and the new Russian queen should be placed in the upper half in a cage. If a separate entrance is provided to the upper half, only young nurse bees will enter the top portion, and the older foraging bees will return to the lower hive

Self-Check -2	Written Test

Name: ___________________________ Date: ________________

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

1. Differences in the colors of bees may be more pronounced in drones.(3 points)

a. Produce fertilized egg

C. informal rank Produced

b. Unfertilized egg

D. queen

Note: **Satisfactory rating - 3 and 5 points Unsatisfactory - below 3 and 5 points**

You can ask you teacher for the copy of the correct answers.

Answer Shee

Name: ___________________________ Date: ________________

Short Answer Questions

Score = ___________

Rating: ____________

1.___________________________________

2.____

____

List of the References

Gotoh, T.; Bruin, J.; Sabelis, M. W.; Menken, S. B. J. (1993). "Host race formation in *Tetranychus urticae*: Genetic differentiation, host plant preference, and mate choice in a tomato and a cucumber strain". *Entomologia Experimentalis et Applicata* (Submitted manuscript). **68** (2): 171–178. doi:10.1111/j.1570-7458.1993.tb01700.x.

2. *Crane, E., Walker, P., & Day, R. (1984). Directory of important world honey sources. International Bee Research Association. ISBN 978-0860981411.*
3. ^ Jump up to:[a] [b] *Crane, Ethel Eva (1999). The World History of Beekeeping and Honey Hunting. Routledge. ISBN 9781136746703.*
4. ^ Jump up to:[a] [b] [c] [d] National Honey Board. "Carbohydrates and the Sweetness of Honey"Archived 1 July 2011 at the Wayback Machine. Last accessed 1 June 2012.
5. ^ Oregon State University "What is the relative sweetness of different sugars and sugar substitutes?". Retrieved 1 June 2012.
6. ^ Jump up to:[a] [b] *Geiling, Natasha (22 August 2013). "The Science Behind Honey's Eternal Shelf*

a. ^ Jump up to:[a] [b] [c] *Michael S. Engel (1999). "The taxonomy of recent and fossil honey bees (Hymenoptera: Apidae: Apis)". Journal of Hymenoptera Research. **8**: 165–196.*
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j. ^ Jump up to:[a] [b] [c] [d] [e] *Maria C. Arias; Walter S. Sheppard (2005). "Phylogenetic relationships of honey bees (Hymenoptera:Apinae:Apini) inferred from nuclear and mitochondrial DNA sequence data". Molecular Phylogenetics and Evolution. **37** (1): 25–35. doi:10.1016/j.ympev.2005.02.017. PMID 16182149.*
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BEEKEEPING
Level-I
Learning Guide-8

Unit of Competence: Identify the Biology of Honeybee
Module Title: Identifying the Biology of Honeybee
LG Code: AGR BKGIM08 LO2-LG-01
TTLM Code: AGRBKGIM08TTLM 0819v1

LO 2: Identifying the development stage of honey

Instruction Sheet -1	Learning Guide # 2

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- **Discussing The development stages of honey bees**

- **Discussing Life cycle of queen**
- **Discussing Life cycle of worker bee**
- **Discussing Life cycle of drone bee**

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to:

- **Discuss The development stages of honey bees**
- **Discuss Life cycle of queen**
- **Discuss Life cycle of worker bee**
- **Discuss Life cycle of drone bee**

Learning Instructions:

12. Read the specific objectives of this Learning Guide.
13. Follow the instructions described in number.14 to 15
14. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
15. Accomplish the "Self-check 1" in page 19.
16. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
17. If you earned a satisfactory evaluation proceed to "Information Sheet 1". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
18. Submit your accomplished Self-check. This will form part of your training portfolio.
19. Read the information written in the "Information Sheet 2". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
20. Accomplish the "Self-check 2" in page 22.
21. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).
22. Read the information written in the "Information Sheets 3. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
23. Accomplish the "Self-check 3" in page 24.
24. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 3).
25. If you earned a satisfactory evaluation proceed to "Operation Sheet 1" in page 20. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #2.
26. Read the "Operation Sheet 1" and try to understand the procedures discussed.
27. 13. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity 3

28. Do the "LAP test" in page 21 (if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work.
29. Read the information written in the "Information Sheets 4. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
30. Accomplish the "Self-check 3" in page 29.
31. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 4).

Information Sheet-1	**Discussing** the development stages of honey bees

2.1. Discussing **the development stages of honey bees**

The development of the honeybee follows a pattern of growth and metamorphosis that is typical of many other insects. The life cycle of the honeybee begins when a queen deposits a single egg near the centre of the bottom of a wax cell.

1. **Egg stage**: The egg laid by honeybees are small measuring 1.3-1.8mm length and weighing 0.12-0.22mg, pearly white in colour and cylindrical and oval in shape. When honeybee first lays an egg, she glues it to the floor of the cell at one end so that it appears to

be standing in the bottom of the cell. In approximately three days before hatching the egg gradually sags until it finally rests on cell floor.

The queen honeybee lays two types of eggs:

- Fertilized egg.
- Unfertilized eggs.

1. **Fertilized egg**. Consists of egg cell and sperm cell and develops into female castes i.e. worker and queen.

2. Unfertilized eggs. Consists of only egg cell and develops into male caste (drone) by the process of **parthenogenesis.** Parthenogenesis is the process or mechanism of reproduction without the intervention of male.Egg stays as egg for three days, then after it develops into larvae.

2. **Larvae stage**: The larvae of honeybee is a whitish, worm like grub with no legs, eyes, antennae, wing, sting but it possesses simple mouth which need only lap up the copious quantities of food placed in the larval containing cell. It is also equipped with huge internal digestive system.

Bee larvae are essentially feeding machine designed for rapid growth.

There are two types of brood food:

1. **Royal jelly (bee milk) :-**
2. **Substituted food:-**

1. Royal jelly is whitish jelly like substance secreted by nurse bees from their hypo pharyngeal glands Larvae of all castes used to feed the bee milk for three successive days but the larvae which is going to develop into queen continuously feeds on royal jelly.

2. Substituted food is a mixture of pollen, nectar, honey and water. This type of larval food is fed to larvae, which develops into **worker** and **drone** ageing beyond three days old.

Developing larvae undergo six moults during which the outer exoskeleton is shed; five of these moulting takes place during the larval stage and the last occurs when the bee emerges as an adult.

The first four larval stages occur approximately once I a day at early stages. The last larval stage is referred to as pre-pupal stage.

3. pre-pupal stage:-

Begins to take on the appearance of adult bees. The wings, however, appear as small pads attached to the thorax.

All honeybee larvae should have a full-bodied, firm appearance, with distinct segmentation. A healthy bee larva is always pearly **white** and moist in appearance although it is dry to touch. Good queens lay eggs in concentric bands usually starting from the canter of a frame. Very few cells should be left vacant and ideally, all of the larvae in each band should be of similar age. When queen and worker larvae are approximately eight days old and drone larvae ten days old, worker bees seal their cells with wax capping.

4. **Pupae stage:-**

The pupal stage is the last stage (period) before the final stage to adult. It is known as sealed brood stage. All adult bee characteristics are shown.

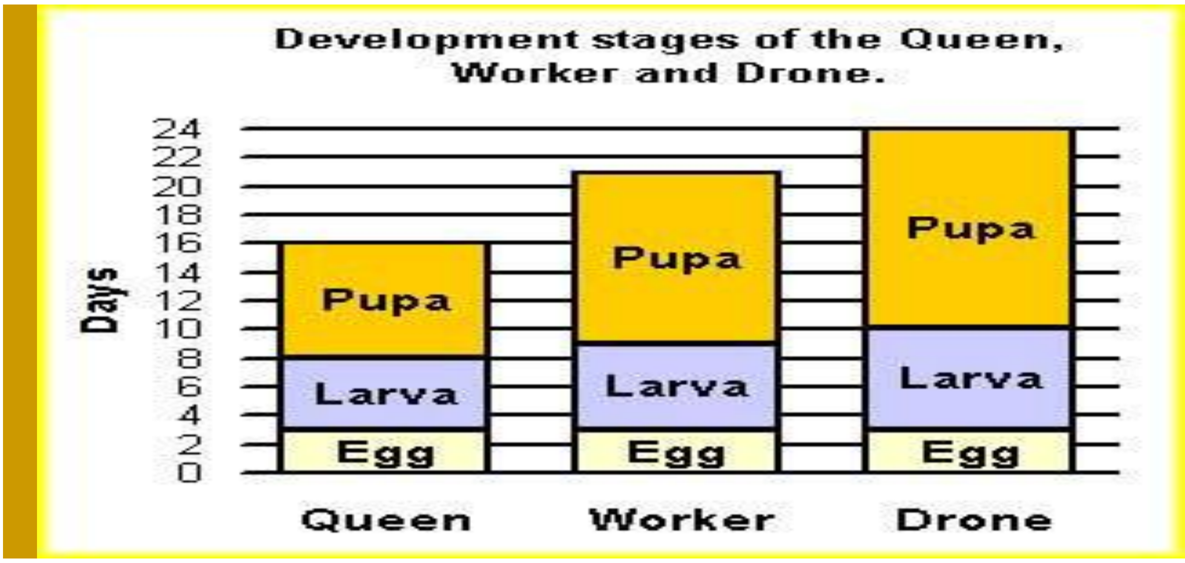
These characteristics are appearance of **head, thorax, abdomen wings, legs and other bee organelles**. The pupae do not grow or change in shape but internally the muscles and organ system undergo massive changes into their adult form. Only the wings are still small and underdeveloped. As pupae develop the cuticles gradually become darker and these well defined colour changes can be used to determine pupal stages.

5. **Adult: -** The adult bee gets out of the cell by chewing the wax capping.

6. Unfertilized eggs.

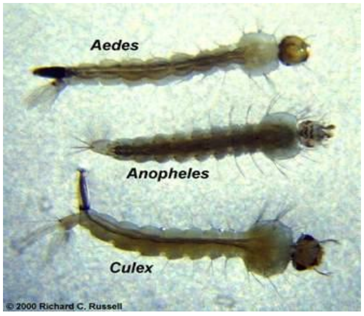
- ☞ Sealed cells of the three castes have their own unique appearances.
- ☞ Worker cells are the smallest of the three, with their wax capping slightly domed and almost level with the surface of the comb. Individual sealed cells range from light tan to dark brown in colour, depending on the age of the comb, and are dry in appearance. Unfertilized eggs.
- ☞ **Drone cells** are wider and deeper than worker cells. Their cappings are **"bullet"** shaped and protrude noticeably from the face of the comb. Drone cells should appear in groupings not scattered individually over the face of the comb. Once capped, all cells should remain sealed with no small evident until the young adults begin chewing their way out.
- ☞ **Queen cells** are distinct from the other two types because they hang downward from the bottom or face of the comb and when sealed are peanut-like in both colour and texture with slightly convex capping. In a normal supersedure situation the workers will build a few queen cells. If many queen cells appear, particularly at the bottom of the combs, the colony is probably preparing to swarm.
- ☞ The total developmental time for the

- ❖ Queen is 16 days,
- ❖ Workers 21 days
- ❖ Drones 24 days from the time the queen lays the egg until the work bee is born three days for the laying egg the egg haches in to the larvae and is feed royal jelly produced from the gland in the adult bees stop feeding royal jelly in to the young worker or drone larvae and change the diet to brood food
- ❖ This consist of diluted honey or nectar and pollen , young chosen queen larvae will their diet of royal jelly until they born.
- ❖ As the larva moves to the pupa stage, brown wax cap is placed on the cel and metamorphous takes place, the same process the transformer a caterpillar in to the butterfly. the larvae will Spain the cocoon around its self and has properties similar



- **The duration of developmental time varies depending on Environment factors**
- Environmental factors:-
- Genetic factors:-
- Temperature
- Nutrition.
- Temperature lower than the normal brood nest temperature of 35 at any stage can delay the emergence for up to five days and under feeding of larvae also will delay development.
- Brood development at the periphery of colonies takes longer to develop than centrally located brood because of problems in maintaining constant temperature and humidity at these locations.

In a normal colony during the active season when honey and nectar are available, all brood stages (**eggs, larvae, preppie** and **pupae**) should be present. To remain



Healthy and productive a honeybee colony must always have adequate reserves of both honey and pollen. If not, it will reduce or curtail its activities and may cannibalize its brood or even die.

