WHAT IS CANNABIS

BOOK ONE



Douglas B.

What Is Cannabis

Book One

The plant, its pieces, its chemistry, and how we know what we know — an introduction to cannabis for the reader who knows nothing about it and leans neither way, built from the science, government, university, and field record, with every claim graded by the strength of its evidence

Douglas J. Brownfield

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What Is Cannabis — Book One

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This book was written with the assistance of AI tools, working from the author's own questions and editorial direction, and from a research record built for this book — the published science, government and university records, and the field literature of the people who grow and study the plant.

The figures and the state of the law in this book are stated as of 2026, each with its basis printed where it appears. Where the record is open, the book leaves it open and says so.

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The cover and the thirteen plates in this book were drawn for it, in the manner of the old botanical engravings, and are printed at the places the text calls for them.

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Dedication

My first memories include a kickboxing champion — a man with endless drive. I remember being at the car with my mother as the steelworkers came off shift, a fleet of men walking out of the mill, my dad among them on his walk to the car, sparks flying in the background — and the game she and I played while we watched for him: who could spot him first. I always got excited. I still do, remembering it.

Growing up, he gave me his Midwestern farm town work ethic, and he taught me the importance of being thorough. Both have carried me through everything since. They made me the person I am.

Thank you for being you.

This book is dedicated to my father, Dennis L. Brownfield.

A note on words and evidence

This book is written for a reader who knows nothing about cannabis and leans neither way about it. If that is you, nothing here assumes your opinion, and nothing here is trying to recruit it. The book's aim is smaller and larger than persuasion: to leave you able to see the plant clearly, in a field where almost everyone who speaks about it is selling something — a product, a policy, or a fear.

The word. This book's word is cannabis — the plant's botanical name, the one used by science and by most of the world's history. The other names appear when they are the subject: hemp when the crop and its law are meant, marijuana when the legal category is meant. Chapter 12 explains what each word carries and why the choice among them is never innocent. Here it is enough to say that cannabis is the name that belongs to the plant itself, before any use, law, or argument — and this book is about the plant first.

The grades. Almost every claim in this book carries its evidence on its face. The scale is modeled on the one used by the National Academies of Sciences, Engineering, and Medicine in its landmark review of the field, whose categories run from conclusive down to insufficient. This book speaks in plainer words, in four grades. Settled: replicated in controlled studies and held by expert consensus. Supported: good studies, consistent, not yet final. Suggestive: early or indirect evidence — a signal, not a finding. Open: lore, anecdote, or a question not yet tested. When a claim in these pages sounds exciting, check its grade before you carry it anywhere; when a claim sounds

damning, do the same. Chapter 11 gives the scale its full chapter, including the difference between "no evidence of an effect" and "evidence of no effect," which are not the same sentence and are constantly traded for each other.

The plates and tables. This book is illustrated with plates — the plant whole and dissected, the life cycle, the gland at magnification — drawn to the text and labeled in the text's own words, so the pictures can be checked against the prose and the prose against the pictures. Tables gather the numbers: compounds, thresholds, timings. Every number in a table comes from the sources listed at the back of the book, and where the sources disagree, the table says so rather than choosing quietly.

The promise. Nothing in this book asks to be believed beyond its grade. Where the record is thin, the book says thin. Where it is settled, the book says settled and does not hedge for politeness. The plant has had a century of being described by its enemies and its salesmen. This series was written to give it, at last, its witnesses.

Chapter 1 — A Plant, First

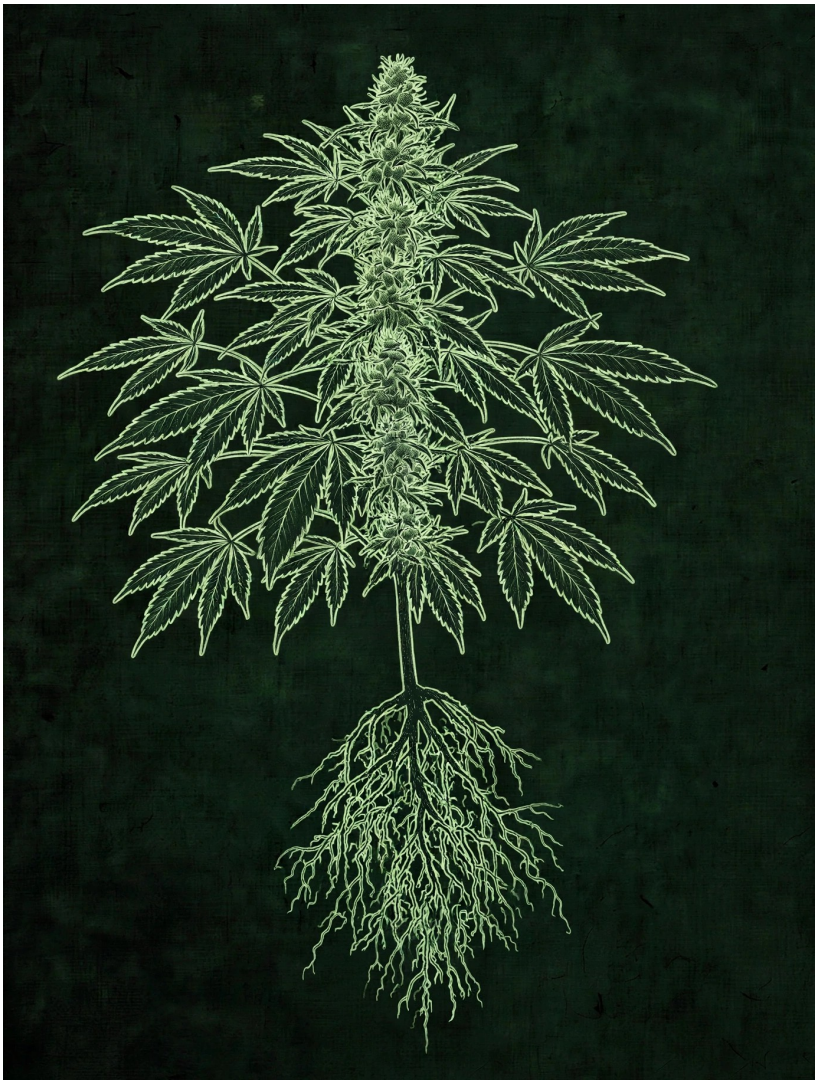


Plate — The whole plant, flowering.

Before it is anything else — before it is a medicine or a crime, a crop or a controversy — cannabis is a plant. That sounds too

simple to be worth a chapter. It is the most important fact in this book, and everything else in the series stands on it. Laws change. Markets change. A plant goes on being a plant, following the same instructions it has followed for a very long time. Start with the plant, and the rest can be understood. Start anywhere else, and it cannot.

What kind of plant

Cannabis is an herb — not in the cook's sense of the word, but in the botanist's: a plant with a soft green stem instead of a woody trunk, which dies back when its season ends. It is also an annual. An annual completes its whole life in one growing season: it sprouts from a seed in spring, grows through summer, flowers, sets seed, and dies, all in a single year. Everything the plant does, it does on that deadline. Its height — anywhere from under a meter to over five in a good season — its hunger for light, its rush to flower as the days shorten: all of it is the behavior of a living thing that has one summer to finish everything.

Like every green plant, it feeds itself from light. Its leaves take in sunlight, water, and air, and build sugar from them — photosynthesis, the quiet chemical trick on which nearly all life on Earth depends. Nothing about that is unusual. What is unusual is where cannabis sits in the plant kingdom, and what it makes.



Plate — The cousins — hop and the wider family.

The family

Every plant belongs to a family, the way every person belongs to a lineage, and cannabis belongs to a small one: the Cannabaceae. Its closest living relative may surprise you. It is the hop — the

plant whose flowers flavor beer. Hops and cannabis are cousins, and the family resemblance is real once you know to look: both grow fast and tall in a single season, both keep their male and female flowers on separate plants, and both cover their flowers in tiny resin glands. In hops, those glands make the bitter, aromatic compounds that brewers prize. In cannabis, as later chapters will show, they make something found almost nowhere else in nature.

The wider family holds a few other genera, including the hackberries — actual trees, which shows how far one family's forms can stretch — and beyond the family, cannabis sits in the order Rosales, which makes it a distant cousin of roses, apples, elms, figs, and nettles. This is worth pausing on. Cannabis is not a botanical freak from outside the order of ordinary things. It is a rose-cousin that took a particular path.

Its habits

Two habits of the plant matter for everything that follows.

First, it keeps its sexes apart. Most flowering plants carry both male and female parts in the same flower. Cannabis, like its cousin the hop, usually does not: there are male plants and there are female plants, and a grower can tell them apart once they flower. (Chapter 2 takes the plant apart piece by piece, including the famous exception — the plant that carries both.) This separation shapes how the plant is bred, how it is grown, and, it turns out, why the female plant makes so much resin: unfertilized, she keeps building flowers and waiting.

The separation of the sexes is itself unusual, and worth a sentence of its own. Only a small minority of flowering plants

— roughly one in twenty species — keep male and female on separate individuals. The great majority carry both in one flower and hedge their bets. Cannabis belongs to the minority, alongside its cousin the hop, the date palm, and the holly tree. Everything in this book that turns on sex — the removed males, the seedless crop, the resin vigil of the unfertilized female — grows out of that one uncommon arrangement.

Second, it trusts the wind. Cannabis flowers are small, green, and dull, with no scent or color meant to attract bees, because no bee is coming. The male plant simply releases pollen in enormous quantities and lets moving air carry it. Wind pollination is an old, plain strategy, and it works: cannabis pollen can travel for kilometers. Remember that when later books take up seeds, neighbors, and the law — the wind does not respect fences.

Where it comes from

The wild homeland of cannabis is Central Asia — the broad steppe country between the mountains, in what is now the region spanning Kazakhstan, Mongolia, and northwestern China. The evidence is of several kinds: fossil pollen in lake sediments, the genetics of the oldest wild and feral populations, and the sheer antiquity of the plant's partnership with people in that part of the world. A large genetic study published in 2021 compared cannabis genomes from around the world and pointed to domestication in East Asia roughly 12,000 years ago — among the earliest of all domesticated plants, taken into human company at about the same time as wheat's ancestors in the west. From there it traveled with us in every direction: as fiber, as food, as medicine, and as a drug, which is to say it traveled as

four different plants while remaining one.

That is the deep history, and Book 2 of this series is given to it entirely. Here it is enough to hold the plain fact: this is an Asian steppe herb that human beings have carried around the planet for some twelve thousand years.

The argument over its name

In 1753, Carl Linnaeus — the Swedish botanist who built the naming system science still uses — gave the plant its formal name: *Cannabis sativa*. Thirty years later, the French naturalist Lamarck examined specimens from India, decided they were a different species, and named them *Cannabis indica*. In 1924 a Russian botanist added a third, *Cannabis ruderalis*, for the tough little wild plants of Central Asia. Botanists have argued ever since about whether cannabis is one species or several, and the argument is not settled by vote or by age; it is a real scientific question about where the lines between kinds should be drawn.

Here is what the genetic evidence shows, stated as plainly as it can be: all of these plants interbreed freely, and their genomes form one connected family with deep regional structure — distinct populations shaped by geography and by human selection, above all the split between plants bred for fiber and seed and plants bred for drug strength. Whether that structure deserves the rank of separate species is the unsettled part.

This book takes the working position most modern references take: one species, *Cannabis sativa* L., with great variety inside it. Chapter 7 examines the words *indica* and *sativa* in full — what they meant, what they mean in a shop today, and why the two meanings parted company. For now: one plant, many kinds.

What the genes added

The naming argument was fought for two centuries with pressed specimens and measurements. In the last decade it gained a new kind of evidence: the plant's own DNA, read at scale. Three findings matter here.

First, the split that runs deepest in the genome is not the split on the shop shelf. A widely cited genetic study published in 2015 compared hundreds of cannabis samples and found that the clearest division was between hemp — plants bred for fiber and seed — and drug-type plants bred for strength. The famous *indica* and *sativa* labels, by contrast, matched the genetics only loosely: plants sold under the two names do differ on average, but the names predict far less than their reputation suggests. Chapter 7 takes that up in full.

Second, the 2021 study of genomes from around the world, mentioned above, found something no one had quite expected: a surviving wild group in China that stands near the root of the whole family tree — the closest living relatives of the first domesticated plants. Every cultivated kind on Earth, fiber and drug alike, descends from that early East Asian stock. The plant's family history has a single hearth.

Third, the family's age can be dated, roughly. Fossil pollen that matches the cannabis-and-hop line appears in sediments in Central Asia going back some 28 million years — long before there were people to name anything. The two cousins, cannabis and hops, parted company somewhere in that deep past and have been running variations on the same body plan ever since: fast annual growth (the hop cheats by dying back to a perennial root), separate sexes, and flowers armored in resin glands.

None of this settles the species argument, because that argument is about where humans should draw a line, and nature is under no obligation to draw it where we would like. But it does fix the ground the argument stands on: one interbreeding family, one ancient origin, and a history written first by geography and then, for the last twelve thousand years, by us.

Why this one

The plant kingdom holds some 400,000 species. Almost none of them are known by name to ordinary people in every country on Earth, argued over by governments, and grown in secret and in billion-dollar facilities at the same time. Cannabis is. The reason is not the fiber, though the fiber is excellent, nor the seed, though the seed is good food. The reason is a family of chemicals — the cannabinoids — that this plant produces in its resin glands in a variety and quantity no other plant matches. (One distant liverwort makes a single similar compound; it is the exception that shows the rule.) Among those chemicals is one that fits, with unusual precision, a system built into the human body — a system most people have never heard of, which Chapter 10 introduces.

That fit is the hinge of the whole story: the medicine and the drug, the fortunes and the prisons, all of it swings on the chemistry of a wind-pollinated steppe herb that would happily have gone on making resin for nobody but itself.

So: a plant first. An annual herb of the hop family, male and female, carried by the wind and then by us, out of Central Asia and into every argument of the modern world. The next chapter takes it apart, piece by piece, and names everything.

