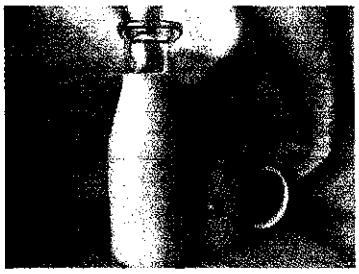
Food Production and Management I

7

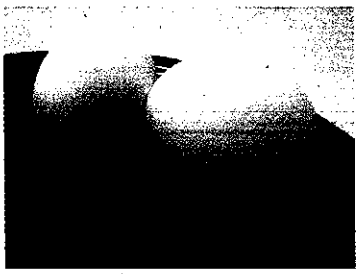
LEARNING OUTCOMES

- Useful microorganisms
- Sericulture
- Apiculture
- Pisciculture
- Poultry farming
- Livestock farming
- Protection of animals against diseases



(a)

(b)



(c)

Observe pictures (a) to (c) carefully. Do you know where each of these products is obtained from? All three products shown in these pictures are obtained from animals. In this chapter, we will discuss some useful microorganisms and animals and the products obtained from them.

TECH FILE

Fermentation involves conversion of sugar into alcohol (using microorganisms such as bacteria and yeast) under anaerobic conditions. This process has an important role in the food processing industry. The science of fermentation is known as zymology.

USEFUL MICROORGANISMS

You must have learnt about microorganisms (bacteria, fungi, algae, etc.) in class 7. There are bacteria, fungi, and algae from which we benefit immensely and hence they are considered to be useful microorganisms.

Useful Bacteria

Several industrial products, which have wide commercial applications, such as ethyl alcohol, acetone, acetic acid, etc., are obtained through bacterial action known as *fermentation*. The familiar household process of curd setting is fermentation of milk sugar (lactose) into lactic acid by the action of a bacterium.

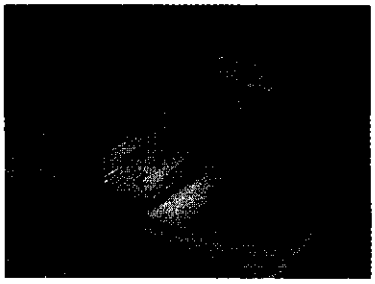


Fig. 7.1 *Bacteria are used to impart flavour to cheese*

Bacteria are used for imparting special flavours to products such as cheese (Fig. 7.1), tea, coffee, cocoa, and tobacco. They are also involved in the preparation of life-saving drugs such as antibiotics and in the preparation of B-complex vitamins. Fibres from coconut husk, jute, hemp, and flax are loosened by the digestive action of bacterial enzymes. Bacteria also help in the process of making leather from animal hides—bacterial enzymes are used to digest the unwanted tissues on the hide.

Useful Fungi

Yeast is used in the baking industry to make bread light and fluffy. Cereals, grapes, and a variety of other products are fermented to obtain alcoholic beverages. Certain antibiotics are also manufactured from fungi (e.g., Penicillin).

Fig. 7.2 *Spirulina tablets*

Useful Algae

Seaweeds are a source of food and are rich in vitamins and minerals. Some species of algae (e.g., *Spirulina* and *Chlorella*) are used as nutritional supplements (Fig. 7.2). Various chemicals of industrial importance too are extracted from them. A laboratory culture medium known as agar is obtained from red algae. A type of algae known as diatoms is the source of silica for several industrial applications.

Alexander Fleming (1881–1955)

Scottish biologist Alexander Fleming was the first to notice the antibiotic properties of fungi. He isolated the antibiotic penicillin from the fungus *Penicillium notatum*.

USEFUL ANIMALS

Ancient humans hunted animals and ate their flesh. They used the hides and furs of animals for clothing; their skins as containers; their bones and horns as tools and weapons; their teeth, claws, and feathers as ornaments; and their fat as fuel. Domestication of animals started around 12,000 BC. The bond between humans and animals useful to them has been strengthened over the years. Farmers rear cattle for milk, meat, and work; goat for milk and meat; sheep for wool; pigs for meat; poultry for eggs and meat; bees for honey; and silkworms for silk.

The bond between man and animals has developed into distinct scientific disciplines such as sericulture, apiculture, pisciculture, poultry, and livestock farming.