The newly emerged adult bee is at first lighter in color than older bees and its hairy covering is usually quite apparent. As the adult bee ages it gradually loses much of this hair, exposing more of the underlying shiny cuticle. I

Self-Check –1	Written Test

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: ______________

Directions: Attempt the following questions after you read information sheet 3 carefully.

1. What does'` mean the development stage of bees (3 points)
2. Write the total development of queen worker and drone (4pts)
3. Mention at the five stages of developing bees (2pts)
4. What are the important personal protective equipments in Artificial insemination work? (3pts)
5. Did you believe that varies environmental factors of developmental stages Why?(2pts)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Short Answer Questions

Operation sheet-1	**Identifies the development stage of honey bee**

A. Identify egg laid by honeybees are small measuring requirement

1. Identify the development stage
2. Arrange your program schedule
3. Depend on the development stage describe the adult and select the workers , , drone and queens
4. By using selection criteria select the queens
5. Observe how stage and the development stage are required
6. Operate members of staff requirement 3 manpower and facilitate

B. Preparation of development stage program schedule

LAP Test	Practical Demonstration

Name: _____________________________ Date: ________________

Time started: __________________________ Time finished: _________________

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 8-12 hours.

Task 1: Identify the life cycle of bees program

Task 2: Prepare your resource material for the program

Task 3: define Arrange training and application facilities such as measuring 1.3-1.8mm length and weighing 0.12-0.22mg,

Task -4 Select or prepare eggs to know the stages of the egg laid by the honey bees

Task -5 discuss Prepare eggs; she glues to identify the shape and size of egg

Task -6 Identify of staff requirement

Information Sheet-2	*Discussing the life cycle of queen*

2.2. DISCUS THE LIFE CYCLE OF QUEEN:-

Queen: - The queen bee has a very important function within the colony, and has the longest life span by far. While the average life span of a queen bee is two to five years, queen bees have been known to live up to seven years, although this is rare. About a week after a new queen emerges from her cell, she goes on several flights in order to mate with as many as 20 drones. After the queen bee returns to lay her eggs, she will rarely leave the colony. Thereafter, the queen bee lays between 1,000 and 2,000 eggs a day inside the hive (she has enough sperm stored in her sperm pouch to enable her to fertilize her eggs for the rest of her life). If the queen bee fertilizes the egg, that egg will become female – a worker bee or a queen bee. However, if the queen bee does not fertilize the egg, it will become a male drone bee.

The queen's survival in the difficult winter months depends largely on how viable her colony is. A strong group of worker bees protects the queen and regulates her temperature.

Self-Check- 2	Written Test

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: _______________

Directions: Attempt the following questions after you read information sheet carefully.

1. Discuss the deity of queen?
2. **Define queen?**

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: ___________________________ Date: ________________

Short Answer Questions

1. ____
2. ____

Information Sheet-3	Discussing the life cycle of worker bee

3.1. Discussing the life cycle of worker bee

Worker's:- The first part of a worker's life is spent

- Working within the hive, while the last part is spent finding food and gathering pollen or nectar.
- Worker bees also gather water to use to cool the inside of the nest on hot days, and use water to dilute the honey before feeding it to the larvae.
- It is worker bees who are responsible for pollination: When they land on plants or flowers, they collect pollen dust all over their bodies, and then use their specially adapted legs to discard the pollen, leaving it on other plants.
- **During summer, worker bees only live for five to six weeks, purely because their heavy workload often gets the better of them.**

This is their most active time of the year, when they spend their days foraging for food, storing nectar, feeding larvae and producing honey. Worker bees live longer in winter – five months or more – because their fat supplies increase and their well-developed glands provide food for larvae.The worker bees keep a close eye on the queen bee to make sure she is up to her job. If she doesn't lay enough eggs, the workers will start developing a new queen to replace the old one, a process known as **supersedure**. The new queen is pampered with food and affection, while the old queen is neglected and left to waste away. In some beekeeping practices, the beekeeper replaces the queen after one or two years.

Self-Check- 3	Written Test

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: _______________

Directions: Attempt the following questions after you read information sheet carefully.

1. _______________**The first part of a worker's life is spent working within the hive?** (5 points)

A. Lay egg

C. workers

B. Drone

D. queen

3. What are the Factors Affecting development stage of honey bee?

4. Define WHY bees during summer, only live for five to six weeks?

***Note:* Satisfactory rating - 3 points Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: ___________________________ Date: ________________

Short Answer Questions

Information Sheet-4	The Life cycle of drone bee:

4.1 The **Life cycle of drone bee: -**

1. Drone bees are male **bees** whose primary job in the colony is to mate with the **queen bee**. They are larger than **worker bees**, with bigger eyes and a thicker abdomen. **Drone bees** do not have stingers.

Drones Adult drones have no useful purpose within the bee hive. They don't provide food, feed the young or produce wax. In fact, they waste the colony's resources and only serve one purpose: To mate with the queen bee. Drone bees first leave the hive six days after emerging from the pupal cell, flying to areas known for drone congregation and going back to the hive only when they have failed to mate. Successful maters die minutes or hours after mating with the queen, and the rest of the drone bees survive only as long as the worker bees allow them to. If there is a shortage of food, the worker bees kill or kick out the drones. Drone bees rarely survive the winter, as the worker bees want to protect their limited resources. When a drone bee is ejected from the hive, he soon dies from cold or starvation. The average life span of a drone bee is eight weeks.

Fig.2.4.1 workers, queen, dome

5. **The drones' main function** is to be ready to fertilize a receptive queen. Drones in a hive do not usually mate with a virgin queen of the same hive because the queen flies further to a drone congregation area than the drones do. Mating generally takes place in or near drone congregation areas. How these areas are selected is poorly understood, but they do exist. When a drone mates with a queen of the same hive, the resultant queen will have a spotty brood pattern (numerous empty cells on a brood frame) due to the removal of diploid drone larvae by nurse bees (i.e., a fertilized egg with two identical sex genes will develop into a drone instead of a worker). The worker bees remove the inbred brood and consume it to recycle the protein.

6. IN FLIGHT MATING

Mating occurs in flight, which accounts for drones needing better vision, which is provided by their large eyes. Should a drone succeed in mating, the first thing that happens is all of the drone's blood in his body rushes to his **endophallus** which causes him to lose control over his entire body. His body falls away, leaving a portion of his endophallus attached to the queen which helps guide the next drone in the queen.

Honey bee queen breeders may breed drones to be used for artificial insemination or open mating. A queen mating yard must have many drones to be successful.

In areas with severe winters, all drones are driven out of the hive in the autumn. A colony begins to rear drones in spring and drone population reaches its peak coinciding with the swarm season in late spring and early summer. The life expectancy of a drone is about 90 days.

Although the drone is highly specialized to perform one function, mating and continuing the propagation of the hive, it is not completely without side benefit to it. All bees, when they sense the hive's temperature deviating from proper limits, either generate heat by shivering, or exhaust heat by moving air with their wings—behaviours which drones share with worker bees.

Drones do not exhibit typical worker bee behaviours such as nectar and pollen gathering, nursing, or hive construction. While drones are unable to sting, if picked up, they may swing their tails in an attempt to frighten the disturber.[2] In some species, drones buzz around intruders in an attempt to disorient them if the nest is disturbed.

Drones fly in abundance in the early afternoon and are known to congregate in drone congregation areas a good distance away from the hive.

7. Behavior mating behavior the drone reproductive organ

The everted endophallus, with the cornua in focus, resembling hooks.The extended **bulbu**s of the **endophallus,** containing sperm, is in focus.The drone endophallus is designed to disperse a large quantity of seminal fluid and spermatozoa with great speed and force. The endophallus is held internally in the drone. During mating, the organ is everted (turned inside out), into the queen. The eversion of the endophallus is achieved by contracting abdominal muscles, which increases hemolymph pressure, effectively "inflating" the endophallus. Cornua claspers at the base of the endophallus help to grip the queen.

Mating between a single drone and the queen lasts less than 5 seconds, and it is often completed within 1–2 seconds. Mating occurs mid-flight, and 10–40 m above ground. Since the queen mates with 5–19 drones, and drones die after mating, each drone must make the most of his single shot. The drone makes first contact from above the queen, his thorax above her abdomen, straddling her. He then grasps her with all six legs, and everts the endophallus into her opened sting chamber. If the queen's sting chamber is not fully opened, mating is unsuccessful, so some males that mount the queen do not transfer semen. Once the endophallus has been everted, the drone is paralyzed, flipping backwards as he ejaculates. The process of ejaculation is explosive—semen is blasted through the queen's sting chamber and into the oviduct. The process is sometimes audible to the human ear, akin to a "popping" sound. The ejaculation is so powerful that it ruptures the endophallus, disconnecting the drone from the queen. The bulb of the endophallus is broken off inside of the queen during mating—so drones mate only once, and die shortly after. The leftover endophallus remaining in the queen's vagina is referred to as the "mating sign". The plug will not prevent the next drone from mating with the same queen, but may prevent semen from flowing out of the vagina.[3]

8. DRONE CONGREGATION AREAS

Mating between the drones and a virgin queen takes place away from the colony, in mid-air mating sites. These mating sites, called '**congregation areas'**, are specific locations, where drones wait for the arrival of virgin queens. A congregation area is typically **10–40 m** above ground, and can have a diameter of **30–200 m.** The boundaries of a congregation area are distinct; queens flying a few meters outside the boundaries are mostly ignored by the drones. Congregation areas are typically used year after year, with some spots showing little change over 12 years. Since drones are expelled from a colony during the winter, and new drones are raised each spring, inexperienced drones must find these congregation areas anew. This suggests some environmental cues define a congregation area, although the actual cues are unknown.

Congregation areas are typically located above open ground, away from **trees** or **hills,** where flight is somewhat protected from the wind (calm winds may be helpful during mating flight). At the same time, many congregation areas do not show such characteristics, such as those located above water or the forest canopy. Some studies have suggested that magnetic orientation could play a role, since drones older than 6 days contain cells in the abdomen that are rich in magnetite.

Congregation areas can be located by attaching a virgin queen (in a cage) to a balloon floating above ground.

The person then moves around, taking note of where drones are attracted to the caged queen.

Congregation areas are not found closer than 90 m from an apiary, and congregation areas located farther away from apiaries receive more drones. In a congregation area, drones accumulate from as many as 200 colonies, with estimates of up to 25,000 individual drones. This broad mixing of drones is how a virgin queen can ensure she will receive the genetic diversity needed for her colony. By flying to congregation areas further away from her colony, she further increases the probability of out-breeding .

A single drone visits multiple congregation areas during his lifetime, often taking multiple trips per afternoon. A drone’s mating flight averages 20–25 minutes, before he must return to the colony to refuel with honey. While at the site, the drones fly around passively, waiting for the arrival of a virgin. When the virgin queen arrives to the congregation area, the drones locate her by visual and olfactory cues. At this point, it is a race to mate with the virgin queen, to be genetically represented in the newly founded colony. The swarming drones, as they actively follow the queen, reportedly resemble a “drone comet”, dissolving and reforming as the drones chase the virgin queen. Drones greatly outnumber the quantity of virgin queens produced per season, so even with multiple mating by the queen, very few drones mate successfully (estimated at less than one in 1000). If needed, a virgin queen can embark on multiple ‘nuptial flights’, to be sure to receive enough semen from enough drones.

Self-Check- 4	Written Test

Direction attempts the following question after you read information sheet carefully.

