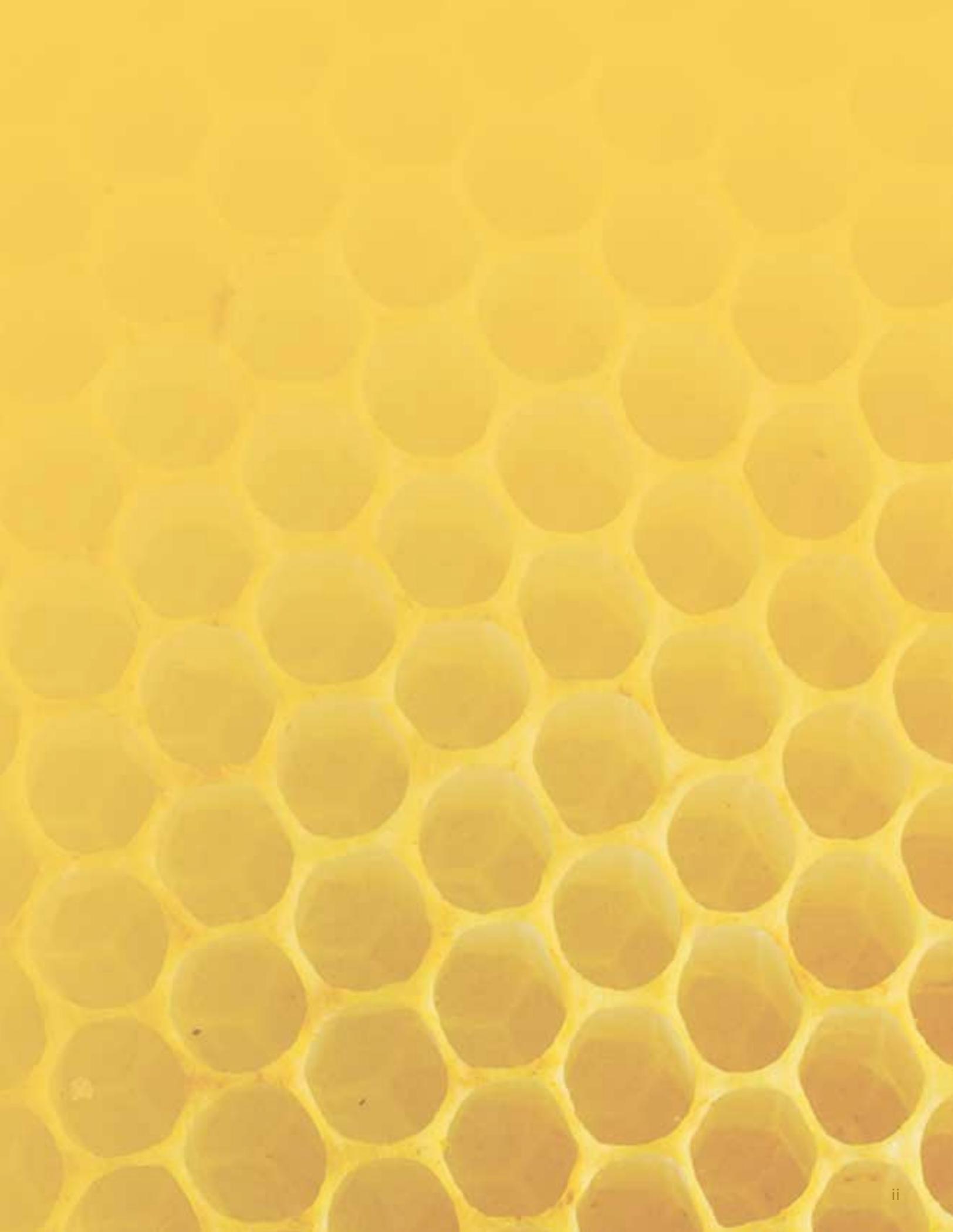


BERMUDA FOLKLIFE
DOCUMENTARY SERIES

Beekeeping



Sturdy Guide





BERMUDA FOLKLIFE
DOCUMENTARY SERIES

Beekeeping

Study Guide



GOVERNMENT OF BERMUDA
Ministry of Social Development and Sports
Department of Community and Cultural Affairs

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HOW TO USE THIS GUIDE

A supplement to the Bermuda Folklife Beekeeping Documentary, created by the Bermuda Government's Department of Community and Cultural Affairs, this study guide is a classroom resource primarily for middle and high school teachers of subjects across the curriculum, including science, mathematics, language, environmental studies, business studies, creative writing and literature. It is especially useful as a resource for promoting writing, particularly for students who prefer to write about expository topics, rather than emotional issues based on personal experience. Beekeeping in Bermuda is an excellent topic for developing research skills since it has many aspects to explore, many of which students can see for themselves. It also allows them the opportunity to interview beekeepers and environmentalists as part of their research process. As a result of their research, students will gain a stronger awareness of Bermuda's environment, including its ecology, and an ability to think critically about it.

Teachers of writing could use the guide to promote the following patterns for writing essays, research papers and business reports:

Analogy

Argumentation

Cause and Effect

Classification

Comparison and Contrast

Definition

Description

Exemplification

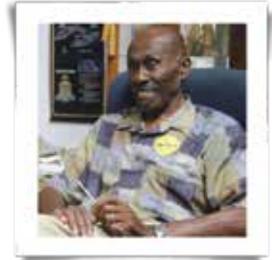
Process

The guide will begin with brief biographies of beekeepers featured in the documentary and a list of preview questions students should consider before watching the documentary. Questions for discussion, comprehension testing and writing, as well as a glossary of terms, will be included in most chapters.

Brief Biographies of Mr. Randolph Furbert Mr. Quincy Burgess and Ms. Jenny Faries

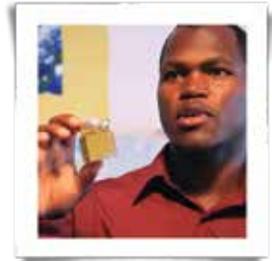
Mr. Randolph Furbert, Jr.

Born in 1934 and brought up on a farm in Hamilton Parish during the Second World War, Mr. Randolph Furbert grew up with bees since his father was a beekeeper. During the early 1970s he decided to follow his father's example and invested in beekeeping as a sideline to his trucking business. Eventually, he became a full-time beekeeper (Beekeeper No. 5) and for many years had the largest amount of hives on the island. He also trained many young people as beekeepers.



Mr. Quincy Burgess

Born in Bermuda in 1980, Mr. Burgess learned beekeeping from Mr. Randolph Furbert and then kept his own beehives. He also gave beekeeping workshops and classes to the public in Bermuda. He now resides in Kenya where he continues to practise beekeeping.



