

COURSE

Beekeeping Fundamentals

10 Chapters

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BEEKEEPING FUNDAMENTALS

Contents

Chapter 1	What Beekeeping Is	2
Chapter 2	The Colony	8
Chapter 3	Hives and Kit	15
Chapter 4	Getting Started	22
Chapter 5	The Bee Year	28
Chapter 6	Swarms and Splits	33
Chapter 7	Pests and Disease	39
Chapter 8	Honey and Hive Products	45
Chapter 9	Bees and the Wider World	52
Chapter 10	First Season Plan	59

Beekeeping Fundamentals

Course 1 · Chapter 1 · What Beekeeping Is: Keeping Colonies

People have taken honey from bees for thousands of years, and keeping the bees themselves is almost as old. This chapter sets out what beekeeping is, the words beekeepers use, what a hive can produce, how the craft developed, and how a modern hive is laid out. Later chapters build on this: the colony itself, equipment, getting started, the beekeeping year, and the harvest.

What Beekeeping Is

Wikipedia's Beekeeping article says beekeeping (or apiculture) is "the maintenance of bee colonies, commonly in artificial beehives". Honey bees of the genus *Apis* are the most commonly kept, though other honey-producing bees, such as *Melipona* stingless bees, are also kept. Hives are kept in an apiary, or "bee yard".

Beekeeper (apiarist)

A person who keeps bee colonies, as a hobby or as a business.

Apiary

A place where hives are kept, also called a bee yard.

Meliponiculture

Keeping stingless bees of the tribe Meliponini, as opposed to honey bees.

Term	Meaning according to the article
Apiculture	Another name for beekeeping, from Latin *apis* + *culture*
Skep	A woven straw basket used as a hive
Movable comb hive	A hive whose combs can be lifted out without destroying the colony
Super	A box added to a hive, used for honey (the article mentions "honey super")

Honey bee is not the only bee

> A common newcomer assumption is that "bee" means "honey bee". Beekeeping is mostly about *Apis* honey bees, but the article also names stingless bees that are kept deliberately, such as *Tetragonula carbonaria* in Australia.

What a Hive Produces

The article says beekeepers keep bees to collect honey and other products of the hive: beeswax, propolis, bee pollen and royal jelly. It lists other sources of income too: crop pollination, raising queens, and producing package bees for sale. Later chapters return to each of these (the harvest in Chapter 8, pollination in Chapter 9).

Source	Kind
Honey	Hive product
Beeswax	Hive product
Propolis	Hive product
Bee pollen	Hive product
Royal jelly	Hive product
Crop pollination	Service
Queens and package bees	Bees sold

A Short History

The article says humans began trying to maintain wild bee colonies at least 10,000 years ago, in hollow logs, wooden boxes, pottery vessels and straw skeps. Beekeeping in pottery began about 9,000 years ago in Anatolia, and beeswax traces turn up in Middle Eastern potsherds from about 7,000 BCE. Egyptian art shows domestication around 4,500 years ago, with smoke used on hives.

Date	Event (per the article)
Before 2,422 BCE	Workers blowing smoke into hives shown on the walls of Nyuserre Ini's sun temple (Fifth Dynasty, Egypt)
About 900 BCE	Thirty intact straw-and-clay hives found at Rehov, Israel, by Amihai Mazar
By 300 BCE	The ancient Maya had reached the highest levels of stingless beekeeping
1669	Oldest evidence of movable-frame basket top-bar hives from Greece
1768	Thomas Wildman describes parallel bars across a straw hive and multi-storey hives
1853	Langstroth publishes *The Hive and Honey-bee*

Working out the Rehov numbers

The article says the Rehov apiary could have held around 100 hives, with a potential yield of 500 kg of honey a year. Dividing by hand: 500 kg / 100 hives = 5 kg per hive. That is my own arithmetic on the article's figures, and "potential" matters: it is an estimate for the site, not a measured harvest.

Why harvesting used to destroy colonies

Before movable comb hives, the article says, harvesting honey frequently destroyed the whole colony: wild hives were broken into using smoke, and in medieval northern Europe the colony in a skep was often killed with burning sulfur so the honey was spared. Old dark brood comb could not be replaced either. The oldest evidence of movable frames (1669) comes from Greece, though the article says their use is probably more than 3,000 years old.

Bee space and Langstroth

In the 19th century Lorenzo Langstroth made practical use of Huber's earlier discovery of a specific distance between the wax combs, later called the bee space. The article gives it as commonly between 6 and 9 mm, though up to 15 mm has been found in populations in Ethiopia. Frames hung at that spacing mean bees leave the gap open as a passage rather than filling it with wax, so any frame can be slid out for inspection. The article says this enabled large-scale commercial honey production in Europe and the US.

Before movable combs	After movable combs
Colony often killed to take honey	Frames slide out; the colony survives
Comb crushed to get honey out	Emptied comb can go back to the bees
Little inspection of brood	Eggs, larvae and pupae inspected without harm

How a Modern Hive Is Laid Out

The article says modern movable-comb hives differ in size from country to country (Langstroth and Dadant in the US, the British National in the UK, the Smith hive still popular in Scotland), but share common features: square or rectangular, movable wooden frames, and a floor, brood-box, honey super, crown-board and roof. A queen excluder sits between the brood-box and the honey supers to keep the queen from laying in cells next to honey intended for eating. Because of mite pests, floors are often replaced, temporarily or permanently, by wire mesh with a removable tray. Here is the layout, top to bottom:

```
# modern hive, top to bottom
roof
crown-board
honey super (one or more)
queen excluder
brood-box
floor (solid, or wire mesh and tray)
```

Chapter 3 covers each part in turn. The order shown is my reading of the article's list and its excluder sentence; the article does not give a single top-to-bottom diagram (check).

> **Start with a question, not a hive**
>
> You do not need to buy anything yet. Before equipment, think about where bees could be kept near you and whether anyone nearby would mind. Chapter 4 covers siting and rules. That advice is my own suggestion rather than the article's.

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Beekeeping article (about 42,500 characters). I read only roughly the first third in detail (introduction, history and hive designs); the remaining sections were not read, so nothing from them appears here.
- **Not in that part.** The idea that a hive's layout is shown top to bottom (check); the advice about siting (check).
- **Dates.** The article gives both "10,000 years ago" and "6,000 BCE" for early honey collecting in different places, and "4,500 years ago" and "3,100 BCE" for Egypt. I have kept the first set and not tried to reconcile them (check).
- **Rehov yield.** Calculated from the article's potential figures; not a measured yield.

Exercises

EXERCISE 1

Using the article's Rehov figures (about 100 hives, 500 kg of honey and 70 kg of beeswax a year), work out the potential honey and beeswax per hive. Then say why the answer is an estimate rather than a measurement.

→ Solution

EXERCISE 2

Match each of the words apiculture, apiary, skep, super and meliponiculture to the best definition, then write one sentence of your own that uses at least two of them correctly.

→ Solution

EXERCISE 3

Using the history table, work out the gap in years between Wildman's 1768 description and Langstroth's 1853 book, and between the 1669 evidence and Wildman. Then

explain in two sentences why the idea of a fixed bee space mattered more than movable bars alone.

→ Solution

Quick Reference

- **Beekeeping:** maintaining bee colonies, usually honey bees in hives
- **Products:** honey, beeswax, propolis, bee pollen, royal jelly
- **1669 · 1768 · 1853:** Greek movable frames · Wildman · Langstroth
- **Bee space:** commonly 6 to 9 mm
- **Hive:** floor, brood-box, queen excluder, honey super, crown-board, roof
- **Check:** layout order, date conflicts, siting advice

Coming next

Chapter 2 looks inside the colony: the queen, workers and drones, and how a colony lives.

Beekeeping Fundamentals

Course 1 · Chapter 2 · The Colony: Queen, Workers and Drones

A beekeeper does not really keep individual bees; they keep a colony. Beekeeping Fundamentals 1 introduced the craft and the hive. This chapter looks inside: the three kinds of bee, how each is produced, how a colony reproduces, and what an individual bee's life looks like. Everything here is needed before Beekeeping Fundamentals 3 (equipment) and Beekeeping Fundamentals 5 (the beekeeping year) make sense.

One Colony, Three Kinds of Bee

Wikipedia's Western honey bee article describes a colony made up of a queen, workers and drones. It also says western honey bee colonies are perennial: unlike most other bee species, they persist year after year. Because of this permanence the article says a colony can be considered a superorganism, meaning the colony rather than the individual bee is the biologically significant unit.

	Queen	Worker	Drone
Sex	Female, fertile	Female, usually infertile	Male
Main job	Lays all the eggs	Everything else: nursing, building, guarding, foraging	Mates with a new queen
Grown from	Fertilised egg, fed royal jelly throughout	Fertilised egg, switched to pollen and nectar after day 3	Unfertilised egg in a larger cell
Sting	Yes, not barbed	Yes, barbed	None
Fate	Lives years	Weeks to months	Dies after mating, or expelled before winter

Queen

Larger than a worker, with a rounder, longer abdomen. She may lay over 2,500 eggs a

Worker

A female who carries out the colony's main tasks while the queen only reproduces.

day at the height of the season, according to the article.

Drone

A male, about 1.5 times the size of a worker, who does not forage or sting.

A bee does not always die when it stings

The article calls the idea that a bee always dies soon after stinging a misconception. A worker's barbed sting tends to stay lodged when it stings a human or another mammal, which usually kills the bee, but the barbs do not always catch, so a bee may occasionally pull free and fly off unharmed. Queens are not barbed.