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: _______________

1. which one of the following are not congregation areas 5 points)
   a. **Congregation areas** **C. A&B**
   b. **in flight mating** **D. All**
2. __________________ Areas with severe winters, all drones are driven out of the hive in the autumn. (3points)
   A. False
   B. True

3. **Define the life span of drone?** (3points)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Score = ___________
Rating: ____________

Answer Sheet

Name: ___________________________ Date: ________________

Short Answer Questions

1.____

2. ____

References[edit]

1. ^ *Nickel, J. (2001). Mathematics: Is God Silent? (Revised ed.). Vallecito, CA: Ross House Books. p. 242. ISBN 1-879998-22-X.*

2. ^ *Reuber, Brant (February 2015). 21st Century Homestead: Beekeeping. LuLu.com. p. 80. ISBN 9781312937338.*
3. ^ *Oldroyd, Benjamin P. (2006). Asian Honey Bees: Biology, Conservation, and Human Interactions. Harvard University Press. p. 112. ISBN 0-674-02194-0*

BEEKEEPING
Level-I

Learning Guide-08

Unit of Competence: Identify the Biology of Honeybee

Module Title: Identifies the Biology of Honeybee

LG Code: AGR BKGIM08 LO3-LG-02

TTLM Code: AGR BKGIM08TTLM 0819v1

LO 3: Describe the duties of the caste in the colony

Instruction Sheet	Learning Guide # 3

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- **Describing *Duties of honey bee casts*.**
- **Describing Duties of queen.**

- **Describing Duties of worker bee.**
- **Describing Duties of drone.**

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to:

- **Describes *Duties of honey bee casts*.**
- **Describes Duties of queen.**
- **Describes Duties of worker bee.**
- **Describes Duties of drone.**

Learning Instructions:

32. Read the specific objectives of this Learning Guide.
33. Follow the instructions described in number.14 to 15
34. Read the information written in the "Information Sheets 1". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
35. Accomplish the "Self-check 1" in page 19.
36. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
37. If you earned a satisfactory evaluation proceed to "Information Sheet 1". However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
38. Submit your accomplished Self-check. This will form part of your training portfolio.
39. Read the information written in the "Information Sheet 2". Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
40. Accomplish the "Self-check 2" in page 22.
41. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 2).
42. Read the information written in the "Information Sheets 3. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
43. Accomplish the "Self-check 3" in page 24.
44. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 3).
45. If you earned a satisfactory evaluation proceed to "Operation Sheet 1" in page 20. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #2.
46. Read the "Operation Sheet 1" and try to understand the procedures discussed.
47. 13. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity 3

48. Do the "LAP test" in page 21 (if you are ready). Request your teacher to evaluate your performance and outputs. Your teacher will give you feedback and the evaluation will be either satisfactory or unsatisfactory. If unsatisfactory, your teacher shall advice you on additional work.
49. Read the information written in the "Information Sheets 4. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
50. Accomplish the "Self-check 3" in page 29.
51. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 4).

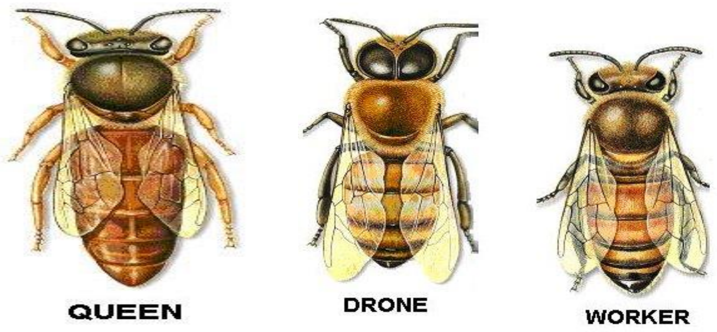
Information sheet-1	Describing *Duties of honey bee casts*.

3.1. Describe the duties of the caste in the colony

The duty definition:- it means any aspect of performance criteria that cast does to their own obligated of working experiment required is called the (duties of honey) the following theater /points are considerable of duties

Honeybee Castes: - Bees are social insects which live in organized communities. They live in colonies usually of between **10,000-60,000** insects. A colony is divided into three different functional castes – **queen, workers** and **drones.**

See the fig. in below 3.1.



Three Castes of Honey Bee: 1. Queen 2. Worker and 3. Drone!

Honey bee is a social insect. The nest of the honey bee is known as the bee-hive. A hive in summer consists of 32 to 50 thousand individuals, depending on the locality.

Colony is termed 'weak' or 'strong' according to the number of worker bees it possesses. There are three types of individuals in a colony, namely the Queen, worker and drone. Due to the existence of several morphological forms, bees are said to be a

1. Queen:

It is a diploid, fertile female. The presence of queen in a colony is a must. The size of the body of queen is much larger than other castes of bees of the colony. Her legs are strong for she is always walking about on the comb. The queen has a sting curved like a scimitar at the tip of the abdomen, which is in fact a modification of the egg-laying organ known as ovipositor. The sting serves as an organ of defense. She never uses it against anybody except her own caste. The queen is responsible for laying eggs for a colony. She lays about 1000 to 1500 eggs everyday and lives a life of two three years However, the number of eggs laid per day may vary from individual to individual, and it has been found that a queen may produce as much as 6,000 eggs per day. She lays both fertilized eggs (from which females develop) and unfertilized eggs (from which males develop).Polymorphic species.

2. Worker:

It is a diploid, sterile female. The size of a worker is the smallest among the castes but they constitute the majority of the bees in a colony. Their function is to collect honey, to look after young ones to clean the comb, to defend the hive and to maintain the temperature of the hive. Numerous adaptations have occurred in the worker for performing her various functions. The body is covered with branched hairs so that when a bee visits a flower, pollen grains adhere to the hairs and other parts of the bodyThe worker cleans off pollen grains with special structures, the antenna cleaners on each foreleg, pollen brushes on all legs and pollen combs on hind legs (Fig. 2). All pollen is stored in the pollen basket present on the outer surface of tibiae on hind legs.Water and nectar are gathered by means of sucking mouthparts which are modifications of the maxillae and labium

Workers are provided by a sting at the tip of the abdomen which is a modified ovipositor. A large poison storage sac is connected with the base of the sting. Two acidic and one alkaline gland mix their secretion to form poison which is injected by the operation of muscles to other animals. During the withdrawal from the prey's body, the stings along with other poison apparatus are torn off, resulting in the death of that particular bee. Workers are female but are incapable of producing eggs. The life span of a worker bee is 4—5 months but during hard working days they persist for five to six weeks only.

3. Drone:

It is haploid, fertile male. The males are larger than workers and are quite noisy. They are unable to gather food, but eat voraciously. They are stringless and their sole function is to fertilize the female (queen). The number of drones in a colony varies from 200—300, but during bad season they are driven out. The drone develops parthenogenetically from unfertilized eggs

The **drones** are male bees while the **queen** and the **workers** are female bees. The largest population of the colony is the **worker,** normally numbering in the hundreds of thousands in an established colony.

❖ **Many duties are performed by workers which are necessary for the colonies survival.**

These duties occur relative to the bee's age.

- Workers constantly remove the waste from the hive and keep it extremely sterile visually.
- The queen is very similar to the worker.
- The queens **somewhere** around her third day of life, she leaves the colony to **mate** with as many as 10 or 12 **drones**.
- The mating takes place "**in flight"** and the **drones**, who leave their sex organs inside of the queen, die shortly afterwards.
- The newly mated queen returns home and begins laying eggs at a rate of 1500 to 2500 eggs a day for a period of up to 5 years.
- The typical colony has only a few hundred Drones.
- They are not productive to the colonies survival and are only kept for mating purposes.
- Drones are stingless, fat and hairy and nearly twice the size of the workers.

3.2. DIFFERENT HONEYBEE CASTES:

1. *Apis mellifera scutellata:-*

- The bee is highly aggressive and has great tendency to reproduce and migrate.
- It is disease resistant. It is a good honey producer and propoliser.
- It is found in the plains and its high reproductive rate is attributed to massive flowering, which occurs in the plains just before the rains.
- It has a short tongue and relatively short wings; the abdomen is slender and yellow with one to two bands. It has very light coloured scutelum

3.3. ***Apis mellifera littorea:-***

- The bee inhabits the low lands of the Kenyan Coast.
- It does not migrate as much as scutellata, but almost as aggressive.
- It has a tendency to rear brood through out the year due to availability of forage along the coast.
- It is a small yellow-stripped bee.
- It has a longer tongue than yemenitica though both belong to lower size scale.
- It is slender and its hairs are a little longer.

4. ***Apis mellifera monticolor:-***

- This bee is called the mountain bee. Found in the cool forests of Mt Kenya, Kilimanjaro, Aberdares, and Elgon.
- It inhabits places where the sun is frequently obscured by clouds and mist and ground frosts at night.
- It is the largest bee in Africa and has tendency to reduce brood rearing at the first sign of forage decline and may not migrate.
- It is less productive and less vicious. It is dark and very gentle with a broad abdomen. It has longer hairs than all other African bees.**Describe the *Duties of honey bee cast***

Every honey bee colony comprises of a single queen, a few hundred drones and several thousand worker castes of honey bees. Queen is a fertile, functional female, worker is a sterile female and the drone is a male insect.

The following are the duties of honey bees

Self-Check- 1	Written Test

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: _______________

Directions: Attempt the following questions after you read information sheet carefully.

1. which one of the following are not duties performed by workers which are necessary for the colonies (4points)

   A. Remove the waste from the hive and keep it extremely sterile visually.
   B. The queen is very similar to the worker.
   C. She leaves the colony to **mate** with as many as 10 or 12 **drones**
   D. All.

2. Define honey bee cast? (3point)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Short Answer Questions

1.___________________________________

2.____

Information Sheet-2	**Describing the *Duties of Queen bees (female)***

3.1. **The duties of Queen:-** and worker develop from fertilized egg while drone develops from unfertilized egg. There is only one queen in a colony. It is considerably larger than the members of other castes. Her wings are much shorter in proportion to her body. Because of her long tapering abdomen, it appears more wasp-like than other inmates of the colony.

☞ The queen is the only individual which **lay eggs in a colony** and is the mother of all bees. It lays upto *2000* eggs per day in *Apis mellifera.* Five to ten days after emergence, **she mates** with drones in one or **more nuptial flights**.

☞ When her spermatheca is filled with **sperms,** she will start laying **eggs**

☞ and will not mate any more. She lives for 3 years

☞ The secretion from **mandibular gland** of the queen is called **queen's substance.**

☞ The queen substance if present in sufficient quantity, prevent swarming and absconding of colonies, prevent development of ovary in workers, and maintains colony cohesion.

☞ The queen can lay either **fertilized** or **sterile eggs** depending on the requirement. The **differentiation in worker and queen** is due to the quantity and quality of food fed to the larva. The larva which .becomes the queen is fed the ***royal jelly,*** a secretion from **hypopharyngeal glands** of the worker bees. The queen is reared in large finger-shaped cells in the lower portion of the combs. Only one queen can remain in a colony, but during unfavourable season two queens are also observed.

☞ The old queen is killed as soon as the new queen is fertilized. Generally queens are reared only during swarming season, but if the queen dies accidentally the bees can rear a new queen.

3.2. **The phenomenon** of raising queen in off-season is called **supersedure**. There is a good family planning in the colony. The number of eggs and egg laying depend on the availability of **pollen** and **nectar** in nature. If the food is scarce, workers do not permit the queen to lay eggs

Fig.2.1.1 sees the differential of cast honey bees

rker bee 2. Drone bee 3. Queen bee

Queen bee is the dominant, adult female bee that is the mother of most, if not all the bees in the hive. A future queen bee's larva is selected by worker bees to be nourished with a protein-rich secretion known as royal jelly so that it can sexually mature.

A newly hatched queen begins her life in a duel to the death with any other queens present in the colony and must destroy potential rivals that have not yet hatched. Once she accomplishes this, she takes her virgin mating flight. Throughout her life, she lays eggs and secretes a pheromone that keeps all other females in the colony sterile.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next

1. ______ is the only individual which **lay eggs in a colony** and is the mother of all bees (3 points)

   A. Queen c. workers

   B. Drone D. All

3. Which one of the following are not the deities of queen?

   A. the only individual which **lay eggs in a colony**
   B. prevent swarming and absconding of colonies,
   C. to look after young ones to clean the comb
   D. All

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Short Answer Questions

1. ____
2. _______________________________________

Information Sheet-3	Describing the *Duties of workers bee*

4.1. Describe the *Duties of workers bee*

Description the *Duties* the Worker:- Description of duties of Worker :-bees are female. They accomplish every chore unrelated to reproduction, which is left up to the queen bee. In their first days, workers tend to the queen. For the remainder of their short lives (just a single month), workers keep busy.Newly hatched worker bees are larvae, unable to feed themselves. Worker bees feed their larvae a liquid called "**worker jelly,"** and they eat as many as **800** times a day to build up fat stores. After eight or nine days, larval worker bees spin cocoons and enter the pupal stage. Three weeks later, fully-formed worker bees chew through their **cocoons**; just a few hours later they're ready to go to work.Incubate the eggs. If it is too hot, the workers collect water and deposit it around the hive, then fan the air with their wings causing cooling by evaporation. If it is too cold, the worker bees cluster to generate body heatThere are **many duties for workers to do, such as:-**

1. **The preserving honey**, feeding drones, building the honeycomb, storing pollen, removing the dead, foraging for food and nectar, carrying in water, fanning the hive to maintain the proper temperature, and guarding the hive against invaders such as wasps.
2. **Worker Making decision**, when necessary, to relocate the colony in a swarm and then rebuild the new nest.
3. **Maintaining proper temperature** for the hive is crucial for the survival of the eggs and larvae. The brood chamber for the bees' young must remain at a steady temperature to

1. The workers are the smallest inhabitants of the beehive.
2. They form the bulk of the population.
3. The number of workers in a colony varies from 1,500 to 50,000.
4. They are imperfect females incapable of laying eggs.
5. On certain occasions when the colony is in need of a queen, some of the workers start laying eggs from which only drones are produced.
6. These workers, called *laying workers,* are killed as soon as a new queen is introduced or produced in the colony.

