INDOOR GROW ROOM FOR BEGINNERS

A STEP-BY-STEP GUIDE TO GROWING MARIJUANA

MATTHEW McCLURE

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This book is dedicated to those who rely on safe, quality marijuana and no longer wish to be at the mercy of external factors.

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INTRODUCTION

Marijuana has become a staple of modern society. The 2018 National Survey on Drug Use and Health found that about half of all American adults have tried marijuana and a September 2019 Pew Research Center survey found that the majority support legalization. For years, some state-run medical marijuana programs have allowed individuals with certain conditions to grow and/or purchase marijuana products, but the average buyer has been left with few, if any, options to obtain the powerful herb.

But now with states and countries continuing to relax cannabis laws, more and more individuals are legally able to cultivate their own marijuana. This book is written for first-time or novice growers and provides all you need to know to set up an indoor grow room, plant your marijuana crop, and harvest your high-quality flower.

We'll take you step-by-step through the process of setting up your space, building out your grow room, growing from seeds, and finally harvesting.

Growing marijuana is an involved process, but it isn't difficult and can be done by anyone regardless of experience level. Besides its well-known medicinal properties, the marijuana plant is beautiful, fast-growing, and fascinating to watch develop throughout its growth stages. We hope this book helps guide you in your journey and acts as your go-to marijuana cultivation reference for years to come.

HOW TO USE THIS BOOK

Congratulations! By reading this book, you've taken the first step toward controlling your own supply of marijuana. Growing marijuana can be a complicated topic, so we've broken down the process into simple steps for you to understand. Full-color illustrations and pictures of setups and plants help make visualizing what you read about as easy as possible.

The content of this book is divided into 11 steps, each focusing on a key topic of the marijuana cultivation and harvesting process. Once you've read the whole book, you can refer back to the individual steps as needed. There's a Resources section and an Appendix at the back of the book devoted to diagnosing nutrient deficiencies.

We know you're ready to dive in to setting up your grow space, but we recommend reading this book in its entirety first. This will provide you with the fundamental knowledge required to strategize and design your ideal grow room. We believe it's best to have an understanding of the complete cultivation process prior to purchasing equipment or creating a grow space.

Step 1
The Basics

No matter whether you call it pot, Mary Jane, Buddha, or herb, marijuana is gaining acceptance across the United States and around the world. But cannabis, in both hemp and marijuana forms, has been cultivated for centuries by many civilizations for its medicinal, therapeutic benefits. Marijuana, also known as "weed," will literally grow like a weed under the right conditions. For those interested in the same benefits our ancestors sought, growing marijuana indoors can yield high-quality product, and the growing process itself can be as cathartic as it is rewarding.

Why Grow Your Own Marijuana?

Due to legalities surrounding the plant, marijuana can be difficult and expensive to procure. Black market marijuana has been available to many Americans for decades, but buying through this route can have risks. These include personal safety, lack of transparency in regard to quality and product safety (think potency or leftover pesticides), and gaps in supply. Those using cannabis products for medical purposes, along with many recreational users, require a steady, ongoing supply of their product of choice.

If you live in a state where weed is legal for recreational use, you can

probably grow marijuana at home or purchase it through licensed dispensaries (check your state laws). The legal weed market is highly regulated, and although dispensaries sell a safer and more transparent product, they charge quite a premium to cover taxes, overhead, and profit. Based on your usage, sourcing from dispensaries may not be a viable, sustainable option. Whether procuring through your local dealer or a licensed dispensary, chances are there are neither refunds nor guarantees.

It's for these reasons that many choose to cultivate cannabis at home and put that time, energy, and money into managing their own supply. When you grow at home, you have full control over the relative size and the frequency of harvests, not to mention control over safety and quality. Why give your hard-earned cash to someone else when you can reap the same benefits and have full control of your marijuana needs?

ORGANIC OR NOT

Organic cultivation means growing marijuana in a sustainable way without pesticides, fungicides, or other chemical and synthetic materials often used to promote crop growth or kill pests. Organic products are also free of genetically modified organisms (GMOs).

The table below compares organic and conventional cultivation methods. OMRI stands for the Organic Materials Research Institute, which maintains a list of prohibited and allowable inputs for organic cultivation. To engage in strict organic production means to use only inputs listed as allowable by the OMRI.

If you want to go "green" with your indoor grow, keep the following table in mind:

METHOD	USED IN ORGANIC GROW	USED IN CONVENTIONAL GROW
Herbicides	OMRI-listed only	Yes
Pesticides/insecticides	OMRI-listed only	Yes
Fungicides	OMRI-listed only	Yes
Synthetic nutrients	OMRI-listed only	Yes
GMOs	No	Yes
Hydroponic Systems	Probably not	Yes

Organic cultivation often involves the use of natural alternatives to popular chemical and synthetic materials. For example, pest control without pesticides may involve the use of plant essences from garlic or neem oil and biological controls such as ladybugs.

Many growers utilize a blend of both organic and conventional growing methods to achieve their preferred balance of time, energy, quality, and yield. For beginners, conventional cultivation is often the easiest path, as organic methods can be a little trickier to implement and are often more costly.

Dispelling Common Myths

"I Don't Have the Right Space."

Successful indoor grows can be smaller than two feet by three feet. A closet- or cellar-size space can easily accommodate a perpetual harvest setup in which you have plants in various life stages and cycle them through so that you can harvest at regular intervals. If your space cannot be kept clean and sanitary in its current state, consider painting exposed concrete block or adding a cheap, flexible wall covering made of a material such as fiber-reinforced plastic (FRP) or plastic sheeting. This also helps insulate the area, allowing you to achieve more consistent environmental conditions.

"It's Hard to Find and Buy the Right Equipment."

In years past, it could be a challenge to source equipment such as lights and hydroponic accessories, as they were mostly reserved for professional, non-cannabis growers. When you could source them, it was often at a premium price. These days there are many options, from online retailers to brick-and-mortar growing supply shops, that allow you to buy everything you need without breaking the bank (see the Resources section). Although indoor grows for personal use can be very elaborate, you don't need much equipment to have a respectable grow that produces happy plants and good yields.

"I Don't Have the Technical Skills to Build a Grow Space."

Fear not. You don't need technical skills or construction experience to put together an adequate grow space. This book was written to provide first-timers with all the information needed to set up and operate a grow room. Cultivating marijuana can be exciting and a lot of fun, and you'll learn

more techniques as you grow.

"It's Way Too Expensive."