Chapter 2 — The Plant in Pieces

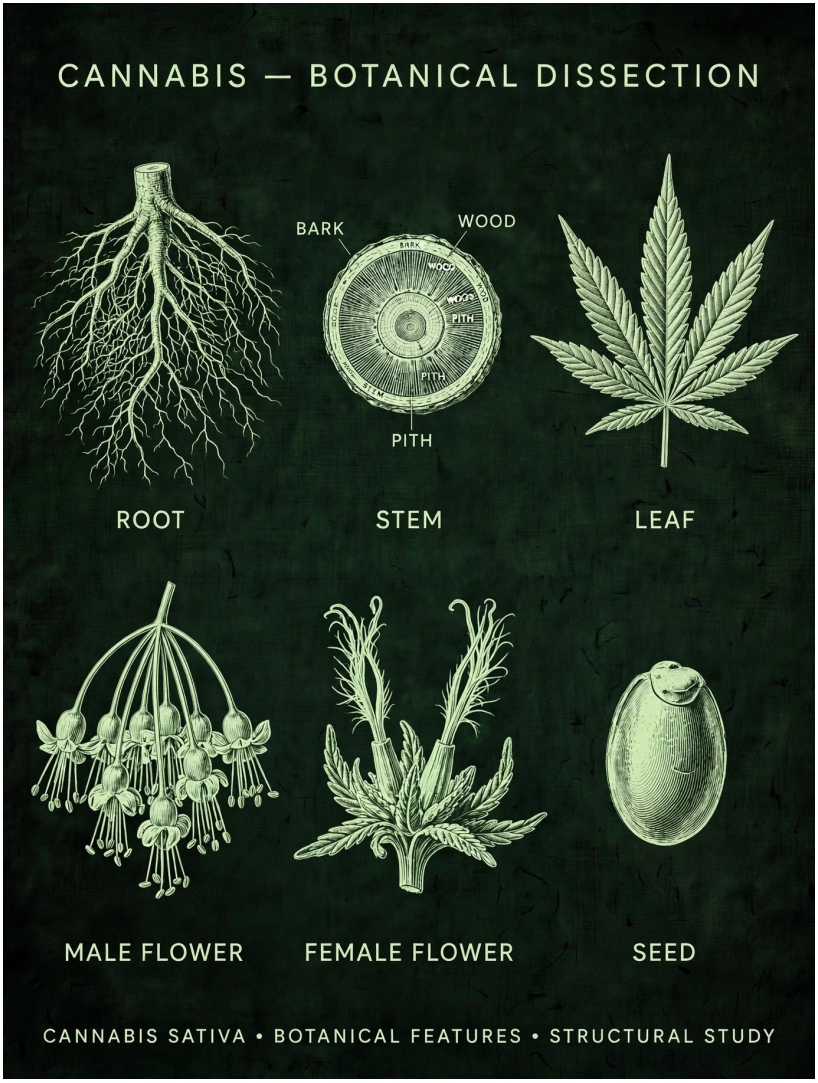


Plate — The plant in pieces.

Take the plant apart and it stops being an argument and becomes a machine — each part with a job, each job understandable. This

chapter names every piece, from the root underground to the seed at the end of the line. The plates in this book draw each part as it is described, so the words and the pictures can be read together. By the end of the chapter you will be able to look at any cannabis plant, at any stage, and say what you are looking at.

The root

Everything starts underground. A cannabis plant grown from seed drives a taproot — one strong central root going down — with finer roots branching off it to the sides. The root does three jobs: it anchors the plant against the wind it depends on, it drinks, taking up water and dissolved minerals, and it stores a reserve. A plant grown from a cutting has no taproot; cuttings root from the stem instead and build a fibrous web of many equal roots. Same jobs, different architecture — and the first quiet lesson of the plant: how it began shapes how it stands.

The root is also where the plant in this book's cover ended its story: pulled whole from its pot, roots hanging in a long mass. Growers read roots the way mechanics read engines. White and branching means health; brown and slimed means trouble. The underground half is half the plant, and it is the half beginners forget.

The stem

The stem is the plant's spine and its highway. Water climbs it from the roots; sugars descend it from the leaves. It grows from its tip, lengthening at the top while it thickens below, and along its length sit the nodes — the joints where leaves and branches attach, separated by stretches of bare stem called internodes.

A mature cannabis stem is not solid wood. At its center is a soft pith; around that, a woody core; and around that, the bark — and the bark is famous. Running the length of the bark are long, strong fibers called bast fibers. Those are the hemp fibers of commerce, the raw material of rope, canvas, and cloth for thousands of years. Strip the bark and the woody core that remains is called hurd — once a waste product, now used for animal bedding and building material. The fiber book of this series returns to both in full. For now, hold the shape: pith, wood, bark, and the long fibers in the bark.

The leaf

The famous leaf is not the flower, not the drug, and not the point of the plant — it is the plant's solar panel and its signature. A cannabis leaf is palmately compound: several pointed leaflets, usually five to nine, radiate from a single point at the end of the leaf stalk, like fingers from a palm. Each leaflet has a saw-toothed edge. Young plants low on the stem carry their leaves in opposite pairs; as the plant matures the arrangement shifts and the leaves come off the stem one at a time, alternating. Botanists read that shift as a sign of maturity, the plant changing its posture as it approaches flowering.

Small leaves that grow directly out of the flower clusters later in the season are called sugar leaves, for the frosting of glands on them. The big shade leaves are fan leaves. Both do the same work — catching light — at different posts.

The male plant

When the days shorten, the plant flowers, and its sex shows. The male plant tends to grow taller and leaner, and at the nodes along

his upper stems he produces clusters of small, hanging, greenish-yellow flowers. Each one is simple: five small petal-like parts and five stamens, the pollen-makers, which dangle so the wind can strip them. A single healthy male releases pollen in the millions of grains. His work done, he yellows and dies ahead of the females — the annual's deadline falls on him first.

Growers of drug cannabis remove males on sight, for reasons Chapter 8 and the cultivation books explain. Growers of seed cannot do without them. The male is half the species; a book about the whole plant gives him his paragraph.

The female plant

The female grows bushier, and her flowers form tight clusters stacked along the upper stem and branches — the structure the world calls a bud. It is worth knowing what a bud actually is, because it is not a single flower. It is a crowded neighborhood of many small flowers, leaves, and glands.

Each individual female flower is modest: a single ovary — the seed-to-be — wrapped in a green sheath called a bract, and from its tip, two feathery stigmas. The stigmas are the pollen catchers. Young, they stand white and fresh; unfertilized, they keep standing, and the plant keeps building more flowers around them; fertilized, they wither as the seed inside swells. The white hairs turning amber that growers watch so closely are those stigmas, aging.

The bracts are coated in the plant's resin glands — so densely that a good female flower cluster glistens. Why she builds all that resin is Chapter 4's question. Where it sits is here: on the

outside of the seed's green cradle, exactly where a threat to the seed would land first.

The seed

If a stigma catches pollen, the ovary becomes a seed — properly, an achene, a small hard fruit with one seed inside, though the whole world calls it a seed and this book will too. It is a self-contained starting kit: an embryo plant, a store of food rich in oils and protein (which is why hemp seed feeds people, Book 5 of this series), and a hard mottled coat. A cannabis seed can wait years for its one spring. The seed enthusiast's shelf of this series takes up its keeping in full.

The plant that carries both

And then there is the exception — the plant on this book's cover. Sometimes a single plant bears both kinds of flower. Botanists call such a plant monoecious, one house instead of two. It happens two ways. Some hemp varieties are bred that way on purpose, so a field can seed itself evenly. And sometimes a female drug plant, stressed — by interrupted darkness, heat, age, or damage — pushes out male flowers among her own, a survival move: no mate coming, so she makes her own pollen as a last resort. Growers call those plants hermaphrodites and pull them the moment they are seen, because one such plant can seed an entire room, and a seeded crop is a ruined one for most purposes. The plant in the cover photograph was pulled for exactly that reason, and held up to the light — which is where a book about this plant properly begins: with the whole thing, roots and all, in the open.

Telling it from its look-alikes

The leaf is so famous that it is constantly being seen where it is not. Several common garden plants carry palmate, serrated leaves and are mistaken for cannabis every summer by somebody: the Japanese maple, the false aralia, the cleome, the Texas star hibiscus, even the young okra. The beginner's field marks separate them plainly. Cannabis leaflets have coarse, saw-tooth serrations along their whole edge and come to a long, drawn-out point; the leaf stalk joins all the leaflets at exactly one point, like the ribs of a fan; and the plant, handled, gives off the family's unmistakable smell from its glands — no look-alike does that. Botanical identification, here as everywhere, is a matter of several marks agreeing, never one mark alone. The forensic shelf of this series builds whole procedures on that principle; this chapter's version is the one a gardener needs.

The pieces, by measure

It helps to put numbers on the pieces, because cannabis is a plant of extremes within its own small frame. The taproot, given loose soil, can drive down a meter or more in a season, with a wide skirt of side roots beneath the surface — which is why the plant tolerates dry country better than its thirst suggests. The stem of a fiber plant can top five meters, taller than a house's eaves, and the bast fibers running through its bark are among the longest single fiber bundles of any crop plant — one reason hemp rope held the age of sail together. A single male plant, in his few weeks of flowering, releases pollen not in the thousands of grains but in the hundreds of millions. And the seed, the piece everything reduces to, runs about fifty to the gram for small kinds and fifteen for large — each one a complete plant, folded.

Hold those numbers together and the plant's strategy is visible: enormous reach above and below ground, enormous generosity with pollen, and then everything it owns packed into a seed small enough to lose in a pocket seam.

Root, stem, leaf, flower, seed — and the glands still unnamed, waiting on the flower's surface. The next chapter steps back and watches the whole machine run: one life, from seed to seed, in a single year.

Chapter 3 — The Life of the Plant

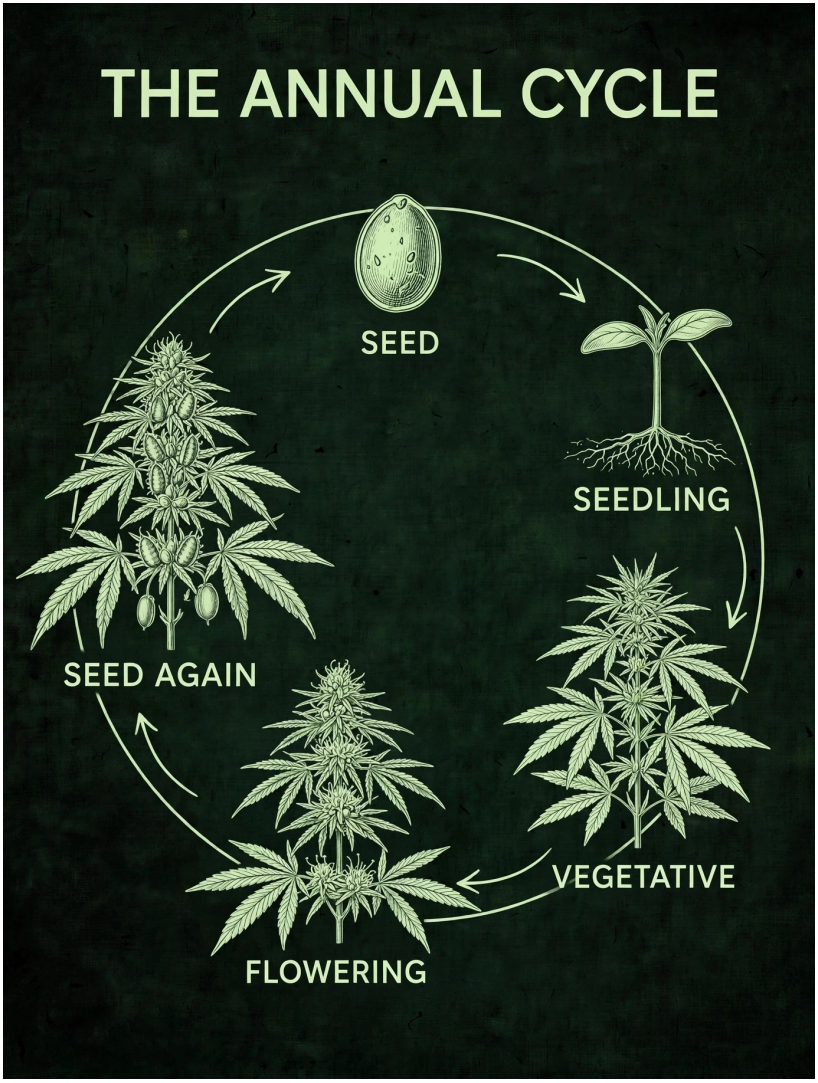


Plate — The year of the plant.

A cannabis plant lives its entire life between one spring and one autumn. Four to eight months, depending on the kind and the

latitude, is all it gets — and in that span it must sprout, grow taller than a person, flower, and set the seed that carries it into a year it will never see. This chapter follows that one life through, stage by stage. Every grower in the cultivation books of this series is, in the end, just managing these stages. Learn them here and the rest of the craft is commentary.

Germination — the waking

A seed at rest is nearly inert: a hard coat, an embryo, a packed lunch. Give it water and warmth and it wakes. First it drinks — the seed takes up water and swells. The coat splits. Out comes the radicle, the first root, which turns downward by gravity before it has seen any light at all. Then the shoot pushes up, wearing the empty seed coat like a helmet it soon throws off, and opens its first two leaves.

Those first two are not true leaves. They are the cotyledons — round, smooth, unserrated — and they are the seed's packed lunch made visible, feeding the infant plant until its real leaves can take over. A germinated seed is a promise already kept once: the embryo was alive the whole time it waited.

The seedling

For its first weeks the plant is small and fragile and does almost nothing but build leaves. The first true leaves have a single leaflet each. The next set has three, then five, then more, the leaflets multiplying as the plant gains strength — a grower can read a young plant's vigor in its leaflets the way you read a child's height on a doorframe. Roots are racing underground the whole time, building the foundation everything later will stand on. The seedling's whole strategy is patience: light above, water

below, no hurry. The hurry comes next.

The vegetative stage — the long green summer

While the days are long, the plant grows. This is the vegetative stage, and it is pure construction: stem thickening, branches reaching, fan leaves unfolding like hands to catch the light. A plant in strong vegetative growth can add inches in a day. It has one job — get big — because its size now decides how much flower it can hold later.