Ms. Jenny Faries

Born in Bermuda in 1982, Ms. Faries was apprenticed to Mr. Randolph Furbert and became one of Bermuda's beekeepers. She is currently at Dalhousie University studying Clinical Vision Science with the goal of becoming an orthoptist and ophthalmic medical technician (part of the healthcare team working with ophthalmologists). She plans to continue beekeeping when she returns to Bermuda.



Preview Questions to Consider before Watching the Documentary

1. Do you know whether European honeybees have always been in Bermuda? Or were they introduced? If so, when?
2. Do you know how and why bees make honey?
3. Do you eat honey? If so, have you noticed whether it is local or not? Does Bermuda honey have a different taste compared to other honeys? If so, why do you think that is?
4. Do you know what else bees make and for what reasons?

5. Besides honey, what other products contain bee-related ingredients?
6. Do you know what a hive is and how it is organised? Have you ever seen one?
7. Did you know that there are beekeepers in Bermuda?
8. Are you frightened of bees because of their stings? Why aren't beekeepers frightened?
9. Why are bees important to Bermuda's environment? What do you think they do besides make honey and maintain their hives?
10. In what ways would working closely with bees to harvest honey be different from, for example, working with cars to fix them? In what ways would working with animals be similar to working with machines? How would you characterise the relationship beekeepers have with bees?
11. Do you know what an apprenticeship is? Have you ever thought about learning a trade or a skill by working for an expert in the field?

Questions for Discussion after Watching the Documentary

1. What are currently the chief threats to bees in Bermuda?
2. Why do Mr. Burgess and Mr. Sinclair argue the varroa mite has had some positive effect for beekeepers in Bermuda?
3. How can you tell from the documentary the beekeepers have a personal relationship with the bees that is not merely to do with the money they will make from them?
4. Do you think humans can learn anything from bees?
5. What do you think motivates beekeepers in Bermuda?
6. Why do you think Mr. Furbert wanted the bees to beard up on his face? Would you want to do such a thing? If so, why? Think about facing and overcoming scary challenges.
7. What life lessons do you think an apprentice can learn from a mentor that he/she might not learn from books?
8. Would you consider becoming an apprentice in order to learn a trade or skill?

Chapter 1: Key Dates in the History of Beekeeping in Bermuda

In 1616 honeybees (*apis melliferae*) were imported to Bermuda from England. We know this because of a letter Robert Rich, one of Bermuda's first settlers, wrote to his older brother, Nathaniel Rich in May **1617**: "The bees that you sent doe prosper very well. They stand as yet in the Governors Garden but I propose towards michellmace (**29 September**) to remove them when I have builded a convenient place for them."

In those days honeybee colonies were kept in wooden boxes, straw beehives called "skeps", pottery vessels, and other containers.



1622: Small quantities of honey and beeswax were exported to the West Indies and American colonies.

1851: Lorenzo Langstroth invented his moveable frame hive. The wax comb foundation was invented in **1857** and the centrifugal honey extractor in **1865**. It is likely Bermuda adopted these inventions soon after they were introduced in the U.S. and Britain.

1875: The giant toad (*Bufo marinus*) was deliberately imported to Bermuda to reduce cockroaches in 1875. Unfortunately, they love to eat bees.

1897: John Hurdis's Natural History mentions the good quality of Bermuda's honey and that it was sold for 2 shillings a bottle. He noted honeybees were frequent in sugar warehouses in town. Bees like to build nests inside buildings and often people would accommodate them by creating pipes to allow them to exit and enter.

1949: The Bermuda Beekeepers Association (BBA) was formed. Because of the racial segregation of the time, it originally consisted of white members only.

1953: The Argentine ant (*Iridomyrmex humilis*) was accidentally introduced to Bermuda. This was bad news for beekeepers since these ants can infest hives and destroy bees and their larvae.

1956-7: The kiskadee (*Pitangus sulphuratus*) was introduced from Trinidad to combat the oleander green shield scale. Apparently, Jamaica anole lizards were eating the beetles that ate the insects attacking the oleander. Kiskadees, said Dr. F.J. Jack Simmons of the Commonwealth Institute of Biological Control, would solve the problem because they would eat the lizards. Unfortunately, kiskadees have a voracious appetite for all sorts of foods, including bees.

1973: Dr. Idwal Wyn "Walwyn" Hughes, who headed the Department of Agriculture and Fisheries, offered a beekeeping course to the public.

1975: American foulbrood, a destructive bee brood disease, was detected in Bermuda. An annual Government inspection of beehives was introduced – Dr. Jock Stewart became Government Bee Inspector 1975 to 1982.

1982: Norris Caines was the first black beekeeper to be elected president of the BBA.

1986: Mr. Randolph Furbert became the first Bermudian to wear a bee beard by allowing hundreds of honeybees to rest on his face. He did this by affixing a small cage holding a queen to his chin so that the bees would follow her.

1986: This year was an excellent year for Bermuda honey. 120lbs were harvested from each hive so that there was a surplus of 500 gallons of honey in June. BUT...

1987: Hurricane Emily destroyed 30 percent of Bermuda's vegetation. The 1987 honey crop was 50 percent lower than normal.

1988: Ms. Caroldey Douglas started bottling honey for tourists. Mr. Randolph Furbert opened a commercial scale extracting facility, the first in Bermuda. His honey can still be found on sale in Bermuda's supermarkets, as well as in stores selling Bermuda-made products.

1999: About 400 beehives were in Bermuda and about 30 members in the BBA.

2001: Randolph Furbert attended the Smithsonian Folklife Festival in Washington to share his knowledge about Bermuda beekeeping.

2003: Randolph Furbert received the Queen's Certificate of Honour.

2000–2009: The average value of the island's honey crop was over \$170,000. Bermuda's beehives reached a high of 350. There were approximately 24 beekeepers.

2009: The varroa mite was first detected in Bermuda. It is unknown how it got here. The only imported bees were queen bees from Hawaii. Once it was known Hawaii had the mite in 2007, all importation of bees was forbidden.

2010: The average value of the honey crop dropped to \$50,000. The number of beehives dropped to 60–70. Hurricane Igor affected the island's foliage, thus depriving the bees of flowers they needed for nectar and pollen.

2015–15: The number of active beekeepers dropped to 14.

2016: The number of beekeepers is on the rise. The latest statistics show 31 beekeepers, 19 with working hives while the remainder are actively looking for bees. The BBA is being resurrected and now has 24 members.