This isn't true. *Buying* weed and other cannabis products is way too expensive! Cultivating your own product and controlling your supply will save you money. The initial investment can be as low as a couple hundred dollars, which wouldn't buy much product on the black market, let alone through legal options. Many items used throughout cultivation and harvest are common household items that you may already have. (You'll also need nutrients and growing media, but they can be had on the cheap.) There is no need to rush out and buy the latest or most expensive equipment. Start small, with items at your disposal, and allow your grow to evolve over time, and you won't need a second mortgage on your home. On average, you should see return on your investment by your first or second harvest.

"I Don't Have a Green Thumb."

That's okay. Cannabis grows fast like a weed and often does just fine without any human intervention at all. How much harm can you do? Like anything in life, there will be some trial and error. This book gives you tips on monitoring and responding to plant issues so you don't have to go through all the R&D on your own. That said, growing marijuana can be looked at like a manufacturing process. Some easy-to-learn activities, such as inspecting your plants, taking soil moisture and pH readings, and ensuring adequate lighting and airflow, will eliminate any factors having to do with the color of your thumb.

MARIJUANA GROW LAWS

Many countries and states have legalized marijuana exclusively for medicinal purposes. California was the first state to do so in 1996, and over 30 other states have since followed suit. The bar for becoming a medical marijuana patient varies from state to state, with many requiring documentation of severe disease or chronic pain.

In 2012, Colorado went a step further and legalized marijuana for recreational use for adults over 21, though with some restrictions. As of 2020, 14 additional states and the District of Columbia have also taken the step to legalize marijuana for recreational use.

Currently, you can legally grow marijuana if:

1. You are a card-holding medical marijuana patient. There are typically restrictions on the number of flowering plants and total plants you can grow at a given time.
2. You live in a state (or country) that has legalized marijuana for recreational use and allows cultivation by individuals. There are usually limits on the maximum number of plants you can grow at a given time.
3. You run a state-licensed cannabis-growing operation.

Before embarking on your indoor garden, make sure you can do so legally. Check out the site MarijuanaAndTheLaw.com for information on your area.

The Four Basics of Growing

The process of growing marijuana plants comes down to four key elements: space, light, environment, and nutrients.

The Space

A space with the right qualities and amenities will consistently produce the best-quality marijuana flower. Keep in mind that how you set up your grow space will have lasting effects on yield, quality, and efficiency, so take your time on the front end. At a minimum, the area you use for your growing operation should have adequate power supply, accessibility to water, floors that clean easily, airflow, and, most importantly, lighting. We'll dig into each of these further in Step 2: The Space.

The Light

More than any other single factor, lighting will dictate your marijuana plants' growth and bud development and therefore your grow room's success. Lighting is key not only to vegetative growth before flowering but also to formation of dense buds in the flowering stage. There are many lighting options and a huge range in costs. Lighting is often the costliest part of a grow operation, so a considerable portion of your grow room budget should be allocated to it. We'll show you detailed information on lighting elements so you can make the right purchase based on your available capital in Step 3: The Light.

The Environment

Your marijuana plants are living, breathing organisms. A quick refresher from fourth grade biology: Humans breathe in oxygen and expel carbon dioxide. Plants do the opposite: They take in carbon dioxide and expel oxygen (which we, in turn, inhale). For your grow operation, the quality of your environment will be determined largely by the air quality (which in turn is determined by factors such as carbon dioxide level, air temperature, airflow, and humidity level). Improper airflow or air circulation can wreak havoc on plants in an otherwise well-controlled environment. We'll dive into some simple monitoring techniques and equipment and discuss ventilation and circulation more in Step 4: The Environment.

The Nutrients

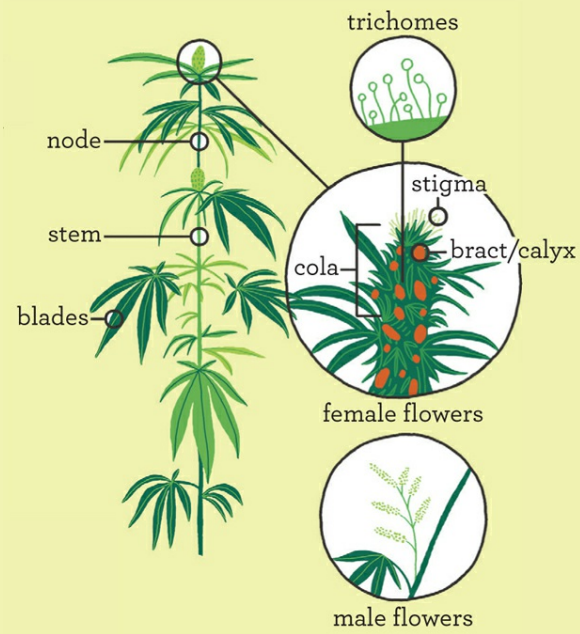
Much like how our overall health is dependent on what we choose to feed ourselves, plants rely on available nutrients to produce roots, stems, branches, leaves, and flowers. Providing proper nutrition is the role of fertilizers. Fertilizers can contain different proportions of the big three macronutrients—nitrogen, phosphorus, and potassium—along with varying levels of micronutrients. Plants require different levels of these nutrients depending on their stage of growth. We'll delve more into the realm of plant nutrients in Step 8: The Nutrients.

ANATOMY 101

Do you know your plant parts?

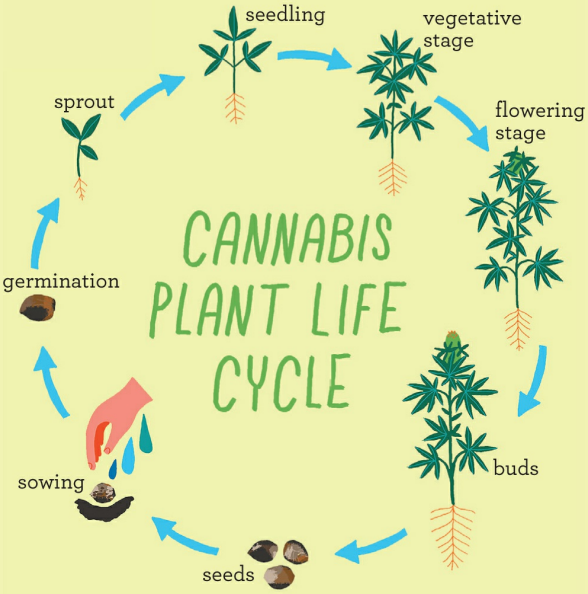
Cola: The cola is the main group of buds on top of the main stalk. It is technically referred to as the apical or terminal bud. In most harvests and depending on your pruning activities, colas will represent more than 60 percent of the total harvested bud.

Stigma and pistil: The pistil is the reproductive part of the flower (bud) and is where the long, hair-like stigma grow from. Stigmas often change in color from white or clear to brown or deep amber once the flower has matured.



