SOCIAL INSECT PROGRAM

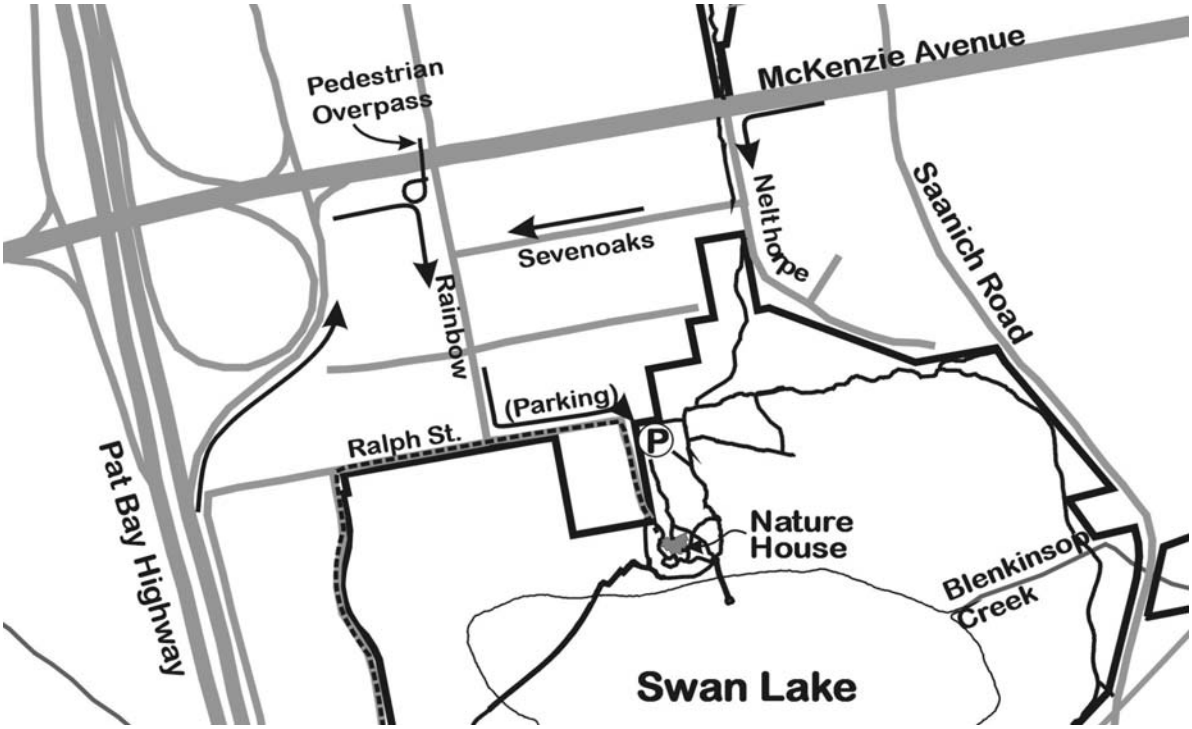
This one and a half hour program is delivered on site at Swan Lake Christmas Hill Nature Sanctuary.

BEFORE YOU ARRIVE:
1. Provide each student with an easily read **name tag** for both indoor and outdoors.
2. Please encourage appropriate **clothing** and **sun protection** for the weather. Remember that at least half of your program is outside.
3. Divide your class into **two groups** before you arrive. It is very helpful if you have another adult to go along with each group, so that they can manage any problems that may arise such as taking a student to the washroom.

The program consists of the following activities:

Inside	Honeybee role-plays	
	Beehive viewing	(45 minutes)
Outside	Insect habitat activity	
	Walk & observation of nests	(45 minutes)

WE'LL MEET YOU IN FRONT OF THE NATURE HOUSE.



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SCIENCE INTEGRATED RESOURCE PACKAGE

Our program will contribute to the following IRP Learning Outcomes

Grade 2:

*Use their senses to interpret observations
*Classify familiar animals according to similarities and differences in appearance, behaviour, and life cycles
*Describe ways in which animals are important to other living things and the environment

Grade 3:

*Ask questions that foster investigations and explorations relevant to the content
*Describe ways in which plants are important to other living things and the environment
*Describe shapes that are part of natural and human-built structures

Our Goals:

The students will be able to:

- recognize the different habitat needs of the 3 local social insects: ants, honeybees, hornets
- recognize the 4 life stages of honeybees: egg, larva, pupa, adult
- understand some of the age-related jobs of adult honeybees
- apply this knowledge to interpret the activities in our beehive

We greatly appreciate students' feedback! If you send artwork and writing describing your experiences at Swan Lake we will display as many as we can around the Nature House.