- **The life-span of a worker** is about **4 weeks** during active season and **8** to **10** weeks during less active season.
- Their range of flight varies from 1,000 to 1,500 m. The division of work within a colony among the worker bees is based on the age of the individual and on the needs of the colony. Normally, the young bees, immediately after their emergence, do the work of cleaning cells and feeding older larvae. When they are grown and their **hypopharyngeal** glands have developed, they secrete the royal jelly with which they feed the younger larvae. These bees are called ***nurse bees****.* For the first **2 to 18 days** of their life, the bees perform indoor duty inside the hive, including comb construction when some young bees start secreting wax. Later on they become foragers, collect water, **pollen, nectar** and propolis (**bee-blue**).
- **Pollen** is a nitrogenous food and is essential for brood - rearing and young bees. Bee's wax, of which the comb is made, is a secretion of the **wax glands located** in the abdomen of the worker bees. For producing **1 kg of wax the** bees consume **10 kg** of honey.

Thus the lifespan of workers can be divided into two phases as first three weeks for house hold duty and rest of the life for outdoor duty.

Works have duties of Household duties

- Build comb with wax secretion from wax glands.
- Feed the young larvae with royal jelly secreted from hypopharyngeal gland.
- Feed older larvae with bee-bread, a mixture of pollen and honey
- Feeding and attending queen.
- Feeding drones.
- Cleaning, ventilating and cooling the hive.

- Guarding the hive.
- Evaporating nectar and storing honey

Outdoor duties

- Collecting nectar, pollen, **propolis** and water.
- Ripening honey in honey stomach.

3.3. Duties of queen are described

The deities of **Queen bee** is typically used to refer to an adult, mated female **(gyne)** that lives in a honey bee colony or hive; She is usually the mother of most, if not all, of the bees in the beehive.Queens are developed from larvae selected by worker bees and specially fed in order to become sexually mature. There is normally only one adult, mated queen in a hive, in which case the bees will usually follow and fiercely protect her. The term "queen bee" can be more generally applied to any dominant reproductive female in a colony of a **eusocial** bee species other than honey bees. However, ***Schwarziana quadripunctata***, a single nest may have multiple queens or even dwarf queens, ready to replace a dominant queen in a case of sudden death. Queens are raised in specially constructed queen cells. The fully constructed queen cells have a **peanut-**like shape and texture. Queen cells start out as queen cups. Queen cups are larger than the cells of normal brood comb and are oriented vertically instead of horizontally. Worker bees will only further build up the queen cup once the queen has **laid an egg** in a queen cup. In general, the old queen starts laying eggs into queen cups when conditions are right for swarming or **supersedure.** Swarm cells hang from the bottom of a frame while supersedure queens or emergency queens are generally raised in cells built out from the face of a frame. As the young queen larva pupates with her head down, the workers cap the queen cell with beeswax. When ready to emerge, the virgin queen will chew a circular cut around the cap of her cell. Often the cap swings open when most of the cut is made, so as to appear like a hinged lid. During swarming season, the old queen is likely to leave with the **prime swarm** before the first virgin queen emerges from a queen cell.

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next

1. _____The following are Works **have duties of Household duties except?** (4points)
   A. Collecting nectar, pollen, **propolis** and water.
   B. Build comb with wax secretion from wax glands
   C. Cleaning, ventilating and cooling the hive.
   D. Guarding the hive.

2. ______ a liquid larvae which worker bees feed ?
   A. "worker jelly,"   c. wrangle sound

B. Cocoon D. All

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Short Answer Questions

3. ____
4. _______________________________________

Information Sheet-4	**Describing the *Duties of Drone (male bees)***

4.2. Describe the *Duties of drone bee*

Describing the *Duties of drone bee*

Definition:-Deities of drone means a specific objective the take apart the responsibilities and job opportunity in the working place.

Definition of A drone:-A drone is a male bee that is the product of an unfertilized egg. Drones have bigger eyes and lack stingers. They **cannot help** defend the hive and they do not have the body parts to collect **pollen or nectar**, so they cannot contribute to feeding the community.

4.3. Describing the *Duties of drone bee*

- The drone's only job is to mate with the queen. Mating occurs in flight, which accounts for the need of the drones for better vision, which is provided by their large eyes.

- Should a drone succeed in mating, he soon dies because the **penis** and associated **abdominal** tissues are ripped from the drone's body after sexual intercourse.
- In the fall in areas with colder winters, worker bees mind the food stores and prevent drones from entering the hive since they are no longer needed, effectively starving them to death.
- Their only function is to impregnate the young queen a task which they are unable to perform until they are about 10 days of age.
- They also help in maintenance of hive temperature.

- They are much larger and stouter than either the queen or the workers although their body is not quite as long as that of the queen.
- They have no sting; a suitable proboscis for gathering nectar is also absent.
- They are, therefore, physically incapable for the ordinary work of the hive.
- They go out of the hive only at the mid-day when the weather is warm. The number of drones in a colony often is very large amounting to hundreds and sometimes to thousands.
- The drones are reared and tolerated during the breeding season.
- They are driven out of the hive to die of starvation before the monsoon and the winter.
- The drones are produced by unfertilized eggs of the queen, or by those workers which take up the reproductive function due to the absence of a queen in a colony.
- The normal life-span of a drone is 57 days. Mating takes place in the open when the queen is in flight. The drone dies in the act or immediately afterwards. Its abdomen has to burst open to allow the genital

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next

1. _____the following are describing the *duties of drone except?*

   A. The drone's only job is to mate with the queen.
   B. To help in maintenance of hive temperature.
   C. Their only function is to impregnate the young queen a task
   D. None of the above.

2. ______ define drone (3points) ?

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Short Answer Questions

1. ____
2. ______________________________________

BEEKEEPING

Level-I

Learning Guide-02

Unit of Competence: Identify the Biology of Honeybee

Module Title: Identifies the Biology of Honeybee

LG Code: AGR BKGIM08 LO4-LG-02
TTLM Code: AGR BKGIM08TTLM 0819v1

LO 4: Describing ways of honey bee communication.

Instruction Sheet-4	Learning Guide # 4

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Describing ***Communications system*** of honey bees
- Describing Dance (round and waggle) of worker bee
- Describing Pheromones(queen substance) of queen are

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:

- Describe ***Communications system*** of honey bees
- Describe Dance (round and waggle) of worker bee
- Describe Pheromones(queen substance) of queen

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5".
4. Accomplish the "Self-check 1, Self-check t 2, Self-check 3, Self-check 4 and Self-check 5" **in page -22, 25, 27, 29 and 32** respectively.
5. If you earned a satisfactory evaluation from the "Self-check" proceed to "Operation Sheet 1 and Operation Sheet 2" **in page -33.**
6. Do the "LAP test" **in page – 34** (if you are ready).

Information Sheet-1	Describing ways of honey bee communication.

4.1 Describe ways of honey bee communication.

Honey bee communication: - honey is communicating direction becomes more complex, as the dancing bee aligns her body in the direction of the food, relative to the sun. The entire dance pattern is a **figure-eight**, with the bee repeating the straight portion of the movement each time it **circles** to the center again.

Honey bees also use two **variations dance**," to teach other workers the location of food sources more than **150 meters** from the hive.

Scout bees fly from the **colony** in search of **pollen** and **nectar.**

If successful in finding good supplies of food, the **scouts** return to the hive and

Honey bees are known to communicate through many different chemicals and odors, as is common in insects. They also rely on a sophisticated dance language that conveys information about the distance and direction to a specific location (typically a nutritional source, e.g., flowers or water). The dance language is also used during the process of reproductive fission, or swarming, when scouts communicate the location and quality of nesting sites.

The details of the signalling being used vary from species to species; for example, the two smallest species, ***Apis andreniformis*** and *A. florea*, dance on the upper surface of the comb, which is horizontal (not vertical, as in other species), and worker bees orient the dance in the actual compass direction of the resource to which they are recruiting.

Apis mellifera carnica honey bees use their antennae asymmetrically for social interactions with a strong lateral preference to use their right antennae.

There has been speculation as to honey bee consciousness.[97] While honey bees lack the parts of the brain that a human being uses for consciousness like the cerebral cortex or even the cerebrum itself, when those parts of a human brain are damaged, the midbrain seems able to provide a small amount of consciousness. Honey bees have a tiny structure that appears similar to a human midbrain, so if it functions the same way they may possibly be able to achieve a small amount of simple awareness of their bodies.

The honey bee first walks straight ahead, vigorously shaking its abdomen and producing a buzzing sound with the beat of its wings. The distance and speed of this movement communicates the distance of the foraging site to the others. Communicating direction becomes more complex, as the dancing bee aligns her body in the direction of the food, relative to the sun. The entire dance pattern is a figure-eight, with the bee repeating the straight portion of the movement each time it circles to the center again.Honey bees also use two variations of the waggle dance to direct others to food sources closer to home. The round dance, a series of narrow circular movements, alerts colony members to the presence of food within 50 meters of the hive. This dance only communicates the direction of the supply, not the distance. The sickle dance, a crescent-shaped pattern of moves, alerts workers to food supplies within 50-150 meters from the hive.The honey bee dance was observed and noted by Aristotle as early as 330 BC. Karl von Frisch, a professor of zoology in Munich, Germany, earned the Nobel Prize in 1973 for his groundbreaking research on this dance language. His book *The Dance Language and Orientation of Bees*, published in 1967, presents fifty years of research on honey bee communication.Honey Bees Communicate through Odor Cues (Pheromones)

Odor cues also transmit important information to members of the honey bee colony. Pheromones produced by the queen control reproduction in the hive. She emits pheromones that keep female workers disinterested in mating and also uses pheromones to encourage male drones to mate with her. The queen bee produces a unique odor that tells the community she is alive and well. When a beekeeper introduces a new queen to a colony, she must keep the queen in a separate cage within the hive for several days, to familiarize the bees with her smell.

Pheromones play a role in the defense of the hive as well. When a worker honey bee stings, it produces a pheromone that alerts her fellow workers to the threat. That's why a careless intruder may suffer numerous stings if a honey bee colony is disturbed.

In addition to the waggle dance, honey bees use odor cues from food sources to transmit information to other bees. Some researchers believe the scout bees carry the unique smells of flowers they visit on their bodies, and that these odors must be present for the waggle dance to work. Using a robotic honey bee programmed to perform the waggle dance, scientists noticed the followers could fly the proper distance and direction, but were unable to identify the specific food source present there. When the floral odor was added to the robotic honey bee, other workers could locate the flowers.

After performing the waggle dance, the scout bees may share some of the foraged food with the following workers, to communicate the quality of the food supply available at the location..

a. **Describe the Dance (round and waggle) of worker bee: - Description Waggle dance** is a term used in beekeeping and ethnology for a particular figure-eight dance of the honey bee. by performing this dance, successful foragers can share information about the direction and distance to patches of flowers yielding **nectar** and **pollen,** to water sources, or to new nest-site locations with other members of the .

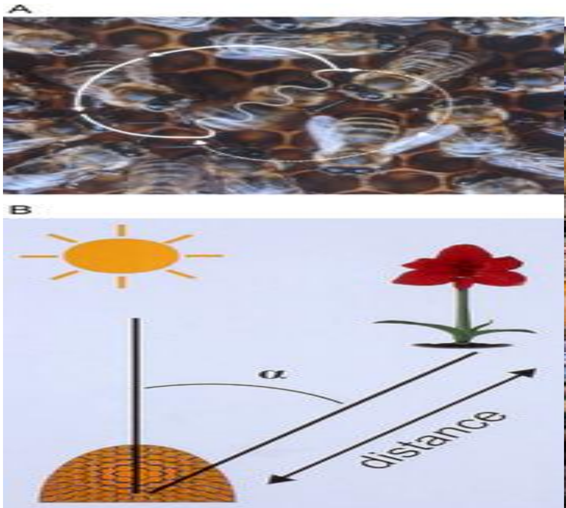
Information Sheet-2	Describing Dance (round and waggle) of worker

4.2. The waggle dance and the **round dance** are two forms of dance behavior that are part of a continuous transition. As the distance between the resource and the hive increases,

- the round dance transforms into variations of a transitional dance, which, when communicating resources at even greater distances, becomes the waggle dance In the case of ***Apis mellifera ligustica*****,**
- the round dance is performed until the resource is about 10 meters away from the hive, transitional dances are performed when the resource is at a distance of 20 to 30 metres away from the hive, and finally, when it is located at distances greater than 40 meters from the hive, the waggle dance is performed The honey bee dance was observed and noted by Aristotle as early as 330 BC. Karl von Frisch, a professor of zoology in Munich, Germany, earned the Nobel Prize in 1973 for his groundbreaking research on this dance language. His book ***The Dance Language and Orientation of Bees***, published in **1967,** presents fifty years of research on honey bee communication.