How a Queen Becomes a Queen

The article says a female egg can become either a queen or a worker. Both are fed royal jelly during the first three days. After that, prospective workers are switched to a mix of pollen and nectar, while prospective queens keep receiving royal jelly. Queens are not raised in ordinary horizontal brood cells: a queen cell is larger and vertical. At the height of the season a queen fertilises each egg with stored sperm as she lays it in a worker-sized cell; eggs laid in larger, drone-sized cells are left unfertilised and develop into drones.

Three reasons for a new queen

Trigger	Name	What happens (per the article)
Hive filled with honey, little room for eggs	Swarming	Old queen leaves with part of the workers; a new queen stays with the rest
Old queen failing, queen pheromone falling	Supersedure	Colony raises a new queen; the old queen is usually killed
Old queen dies suddenly	Emergency supersedure	Workers choose eggs or larvae of the right age and feed them royal jelly

Reading the comb

The article says emergency supersedure can generally be recognised because the new queen cells are built out from the face of the comb rather than hanging from the bottom of a frame. This is the sort of sign Beekeeping Fundamentals 6 will come back to.

Swarming: How a Colony Reproduces

The article says colonies reproduce by swarming, usually in spring and early summer when flowers are abundant. The hive creates one to two dozen new queens; just before they emerge, the old queen and a large share of the workers leave to find a new home. In the old colony the daughter queens fight until one remains, and she then goes on one or more mating flights, mating with 1 to 17 drones each time, usually within two weeks of emerging. She then stays in the hive to lay.

The source disagrees with itself

The same article says two things about the size of a swarm. In the colony life-cycle section the old queen leaves with "approximately two-thirds of the adult workers". In the queens section a swarm takes "about half the worker bees". I cannot tell which is better; the figures may describe different situations, or one may be rougher. Treat both as unchecked and expect the real share to vary.

To see what the two figures mean, take the article's midsummer population of 40,000 to 80,000 bees and apply each fraction by hand (I also ran a one-line calculation to confirm):

Colony size	Leaves at two-thirds	Stays at one-third	Leaves at one-half
40,000	about 26,667	about 13,333	20,000
80,000	about 53,333	about 26,667	40,000

These sums treat all of the colony's bees as workers, which slightly overstates the numbers because the article does not say what share of the 40,000 to 80,000 are drones or brood (check).

Inside the Individual Bee's Life

The article says the western honey bee has four life stages: egg, larva, pupa and adult. Because of the colony's social structure all four stages occur at the same time through much of the year. The queen lays a single egg in each cell. The legless, eyeless larva is fed by nurse bees; after about a week the nurses seal it in its cell and it begins its pupal stage; after another week it emerges as an adult. A worker's job changes with age:

Worker age (days)	Typical task (per the article)
First 10	Cleaning the hive and feeding larvae
After that	Building comb cells
16 to 20	Receiving nectar and pollen from older workers and storing it
After day 20	Leaves the hive and works as a forager for the rest of life

Bee	Lifespan (per the article)
Queen	Average 3 to 5 years in most subspecies; up to 8 reported for one subspecies; beekeepers often replace queens every year or two
Spring and summer worker	Only a few weeks
Autumn worker	Several months, staying inside as the colony clusters
Whole worker population	About 1% die naturally per day; all replaced about every four months

Those last two figures can be cross-checked. If 1% died every day for 120 days (about four months), the share who had died would be 1 minus 0.99 to the power 120, about 70% (I computed this). That is not "all replaced", but the article's figures are rough averages, and the colony is also growing and shrinking over the year, so a gap is not alarming (check).

> **The "one week plus one week" shortcut**

> The article's description of larva to adult is very compressed (about a week, then about another week). From general knowledge, the full time from egg to adult worker is longer, about three weeks, and differs between queens, workers and drones (check). The article does not give those figures, so this chapter does not rely on them.

What This Means for a Beekeeper

Several of the article's facts matter directly for how beekeeping works. The queen lays all the eggs, so a failing queen is a colony-wide problem, and the article says her sperm store depletes near the end of her life, so she lays more unfertilised eggs. That is why beekeepers often replace queens every year or two. A swarm also takes a large part of the workforce away, which is why Beekeeping Fundamentals 6 treats swarm control as a main spring task. Using the beekeeper's viewpoint to rank those priorities is my own interpretation (check).

```
# egg fate, as the article describes it
egg laid in worker-sized cell   -> fertilised   -> female
    fed royal jelly 3 days, then pollen and nectar -> worker
    fed royal jelly throughout, in a queen cell    -> queen
egg laid in drone-sized cell    -> unfertilised -> male (drone)
```

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Western honey bee article (about 54,500 characters). I read the colony life cycle, individual life cycle and social caste sections (queens, workers and drones). The rest (behaviour, communication, products, genome, microbiome, hazards, immunity and others) was not read, so nothing from it appears here.
- **Conflict.** Swarm share: two-thirds in one section, about half in another. Not resolved.
- **Not in that part.** The roughly three-week egg-to-adult figure and the "overstated" population caveat (check); the point about which tasks matter most to a beekeeper (check).
- **Arithmetic.** The swarm numbers and the 1%-per-day cross-check are my own calculations on the article's figures, run in Python and matching the tables above.

Exercises

EXERCISE 1

A colony has 60,000 bees in midsummer. Using each of the article's two swarm fractions (two-thirds and one-half), work out how many bees leave and how many stay. Then say which figure you would use for a plan and why, given the source disagrees with itself.

→ Solution

EXERCISE 2

Make a day-by-day timeline for a worker from day 1 to day 25 using the article's task table, marking where each job changes. Then answer: on day 12, which task is the worker most likely doing, and what does the article not say about days 11 to 15?

→ Solution

EXERCISE 3

For each of the following, say whether it produces a queen, a worker or a drone, and give the article's reason: (a) a fertilised egg fed royal jelly for three days then pollen and nectar; (b) an unfertilised egg laid in a large cell; (c) a fertilised egg in a vertical queen cell fed royal jelly throughout.

→ Solution

Quick Reference

- **Colony:** one queen, workers (female), drones (male); perennial
- **Queen:** lays all eggs; may lay over 2,500 a day; lives years
- **Worker:** fertilised egg; nurse, builder, storer, forager; weeks to months
- **Drone:** unfertilised egg; no sting; mates with a new queen
- **New queen:** swarming, supersedure, emergency supersedure

- **Stages:** egg, larva, pupa, adult
- **Check:** swarm share, egg-to-adult time, population caveat

Coming next

Chapter 3 looks at the hive in detail: its parts, the frames, and the clothing and tools a beekeeper uses.

Beekeeping Fundamentals

Course 1 · Chapter 3 · Hives and Kit: What You Work With

Beekeeping Fundamentals 1 showed that the movable-frame hive made modern beekeeping possible, and Beekeeping Fundamentals 2 looked at the colony living inside it. This chapter looks at the hives themselves, in their main families, and at the three pieces of everyday kit the source describes: protective clothing, the smoker and the hive tool. It does not cover buying or costs; that is for Beekeeping Fundamentals 4.

Two Families of Hive

Wikipedia's Beekeeping article has a section on hives and other equipment. It separates horizontal hives from vertical stackable hives. The first family it describes is the horizontal top-bar hive: a single-storey, frameless hive in which the comb hangs from removable bars that form a continuous roof over the comb. The vertical stackable family has three types: hanging (top-access) frame, sliding (side-access) frame, and top bar.

Family	Type	Key point (per the article)
Horizontal	Top-bar hive	Single storey, frameless; usually one box; more than twice as wide as common multi-storey framed hives
Vertical stackable	Hanging frame	Langstroth, British National, Dadant, Layens, Rose; differ in size and number of frames
Vertical stackable	Sliding frame	Any hanging-frame design can be built this way; the AZ Hive is the original
Vertical stackable	Top bar	Uses top bars instead of full frames; the Warre hive is the most common

Hanging frame

Frames hang down from the top of a box. The article calls the Langstroth the first successful top-opened hive with movable frames.

Sliding frame

Frames slide in from the side. The article says the AZ Hive uses Langstroth-sized frames integrated into a honey house, which can be a portable trailer.

Top bar

Only the bar the comb hangs from, with no full frame around it.

Which hive where

Hive	Where the article says it is common
Langstroth	Most common size in the United States and much of the world
British National	Most common size in the United Kingdom
Dadant and Modified Dadant	Widely used in France and Italy
Layens	Used by some beekeepers, where its large size is an advantage
Square (12-frame) Dadant, "Brother Adam" hive	Large parts of Germany and other parts of Europe, by commercial beekeepers

A difference you can see in the chapter's sources

Beekeeping Fundamentals 1 quoted the same article saying that in Scotland the smaller Smith hive is still popular, while this section says the British National is the most common size in the United Kingdom. Those are compatible (a local preference inside a country-wide pattern), but a reader looking for "the" hive for Scotland would find two answers. I have not checked how widespread the Smith hive is (check).

The management difference

The article notes that conventional advice often recommends inspecting each colony each week during the warmer months, but some beekeepers fully inspect top-bar hives only once a year, and only one comb needs to be lifted at a time. It says top-bar hives allow methods that interfere very little with the colony. Whether weekly inspection is actually necessary for framed hives is not argued in the article, so treat the contrast as description, not a recommendation (check).

Not all "top-bar" hives are the same

The article says hives that have frames, or use honey chambers in summer but otherwise follow top-bar management principles, are sometimes also called top-bar hives. And a stackable top-bar hive is a different shape from the single-storey horizontal one. So the name alone does not tell you whether a hive is horizontal or stacked.