PROGRAM OVERVIEW

Inside

1. Honeybee Role-Play

In the classroom, a short introduction about social insects will be given, specifically about the honeybee. Using props, the children will learn about the community structure by playing out the **age-related roles** of the bees. The roles stressed will be:

Queen
Egg, Larva, Pupa development
Adult Workers: Cleaner
Nurse
Builder
Guard
Forager/Scout (Field Bees)
Drone

2. Beehive Activities

The children, in small groups, will be able to find the Queen and the worker bees (doing some of the jobs role-played in the classroom) in our demonstration hive. Children will be given **free time** to explore the Nature House.

Outside

1. Insect Habitat Activity

The game *Habitracks* from **"Project Wild"** is played, using 3 local insects: **honeybee, ant** and **bald-faced hornet**. The children are put into those 3 groups and then asked to find the 3 essential components of its habitat: **shelter, food and water**. These components are written on colour-coded, pie-shaped pieces of cardboard that are hidden in appropriate places in the grassy area around the Nature House. The children are given a few minutes to find them. The students will share their information in a **sharing circle** and more information will also be discussed. Each group will then return the habitat pieces to the same place that they find them. The distance between the habitat components will be discussed as the amount of **space** the animals need for their habitats. Honeybees generally need more space than hornets, which need more space than ants (ants only have wings to mate).

2. Walk and Observation of Nests

A short walk outside the Nature House will show students the habitats of the bees, ants and hornets, including any new nests. Abandoned nests from our collections may also be observed. Orchard Mason bees, native, non-social bees, may also be seen.

Resource information on Social Insects

Social insects live in an organized society, with each member dependent on the others. They cooperate with each other to such an extent that there is a **definite division of labour**. Almost all social insects undergo **complete metamorphosis** with the stages: **egg, larva, pupa and adult.**

Usually **one matriarch** produces the eggs. The **young are nurtured** and fed progressively on a daily basis. The adult workers assume special roles within the community depending on age-readiness, size or other factors. **Trophallaxis** is usually the main activity that bonds the members together. It is the mutual exchange of food or other desirable substances. Adults feed each other and the larvae with regurgitated food. The larvae and some adults may secrete liquids that others relish. This mutual licking of each other's bodies is responsible for inter-communication and cohesiveness of the colony, and the maintenance of its own **special odour**.

Only 2 orders of insects show true social behaviour: **Isoptera** (termites) and **Hymenoptera** (ants, bees and wasps).

ANTS

There are many species of ants, (Family Formicidae), from the large Carpenter Ants to the small Honey Ants. Each has its own social structure. Generally each colony has one to several Queens that may live up to 25 years, although workers live only 2 to 3 years. The workers, all non-fertile females, are of **different sizes**, from the small **minims**, the **medias**, to the largest **majors or soldiers**. The size of the workers is a reflection of nest size. The first raised are the minims, because they take a shorter time to go through the larval stages, so colony numbers increase faster

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The jobs in the colony can be performed by most of the workers, but are usually specified **according to size**. Larger workers, majors, do outside chores such as food gathering, defending and outside nest maintenance. Medias also help gather food, especially honeydew from aphids. Smaller workers, the minims, do the indoor jobs such as tending the queen, caring for the brood, and cleaning the nest.

The **mating flight** occurs in early spring, between the large winged Queens and the small winged males. She only mates once in her life. The males, which grow from **unfertilized eggs**, live only a short time.

Ants have **well-developed senses**, especially **taste** and **touch** and are extremely sensitive to vibrations. Their greatest sense organs are their **antennae**. Ants often secrete **pheromone** from their anus to mark **trails** leading from the nest to large food sources. If the scent is wiped away, it will take the ants a while to find the continuation of the trail.