However, even close to the nest, the round dance can contain elements of the waggle dance, such as a waggle portion it has therefore been suggested that the term "waggle dance" is better for describing both the waggle dance and the round dance

Figure-eight-shaped waggle dance of the honeybee ***(Apis mellifera***) For queen mark



A waggle run oriented 45° to the right of ‘up’ on the vertical comb (A) indicates a food source 45° to the right of the direction of the sun outside the hive (B).

The abdomen of the dancer appears blurred because of the rapid motion from side to side.

A waggle dance consists of one to **100** or more circuits, each of which consists of two phases:

the waggle phase and the return phase. A worker bee's waggle dance involves running through a small **figure-eight pattern**: a waggle run (aka waggle phase) followed by a turn to the right to circle back to the starting point (aka return phase), another waggle run, followed by a turn and circle to the left, and so on in a regular alternation between right and left turns after waggle runs. Waggle-dancing bees produce and release two alkanes, tricosane and pentacosane, and two alkenes, (*Z*)-9-tricosene and (*Z*)-9-pentacosene, onto their abdomens and into the air

The direction and duration of waggle runs are closely correlated with the direction and distance of the resource being advertised by the dancing bee. In an experiment with capture and relocation of bees exposed to a waggle dance the bees followed the path that would have taken them to an experimental feeder had they not been displaced The resource can include the location of a food source or a potential nesting site For cavity-nesting honey bees, like the western honey bee (*Apis* ***mellifera*)** or ***Apis nigrocincta*,** flowers that are located directly in line with the sun are represented by waggle runs in an upward direction on the vertical combs, and any angle to the right or left of the sun is coded by a corresponding angle to the right or left of the upward direction. The distance between hive and recruitment target is encoded in the duration of the waggle runs The farther the target, the longer the waggle phase. The more excited the bee is about the location, the more rapidly it will waggle, so it will grab the attention of the observing bees, and try to convince them. If multiple bees are doing the waggle dance, it's a competition to convince the observing bees to follow their lead, and competing bees may even disrupt other bees' dances or fight each other off. In addition, some open-air nesting honeybees such as the *Apis andreniformis*), whose nests hang from twigs or branches, will perform a horizontal dance on a stage above their nest in order to signal to resources.

Waggle dancing bees that have been in the nest for an extended time adjust the angles of their dances to accommodate the changing direction of the sun. Therefore, bees that follow the waggle run of the dance are still correctly led to the food source even though its angle relative to the sun has changed.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

i. _______ A term used in beekeeping and ethnology for a particular figure-eight dance of the honey bee. (3 points)

A. **Nectar** and **pollen** C. Duties s of bees

B. **Waggle dance** D. **Apis mellifera ligustic**

c.

ii. ___________A worker bee's waggle dance involves running through a small

A. **Nectar** and **pollen** C. ***Apis nigrocincta*,**

B. **figure-eight pattern**: D. **Apis mellifera ligustic**

Note: **Satisfactory rating – 3 points Unsatisfactory - below 3 and 4 points**

Answer Sheet

You can ask you teacher for the copy of the correct answers.

Score = ___________

Rating: ____________

Name: ___________________________ Date: ________________

Short Answer Questions

Information Sheet-3	Describing the Pheromones(queen substance) of queen

3.1. A Pheromone secreted from the **mandibular** glands of a queen honeybee and smelled, eaten, and absorbed by the worker bees, having the effect of preventing them from producing or rearing rival queens.

As emphasized for alarm **pheromones**, a pheromone can communicate many meanings depending on context. The queen pheromone of the honey bee (***Apis mellifera*)** exemplifies this principle, which has been termed "pheromonal parsimony" by Murray Blum of the University of Georgia. The queen pheromone is produced by the queen's mandibular glands and its five known components are **9-oxo-(*E*)-2-**decenoic acid, **(+)- and (−)-9-hydroxy (***E*)-2-decenoic acid, methyl *p*-hydroxybenzoate, and 4-hydroxy-3-methoxyphenylethanol. The queen produces about 500 µg of this mixture daily, most of which is picked up by the continually changing retinue of a dozen or so workers that constantly groom the queen. Trophallaxis (interchange of food), antennation, and grooming among colony members in turn disperse queen pheromone throughout the colony.

The releasing functions of the queen pheromone include the "**retinue"** behavior (attendance and grooming of the queen—these behaviors require all five components), suppression of construction of new queen cells, and a delay in **swarming.**

Outside the hive, swarming bees without a queen are attracted to a source of 9-oxo-(*E*)-2-decenoic acid, but they will not form a cluster without the addition of 9-hydroxy (*E*)-2-decenoic acid. Drones (males) are attracted to virgin queens flying 10 or so meters above ground level by her release of 9-oxo-(*E*)-2-decenoic acid. Perhaps the most dramatic effect of the queen pheromone is in its governance of colony productivity. Without queen or queen pheromone in the colony, many workers remain **idle**.

Queen pheromone stimulates comb construction, brood rearing, foraging, and food storage. Artificial application of queen pheromone increases all these activities.

The queen pheromone also has a clear primer effect inasmuch as it inhibits development of the workers' ovaries. In the absence of the queen (and the queen pheromone), egg production is triggered in up to one quarter of the workers, and these "false queens" and other workers in turn produce some queen pheromone

4.1.2. Types of honey bee pheromones

1. Alarm pheromone

Two main alarm pheromones have been identified in honeybee workers. One is released by the **Koschevnikov gland**, near the sting shaft, and consists of more than 40 chemical compounds, including **isopentyl acetate** (IPA), **butyl acetate**, **1-hexanol, *n*-butanol**, 1-octanol, hexyl acetate, octyl acetate, *n*-pentyl acetate and 2-nonanol. These chemical compounds have low molecular weights, are highly volatile, and appear to be the least specific of all pheromones. Alarm pheromones are released when a bee stings another animal, and attract other bees to the location and causes the other bees to behave defensively, i.e. sting or charge.

The alarm pheromone emitted when a bee stings another animal smells like bananas. Smoke can mask the bees' alarm pheromone.

The other alarm pheromone is released by the mandibular glands and consists **of 2-heptanone**, which is also a highly volatile substance. This compound has a repellent effect and it was proposed that it is used to deter potential enemies and robber bees. The amounts of 2-heptanone increase with the age of bees and becomes higher in the case of foragers. It was therefore suggested that 2-heptanone is used by foragers to scent-mark recently visited and depleted foraging locations, which indeed are avoided by foraging bees. However, this has recently been proven false. In a new discovery, it was determined that bees actually use 2-heptanone as an anesthetic and to paralyze intruders. After the intruders are paralyzed, the bees remove them from the hive.

2. Brood recognition pheromone

Another pheromone is responsible for preventing worker bees from bearing offspring in a colony that still has developing young. Both larvae and pupae emit a "brood recognition" pheromone. This inhibits ovarian development in worker bees and helps nurse bees distinguish worker larvae from drone larvae and pupae. This pheromone is a ten-component blend of fatty-acid esters, which also modulates adult caste ratios and foraging ontogeny dependent on its concentration. The components of brood pheromone have been shown to vary with the age of the developing bee. An artificial brood pheromone was invented by Yves Le Conte, Leam Sreng, Jérome Trouiller, and Serge Henri Poitou and patented in 1996.[7]

3. Drone pheromone

Drones produce a pheromone that attracts other flying drones to promote drone aggregations at sites suitable for mating with virgin queens.

4. Dufour's gland pheromone

The Dufour's gland (named after the French naturalist Léon Jean Marie Dufour) opens into the dorsal vaginal wall. Dufour’s gland and its secretion have been somewhat of a mystery. The gland secretes its alkaline products into the vaginal cavity, and it has been assumed to be deposited on the eggs as they are laid. Indeed, Dufour’s secretions allow worker bees to distinguish between eggs laid by the queen, which are attractive, and those laid by workers. The complex of as many as 24 chemicals differs between workers in "queenright" colonies and workers of queenless colonies. In the latter, the workers’ Dufour secretions are similar to those of a healthy queen. The secretions of workers in queenright colonies are long-chain alkanes with odd numbers of carbon atoms, but those of egg-laying queens and egg-laying workers of queenless colonies also include long chain esters.[8]

5. Egg marking pheromone

This pheromone, similar to that described above, helps nurse bees distinguish between eggs laid by the queen bee and eggs laid by a laying worker.

6. Footprint pheromone

This pheromone is left by bees when they walk and is useful in enhancing Nasonov pheromones in searching for nectar.

In the queen, it is an oily secretion of the queen's tarsal glands that is deposited on the comb as she walks across it. This inhibits queen cell construction (thereby inhibiting swarming), and its production diminishes as the queen ages.

7. Forager pheromone

Ethyl oleate is released by older forager bees to slow the maturing of nurse bees.[9] This primer pheromone acts as a distributed regulator to keep the ratio of nurse bees to forager bees in the balance that is most beneficial to the hive.

8. Nasonov pheromone

Nasonov pheromone is emitted by the worker bees and used for orientation and recruitment. Nasonov pheromone includes a number of different terpenoids including geraniol, nerolic acid, citral and geranic acid.

Other pheromones

Other pheromones produced by most honey bees include rectal gland pheromone, tarsal pheromone, wax gland and comb pheromone, and tergite gland pheromone.

Types of queen honey bee pheromones.

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9. Queen mandibular pheromone

Queen mandibular pheromone (QMP), emitted by the queen, is one of the most important sets of pheromones in the bee hive. It affects social behavior, maintenance of the hive, swarming, mating behavior, and inhibition of ovary development in worker bees.[10] The effects can be short and/or long term. Some of the chemicals found in QMP are carboxylic acids and aromatic compounds. The following compounds have been shown to be important in retinue attraction of workers to their queen and other effects.[11]

- (*E*)-9-Oxodec-2-enoic acid (9-ODA) – inhibits queen rearing as well as ovarian development in worker bees; strong sexual attractant for drones when on a nuptial flight; critical to worker recognition of the presence of a queen in the hive
- (*R*,*E*)-(−)-9-Hydroxy-2-enoic acid (9-HDA) promotes stability of a swarm, or a "calming" influence
- (*S*,*E*)-(+)-9-HDA
- Methylparaben (HOB)
- 4-Hydroxy-3-methoxy phenylethanol (HVA)

Work on synthetic pheromones was done by Keith N. Slessor, Lori-ann Kaminski, Gaylord G. S. King, John H. Borden, and Mark L. Winston; their work was patented in 1991. Synthetic queen mandibular pheromone (QMP) is a mixture of five components: 9-ODA, (−)-9-HDA, (+)-9-HDA, HOB and HVA in a ratio of 118:50:22:10:1.

Queen retinue pheromone

The following compounds have also been identified,[12] of which only coniferyl alcohol is found in the mandibular glands. The combination of the 5 QMP compounds and the 4 compounds below is called the queen retinue pheromone (QRP). These nine compounds are important for the retinue attraction of worker bees around their queen.

- Methyl oleate[13]
- Coniferyl alcohol[14]
- Cetyl alcohol[15]
- α-Linolenic acid[16]

Self-Check- 2	Written Test

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: _______________

Directions: Attempt the following questions after you read information sheet carefully.

What the first part of a worker's life is spent (5 points)

1. ____ is produced by the queen's mandibular glands and its five known components are **9-oxo-(*E*)-2-** decenoic acid, **(+)- and (−)-9-hydroxy (*E*)- ?**
   A. pheromones
   B. mandibular glands
   C. variations dance,"
   D. All

2. Define the Pheromones (queen substance)

***Note:* Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: ___________________________ Date: ________________

Short Answer Questions

1.___________________________________

____

____

2.