Here is the stage's remarkable secret: it has no fixed end. As long as the days stay long, most cannabis plants simply keep growing, season be forgotten. Growers indoors exploit this ruthlessly, holding mother plants under long light for years — an annual that never flowers, kept in a permanent summer, cloned again and again. The plant's clock is not counting days. It is watching the nights.

The signal — measuring darkness

Cannabis is what botanists call a short-day plant, which is a misleading name: what it measures is not the shortness of the day but the length of the unbroken night. Inside the leaf is a pigment system that tracks darkness the way an hourglass tracks sand. Through summer the nights are too short, and the plant grows. As autumn approaches and the nights lengthen past a threshold — for most kinds, roughly when darkness stretches toward ten or more hours — the signal lands, and the plant's whole economy turns from building to breeding.

The signal's precision matters. Interrupt the night with light and the plant can be confused, delayed — or stressed, and stress, as the last chapter showed, is one of the roads to the plant that

carries both kinds of flower. There is also an exception in the family: kinds descended from the tough wild plants of the far north, where summer nights barely exist, gave up on the signal entirely and flower by age instead, a few weeks after sprouting whatever the light does. Growers call them autoflowering. Evolution wrote both strategies into one species, for different skies.



Plate — Light and the turn to flower.

Flowering

Flowering begins with a stretch — the plant surges upward, sometimes doubling in height, as if spending its savings. Then the sexes show, exactly as Chapter 2 described: the males loosen

their pollen to the wind and are done; the females begin stacking flowers. Week by week the clusters thicken. The stigmas stand white, fishing for pollen. And over the bracts, the resin glands multiply and swell — the plant is now building, at full effort, the chemistry this whole series is about.

If pollen lands, the female's priorities change overnight: flower-building stops, and everything goes to the seeds, which ripen in about five or six weeks. If no pollen comes — the condition growers protect with such vigilance — she keeps building and waiting, building and waiting, piling up resin in a vigil that, in the wild, would simply mean she was not chosen.

Ripening and the end

Ripeness announces itself. The stigmas brown and curl. The glands shift in color — clear, then cloudy, then amber — a slow chemistry that Chapter 5 will name precisely, and that growers read the way farmers read wheat. If the plant was pollinated, the seeds harden and darken, ready to fall.

Then the annual pays its bill. The great fan leaves yellow as the plant pulls their nitrogen and sugars inward, toward the seed — nothing wasted, even at the end. The stem hollows and dries. The plant dies standing, in the field, in the first cold. It does not survive the winter. Its seeds do: in the soil, in the cold and the dark, carrying the whole design in a coat the size of a grain of rice, waiting for water and warmth to say the one word they understand.

The calendar by latitude

The life in this chapter is timed by the sky, and the sky differs by latitude — which is why the kinds of Chapter 7 keep different

calendars. A plant from the equator, where day and night stand near twelve hours all year, reads that balance as the flowering signal almost from birth and may grow and flower in overlapping waves for many months. A plant from the far north, where midsummer nights barely darken, cannot use the signal at all — hence the autoflowering kinds. And a plant from the temperate middle latitudes runs the calendar this chapter described: long summer days to grow, lengthening autumn nights to flower, seed ripe before the frost. Move a kind to the wrong latitude and its calendar breaks — equatorial plants brought north are still flowering when the frost arrives, unfinished. The plant's whole life is a negotiation between its inheritance and its sky, and every traditional kind is a record of one sky, negotiated successfully.

The seed that waits

The life described in this chapter runs spring to autumn, but the seed plays a longer game. A ripe seed that falls into soil and finds no good season does not die on schedule: cannabis seed holds its life in reserve, dormant, and can wake years later when conditions finally suit it. Farmers who once grew hemp know this as a nuisance — volunteer plants rising in fields seasons after the last sowing — and seed keepers know it as a gift: kept cold, dry, and dark, cannabis seed stays viable for many years, which is why the world's seed vaults can hold the plant's whole genetic inheritance in envelopes.

Dormancy is not sleep so much as patience with a trigger. The seed is measuring its world through its coat — water, temperature, light at the soil surface — and refusing to spend its one life cheaply. For a plant with a single season to live, the

decision of when to start is the most consequential one it ever makes, and it makes that decision before it has a single leaf.

The life that skips the seed

There is one more way this plant lives, and it belongs to the human chapter of its story. A cutting taken from a growing plant, given water and light, will root and become a plant in its own right — genetically the same individual, continued. Growers call the kept parent a mother plant and her cuttings clones, and a prized female can be continued this way for years, even decades, long past the autumn that would have ended her. Every cutting is the same age, in a sense, as the original seed she came from, and carries her exact chemistry — which is why one exceptional plant can become, through cloning, the ancestor of a whole region's gardens without ever making a seed.

Telling a clone from a seedling

A grower handed two young plants in their green stage can tell which came from a seed and which from a cutting, without asking — the plant's node structure gives it away.

A plant grown from seed builds symmetrically. Through its vegetative stage its branches leave the stem in opposite pairs, two at each node, mirror images of each other, rung after rung like a ladder. Only as the plant approaches maturity does the arrangement loosen into the alternating pattern Chapter 2 described.

A clone never has that ladder. A cutting is taken from a branch of an already mature plant, and it keeps the maturity it was cut from: its nodes come staggered from the very first one, branches alternating up the stem, one side then the other, with none of the

seedling's paired symmetry. The difference continues underground. The seedling drives the single taproot of Chapter 2; the clone, having no embryonic root, builds a fibrous mat of roots out from the cut stem's base instead. Opposite pairs and a taproot: a seed's childhood. Staggered nodes and fibrous roots: a cutting's. The plant carries its own birth certificate in its structure, readable at a glance by anyone who knows the two patterns — and the cultivation books of this series work with both kinds throughout.

Seed to seed, in a single year — that is the life. But through the flowering weeks, the plant was doing something this chapter kept deferring: covering itself in microscopic glands and filling them with chemistry. The next chapter goes down to that scale, to the tiny factories themselves.

Chapter 4 — The Tiny Factories

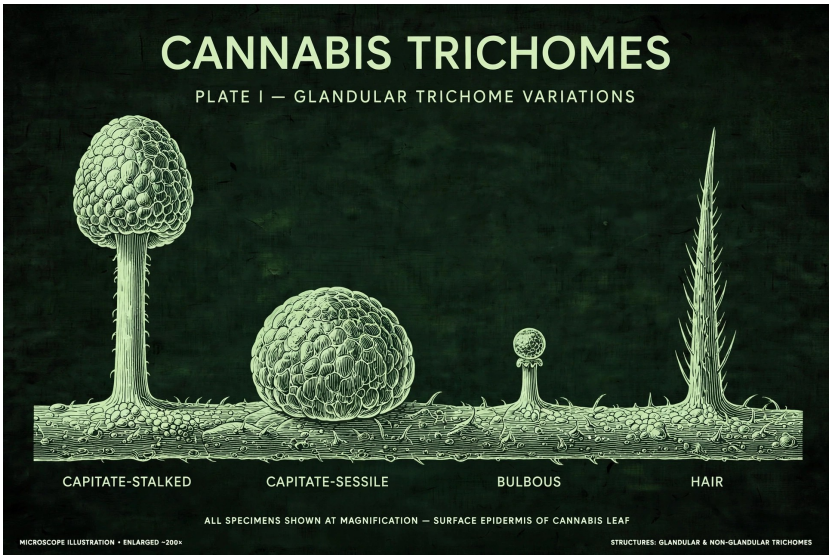


Plate — The glands at magnification.

Everything this series is about — the medicine, the drug, the money, the law — is manufactured in structures too small to see clearly with the naked eye. Growers carry a jeweler's loupe to look at them. Under that loupe, the surface of a ripe female flower stops looking like a plant and starts looking like a forest of tiny glass mushrooms, crowded shoulder to shoulder, glistening. Those are the trichomes, and this chapter is theirs.

What a trichome is

A trichome is an outgrowth of the plant's skin — a hair, a scale, or a gland that a plant builds on its surface. Many plants have them: tomatoes are fuzzy with them, nettles sting with them. Cannabis carries several kinds at once, and they divide into two companies: plain hairs that only protect, and glandular trichomes

that manufacture.

The plain hairs are the simpler story. They give the leaves their slightly rough, sandpapery feel — some are stiff little spikes mineralized with calcium carbonate, hard on the mouthparts of small insects. They are the plant's fence. The glandular kinds are its factories, and there are three.

The three factories

The smallest are the bulbous trichomes: a tiny ball of resin on a stalk so short it is barely there, scattered over the whole plant. They make chemistry in miniature, in small amounts, everywhere.

Next are the capitate-sessile trichomes — a gland head sitting almost directly on the surface, like a ball resting on the ground. They coat the flowers and the leaves near them and contribute their share of resin.

The third kind does most of the work and gets most of the fame: the capitate-stalked trichome. It stands on a stalk of cells, and on top sits a round head — a ball of secretory cells wrapped in a waxy skin. These are the glass mushrooms of the loupe, fifty to a hundred-odd micrometers across the head, and they stand thickest exactly where Chapter 2 left them: on the bracts of the female flower and the little sugar leaves among the clusters. The overwhelming share of the plant's cannabinoids and aromatic compounds is made and stored in these heads. When a grower judges ripeness by the glands — clear, then cloudy, then amber — it is these she is reading: the factory's own gauge, changing color as its chemistry matures.

Inside the head

The head is a factory with the machinery in the walls and the warehouse in the middle. The secretory cells around its base build the resin's compounds from simple ingredients the plant supplies, and then export them — out of the cells, into the space under the waxy skin. The ball swells with stored resin as it works, the way a balloon fills. The finished chemistry never stays inside living cells; it is stockpiled outside them, in that shining dome, held by a film of wax.

This arrangement is the whole ballgame, for plant and human alike. Because the resin sits outside the cells, in detachable heads on stalks, it can be collected without destroying anything else — a fact the next sections return to. And because the heads are fragile, they break: brush a ripe flower and the scent that rises, and the stickiness on your fingers, is broken factories spilling their stock.

Why the plant builds them

Not for us. That must be said plainly, because everything about these glands makes sense once their real customer is named: the plant itself, defending its seed.

The evidence supports several jobs. The resin is bitter, sticky, and laced with compounds that sicken or repel insects and discourage grazing animals — a chemical fence around the seed at exactly the place a threat lands first, as Chapter 2 noted. The cannabinoids also absorb ultraviolet light, and plants grown under stronger sun — high altitudes, fierce climates — tend to make more of them, which supports the reading of the resin as a kind of sunscreen for the flower's precious cargo. There is

evidence, too, of antimicrobial action: a resin coat is a poor home for molds. Which of these jobs came first in evolution is a live question; that defense and sun protection are among them is the supported core. The plant is not making medicine or merriment. It is making armor and shade, out of chemistry.

The male's smaller factories

The factories belong mainly to the female, but not entirely. Male plants carry the same kinds of glandular trichomes, sparser and smaller, on their leaves and around their flowers, and they make the same chemistry at a fraction of the female's scale — a male is not the chemical blank he is often assumed to be. Breeders have always known a version of this: the male half of a cross contributes to the resin of the daughters, which is why serious seed-makers judge their males by more than their shape. The female is the factory floor. The male is a branch office of the same firm, and his chemistry is part of the inheritance every seed receives.

How a factory gets built

A gland does not appear finished. It begins as a single cell of the plant's skin that swells outward — a bump on the surface. In the stalked kind, cells divide and stack beneath the bump to raise a stalk, while the cells at the top multiply into a cluster, flatten into a disc of secretory cells, and begin their work. As resin pours out of those cells, the waxy skin over them lifts and stretches into the dome that holds the stock — the balloon filling, day by day, through the flowering weeks.

The glands arrive in sequence with the plant's own development. The sessile kind appears early, on young leaves, before the plant

has any thought of flowering; the great stalked factories rise as the female flowers form, and their density on the bracts climbs as flowering deepens. At the peak of ripeness the fields of heads stand at their fullest and their contents at their richest — and then the factories themselves begin to fail. Stalks weaken, heads grow brittle and break away at a touch, and the resin left exposed darkens and degrades in the air. The harvest window growers speak of with such anxiety is, at this scale, simply the interval between the factories finishing their work and the factories falling apart.

What humans collect

Humankind's oldest cannabis concentrates are nothing more than these heads, gathered. Rub ripe flowers between the palms and the broken heads smear into a dark resin — the hand-rubbed hash of the Himalaya foothills. Sieve dried flowers and the detached heads fall through as a pale powder — kief. Wash the flowers in ice water and the frozen heads snap off their stalks and can be filtered out nearly pure. Three technologies, centuries apart, one idea: the plant stores its chemistry in detachable balls, and people learned to detach them. The extraction book of this series builds whole laboratories on that single anatomical fact.

But what, exactly, is inside the heads? Open one and you find not a substance but a crowd — over a hundred related compounds, plus the aromatics, each with its own properties. The next chapter opens the factory doors and names what it makes: the cannabinoids, one by one.

Chapter 5 — The Chemistry: Cannabinoids

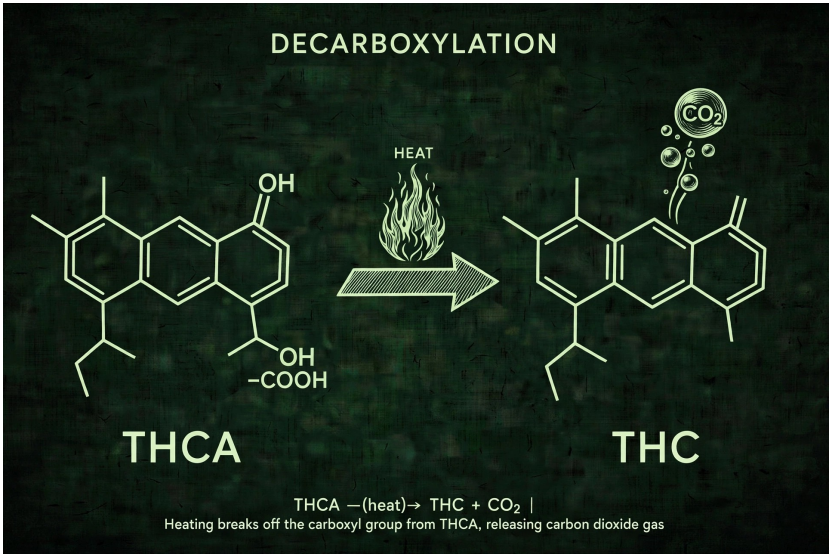


Plate — Heat and time: the acid becomes the compound.