The article adds that any hanging-frame hive can be converted to a top-bar stackable hive by using only the top bar, which may work less well with larger frames, where cross-comb and attachment can occur more readily.

Protective Clothing

The article says most beekeepers wear some protective clothing. Novices usually wear gloves and a hooded suit or a hat and veil. Experienced beekeepers sometimes skip gloves because gloves get in the way of delicate manipulations. The face and neck are the most important areas, so most beekeepers wear at least a veil: the article says defensive bees are attracted to the breath, and a sting on the face can bring much more pain and swelling than a sting elsewhere. A sting on a bare hand can usually be removed quickly by a fingernail scrape to limit the venom injected.

Item	Who usually wears it (per the article)
Veil	Almost everyone, at least
Hooded suit, or hat and veil	Novices usually
Gloves	Novices usually; some experienced beekeepers choose not to

Colour, scent and washing

The article says beekeeping clothing is traditionally pale because of the natural colour of cotton and the cost of dyeing workwear; some people consider pale clothing better because the colony's natural predators, such as bears and skunks, tend to be dark. It also says bees see in ultraviolet and are attracted to scent, and that the fabric conditioner used has more effect than the fabric colour. Stings left in the fabric keep pumping out an alarm pheromone that attracts further stinging, which regular washing can reduce.

Wash, and watch the conditioner

From those statements, two practical points follow: wash bee clothing regularly, and choose fabric conditioner with care (or avoid it). Those inferences are mine; the article states the facts but not the advice (check).

The Smoker

The article says most beekeepers use a smoker, a device that produces smoke by incomplete combustion of fuel. It says that although the exact mechanism is disputed, smoke is said to calm bees; some claim it triggers a feeding response in anticipation of the hive being abandoned because of fire; and smoke is thought to mask the alarm pheromones released by guards or by squashed bees. The resulting confusion gives the beekeeper time to open the hive without provoking a defensive reaction.

Idea	Status in the article
Smoke calms bees	"It is said"; mechanism disputed
Smoke triggers feeding in case of fire	"Some claim"
Smoke masks alarm pheromones	"It is also thought"

On fuel, the article says many fuels work as long as they are natural and not contaminated with harmful substances. Examples it lists: hessian, twine, pine needles, corrugated cardboard, and rotten or punky wood; coconut fibre in Kerala, India; commercial products such as pulped paper, compressed cotton and aerosol cans of smoke; and sumac, which makes a lot of smoke without an odour. It also describes "liquid smoke", a water-based spray, and says a spray of clean water can encourage bees to move on.

Chilled gas

The article says chilled air can induce torpor, while chilled carbon dioxide may have harmful long-term effects. It also describes research on smoke from burning certain fungi and notes hydrogen sulfide, toxic to humans at high concentrations, as the main

combustion product responsible for sedation. I read this passage but have not checked the studies behind it, and it is not a method for a beginner (check).

The Hive Tool

The article says most beekeepers use a hive tool. The two main types are the American hive tool and the Australian one, often called a "frame lifter". They are used to scrape off burr-comb from around the hive, especially on top of the frames, and to separate the frames before lifting them out. It gives no more detail on their shapes.

```
# basic kit named in this chapter
protection: veil (at least), hooded suit or hat and veil, gloves (optional)
smoker:     natural, uncontaminated fuel
hive tool:  American or Australian ("frame lifter")
# Chapter 4 covers what to buy first
```

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Beekeeping article (about 42,500 characters). This chapter uses its "Hives and other equipment" section (horizontal and vertical hives, protective clothing, the smoker and the hive tool), which I read in full. The sections on safety and husbandry, swarming, pests, diseases and world apiculture were not read for this chapter.
- **Conflicts.** None inside the section. Two statements about hive preference in the UK versus Scotland come from different parts of the article and are compatible (check).
- **Not in the article.** The practical advice about washing and conditioner (my inference); the remark that the weekly-inspection contrast is description only (my caution).
- **Not checked.** The fungal-smoke studies and the claims about chilled gases; I only report that the article mentions them.
- **Code.** This chapter has no executable code and no calculations, so nothing was run.

Exercises

EXERCISE 1

Sort these into horizontal top-bar, hanging frame, sliding frame or stackable top-bar: Langstroth; Warre; AZ Hive; the single-storey frameless hive. Then explain in one sentence why the name "top-bar" can be confusing.

→ Solution

EXERCISE 2

Using the "Which hive where" table, say which hive each person would most likely meet: (a) a beginner in the United Kingdom; (b) a commercial beekeeper in Germany; (c) a beekeeper in France or Italy. Then say what the article does not tell you about hive choice for a first-time beekeeper.

→ Solution

EXERCISE 3

A new beekeeper can only afford protective clothing one item at a time, before adding a smoker and a hive tool. Using the article's statements, list the protective items you would prioritise in order, and give the article's reason for the first one.

→ Solution

Quick Reference

- **Hive families:** horizontal top-bar; vertical stackable (hanging frame, sliding frame, top bar)
- **Common sizes:** Langstroth (US and much of world), British National (UK), Dadant (France, Italy)
- **Protection:** at least a veil; face and neck matter most
- **Smoker:** natural, uncontaminated fuel; mechanism disputed
- **Hive tool:** scrapes burr-comb, separates frames

- **Check:** Scottish hive preference, advice drawn from facts, studies mentioned

Coming next

Chapter 4 takes you from kit to the first colony: where to put hives, the rules to find out about, and where bees come from.

Beekeeping Fundamentals

Course 1 · Chapter 4 · Getting Started: Stings, Sites and Styles

With the colony (Beekeeping Fundamentals 2) and the kit (Beekeeping Fundamentals 3) understood, the next questions are practical: what happens when you are stung, where should the hives go, and what style of beekeeping suits you? This chapter draws on the safety and husbandry section of the source. It does not cover buying bees, legal rules, insurance or costs, because the source does not; those would need other sources, and the chapter flags them rather than guessing.

Stings

Wikipedia's Beekeeping article describes the symptoms of a sting as redness, swelling and itching around the site. In mild cases pain and swelling subside in two hours. In moderate cases the red welt grows slightly for one or two days before healing. A severe reaction, which the article says is rare among beekeepers, is anaphylactic shock.

Reaction	What the article says
Mild	Redness, swelling, itching; pain and swelling subside in two hours
Moderate	Welt slightly larger for one or two days before healing
Severe	Anaphylactic shock; rare among beekeepers

> **Severe reactions are an emergency**
>
> The article names anaphylactic shock but gives no treatment steps. From general knowledge, it is a medical emergency needing emergency help, and people who know they react badly to stings should speak to a doctor before keeping bees (check). This chapter is not medical advice.

What to do after a sting

The article says to remove the sting without squeezing the attached venom glands. A quick fingernail scrape is effective and intuitive and stops more venom spreading, so the side effects

go away sooner. Washing the area with soap and water can also stop the spread of venom, and ice or a cold compress can be applied.

```
# after a sting, per the article
1. scrape the sting out with a fingernail (do not squeeze the venom glands)
2. wash the area with soap and water
3. cool it with ice or a cold compress
# the order is mine; the article lists these without numbering (check)
```

Do stings build tolerance?

The article says some beekeepers believe pain and irritation decrease with more stings, and consider it important for safety to be stung a few times a season. It also says beekeepers have high levels of antibodies, mainly Immunoglobulin G, in reaction to the major antigen of bee venom, phospholipase A2, and that antibody levels correlate with how often they are stung. The article presents the first idea as a belief, not a finding, and does not say whether the antibodies protect or merely mark exposure (check). Nothing here is a reason to seek stings.

> **Clothing and stings, a link back**
>
> Beekeeping Fundamentals 3 reported that stings left in fabric keep releasing alarm pheromone. This section adds that clothing allowing you to tug out the sting and venom sac can reduce venom entry, and that a worker's barbed sting is less likely to lodge in clothing than in skin. Both points come from the same article, so they fit together: wear clothing that lets you remove stings, then wash it.

The Hive's Own Temperature

The article says bees keep the hive at about 35 °C (95 °F), an ability called social homeostasis first described by Gates in 1914. In hot weather they cool the hive by circulating air from the entrance and, if needed, by placing fetched water around the hive for evaporative cooling. For cold weather the article says packing and insulation are "believed to be beneficial": they are believed to reduce honey consumption, and encouraged double-walled hives with timber or polystyrene outer walls, and ceramic hives.

The two temperatures are consistent: 35 × 9/5 + 32 = 95 °F. I checked this in Python and it returned 95.0.

Where to Put Hives

The article says there has been considerable debate about the best location. Virgil thought hives should be near clear springs, ponds or shallow brooks; Wildman thought they should face south or west. The article says all writers agree hives should be sheltered from strong winds. In hot climates hives are often put under shade in summer.

Question	What the article says
Wind	All writers agree: sheltered from strong winds
Water	Virgil: near clear springs, ponds or brooks
Direction	Wildman: south or west
Heat	Hot climates: shade in summer

Agreed

Shelter from strong winds.

Debated

Which direction to face; how close to water.

Not in the article

Neighbours, local rules, flight paths, access for you and the harvest.

What the source leaves out

The article does not say anything about neighbours, local registration or planning rules, or how far to place a hive from a path. Those matter in practice (check). Look up your own local rules and talk to nearby beekeeping groups before you buy bees; this course cannot tell you what applies where you live.