____

____.

Reference

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BEEKEEPING
Level-I

Learning Guide-8

Unit of Competence: Identify the Biology of Honeybee

Module Title: Identifying the Biology of Honeybee

LG Code: AGR BKGIM08 LO5-LG-01

TTLM Code: AGR BKGIM08TTLM 0819v1

LO 5: Recognize anatomy and physiology of honey bees.

Instruction Sheet	Learning Guide # 5

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying Components and functions of ***external body parts*** of honey bees
- Identifying Components and functions of ***internal body parts*** of honey bees

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to:

- Identifies   Components and functions of ***external body parts*** of honey bees
- Identifies Components and functions of ***internal body parts*** of honey bees

Learning Instructions:

7. Read the specific objectives of this Learning Guide.
8. Follow the instructions described below 3 to 6.
9. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3, Sheet 4 and Sheet 5”.
10. Accomplish the “Self-check 1, Self-check t 2, Self-check 3, Self-check 4 and Self-check 5” **in page -22, 25, 27, 29 and 32** respectively.
11. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 and Operation Sheet 2” **in page -33.**
12. Do the “LAP test” **in page – 34** (if you are ready).

Information Sheet-1	**Identifying Components and functions of *external body parts* of honey bees**

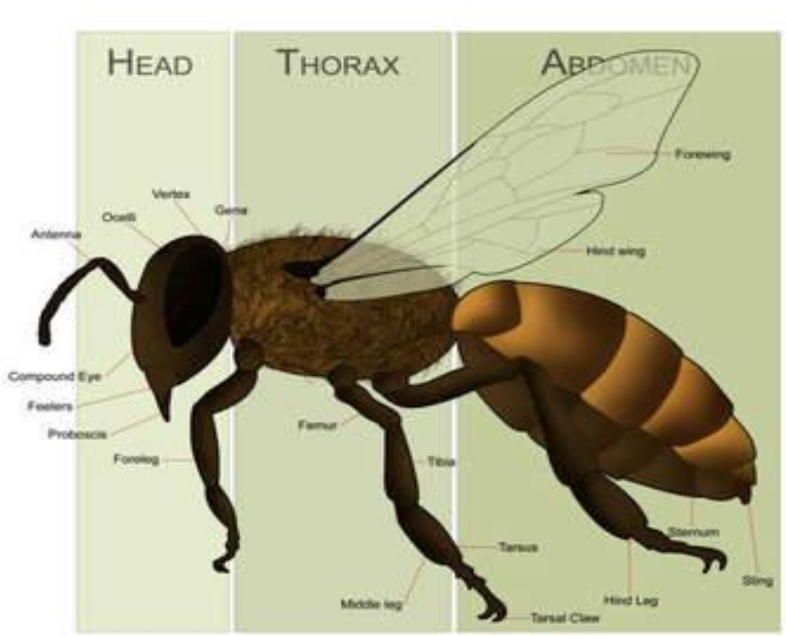
1.1. Anatomy and physiology of honeybees

. ***Definition terms:-***

3. The term **Anatomy** is defined as a science, which deals with the form and structure of

living organisms.

The exoskeleton of honeybee consists of layers of cuticle, which provides a hard protective casing that encloses the body of (the outer cuticle is water proof). Much of it is covered with hairs, which are protective and thermal insulation. Some are important in gathering of pollen and in certain sense organs. Like all insects, the honeybee has three main parts: head, thorax and abdomen. Each of these develops from segments that are formed during embryonic stage.



5.1. Identifying the Components and functions of *external body parts* of honey bees are

He following external part organs their function component are listed in below

- Head Antennae, Eyes, Mouth, Wings, Legs, Spiracles, Wax Scales Sting.

1. **The function of Head**: The head is triangular in shape. It consists of the mouthparts: the two mandibles and proboscis etc, most organs of sensory perception especially in the five eyes and two antennae, which are coordinated by the brain. The structure of the head differs among the members of the colony, worker and queens have triangular head but drone has a slightly circular head due to the enlarged compound eyes.**Proboscis:** Unlike the proboscis of all other suckinginsects that of the honeybee are not a permanent functional organ. The proboscis consists of the postmontem and prementom and joined to the later, the labial palps, the long glossa (tongue) and two paraglossa. The glossa (salivary canal) is a hollow tube and ends in a small spoon shaped labellum (or flabellum). It is used for drawing up liquid foods such as sweet juices, nectar, water, water and honey. The proboscis is folded back when not in use. For action, they are swung forward on the cardines and the extended so that they protrude well beyond the mouth. The galeae and labial palpi are brought together to form a tube round the glossa-this is a food tube where liquid food is sucked in to the mouth. Solid foods are not imbibed in the same; first it is moistened and scrubbed with the labellum, until some dissolves which islifted by the glossa and taken in to the food canal.

b. **The function Mandibles:** These are pairs of jaws suspended from the head and of the bees mouth. The insect uses them to chew wood when redesigning the hive entrance, to chew pollen and to work wax for comb building. They also permit any activity requiring a pair of grasping instruments. Mouthparts of the workers are of more specialized than those of the queen and the drones and the proboscis is longer.

c. **The function Antennae:** These are a pair of sensitive receptors whose base is situated in the small socket like membranous areas of the head wall. They move freely in every direction. The functions are to feel or touch and to smell, and thus to guide the bee outside and inside the hive, to differentiate floral and pheromone odors, and to locate hive intruders. Terminal segments of worker and drone antennae also react to difference in temperature, humidity and co2 concentration. The antennae consist of a long segment, the scape and the flagellum where many thousands of sensory cells are located. Workers have 11 segments and queen and drones antennae are much longer and thicker than that of the worker or a queen.

d. **The function Visual organs (eyes):** The visual apparatus of honeybee consists of three simple eyes known as ocelli and two compound eyes with unusual capacities. The compound eyes are composed of many thousands of simple light sensitive cells, called ommatidia, which enable the bee to distinguish light and color and to detect directional information from the suns ultraviolet rays. The ocelli are able to monitor light intensity, period of exposure to light, and color, also regulate the daily start and finish of foraging and, by registering the brightness of the sky, help to maintain the bee in level flight. The eyes of the drone are larger by far than those of the worker or the queen bee, occupying a large proportion of the total volume of the head. The eyes assist the drones to locate the queen for mating purpose.

e. **The function Thorax:** This is alarm plated mid section of the insect body and supports pairs of wings and 3 pairs of legs and carries the locomotors or engine and the muscles that control the movement of the head, the abdomen and the wings. The thorax consists of four segments; the true segments, pro, meso and Meta thoracic and the propodium. Each segment consists of four plates, a tergite (dorsal), sternite (ventral) and the two pleurite (lateral). Together the plate of the three segments forms a nearly spherical box, where boundaries between the plates and between the segments are always distinct.

f. **The function Legs:** honeybees have six legs with five segments i.e. coax, trochanter, femur, tibia and tarsus 9 has five sub segments, the first and the largest being the base tarsus and the final one pretarsus or foot). Each pair differs in size and shape. The primary function is to serve the bees to walk and run, but it also functions other than this. The foreleg is close behind the head and is used by the bees for cleaning dust, pollen and other contaminant from the head. This important part used for cleaning is known as antennae cleaner. It is located on the inner margin of the tibia of the forelegs and consists of a deeply cut semi circular notch, equipped with a comb like row of small spines. All the bee castes have this cleaning apparatus. The middle legs have no special tools have hairs covering the inner side of the base tarsus of the workers are used for cleaning pollen from the thorax and passing to the hind legs. The hind legs of the workers have specialized structures on the tibia and base tarsus known as pollen basket or corbiculae that are used when a forager collects and packs pollen to carry back to the hive. These pollen baskets are concave in shape and surrounded with several long hairs, which bind the contents into an almost solid mass, making pollen movement safer.

g. **The function Wings:** The wings of the honeybee, like most of other insects are thin, flat and two-layered. They are joined to the thorax, between the tergite and the pleurite of the mesa and Meta thorax respectively. Wings are formed quite late during the development (prepupal stage) and grow out from the thorax as a small pouches containing trachea which disappear as the wings become fully formed, but their position are marked by veins which stiffen the thin membrane of the wing in the adult stage. Honeybees contain two pairs of Wings, namely front and hind wings. The front wings are larger than the hind wings because they have veins, which make them strong. The veins help them to strengthen, carry blood and nerve to the extremities of the wing. The anterior part of the hind wings contains special structure called hamuli or hook. This structure helps to lock the front and hind wings together.

The wing beat of honeybees is 200-300 cycles/second. This is too fast for coordination of the

h. **The function nerve system** and difficult to detect with naked eyes unless we use electrical system. Bees can fly at a speed of 18-miles/hour outward flights and 15-miles/hour inward flights because they are loaded with nectar and pollen. Bees can travel up to 7 km distance but need forage for travel, therefore we have to supply them with food and water in their vicinity i.e. 0.5 km radius of their apiary.

Wings are moved by the two systems of muscles in the thorax i.e. the small direct flight muscles which adjust the scant of the wings and furl them and the wings are disengaged and folded back over the body, a bee is able to vibrate its wing muscles, thereby producing heat or sometimes sounds such as those created by workers while dancing on the combs. In honeybees the front wing is much longer than the hind wings and their venation is much stronger. The workers wings are used for both flight and for ventilating the hive, while the drones and the queen for flight only. When honeybees regulate the hive temperature, they face inward to the hive entrance whereas when they evaporate the moisture content of honey they face outward from the entrance.

i. **The function Abdomen:** Like the thorax, the lower part is armor-plated. It contains vital parts of several internal systems such as the heart, honey sac, stomach intestines, reproductive organ, the sting, wax glands and scent or nasanov gland. The abdominal segments contain only two plates i.e. a dorsal plate (tergite and a ventral plate (sternite).

The structure of the abdomen differs among members of the colony; the abdomen of worker bees is broad anteriorly and tapered towards the posterior, the abdomen of queen is similar to that of workers but relatively larger and looks cylindrical, the abdomen of drones is more rounded **posterior.**

Self-Check- 1	Written Test

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: _______________

Directions: Attempt the following questions after you read information sheet carefully.

1. _____ a science, which deals with the form and structure of living organisms.

A. physiology of honeybees

B. Anatomy

C. function of Head

D. none

4. Define **Anatomy and physiology of honeybees**? (3point)

5. Write the function of Antennae of bees

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Short Answer Questions

1. ____
______
2. ____
____

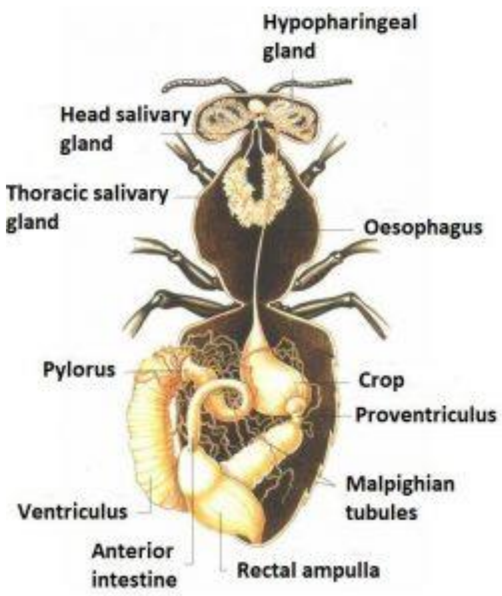
Information Sheet-2	Identifying Components and functions of *internal body parts* of honey bees

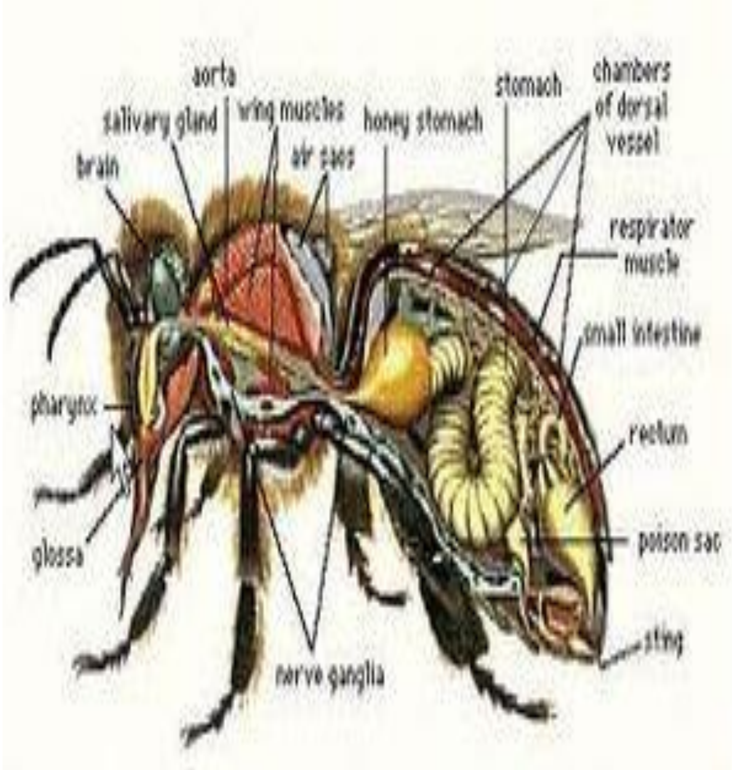
5.2. Components and functions of *internal body parts* of honey bees are

The external and internal morphology (Anatomy) of honey bees essentially corresponds to that of other insects. The same can be said about physiology (vital functions). However there are differences that must be pointed for a better understanding of their ethology (behaviour). Logically, anatomical peculiarities and vital functions are interrelated.