Bract and calyx: These parts provide the structure for the flower itself. The bract is a teardrop-shaped leaf that houses the female reproductive machinery. Bracts contain trichomes, which are found underneath the resinous sugar leaves. Buds are primarily made up of bracts and sugar leaves. The calyx isn't visible to the naked eye. It consists of a transparent layer at the base of the flower.

Trichomes: Trichomes are small filaments on the flowers that produce resin. Trichomes are what give marijuana its telltale stickiness, and their maturity can be used as a signal to determine when to harvest. The resin produced by trichomes contains terpenes, which give cannabis strains their unique flavors, aromas, and medicinal properties.



LIFE CYCLE

Review this diagram of the life cycle of a cannabis plant. Each stage requires specific actions on your part to ensure your harvest is healthy and abundant. But don't worry, we detail all of these stages in subsequent steps within this book. For now, familiarize yourself with the basics of the process.

TAKEAWAYS

You made it through the first section. Way to go! You're on your way to growing your own marijuana indoors, saving money, and producing marijuana you can trust. In Step 1: The Basics, we covered:

- The basics of marijuana, including organic grows and marijuana grow laws
- Common myths about growing marijuana
- The four key elements of growing: space, light, environment, and nutrients
- Anatomy 101: the cola, stigma, pistil, bract, calyx, and trichome

In the next section, Step 2: The Space, we'll take an in-depth look at what makes for a successful cultivation space.

Step 2
The Space

In this section, we'll discuss the requirements of the grow space itself. This is perhaps the most involved of the four basic growing requirements because it requires you to select the best location, determine the basic layout and design, and ultimately build out the area. Keep in mind that an indoor grow is the gift that keeps on giving, and the time, money, and energy put into the grow room itself will yield manyfold returns over the life of your operation.

Finding the Right Space

The better the design and construction of your space from the outset, the easier it will be to maintain a pest- and pathogen-free area that can be easily cleaned and will provide happy, healthy plants for years to come.

Size Matters

If you don't have a spare room and your roommate or significant other won't let you convert your master bedroom into a pot-growing den, that's okay. You have other options. Virtually any size space can accommodate a grow room. Successful indoor grows can be smaller than two feet by three feet. Taking over an existing space in your home, such as a closet,

cellar, or bedroom, is ideal. If you don't have a suitable space readily available but know (or are able to hire) someone who knows a little about construction, consider building a room within a room. Other options include tents or specialized, compact growing systems designed for small spaces. Tents can be quite functional but sometimes have drawbacks in terms of maintenance and cleanability. With a little help, even a kitchen or bathroom cupboard can serve as a productive indoor grow space. Though you can prune and train your plants to operate in almost any space, a height of three feet or more is preferred to allow room for lighting and plant growth. (For help deciding on what kind of space is right for you, check out Room, Closet, or Tent?).

Power Supply

You need a good power supply to be able to constantly run fans and lights, which tend to have a higher energy requirement than many other devices. Many first-time growers working in a small area can get away with using a standard grounded duplex outlet that is nearby. If you can, sketch out your entire room on paper before starting out. This way you can calculate the actual power needed for your grow and ensure adequate capacity. Depending on your chosen lights and fans, you may be able to get away with one power outlet, but in most cases you'll need to spread out the power usage over multiple outlets or even borrow from nearby rooms so as not to blow a fuse or exceed breaker amperage. If more power is required, consider having a licensed electrician install more outlets running directly from the fuse panel.

Water Supply

Using the right type of water is critical to plant health. If using city water, you'll want to make sure to check pH and hardness levels. Typically, pH should be in the 5.5 to 6.5 range, with a hardness of no more than 200 ppm (parts per million) of TDS (total dissolved solids). If using a private water source, in addition to pH and hardness, you may also want to check for heavy metals, salts, and residues from water softening, as these can inhibit normal plant growth and development. Investing in decent pH and TDS meters will help (these tools are also often used to monitor plant

and soil health). If possible, use distilled water with TDS levels as close to zero as is practical. Reverse osmosis (RO) machines can purify standard tap water to this level and are relatively inexpensive. You can also buy distilled water, but this is more costly in the long run. Using water free from any minerals and solids will set a pure baseline that won't interfere with the other nutrients and chemicals you give your plants.

Walls and Floors

Your grow space should have cleanable walls and floors. To create these, concrete floors can be sealed with sealant and a roller, or, if you want to enhance your space, you can opt for epoxy or a similar floor coating. Wooden floorboards should be covered and sealed. Walls can be treated with antifungal paints and sealed with latex or epoxy paint. Another option is to use fiber reinforced plastic (FRP). Each of these items can be found at your local hardware store at relatively low costs. Whatever material you choose, it must be nonporous and able to withstand repeated cleanings, often with harsh chemicals. Pay special attention to the transition between the floor and walls—it should be smooth and easily cleanable and should not collect debris or water. When this is not an option, a properly installed and sealed rubber baseboard can suffice. The goal of cleaning is to eliminate any mold, pests, or phytopathogens that may have found a home in your grow room in previous growing cycles.

Lighting

The process of selecting the right light source for your indoor grow will be covered in detail in Step 3: The Light. For now, just focus on making your space lightproof. Light seeping in from outside your grow space can confuse plants, which then may produce male flowers, going against the main goals of your indoor grow operation since female plants are what produce seedless marijuana buds. It is important to avoid light leaks (we'll cover how to check for them in Testing for Light Leaks here).

The Benefits of Starting Small

Start small and stay small until you're ready to graduate into a larger

space that is more complex, expensive, and time-consuming. A larger space only becomes valuable once you have the experience and know-how to manage it properly. When starting a quick and efficient operation, it's best to err on the small side.

Less Expensive

The smaller your operation, the less expensive it will be to set up and maintain. The front-end costs will be lower, and so will the need for ongoing supplies such as growing media, fertilizer, trellis netting, gloves, etc. The smaller the grow room, the fewer the items that will inevitably break and need replacing.

Less Time-Consuming

Many first-time growers are surprised by how much time is involved in running a basic growing operation. Although they typically require only a few minutes per day to maintain once set up, there are certain parts of the grow cycle that demand significant time and attention from the grower, such as preparing the room and growing media before planting, repotting, and harvesting. The time it takes for activities such as watering, sexing, and pest monitoring depends directly on the amount of space and the number of plants you choose to grow.

Fewer Costly Mistakes

Each group of plants you harvest represents a chunk of your hard-earned cash. Mistakes *will* happen, but the smaller the number of plants affected, the less costly the ramifications. Incorrect ratios of fertilizer may require dilution with more soil. Incorrect nutrient formulations may require dilution or the throwing out of prepared solutions. Even in the absence of outright mistakes, many growers have lost a crop to pests or accidents involving climate control or watering systems. It's okay to have setbacks and even lose some plants now and then, but, especially when starting out, by going small you'll minimize the impact on your wallet.