Open one of the factory heads from the last chapter and analyze what is inside and you find a family: more than a hundred related chemical compounds, found almost nowhere else in nature, called cannabinoids. This chapter introduces the family properly — where they all come from, the two famous members, the supporting cast, and one fact that overturns most people's picture of the plant: fresh cannabis is not, in the usual sense, intoxicating at all.

The mother compound

Every cannabinoid begins as one molecule. Deep in the gland head, the plant assembles a compound called CBGA — cannabigerolic acid — and CBGA is the parent of the clan. The

gland holds a set of enzymes, molecular machines each shaped to do one job, and they take CBGA and fold it into different children: one enzyme makes THCA, another makes CBDA, a third makes CBCA. Which enzymes a plant carries is written in its genetics — which is why one plant grows up rich in THC and its cousin, carrying different enzyme instructions, grows up rich in CBD. The chemistry of a cannabis plant is, at this level, an inheritance. The genetics book of this series takes up that inheritance in full; the terpenes and minor-compounds book takes up the rest of the family tree.

What is left over, unconverted, stays CBGA and becomes CBG — the parent surviving in small amounts among its children. Remember that name; it returns below.

The acid truth

Now the overturning fact. The plant does not make THC. It makes THCA — tetrahydrocannabinolic acid — and likewise CBDA and CBGA: the cannabinoids in a living or freshly picked plant are almost all in these acid forms, each carrying an extra chemical attachment, a carboxyl group, like a cap on the molecule.

The cap matters. THCA does not produce the cannabis high; it does not engage the body's receptors the way THC does. Eat raw cannabis flower and, that chemistry aside, essentially nothing happens. The cap comes off with heat — or slowly, with time. Chemists call the uncapping decarboxylation: heat the material and the acid sheds its extra piece as carbon dioxide and becomes the neutral compound — THCA becomes THC, CBDA becomes CBD. Smoking does it instantly. Cooking does it deliberately. Drying and aging do it a little. Every intoxicating use of

cannabis in human history has depended on this one small chemical event, most of it performed unknowingly, by fire.

THC — the famous one

THC — delta-9-tetrahydrocannabinol, to give it its working name — is the principal intoxicating compound of cannabis, the one that engages the CB1 receptors of the brain and produces the high, with all its pleasures and its risks; Chapter 10 explains the engagement, and the medical and safety books weigh the consequences. Its structure was determined in 1964, in Jerusalem, by the chemist Raphael Mechoulam and his colleague Yehiel Gaoni — the first time anyone could point at the molecule responsible for an effect humanity had known for millennia. THC is also fragile: with heat, light, air, and time it degrades, oxidizing into another compound — which brings in the supporting cast.

CBD — the famous other

CBD, cannabidiol, is THC's sibling and opposite in reputation. It is made by the parallel road — CBDA, uncapped by heat — and it does not produce a high: it does not engage the brain's CB1 receptors in THC's manner at all. What it does instead is subtler and still being mapped; it interacts with many systems at once, modestly. One thing about it is settled at the highest level of evidence: purified CBD is an approved medicine — the drug Epidiolex, approved by the U.S. Food and Drug Administration in 2018 for certain severe childhood epilepsies — the first cannabis-derived drug to pass that bar. Beyond that approved use, claims for CBD run far ahead of the proof, and this series grades them claim by claim in the medical book. Here it is enough to know what CBD is: the non-intoxicating cannabinoid,

bred to dominance in whole families of modern plants.

The supporting cast

Four more members deserve a first introduction; the minor-compounds book gives the full roll.

CBG, cannabigerol — the parent compound's own neutral form, left over in small amounts after the enzymes take their shares. Long ignored because there was so little of it, now bred for directly.

CBN, cannabinol — the compound THC becomes. As THC ages and oxidizes, it converts to CBN, which is only mildly intoxicating and is associated in growers' and users' lore with heaviness and sleep; the lore runs ahead of the studies, and the safety book grades it. CBN is also the answer to a promise made in Chapter 3: the glands' turn from cloudy to amber is the visible sign of this slow chemistry — maturation, then the beginning of decay. The gauge growers read is, in part, THC quietly turning into something else.

CBC, cannabichromene — the third child of the parent compound, present in meaningful amounts in some plants, non-intoxicating, studied for a range of possible effects and proven for few so far.

The varins — THCV and CBDV — the family's leaner branch: same architecture as THC and CBD but built with a shorter chemical tail, which changes their behavior; THCV at ordinary doses does not behave like THC and may blunt it. And a name to file for later books: delta-8-THC, a near-twin of THC that the plant itself makes only in traces — the delta-8 sold widely today is mostly manufactured from CBD in laboratories, a fact that

belongs to the synthetics and hemp-loophole books, where it gets the full hearing it requires.

Fresh, cured, and old — the chemistry of keeping

A harvested plant's chemistry does not freeze; it drifts, and the drift has a direction. In stored flower, the acid forms slowly shed their caps even at room temperature, so an old sample holds more neutral THC than it did fresh. The THC itself then oxidizes toward CBN, steadily, faster in heat and light. The terpenes, built to evaporate, leave first and fastest — which is why age flattens a flower's smell before it flattens anything else. The net result is the profile users describe in old cannabis: duller in scent, heavier and sleepier in effect, weaker at the peak. Curing — the slow, controlled drying of the post-harvest book — is the craft of slowing this drift and steering it: moisture leaves gradually, harsh compounds break down, and the acids convert in an orderly way. Every jar on every shelf is a slow chemical argument between the plant's chemistry and time, and storage is how the argument is refereed.

The strength question, in numbers

How much THC does cannabis actually carry? The honest answer is a range so wide it explains half the arguments in this field. At one end stands hemp: by law under 0.3 percent THC, and in practice usually far under. At the other end stand modern drug varieties, bred for fifty years toward one trait: their flower commonly tests between 15 and 25 percent THC by dry weight, and the strongest exceed 30. Concentrates go further still — the laboratory forms of Chapter 9 can pass 80 or 90 percent, numbers the plant itself never reaches.

The range was not always so wide. The longest-running measurement program in the United States, which has analyzed seized and submitted cannabis for decades, records the average THC of flower rising from around 4 percent in the mid-1990s to roughly 16 percent by the early 2020s — a fourfold climb in one generation of breeding, while CBD in the same material fell away to almost nothing. Two consequences follow. Comparisons across eras are treacherous: the cannabis of a 1970s study and the cannabis of a modern dispensary are the same species and barely the same drug. And dose — the subject the safety book weighs in full — cannot be judged by the plant's name or form alone. It lives in these numbers, which is why the testing book of this series exists.

Holding the chapter

One parent, a set of enzymes, a cap that heat removes: that is the whole architecture. THC and CBD are two roads from the same molecule, chosen by the plant's inheritance. The acids are what the plant actually makes; the famous compounds are what fire and time make of them.

But cannabinoids are not the whole of what the factory produces — they are nearly odorless, all of them. The smell of cannabis, the thing that announces it through a wall, is a different family of compounds entirely. The next chapter follows your nose.

Chapter 6 — The Aromatics: Terpenes and Flavonoids

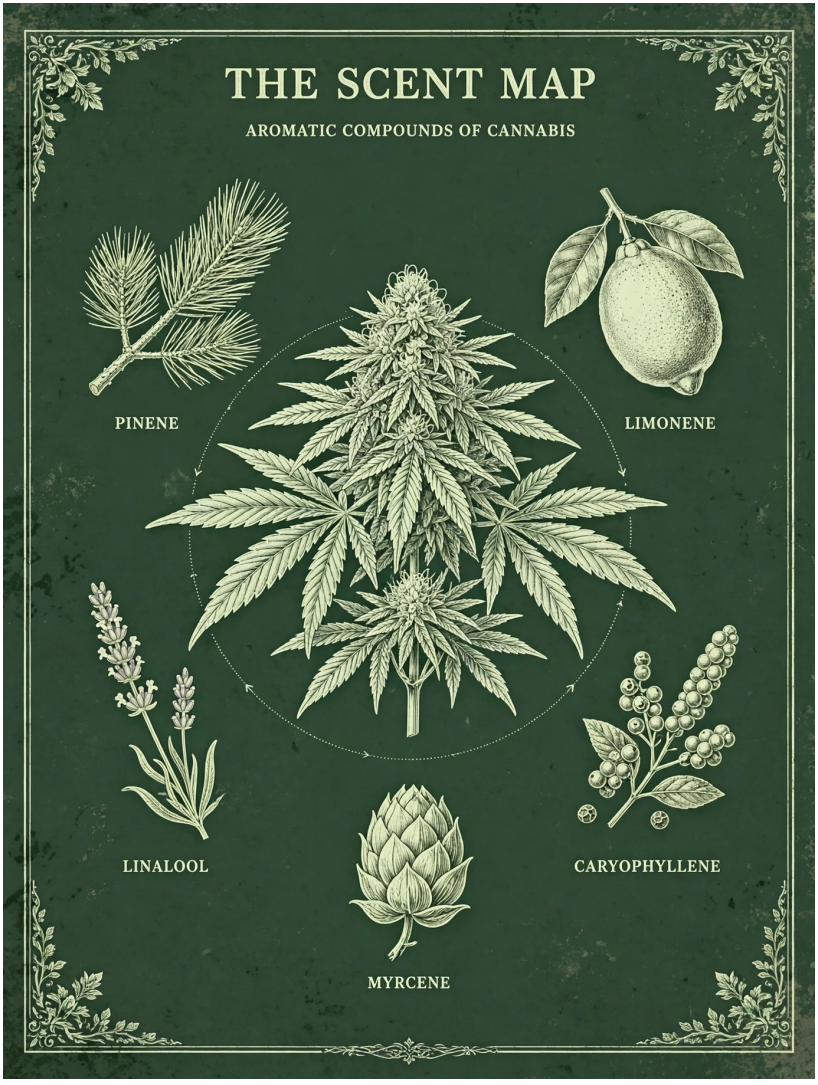


Plate — The scent map.

Cannabis announces itself. The smell crosses rooms and property lines, and it has started more arguments, and more police visits, than any other property of the plant. Yet the famous compounds of the last chapter have almost no smell at all. The announcement is made by a second family of chemicals, made in the same gland heads, doing different work: the terpenes — and behind them, quieter, the flavonoids, the pigments. This chapter names them.

Terpenes — the scent family of the whole plant kingdom

Terpenes are not cannabis's invention. They are the largest family of natural compounds on earth, built by nearly every plant — the smell of pine forest, lemon peel, lavender, and rain on herbs is terpenes, all of it. They are assembled from a simple five-carbon building block, joined into tens (the light, quick-evaporating monoterpenes, the bright top notes of any scent) and fifteens (the heavier sesquiterpenes, the deep base notes). Cannabis makes well over a hundred of them, and a plant's particular mixture — its terpene profile — is most of what makes one kind smell of citrus and another of pine, one of pepper and another of flowers.

The majors, the ones a beginner will meet again and again:

Myrcene — earthy, musky, a little fruity. Usually the most abundant terpene in modern drug cannabis. Also the main scent note of hops — the plant's own cousin — and present in mangoes and lemongrass.

Limonene — unmistakably citrus. It is the smell of lemon and orange rind, where it also lives in quantity.

Pinene — pine resin, a walk in conifers. Among the most common terpenes in nature; rosemary carries it too.

Linalool — floral and soft. It is the signature scent of lavender.

Caryophyllene — warm, peppery, spicy: the bite in black pepper and cloves. It earns a paragraph of its own below.

Humulene — dry, woody, hoppy; another cousinly compound, named for hops.

Terpinolene — fresh, piney, citrus-herbal all at once; the dominant terpene in a minority of varieties, where it gives a bright, almost lilac character.

None of these belongs to cannabis. What belongs to cannabis is the recipe — the proportions — and the company they keep: nowhere else in nature do these common aromatics sit dissolved in a bed of cannabinoids.

Reading a terpene report

Where cannabis is sold legally, laboratory reports increasingly list the terpenes beside the cannabinoids, and a beginner can learn to read one in a minute. Three habits suffice. Read the total first: the terpenes together usually make up only one to three percent of the flower's weight — the scent family is a small share of the mass doing an outsized share of the talking. Read the leader second: the single dominant terpene, often a third or more of that total, sets the scent's character more than the long tail behind it. And read presence last and skeptically: a terpene listed at a hundredth of a percent is a fact, not a flavor. The report, read this way, is the plant's recipe card — the same discipline Chapter 11 teaches for every claim in this field,

applied to a label.

The skunk note

One part of the smell long refused to be filed under terpenes at all: the skunky reek that the strongest modern varieties give off, the note that carries furthest and offends most. It is not a terpene. In 2021, researchers analyzing the headspace above flowering plants identified its source as a small family of volatile sulfur compounds — chief among them a molecule also found in garlic and in the spray of an actual skunk. These compounds are present in tiny amounts and are potent out of all proportion to their quantity, which is why the skunk note can dominate a whole plant's scent while the terpenes do the quieter work beneath it. The discovery is a useful lesson in how this plant keeps being measured: a smell humanity has known for centuries waited until 2021 for anyone to name the molecule responsible.

The boundary-crosser

Caryophyllene deserves its extra line because it breaks the filing system. Most terpenes are scent and only scent, as far as the body is concerned. But caryophyllene also fits the body's CB2 receptor — the second cannabinoid receptor, found mostly in immune tissues — and switches it on, which makes this pepper terpene, by function, something like a cannabinoid as well. Researchers call it a dietary cannabinoid: you season food with it. It is the standing proof that the plant's two chemical families are not strangers to each other, and it is one of the firmer footholds for the idea, examined below, that the families work together.

What the scent is for

For the plant, scent is not perfume; it is communication and defense carried on air. Terpenes repel some insects and sicken others; some slow the growth of rival plants and microbes; the plume rising off a flowering female is a chemical announcement to the whole neighborhood of insects — keep off, in most dialects. The same volatility that does this work is why cannabis smells so far: these molecules are built to leave. They evaporate at room temperature, break down in light and air, and fade — which is why old cannabis smells flat and tired, why careful curing and storage are really terpene conservation (the post-harvest book is half about this), and why the smell of the fresh plant is, chemically, the plant spending itself into the wind.