2016: Statistics collected are not yet complete but the number of hives has risen since 2010. A definite minimum number is 107. The final number for 2016 will be between 175 and 200. Once the beekeeper with the most hives, Mr. Furbert is reducing his number. Mr. Lowell Woolridge currently has the largest amount of hives.

Did You Know

- Bermuda had European honeybees before the American colonies. They were sent from England to Bermuda in 1616 and to Virginia in 1622.

Questions for Discussion, Comprehension and Writing

1. What local materials might Bermuda's beekeepers during the 17th and 18th centuries have used for making honeybee containers?
2. What and why were some animals from other countries introduced to Bermuda? Give examples of unexpected and negative outcomes. What lessons were learned?
3. Give reasons for the rapid decline of bees since 2009.
4. What effects do you think the decline of bees will have on the island and its inhabitants?



The varroa mite



Chapter 2: Equipment, Tools and Protective Clothing Necessary for Beekeepers

Beekeeping is an exacting practice as it requires a deep knowledge of the bees' biology, behaviours and organisation and a constant attentiveness to their wellbeing. Catching a swarm, splitting a hive, removing mites dangerous to the bees, removing drones, removing wax caps and honeycombs before taking the honey are just some of the activities beekeepers regularly carry out. Because worker honeybees have stingers to guard the hive, beekeepers always risk being stung – stings are often a part of the trade. Therefore, appropriate beekeeping equipment, tools and protective clothing are essential.



Hives

Hives are structures for housing a bee colony. It is likely the first settlers in Bermuda used cedar to make boxes or woven palmetto leaves to make skeps. Bees would attach their wax combs to the hives' walls and roofs, just as they would attach their combs to natural hives. In both cases, removing the honey could damage or destroy the whole bee colony.

Langstroth Hive

By 1851 Lorenzo Langstroth invented a hive with movable frames. Frames hung from the top ends of the hive, leaving a 3/8 inch space between all sides of the frames and the hive body. The space is important since bees do not build comb in space less than a quarter of an inch. Honey could be removed in an extractor without breaking the comb.

In Bermuda most beekeepers use variants of the Langstroth hive. They typically use a sheet of wax foundation (see below). The frames can be removed and put into a honey extractor and then put back.

Top Bar Hive

Bars are placed on the top of the hive. A little wax is placed on them to encourage the bees to come and build naturally. This is a more natural way of beekeeping but the wax has to be cut off and the honey garnered manually so that the comb may be damaged. An extractor cannot be used. As Mr. Sinclair point out, some Bermudian beekeepers use these, but not many. Ms Faries believes beehives, of whatever type, should be white because they reflect the heat and do not heat up as much in the summer.

Nuc

A nuc is a smaller hive with just five frames – good for starting up a new colony.

Observation Hive

A glass frame can be attached to the hive case allowing beekeepers and visitors to watch the bees as they carry out their different duties.

Honey Super

A honey super is a box placed in the hive above the brood nest area into which 8-10 frames are hung. Bees can build a honeycomb onto each frame into which they store the nectar.

Wax Foundation or Honeycomb Base

Beekeepers can insert human-made wax plates with the base of a honeycomb into a frame. Bees can then build their honeycomb on it.

Advantages

1. The wax foundation means bees build the honeycomb faster, and therefore make honey sooner.
2. The number of drone cells is lessened, so there are fewer drones.
3. The honeycomb is stronger and less prone to damage from the heat and centrifugation of a honey extractor.

Smoker

A smoker is a device made of tin or copper that generates smoke from smouldering fuel. Beekeepers use it to send a stream of thick, white, cool smoke into the entrance of a beehive to calm the bees when the beekeepers harvest honey or want to check on the bees. A smoker can have bellows at the bottom but as Mr. Sinclair point out, that's not very practical as the fuel can shift or fall out. Squeezing bellows placed at the top is more efficient. Bermudian beekeepers use any of the following natural materials as fuel:

- Burlap taken from potato bags
- Banana leaves
- Straw
- Pine needles
- Sisal twine

NB The smoke must not be too hot as it could burn the bees.

Uncapping Fork

This tool is used for uncapping the wax tops to the cells of honey. A hot or cool knife can be used as well.

Hive Tool

A hive tool is an instrument used for scraping wax off the frames so the honey can be accessed.



Honey Extractor

After the sealing wax is taken off the cells, the frames are put into the extractor which through centrifugal force whips the honey out of the comb. The honey falls into a separate container and then is pumped into a barrel. The honey extractor used by Mr. Furbert can hold 36 frames.

Wax Melter

This is used for melting beeswax. Many beekeepers use solar wax melters – black boxes with glass lids, which generate enough heat to melt the wax. Some beekeepers use electric wax melters. The wax is then solidified into blocks, ready for sale. Some beekeepers send the wax away to be formed into new wax comb foundations.

Protective Clothing for Beekeepers

Beekeeper suits are equipped with a veil to protect the face. They are designed to be tucked into shoes or boots. If the full suit is not used, beekeepers will often protect themselves with a hat, veil, and gloves.

Did You Know

- Smoke calms the guard bees by making them want to eat honey (they are tricked into thinking they should flee the hive because of fire and eat as a defence tactic). Eating the honey distends their stomachs, making it more difficult to sting. Smoke also obscures the pheromones (see terms) they use to communicate.
- Thirty-six frames can yield between 15 and 17 gallons of honey.
- A beekeeper suit is almost always made completely out of white material. This is because it helps the bees differentiate between beekeepers and predators. Most enemies who take the bees' honey are mammals with dark fur such as bears.

Questions for Discussion and Writing

1. Where bees are concerned, does nature always know best or can human inventions and trickery aid natural processes in positive ways? Who most benefits from human intervention: the bees or the humans? See Chapters One, Four and Five. Conduct interviews with Conservation Officer Dr. Jeremy Madeiros and former Conservation Officer Dr. David Wingate, and with Alison Copeland at the Department of Conservation.
2. In what ways have hives changed over the centuries? How have different varieties influenced beekeeping practices? Students can further research the history of hives.

Chapter 3: An Overview of Honeybees' Homes, Anatomy, Life Cycle and Social Organisation

Homes

Bees live in large colonies, which can contain up to 60,000 bees. They can grow wild – in tree holes, for example, or under rocks, but in Bermuda, beekeepers house them in human-made wooden hives, which can hold up to 85,000 bees in mid-summer. (See Chapter 2 for more detail about hives). They build a home out of beeswax called a **honeycomb** which consists of **hexagonal** wax cells attached to a frame. It is used for storing larvae, pollen and honey. The cells, or chambers, vary in size according to their purpose. The largest ones are chambers for queen bees. Drones are raised in the next largest cells while female worker bees live in the smallest.