A caution about competition

The article says researchers in the U.S. found that domestic honey bees in national parks compete with native bee species for resources. A further review concluded that large concentrations of hives on continents where honey bees are not native, such as the Americas, could compete with native bees; this was not as strongly observed where domestic bees are native, such as Europe and Africa. So where you keep bees may matter to wild bees, not only to you. The article does not set a safe number of hives (check).

Styles of Beekeeping

Style	Idea (per the article)
Natural beekeeping	Holds that modern practices such as crop spraying, hive movement, frequent inspections, artificial insemination, routine medication and sugar-water feeding weaken hives; tends to use top-bar hive variations
Urban and backyard	Small-scale colonies that pollinate urban gardens; some find city bees healthier because of fewer pesticides and more biodiversity
Indoor	Bees raised indoors in controlled conditions or observation hives; large operations may move colonies to wintering warehouses

On natural beekeeping, the article ties its recent spread to two 2007 books and describes the Warré hive as a vertical top-bar design based on the work of Abbé Émile Warré (1867 to 1951). Subtracting, the priest lived 84 years (1951 − 1867, confirmed in Python), though the article gives only the years and does not say how old he was.

Urban bees and forage

The article says urban bees may fail to find forage, and homeowners can help by planting flowers that provide nectar and pollen. It says year-round, uninterrupted bloom gives an ideal environment for colony reproduction. It also says managed colonies filling the pollinator niche in cities is thought to be crucial to preventing feral colonies of more destructive species such as the Africanized honeybee; I would treat that as a claim to verify, since the article does not give a source for it in the text I read (check).

Indoor beekeeping

The article describes a 2015 indoor project that simulated springtime through the winter with food and long days and saw activity and reproduction comparable to warm outdoor weather. It concludes an indoor apiary could be sustained year-round if needed. That is eight years after the 2007 natural beekeeping books (2015 − 2007 = 8, checked in Python), a reminder that these styles were developing at the same time rather than in sequence (my observation).

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Beekeeping article (about 42,500 characters). This chapter uses its "Safety and husbandry" section (stings, internal temperature, hive location, natural, urban and indoor beekeeping), which I read in full. Other sections were not read for this chapter.
- **Not in the source.** How to buy bees, local rules and registration, insurance, costs, neighbours, medical advice for severe reactions. None of these are given here as facts (check).
- **Conflicts.** None found in this section.
- **My own additions.** The numbering of the sting steps, the observation about styles developing in parallel, and the caution on the claim about feral colonies.
- **Code.** A one-line Python run checked the temperature conversion and the two year subtractions; the outputs (95.0, 84, 8) match the page.

Exercises

EXERCISE 1

Convert the hive temperature (35 °C) to Fahrenheit by hand, then convert 25 °C as well. Check the first against the figure printed in the article and say whether they agree.

→ Solution

EXERCISE 2

Draw up a siting checklist for a hive in your own garden or in a plot you know. Mark each item as "agreed in the article", "debated in the article" or "not in the article, so I must look it up".

→ Solution

EXERCISE 3

A beekeeper is stung on the back of a bare hand. Using only the article, write the three steps in order, and name one thing the article does not say that you would want to know before relying on the steps.

→ Solution

Quick Reference

- **After a sting:** scrape, wash, cool; do not squeeze the venom glands
- **Hive temperature:** about 35 °C (95 °F)
- **Siting:** sheltered from strong winds (agreed); other points debated
- **Styles:** natural, urban and backyard, indoor
- **Missing from the source:** buying bees, local rules, medical treatment
- **Check:** emergency advice, tolerance claim, feral-colony claim, local rules

Coming next

Chapter 5 follows the beekeeping year: what a beekeeper does in each season, based on the source's account of colony behaviour.

Beekeeping Fundamentals

Course 1 · Chapter 5 · The Bee Year: Seasons and Temperatures

A colony's life follows the year: slow in winter, then a surge in spring, a peak in summer and a wind-down in autumn. Beekeeping Fundamentals 2 described the colony and Beekeeping Fundamentals 4 described the hive's own temperature. This chapter joins those into a year, using what two sources say about seasons and about the temperatures bees can work in. It is honest about a limit: the sources describe the bees' year, not a month-by-month list of beekeeper jobs, so inspection schedules and record-keeping are covered only where the sources say something.

The Colony's Year

Wikipedia's Western honey bee article says that in temperate climates the bees gather in the hive and wait out the cold season, when the queen may stop laying and activity is slow. The colony then lives on its stored honey, which is also used to make metabolic heat. In mid to late winter the queen starts laying again, probably triggered by day length. In spring and early summer, with flowers abundant, the colony may swarm. Through the rest of the growing season it produces many workers who bring in pollen and nectar as food for the cold season, and in midsummer a healthy hive's population may reach 40,000 to 80,000 bees.

Season	What the colony does (per the article)
Late winter	Queen resumes laying, probably triggered by lengthening days
Spring and early summer	Plenty of flowers; swarming season; laying at its peak in spring
Midsummer	Population may reach 40,000 to 80,000 bees; nectar turned into honey and capped
Early autumn	Queen generally begins slowing egg-laying
Winter	Bees clustered in the hive; queen may stop laying; honey stores consumed

Where the "year" comes from

The table combines statements from two different sections of the article (the colony life cycle, and the queen section). The wording "generally" and "may" is the article's own. In other climates the pattern would differ; the article says its description is for "temperate climates to which western honey bees are adapted" and gives no southern or tropical version (check).

Temperature: What Bees Can and Cannot Do

The same article gives a set of temperature thresholds. A bee needs an internal body temperature of 35 °C (95 °F) to fly, and the nest is kept at that temperature to develop the brood; it is also optimal for making wax. The winter cluster's internal temperature may be as low as 20 to 22 °C (68 to 72 °F), and the cluster's outside edge varies with the air temperature.

Temperature	Figure in the article	What it means
20 to 22 °C	68 to 72 °F	Winter cluster's inside may be as low as this
22 to 25 °C	72 to 77 °F	Optimal air temperature for foraging
35 °C	95 °F	Body temperature needed to fly; nest temperature
Below 7 to 10 °C	45 to 50 °F	Bees are immobile
Above 38 °C	100 °F	Activity slows
Up to 50 °C	122 °F	Tolerated for short periods

Checking the conversions

I converted the Celsius figures myself with F = C × 9/5 + 32 and ran the calculation in Python. Most agree with the article's Fahrenheit values after rounding: 7 °C is 44.6 °F (the article says 45), 10 °C is 50.0, 20 °C is 68.0, 22 °C is 71.6 (72), 25 °C is 77.0, 35 °C is 95.0, 38 °C is 100.4 (100) and 50 °C is 122.0.

One conversion that is not a conversion

The article says bees can forage over "a 30 °C (86 °F) air-temperature range". But 86 °F is what you get by converting 30 °C as a thermometer reading. A range of 30 degrees

Celsius is a difference of 54 degrees Fahrenheit (30 × 9/5). Elsewhere the article handles a difference correctly, saying a droplet lowers the head temperature by 10 °C (18 °F). So the 86 °F looks like a small mistake in the source; the 30 °C range itself I cannot check without the underlying research (check).

The Mechanisms Behind the Numbers

The article says bees forage over that wide range thanks to behavioural and physiological regulation of their flight muscles. From cold to hot, it lists: shivering before flight and pausing flight to shiver more; passive body temperature regulation based on the work being done; and evaporative cooling from regurgitated honey-sac contents. In hot conditions a bee dissipates heat from the thorax through the head, producing a "honeycrop droplet" that lowers the head temperature by 10 °C (18 °F).

Cold

Shivering to warm the flight muscles; below about 7 to 10 °C bees cannot move.

Comfortable

Foraging is best at 22 to 25 °C.

Hot

Evaporative cooling; activity slows above 38 °C.

What the Source Does Not Give

The sources I read describe what bees do through the year. They do not give a calendar of beekeeper tasks, how often to inspect, how to keep records, or what to do in each month. Beekeeping Fundamentals 3 mentioned that conventional advice often says to inspect weekly in warmer months, but that was a passing remark in the source, and it is not a recommendation here.

Build your own year from the bees

A sensible way to plan (my suggestion, not the sources') is to write the bees' year from the table above in your own notebook, add your local weather dates, and then note what you actually see in the hive each visit. Over a few seasons that becomes your own local calendar (check).

```
# a minimal observation record (my suggestion, not from the source)
date:          2026-__-__
air temp:      __ C
flying:        none / a few / many
queen laying:  seen eggs? yes / no
stores:        low / ok / full
notes:         ____________________
```

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Western honey bee article (about 54,500 characters). This chapter uses its colony life-cycle, queen and thermoregulation sections, which I read in full. A passing reference to inspection frequency comes from the Beekeeping article used in earlier chapters. Other sections of both articles were not read for this chapter.
- **Conflict or error.** The "30 °C (86 °F) range" is probably a conversion mistake in the source (explained above).
- **Not in the sources.** Seasonal task lists, inspection frequency, record keeping, and the form of the observation record above (my suggestion). Also behaviour outside temperate climates (check).
- **Code.** A short Python calculation converted the temperatures; every value matches the page.

Exercises

EXERCISE 1

Convert 7 °C, 22 °C, 25 °C and 38 °C to Fahrenheit using F = C × 9/5 + 32, and compare with the table. Then explain why a temperature range of 30 °C is not the same as 86 °F.

→ Solution

EXERCISE 2

Using the seasons table, say in each season whether the colony is growing, steady or shrinking, and give the source's reason. Then name one thing about the year the article does not tell you.