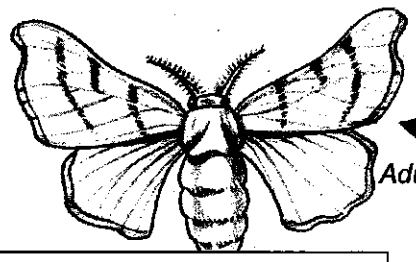
Sericulture

The raising and care of silkworms (larvae of silk moth) for the production of raw silk is referred to as ***sericulture.*** Of the several types of silk moths, *Bombyx mori* is most widely used in sericulture. *Bombyx mori* completes its life cycle in four stages: egg, larva, pupa, and adult.

FACT FILE

Nearly 55,000 cocoons are required to obtain a kilogram of silk.

Adult The adult moth emerges from the cocoon at the end of the pupal stage.



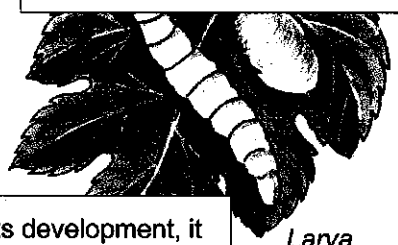
Adult

Eggs

Egg The eggs are small, slightly yellowish, and are covered by a smooth, hard chitinous shell.

Pupa The mature larva stops feeding and starts spinning silk around its body to form a *cocoon*. The cocoon is made of a silken thread which is over 500 metres long.

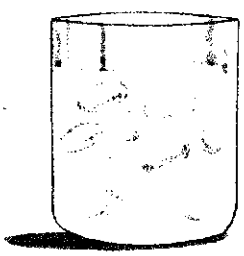
Pupa

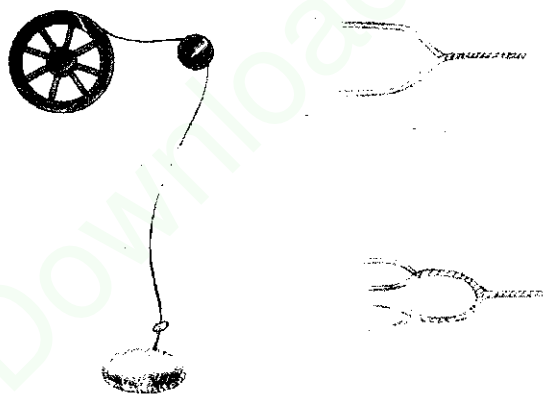


Larva

Larva When the embryo completes its development, it hatches out of the egg in the form of a larva. The larvae feed on mulberry leaves.

The adult moth emerges from the cocoon by cutting a hole into it, which damages the silk thread. Therefore, silk extraction is done before the moth emerges from the cocoon.





For the purpose of silk extraction, ten day old cocoons are immersed in hot water. This kills the pupa in the cocoon.

The silk thread is skillfully unwound from the cocoon and threads drawn from several cocoons are twisted into yarn.

Apiculture

The raising and care of domesticated bees for the production of honey is referred to as ***apiculture****. The place where the bees are kept for rearing is called an* ***apiary****.*

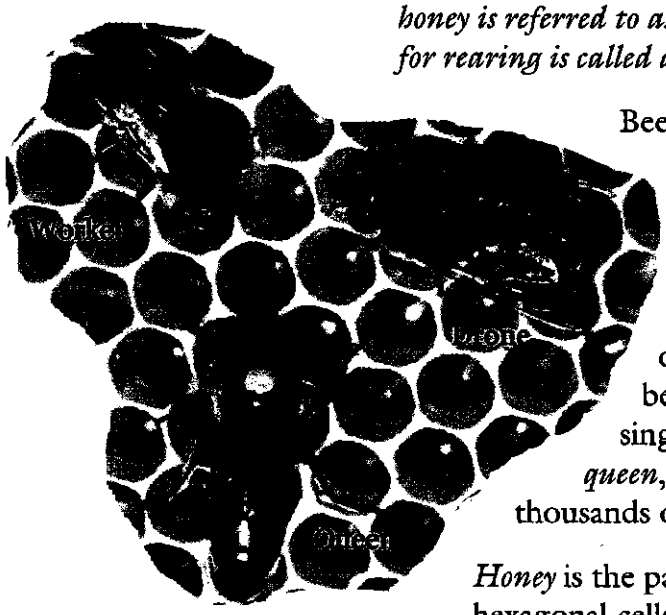
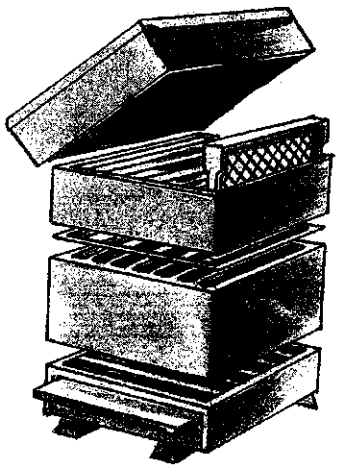