When honeybees move to another site, they **swarm**. Usually, a portion of the bees leave the hive with the old queen to find a new home. But if they feel threatened by enemies or by shortage of food, they all leave or abscond.



Worker Honeybee Anatomy

All honeybees have three main body parts: the head, thorax and abdomen.

Head

Honeybees have five **eyes** – three smaller eyes and two eyes which are compound, made up of thousands of tiny lenses. They have two **mandibles** on each side of the head, used for various activities such as cutting, constructing the comb, taking pollen from flowers, cleaning the hive and gripping enemies. They have segmented antennae, important for receiving sensory information. Their antennae, for example, can help them judge lengths and widths when building their cells. They use their **proboscis**, or long, hairy tongue, to suck liquids. The proboscis is kept folded away behind the mouth when not in use.

Thorax

The thorax, or middle part of the bee, anchors the three pairs of legs. On the outer hind legs of the worker bees are pollen baskets for carrying pollen from the flowers back to the hive. Rakes and combs on the legs are used for collecting pollen from the bees' bodies, and a pollen press between the two largest segments of the hind leg is used for pressing the gathered pollen into pellets. In adults, the thorax also anchors two sets of wings.

Abdomen

The adult honeybee's abdomen consists of nine segments and contains scent and wax glands. The **wax glands** (see beeswax in Terms below) are used to secrete liquid wax. When the worker bee ceases to create wax (see Social Organisation chart below), the glands become flat cells. Only female bees have stingers, located at the end of the abdomen.

NB When the worker bee stings, it leaves its stinger and also part of its digestive tract, including muscles and nerves, inside the victim's flesh. This abdominal rupture kills the bee.

Honeybee Life Cycle

Honeybees in a colony are classified as female workers, male drones, and queen bee

The honeybee's life cycle is one of metamorphosis, taking place in four stages: **egg**, **larva**, **pupa** and **adult**. The queen bee is responsible for laying the eggs.

Female Worker

- Day 1** The queen bee lays one fertilised egg in a cell of the comb.
- Day 4** The egg hatches into a larva which the worker bees feed with **royal jelly**.
- Day 7** The larva's diet switches to **beebread**.
- Day 9** The cell is capped with wax and the larva turns into a **pupa**.
- Day 21** The **adult** worker bee emerges with wings, legs and hairy body.

Drone (Male)

- Day 1** The queen bee lays an unfertilised egg in a larger cell than the worker's.
- Day 4** The egg hatches into a larva which the worker bees feed with **royal jelly**.
- Day 7** The larva's diet switches to **beebread**.
- Day 9** The cell is capped with wax and the larva turns into a **pupa**.
- Day 24** The adult drone appears – wider-bodied and with a more rounded abdomen than that of the worker bee.

Queen Bee

- Day 1** The queen bee lays a fertilised egg in a larger cell created by the workers. The cell resembles a peanut.
- Day 4** The egg hatches into a larva. When the worker bees decide they need a new queen, they feed the larva with **royal jelly** for the whole of this period. The royal jelly helps to develop the queen's ovaries.
- Day 9** The cell is capped with wax and the larva turns into a **pupa**.
- Day 16** The adult virgin queen, larger than the workers or drones, emerges. She continues to be fed royal jelly.



Social Organisation

Female worker bees constitute the vast majority of the bees in the colony. Worker bees can lay eggs but usually only do so when the queen is absent. Their eggs produce only drones so the hive cannot survive without a queen. Worker bees carry out different duties according to their age:

Period	Duties
Days 1–3	Cleaning, cells and removing dead bees and fanning the hive to cool it
Day 3–6	Feeding older larvae
Day 6–10	Feeding younger larvae
Day 8–16	Receiving nectar and pollen from field bees and making honey
Day 12–18	Beeswax making and cell building
Day 14 onwards	Guarding entrance; nectar, pollen, water and propolis foraging; and robbing other hives

Drones

Drones make up about five percent of the bee population in a hive. Because they hatch from unfertilized eggs, they have the queen's chromosomes only. They have no duties to carry out other than to mate. While they are waiting for an opportunity to mate, they are fed and cared for by workers. If they don't succeed in mating they are ejected and must look after themselves. Since they do not have the ability to forage, they generally perish. Once a drone mates with a queen, it immediately dies.

Queens

There is only one queen bee in a colony. Beekeepers will paint a dot on the queen's thorax to identify her easily.

A newly emerged queen will destroy other undeveloped queens in their pupal stage. She herself can be endangered if she is recognized by the current queen who might kill her by stinging her. However, often the old queen will leave the hive, taking half the colony with her. This is called a **swarm**.

A week or two after the virgin queen has emerged from her pupa, she takes a nuptial flight. She produces a **pheromone** to attract drones. She will mate with up to 20 of them and store their sperm in her **spermatheca**. She then returns to the hive to lay her eggs in the cells of the honeycomb for the rest of her lifetime. As long as she produces eggs, she is constantly cared for by the workers who feed her royal jelly. If she is too old or weak or does not produce enough eggs, she is **superseded** by a new queen.

The Importance of Pheromones

1. As mentioned above, the Queen releases a pheromone to attract drones. The queen also releases a pheromone known as “queen substance” which the other bees can identify and which allows her to maintain her status in the hive. If a beekeeper wants to instate a new queen from another source, he places her in a cage within the colony for a few days until the bees become accustomed to her smell.
2. When worker bees sting, they release alarm pheromones to alert other bees to danger.
3. Guard bees at the hive entrance can smell other bees trying to enter the hive. If the bees have a different odour to the ones in the guards’ hive, they are expelled.