1. the function of digestive system

The physiology part of honey internal





The mouth is the first part of honeybees' digestive system. Its shape is a continuous tubular form. It is located in the front of the head. Bees have lapping mouthparts: the labrum or upper lip covers their jaws. Queens, workers and drones have different mandible parts. Worker bees' jaws are narrower in the central part than in the base. At their ends —where they have horizontal movements— they are smooth and spoon-shaped.

These jaws are used to open the anthers of the stamens and collect pollen from flowers. They are also used to soften, knead and shape wax sheets with saliva and to build cells and honeycombs, as well as to remove foreign elements from hives.
When bees take liquid foods they use a specialized structure: the proboscis. It is formed by different mouthparts and it gets adapted to this kind of use when necessary.
Bees' tongue is long, flexible, hairy and grooved. Its end it is a kind of spoon-shaped button. It is located between the labial palps and at its proximal end has paraglosses.
The proboscis, at rest, is retracted under the head. When bees want to absorb liquids, they stick it out, extending its distal parts around the tongue. This way, the honeybee form a straw or tube is that closes in front of the maxillas distal end. At the back it is closed by the labial palps.
When the proboscis is extended, bees introduce it in the liquid and do rapid movements back and forward to absorb it. When jaws and proboscis are contaminated, they are the vehicle for infestation of larvae from American foulbrood (Paenibacillus larvae) or European foulbrood (Melissococcus pluton).
The honeybee mouth is located between the bases of the jaws. It gets opened at the end of the suction organ. After its opening, bees' mouth is arranged vertically along the head to the oesophagus. It is a sac-shaped cavity with muscular walls that allow aspiration (dilators) of fluids from the proboscis and pass them to the oesophagus through the pharynx (compressors).

The oesophagus is a tube that stretches along the thorax. Food advances through it due to its contraction movements.

At the proximal end of the abdomen, the digestive tract widens into a thin, highly elastic sac. In honeybees it specifically called crop or honey stomach. When it is filled with food, its walls expand rhythmically causing its content (pollen, nectar, solid elements) to mix. It is also used as a food store. It serves the bee for the transport of nectar and water from the outside to the hive, where it is regurgitated.
The crop also distends when bees consume solid food or liquid with a large load of viruses which enter through the digestive system. The proventriculus controls food entry into the stomach (ventriculus or midgut) of bees. It acts like a filter, as it eliminates solids elements from the content of the molar crop.

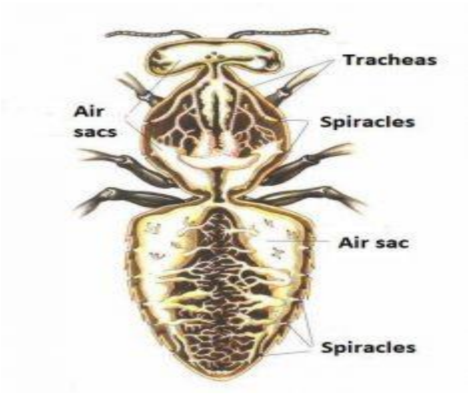
The ventriculus or midgut is the place where digestion and absorption of food material takes place. The folds of its inner membrane increase the digestive surface. The peritrophic membrane protects the epithelium from the direct action of food and leads the passage of digestive juices towards food and from these, when digested, towards the absorption zone.

In larvae, the midgut is the place where Paenibacillus larvae (American foulbrood) attack. The spores of these bacteria germinate in the ventriculus just after the operculation, which is the moment in which the concentration of sugars drops. Later, these bacteria invade the whole larva.
Bees' midgut is also the place of germination of Ascophaera apis (Ascospherosis) asci. Its hyphae invade larvae and cause their death before the operculation. The Morator aetutalas virus (Sacbrood virus) also begins its invasion through the ventriculus.
It is also the place where the microsporidium Nosema apis (Nosemosis) gets appropriately developed. It multiplies its effectiveness when bees' defences are low enough to allow it.

The small intestine is the next segment of the digestive system and it ends in the rectum. In this part of the intestine, the Malphygian Tubules, which act as filtering elements (kidneys), empty their contents. In these tubules is located the causative agent of Amebosis (Malpigamoeba mellificae).
In its distal part is the rectal ampulla, which has a main role in the absorption of water and in retaining the faecal material until evacuation occurs outside the hive.

Nosemosis (Nosema apis) produces a large quantity of waste material that, when accumulated in the ampoule, causes a great distension of the midgut, pressing the air sacs and thus preventing the flight.
Here we can also find Malpighamoeba mellificae cysts, which come from the Malphygian tubules. During winter, bees store their waste materials in the rectal ampulla and do not empty it until they carry out the so-called cleansing flights at the beginning of spring.
This strategy followed by honeybees in regard to undigested elements favours extraordinarily the hygiene inside the hive. The presence of faecal spots in different parts of the hive warns bees about the presence of problems of physiological or pathological order.

2. The function of respiratory system



Honeybees do not have a specific organ for gas exchange. This is done by a tracheal system which consists of spiracles, tracheas, air sacs and tracheoles (this is where gas exchange really occurs).

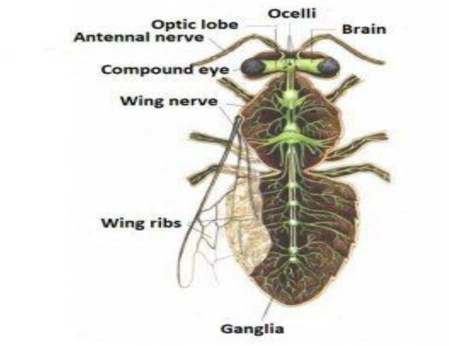
The spiracles are external holes that used for ventilation. Both in larvae and adults there are 10 pairs and all of them except the second —which is very small— have closing valves. Spiracles are opened in response to low concentrations of oxygen or high concentrations of carbon dioxide in tissues, allowing the air to enter and exit.

The valve of the first spiracle does not close completely; bees remedy this with hairs. This first spiracle is also the entry point of the mite Acarapis woodi (Acarapisosis). This mite enters especially in new born or young bees, crossing the hair barrier —that in these bees is not very hardened—. The causative agent of septicemia also enters through this spiracle.
Tracheas are conduits that communicate spiracles with the air sacs. The longest are those those of the first pair. In these is where A. woodi predominates. This mite feeds on hemolymph and obtains it by perforating the trachea. This causes processes of melanisation on it.
The main tracheas extend to the sides of the body and form large widenings on the sides of the abdomen.
Gas exchange occurs in the so-called tracheoles. Bees lack lungs similar to mammals; oxygen is directly carried to all parts of the body by a series of tubes called tracheas.

Honeybees' breathing is almost opposite to that of all vertebrates. Instead of directing the blood towards the air —that is, towards the lungs—, air is transported towards the blood. Honeybees' blood is a clear and yellowish liquid (called hemolymph). Oxygen reaches tissue proximities and reduces the transport of gases in liquid phase to a minimum.

Air sacs (or tracheal sacs) are constituted by a tracheal widening and are distributed by the body in an irregular manner. They collapse because of the pressure and play an essential role in tracheal ventilation. They intervene in the flight mechanism. All of the sacs are interconnected.

3. the function of nervous system



Larvae have a brain with a suboesophageal ganglion, as well as eleven ganglia, longitudinal corners formed by pairs of twin nerves. Adult bees have a larger brain with a suboesophageal ganglion, as well as seven ganglia which form a ventral cord that runs below the gastrointestinal tract.

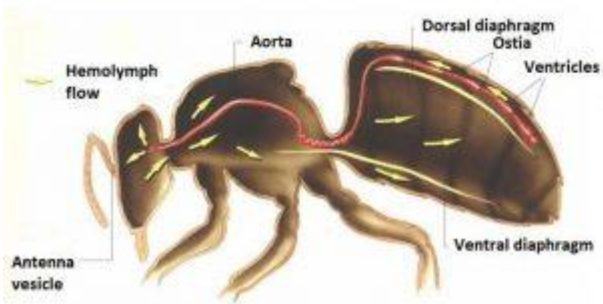
In the thorax are two thoracic ganglia. The nerves that come from the first of them are directed to the first pair of legs. The nerves of the second ganglion are directed towards the flight muscles and the second and third pairs of legs.

In the abdomen there are five other ganglia that regulate intestines and breathing organs functions. The last two, somewhat larger than the others, regulate the reproduction organs and the stinger. As a consequence of this nervous system distribution, each of the three parts of honeybees body (head, thorax and abdomen) function more or less independently.

We can see this by cutting off the head of one of these insects. We will see that the rest of the body can continue moving from one part to another, moving the wings and continue their vital functions for a long time, but irretrievably dying in the end.

The same thing happens if we cut the abdomen. The insect can continue to absorb liquids, nectar and syrups, but everything that is ingested will immediately come out to the outside. Worker bees' brain is much larger than that of the drones in spite of being the head of the last ones greater.
Our greatest interest lies in the fact that it is the target of neurotropic viruses.

4. the function of circulatory system



The circulatory system of honeybees is composed of a long tube that runs throughout their body. It is closed at the abdominal end and opened in the head. It stretches along the digestive track.

Its main function is the transport of nutrients and removal of waste. Its components are; hemolymph, ventral and dorsal diaphragms, heart, aorta and antennae vesicles.

The hemolymph is a complex fluid that contains cells called lymphocytes. These cells have phagocytic capacity, do their own movements and circulate freely through the body every time it is driven by the heart to the brain.
Nosema apis (Nosemosis) causes anemia. We can also find Pseudomonas aeruginosa (P apiseptica) here.

In the dorsal part of the abdomen there is an organ called heart. Bees' heart is formed by ventricles joined together by valves called ostia. Ostiolar chambers are joined by valves that open only forward, this allows the advancement of hemolymph, but not its recoil.

The dorsal and ventral diaphragms are responsible for circulation in the abdomen and help blood to return from the thorax. Antennae vesicles pump blood to the antennae.

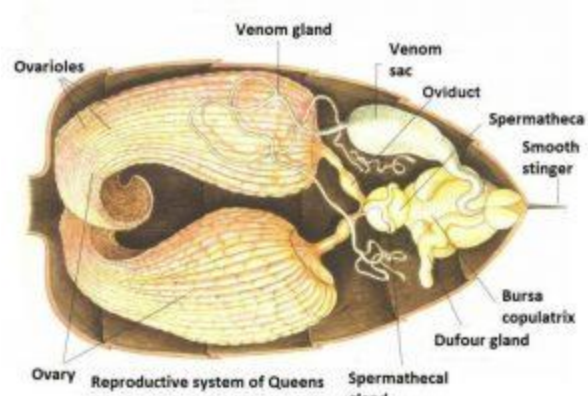
5. The function of excretory system.

It is formed by the malpyghian tubules, which remove waste substances from blood and pour them into the anterior intestine to eliminate them with faeces. These substances are mainly nitrogen derivatives. It is the target of Malpighamoeba mellificae.

6. the function of fat cells

They form thin membranes that are scattered along the abdomen walls. In winter these cells are poor in fat and rich in albumin, while in summer is the other way around. Among fat cells are the oenocytes, which are cells related to wax metabolism. These cells, along with fat, contain proteins and glycogen. Pseudomonas apiseptica grows here before invading the blood.