Fig. 7.3 *Apis mellifera (honeybee): worker, drone, and queen*

Bees are the best pollinators in nature. They collect nectar and pollen grains from flowers and, while doing so, bring about the transfer of pollen from one flower to another. Honeybees live in colonies in a beehive, which in the wild is normally built on trees with the wax that they produce. In a beehive, there are three types of individuals: a single large fertile female referred to as the *queen*, some males referred to as *drones*, and thousands of sterile *workers* (Fig. 7.3).

Honey is the partially digested flower nectar stored in the hexagonal cells of the hive for future use. It consists of sugar, water, minerals, and enzymes. Honey has medicinal properties and is a valuable food. *Beeswax* is a secretion produced by the worker bees for building their hive. It is used in the cosmetics industry, and in other industries connected with the manufacture of polishes, candles, and electrical goods.

(a)



(b)

Fig. 7.4 *(a) Natural and (b) artificial beehive*

Bee-keeping is a profitable pastime. For this one or more boxes are made and mounted on a stump about 5 feet high (Fig. 7.4). A colony is introduced into each set-up, which has an opening narrow enough to allow only the workers to come out or go in. Inside the box there are frames on which the bees construct the hives. When the cells in the hive are filled with honey, the frames could be removed and the honey extracted with the help of a centrifugal machine, without damaging the hive. The frame, with the hive intact, could be put back for the bees to collect more honey.

Pisciculture

The breeding and rearing of fish for food or as an industry is referred to as ***pisciculture****.* Fish is an excellent source of proteins.

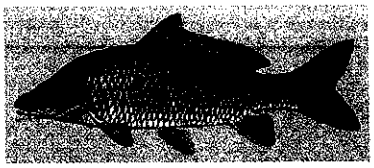
An ideal pisciculture farm should consist of three different tanks, a nursery tank, a rearing tank and a stocking tank.

Nursery tank: These are also called hatcheries and are used for developing fish eggs or *seed* into *fry* (the tiny young ones that hatch out of the eggs). Fry are delicate and need special care and protection from predators.

Rearing tank: This is used for the development of the fry into *fingerlings* (small fish, about the length of a finger), which are big enough to be released into the main tank.

Stocking tank: This is the main tank where the fish are grown to maturity and are finally harvested. It is a large tank, about 10 feet deep.

The popular 'six species culture' includes a mix of catla, rohu, mrigal, silver carp, common carp (Fig. 7.5), and grass carp, all of which are high-quality food fish. Alkaline soil and water conditions are more beneficial for increasing productivity. Lime is commonly used to maintain alkaline conditions. Other requirements in an ideal fish farm are regular cleaning, disinfecting, etc. Fish are mostly fed rice polish. rice bran, mustard oil cake, and groundnut oil cake. Some like grass carps eat green leaves too.



(a)

(b)

Fig. 7.5 *(a) Common carp and (b) grass carp*

Poultry farming

Poultry farming *is raising chickens, turkeys, ducks, and other fowl for eggs or meat* (Fig. 7.6). Till a few decades ago, poultry farming was a household affair—the farmer's wife throwing some feed out to the chickens wandering in the backyard. Today poultry raising is big business!

Eggs are rich in proteins, fats, vitamins, and minerals. Chicken meat is a rich source of proteins. Chicken raised for meat are called *broilers.*

Egg-laying chickens are usually raised in cages made with wire mesh. The droppings fall to the ground and are cleaned regularly. Feeding trays and egg trays are kept in front of the cage. The birds are fed on a combination of maize, soy, rice bran, and cereals. Plenty of clean water is a must for egg and meat production. Since egg production is related to day-length, artificial lighting to increase the day-length in winter will tend to increase egg production.