Key Terms

Colony – a large family group of working bees, including a queen, workers and drones

Hexagonal – six-sided

Chambers – cells

Beeswax – is excreted from glands in the worker bees’ stomachs in tiny flakes. Bees chew the wax to mould it into cells

Swarm – a large group of bees in flight to find a new colony

Mandibles – mouthpieces and jaws

Royal jelly – substance secreted from glands in the worker bees and fed to larvae and adult queen bees

Beebread – a mixture of pollen and nectar fed to female worker bee larvae

Larva – a legless grub hatched from the egg

Pupa – the bee at the stage between larva and adult. Enclosed in a case or cocoon, it stops feeding and undergoes internal changes

Brood – refers to the egg, larva and pupa stages of the honeybee

Pheromones – different perfume-like substances that workers, drones and queens release to communicate and that can change their behaviour and physiology

Spermatheca – queen bee’s special pouch for storing sperm

Supersedure – replacing an old queen with a new one

Did You Know



- Worker honeybees consume eight pounds of honey to secrete one pound of beeswax.
- During the spring and summer, female workers live up to six or seven weeks. In winter or on cold days, they huddle around the queen and could live from four to six months. In Bermuda they continue to forage during the winter on sunny days but the honey is for their own survival.
- The queen bee can live up to three or four years or even six, but usually lives for a year and a half.
- Up to 2,500 drones may compete for one queen.
- Mating between one drone and a queen occurs mid-flight and takes up to five seconds.
- The drone can live up to four months. But if it mates with a queen, it immediately dies.
- When a honeybee stings a mammal, the honeybee dies.
- Queen bees have stingers as well, but they use them to sting and kill rival queen bees. They do not die after stinging because their stingers have no barbs.
- Queen bees may lay 1,000 – 2,000 eggs per day – one egg every 20 seconds - and more than her own body weight in eggs.

Questions for Discussion, and Writing (see Chapter Four for further relevant information)

1. Why do you think bees build hexagonal cells for their honeycomb? Why not another shape? (*Students interested in Mathematics might like to explore the Honeycomb Conjecture*)
2. Could honeybees be seen to be civilized? What similarities can you see between the honeybee and the human social organizations? What are the differences? To argue your point of view, you could use comparison/contrast and analogy writing strategies.
3. What could humans learn from bees? How could those lessons affect the way we live our lives in the workplace or at home? Would those lessons necessarily be “good” for humans? Give reasons for your answer. You might like to interview beekeepers for their views.
4. Which are more brutal – bees or humans? Explain.
5. After conducting further research, explain how and why bees communicate.

Chapter 4: The Interdependent Relationship between Honeybees and the Natural Environment

How the Plants Help the Bees

Female honeybees need **pollen** and **nectar** from flowers in order to create the food they need to eat and to feed larvae. So they go on **foraging** expeditions to fields, gardens and woodland where they can find flower blossoms to feed from. Bees also gather water for cooling the hive in the summer and also for diluting the honey they feed to the larvae.



Finding Plants – Scout Bees and the Bee or “Waggle” Dance

A few worker bees, called **scouts**, go searching for new flowering plants. They can fly long distances, up to six miles. When they find new plants, they go back to the hive and perform a figure eight dance on one of the combs, wagging their abdomens from side to side, indicating to the other bees the direction and distance of the flowers. The direction the bee moves in relation to the hive indicates direction; if it moves vertically, the direction to the source is directly towards the sun. The duration of the waggle part of the dance signifies the distance. Once the worker bees receive the information, they fly in a straight line directly to the new source of food.

What Bees See

Bees see colours in the spectrum ranging from ultraviolet to yellow, but do not see red. Many flowers have shiny patches of ultraviolet that humans can't see except with special equipment. These ultraviolet patches are called bee guides or nectar guides. Bees can best differentiate colours in the blue-green, violet and bee's purple colours (yellow mixed with ultraviolet).

Making Honey

Bees drink the nectar from flowers, using their proboscises or tongues, and store it in a pouch on their bodies while flying back to the hive. Once back at the hive, they regurgitate it to other worker bees in the hives. The receiving bees mix the liquid with enzymes by chewing it for about 20-30 minutes until it gradually turns into honey. Then the bees put it into honeycomb cells. They fan it with their wings to dry it out and then they seal the cells with wax.

Honey Harvest in Bermuda

In Bermuda there are two **honey flows**: a minor flow in June-July, when the fiddlewood blooms, and a major one in September-October-November when the Brazilian pepper, locally known as Mexican pepper, blooms. Some beekeepers, including Mr. Furbert, harvest at both those times; others, only at Christmas. Beekeepers always leave enough honey in the hive for the bees to survive during the winter. They sometimes also leave a solution of water and nectar or sugar from which they can take sustenance.

Why Bermuda Honey is Unique

When bees go on a foraging trip, they tend to visit one species of flower at a time. In larger countries bees can fly to vast acres of land growing just one plant species – in Scotland, for example, honey often tastes of heather; in France, of lavender. Because Bermuda is so small, honeybees visit far more species and therefore the taste of Bermuda honey is, according to Mr. Furbert, unique.

Gathering and Using Pollen

The hairs all over bees' bodies and in their eyes catch the pollen as the bees search for nectar inside the flowers. The bees use the combs and rakes on their legs to move the pollen to their pollen baskets. Often as they go back to their hives, green or yellow pollen can be seen hanging from their baskets. In the hive the worker bees mix the pollen with some of the nectar to form beebread, the diet fed to all larvae except the queen bee larvae.

How Bees help the Plants

As bees move from plant to plant, they transfer the pollen on their hairs from flower to flower thus allowing the first stage of plant reproduction, vital for a plant's ability to bear fruit and seeds, to occur. This transference is called pollination.

Plant Cross-Pollination Process

Pollen is transferred from the male part of the flower (the anther and filament, together called the stamen) to the female part (the carpel, consisting of stigma, style and the ovary containing the female gametes positioned at the base of the flower.) Pollen lands on the sticky stigma, travels down the style to the ovary where the male sperm fuse with the female eggs in a process called fertilisation. Fruit and seeds then develop and mature.

Self-Pollination

This happens when pollen is transferred from the anther to the stigma within a single plant.

Bermuda Plants and Trees whose Flowers Honeybees Like and Help to Pollinate

Allamanda	Kale	Rosemary
Avocado	Brazilian, or	Squash
Bananas	Mexican pepper – (1/3 of honey	Strawberries
Baygrape	is made from this	Sunflowers
Beans	plant's nectar)	Vetch
Bottle brush	Nasturtiums	Weeds
Broccoli	Orange	Yucca
Buddleia	Oxalis	
Cabbage	Palm tree	
Carrots	Parsley	
Cauliflower	Pawpaw (Papaya)	
Celery	Peppers	
Coriander	Pigeon berries	
Cucumbers	Pittosporum	
Eggplant	Pride of India	
Fennel	Pumpkin	
Fiddlewood	Radishes	
Grapefruit		

Encouraging Bees in Bermuda

The public can help by planting in their gardens flowers that bees like (see above) and by making sure water is available in dry months. While beekeepers often have their own apiaries, members of the public can help by allowing beekeepers to place hives on their property. In return, property owners will receive free honey. Farmers, of course, benefit by having hives on their property since bees pollinate the crops.