Nests types and their size are varied depending on the species and are usually found **underground**, with a few in natural cavities, or in damp wood like the nests of Carpenter Ants. Some ants are **scavengers**, eating dead insects and some are **predators**, squirting **formic acid** into bite wounds of their victims. Formic acid is also used in defence. Other ants

have a **symbiotic relationship** with aphids. They herd the aphids like cows and protect them. The ants rub the sides of the aphids to make them secrete **aphid honeydew**, a product of sap which the aphids have sucked from plants. Some ants are seed-eaters or plant-eaters, and others, like the Leaf Cutter Ants, cultivate fungi growing underground on the leaf pieces they carry there. Many ants are general scavengers, with a few preferring sweets. Most ants will get the water they need from their food, or from **flower nectar**.

Around Victoria, ants can be **dormant during the winter**, so there is no need to gather a winter supply of food.

BALD-FACED HORNET - *Vespula maculata*
The **bald-faced hornet** (a kind of yellow-jacket wasp) is a member of the paper wasp Family Vespidae. **Hornets and yellow-jackets** are common names for vespids that have black and yellow bodies and build nests of **paper**. The hornets are generally bigger. Vespids make the paper from wood, leaves or paper scraped and then chewed with their saliva. The "paper spit lines" can be easily seen on the hornet/wasp nest. In general, different kinds of wasps and hornets build nests above ground, than the **yellow-jackets** that build nests underground or in attics. The nests of the latter are more delicate.

The **colony** is an **annual** one. The fertilized Queen is the only one to over-winter. She builds a one-tiered nest, 3 to 5 cm. in diameter, lays her eggs in the **hexagonal cells** and nurtures the larvae. As workers (sterile females) are produced, they enlarge the nest gradually over the summer, into one of several tiers surrounded by an outer covering. From late spring to mid-autumn, the hive grows as the adult workers become more numerous. Bald-faced hornets may have up to **5,000 members in a hive.**

Nutrition seems to be the main factor in determining if the female egg develops into a queen or into a worker. If the larva is underfed or improperly fed, or exploited too much with **trophallaxis**, it will develop into a worker.

Unlike the ants, the workers are the same size, and jobs seem to be **age-related**. The younger workers do the inside jobs of cleaning, tending the Queen, and caring for the brood, while the older wasps are outside workers, gathering food and protecting the hive.
Wasps are **predators**, hunting food and injecting venom into their prey with their needle-like stingers. Prey is usually other insects, particularly soft-bodied ones like caterpillars. Wasps are also **scavengers** of dead meat which is why they are often unwelcome guests at our summer barbecues. They drink **nectar** from flowers and fruit.

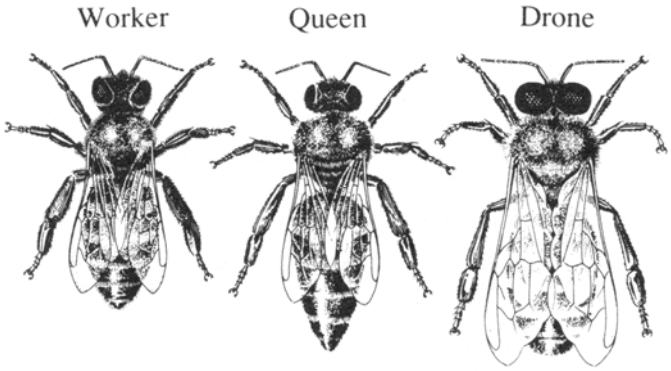
As summer nears its end, the Queen lays eggs that develop into **fertile females and males**. They mate and the **new fertilized Queens over-winter**. After this, the old Queen stops laying eggs, the workers stop feeding the larvae and may even eat them, and the **social structure disintegrates**. The adult workers spend less time at the hive, and more on their own, gorging themselves with sweets, like nectar and ripening fruits. It's as if they have one last fling before death.

HONEYBEE - *Apis mellifera*
The honey-producing bee lives in a **perennial colony** with up to **35,000 to 50,000 members**. They live as either **wild bees** in old, hollow trees, or as **hive bees**. The caste system includes a fertile Queen, male drones, and the non-fertile female workers. Although the Queen can live from 2 to 3 years, the workers live only 6 weeks in the summer, or up to 6 months in the cooler, less active months. The drones live only a short time in the late spring and summer. If they do not mate with a new queen from another hive, they are evicted from the hive at the beginning of autumn, so as not to be a drain on the hive.