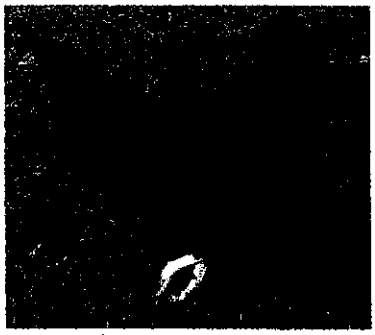
(a)

(b)

(c)

(d)

Fig. 7.6 *Poultry: (a) chicken, (b) turkey, (c) duck, and (d) goose*



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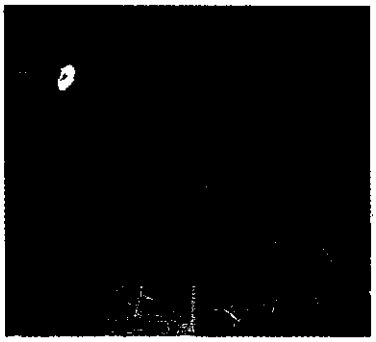


(b)

Fig. 7.7 *(a) Rhode Island red and (b) brown leghorn*

Broilers are raised in well-ventilated rooms with a thick layer of sawdust to absorb the droppings. The feed and water are kept at intervals so that all birds will have free access to them. After raising a batch, the room is cleared of the dropping and sawdust, sterilized, and is again prepared with a fresh spread of sawdust to raise another batch.

Good egg layers are Rhode Island reds (which lay brown eggs) and leghorns (which lay white eggs) (Fig. 7.7). Great meat comes from Ross and Peterson chickens, which were named after the breeders who raised them.

Bird droppings from poultry farms are an excellent source of nitrogen for plants and are valuable organic manure.

Livestock farming

Domestic animals kept for use on a farm or raised for sale and profit are collectively referred to as ***livestock****. The rearing of livestock is called* ***animal husbandry****.* Cattle and buffaloes are the major livestock in India. Sheep, goat, and pig are also commonly kept livestock.

Cattle and buffaloes

Cattle and buffaloes are used for a variety of tasks. These may be considered under two broad categories: dairy breeds and draught breeds.

Dairy breeds Animals bred for milk production are called *milch animals.*

Milch cows Increase in milk yield is achieved by cross-breeding Indian cows with European bulls such as Brown Swiss and Jersey. Sahiwal and Red Sindhi are examples of Indigenous milch cows. Jersey and Brown Swiss (Fig. 7.8) are examples of exotic milch cows. Karanswiss and Sunandini are examples of cross-breeds between the exotic and indigenous breeds.

Milch buffaloes Buffaloes have greater disease resistance and longevity and their milk is comparatively high in its fat content compared to that of cows. Murrah, the original breed of Punjab and Haryana has the highest yield. Mehsana is another high-yielding breed common to Gujarat.

FACT FILE

Araucana, a variety of chicken found in South America, lays blue-green eggs.

Fig. 7.8 *Brown Swiss*

Draught breeds Animals such as horses, donkeys, mules, elephants, and camels are kept mostly for heavy work. Bullocks also can be put under this category. These are referred to as *draught animals.* Elephants are used in hauling and handling timber; donkeys and mules are used for transportation of goods in hilly terrain; camels and bullocks are used for taking goods to the market; and horses and bullocks are used for pulling carriages in rural areas (Fig. 7.9).

***Fig. 7.9** Draught animals*

Sheep and goats

Highly nutritious and protein-rich mutton comes from goat and sheep. Mutton from goat is superior to that of sheep. Goats also provide milk.

Goats These have been domesticated by man since long. They give us superior quality mutton, milk, and hide. Some goats such as the Cashmere goat (Fig. 7.10) yield excellent fine wool on which the famous *pashmina* shawl industry is based. Goats eat the leaves of a variety of vegetation and can thrive even under harsh conditions. They graze even on steep and precarious mountain slopes and cliffs with ease. Goat raised for mutton must be given a supplementary diet of gram chaff, oil cakes, and vitamin-mineral mixtures.

***Fig. 7.10** Cashmere goat*

Sheep These provide wool, hide, and meat. They graze on the grass in pastures on the mountains as well as in the plains. Sheep do not require any formal shelter. In the mountains, the shepherds keep moving from pasture to pasture with their flock from April to October. In winter the sheep are kept in houses and fed foliage, dry fodder, and grains.

