Teachers' Notes

infodigmedia
PO Box 1181 | ph 02 8915 1725
Mona Vale NSW 1660 | fx 02 8915 1726
Australia | www.infodig.com.au

Bees
Biology and Society

Chapters
Division of Labour
Food Gathering
Communication
Sight

1. Division of Labour
Until a bee becomes a 'field bee', she must undertake a wide variety of appointed tasks within the beehive.

In the first three days of their life, the workers clean the hive. The walls and the floor of the empty cells are cleaned with the tongue and the jaw.

In the second part of the bee's life, the hypopharyngeal gland swells up and is activated. This gland produces protein-rich food, called 'Royal Jelly'. The worker bee feeds it to the young larvae.

She is now called a nursing bee.

When the bee is ten days old her activities change once again. The hypopharyngeal gland has now developed and the wax glands in her abdomen are activated.

The bee now makes herself useful as a house bee.

During the comb building the bees hang onto each other, forming a chain. Small plates of wax emerge between the abdominal rings. The bee uses its legs to move these plates of wax, and then moulds them with its mandibles and jaw to form the walls.

The house bees cap the end of the cells with bits of wax taken from various other combs.

From the 17th day of their life, the house bees come into contact with the outside world more and more often. They already receive some nectar at the entrance of the hive, but mostly they receive it within the hive. The mutual touching of the antennae aids the exchange of nectar.

After the house bees have manipulated the nectar by adding an enzyme in their honey sac, the finished honey is deposited in the cells. The bees are now designated honey makers.

The worker bee spends the first 3 weeks of its life inside the hive in complete darkness. After this period, some bees will begin their outdoor duties as guards in front of the hive. With their antennas they smell every insect that passes the entrance. Bees with a strange, unusual smell are driven away.

In the very last part of her life, the worker bee will become a field bee. On her visits to flowers she sucks the nectar with her nose or gathers pollen, which is transported in the pollen baskets. On hot days she also transports water to the hive to cool it down.

2. Food Gathering
Honey comes from honeydew secreted by types of scale insects, which live on various plants. Nectar and honeydew are the main ingredients of honey.

Nectar is separated at the part of the flower called the calyx. With her nose, or proboscis, the bee sucks up the sugary liquid. The bee's honey sac is only the size of a pin-head, but to fill it up, she must find up to one thousand flowers.

In the honey sac, also called the honey stomach, the bees transport the nectar to the hive. Upon arrival, the field bee regurgitates it from the honey sac back to the proboscis and passes it on to other bees. For two or three days the nectar passes from honey sac to honey sac. During this time it is mixed with body juices which contain enzymes. Only after it has been through this process is the honey ripe and ready to be stored in the empty cells.

On a visit to a flower, the bee works the flower with her jaw and legs, causing some pollen to stick to her thick hair.

In the pollen baskets the pollen is carried to the hive, where it is stored in its own cells. The bees store the

pollen and honey to eat on the cold winter days.

3. Communication

In the hive, field bees meet house bees. They communicate with each other by touching their antennas together. The antennas are sensitive to touch and odours – they play an important role in communication because inside the hive it is totally dark. Even the queen, recognised by her large abdomen, is touched and licked by surrounding worker bees. The chemicals, or pheromones, that she secretes, which are also referred to as queen substance, are passed to the workers this way. Because the worker bees are constantly exchanging their food, these chemicals are passed through the entire colony within a few hours.

This continuous exchange of information is the basis for the harmonious life in the beehive.

Bees also communicate using the wagtail dance – a series of very specific movement patterns. Bees use the dance to tell the other bees where food is. By making contact with the dancer bee with their antennas and by following their dance, the worker bees decode the information.

4. Sight

At a feeding station we placed a yellow pad and a blue pad next to each other. The yellow dish stays empty and the blue dish is filled with sugar syrup. The bees are fed on the blue cardboard and are therefore trained on blue. Soon many bees have gathered. Even after we replace the dish full of syrup with an empty dish, the bees keep going to the blue pad.

To make sure that the bees can actually identify a certain colour, and are not drawn by an odour, or just returning to the same place, further experiments must be made.

Again the bees are trained to blue. To show that the bees do not approach the blue pad because of the scent, the used pad is replaced by a new one. The bees continue their search on blue, which proves that they do not go there because of a familiar smell, but because they can tell the colour.

Nine new coloured pads are given to the bees; eight yellow and one blue. Again, they head straight for the blue. The position of the blue pad is changed a few times during the experiment. The bees continue their search on blue, proving that they are not relying on the position of the dish.

It is easier to tell blue and yellow apart in black and white because of their distinct shades.

The feeding station shows eight different grey pads and one blue pad. They will only be fed on blue. Although there are many changes in the location of the pads, and new pads are used to eliminate the smell, the bees continue to search on blue. In black and white, you can see that the shade of some of the grey pads is the same as the blue pad. This shows that the bees are capable of separating blue from the laid out grey tones.

Other Work

Organisms have effective methods for communicating with each other. Find out more about human communication. What are the main forms of human communication? List and describe them giving examples where possible.

Research

Research another organism where there exists a clear division of labour. Describe the different roles and explain their methods of communication.

Student Worksheet

A. Division of Labour

Complete the table:

Stage in Life	Name	Job
First 3 days	Worker Bee	
3-10 days		Feeds the protein-rich ‘Royal Jelly’ to the young larvae.
	House Bee	Secretes wax from between its abdomen rings to form the walls of the comb.

17 days		House bee starts to go into the outside world more. It receives nectar and adds an enzyme in their honey sac to complete the honey.

B. Food Gathering

Fill in the blanks:

a) Honey comes from honeydew secreted by types of _____ insects living on plants. _____ and honeydew are the main ingredients of honey _____.
b) A bee uses its nose (or _____) to suck up the sugary liquid from the flower.
c) A bee must find up to one_____ flowers to fill up its pin-head sized honey _____ (also called honey _____).
d) The bee transports the nectar in its _____ _____ to the hive and upon arrival regurgitates it back out of its proboscis to the other bees.
e) The nectar is passed from honey sac to honey sac for 2-3 days and is mixed with _____ juices containing _____. This process _____ the honey so it can be stored in the empty cells.
f) Pollen from flowers is carried in the pollen _____ on the bee's hind legs. It is brought to the hive and stored in its own cells.
g) Pollen and honey are stored by the bees to be _____ on cold _____ days.

C. Communication

Match the ways in which bees communicate to its purpose by drawing a straight line.

Method of Communication	Purpose
Secreting a scent on the landing platform	To transfer the pheromones amongst the worker bee colony.
Wagtail dance	To enable the bees to navigate through the dark hive.
Touching and Licking	To indicate the distance and direction of food to other bees.
Touching the sensitive antennas together	To make the journey home easier for the less experienced members of the colony

D. Sight

Describe an experiment that shows that bees can identify and distinguish between colours. Consider the following questions:

a) Why is the used blue landing pad replaced by a new one?
b) Why was the position of the blue food dish moved around?
c) Why were different grey landing pads used together with the blue landing pad?
d) What do these experiments collectively prove?