

Program Script

Bees

Biology and Society

1. Division of Labour
2. Food Gathering
3. Communication
4. Sight

1. Division of Labour

A Honeybee collects pollen. However, until a bee becomes a 'field bee', she must undertake a wide variety of appointed tasks within the beehive.

A young worker bee emerges from her cell. Her wings and feather-like hairs are still moist and cling to her body.

In this cross-section we can clearly identify the hypopharyngeal gland in the head, and the wax glands in her abdomen. In the first part of her life, these are not active.

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

The hypopharyngeal gland swells up and is activated in the second part of the bee's life.

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.

In these cells, larvae are getting ready to spin their cocoon. 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 field bees deliver pollen to the hive in their pollen basket, located on the hind-legs. They then brush it into the empty cells. Certain house bees will push down the loose pollen spores into the cells.

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 - such as the one in the centre - are driven away.

Every now and then a wasp will force its way into the hive to steal honey. It is stung and violently expelled from the hive.

Meanwhile the wax glands have re-formed.

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

On warm, dry days many bees are out and about. On visits to flowers, they gather nectar or pollen.

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 this 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 the 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 slow motion, you can see how the bee brushes and strokes the pollen into the basket on her hind-legs.

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

Bees return to the hive. Many of them secrete a scent on the landing platform, to make the journey home easier for the less experienced members of the colony.

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.

However, bees also communicate using the wagtail dance – a series of very specific movement patterns. To observe the wagtail dance, we placed an artificial food source close to the hive.

We put some sugar syrup in a dish, and painted a pink dot on this field bee. After the bee has returned to the hive, she moves rapidly in circles, suddenly makes a turn and moves in the opposite direction, again in a circular motion. She is using the dance to tell the other bees where the food is. Again and again she passes out tastes of the syrup to the other bees. A few bees find it hard to imitate the dance, which makes it hard for them to decode the information.

The round dance shows that the food source can be found within the immediate surroundings.

We put some more sugar syrup approximately 100 metres from the hive. We painted this field bee blue.

On a vertical plane in the hive, the field bee does the wagtail dance – she is indicating the direction and distance of the food source. The dancing pattern is only occasionally interrupted, so that other bees can have a taste of the food.

In slow-motion, we can watch the wagtail dance more closely. The dancing bee runs in a straight line, and then shakes her abdomen around. After this she does half a circle to the right, another wag of the tail moving straight ahead, which is followed by a semi-circle to the left. The wagtail dance is therefore always arranged between two round arches.

The wagging movement here is pointed upwards in a vertical direction, against gravity. This means that the food source lies towards the sun.

At another food source a bee is marked yellow.

This bee also dances the wagtail dance, not up the honeycomb, but down towards the left. Due to the change of the angle towards gravity, the bees can comprehend the place of the food source. Here the food source lays approximately 130 degrees left of the sun. The bees translate the angle between the food source and the sun as an angle between gravity and the plane of the honeycomb.

By making contact with the dancer bee with their antennas and by following their dance, the worker bees decode the information.

The next food source lies in the same direction as the last one, but is further away. The direction of the dance therefore stays the same, but the wag of the tail lasts a little longer and is done at longer intervals. The number of wags within a set time limit indicates the distance of the food source: the slower the dance, the greater the distance to the food.

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 to us 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. In the next experiment, we'll try to make sure that the bees can actually react to a colour and not just to different 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 certainly capable of separating blue from the laid out grey tones.