ROOM, CLOSET, OR TENT?

Your choice of space will have lasting ramifications on the life of your operation in terms of efficiency and manageability. No pressure!

The basic options for containing your plants are a purpose-built room, closet/cellar, or tent. (Once you know what you want to use, check out Time to Construct Your Space here.) Here are some advantages and disadvantages of each:

ROOM

For those with space: A purpose-built room, which can be the product of new construction or retrofitting, allows for optimal growing conditions when compared to a tent or a closet. With this approach, you can design and lay out larger, more advanced growing operations that will net bigger yields. Rooms tend to be easier to insulate and control environmentally than closets or grow tents. The additional space also allows for separate areas for germinating, vegetative, and flowering plants. As you can imagine, the cost of setting up and maintaining a full room is significantly higher than that of setting up a closet or a grow tent, but so are the rewards. Besides the increased space, purpose-built rooms typically offer the highest level of security, and odors can be more easily routed outside.

TENT

For those wanting a simpler solution: Grow tents have become mainstream over the years, and a variety of high-quality, affordable options exist. For those without a larger space available to commandeer, tents specifically designed for growing plants can be a good solution. Depending on the configuration, they are often covered with reflective material inside and have attachments for lighting and ventilation apparatuses. One of the drawbacks of tents is they tend to get beat up more readily,

from rips and punctures to failing zippers. Tents represent the low end of the spectrum as far as security, and routing odors outside can be more cumbersome. Money talks, though, and if you're just starting out, tents may present an attractive option.

CLOSET

For those wanting something in the middle: Somewhere in between a purpose-built room and a tent is the closet grow. Like rooms, closets are typically easy to insulate and offer good security and restricted access. Limited space and the challenge of keeping odors from penetrating the rest of your home are the major cons. That said, many expert growers started out with closets, and, if set up strategically, closet grows can still produce significant amounts of marijuana. The cost to outfit a closet is usually similar to or even lower than that of a tent setup. Cleanability is another factor to consider and will vary depending on your closet setup. Compared to tents and rooms, closets can face bigger challenges with ventilation, requiring you to bring in fresh air and expel odors, which is usually done through ducting and filters.

	PURPOSE-BUILT ROOM	CLOSET	TENT
Difficulty	Experienced	Beginner	Beginner
Cost	High	Low	Moderate
Accessibility	Best	Moderate	Worst
Working life	Long	Moderate	Short
Security	Best	Best	Worst
Cleanability	Best	Variable	Moderate

Think Beyond the Plants

When you set out to design your grow space, factor in all the other stuff besides just plants that will take up square footage: equipment, containers, supplies, and space for you to move through your personal jungle. You want your operation to be as efficient as possible, and a cramped space that's hard to work in can kill the fun and ultimately produce subpar product.

Room for Lights, Ducting, and Fans

When designing your indoor grow, leave adequate space for infrastructure like lights, ducts, and fans. The lighting apparatus, which we'll talk about in depth in Step 3: The Light, will typically need to be

suspended and positioned above the plants to maintain light intensity. Using more powerful lights with highly reflective surfaces in your grow space can eliminate the need for this, but the lights themselves may require a bit of distance, so you'll want to take that into account. Depending on your specific configuration, ductwork and related equipment may also take up a bit of your available height.

Room for Plant Height

With standard pruning, many plants can still reach three to four feet in height before they are ready for harvest, with much of this height made up by the bud-laden main colas. In addition to plant height, flowering marijuana plants can often be bushy and require a two- to four-foot-diameter space. Some growers say marijuana plants do better with a little space in between them, but others have achieved prodigious yields and great-quality bud with barely enough space to move between plants. Marijuana plants can grow to extreme heights, so you'll want to maximize the available height of your grow space (but plan for basic pruning and training to be part of your standard routine).

Room to Monitor and Tend to Plants

You need a little room in between your plants to perform inspection, maintenance, and some standard cultivation activities like repotting, watering, and pruning. If you're using a tent, keep in mind that you'll probably need the space outside it for maintenance and storage of cultivation supplies. If you're using a closet or room, it's often nice to be able to perform at least the majority of your gardening activities inside it and have peace of mind that your grandma (or grandson) is not going to pop over and catch you growing pot. Be sure to account for the space taken up by supplies that will be stored inside the closet or room, such as a small table or cart, extra growing containers, or fertilizers. Lastly, the biggest thing those new to setting up indoor personal growing operations most often overlook is the space required for the largest thing in the room: You! Ensure you have enough room to move about freely and perform your cultivation activities. You'll be spending a lot of time in your grow space—make working in it as comfortable and ergonomically

friendly as you can.

Other Variables to Consider

Before you bite the bullet on a grow space, it's important to consider other factors, such as privacy, security, climate issues, and ease of access. These are often afterthoughts but can make a big difference in the overall success of your grow.

Privacy

So, your state went legal for marijuana and you can grow six plants in your house? That's awesome, but you might want to make sure the neighbors don't find out, because your house can become a target for break-in or theft. If you have kids, you'll also need to beef up security unless you like prison. Recreational marijuana, even where legal, is limited to those 21 years of age or older. This includes the growing process, and having unsecured plants in your house with kids around could be a criminal act. Your entire growing area should be under lock and key, and cameras don't hurt either. It's important to deodorize the air evacuated to any kind of common area or outside where neighbors might catch wind (literally) of what you are doing. Even if they're pot-friendly, marijuana grows can attract attention from strangers, so the lower your profile, the better.

Temperature

Your space should ideally be cool (65°F to 75°F) and dry. Whatever space you choose, you can often insulate and/or build walls as necessary to create an area that can be climate controlled, but this comes at a cost. Plants like consistency, so temperature and humidity swings in the cultivation environment can create challenges for your grow, even if the swings are temporary and ultimately corrected by equipment such as heaters, fans, and dehumidifiers. Controlling humidity can be cumbersome if you choose a space, such as a basement cellar, that lacks insulation or shares an exterior wall of your house. If your space is on the exterior of your house in a hotter climate, make sure the heat of the

midday sun won't pose an issue for controlling the temperature inside your grow area. When you plan your space, look at the worst-case environment scenario (such as midday sun in the height of summer) and design with that in mind versus the average environment. Even if a fluctuation in temperature from sun or climate rarely happens, it only takes one extreme temperature blip to ruin your plants.