→ Solution

EXERCISE 3

The day is 8 °C and still. Using the article, would you expect bees to be flying? Then say what you would expect at 23 °C, and at 40 °C. Give the figure you used each time.

→ Solution

Quick Reference

- **Winter:** clustered; queen may stop laying; honey used for heat
- **Late winter:** queen resumes laying (day length, probably)
- **Spring to summer:** peak laying; swarming; 40,000 to 80,000 bees
- **35 °C:** flying temperature and nest temperature
- **22 to 25 °C:** best foraging air temperature
- **Below 7 to 10 °C:** immobile; above 38 °C: slows
- **Check:** other climates, 86 °F range figure, local calendar

Coming next

Chapter 6 takes up swarming and colony management in detail: what triggers a swarm, how queen cells differ, and what an artificial swarm is.

Beekeeping Fundamentals

Course 1 · Chapter 6 · Swarms and Splits: Managing Colony Reproduction

Beekeeping Fundamentals 2 introduced swarming as how a colony reproduces, and Beekeeping Fundamentals 5 placed it in the year. This chapter looks closer: what makes a colony more likely to swarm, how to tell swarm preparation from queen replacement, what happens to a swarm afterwards, and how beekeepers use the bees' own queen-raising ability to split a colony. It is based on the Colony reproduction, Factors that trigger swarming and Artificial swarming sections of the Beekeeping article.

Two Ways to Replace a Queen

The article says colonies depend on their queen, the only egg-layer. When her pheromones fail (because she is injured, has run out of sperm, or her scent has faded too far to control the bees), the workers make queen cells by modifying existing worker cells that hold a normal female egg. They then either supersede the queen without swarming or divide the hive into two colonies through swarm-cell production, which leads to swarming.

	Supersedure	Swarm preparation
Queen cells	One or two	Twelve or more
Where on the comb	Most often in the centre of the comb's face	Often around the edges: sides and bottom
Shape	(not described)	Large, peanut-shaped protrusions that need space
Result	New queen; old queen dies or is killed; no stock lost	Colony splits in two

The sources do not quite agree

Beekeeping Fundamentals 2 reported the other article saying a colony "creates one to two dozen new queens" before a swarm; here the Beekeeping article says "twelve or more". Those overlap (12 to 24), so they are compatible. On queen lifespan they differ more: the other article gave 3 to 5 years on average, this one gives 3 to 4, and also says that

> lifespans of under a year are "commonly and increasingly observed". I cannot reconcile these; treat the ranges as rough (check).

The other article (Beekeeping Fundamentals 2) described emergency queen cells built out from the comb face rather than hanging from the bottom of a frame. The two articles stress different positions, so a beginner should not rely on position alone; the Beekeeping article gives the count as the main difference (check).

```
# the article's counts as a tiny function
def cell_type(count):
    return ("swarm preparation" if count >= 12
            else "supersedure" if count in (1, 2)
            else "unclear")

# output when I ran it:
# 1 supersedure / 2 supersedure / 5 unclear / 12 swarm preparation / 24 swarm prepa
```

The point of the function is the gap: a count of 3 to 11 is not classified by the article at all, so a real hive may show a number that does not fit either pattern. I ran the code and the output is exactly the five lines listed in the comment.

What Pushes a Colony to Swarm

The article cites George S. Demuth for the main factors that raise the tendency to swarm, noting he attributed some comments to Snelgrove:

#	Factor (per Demuth, in the article)
1	The genetics of the bees: the strength of the swarming instinct
2	Congestion of the brood nest
3	Insufficient empty combs for ripening nectar and storing honey
4	Inadequate ventilation
5	Having an old queen

#	Factor (per Demuth, in the article)
6	Warming weather conditions

Space

Factors 2 and 3 are about room for brood and for honey.

Air

Factor 4 is ventilation.

The bees themselves

Factors 1 and 5: genetics and queen age. Factor 6 is the weather.

The article also says different subspecies swarm differently: in North America, northern black races are thought to swarm less and supersede more, while southern yellow-and-gray types are said to swarm more; Italian bees are described as prolific and inclined to swarm, and Northern European black bees as strongly inclined to supersede. Cross-breeding makes it complicated, and the article does not say how these labels map onto the bees you would actually get (check).

> **A list is not a score**
>
> The article does not weight the six factors or say how many mean a swarm is certain. My Python check ran `risk(["old queen", "warming weather"])` and printed "2 of 6 factors present". That count is only a tally for keeping notes. It is not a prediction (check).

After the Swarm Leaves

The article says the old queen leaves when the first queen cells hatch, with a large number of young "wax-secretor" bees who form the basis of the new hive. Scouts look for hollow trees or rock crevices. Within hours the new colony builds wax comb using honey the young bees filled themselves with before leaving. Only young bees can secrete wax, which is why swarms tend to contain more young bees. Often a number of virgin queens accompany the first (prime) swarm; the old queen is replaced as soon as a daughter queen mates and lays.

Back in the original hive, the article says a beekeeper may capture the swarm and put it into a new hive; otherwise it reverts to a feral state. A small after-swarm has less chance of survival and may threaten the original hive if too few bees remain. If a hive swarms despite the beekeeper's preventive efforts, the article says the beekeeper may give the reduced hive two frames of open brood with eggs, so it recovers faster and has a second chance to raise a queen if mating fails.

Splitting a Colony

The article says that when a colony loses its queen it is "queenless"; the workers notice after around an hour as her pheromones fade. They choose cells with eggs less than three days old and enlarge them into "emergency queen cells", about one inch (2.5 cm) long and peanut-shaped, hanging from the centre or side of the brood combs. The larva is fed differently, getting plenty of royal jelly, and emerges as a queen after metamorphosis and pupation.

Beekeepers use this ability to increase colonies by splitting. They take several brood combs from a healthy hive, leaving the old queen behind. The combs must contain eggs or larvae under three days old and be covered with young nurse bees, which care for the brood and keep it warm. These go into a small nucleus hive with combs of honey and pollen, where the nurse bees, finding themselves queenless, begin building emergency queen cells.

Step in a split (per the article)	Requirement
Choose a healthy hive	The old queen stays behind
Remove several brood combs	Eggs or larvae less than three days old
Cover them with bees	Young nurse bees
Put them in a nucleus hive	Also combs with honey and pollen
Wait	Nurse bees build emergency queen cells

> **Where the source stops**
>
> The article's splitting passage ends with the nurse bees building emergency queen cells. It does not say here how the new queen is mated or what the beekeeper does next, so this chapter does not either (check).

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Beekeeping article (about 42,500 characters). I read the Colony reproduction, Factors that trigger swarming and Artificial swarming sections. I read all three in full; the source's splitting passage simply ends before mating and later steps, so those are not covered. Other sections were not read for this chapter.
- **Conflicts.** Queen lifespan and the number of queen cells differ between the two articles used in this course; the cell counts are compatible, the lifespans are not fully (check).
- **Not in the source.** A way to score swarm risk, and a rule for what to do with queen-cell counts between 3 and 11. The function above is only an illustration.
- **Code.** A short Python script ran the classification and the tally. Its output matches the comment in the code block and the figure printed on the page.

Exercises

EXERCISE 1

A beekeeper finds two peanut-shaped queen cells near the middle of a comb, and another finds fifteen around the edges and bottom. Say what the article suggests each is preparing for. Then say which count the article does not classify and why that matters.

→ Solution

EXERCISE 2

List Demuth's six factors and, for each, say whether a beekeeper can influence it, with a short reason. Mark any answer that goes beyond the article as your own opinion.

→ Solution

EXERCISE 3

Write the steps of a split in order, as the article gives them. Then name the age limit on eggs and larvae and say why the workers' behaviour makes that limit matter.

→ Solution

Quick Reference

- **Supersedure:** 1 to 2 queen cells, centre of the comb face
- **Swarm preparation:** 12 or more, edges and bottom
- **Swarm factors:** genetics, crowding, too few empty combs, ventilation, old queen, warming weather
- **Split:** brood combs with eggs or larvae under three days old, young nurse bees, nucleus hive
- **Queenless:** workers notice after about an hour
- **Check:** lifespan figures, subspecies labels, what comes after the split

Coming next

Chapter 7 turns to pests, diseases and threats to the colony.

Beekeeping Fundamentals

Course 1 · Chapter 7 · Pests and Disease: What Threatens a Colony

A colony can be strong in spring and gone by the next. This chapter lists what the source names as threats: diseases, parasites and pests, predators, and the unexplained losses called colony collapse disorder. It is a naming chapter. The source says what each threat is but, in the passage I read, gives almost nothing about treatment, so this chapter does not tell you how to treat anything. For that you would need a local beekeeping association or a proper beekeeping manual (check).

Disease in Adult Bees

Wikipedia's Beekeeping article says the common agents of disease in adult honey bees include fungi, bacteria, protozoa, viruses, parasites and poisons. It adds that the gross symptoms in affected adults are very similar whatever the cause, so working out the cause is difficult without microscopic identification of microorganisms or chemical analysis of poisons.

> **You cannot diagnose by looking alone**
>
> Because the visible symptoms look alike, the article says the cause usually cannot be told apart by eye. A beekeeper who sees something wrong should not guess a cause from the symptoms. This follows directly from the article's statement; what to do instead is beyond the passage (check).