In the spring, if the hive is overcrowded, or if the old Queen is failing, the colony senses the dilution of her **pheromone**, spread throughout the hive by **trophallaxis**, and builds special large, **peanut-shaped queen cells**. The Queen lays **fertilized female eggs** in these and the workers feed them solely with **royal jelly**, a protein-rich substance made by glands in the mouths of the workers. These will become new **queens**. If these larvae are fed royal jelly for the first 3 days, and then a mixture of **honey and pollen** ("bee bread") they will develop into non-fertile **workers**. Other special large cells are built for the rearing of the drones. The Queen measures this cell by putting her foot into it and by measuring with her antennae. Because it is deeper, she lays a **non-fertilized egg** into it, which will develop into a **drone**.

With the new queen(s) developing, the old Queen will take many of the workers (up to 35,000) out of the hive in a **swarm**, to start a new colony. Up to 70% of the swarm are young workers who have yet to learn to fly, so swarms start their flight slowly, following the directions of the experienced scout bees.

In the **mating flights of spring**, the new queen receives sperm from ten or more drones, which she stores in a sac and which serves her for her lifetime of 3 to 4 years. In summer, the Queen can lay up to **1,500 eggs a day.**



The following is a general **Growth Cycle** comparison:

Stage	Queen	Worker	Drone
Egg	3 days	3 days	3 days
Larva	5.5 days	6 days	6.5 days
Pupa	7.5 days	12 days	14.5 days
Adult emerges	16 days	21 days	24 days
Adult	3-4 years	6 weeks	8 weeks

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The non-fertile adult workers have jobs that are **age related**. During the first 2 to 3 weeks they are **house bees**. The first jobs are: **cleaning** the cells, and **feeding** the larvae and Queen. The house bees also **change nectar into honey**.

Important enzymes are added to the nectar by the saliva and in the "**honey stomach**" (of the foraging bee). The enzymes, along with evaporation convert the nectar into honey. The rate of evaporation is increased by the house bees. They suck up the nectar on their tongues, and then spit it back into the cell. This increases the surface area exposed to the air for evaporation to get the moisture content down to 18%. They also fan the honey with their rapidly beating wings.

As the bees mature, **wax flakes** are produced on the abdomen. Wax is excreted from 8 small glands, as a liquid, which then solidifies. The bees chew it and then cap the existing wax cells full of honey, pollen, or larvae ready to pupate. These **builder bees** also make new hexagonal cells. When the glands stop producing wax, the worker bees move on to do the outside job of guarding.

At the entrance, the **guard bee** learns to **fly,** flying backwards at first, to memorize what the door and surroundings look like. Guard bees smell every bee that enters the hive. If the bee does not have the special hive odour, the guard disperses an **alarm pheromone** which indicates there are intruders in the hive. The bees chase away intruders but sometimes they have to sting the enemy.

Bees have **barbed stingers with venom**. Unlike wasps, they can only **sting once**; the barbs hook into the victim's body, and when the bees try to get away, their bodies rip apart. **Honeybees only sting in self-defence or in defence of their colony**.

The oldest bees then become **field bees**, **foraging and scouting** for food up to 5 km (3 mi.) away. They collect **nectar, pollen and water** for food, and **resins** to make **propolis** to weatherproof and patch the hive.

The nectar is sucked from the flowers through a straw-like tongue, and put into a special "**honey stomach**" or crop. It is later regurgitated into the honeycomb cells. Pollen collects on the fine hairs all over the bee bodies, even on their eyes! The bees scrape it off their bodies with their legs, and from flowers with their mouths. They mix it with nectar to make it sticky, and then it is transferred by the forelegs to the middle legs and finally to the **pollen baskets** on the hind legs. Generally, a bee will feed from the same species of flower, so the pollen is a uniform and characteristic colour. The pollen is put into the outer cells in the hive, tamped down, and spat upon. The saliva changes it into "**bee bread**" with natural preservatives to keep it from rotting.

On returning to the hive, the scout bees dance to communicate the location of the source of the food they've collected. The intensity of the dance is a reflection of the abundance of food. A simple **round dance** indicates a very close source, less then 100 meters.