Ease of Access

Once your indoor grow operation is up and running, checking or watering your plants will become part of your daily schedule. If your indoor grow is inside your house, make sure you can access the space on a daily basis without interference from neighbors, roommates, or family members. If you choose to have an off-premises site, ensure the distance can be traveled easily from your home and that you don't set off anyone's suspicion by going to that same spot every day. Trying an indoor grow in the woods might present challenges when it comes to getting supplies and water, not to mention the security implications of not residing where you grow.

TAKEAWAYS

Are you still with me? Great job making it this far! In Step 2: The Space, we talked about:

- What to consider when looking for the right space to outfit
- The pros and cons of closets, tents, and grow rooms
- The benefits of starting out with a smaller operation
- Thinking beyond just the plants themselves

Prepare to be illuminated, as the next section, Step 3: The Light, will give you a better understanding of how crucial lights are to plant growth and development.

Step 3
The Light

In this section, we'll tackle the basics of lighting and the different types of lights available, how to determine the right amount of light for your space, and the equipment you'll need to brighten up your space and give life to your plants. The amount of light available to your babies is often the number one factor dictating the success of their growth and bud development.

The Light Setup

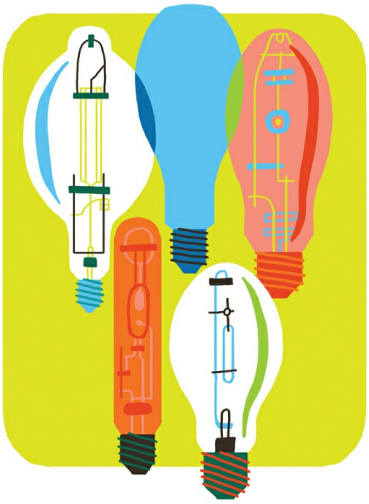
Your choice of lighting setup will be one of the foundational aspects of your indoor growing operation and can limit you accordingly. Lights are typically the single largest expense of a grow room and, all things being equal, have the greatest impact on your ability to produce fully developed marijuana as quickly as possible. They also determine the frequency of your harvests. Lighting is one thing you should enhance to whatever level your budget will allow. Although lights come in many different types and configurations, in general they share three features in common: the ballast, the lamp, and the reflector. Let's take a closer look at each.

Ballast

A ballast is a device that regulates electrical current to provide a steady

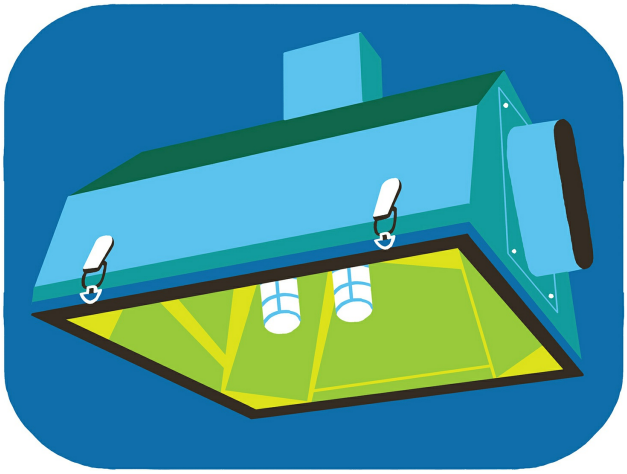
output of light at a given intensity. Unless you purchase separate components, most light setups will include an appropriate ballast. The ballast is the workhorse of the broader light setup, and although high-quality ballasts are costly, you can't run high-quality lamps without them. Check out the illustration of the complete grow light kit here—the ballast is integrated into the unit and is not visible. Fluorescent bulbs have relatively small ballasts, while high-intensity discharge (HID) lamps require bulkier ballasts typically containing a fan and additional capacitors. Light-Emitting Diode (LED) lights and Compact Fluorescent Lights (CFLs) require no ballast at all.

Lamps



Without taking you on a bad trip into the physics of light, we can tell you that the cannabis plant responds better to blue light in the 400 to 500 nm (nanometer) range for vegetative growth and to red light in the 620 to 780 nm range for flowering and bud development. Some growers will choose to have two sets of lights, each one producing one of these ideal ranges. Most indoor grows with a perpetual harvest will have a smaller area set aside for vegetative-state plants and the bulk of the space devoted to the larger flowering plants. This, however, can sometimes present challenges when it comes to keeping light out of the flowering plants during the flowering stage's 12-hour dark period. Fluorescent lights are the least costly of the options and may be suitable for vegetative growth but often

don't contain enough of the red spectrum to produce decent buds. Historically, LEDs were found to produce decent vegetative growth but suffered when it came to bud development, but today technological advances have resulted in increased acceptance of the use of LEDs for all stages of the plant's life cycle. There are many varieties of lamps with different costs and benefits; we'll look more closely at LED, HID, and other types of lamps in the next section, the Light Source.



Complete, self-contained grow light kit containing lamp, ballast, and reflector. This is the route many new growers will take versus individually sourcing and combining a ballast, lamp, and reflector.

Reflector

Once you've chosen a lamp and appropriate ballast to power it, the next thing you'll need is a reflector. A lamp by itself scatters light in all directions. The reflector concentrates the light from the lamp so your plants get the bulk of the light produced. Reflectors usually have angular surfaces to reflect and deflect the light onto a focal point. They also contain the socket for your chosen lamp, a cord to connect to a ballast, and installation hardware. Many light setups are suspended on a pulley system so the light can be raised as the plants grow and lowered when beginning a new crop.

The Light Source

Your light source and the quality of light it produces are crucial for your

indoor grow space. Outdoor spaces have to rely on the sun, so a major benefit of an indoor grow space is being able to choose your own lighting source. A huge variety of lighting types exist, which can be overwhelming. Lights will most likely be your biggest expenditure, so do your research online and ask other growers. Consider how much you can/want to invest, and get the best possible lighting setup you can. You'll want to strike a balance between your budget, the type of light(s) you choose, and their intensity.

Fluorescents

Fluorescent bulbs include most standard household bulbs and come in two basic styles: Compact Fluorescent Lights (CFLs) and tubes. Tubes range in length and configuration designations from T2 up to T38. Common fluorescent growing tubes are usually of the T5 variety. Fluorescents give off less heat than most other types of lights.

Pros:

- CFLs are the most widely available and least costly light source
- Don't require ballast
- Accommodate standard light sockets
- Low heat output

Cons:

- Wattage tends to be limited per bulb, so many bulbs can be needed
- Not ideal for flowering plants due to lack of intense red spectrum light

CFLs are easy on the budget and simple to set up. They are ideal for the seedling, clone, and vegetative stages.