The entourage question — graded honestly

Do the terpenes change the effect of the cannabinoids they travel with? The idea has a name — the entourage effect — proposed in the late 1990s by researchers in Mechoulam's circle and argued since by many. It is the claim behind a common experience: two plants with the same THC percentage can feel noticeably different, and their clearest chemical difference is the terpene profile.

Here is the honest grade, in this series' manner. The ingredients are real, the interactions are plausible, and laboratory studies support some of them — caryophyllene's receptor action above is the hardest fact in the file. But direct proof in humans, at the doses actually present in a flower, is thin; the famous sub-claims — that myrcene is what makes some cannabis sedating, for instance — rest more on lore and animal work than on settled trials. The entourage effect is best described as a live hypothesis

with strong ingredients, not a proven law. Later books return to it wherever it is invoked, with the same grade attached. A reader who knows nothing deserves the excitement and the grade in the same breath.

Flavonoids — the pigments

The third family is the quietest. Flavonoids are the pigments and protectors of the plant world — tens of thousands of them across nature, coloring flowers, screening ultraviolet, signaling to insects. Cannabis carries about twenty. Most are shared with ordinary foods — the same flavonoid families that color blueberries and onions appear here. The purple in purple varieties of cannabis is anthocyanin, the blueberry pigment, often drawn out by cold nights — a color, it should be said plainly, that says nothing reliable about strength.

Two flavonoids, though, are cannabis's own: the cannflavins, found nowhere else in nature so far as is known. On the laboratory bench they show anti-inflammatory activity — in one early study, stronger than aspirin in a dish — and they are studied still. A dish is not a body, and this series does not promote bench findings into medicines; the cannflavins are recorded here as what they are: a signature compound family, unique to this plant, at the beginning of its evidence road rather than the end.

Holding the chapter

Three families, then, come out of the one small factory: cannabinoids for the body's receptors, terpenes for the air, flavonoids for color and screen — defense, announcement, and armor from a single gland. And since every plant mixes the three

in its own proportions, no two kinds of cannabis are quite the same chemistry. Which raises the question the next chapter takes up: what are the kinds, and what, if anything, do their names mean?

Chapter 7 — Kinds of Cannabis



Plate — The two forms, side by side.

Walk into a shop where cannabis is sold and the first question is usually a choice between two words: sativa or indica? The

words are offered as if they were kinds of the plant, with kinds of effects — one uplifting, one sedating. This chapter traces those words from their scientific birth to their shop-counter present, and gives the reader the classification that actually predicts something: not the label, but the chemistry.

The names from science

Chapter 1 told the short version. Linnaeus, in 1753, named the plant he knew — European fiber hemp — Cannabis sativa, sativa meaning simply "cultivated." In 1785 Lamarck received specimens from India: shorter, denser plants with broader leaflets and a noticeably stronger intoxicating power, and he named them a second species, Cannabis indica — indica meaning "of India." In 1924 the Russian botanist Janischevsky described a tough wild plant of the northern steppes and gave the world a third name, ruderalis, from ruderal — growing where ground is disturbed, roadsides and waste places. That wild northern plant is the ancestor of the autoflowering kinds from Chapter 3: it traded the night-signal for flowering by age, under skies where summer nights are too short to measure.

Modern genetics, as Chapter 1 said, leans toward one species wearing all three names as regional forms. The forms are real. What the names can bear is another matter.

The shapes underneath the folklore

The folklore grew from real plants. The tall, narrow-leafleted kinds come from equatorial regions — Thailand, Colombia, southern Africa, Mexico — where the season is long; they grow like climbers, flower slowly, and their effect was traditionally described as bright and cerebral. The short, broad-leafleted

kinds come from the mountains of Central Asia — the Hindu Kush country of Afghanistan and Pakistan — where the season is short and harsh; they grow like shrubs, flower fast, and their effect was described as heavy and bodily. Generations of growers knew these two silhouettes the way farmers know breeds of dog, and the silhouettes are genuine: leaf shape, height, and pace do travel with ancestry.

The trouble began when the shapes were crossed. A century of breeding — and an intense few decades of it under prohibition, indoors, where short and fast was survival — hybridized nearly everything. Most drug cannabis grown today is a blend of both ancestries in unknown proportions, whatever its label says. The two silhouettes survive as tendencies. The pure lines survive mostly as heirlooms.

Landraces — the kinds a place made

Before the breeders, there were landraces: populations shaped by one place over generations, half by the land and climate, half by the local farmers keeping seed from the plants they liked. Afghan, Thai, Colombian, Durban, Acapulco — the old names on the map are landrace names, and the landraces are the original gene pools from which all modern breeding descends. They matter to this series twice: as history (the deep-history book walks their roads) and as genetics (the seed book treats them as the library the future breeds from). A landrace is a kind of cannabis the way a dialect is a kind of language: made by a place, over time, out of use.

Strain names — and why they wobble

The shop's other vocabulary is the strain name — the colorful, trademarked- sounding names on the jars. A beginner should know three things about them. First, the correct horticultural word is cultivar, a cultivated variety; "strain" is borrowed from microbiology, where it means something stricter. Second, cultivar names in cannabis are unregulated: there is no registry with legal force, no standard a name must meet, and nothing to stop two unrelated plants being sold under one famous name, or one plant under five. Third, studies that compared labeled products against their actual genetics and chemistry found exactly the wobble that predicts: the same name from different sources is often chemically different, and the sativa/indica label on the jar predicts the chemistry inside only weakly. The names are not lies, exactly. They are folklore with a price tag — sometimes attached to the real lineage, sometimes not, with no way for the buyer to tell from the name alone.

The seed banks

The modern kinds were made in a specific place and time, and the place was, of all places, the Netherlands. In the 1970s and 1980s, breeders carrying landrace seed out of Afghanistan, Thailand, Colombia, and Mexico gathered where the law gave them a crack of light, crossed the old silhouettes deliberately, and stabilized the results as named, reproducible seed lines — sold by mail, in catalogs, under rules of craft the drug underground had never had: keep the parents, select ruthlessly, name honestly. Almost every variety in a modern shop descends from that work and its American continuations. It is the moment cannabis breeding changed from a folk practice of farmers keeping seed to a deliberate discipline of crossing and selection — and, as the strain section warns, the naming discipline of that

era has not survived into the age of the jar label.

The feral kind

One more kind deserves its paragraph, because no one planted it — lately. Across the American Midwest, in Indiana, Illinois, Nebraska, Iowa, and Kansas, cannabis grows wild in ditches and along field edges: the descendant of the fiber hemp planted under government encouragement during the Second World War and abandoned to the birds when the program ended. Locals call it ditch weed. It is cannabis returned to the wild — reverted, over eighty generations of nobody selecting it, toward the hardy, low-strength wild form its ancestors started as. Its THC is negligible; generations of teenagers have confirmed this experimentally and been disappointed. Law enforcement programs have spent decades eradicating it by the millions of plants, a war against a weed that is, chemically, barely the drug at all. The feral kind is the plant's own argument for Chapter 1's position: left alone, it does not stay a drug crop or a fiber crop. It just goes on being cannabis.

The classification that predicts: chemotypes

Science's working answer is to classify by chemistry — the chemovar, or chemotype: what the plant actually makes, measured. The scheme most used divides cannabis into five types:

Type I — THC-dominant. Most modern drug cannabis. **Type II** — mixed, THC and CBD in comparable measure. **Type III** — CBD-dominant, with little THC. Most legal "hemp" flower. **Type IV** — CBG-dominant, bred from the parent compound's line. **Type V** — essentially no cannabinoids at all; fiber and seed

plants at their purest.

A chemotype does not tell you everything — the terpenes ride along and shade the experience, as Chapter 6 graded honestly. But a type number predicts the main event of a plant's effect in a way no silhouette and no jar label can. When this series needs to be precise about kinds, it reaches for the chemotype first, the ancestry second, and the shop label last.

Holding the chapter

So what should a beginner do with sativa and indica? Use them the way they deserve: as a rough sketch of ancestry and shape — a tall narrow plant and a short broad one — and as the first word of a conversation, never the last. The plant's chemistry is its identity; everything else is its biography. The next chapter takes up one more pair of names, the most consequential of all, because these two are written into law: hemp and marijuana.

Chapter 8 — Hemp and Marijuana

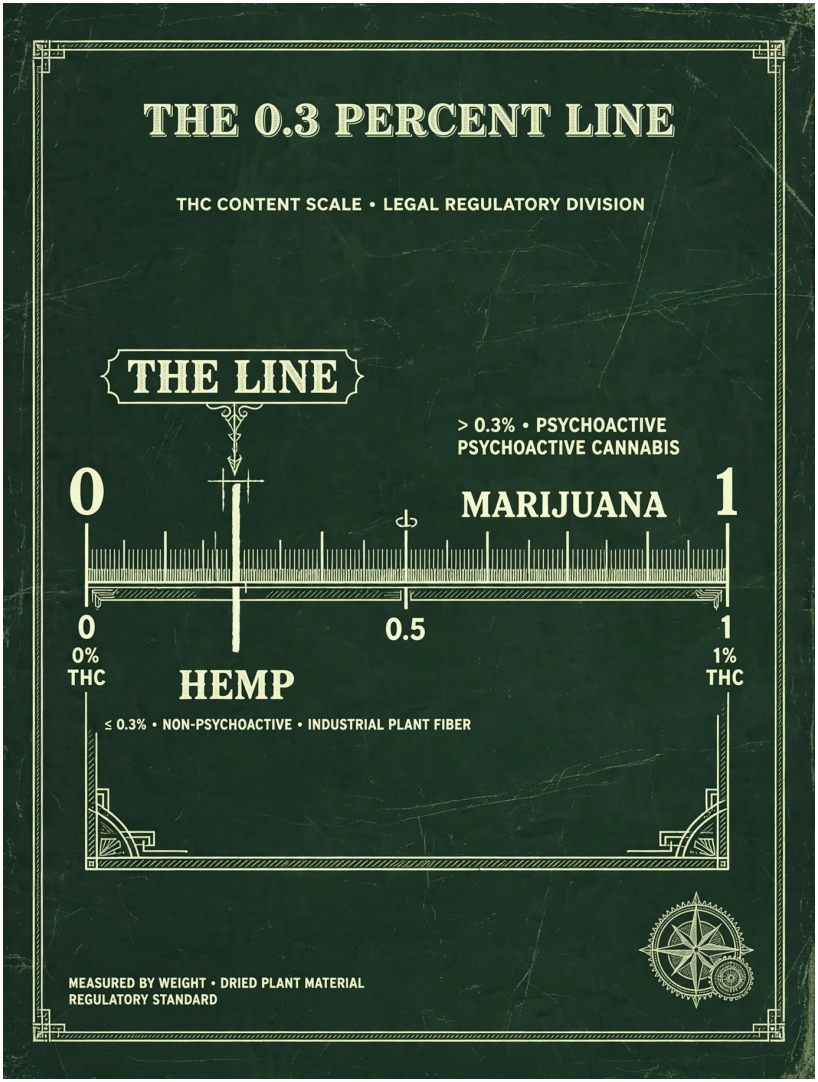


Plate — The line at 0.3 percent.

Two fields can stand side by side, planted with the same species, grown from cousin seed, and exist in different legal universes — one a farm commodity, the other a controlled substance. Nothing about the plants explains it. The difference is a line drawn by law across the middle of one species, and this chapter draws it where a beginner can see it: what the two words originally meant, where the line sits, how it is measured, and what it costs the people who farm near it.

The old word

Hemp is the plant's oldest English name — it descends from the Old English hænep and its Germanic cousins, and for most of history it meant cannabis itself, full stop: the fiber crop, the seed crop, the plant in the herb-garden. Nobody asked how strong a hemp plant was, because the question the word answered was what the plant was for: rope, cloth, sail, seed, oil. The fiber book of this series is, in that old sense, the hemp book — and it begins where this word does, in a world that had only one name because it had only one relationship with the plant.

The newer word

Marijuana is a much younger word in English. It comes from Mexican Spanish — marihuana — and it rose in American usage in the early twentieth century, attached specifically to the plant as a smoked drug, at exactly the moment the plant was being recast in American public life as a foreign menace. The prohibition book of this series tells that campaign in full; the fact needed here is simpler. When the United States wrote its first federal law against the plant in 1937, it legislated against "marihuana" — and exempted the stalks, fiber, and sterilized seed of the old hemp economy in the same text. From the

beginning, the law has kept two vocabularies for one plant: the crop and the drug. Botany never made that split. Law did.

The line

The modern form of the split is a number. Under the United States' 2018 Farm Act, hemp is defined as Cannabis sativa and every part of it with a delta-9 THC concentration of not more than 0.3 percent, measured on a dry-weight basis. At or under the line: hemp, a legal agricultural commodity, removed from the Controlled Substances Act. Over it: marijuana, a controlled substance under federal law, whatever a given state's own law says.

Where did 0.3 come from? Not from the plant. In the 1970s the Canadian researcher Ernest Small, working on the taxonomy problem of Chapter 1, needed a practical dividing line between drug-type and fiber-type plants for his classification, and he drew one at 0.3 percent — a line he has acknowledged was a pragmatic choice, not a boundary found in nature. The line was picked up by regulators, first in Canada, then in Europe and the United States, until a taxonomist's convenience became the legal definition of two different plants that are not two plants. Other jurisdictions draw it elsewhere — the European Union long used 0.2 percent before raising its line to 0.3; a few countries allow up to 1 percent. The plant does not know any of these numbers. Enzymes, as Chapter 5 showed, do not read statutes.

How the line is measured — and the crop it destroys

The measurement carries a catch, and the catch ruins harvests. Because THCA becomes THC with heat, regulators test for total THC — the THC present plus the THC the acid would become.

A crop can sit under the line on one measure and over it on the other. And a living crop will not sit still: THC climbs as flowering advances, and heat and stress can push it, so a field legal in August can test "hot" in September. Over the line, the crop is not sold at a discount. Under the rules it is destroyed, at the farmer's loss, by the farmer's hand or under supervision. Every hemp farmer in the regulated world farms with one eye on that number, harvesting early against it — a whole agriculture shaped by the gap between a botanical gradient and a legal cliff.