Parasites and Pests the Source Names

Threat	What the article says
Nosema (*Nosema apis*)	A microsporidian causing nosemosis; the most common and widespread disease of the adult honey bee
Wax moths (*Galleria mellonella*, *Achroia grisella*)	Larvae tunnel through and destroy comb containing bee larvae and honey; silk-lined tunnels entangle and starve emerging bees; leaking honey is wasted

Threat	What the article says
Small hive beetle (*Aethina tumida*)	Native to Africa, now on most continents; a serious pest of honey bees not adapted to it
Varroa mite (*Varroa destructor*)	Established pest of two honey bee species across many parts of the world; blamed by many researchers as a leading cause of colony collapse disorder
Tropilaelaps mites	Four species, native to other *Apis* species, spread to *Apis mellifera* after they were introduced to Asia
Tracheal mite (*Acarapis woodi*)	Infests the trachea of honey bees

Attack the bees

Nosema, the mites (varroa, tropilaelaps, tracheal).

Attack the comb and stores

Wax moth larvae; the article also describes the small hive beetle as a serious pest, without saying how it harms the hive.

Depends on the colony

A healthy hive can manage wax moths, but weak colonies, empty hives and stored frames can be decimated.

Links back to the hive

Beekeeping Fundamentals 1 quoted the same article saying that, since mite pests arrived in the twentieth century, hive floors are often replaced, temporarily or permanently, by wire mesh with a removable tray. This section names the mites behind that change. The article does not explain how the mesh floor helps, and I have not explained it either (check). The wax moth sentence also matters for stored equipment: the article says stored frames can be decimated, which is a reason to think about how spare frames are kept (my inference; the article gives no storage advice).

```
# threats named in the article's parasite list
nosema              disease of adult bees
```

```
  small hive beetle    pest of bees not adapted to it
  tracheal mite        infests the trachea
  tropilaelaps mites   mites, four species
  varroa mite          pest, blamed by many researchers for CCD
  wax moth larvae      destroy comb, honey stores
  # 6 named in the parasites list
```

That listing is the output of a short Python script that holds the six threats in a dictionary and prints them in alphabetical order. The count of six is mine, from counting the article's entries; the article's own wording groups wax moths under two species, so someone counting species would get seven (check).

Colony Collapse Disorder

The article says that since 2006, losses from colony collapse disorder (CCD) have been increasing across the world, "although the causes of the syndrome are unknown". In the U.S., commercial beekeepers have been increasing hive numbers to deal with higher rates of attrition. The article elsewhere says varroa is blamed by many researchers as a leading cause. Those two statements sit uneasily: the causes are "unknown", yet varroa is "blamed by many". I take it to mean there is a leading suspect but no settled explanation, though the article does not say so itself (check).

> **Two statements to hold together**
>
> "Causes unknown" and "blamed by many researchers" are not exactly a contradiction, but they are not a tidy agreement either. When a source says both, the honest reading is: a leading suspect, no consensus. Also note that "since 2006" means the pattern was about twenty years old at the time of writing (2026 − 2006 = 20, checked in Python).

Predators

The article says most predators avoid honey bees because of the sting. Common predators include large animals such as skunks and bears, which seek the honey and brood as well as the adult bees. Some birds eat bees, such as bee-eaters, as do some robber flies, one of which the article calls a pest of beekeeping in South America because it eats workers while they forage in

meadows. Beekeeping Fundamentals 3 noted a traditional reason for pale beekeeping clothing was the idea that dark clothing resembles those dark predators.

Are Bees Living Shorter Lives?

The article reports a 2022 study by researchers at the University of Maryland, College Park, which found that the lifespan of caged worker bees is half as long as that observed 50 years ago. The researchers hypothesised that shorter worker lifespans should correlate with lower honey production. Subtracting, the earlier observation would be from about 1972 (2022 − 50, checked in Python), though the article gives no earlier year, so that is my arithmetic from "50 years ago".

> **Read the wording**
>
> Two cautions from the article's own words: the bees in the study were caged, so the result is not necessarily the same as for bees living normally in a hive, and honey production is a hypothesised link, not a finding. The article does not give the study's methods or sample size, and I have not looked up the study (check).

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Beekeeping article (about 42,500 characters). This chapter uses its Pests and diseases section (Diseases, Parasites, Predators, Decreasing lifespan), which I read in full. The Recent developments section, which follows it, was also read, but I use it in a later chapter.
- **Not in the passage.** Treatment, monitoring, prevention, how the mesh floor helps, how the small hive beetle harms a hive, and the study's methods. None are stated here as fact (check).
- **Conflicts.** None direct. The "causes unknown" versus "leading suspect" tension is noted above.
- **Code.** A short Python script printed the threat list shown in the code block and checked the two year subtractions (1972 and 20). The outputs match the page.

Exercises

EXERCISE 1

Sort the article's six threats (nosema, wax moths, small hive beetle, varroa, tropilaelaps, tracheal mite) into those that the article says attack the bees themselves and those that attack comb and stores. Mark any you cannot place from the article alone.

→ Solution

EXERCISE 2

The article says colony collapse disorder has unknown causes but also that varroa is blamed by many researchers as a leading cause. Write two sentences that report both statements fairly without overstating either. Then give the year arithmetic for how long CCD had been reported by 2026.

→ Solution

EXERCISE 3

Read the lifespan study as the article reports it. List what it says, what it only hypothesises, and two things you would want to find out before trusting the result.

→ Solution

Quick Reference

- **Disease agents:** fungi, bacteria, protozoa, viruses, parasites, poisons; symptoms look alike
- **Nosema:** the most common adult-bee disease
- **Wax moths:** destroy comb; weak and empty hives and stored frames at risk
- **Mites:** varroa, tropilaelaps, tracheal
- **CCD:** rising since 2006; causes unknown
- **Predators:** skunks, bears, some birds, robber flies

- **Check:** treatment, mesh floors, study details

Coming next

Chapter 8 turns to the harvest and the hive's products, including the source's account of honey fraud.

Beekeeping Fundamentals

Course 1 · Chapter 8 · Honey and Hive Products: What a Colony Yields

Beekeeping Fundamentals 1 listed what a hive produces. This chapter looks at how honey is made, what the other products are, how bees themselves are sold, and a modern problem, honey fraud. It uses two sources: the Products section of Wikipedia's Western honey bee article and the Honey fraud section of its Beekeeping article. Neither source gives the practical steps of extracting honey from a frame, so this chapter says what the products are, not how to harvest them (check).

How Bees Make Honey

The Western honey bee article says honey is a complex substance made from nectar and sweet deposits from plants and trees, gathered, modified and stored in the comb. Chemically it is a mixture of inverted sugars, mainly glucose and fructose. The process it describes:

Step	What the article says
1. Collect	Foragers gather nectar, a clear liquid of nearly 80 percent water plus complex sugars, and carry it in a second stomach
2. Transfer	In the hive, worker bees take the nectar from the foragers
3. Digest	Workers digest it for about 30 minutes with enzymes, breaking complex sugars into simpler ones
4. Dry	Spread in empty cells to dry until the water content is under 20 percent; wings fan a draft through the hive
5. Cap	When dry, the cells are sealed with wax

How much nectar makes a kilogram of honey?

Using the article's figures, start with 1 kg of nectar that is 80 percent water: 0.2 kg is sugar and other solids. If the honey ends up at 20 percent water, those 0.2 kg make up 80 percent of the honey, so the honey weighs 0.2 / 0.8 = 0.25 kg. So about 4 kg of such nectar is needed per kilogram of honey. I ran this in Python and got 0.25. It follows only

from the two rough figures ("nearly 80" and "less than 20"), so the true ratio will differ (check).

Keeps well

The article says honey will not rot or ferment under normal storage, but will crystallise over time.

Bees and crystals

Bees can use only liquid honey and will remove and discard crystallised honey from the hive.

Other claims

Antibacterial and antifungal properties, including a specific activity against one bacterium. I did not check these (check).

The Other Products

Product	Source says
Beeswax	Secreted by mature workers from abdominal glands for comb walls and caps; collected at harvest for candles and seals
Bee pollen	Carried in a pollen basket; ferments into bee bread, the brood's protein source; excess can be collected; may cause allergic reactions
Bee brood	Eggs, larvae or pupae; edible and highly nutritious; often a by-product when the beekeeper has excess bees
Propolis	Resin from tree buds and sap flows, used to seal unwanted gaps; used in wood finishes; health claims alleged; may cause severe allergic reactions
Royal jelly	Secretion that feeds larvae and the queen; health claims "alleged but unsupported"; may cause severe allergic reactions

Several products carry allergy warnings

> The article says bee pollen, propolis and royal jelly can each cause allergic reactions, and says severe ones are possible for propolis and royal jelly. It also calls the health claims for propolis "alleged" and those for royal jelly "unsupported". Do not treat any of them as a remedy on the strength of this chapter. For anyone with allergies, a doctor is the right first step (check).

Buying Bees

Chapter 4 said the Beekeeping article does not say how to get your first colony. The Western honey bee article does say how bees are sold: as mated queens, as spring packages of a queen plus two to five pounds (0.91 to 2.27 kg) of bees, as nucleus colonies that include frames of brood, or as full colonies.

Form	What you get
Mated queen	A queen only
Package	A queen with 2 to 5 pounds of bees
Nucleus colony	Includes frames of brood
Full colony	A whole established colony

The article adds that commerce in western honey bees goes back to at least 1622, when the first colonies were shipped from England to Virginia, and that modern queen-rearing and colony-division methods date to the late 1800s. It says the first commercial beekeeper in the United States is considered to be Moses Quinby of New York, who experimented with movable box hives, and that road and vehicle improvements after the First World War let commercial beekeepers grow. It does not say what bees cost, or how to judge a good seller (check).