Pigs Pigs (Fig. 7.11) are known to be the most economical 'meat producer' that nature has ever produced. Pig meat, referred to as *porks*, is used in the production of ham, bacon, and sausages. The hide is processed into leather and its bristles are used in the manufacture of brushes. The fat (lard) is used in the soap industry.

***Fig. 7.11** Pig*

PROTECTION OF ANIMALS AGAINST DISEASES

All living things are exposed to disease-causing organisms and animals are no exception to this. However, just as human beings

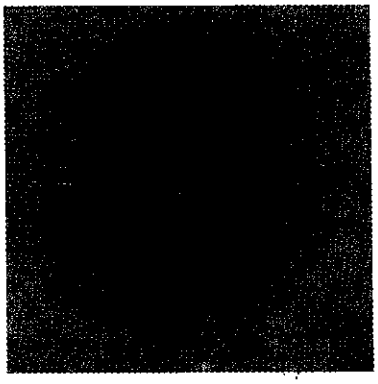


Fig. 7.12 Myxobolus

are protected against certain infectious diseases by vaccination, animals also can be protected from diseases through preventive vaccination.

Silkworms Silkworms are exposed to diseases caused by protozoa, fungi, viruses, and bacteria. The diseases cause large-scale destruction of silkworms. *Nosema bombycis* is a protozoan parasite that causes pébrine disease in silkworms. Hygienic rearing rooms, where temperature and humidity are maintained at the optimum, and timely destruction of infected worms, if any, are essential in safeguarding the health of the silkworms.

Honeybee Honeybees are exposed to diseases caused by bacteria, fungi, and viruses. European foulbreed and American foulbreed are bacterial diseases that affect larvae and adults. Chalkbrood is a fungal disease that affects larvae.

Fish Diseases of fish are basically attributed to poor quality of water. Fish are exposed to diseases and pathogens, but a healthy fish's immune system is good enough to withstand them. However 'stress' weakens their immune system, leading to increased susceptibility to disease. Most of the diseases of fish in pisciculture tanks can be prevented by avoiding stress. If fish are seen gasping at the surface or have purple gills, high ammonia or low dissolved oxygen may be the problem. Certain parasitic protozoans such as *Myxobolus* (Fig. 7.12) cause diseases in freshwater fish.

FACT FILE

Silkworm pupae are eaten in some countries!

Poultry Diseases like Raniket, fowlpox, and fowl cholera are a serious threat to poultry farming. With better management, hygienic housing, good diet, clean water, and timely vaccination of the chicks, most of these diseases can be controlled.

Cattle and buffaloes Cattle suffer from 'foot and mouth disease' caused by virus. The symptoms are blisters on feet and mouth, excessive salivation, reduced appetite, and fever. Cowpox is also caused by virus. The disease is characterized by high fever and appearance of small nodules over the body. Anthrax (Fig. 7.13) is a bacterial disease characterized by high fever and swelling on the body. The disease is highly infectious and fatal; death usually occurs within hours. Rinderpest (cattle plague) is also caused by bacteria. The symptoms include high fever, excessive salivation, redness of eyes, and loss of appetite.

Fig. 7.13 Bacteria that cause anthrax

Protection is given by vaccination. Mad cow disease is a fatal degenerative disease affecting the central nervous system.

Sheep and goat The common diseases of sheep and goat are caused by virus and bacteria. Proper sanitation and preventive vaccination can ensure protection against these diseases.

Pigs Pigs are affected by bacterial and viral diseases. Timely vaccination can prevent most of these diseases. Pigs are never fussy about their food. They feed on garbage, kitchen waste, vegetables, and even human faeces, thus becoming instrumental in the spread of tapeworm (Fig. 7.14). Improperly cooked pork may cause tapeworm infection.