The line, worldwide

The 0.3 line is American law, not world law, and the map of other lines shows how arbitrary any single one is. Switzerland permits hemp up to 1 percent total THC — more than three times the American line — and sells low-THC flower openly as a tobacco substitute, a market that cannot legally exist across its borders. The European Union farmed for years under 0.2 percent before raising its line to match the American 0.3. Canada draws its line at the same 0.3. Colombia allows 1 percent. The same plant, the same enzymes, the same field could be a legal crop in Zurich, a regulated crop in Toronto, and a felony in Texas. Nothing in that sentence is about botany. It is the cleanest demonstration in this book that hemp and marijuana are not kinds of plant. They are kinds of permission.

The third agriculture: grain

Between the fiber field and the drug garden stands a third way of farming this plant, older than both in spirit: growing it for the seed itself. Grain hemp is planted like a cereal crop, the sexes left together, pollination not merely allowed but required — no seed without it — and the harvest taken by combine like wheat.

The seed that comes off those fields is the food of Book 6 of this series: roughly a quarter protein, a third oil, carrying the essential fatty acids in proportions nutritionists praise. The same plant that law sorts into two boxes is farmed, quietly, in a third — for the one part of it that was never intoxicating, never fiber, only food. A beginner who holds all three agricultures in view at once — fiber, grain, and flower — has the whole plant in a way the law's two words never give.

Sinsemilla — the other consequence

Chapter 2 left a debt: why growers remove the males. Here is the payment. Drug cannabis is grown for the unfertilized female flower. Pollinate her and her economy turns to seed — resin production stalls, the harvest fills with seed instead of flower, and the product is weaker by weight and worse to use. So the males go, and the females flower unfertilized to the end. The product has a name from the Spanish: sinsemilla, "without seed." The seedless flower was known for centuries in the old hashish countries; it became the standard of the modern drug crop in the 1970s, and it is why the drug and the fiber crops are farmed in opposite ways — fiber hemp is planted dense and harvested by machine, seed and all welcome, while drug cannabis is planted wide, sexed, weeded of males, and picked by hand. One species, two agricultures, and the split between them is not in the seed. It is in what the buyer wants and what the law allows.

Holding the chapter

Keep the two vocabularies separate and both will serve you. In botany, there is one plant, with fiber forms and drug forms shading into each other along a chemical gradient. In law, there

are two plants, divided by a line at 0.3 percent that a taxonomist drew for convenience and parliaments adopted for control. Nearly every confusion in the public conversation about cannabis — and several books of this series — live in the gap between those sentences. The plant, meanwhile, goes on making its chemistry without regard to either. The next chapter catalogs what people actually do with it: the forms in which cannabis is used, from the oldest flower to the newest laboratory glass.

Chapter 9 — The Forms People Use

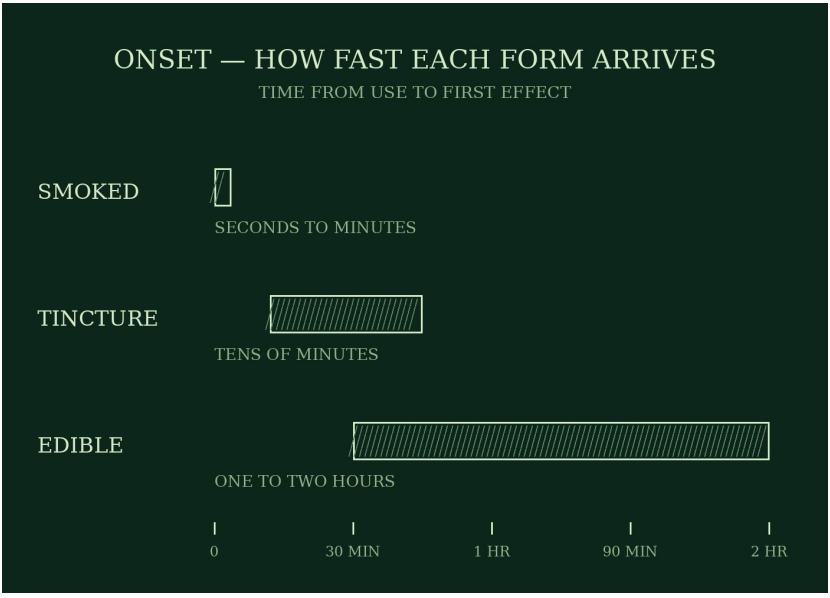


Plate — Onset and duration, by form.

One plant, one chemistry — and a dozen ways of delivering it, spread across five thousand years. The form is never a detail. It decides how fast the chemistry arrives, how long it stays, how strong it feels, and how much control the user has. This chapter walks the forms in the order history made them, and gives the beginner the one piece of practical knowledge every form carries: its timing.

Flower

The original form is the plant itself: the dried female flower, trimmed and cured, used as it grew. Smoked, it delivers its chemistry to the blood through the lungs within seconds to

minutes; vaporized — heated without burning — it delivers the same chemistry with less of combustion's wreckage. Effects rise fast, peak within the half hour, and fade over one to three hours. The fast timing is its own safety feature: the user can feel each step and stop.

Flower is also the measuring stick of potency. Modern drug flower in legal markets commonly tests between 15 and 25 percent THC, some higher — against the few percent typical of the seized cannabis of the 1970s. The plant did not change species; breeders spent fifty years selecting for the glands of Chapter 4, and the numbers followed. Every other form in this chapter is, in some way, an attempt to concentrate, preserve, or re-deliver what the flower holds loosely.

The old resin world

The first improvement on flower was to collect the factories themselves — Chapter 4's detachable heads — and the old world built three forms on them.

Hashish is the heads, sieved or rubbed from the plant and pressed into a cake or ball: cannabis resin, storable, transportable, and far stronger by weight than flower. It has been made for centuries across Central Asia, the Middle East, and North Africa. Charas is its hand-rubbed Indian cousin, made from living plants in the Himalaya foothills. Kief is the unpressed stage — the loose pale powder of detached heads, gathered in the bottom of a grinder or through a sieve. India's classical trio names the whole old menu at once: bhang, a drink and food preparation of the leaf; ganja, the flower; charas, the resin. Three forms, graded by strength, already old when Europeans first wrote them down.

Tinctures — medicine's form

Steep the plant in strong alcohol and the alcohol pulls the cannabinoids out and keeps them: a tincture, dosed by drops. This was the form in which nineteenth-century Western medicine adopted cannabis — extracts and tinctures stood in the United States Pharmacopeia from 1850 until 1942, stocked in pharmacies, prescribed for pain and spasm and sleeplessness. Taken under the tongue, a tincture arrives in tens of minutes — faster than food, slower than smoke. The form never vanished; it waits in modern bottles on dispensary shelves, wearing better labels.

The modern laboratory forms

The last generation added machinery, and the forms multiplied. Solvent extracts wash the plant with butane or carbon dioxide and keep the resin — oils and waxes testing 60 to 90 percent THC. Rosin takes the solventless road: heat and pressure squeeze the resin from the flower whole. Distillate refines an extract down to nearly a single compound — THC or CBD as a clear, almost flavorless oil, the terpenes stripped and sometimes added back. Isolate goes one step further: one cannabinoid as a pure white crystal. Vaporizer cartridges put extract in a pen — the form at the center of the 2019 lung-injury outbreak, when a cutting agent used in illicit cartridges, vitamin E acetate, injured thousands; the safety book of this series gives that episode its full chapter, because it is the modern proof that the form and its supply chain, not only the plant, decide the risk.

Each step up this ladder trades the whole plant for strength and precision — and trades away flower's built-in pacing. A form that arrives in seconds can be titrated breath by breath. A form at

80 percent, in one breath, cannot.

Smoking, examined

The oldest road deserves one clear-eyed paragraph. Burning plant material — any plant material — makes smoke, and smoke carries tar, carbon monoxide, and the fine particles and combustion compounds that lungs are not built for; cannabis smoke shares most of that cargo with tobacco smoke, differing in its chemistry, not in being smoke. A water pipe cools the smoke and traps some of the water-soluble fraction; it does not make smoke clean. The vaporizer exists precisely as the engineering answer: heat the flower or extract hot enough to uncap the acids and boil off the cannabinoids and terpenes — most vaporize between roughly 160 and 220 degrees Celsius — but below the point of combustion, and the cargo of burning is largely left behind. The safety book weighs the respiratory evidence in full. Here the form itself is the lesson: smoking is the fastest road and the crudest, and every other inhaled form is an attempt to keep its speed and lose its fire.

Edibles — the slow road, and the liver

Cook the plant into fat — butter, oil — and the chemistry rides food. The fat is not a preference: cannabinoids dissolve in fat and alcohol, not water, which is why there is no true cannabis tea from plain water and why the vehicle of every edible is something fatty. The cooking also does Chapter 5's chemistry, uncapping the acids into active form.

The oral road is a different journey. Swallowed THC passes through the liver, which converts a large share of it into a related compound, 11-hydroxy-THC — stronger at the receptor and

longer-lived than THC itself. Edibles therefore arrive slowly, thirty minutes to two hours; feel stronger and stranger than the same dose smoked; and last four to eight hours or more. Nearly every beginner's worst cannabis story is a timing error on this road: nothing felt at forty minutes, a second dose taken, and both arriving together. The form is not dangerous in the way poisons are dangerous, but it is unforgiving of impatience — the single most useful sentence in this chapter is that the edible has not failed to work; it has simply not arrived yet.

Topicals — the form that stays outside

Rubbed on the skin, cannabinoid creams and balms work where they are put and, in ordinary use, do not reach the blood in amounts that matter — no high, by design; their evidence and their limits belong to the medical book. The exception proves the rule: transdermal patches are engineered precisely to push the chemistry through, on a slow all-day schedule, and are labeled as the medical devices they are.

The dose problem

One warning belongs to this whole catalog rather than to any single form: doses do not translate between forms. Five milligrams of THC eaten is not five milligrams smoked — the liver's conversion on the oral road makes the eaten dose effectively stronger and far longer, as the edible section explained; and five milligrams in a concentrate arrives in a single breath that flower would spread over a session. Regulators have had to pick a standard unit anyway — many jurisdictions set the single serving of an edible at 5 or 10 milligrams of THC — but the number is a legal convention, not a biological equivalence. The practical rule the safety book

builds on starts here: every form is its own country, with its own dose, its own clock, and its own customs, and experience in one buys less knowledge of another than people assume.

Holding the chapter

Flower, resin, tincture, oil, food, cream: the forms are a history of people solving delivery problems — how to store it, strengthen it, dose it, slow it, keep it out of the blood or get it in. But every road, fast or slow, ends at the same destination. However the chemistry arrives, it meets a system in the body that was built for it before anyone knew it existed. The next chapter opens that system: cannabis and the body.

Chapter 10 — Cannabis and the Body, in Brief

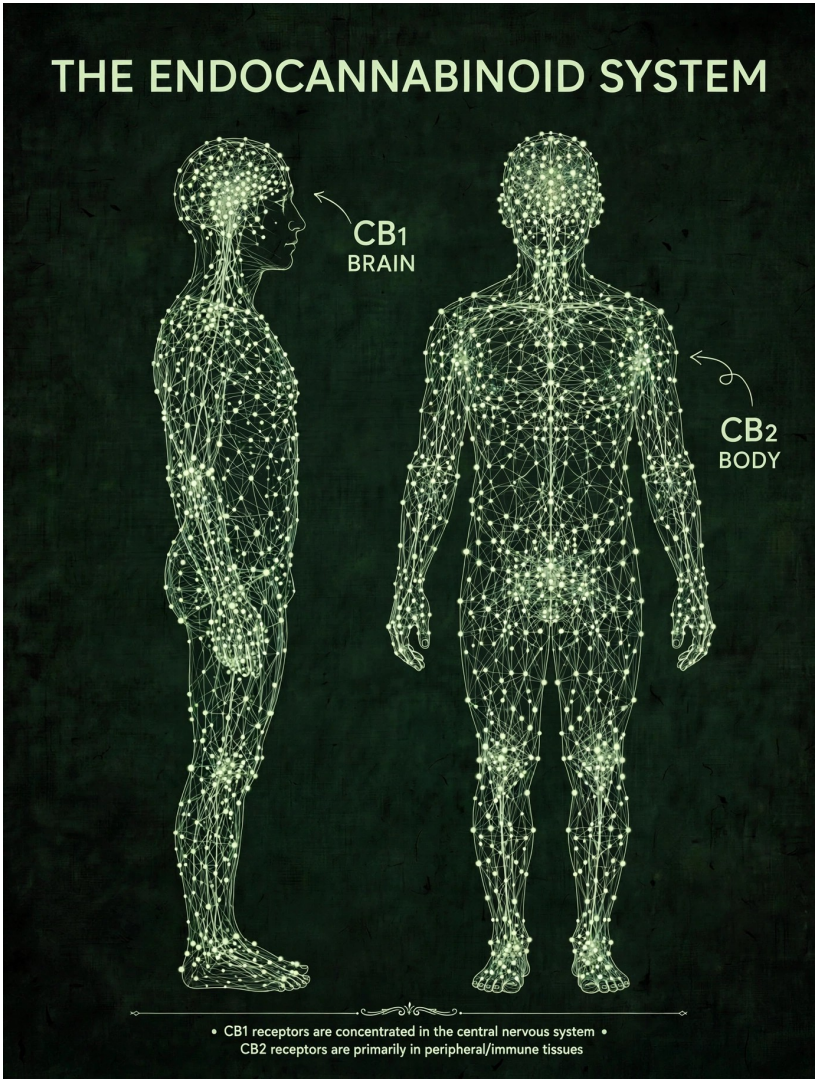


Plate — The body's own system.

Here is the strangest fact in this book. For most of history, nobody asked why cannabis works on the human body — it plainly did, and that was enough. When science finally asked, in the late twentieth century, the answer turned out to be stranger than the question: the body carries a whole signaling system that the plant's chemistry happens to fit — a system nobody had noticed, running in everyone, cannabis user or not. This chapter is that system, in brief; the medical book gives it the volume it deserves.