LED (Light-Emitting Diode)

LEDs are gaining favor due to their affordability and reliability. Like fluorescents, LEDs are energy efficient and give off little heat. This can be good or bad depending on the outdoor climate your indoor grow room is located in. If you choose to go with LEDs, make sure they have switchable vegetative and flowering growing spectrums or cover a light spectrum

suitable to both growing stages.

Pros:

- Don't require ballasts
- Accommodate standard electrical outlets
- Dual spectrum available
- Low heat output

Cons:

- Can be expensive compared to similar-watt HID lights

LEDs provide a middle ground between CFLs and high-intensity discharge (HID) lamps in terms of performance and cost.

HID (High-Intensity Discharge)

High-intensity discharge (HID) lamps include metal halide (MH), high-pressure sodium (HPS), and dual spectrum (DS) varieties. They make up a family of lights with high performance and intensity for a moderate cost. Before the recent advances in and new applications of LEDs, HID lighting was the pinnacle for growers. It and is still used in the majority of indoor grows today.

Pros:

- High-intensity light best for growth and flowering
- Reasonable cost
- Proven performance

Cons:

- High heat output and energy cost
- Relatively more frequent replacement costs
- Need different lights for different stages: MH for vegetative and HPS for flowering (unless using DS)

Though typically requiring separate light setups for the vegetative and flowering stages, HID lights give the grower the best bang for their buck and have a history of producing high-quality cannabis indoors with the

greatest yield and potency.

Metal Halide (MH)

Metal Halide (MH) lights emit light in the cooler blue part of the spectrum, so they are ideal for the earlier stage of vegetative growth, producing stocky plants with strong stems, branches, and leaves. The downside to MH lights is that they should not be used by themselves as they don't emit enough red spectrum light to produce flowers and buds. Those choosing to go the MH route will need an additional light or lamp for the flowering stage. MH lights often have shorter lives than many other types of bulbs, requiring more frequent replacement and thus increasing costs.

High Pressure Sodium (HPS)

When MH lamps are used, HPS lamps often accompany them to provide the light from the warmer red part of the spectrum needed for flowering and the development of buds. HPS lights are energy vacuums and are the most expensive type of light to operate. Besides light, they also give off intense heat, so the surrounding air needs to be cooled or vented. Because of this, HPS lights may not be ideal for extra-small spaces where the heat from the lights can constitute a fire hazard. They also have a tendency to lose performance over their lifetimes, so factor in replacement costs as you plan your budget.

Dual Spectrum (DS)

Dual spectrum HIDs combine both the blue and red spectrums in a single lamp that can be used continuously in your grow, regardless of which stage of growth your plants are in, so you don't have to switch out bulbs when your plants transition from vegetative to flowering states. Though typically not as expensive as MH and HPS lamps purchased together, dual spectrum lamps can still be costly.

Supplemental Grow Lights

Some growers choose to supplement the primary lighting equipment in their grow space to add light or to change the light spectrum. Plasma-based lamps are a recent development and boast the full color spectrum, making them a good—but costly—option for a small indoor grow. Plasmas

don't quite meet the light intensity levels seen from MH or HPS lights but put out heat on a scale similar to HPS lights.

Another new and rather expensive alternative is the Ceramic Discharge Metal Halide (CDM) lamp. These bulbs are the next iteration of MH and use ceramic instead of quartz. They consume less energy than standard MH lamps and output a broader spectrum, though still not broad enough to replace your HPS lamps.

COST-EFFECTIVE LIGHTING

The goal of your light source is to mimic the sun and the natural light your plants would experience if they lived outdoors. Blue lighting represents the light spectrum seen in spring and summer, when plants use their energy to increase their biomass, and red lighting represents the spectrum seen in fall, when plants shift gears into focusing on their progeny through the flowering (reproductive) process. The amount of light you need inside your indoor grow is dictated by how many plants you are growing. Too much light can actually impede growth. You won't win any awards for your grow light being visible from outer space.

As previously mentioned, your lighting system will most likely be the biggest cost of your growing operation, so make sure it's an efficient use of your dollars and that light is going into the development of buds and not being wasted. Pruning and plant training can be major allies in this respect, giving you more bud per lumen of light. Here are a few tips to save on energy for lighting:

- Run your lights at night to help with maintaining climate control in the cooler nights.
- Inspect your plants with a head lamp instead of turning on your complete lighting apparatus.
- Use reflective materials on walls and partitions to maximize reflectivity and allow plants to capture all available lumens.
- Keep your lights as close to your plants as possible to maximize the lights' benefit and encourage faster development.
- Change lamps on an appropriate schedule to avoid the lower light intensities common in aging lamps.

The Right Amount of Light

Light provides the sustenance marijuana plants need to grow stems,

leaves, branches, and ultimately buds. Light is as critical to plants as food is to humans, and its effects are just as pronounced. The right amount of light will make happy, healthy plants that will grow into substantial harvests. Too much light can cause light burn and bleaching. It can also lead to nutrient toxicities, because as light is increased, so is a plant's water/nutrient uptake. Plants don't discriminate as to what their roots do or do not take in. If fertilizers or nutrients are present in the soil or nutrient media, too much light will make a plant take them in faster than it can use or relieve itself of those compounds.

Signs Your Plant Is Getting Too Much Light:

- Leaves curling up on the edges
- Tips of leaves curling up and yellowing or browning
- Yellowing of leaves, especially those closest to lights and at the top of plants
- Dry, crispy leaves