7. the function of reproductive system

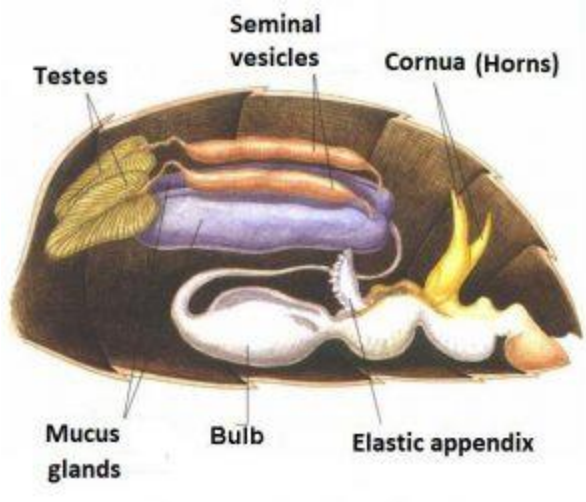


Reproductive system of Queens

In queens it is constituted by two pear-shaped ovaries. These are constituted by long tubes called ovarioles, which end in little tips. These tips are inserted near the ventral side of the heart. **Ovarioles** are full of ovules **(oocytes**) in different stages of maturation.

At the end of the ovary it is also the **chorion**. A queen can lay up to 3,000 eggs per day, although it is normal for them to put up to 1500. In a year a queen can lay up to 200,000 eggs. Ovaries end in separate oviducts, which then join in a common conduit, or middle oviduct. At its base it communicates with the **spermatheca**, which is where the spermatozoa of copulas are accumulated until their use.

This system continues with the vagina, which ends at the vaginal opening, which is protected by a fold. At that height there are two lateral bags and the bursa copulatrix.



Drones' reproductive system

Drones' reproductive system is made up of two testes, two **vase deferential,** two seminal vesicles, two mucus glands, ejaculatory duct and copulatory organ. Testes are formed the testicular tubes inside them is where spermatozoa are produced. As the drones mature, testes lose size until they get reduced to 1/3 of their original size (pre-birth).

The vasa deferentia communicate testicles with the seminal vesicles. In this path, spermatozoa continue to mature.

The seminal vesicles produce secretions that accompany spermatozoa and inside them they finish maturing. Mucus glands communicate with the seminal vesicles and the ejaculatory duct. They produce a substance that solidifies in contact with air and water, but not with seminal secretions.

The ejaculatory duct communicates the mucus glands with the copulatory organ. The copulatory organ in the resting state is invaginated. When it gets evaginated, it is introduced in queen's bursa copulatrix and it is detached from the drone once semen is introduced, functioning as a stopper.

Drones' abdominal muscles are very developed. This is important from the physiological point of view, so that at the moment of copulation the endophallus eversion can be produced quickly.

8. The function of glandular system.

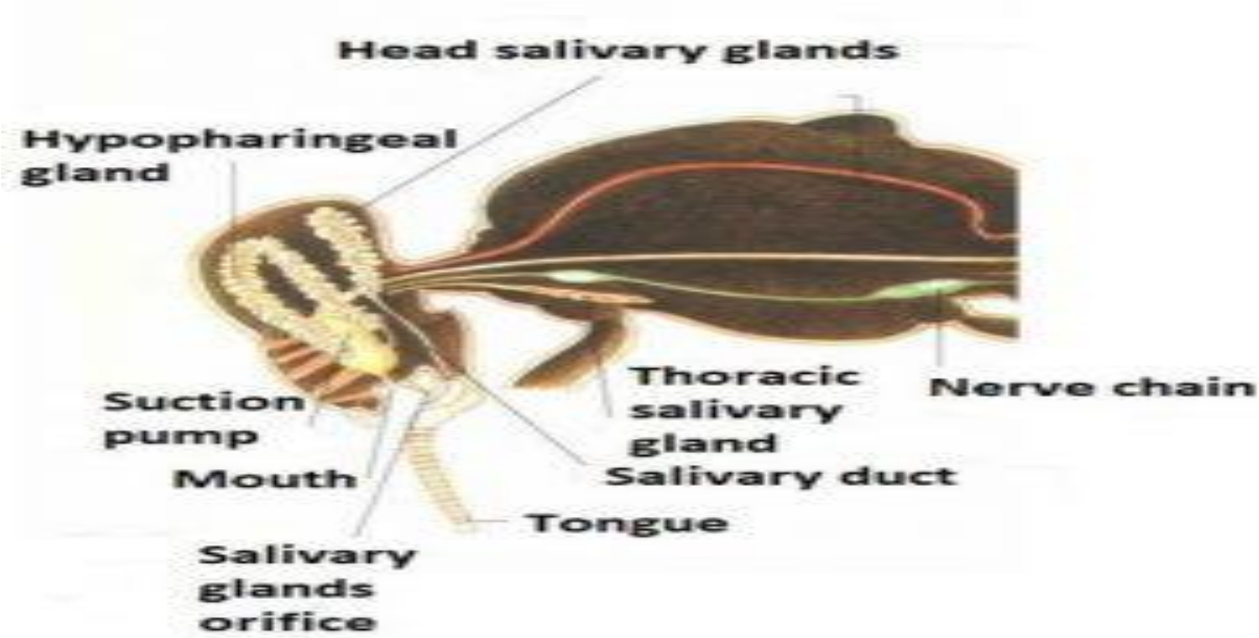
A gland is a specialized organic formation or a set of cells differentiated from the epithelial tissue. Glands are responsible for elaborating, secreting and excreting certain substances that exclusively intervene in certain physiological processes.

9. The function of Hypopharingeal glands.

They are located in the head of worker bees. They are spherical-shaped and very developed in the nursery stage. In queens they are rudimentary and in drones they do not exist. Its secreting cells are grouped in clusters and pour their secretion in the lower part of the larynx through a central duct. Here is the Sacbrood Virus.

Their secretion's product serves as food for larvae in their first three days of life and for queens throughout their lives. It's the well-known royal jelly. When bees mature, these glands lose their functionality, their volume decreases and they start producing the invertase, necessary to cause the cleavage of nectar sugars.

10. Salivary glands.



These glands are found in head and thorax (post-cerebral or thoracic). The two common ducts pour saliva (slightly alkaline aqueous liquid) on both sides of the tongue.

Saliva helps dilute honey and dissolve sugar crystals. In addition, it moistens the substances involved (pollen at the time of collection). It also contains enzymes which are responsible for the transformation of nectar and honeydew in honey. Acute paralysis viruses are located in the thoracic glands.

11. The function of Mandibular glands.

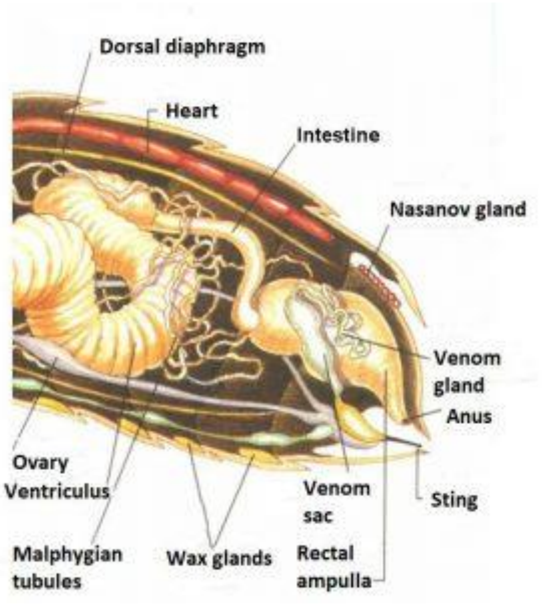
They are placed on the head of worker bees and queens (drones lack them). The excretory duct pours secretions into the inside of the jaws.

In worker bees it produces a fraction of the royal jelly and in queens releases a pheromone that plays an important role in the social cohesion of the colony (binding effect to worker bees, inhibition of queen cells construction, attraction of drones in the nuptial flights).

12. The function of Nassanov gland.

The **Nassanov** gland is an odoriferous gland, located in the dorsal part of the abdomen, in the anterior face of the 7th abdominal targeted. When bees are at rest it is not appreciated. This gland is only seen when bees dilate their abdomen and adapt the characteristic “call” position with the abdomen upwards and beating their wings. Then it gives off a characteristic smell that identifies and attracts to all the bees of the same colony that can be disoriented.

17. Wax glands



In the anterior part of the sternites of segments four to seven are located the wax glands — four pairs, one for each segment—. In each sternite there are two light-colored areas called “wax mirrors” that carry pores where the greasy secretion of the wax glands, located in the inner part of each sternite, comes out.

The scales or plates of wax are carried by bees to their mouth with the second pair of legs. Then they use their jaws to knead and shape them to later build the combs. The scales have an irregular pentagon shape and are very small, each weighing 0.0008 g (approx 0.00003 oz). An amount of approximately 1,250,000 flakes are required to produce 1 kg of wax.

Only bees have wax glands. They begin to work approximately at the day 12 of the bee’s life and end at the day 20, when bees become foragers.
To make wax bees have to consume a lot of pollen and honey. When hives are loose bees consume about 15 kg of honey and pollen to produce 1 kg of wax. On the contrary, when hives are strong, they consume only about 10 kg of honey and pollen.

18. The function of venom gland.

The defense apparatus is indispensable for the survival of the species. Without it, the attraction of honey on men and other animals would have disappeared centuries ago. This defence organ is composed mainly of the sting and the poison bag.
The sting has a pair of lancets attached to each other so that they form a channel, through which poison passes. Then, poison comes out by the curved teeth or beards that gird the tip of the lancets. Each lancet has about nine teeth, with their tips turned back like a hook, and when they dig into the wound, they cannot get it out. When bees try to remove the sting, they are unable to do it, and in this struggle lose this organ and part of the intestine, which leads them to die.

Another component is a whitish vesicle called “venom sac”. It contains a liquid that is produced by two glands that drop their secretions in this bag, one of which pours an acidic substance and the other an alkaline substance. None of these substances is toxic itself, but when combined produce a strong irritation with subsequent inflammation.

The defence apparatus possess powerful muscles which bees use to nail the lancets into the wound. They also do contractile movements that last a few minutes after being detached from the bee. Due to those movements, poison is still being introduced into the wound.
The sting of the queen is smooth, curved and somewhat longer than that of workers. It is only used when queens fight each other
Wasps also have a smooth sting and they can nail it several times without the risk of losing it. These stings usually cause more irritation than bees’ ones.
Immune system

The basis of good health in both humans and animals is being able to successfully defend against pathogens (bacteria, parasites, viruses, etc.).
The immune system in insects has been little studied. Insects have chitin —main element of the exoskeleton protection of the intestinal wall on the inside— as protection against aggressions that come from the outside. Bees have immune defences in their body. The cells called hemocytes, of which there are different types, protect bees from the invasion of bacteria and parasites by using several mechanisms: phagocytosis, encapsulation and nodule formation.

The phagocytosis process consists of the emission, by the defence cells, of prolongations that include foreign particles. This process ends the digestion of foreign particles by enzymes that come from the lysosomes. When the foreign body is very large it cannot be phagocytosed and instead is encapsulated. To do this, several hemocytes join together and create a kind of capsule that surrounds it. The lack of oxygen or the accumulation of toxic waste causes the death of the foreign body.

When the number of foreign bodies is very high, the mechanism used is the nodule formation. This mechanism is a kind of mixture of phagocytosis and encapsulation.

The formed nodules adhere to the walls of internal organs where foreign bodies will be destroyed. It has also been possible to demonstrate the existence of not cellular immune defences, apidaecins and lysozymes that develop antibacterial action in the hemolymph. Apidaecins are formed by groups of polypeptides that have a broad bactericidal power. Lysozymes are enzymes present in small quantities in healthy bees and which increase when bees are infected by bacteria. On the other hand bee colonies react to the presence of pathologies with the elimination of the sick bees and the extraction of the affected broods.

Self-Check- 4	Written Test

Name: ___________________________ Date: ________________

Time of started: ______________________ time finished: _______________

Directions: Attempt the following questions after you read information sheet carefully.

What the first part of a worker's life is spent (5 points)

1. ________ is a specialized organic formation or a set of cells differentiated from the epithelial tissue

E. **Function of glandular system.**

C. Fat cell

F. **Wax glands**

D. all

2. Define the function of digestive system

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = ___________

Rating: ____________

Name: _________________________ Date: _______________

Short Answer Questions

1.____

2.____

References

List of Reference Materials

Vice Chairman and Director of Institutional Relations Fundación Amigos de las Abejas

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