Pollination as a Product

The article says pollination accounts for much of the species' commercial value, estimating the commercial value of western honey bees at just under 200 billion dollars worldwide in 2005, and a 2000 calculation by two Cornell researchers at 14.6 billion dollars for American food crops. Those two figures differ by far more than currency or geography alone suggests; they come

from different studies and scopes, and I have not compared their methods (check). Migratory beekeepers supply hives during a bloom and move them afterwards. The article gives the example of one orchard crop needing two hives per acre, or about 2,000 square metres per hive.

That last conversion checks out roughly: an acre is about 4,047 square metres, and two hives per acre gives about 2,023 square metres per hive, close to the article's 2,000. I computed this in Python.

World Hive Numbers and Honey Fraud

The Beekeeping article gives Food and Agriculture Organization figures: the world's hive stock rose from about 50 million in 1961 to about 83 million in 2014, which it calls an annual average growth of 1.3 percent, accelerating to 1.9 percent since 2009.

> **The growth rate does not quite reproduce**
>
> Over 53 years (2014 − 1961), compound growth from 50 to 83 million is (83/50)^(1/53) − 1, which Python gives as about 0.96 percent a year. Straight-line growth (33 million over 53 years, divided by the 50 million start) gives about 1.2 percent. The article's 1.3 percent matches neither exactly. It may use a different method, such as averaging each year's growth rate, which I cannot test without the yearly data (check).

Honey fraud

The Beekeeping article says that in 2023 the European Commission reported on honey fraud in 17 European countries, finding that 46 percent of samples were suspicious of being non-compliant with EU honey purity standards, a significant increase from a 2015 study and following improved detection of sugar additives. The article says a US Food and Drug Administration report found that for 2021 to 2023, three to ten percent of imported honey violated purity criteria. It also says an international beekeeping organisation removed honey judging from its awards in 2024, saying adequate testing was impossible, and called in 2020 for rules to track the origin of honey.

> **Two numbers, not one trend**
>
> 46 percent is "suspicious of being non-compliant" in one European survey; 3 to 10 percent is "violated purity criteria" among US imports. These measure different things in different

places, so they cannot be compared or averaged. The eight-year gap between the 2015 and 2023 European studies (2023 − 2015 = 8, checked in Python) also says nothing about how fast fraud is rising, since the article gives no 2015 figure (check).

```
# checks run for this chapter
nectar-to-honey:    0.2 / 0.8 = 0.25 kg per kg of nectar
hives per acre:     4046.86 / 2 = 2023.43 m2 per hive
hive stock growth:  compound 0.96 percent a year; straight-line about 1.2
# the article says 1.3 percent
```

Not Yet Verified, and Sources

- **Source.** The honey, hive products, buying and pollination material comes from the plain-text version of Wikipedia's Western honey bee article (about 54,500 characters); I read its Beekeeping, Products, Honey bees, Pollination, Honey, Beeswax, Bee pollen, Bee brood, Propolis and Royal jelly sections in full. The hive numbers and honey fraud material come from the plain-text version of the Beekeeping article (about 42,500 characters); I read the World apiculture and Honey fraud sections. Other sections of both were not read for this chapter.
- **Not in the sources.** How to extract honey, how to store it, what bees cost, and how to judge a supplier (check).
- **Unchecked claims.** The health and antibacterial statements, both valuations, and the fraud percentages as reported.
- **Possible mismatch.** The growth rate (above).
- **Code.** A short Python script computed the figures shown in the code block; the outputs match the page.

Exercises

EXERCISE 1

Using the article's figures (nectar nearly 80 percent water; finished honey under 20 percent), work out how many kilograms of nectar are needed per kilogram of honey. Show the working and say why the answer is only approximate.

→ Solution

EXERCISE 2

Calculate the compound annual growth rate for hive stock from 50 million (1961) to 83 million (2014), and the straight-line rate. Compare each with the article's 1.3 percent and suggest one reason for any difference.

→ Solution

EXERCISE 3

Make a table of the five ways bees are bought or sold (queen, package, nucleus colony, full colony and brood by-product) and list for each what the article says is included. Say which of the first four a complete beginner might find hardest to judge, labelling your answer as opinion.

→ Solution

Quick Reference

- **Honey:** nectar (about 80 percent water) digested, dried to under 20 percent, capped with wax
- **Other products:** beeswax, pollen, brood, propolis, royal jelly (allergy warnings)
- **Buying bees:** queen, package (2 to 5 pounds), nucleus, full colony
- **Honey fraud:** 46 percent suspicious (Europe, 2023); 3 to 10 percent violating (US imports, 2021 to 2023)
- **Hive stock:** about 50 million (1961) to about 83 million (2014)
- **Check:** health claims, growth rate, valuations, extraction methods

Coming next

Chapter 9 looks at bees and the wider world: pollination, wild bees and forage, and how bees fit into the landscape.

Beekeeping Fundamentals

Course 1 · Chapter 9 · Bees and the Wider World: Communication and Impact

So far this course has looked at the hive from the inside. This chapter looks outwards: how foragers tell each other where food is, how honey bees relate to the other bee species in the genus, and what a systematic review says about whether managed bees affect wild bees. It also revisits a claim from Beekeeping Fundamentals 4 and adds a caution. The source is the Western honey bee article's communication, pheromone, environmental-threat and close-relatives sections.

How Foragers Communicate

Wikipedia's Western honey bee article says Karl von Frisch received the 1973 Nobel Prize in Physiology or Medicine for his study of honey bee communication, noticing that bees communicate by dance. A returning forager dances on the vertical comb to convey the distance, situation and direction of a food source.

Signal	What the article says
Round dance	Tells other foragers food is within 50 metres (160 ft) of the hive, but gives insufficient information about direction
Waggle dance	May be vertical or horizontal; gives more detail about distance and direction
Shaking signal (jerking dance, vibration signal)	A worker vibrates its body while holding another bee with its front legs; most common among workers, also appears in reproductive swarming
Smell	Foragers are also thought to use smell to find a source after being directed by the dances

A unit check on the round dance

The article says 50 metres is 160 feet. Python gives 50 × 3.28084 = 164.04 feet, so 160 is a rounded figure, not an exact conversion. That is fine for a rough distance; I mention it only because earlier chapters found a real conversion slip in the same article.

The shaking signal in numbers

The article quotes a study by Jacobus Biesmeijer: experienced foragers made 92 percent of the shaking signals he saw, 64 percent were made after discovering a food source, and about 71 percent occurred before a bee's first five successful foraging flights of the day, whereas other signals such as the waggle dance came more often after the first five. He concluded it is a "transfer message" for several activities. It sometimes increases activity (active bees shaking inactive ones) and sometimes inhibits it, as at the end of the day, but is preferentially aimed at inactive bees.

> **The percentages are not a partition**
>
> 92, 64 and 71 percent describe different questions about the same signals (who made them, when, and after how many flights), so they do not add up to anything and overlap freely. To see this, imagine 200 observed signals: 184 by experienced foragers, 128 after finding food and 142 before the fifth flight (the numbers I got in Python). Nothing says these groups are separate (check).

Pheromones

The article says western honey bees use pheromones for nearly all behaviour: mating, alarm, defence, orientation, recognising kin and colony, food production and coordinating colony activities. It also says the alarm pheromone has been shown to attract the small hive beetle, which senses it at a lower threshold than the bees do, creating a trade-off between recruiting guards and attracting beetles. Beekeeping Fundamentals 3 noted that stings left in clothing keep releasing alarm pheromone and Beekeeping Fundamentals 7 listed the beetle as a pest; this passage links the two, though the article does not link them to clothing (my connection; check).

Honey Bees and Other Bees

The article says there are six other species in the genus *Apis* apart from the western honey bee, all originating in southern and southeastern Asia, whereas only *Apis mellifera* is thought to have originated in Europe, Asia and Africa:

```
# genus Apis, as listed in the article
Apis mellifera       # Europe, Asia, Africa
Apis andreniformis   # southern and southeastern Asia
Apis cerana
Apis dorsata
Apis florea
Apis koschevnikovi
Apis nigrocincta
# 6 others + mellifera = 7 species (counted in Python)
```

The article also says western honey bees change the precision of the waggle dance to indicate the type of site chosen as a new goal, which their close relatives, the dwarf honey bees, do not. It concludes that western honey bees seem to have evolved a better means of conveying information than their common ancestors with dwarf honey bees. I treat that as the article's interpretation, not settled fact (check).

What Does Managing Bees Do to Wild Bees?

The article has a section titled "As an environmental threat in the Americas". It says some entomologists have observed that non-native feral western honey bees can have negative impacts: imported bees may displace native bees, and may promote reproduction of invasive plants that native pollinators ignore. Other experts are concerned that the public's positive association between honey bees and the environment may be misplaced. Honey bees are not native to the Americas, arriving with colonists in North America in the 18th century.

Evidence in the article	What it says
2025 San Diego County study	Western honey bees about 98 percent of bee biomass and about 90 percent of individual bees
United Kingdom	Honey bees compete with native bumblebees at the same foraging sites; bumblebees forage early in the morning, honey bees in the afternoon
2017 systematic review	Most studies conclude managed bees negatively affect, or could negatively affect, wild bees; but many were short or did not measure direct effects

Evidence in the article	What it says
US Department of Agriculture	Does not presently list western honey bees as an invasive species

What the review found, point by point

Competition

"There is evidence for the presence of competition ... though there is little evidence that this competition can lead to wild bee population declines."

Plant communities

An equal number of studies found positive and negative effects; the effect on wild bees through this route "remains speculative".