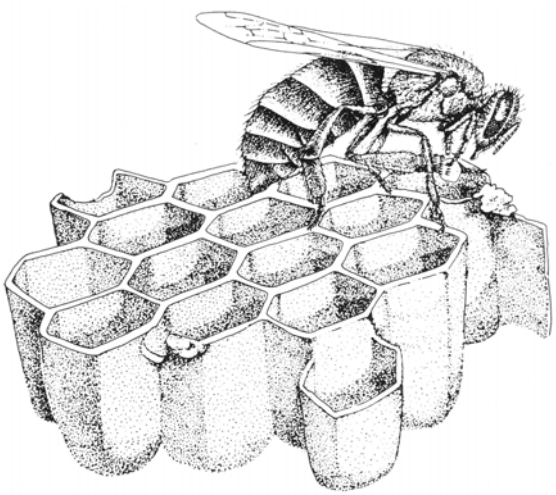
Over this distance, the **waggle dance** is done in a **figure 8**, with the **straight runs showing the direction of the food** in relation to the sun. If these straight runs are made upwards on

the vertical side of the hive, the food is in the direction of the sun. If they are 40 degrees to the right, then the food is 40 degrees to the right of the sun on a horizontal plane. The **speed of the tail-waggle shows the proximity** of the food. The farther away, the slower the waggle. The taste and smell of the forager gives information about the kind of food. The other bees get this information using their antennae, and may imitate the dance.

Honeybees **do not hibernate** in the winter. They keep slowly active, usually staying inside the hive, **feeding on the stored honey and pollen**. Egg laying and brood rearing are minimal. Most drones have been evicted, and the colony population is low. To keep warm, **bees cluster** around the Queen, huddling tightly when it is very cold and relaxing when the temperature goes up. The bees on the outside of the cluster barely move while the inside ones **move to generate heat** for the hive. The bees then change positions. Towards the end of February, as the weather is warming, the Queen starts to lay eggs. The colony is revitalized.

For people, the most important work of the honeybee is to **pollinate flowers**. They also provide us with **honey**. Caveman paintings show ancient man taking honey from bees.

The honeybee is a **naturalized, but not a native species**. It was introduced to eastern North America from Europe. Swarms travelled south, west and then north along the coast to B.C. They crossed the NA continent even before the white man.



SUGGESTIONS TO ENHANCE YOUR VISIT:

1. The Audio-Visual Department of your School or School District may have several **videos or films**.

2. The following could be discussed **before the visit**:
   - **Habitat** being an animal's home with all that it needs:
     food, water, shelter, space
   - **Insect stages**: egg, larva, pupa, adult
   - Insects have 3 main body parts, 6 legs and 2 antennae
   - What **social insects** are:
     -they live in a colony
     -with 1 Queen, some males, and many workers
     -look after their young
     -cooperate
     -and have special jobs

3. **Follow-up activities**:

*Investigate the **shape of the hive cells**; using hexagon, circle and square shapes, children can be encouraged to understand why the hexagon is the best shape for the cells in the hives of bees and wasps. It allows for shared walls, greater strength and the least amount of wasted space both inside and outside each cell.
*Make **insect shapes**: children can trace a large worker bee body, using tracer shapes for the 3 main body parts: head, thorax and abdomen, and the wings. They can add the 6 legs and 2 antennae themselves...or use solid objects and build insects (e.g. start with a potato)
*A visit to a **beekeeper**
*Tasting different **kinds of honey**, including **honeycomb**
*Doing other activities or games from **Project Wild**
*Comparing the social life of insects to the lives of people, i.e. how jobs change as they grow up.

4. There are many **resource books** including:

A Field Guide to the Insects of America. "Peterson Field Guide Series". D.Borer & R.White. 1970. Houghton Mifflin Co. Boston.
The Biology of the Honey Bee. Harvard Univ. Press. 1987

Bees. Elin Kelsey. "Nature's Children Series". 1986. Grolier Ltd. N.Y.

1001 Questions Answered About Insects. Alexander & Elsie Klots. 1961. Dover Publications Inc. N.Y.
Life of the Honeybee. Heiderose & Andreas Fischer-Nagel. Carolrhoda Books Inc.

A Guide to Observing Insect Lives. Donald Stokes. "Stokes Nature Guides". 1983.Little, Brown & Co. Toronto

Payment
In invoice will accompany the confirmation letter you received. **Payment** is due at the time of the program, and cheques should be made out to **Swan Lake Nature Sanctuary** and given to the programmer. **VISA or MC** can be phoned in.
Receipts will be sent by e-mail or fax upon request.

Change of Dates and/or Times:
If you wish to change the date or time of your program please contact us at **250.479.0211** or at **programs@swanlake.bc.ca.** We will do our best to accommodate your request, depending on available times and dates.

If you have any questions or comments about your program please don't hesitate to contact us; we always welcome your feedback.

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