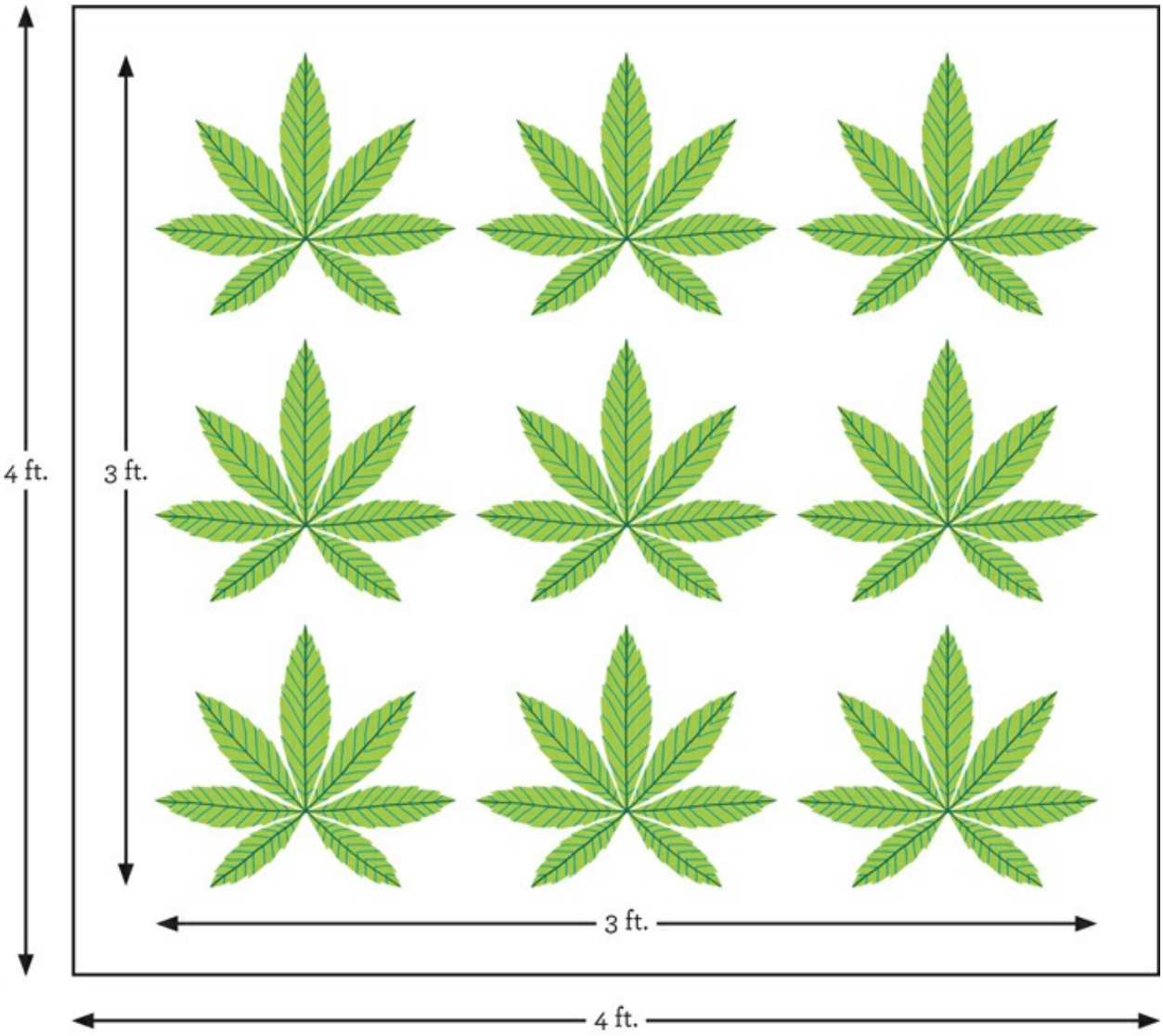
Signs Your Plant Isn't Getting Enough Light:

- Plants growing tall and spindly with increased distance between nodes (where leaves emerge from the stem)
- Anemic leaves (instead of deep, vibrant green)

- Plants leaning or stretching in an attempt to get more light

Determining Your Lighting Needs

Some rookie growers mistakenly use the full volume of their enclosure (length multiplied by width multiplied by height) when calculating the amount of light needed for their indoor grow. Although the volume, measured in cubic feet, is important when looking at ventilation, airflow, and circulation, the amount of light you need for your grow space isn't related to the volume of the space. Regardless of your choice of tent, closet, or room, you'll instead want to look at the area taken up by the canopy of your plants to determine your lighting needs. If you have a space that is four feet by four feet but your plants only take up three feet by three feet, you would base your lighting on the latter. As a rule of thumb, target 20 to 50 watts per square foot. Based on this, a canopy that is three feet by three feet would require a light source in the 180-to-450-watt range.



Aerial view of your indoor grow space targeting the canopy area for lighting

Measuring Light

Lumens are a measurement of light output and intensity. Lux is a measure of how much light is received by a surface, such as the leaves of your plant. An inexpensive lux meter can be a great tool in your arsenal to figure out exactly how much light your plants are getting. Your marijuana plants have different light-intensity needs over the course of their life cycle, as shown in this table:

GROWTH STAGE	OPTIMAL LUX RANGE

Seedling	4,000 to 7,000
Vegetative	10,000 to 50,000
Flowering	35,000 to 75,000

The easiest way to change the amount of lux your plants get is to change the light's vertical distance from the tops of your plants.

Distance from Lights to Plants

In general, position your lights as close to your plant tops as you can without causing any ill effects. Fluorescents and LEDs will generally allow for the closest positioning to plants—as little as a few inches away. The greater the output of light, the farther away you'll need to position your light relative to the plants. When it comes to HIDs, as a baseline, you'll want the tops of your plants no closer than 16 inches to a 1,000-watt unit and no closer than 10 inches to a 250-watt unit.

POWER REQUIREMENTS

To determine how much energy your lights will use, look at how many amps your lighting and other devices are rated for. Most standard outlets are on a 15-amp breaker and can support up to 1,400 watts. This could accommodate two 600-watt lights and a 200-watt fan, which is a lot for the size of most spaces we've been talking about. The key is to know how many outlets you have and to evenly distribute your power needs across multiple outlets. If you have any questions or start tripping breakers, it's always best to consult a licensed electrician.

FOR AVERAGE ENERGY COST PER DAY IN A SPECIFIC GROWTH STAGE, USE THE FOLLOWING FORMULA:

(Wattage of device/1,000) x (Number of hours used in growth stage per day) x (Cost per kWh)

For example, if you have a 600-watt light you run for 20 hours per day while in the vegetative stage and 12 hours per day during flowering, and the cost per kWh from your electricity provider is $0.15:

(600 watts/1,000) x (20 hrs/day) x ($0.15/kWh) = $1.80 per day for vegetative stage

(600 watts/1,000) x (12 hrs/day) x ($0.15/kWh) = $1.08 per day for flowering stage

FOR AVERAGE ENERGY COST PER DAY ACROSS THE ENTIRE GROW CYCLE, USE THE FOLLOWING FORMULA:

((Cost per day vegetative x number of days in vegetative stage) + (Cost per day flowering x number of days in flowering stage)) / Total number of days in cultivation

So, using the same example and assuming the typical 21 days of vegetative growth and 42 days in the flowering stage:

(($1.80/day x 21 days) + ($1.08/day x 42 days)) / 63 days = $1.32 per day for the entire grow process (and $83.16 total for one full grow cycle)

Good yields range from 0.5 to 1.0 grams of useable marijuana for every watt of lighting. In a perfect world, a 600-watt light would yield 600 grams, or roughly 21 ounces, of marijuana. That's a lot of weed for $83 in electricity costs.

Keeping It Lightproof

Not only is having the right amount and quality of light for your plants important, but so is ensuring uninterrupted hours of darkness. The dark period is similar to sleep for humans in that it is a time of rest and regeneration. By providing a period of darkness, we mimic a natural outdoor setting that supports plant growth and flower development.