Found backwards

The discovery ran in reverse. Usually medicine finds a system in the body and then looks for drugs that touch it. Here the drug came first: THC was isolated in 1964, and for two decades nobody knew what it touched. In 1988 researchers demonstrated the lock it fits — a specific receptor in the brain, now called CB1. In 1993 a second receptor, CB2, was found, mostly in the immune system.

A receptor with no known key is a riddle, and the riddle's answer arrived in 1992: the body makes its own key. Raphael Mechoulam's laboratory in Jerusalem — the same school that had isolated THC — identified the first of the body's own cannabinoids and named it anandamide, from the Sanskrit ananda: bliss. A second, called 2-AG, followed in 1995. Together these molecules are the endocannabinoids — endo, from within — and the whole apparatus, receptors, keys, and the enzymes that build and dismantle the keys, is the endocannabinoid system.

The parts

The system has four kinds of part, and a beginner can hold all four.

Two receptors. CB1 stands thick across the brain — in the cortex, the memory centers, the movement centers, the appetite circuits — and more sparsely through the body. CB2 stands mostly on immune cells and in the body's outskirts, rising where there is injury or inflammation.

Two keys of our own. Anandamide and 2-AG are not stored in advance like most of the body's messengers; they are made on demand, from the fatty material of the cell's own membrane, at the moment and place they are needed.

A cleanup crew. Enzymes — FAAH dismantles anandamide, MAGL dismantles 2-AG — destroy the keys within moments of their making. Our own cannabinoids are whispers: local, brief, and gone.

And one direction of travel that surprised everyone. Most signals in the brain run forward, from a sending cell to a receiving one. Endocannabinoids run backward: the receiving cell sends them back across the junction to tell the sender to quiet down. The system is, in its basic posture, a dimmer switch — the brain's way of turning down its own volume, junction by junction.

What the system is for

A dimmer on everything would be a strange thing to evolve, until its jobs are listed: appetite and energy, pain, mood, memory, sleep, immune balance, stress recovery. Researchers who work on the system summarize it in five verbs — eat, sleep, relax, forget, and protect — and the common thread is balance:

the endocannabinoid system is one of the body's great regulators, nudging excited systems down and quiet ones up, keeping the whole within its working range. It is running in you now, whether or not cannabis has ever come near you. The plant did not create this system. The plant's chemistry eavesdrops on it.

The resting level — tone

Because the system is a regulator, researchers speak of its resting state as a tone: the background level of endocannabinoid activity a body runs at, person to person, system to system. Tone explains a puzzle a beginner will meet everywhere in this field — why the same dose of the same plant can barely touch one person and overwhelm another. The receptors differ, the cleanup enzymes differ in speed, and the tone the plant's chemistry lands on differs before the first breath is taken. One research program has gone further and proposed that several hard-to-treat conditions — migraine, fibromyalgia, irritable bowel — share a low underlying tone, a clinical endocannabinoid deficiency. The proposal is graded suggestive here: the pattern is real enough to publish and nowhere near proven enough to build treatment on. The medical book examines it in place. For this chapter, tone is the idea to keep: the plant does not act on a blank body. It acts on a system already set, by inheritance and by life, to its own level.

The system at play

One modern finding shows the system doing its ordinary work in a place nobody expected. For decades the euphoria after long exercise — the runner's high — was credited to endorphins, the body's own opioids. The evidence has shifted: endorphins cross

into the brain poorly, while anandamide rises measurably in the blood during sustained exercise, crosses easily, and in animal studies the calm, pain-dulled state after a run disappears when cannabinoid receptors are blocked, and stays when opioid receptors are blocked instead. The grade here is supported, not settled — human work is still catching up to the animal work — but the direction is plain enough to teach the chapter's lesson in one example: this system is not a drug system waiting for a plant. It is a working part of ordinary life — appetite, mood, pain, exertion, rest — and the plant is the imitator, not the inventor.

Why the plant's version overwhelms

THC fits CB1 because its shape resembles anandamide's closely enough to turn the same lock. But the resemblance ends at the lock. Anandamide arrives in pinpoint amounts, at one junction, and is dismantled in moments. THC arrives everywhere at once, at every CB1 receptor in the brain simultaneously, and the cleanup crew cannot dismantle it quickly — it lingers for hours. The difference between the body's signal and the plant's is the difference between a whisper in one ear and a shout in every room of the house at once. That single contrast explains both the breadth of the cannabis high — appetite, time, memory, mood, body, all turned at once — and its occasional overshoot into anxiety: every dimmer in the building, pushed down together, further than the system ever pushes itself.

Two honest footnotes belong here. The brainstem — the deep center that runs breathing — carries very few CB1 receptors, which is why cannabis, unlike the opioids whose receptors crowd that center, does not stop breathing; the absence of a

fatal-overdose mechanism of that kind is anatomy, not advocacy. And with heavy, daily use the brain adapts, thinning its CB1 receptors — tolerance — and restores them in abstinence; dependence is real, is carried in full by the medical and safety books, and begins in this reversible thinning.

CBD, the other famous compound, barely fits either lock — its low grip on CB1 and CB2 is exactly why it does not intoxicate — and it works instead by smaller touches on many systems at once, which is why its science is real and its claims need the grading the medical book gives them.

Holding the chapter

The body keeps a cannabis-like system of its own, for balance; the plant makes molecules that fit it, louder and longer than the originals. Every effect in this series — medical, recreational, harmful — is a footnote to that fit. But a fair question now stands over everything this book has told you: how solid is any of it? The next chapter grades the evidence itself — because a series that began by promising grades owes the reader the scale.

Chapter 11 — How We Know

Every claim in this book arrived with a quiet grade attached — settled, supported, suggestive, open. This chapter shows the grading scale and the reason it exists. Cannabis knowledge comes to a beginner polluted from two directions at once: a century of prohibition, which had reasons to exaggerate the plant's dangers and to prevent its study, and a young legal industry, which has reasons to exaggerate its virtues. Between the two stands the evidence — thinner for this plant than for almost any comparable subject, for reasons that are themselves part of the record. Learning to weigh it is the most durable skill this book can give you, because it still works on every claim made after the book is closed.

The ladder

Evidence comes in kinds, and the kinds have an order.

At the bottom stands the anecdote — one person's experience, sincerely told. Anecdotes are where knowledge starts and where it must not stop: a human body varies, a memory edits, and hope and fear both report for duty.

Above it, observation: case reports, surveys, population studies. These can show that two things travel together — that heavy users show more of some illness, say — but traveling together is not causing. People who use cannabis heavily also differ from people who don't, in income, in other substances, in the troubles that may have led them to it. Untangling which strand pulls the others is the hardest work in the field, and honest researchers say so.

Above observation stands the controlled trial: people assigned by lot to the substance or to an identical-looking substitute, neither side knowing which, outcomes measured against a plan fixed in advance. This is the strongest single instrument medicine owns. Above even that stands the review of all the trials together — the systematic review, and its summit, the consensus report, where a body like the National Academies gathers the whole field and grades it. Its 2017 report on cannabis drew roughly a hundred conclusions and labeled each: conclusive, substantial, moderate, limited, or insufficient evidence. That report is the closest thing the field has to bedrock, and this series leans on it accordingly — while noting it is now years old, in a field that has not stood still.

Why this ladder is missing rungs

For most subjects, thin evidence means the questions are new. For cannabis, the thinness was policy. Classified for half a century in the most restricted category of drug law — a category defined by "no accepted medical use" — the plant could be studied only under heavy license, and for decades American researchers could obtain it from exactly one federally approved farm, in limited forms that resembled little of what anyone actually used. The circle closed on itself: the classification rested on an absence of evidence that the classification itself enforced. Money followed the same channel — for years, funding flowed overwhelmingly to studies of harm, not of benefit, so the record grew lopsided by design. And the target keeps moving: the flower of the studies is not the concentrate of the shops. None of this makes the existing evidence false. It makes it partial, dated, and tilted — three more facts the reader deserves alongside every claim, and the seed of a later book in

this series on how the science was slowed.

The animal caveat

A large share of everything believed about this plant's chemistry rests on animals and on cells in dishes, and the ladder of this chapter needs the caveat stated plainly. Mice are not small people: their endocannabinoid systems differ from ours in detail, the doses given them are often enormous by human measure, and a compound that performs beautifully in a dish may never reach the human tissue it would need to touch. The cannflavins of Chapter 6, much of the entourage evidence, and many a headline cure live at exactly this level — real experiments, honestly reported, several species away from the reader. The rule for the beginner is simple: an animal result is a reason to run the human study, not a reason to announce the human answer. This series keeps the species in view every time a study is cited, and grades accordingly.

The blinding problem

Cannabis trials carry a flaw built into their strongest instrument, and a beginner should know it by name. A controlled trial works only if nobody can tell who got the real thing — the blinding. But THC announces itself: a volunteer who feels unmistakably high knows which arm of the trial she is in, and so, often, does the researcher watching her. The blind leaks, and with it leaks everything the blind was protecting — expectations rush in, and expectation is itself a powerful drug, especially for pain, nausea, and mood, the very outcomes cannabis trials most often measure. Studies of pain in particular show large responses in the placebo arms, which is one reason headline effects so often shrink when the trials get stricter. This does not make the trials

useless; it makes their grades honest. A field whose drug cannot hide is a field where even the best instrument must be read with its known flaw in view — and where a claim graded moderate may be carrying more certainty, not less, than a louder claim elsewhere.

The scale this series uses

Four grades, used from the first chapter onward, stated here in full.

Settled — replicated in controlled studies, consistent, and held by expert consensus. CBD stops certain childhood seizures; THC engages CB1 and intoxicates. Claims at this grade are load-bearing.

Supported — good studies point one way, consistently, but the final instrument — large controlled trials — is missing or incomplete. Much of the plant's defensive chemistry sits here.

Suggestive — early, indirect, or animal evidence; a real signal, not yet a finding. The cannflavins live here, and so does much of the entourage effect.

Open — lore, anecdote, marketing, or a question simply untested. Open is not a dismissal; it is a location. Half the map of this plant is still open country, and the back of this book charts it honestly.

One distinction the scale depends on: "no evidence of an effect" and "evidence of no effect" are different claims, and sloppy speakers trade one for the other in both directions — advocates and prohibitionists alike. The first says the study hasn't been done. The second says it has, and the answer was no. This series

never swaps them.

Five questions for any claim

When a claim about cannabis reaches you — from a headline, a label, a friend, or a later book of this series — five questions weigh it. Who paid for the study, and what do they sell? What exactly was studied — which compound, what dose, in what form? In whom — patients, volunteers, mice? Compared against what — nothing, or a real alternative? And has anyone else, elsewhere, found the same? A claim that survives the five is worth your belief in proportion to its grade. A claim that cannot answer them is marketing, whatever costume it wears.

Holding the chapter

The plant is real, the body's system is real, and the record is real but partial — built under a ban, tilted by money, chasing a moving product. That is not a reason to believe nothing. It is a reason to believe at the right strength, claim by claim, which is the only kind of believing this series has ever asked for. One chapter remains, and it is about the tool you will use more than any other in this field: the words themselves.

Chapter 12 — The Words

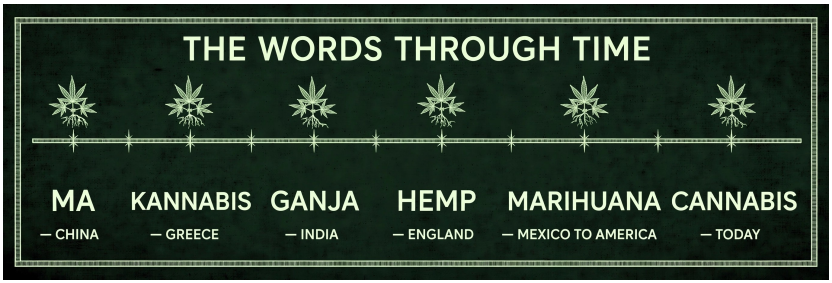


Plate — The words, in their centuries.

This book ends with its smallest subject and its most used one. Every argument about cannabis is, in part, an argument about words — which name gets used, by whom, and what the name quietly decides before the facts arrive. A beginner who owns the words cannot be talked past. So the last chapter is a sorting: the names this plant has carried, the registers they belong to, and the loads some of them smuggle.

The names of the world

The plant has been named by every culture that met it, and the names are a map of its travels. Cannabis itself comes down from the Greek kannabis, likely borrowed from the Scythians, the horse peoples of the steppe who threw the plant on hot stones in their tents — the Greek historian Herodotus described it in the fifth century before Christ, in the oldest eyewitness account of the plant's use that survives. In India it is ganja and bhang, from Sanskrit. In China it is ma — one of the oldest words in that language, a character so old it pictures the plant hanging to dry, and for most of Chinese history it meant fiber and medicine before it meant anything else. In Morocco the prepared resin is

kif; in South Africa, dagga; in Hawaii, pakalolo, "crazy tobacco." Hemp is the Germanic name. Marihuana came last to English, through Mexico, in the twentieth century.

No culture named it carelessly. Each name carries its relationship: the crop, the medicine, the sacrament, the smoke, the menace. When you hear a name, you are hearing which of those relationships is speaking.

The registers

Modern English keeps at least five vocabularies for this one plant, and a fluent reader can hear them change rooms.

Botany speaks Latin and structure: Cannabis sativa, trichome, bract, chemotype — words built to be exact and to travel across languages unchanged. Law speaks in thresholds and definitions: hemp, marijuana, controlled substance, total THC — words built to draw lines a court can enforce, precise about numbers and silent about everything else. Medicine speaks in systems and grades: endocannabinoid, indication, adverse event — words built to be cautious in public. The street speaks in slang, and slang turns over by the generation — pot, grass, weed, and their hundred cousins — words built for belonging, which is why they date so fast and pretend to nothing else. And marketing speaks in promise: natural, premium, craft, wellness — words built to sell, and the only register whose purpose is not to describe the plant at all.

None of these registers is the true one. Each is a tool with a job. Trouble starts when a word crosses registers without changing clothes — when a legal category is quoted as if it were a botanical fact, or a marketing word is worn as if it were a

medical one.

Words that smuggle

Some words arrive with the conclusion already inside them, and the beginner should learn to hear the smuggling.