Pathogens

"Strong evidence for the transmission of pathogens" between managed and wild bees, but the effects are not yet well understood.

Reading the review fairly

The review's opening sentence sounds worrying (most studies find negative or potentially negative effects), but its details are cautious: competition exists, evidence of population decline is thin, and more long-term work is needed. Quoting only the first part, or only the cautions, would mislead. Both have to be reported together. I have not read the review itself; this is the article's account of it (check).

Revisiting an earlier chapter

Beekeeping Fundamentals 4 reported the other article saying managed colonies filling a pollinator niche in cities were thought to be crucial to preventing feral colonies of more destructive bees. This chapter's source cuts the other way on native competition and says other experts doubt the positive image of honey bees. The two statements are about different things

(feral colonies of one type of bee versus native wild bees), so they do not strictly contradict, but a beginner should hold both and not assume bees are good everywhere (check).

Pollination: not all bees do the same job

The article says most flowering plants depend on specialised pollinators. It gives an example of a crop pollinated by specialist bees that visit early-blooming male flowers before sunrise, when honey bees are inactive. It also says honey bees do not properly extract pollen from plants whose pollen is released through tiny pores, which needs a buzzing behaviour honey bees rarely show, and that honey bees reduced fruiting in one such plant by robbing its stigmas of pollen. This tempers the commercial pollination story told in Beekeeping Fundamentals 8: honey bees are valuable pollinators, but not equally good for every plant.

The article ends the section with one possible mitigation: zoning rules limiting the routes and areas through which beekeepers may transport colonies. It presents this as one potential solution, not a recommendation, and I have not looked for evidence on it (check).

Not Yet Verified, and Sources

- **Source.** Everything attributed to "the article" comes from the plain-text version of Wikipedia's Western honey bee article (about 54,500 characters). I read the Communication (including pheromones), As an environmental threat in the Americas, and Close relatives sections. A long quotation from a historical writer in that section was read but not used. Other sections were not read for this chapter. Earlier-chapter claims about the Beekeeping article come from that article as used before.
- **Not looked up.** The review and the studies themselves; the interpretation of dwarf honey bee dance precision; the zoning idea.
- **Conflicts.** No direct conflict, but a tension with the earlier chapter's statement on managed colonies in cities (explained above).
- **Code.** A short Python script checked the distance conversion, counted the species, and computed the example proportions. The outputs match the page (164.04, 7, and 184, 128, 142).

Exercises

EXERCISE 1

Compare the round dance and the waggle dance using the article: what each tells a forager, and what each leaves out. Convert 50 metres to feet and say whether the article's 160 feet is exact.

→ Solution

EXERCISE 2

The 2017 review is quoted as saying that managed bees "negatively affect, or have the potential to negatively affect" wild bees, but also that competition has "little evidence" of causing population declines. Write a three-sentence fair summary that includes both statements and the review's call for more studies.

→ Solution

EXERCISE 3

Of 250 shaking signals, use the article's percentages to work out how many were made by experienced foragers, how many after finding a food source, and how many before the first five flights. Explain why you cannot add the three numbers to get a total.

→ Solution

Quick Reference

- **Round dance:** food within 50 metres; little direction
- **Waggle dance:** distance and direction
- **Genus *Apis*:** seven species; six others from southern and southeastern Asia
- **Managed bees:** competition, plant effects and pathogens; little evidence of population declines
- **Honey bees as pollinators:** not equally good for every plant

- **Check:** review details, dance interpretation, zoning idea, link to earlier chapters

Coming next

Chapter 10 is the capstone: planning a first season using everything from the nine chapters.

Beekeeping Fundamentals

Course 1 · Chapter 10 · First Season Plan: Putting It Together

This last chapter turns nine chapters of facts into a plan. It is a planning exercise, not a manual: the sources behind this course describe the craft, the colony and the bees' year, but they leave out much that a first-time beekeeper needs. The most useful part of the chapter is therefore the list at the end of what you still have to find out, from local people and proper manuals.

What the Course Covered

Chapter	Main point
Beekeeping Fundamentals 1	Beekeeping keeps colonies, mostly honey bees, in movable-frame hives; the bee space made it practical
Beekeeping Fundamentals 2	A colony has a queen, workers and drones; it reproduces by swarming
Beekeeping Fundamentals 3	Hive families; a veil at least; smoker; hive tool
Beekeeping Fundamentals 4	Sting first aid; shelter from wind; styles of beekeeping
Beekeeping Fundamentals 5	The bees' year and the temperatures that limit them
Beekeeping Fundamentals 6	Queen cells, swarm factors, splitting a colony
Beekeeping Fundamentals 7	Diseases, mites and other pests, and unexplained colony losses
Beekeeping Fundamentals 8	How honey is made, other products, how bees are sold
Beekeeping Fundamentals 9	Communication, and managed bees' impact on wild bees

A Season Plan Built from the Course

Below is a plan that uses only facts the course has already given, arranged by the bees' year from Beekeeping Fundamentals 5. The phases and wording are my own arrangement; the sources do not provide a calendar of beekeeper tasks, so every task should be checked with local advice before you rely on it (check). I wrote it as a short Python script and ran it.

```
# output of the plan script
1. Before bees: find out local rules; choose site (sheltered from wind); get veil, s
2. Late winter: queen resumes laying; keep notes on weather and flights
3. Spring: watch for queen cells (12 or more = swarm preparation); give room
4. Summer: population may reach 40,000-80,000; honey capped when dry
5. Autumn: queen slows laying; check stores; watch for pests
6. Winter: colony clusters; leave it alone and keep records
# 6 phases
```

Sourced

Wind shelter, kit, queen cells, swarm numbers, population, the queen's laying pattern, and clustering come from the sources.

Inferred

"Give room", "check stores", "leave it alone" and "keep records" are my reasoning from the sources, not statements in them (check).

Missing

Costs, rules, buying bees well, harvest technique, treatment and exact timing.

Decisions to Make Before Spring

Decision	Options the course described
Hive	Hanging-frame (the common size where you live), sliding frame, top-bar, horizontal top-bar

Decision	Options the course described
Style	Conventional, natural, urban or backyard, indoor
How to get bees	Mated queen, package, nucleus colony, full colony
Protection	At least a veil; novices usually add a hooded suit or hat and veil, and gloves
Products	Honey first; wax and others later; check allergy warnings

Medical and legal gaps

The sources described stings and named a severe allergic reaction as an emergency in my reading (see Beekeeping Fundamentals 4) but gave no treatment. They also said nothing on local rules, neighbours or insurance. Do not start without checking both: your doctor if you might react badly, and your local authority or beekeeping association for the rules (check).

Reading Your Own Colony

The course gave you a few signs worth knowing. Their numbers come with the cautions already stated in earlier chapters:

- **Queen cells.** One or two suggest replacing the queen; twelve or more suggest swarm preparation; counts between are not classified by the source (Beekeeping Fundamentals 6).
- **Temperature.** Bees are immobile below about 7 to 10 °C and forage best at 22 to 25 °C (Beekeeping Fundamentals 5).
- **Disease.** Symptoms look alike, so do not guess a cause from looks alone (Beekeeping Fundamentals 7).
- **Products.** Three of the other products carry allergy warnings (Beekeeping Fundamentals 8).

A check across chapters

Beekeeping Fundamentals 5 found a probable conversion slip in one source, and Beekeeping Fundamentals 8 found a growth rate that did not reproduce. In both cases the

fix was to recompute from the source's own figures, not to trust the printed number. Carry that habit forward: when a figure drives a decision, recalculate it.

Not Yet Verified, and Sources

- **Source.** This chapter summarises Beekeeping Fundamentals 1 to 9. Its facts therefore come from the same two sources: Wikipedia's Beekeeping article and its Western honey bee article, each used in part, as the earlier chapters say. No new source was read for this chapter. Sections of both articles that earlier chapters did not read (for example parts of the swarming material and the broader sections on behaviour, genome and microbiome) are still unread.
- **Inference.** The season plan's phases, the tasks marked inferred, the decisions table and the cross-chapter observation are my own arrangement (check).
- **Not covered by any source used.** Costs; legal rules; how to buy bees well; harvest technique; disease treatment; when exactly to do what in your area; how many hives; medical advice (check).
- **Unresolved conflicts from earlier chapters.** Swarm share (two-thirds versus half); queen lifespan ranges; the growth rate; and the range figure from Beekeeping Fundamentals 5. These stand as flagged there.
- **Code.** A short Python script printed the six-line plan above; the output matches the code block exactly.

Exercises

EXERCISE 1

Write your own six-phase season plan for your own location, keeping the course's phases but replacing the example tasks. Mark each task "from the course", "my inference" or "must look up".

→ Solution

EXERCISE 2

Make a "what I still need to find out" list of at least eight items that none of the course's sources covered, and for each say who you would ask or what you would read.

→ Solution

EXERCISE 3

Pick any three numbers from the course (for example a population, a temperature, a percentage). For each, say which chapter it came from, recompute or sanity-check it, and say how confident you are in it.

→ Solution

Course complete

You now have the whole sequence: what the craft is, the colony, the hive and kit, getting started, the bees' year, swarms and splits, pests and disease, honey and other products, the wider world, and a plan for a first season. The next step is to talk to local beekeepers and read a proper manual.

Quick Reference

- **Plan phases:** before bees, late winter, spring, summer, autumn, winter
- **Decide:** hive, style, how to get bees, protection, products
- **Watch:** queen cells, temperature, disease signs
- **Find out locally:** rules, costs, timing, treatment, medical advice
- **Check:** inferred tasks, gaps in the sources