Where NOT to Place Hives

Beehives should **NOT** be placed:

- Close to heavy traffic
- On a neighbour's border
- Near a children's playground
- Near a house with porch lights

Did You Know



- A bee produces a 12th of a spoonful of honey in its lifetime.
- Honey never goes bad, not even after thousands of years.
- The older the honey, the darker it becomes.
- Creamy honey is not mixed with cream but is whipped until it resembles butter.
- Although many other creatures, including bats, pollinate plants, bees are the most important because they actively seek pollen to feed their larvae.
- The phrase “making a beeline” originates from the way bees fly a direct line to a food source.
- Bees flap their wings 230 times a second.
- Bees in an average-sized colony can bring in 100 pounds of pollen in a season.
- Bees love invasive plants in Bermuda – fiddlewood and Mexican pepper

Key Terms

Nectar – a sweet fluid produced by flowers

Pollen – sticky, powdery substance produced by male of the plant, the flower’s anthers

Gametes – male sperm in pollen, female eggs in ovary

Foraging – flying to hunt for nectar and pollen from flowers

Crop – the pouch a worker bee uses to store the nectar

Honey Flow – a period when bees can collect plenty of nectar because flowers are abundant

Scout Bee – a worker bee who looks out for sources of pollen, nectar, water or a new site for the colony

Questions for Writing and Discussion

1. After conducting further research, explain how and why bees communicate. (See Chapter Three for more relevant information)
2. Create a plan for a garden you might create to attract honeybees. (See also Chapter Five)

Chapter 5: Threats to Bees in Bermuda and How Bermuda's Beekeepers have Risen to Challenges

As noted in Chapter One, honeybees have been kept in Bermuda since 1616 when they were introduced from England. Beekeepers in Bermuda have generally had an easier time of it than beekeepers in other parts of the world since, until relatively recently, bees in Bermuda were relatively free of pests and diseases. Nevertheless, a number of issues have always challenged Bermuda's beekeepers, including hurricanes and the impact of changes to Bermuda's habitat. In the 20th and 21st centuries, loss of arable land and open space, pests, diseases and the use of pesticides have also threatened bee colonies. The years 2009 and 2010 were very bad for Bermuda bees. The combination of Hurricane Igor with its ensuing damage to the island's foliage and the presence of the varroa mite led to a reduction in beehives, honey and beekeepers. However, as both Mr. Burgess and Mr. Sinclair point out on a positive note in the documentary, the discovery of varroa in Bermuda subsequently sparked public interest in beekeeping.



Hurricanes

Bermuda's hurricane season runs from June to the end of November although typically hurricanes have struck the island in September and October. Because severe hurricane force winds burn foliage, destroy flower gardens and fell trees, bees suffer from severely reduced food sources. Hurricane Emily in 1987, Fabian in 2003, and more recently Fay and Gonzalo in 2014 and Joaquin in 2015 destroyed nectar plants, particularly Mexican pepper which flowers from September to October. The bees' honey flow was severely reduced as a result. Hurricane Igor in 2010 was significant to all the beekeepers featured in the documentary since it resulted in a poor honey harvest and depletion in hives. Of course the recent detection of the varroa mite did not help. (See varroa mite below)

Pests and Mites

Bermuda was fortunate for many years to escape bee diseases caused by mites and bacteria. But beekeepers have had to contend with at least some of these threats since the 20th century.

The **giant toad** (*Bufo marinus*), deliberately introduced in 1875, threatens bees. Beekeepers respond to the threat by raising their hives at least 20 inches off the ground.

The **Argentine ant** (*Iridomyrmex humilis*), accidentally introduced to Bermuda in 1953, can infest hives and destroy bees and their larvae. Beekeepers have to be constantly vigilant, especially during heavy rain when ants can evacuate their nests (see varroa mite below).

In 1975 the **American Foulbrood** (*Paenibacillus larvae*), a destructive bee brood disease, prevalent in North America and the UK, was detected in Bermuda. This disease is caused by bacteria that attacks a **brood**. Beekeepers can detect it by noticing a sunken brood pattern in the comb and by its unpleasant smell. As Mr. Furbert mentions in the documentary, the solution is to burn the affected brood with gasoline.

Wax moths (*Galleria mellonella*) also attack bee brood but vigilant beekeepers (as well as bees) can keep them under control. Wax moths can breed on honey supers stored away in the winter. Mr. Furbert prevents this by stacking them in double newspapers, and Para-Moth crystals are placed between the sheets to keep the moths under control. Ms. Faries resisted using chemicals but was considering using an organic pesticide to spray on the supers. Beekeepers need to regularly inspect their hives and to keep them clean of excess comb.

Varroa Mite

In 2009 the varroa mite was detected in Bermuda. A member of the arachnid family, it is a parasitic mite that attaches itself to the body of a bee and weakens it. The female enters a bee brood cell. After the cell is capped, the varroa mite lays eggs on the bee larva. It hatches and leaves the cell with the bee. As the beekeepers in the documentary agree, nobody knows how the varroa reached Bermuda. Queen bees had been imported from Hawaii but once the varroa was found there all importation of bees stopped.

After the detection of the mite, Government Departments of Parks, Environmental Protection and Conservation all collaborated with the BBA to conduct an island wide survey of beehives. By 2010 the numbers of managed hives and beekeepers in Bermuda dropped and, as Mr. Sinclair explains in the documentary, those declines were primarily due to the varroa. The numbers of varroa mites were very high compared to numbers abroad; perhaps, as Mr. Sinclair says, because Bermuda's bees were completely unprotected. The US, for example, has had the varroa for 20 years and as a result has developed ways of controlling it.

Treatment of Varroa in Bermuda

1. Chemical Treatments

As Ms. Faries explains in the documentary, she initially tried a chemical (the **Mite Away Quick Strip** (MAQS) formic acid treatment) to treat the varroa infestation. However, when she applied it, temperatures and humidity were high in Bermuda which led the bees to abandon their combs and "beard up" on the outside of some of the combs. Hurricane Igor destroyed so much foliage and food that ants moved into her hives and infested them.

Generally, beekeepers in Bermuda today resist using chemical treatments other than possibly organic ones.

2. Tricking with Drone Brood

Another treatment that both Ms. Faries and Mr. Sinclair describe involves breeding more drone brood because the mite prefers the larger cells. The problem with that is that the drone brood must be removed every two weeks which means disturbing the bees and running the risk of crushing the queen. If beekeepers forget to remove the drone brood, the hive will have too many drones. This method also proved unsuccessful and is no longer practised.