Drug, medicine, and substance can be the same molecule on three different days: a drug in the arrest report, a medicine in the pharmacy, a substance in the laboratory. The molecule does not change. The word announces the speaker's verdict before the evidence is heard. Official language once built the verdict into the diagnosis itself — for decades the clinical term was cannabis abuse, a name that presumes what a neutral description would have to prove; the field has since moved to cannabis use disorder, which at least describes a pattern instead of a crime. Natural is marketing's favorite smuggler: hemlock is natural, and so is fiber, and the word settles nothing in either direction. Recreational and adult use are the same activity in two suits — one chosen by the industry's critics, one by the industry — and medical, in most laws, names not a property of the plant but a permission slip from a state. Even marijuana carries its history: historians of the prohibition era note that American officials of the 1930s favored the foreign-sounding word over the familiar hemp and cannabis precisely because it sounded foreign — the campaign's full story belongs to the prohibition book, but its fingerprint is on the word itself, and it has never quite washed off.

Against all of these, set the words this book has tried to give you, because they were built to carry facts and nothing else: cultivar, chemotype, trichome, decarboxylation, sinsemilla, endocannabinoid. A reader who can say "a Type III cultivar,

decarboxylated" has said something checkable in any country on earth. That is what precision words are for — not to impress, but to make a claim that can be tested, by anyone, anywhere. It is the same virtue as the evidence grades of the last chapter, in miniature: language at the right strength, claiming exactly what it can hold.

The word that is winning

The sorting has a direction, and a beginner entering the field now should know which way the language is moving. In statute after statute, the word marijuana is being retired and the word cannabis put in its place — several American states have rewritten their laws to make the swap, on the stated ground that the old word carries the prohibition era inside it. The industry, for its own reasons, prefers the Latin word too: it sounds like science and shelves well. Even the slang is being outlived by the legal word, as shops and clinics normalize it. This book chose cannabis on the first page for the plainest reason — it is the plant's scientific name, the one word every register can share — but it is worth seeing that the choice is also where the language itself is going. Words, like the plant, are cultivated. What gets planted everywhere eventually looks like what was always there.

The qaneh question

One word-fight deserves its own paragraph because it shows every register of this chapter colliding at once. In the Hebrew Bible, a fragrant plant called qaneh-bosm appears among the ingredients of the holy anointing oil. In 1936 the Polish scholar Sula Benet argued that the word is cannabis — qaneh sounding, to her ear, like the plant's name in other ancient tongues. The claim has been repeated ever since, usually as a settled

discovery: cannabis in the Bible. Weighed on this book's scale, it is open. The sound-resemblance is real; the mainstream of biblical scholarship reads the word as a different aromatic reed or grass, the ancient translations do not support Benet, and no residue or artifact has settled it. The sacred-plant book of this series gives the argument its full hearing. Here it stands as the chapter's working example: a claim can be old, beloved, and repeated in a thousand places, and still be exactly as proven as it was in 1936.

The end of the first book

You came to this book, if the book did its work, knowing nothing in particular about an annual herb of the hop family. You leave it knowing the plant's pieces and its one-year life; its tiny factories and the three families of chemistry they make; its kinds and the limits of their names; the line the law drew through it and the crop that line destroys; the forms people use and their timings; the system in your own body that the plant's chemistry fits; the grades by which every claim in the field should be weighed; and now, the words.

What you do not yet know fills the rest of the series — the deep history, the prohibition, the medicine and the harms weighed in full, the growing and the making, the markets and the money, the questions still open at the back of this book. All of it stands on what stood here first, unchanged since the first page: before the arguments, before the laws, before the words — a plant, first. It is still out there being one, in fields and windowsills and wild roadsides, indifferent to everything said about it. The series continues whenever you are ready. The plant will keep its own schedule either way.

What this book did not do

This book answered one question: what is cannabis? In answering it, it walked past a hundred doors it did not open. They are not forgotten; they are the rest of the series. The map below is the honest one — the questions this book left open, and the volume that takes each of them up.

Asia, the ancient uses, the archaeology and the genetics of the journey — *The Deep History*.

statutes, and the inquiry into whether the fiber was suppressed by rival industries, claim by claim — *Prohibition and Law*.

war on drugs, the culture that carried the plant through its banned century — *The Social Movement*.

across religions — *The Sacred Plant*.

building material, food — *Fiber and Food, Without the High*.

The Medical Book. **Who must be most careful with it?** The young, the pregnant, the vulnerable — *The Vulnerable Populations*.

of the minor compounds?* Terpenes and the Minor Compounds*.

Ways to Grow*, including light, organic practice, and the seed keeper's craft.

Laboratory, Testing and Tracking, *and the data record itself,* Cannabis by the Numbers*.

Formulation *and* Safety and Toxicology. ***What happens after harvest?*** Post-Harvest*.

Market *and* The Economics. ***What does the plant do to the planet, and the planet to it?*** The Plant and the Planet*.

and *Cannabis and Sport*. **What happens outside the law entirely?** *The Unregulated Market*.

seam they slipped through, *The Hemp Loophole*. **What of animals?** *Cannabis and Animals*.

comes next?* The Future*.

- **Where did the plant travel, and with whom?** The roads out of Central
- **How was it banned, and by whom?** The treaties, the campaigns, the
- **Who fought back?** The reform movement from NORML's founding onward, the
- **What has the plant meant to the spirit?** Its sacred and ritual life
- **What does the fiber and the seed actually do?** Textiles, rope, paper,
- **What does it heal, and what does it not?** Every medical claim, graded —
- **How is it bred, kept, and read in its genes?** *Genetics and Seed*. **What
- **How is it grown — lawfully, and well?** *The Law of the Grow* and *The

- **How is it extracted, tested, and tracked?** *Extraction and the
- **How is it made into products, and what can go wrong?** *Products and
- **How is the market read, and how does the money move?** *Reading the
- **What of work, driving, and sport?** *Impairment and the Working World*
- **What of the laboratory look-alikes?** *The Synthetics*, and the legal
- **Why is the record so thin?** *How the Science Was Slowed*. **And what

A reader who stops here owns the foundation. A reader who continues owns the house.

Glossary

Achene — the botanical name for the cannabis "seed": a small hard fruit holding one seed inside. **Anandamide** — the first endocannabinoid discovered; the body's own cannabis-like messenger, named from the Sanskrit for bliss. **Annual** — a plant that completes its whole life — sprout, growth, flower, seed, death — in one growing season. **Anthocyanin** — the pigment family behind the purple in some cannabis varieties; the same pigments color blueberries. **Autoflowering** — kinds that flower by age rather than by lengthening nights, descended from the wild northern form. **Bhang** — the Indian preparation of cannabis leaf, taken as food or drink. **Bract** — the green sheath wrapping each female flower's ovary; the surface where most resin glands stand. **Bud** — the common name for the female flower cluster: many small flowers, bracts, and glands together. **Bulbous trichome** — the smallest gland type: a tiny resin ball on a barely visible stalk. **Cannabidiol (CBD)** — the non-intoxicating cannabinoid; an approved medicine for certain severe childhood epilepsies. **Cannabigerolic acid (CBGA)** — the parent cannabinoid from which the plant builds THCA, CBDA, and CBCA. **Cannabinoid** — one of the family of compounds, over a hundred known, made almost only by cannabis and acting on the body's cannabinoid receptors. **Cannabinol (CBN)** — the compound THC degrades into with age, air, and heat; mildly intoxicating. **Cannflavins** — flavonoids found only in cannabis, under study for anti-inflammatory activity. **Capitate-stalked trichome** — the large resin gland on a stalk, crowned by a secretory head; the main factory of the plant's chemistry. **Caryophyllene** — a

peppery terpene that also activates the CB2 receptor; a terpene that behaves partly like a cannabinoid. **Charas** — hand-rubbed hashish, made from living plants. **Chemotype (chemovar)** — a kind of cannabis defined by its measured chemistry; Types I–V run from THC-dominant to nearly cannabinoid-free. **Cotyledons** — the seed's first two round leaves; its packed lunch made visible. **Cultivar** — the horticultural term for a cultivated variety; the correct word where "strain" is used loosely. **Decarboxylation** — the removal, by heat or time, of the acid cap from THCA and CBDA, producing THC and CBD. **Dioecious** — keeping the sexes on separate plants, as cannabis usually does. **Endocannabinoid system** — the body's own cannabinoid signaling system: CB1 and CB2 receptors, anandamide and 2-AG, and the enzymes that build and dismantle them. **Entourage effect** — the hypothesis that cannabis's compounds modify one another's effects; plausible, partly supported, not settled. **Enzyme** — a molecular machine that performs one chemical job; the gland's enzymes turn CBGA into its children. **Flavonoid** — the pigment-and-protector family of compounds; about twenty occur in cannabis. **Ganja** — the Indian name for cannabis flower. **Hashish** — pressed cannabis resin: the collected gland heads, sieved or rubbed and formed into cakes. **Hemp** — cannabis at or under the legal THC threshold (0.3 percent in the United States), grown for fiber, seed, or oil; the plant's oldest English name. **Hurd** — the woody core of the stalk left after the bark fiber is stripped. **Indica** — Lamarck's name for the short, broad-leafleted Indian form; in shops, a loose label for sedating kinds. **Kief** — the loose powder of detached resin-gland heads. **Landrace** — a population shaped by one place over generations, half by land and half by farmers. **Marijuana** — cannabis over the legal THC threshold;

in law, the controlled category; the word entered English from Mexican Spanish in the twentieth century. **Monoecious** — bearing both sexes on one plant; the condition of the "hermaphrodite" of growers' speech. **Node** — the joint on a stem where leaves and branches attach. **Photoperiod** — the length of day and night; cannabis flowers when the unbroken night grows long enough. **Radicle** — the first root out of a germinated seed. **Ruderalis** — the wild northern form of cannabis; ancestor of the autoflowering kinds. **Sativa** — Linnaeus's name for the species, meaning "cultivated"; in shops, a loose label for uplifting kinds. **Sinsemilla** — "without seed": unfertilized female flower, the standard drug product. **Stigma** — the feathery tip of the female flower that catches pollen; the "hairs" that turn from white to amber. **Terpene** — one of the aromatic compounds that give cannabis (and most plants) their smell; over a hundred occur in cannabis. **Tetrahydrocannabinol (THC)** — the principal intoxicating cannabinoid; delta-9-THC is the measured form in law. **THCA** — the acid form of THC that the plant actually makes; converted to THC by heat. **Total THC** — the measure regulators use: THC present plus the THC its acid would become. **Trichome** — any outgrowth of the plant's skin; the glandular kinds make and store the resin. **2-AG** — the second endocannabinoid discovered; the body's most abundant cannabinoid messenger.

Sources — principal works, by chapter

The full shelf for the series is kept in the series library. What follows are the principal works each chapter rests on.

Front matter and Chapter 11 — National Academies of Sciences, Engineering, and Medicine, *The Health Effects of Cannabis and Cannabinoids* (2017), the consensus review whose evidence categories this book's grades follow. **Chapter 1** — Robert C. Clarke and Mark D. Merlin, *Cannabis: Evolution and Ethnobotany* (2013); Ernest Small, *Cannabis: A Complete Guide* (2017); Ren et al., "Large-scale whole-genome resequencing unravels the domestication history of Cannabis sativa," *Science Advances* (2021). **Chapter 2** — Clarke and Merlin (2013); Small (2017); the botanical descriptions of the UNODC identification literature. **Chapter 3** — Clarke and Merlin (2013); Small (2017); the practitioner canon of the cultivation shelf, checked against both. **Chapter 4** — Hammond and Mahlberg's trichome studies (1970s); Livingston et al., "Cannabis glandular trichomes," *Current Biology* (2020). **Chapter 5** — Gaoni and Mechoulam, the isolation and structure of THC (1964); the PubChem compound records; the U.S. FDA approval record for Epidiolex (2018); the University of Mississippi potency monitoring record. **Chapter 6** — Ethan Russo, "Taming THC," *British Journal of Pharmacology* (2011); Booth and Bohlmann, "Terpenes in Cannabis sativa," *Plant Science* (2019); Oswald et al., identification of the volatile sulfur compounds behind the skunk aroma, *ACS Omega* (2021). **Chapter 7** — Small and Cronquist, "A practical and natural

taxonomy for Cannabis," *Taxon* (1976); Sawler et al., "The genetic structure of marijuana and hemp," *PLOS ONE* (2015); the chemotype scheme of de Meijer and successors. **Chapter 8** — The Agriculture Improvement Act of 2018 (the Farm Act), text of the hemp definition; USDA hemp production rules; Small (2017). **Chapter 9** — The United States Pharmacopeia, cannabis listings 1850–1942; the University of Mississippi potency monitoring record; the CDC's EVALI outbreak reports (2019–2020). **Chapter 10** — Devane et al., the CB1 receptor (1988) and anandamide (1992); Mechoulam et al. on 2-AG (1995); Di Marzo on the endocannabinoid system's functions; National Academies (2017). **Chapter 12** — Herodotus, *Histories*, Book IV (the Scythian account); Martin Booth, *Cannabis: A History* (2003); the Oxford English Dictionary's etymologies; Sula Benet's qaneh-bosm argument (1936) and the mainstream biblical-scholarship response to it.

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About the Author

Douglas J. Brownfield is a human with experience. As an author, he writes about the things he has learned and uses, and believes others need to know. Cannabis has spanned nearly his entire life: first exposure in high school, the illicit market years in Chicago before legalization, learning cultivation by working on a California farm, then working professionally as an outdoor organic cultivation specialist in Sonoma, California, three seasons of private cultivation on his own off-grid acreage under a medical allotment, and consulting work in Michigan's state-regulated industry. His other interests and experience include, but are not limited to, tattoo and piercing, brick-and-mortar retail, wholesale design and production through to e-commerce, visual and audio art production, music industry management and engineering, public service works, and developing useful and compliant software and websites, augmented with AI.

This book opens a series written to introduce cannabis to the whole world of its facts, science, and truths — book by book, for the reader who knows nothing about the subject and leans neither way about it. The author came to the plant the way he comes to everything he builds: from the primary record outward, with the open questions left open and labelled. Book One is the plant itself; the books that follow take up its history, its law, its medicine, its growing, and its trades, one at a time.

The author's books stand on the same shelf rule: one subject, primary sources, no drama framing — the facts at the strength the evidence supports, and the open questions left open and

labelled.

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