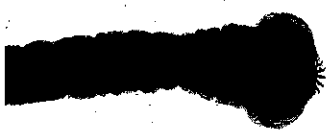


Fig. 7.14 Tapeworm

KEYWORDS

Sericulture The raising and care of silkworms for the production of raw silk
Apiculture The raising and care of domesticated bees for the production of honey
Pisciculture The breeding and rearing of fish for food or as an industry
Fry Tiny fish that hatch out of eggs
Fingerlings Small fish, about the length of a finger
Poultry farming Raising chickens, turkeys, ducks, and other fowls for eggs or meat
Broilers Chicken raised for meat
Livestock Domestic animals kept for use on a farm or raised for sale and profit
Animal husbandry The rearing of livestock
Milch animals Animals bred for milk production
Draught animals Animals used for heavy work

SUMMARY

- Many useful products are obtained from microorganisms and animals.
- The silk moth *Bombyx mori* completes its life cycle in four stages: egg, larva, pupa, and adult.
- Silk extraction is done before the adult moths emerge from the pupae (cocoons).
- There are three types of individuals in a beehive: queen, drones, and workers.
- Honey and beeswax are the main products of apiculture.
- The ideal pisciculture farm should consist of a nursery tank, a rearing tank, and a stocking tank.
- Poultry provide meat and eggs. Bird droppings are a valuable organic manure.
- Cattle and buffaloes can be divided into two broad categories: dairy breeds (which are raised for milk) and draught breeds (which are kept for heavy work).
- Animals are exposed to diseases caused by organisms such as protozoa, fungi, viruses, and bacteria. By keeping the shelters of livestock clean and hygienic and by giving nutritious food, they can be kept healthy.

EXERCISES

I. Review questions

A. Fill in the blanks

1. ..... (Fungi/Bacteria) help us in setting curd.
2. ..... (*Spirulina*/Penicillin) is an antibiotic.
3. Silkworms feed on ..... (mulberry/coconut) leaves.
4. The place where honeybees are kept for rearing is called an ..... (apiary/cell).
5. Animals bred for milk production are called ..... (draught/milch) animals.

B. Tick the correct answer

1. Chickens raised for meat are called
   (a) fry (b) fingerlings (c) broilers (d) drones
2. A secretion produced by worker bees for building the hive
   (a) beeswax (b) gum (c) honey (d) cocoon
3. A milch cow
   (a) Ross (b) Murrah (c) Mehsana (d) none of these

C. Correct the statements that are false

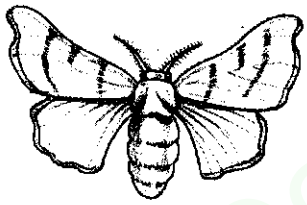
1. Bacteria help in the process of making leather.
2. Leghorn is a type of chicken
3. Horse, poultry, and fish are examples of milch animals.

D. Answer the following

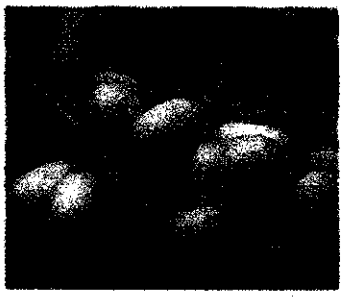
1. List any two ways in which bacteria are useful to us.
2. Describe the life cycle of *Bombyx mori* in brief.
3. What is apiculture? Name the three types of honeybees found in a beehive.
4. What is pisciculture?
5. How are cattle and buffaloes useful to us?
6. Name any two diseases affecting cattle.

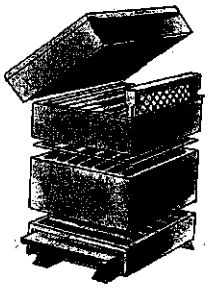
II. Skill-based questions

E. Arrange the following images in the correct sequence:

F. Identify the following images:





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III. Fun Time

Unscramble the following words (Hint: You must have come across these words in this chapter.)

OCONCO	NODER	ROBILER	UERSIECURLT	REALPICTUU
.....	.....	.....	.....	.....

PROJECT IDEAS

- Students can write a report on different breeds of sheep reared in India. The report should include information such as feeding habits, breeding time, and the quality of wool.

TEACHER'S NOTES

- Visiting a sericulture farm, an apiary, and a poultry farm will help students in understanding these topics better.
- Films on sericulture, poultry farming, apiculture, and livestock farming could be shown, if possible.
- A veterinarian could be invited to talk to the students about common diseases of domesticated animals and their prevention.

Website References

http://www.cals.ncsu.edu/course/ent425/text01/sericulture.html (accessed 8 June 07)
http://www.pbs.org/wgbh/nova/bees/hive.html (accessed 12 June 07)