Coping with the Varroa Mite Today

Mr. Sinclair says it's not possible to eliminate the mite in Bermuda. To do that, all the bees presently in Bermuda would have to be destroyed. Even then, there would be no guarantee that the varroa would be eradicated since it could still come to Bermuda with imported bees. At present beekeepers are controlling it by splitting their hives and by catching swarms. Honey produced in Bermuda has increased since 2010 and in 2015-16 the public reported seeing more bees than in the previous years. Mr. Sinclair hopes the bees will develop a resistance to the mite. Perhaps that is already happening.

The Impact of Changes to Bermuda's Habitat

Plant Species Introduced to Bermuda

Since 1616, Bermuda's habitat has changed significantly and trees, plants and animals that were not in Bermuda during the early settlement have since been introduced either deliberately or accidentally. The first settlers would not have seen Mexican pepper or fiddlewood; both were introduced to Bermuda and are now considered by environmentalists as **invasives**. However, they are an important source of food for bees, as are many other ornamental plant species deliberately brought to Bermuda during the late 17th, 18th and 19th centuries – plants such as Easter lilies, freesias and bottlebrush. Bees have a far more varied food source thanks to these introductions.

Lack of Open Space and Arable Land

Bermuda has always had a tiny land mass, a mere 21 square miles. But its transition from having an agrarian economy to one based on international business and tourism has meant proportionately a huge loss of open space. Since bees depend on plants for food, they will be further threatened if there is any additional loss of land. Bermuda presently has 700 acres of agricultural land out of which about 360 acres have been cultivated. Furthermore, bees like peace and quiet and find heavy vibration caused by traffic and industrial noise particularly distracting.

Pesticides

Pesticides are used in Bermuda but not, in Mr. Sinclair's view, as extensively as in other countries where genetically modified crops are grown. Local farmers tend to spray only when necessary instead of at fixed intervals. But, as he says, any pesticide, organic or synthetic, can endanger bees if used improperly. It is better to apply the pesticide in the early morning and evening when the bees aren't on the plants. It is also important to read the labels on the pesticide containers very carefully.

Did You Know



- As a wax moth larva moves through a honeycomb, eating honey and pollen, it builds itself a shell out of wax and its own silk and excrement. The shell protects it from honeybee stings.
- The small hive beetle, which attacks storage areas as well as hives, is now in Australia and Italy. So far, Bermuda doesn't have it.
- Bees can fly up to six miles to reach a food source.
- Bermuda has just between 300 and 400 acres of cultivated agricultural land.
- Beekeepers catch swarms in trees by soaking the bees with water, shaking the branch so that the bees fall into a bucket. Once the queen is caught, the other bees follow.

Key Terms

Invasive – a plant species that grows so aggressively it stifles other pre-existing plants

Colony collapse disorder (CCD) – happens when the majority of bees leave the queen behind along with plenty of food, a few nurse bees and larvae. Pesticides, malnutrition and threat of fire can be causes of CCD.

Brood – refers to the egg, larva and pupa stages of the honeybee

Apiaries – places where beehives are kept

Questions for Discussion and Writing

1. What are the consequences of the Bermuda bees' attraction to Mexican pepper? Are they negative or positive? Write a report on Mexican pepper in Bermuda, including conclusions and recommendations. Include in your report different points of view – that of the environmentalists and that of the beekeepers.
2. Write a report on the challenges beekeepers face in Bermuda today and include conclusions and recommendations.
3. Write an essay on the future of bees in Bermuda – on what issues will it depend?
4. What qualities do you think a beekeeper should possess to be a good beekeeper?

Chapter 6 Reasons for Beekeeping

Working with Nature

As can be seen in the documentary, most beekeepers are passionate about beekeeping. They share a fascination with the way bees continually work together as a unified social organisation. They enjoy the responsibility of caring for their bees and working with nature.



Beekeeping as a Business

Most beekeepers keep bees as a hobby although for Mr. Furbert, it eventually became his life's work and he has trained many apprentices, including Ms. Faries and Mr. Burgess. Beekeepers can make money by offering a swarm removal service and by selling products.

Bee-related Products

Honey – for eating, but also used for making wine, in herbal remedies and in salons for massage.

Beeswax – is used in:

- Cosmetics
- Hair removal kits
- Soaps
- Hand creams
- Lip balms or salves
- Crafts
- Furniture and floor polish
- Candles – good scent, long lasting and with no smoke

Opportunity for Travel

Beekeeping also gives some beekeepers the opportunity to travel through attending workshops and conferences offered by beekeeping associations all over the world. Mr. Furbert has travelled to many places, including the UK, China, Australia, South Africa, Nigeria, the Caribbean and Israel. Both Mr. Furbert and Mr. Burgess have travelled to Africa specifically to teach beekeeping skills and to set up hives.

Did You Know



- Honey should never be given to a child under the age of 12 months old because it may contain spores that can lead to botulism poisoning.
- Mead is a honey wine, first made over 9,000 years ago.
- In Bermuda, beeswax is worth four times as much as honey.
- Bee stings can be good for arthritis or rheumatism, provided patients are not allergic to bee stings.

Questions for Discussion and Writing

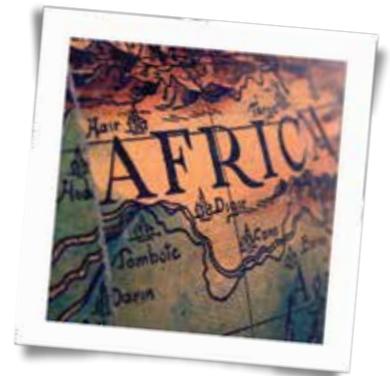
1. Would you consider keeping bees? Think about reasons for your answer.
2. What products that include honey or beeswax do you use?
3. Honey is often advertised as being excellent for good health. After researching this topic, argue to what extent, if any, this is true.
4. You are considering setting up a business selling bee-related products. Conduct the necessary research by interviewing, surveying and reading. Then write a business proposal explaining what products you would sell, where you would source them, and how and to whom you would market them.

Extra Activities

1. Visit the Bermuda National Gallery and look at the painting by Cranach, “Cupid Complaining to Venus”.
2. Listen to Rimsky–Korakov’s composition, “The Flight of the Bumble Bee”

Chapter 7 Bees in Myth and Folklore

This chapter gives a short sampling of how bees have featured in myths and folklore all over the world. Students interested in literature might like to research this topic further while creative writers might draw on the stories, creating their own fiction. The chapter also contains a list of sayings related to bees.



Creation Myths from Africa

- In an African creation myth, the people of the Kalahari Desert tell how a kind bee carried a mantis across a wide river to reach its family. A strong wind left the bee exhausted. The bee saw a beautiful flower floating in the river and dropped the mantis upon it. After planting a seed in the mantis's body, the bee died. When the sun rose the first human being was curled up on the flower, thanks to the bee's sacrifice.
- A myth from Uganda tells the story of the first man on earth, Kintu. He wanted to marry Nambi, the daughter of Ggulu who lived in heaven. Kintu had to go through five tests – in the final one he had to choose Ggulu's own cow from thousands of cattle. Nambi transformed herself into a bee and whispered to Kintu that he should choose the cow whose horn she landed upon.

Ancient Greek Myth

- In Greek myth Aristaeus was the god of beekeeping who caused the death of Orpheus's wife, Eurydice, after she stepped on a snake while fleeing Aristaeus's pursuit of her. Her sisters punished Aristaeus by killing all his bees. Advised by Proteus, he sacrificed four bulls and four cows, allowing their bodies to rot. From one of the carcasses a swarm of bees rose, which he used to fill his empty hives. This story led to the practice of **bugonia** described in early agricultural textbooks such as the *Georgics* by Virgil and the *Geoponica* issued from Constantinople in the 10th century.
- Apollo's gift for prophecy was said to come from three bee maidens.

Ancient Egyptian Myth

- Bees are associated with kingship – in ancient Egypt the bee was the insignia of kingship. Once Lower and Upper Egypt were unified, each pharaoh was described as "He of the Sedge and of the Bee." Napoleon Bonaparte revived the bee emblem of the Merovingians as did his nephew Louis-Napoleon Bonaparte, Emperor of the Second French Empire.
- The sun god Ra's tears fell on the desert. Out of them grew bees.

Hindu Myth

- The goddess Parvati killed the demon Arunasura by stinging him with the help of bees flying out of her body.

Did You Know

- In ancient Aegean culture, the bee was sacred because it was thought of as a bridge between the natural world and the underworld.
- Bees can symbolise immortality and resurrection, as well as diligence and stamina.
- In English folklore, swearing was believed to drive away bees. It was considered essential to tell the bees important news; otherwise they would die or stop honey production. Often they were invited to weddings.
- In Welsh folklore they were believed to be the only creatures to have come from Paradise.

Questions for Discussion and Writing

1. Why do you think bees can symbolize immortality, given their short life span?
2. Write a story or a diary entry on a day in the life of a bee from the point of view of a drone or a worker or a queen bee.
3. Write a story that includes a character who is a beekeeper.
4. Write explanations for the bee-related common sayings listed below:
 - Busy as a bee
 - Making a beeline
 - No bees, no honey, no work, no money – old proverb
 - Bee in the bonnet
 - Bees knees

Key Terms

Mantis – insect related to the cockroach

Bugonia – a ritual based on the belief bees can be generated from the rotting carcass of a cow

Proteus – ancient Greek god of the sea and the rivers

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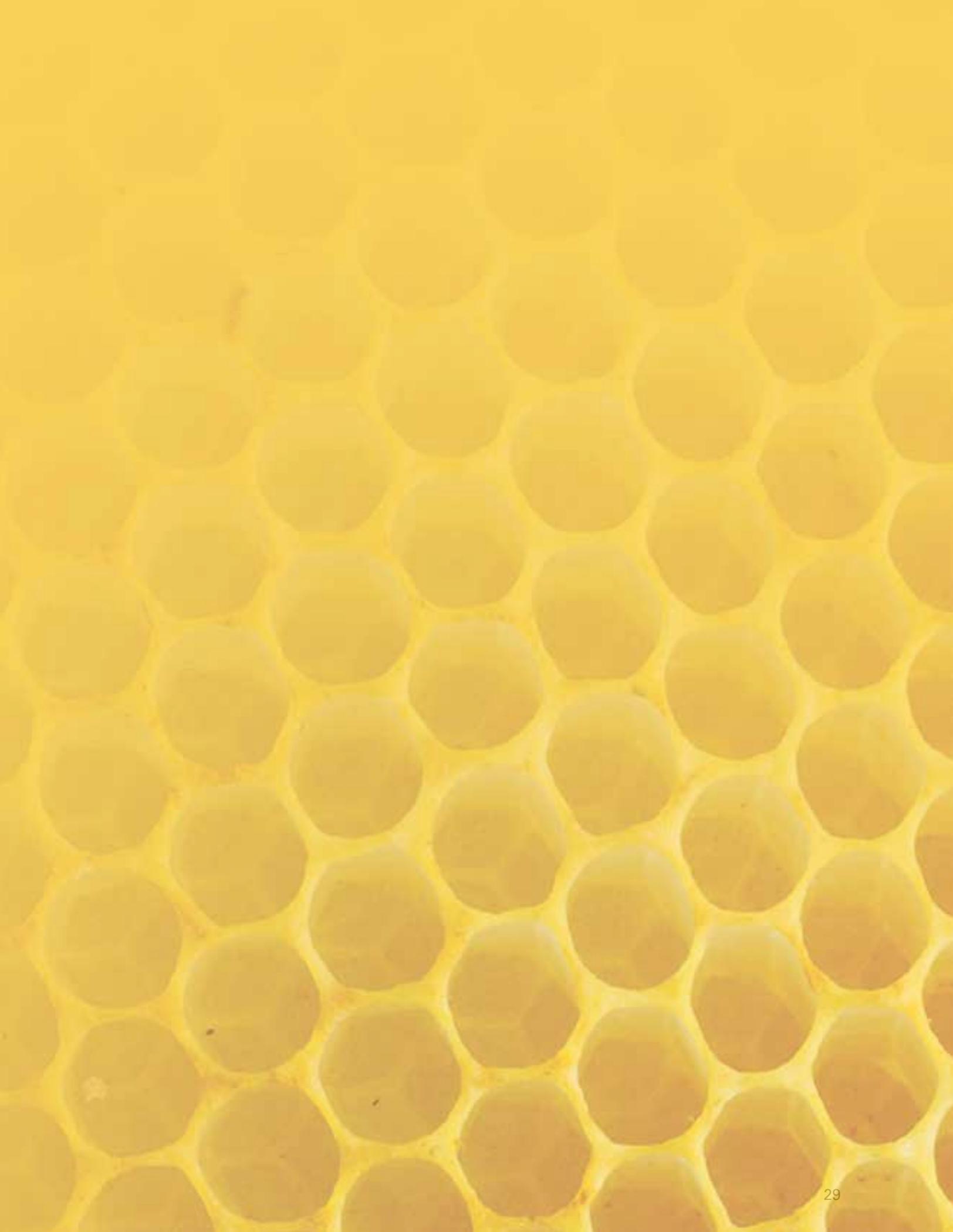
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