When Light Leaks In

Any intrusion of light in what should be a period of darkness will confuse plants. Confused plants may turn hermaphroditic, a state in which they exhibit the sex traits of both male and female plants. The job of male plant parts is to pollinate female plants, which in turn produce seeds. But just like undetected males, hermies can ruin your crop in a heartbeat because most indoor growers are in it for sinsemilla, or high-quality, seedless buds. For this reason, indoor growers may purchase exclusively feminized seeds and/or perform periodic inspections and cull any plants exhibiting male traits. We'll talk about sexing of marijuana plants more in Step 9: The Care.

Testing for Light Leaks

There is no truly technical way to test for light leaks in a small grow operation. Before starting cultivation in your new grow space, turn off all lights and equipment within the grow area and turn on any lights just outside the grow area, using portable lamps if necessary. You need a light source outside the grow area to test if light is making its way in. If your grow area is big enough, have a friend seal you inside it to replicate what

plants will see in the dark period. Make a note of or use tape to tag any areas where light is coming in. Pay special attention around zippers, flaps, doors, seams, and penetrations into your growing space.

Dealing with Light Leaks

Repair or cover the identified areas in a way that doesn't compromise access. If mending the interior, think about using reflective or bright white tape to maintain the level of lighting intended versus, for example, black electrical tape that will absorb much of the light instead. Once modifications are complete, verify they were effective and no light is entering the growing space before you proceed with cultivation. If light interruption occurs during the grow cycle but is relatively short during the vegetative stage, you can probably get away with returning to the proper light schedule and monitoring for hermaphrodites (see Hermaphroditic Plants). If the light interruption was relatively long (more than two hours) during flowering, then plants may revert to the vegetative phase, so you'll want to identify any hermies ASAP and stay vigilant in case more appear. Plants that are stressed by any of these events, even if salvageable, will often produce significantly lower yields.

TAKEAWAYS & EQUIPMENT LIST

Look at you go! Another chapter under your belt. You'll be growing like an OG in no time. The section you just made it through is one of the drier parts of the book, so if you're still awake, great work.

In Step 3: The Light, we were exposed to the ins and outs of lighting a personal, indoor grow space, including:

- The basic components of grow lights: ballast, lamp, and reflector
- Different varieties of lamps and their pros and cons
- Tips to reduce energy consumption
- The right amount and quality of light for your operation

- The importance of lightproofing your growing space in order to maintain dark periods

SHOPPING LIST FOR LIGHTING YOUR GROW SPACE

- ☐ Apparatus to suspend and raise or lower light assembly as needed
- ☐ Head lamp to wear while inspecting and monitoring plants
- ☐ Lux meter to measure light received by plants
- ☐ Reflective or white tape
- ☐ Self-contained grow light of appropriate wattage or correctly sized ballast, lamp, and reflector that accommodate one another
- ☐ Tape measure to measure canopy and plants' distance from lights

Let's continue on with our green journey. In Step 4: The Environment, we'll talk in detail about monitoring and managing air supply so your babies will not just survive but thrive.

Step 4

The Environment

When we talk about the environment of your marijuana plants, we are primarily referring to the air quality and composition. Key parameters include temperature, humidity, ventilation, circulation, and CO_2 level. Most of these are critical to plant health and should be monitored regardless of the scale of the operation. Monitoring and correcting CO_2 levels can be more complicated than maintenance of the other parameters, and you might leave CO_2 levels to tackle only if there are observed issues with the performance of your grow.

Air Temperature

After determining the right lighting setup, the next step is to determine how much heat the lights will emit so you can set up the right air exchange to ensure the best indoor temperature for your plants. You'll need to replace hot, moist, stale, CO_2-depleted air with fresh, CO_2-rich air. All of this will be determined by the size of your grow space.

Cooling Needs

Marijuana plants require slightly different temperatures in different stages of the growth cycle. A temperature of 68°F to 78°F is generally a nice target range for beginners. Clones, seedlings, and vegetative plants do best at 75°F to 78°F, and flowering plants prefer it a little cooler at 68°F to 75°F. If you are limited on space or don't have the ability to partition your grow area, a consistent 74°F to 75°F throughout the various growth phases can still produce some fantastic buds. These temperatures are the maximum temperatures reached with lights on in the grow space. Air temperatures during dark periods should be no more than 15°F lower than what they are with the lights on. If your space cools off more than this, consider the use of supplemental heat. The use of supplemental CO_2 allows plants to respire more quickly, so if you're using supplemental CO_2, you can set the temperature in your grow space a few degrees higher.

Using Outside Air to Cool

Depending on what type of climate you live in and the time of year, you may be able to bring in outside air to ventilate your grow space directly. When outside air temperatures are in the 60°F to 80°F range and humidity is relatively low, you can use intake fans to bring in air directly from the outside without much need for correction. Much of the fall and spring across the United States provides ideal outside weather to feed into your grow space. In cooler climates, such as those of much of the midwestern and northern United States, you'll want to avoid bringing in very cold or moist air that will require heating and dehumidification to achieve the proper environment. In warmer climates, such that of the southwestern United States, you'll only be able to use outside air directly for part of the year, as the extreme temperatures will make your grow room space hotter than can be effectively cooled by A/C. If using unaltered outside air isn't an option, there are a variety of compact HVAC units that can adjust outside air to the perfect conditions, many of which can accommodate a small indoor growing operation. Bringing in conditioned air from another part of your home can be a good solution as well.

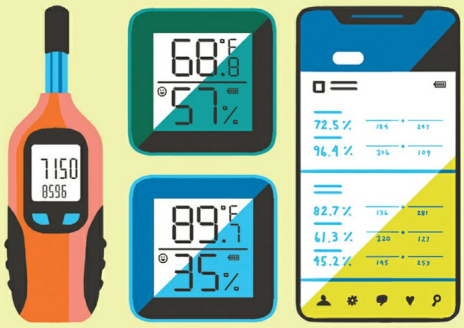
Using Fans to Cool

An alternative to bringing in outside air is removing hot, humid, CO_2-depleted air with exhaust fans. Be aware that the exhausted air will contain a strong odor from the grow room. Some growers choose to use activated charcoal or other means of ultrafine filtration to remove odors. This step is highly recommended, but its feasibility will depend on your budget.

Oscillating fans strategically placed within your grow space will help cool plants from the heat of grow lights. Consider the use of temperature-controlled fans that automatically turn on and off based on outside temperature fluctuations. When temperatures are warm, the fans turn on to move the air and cool the plants. When temperatures are cool, the fans turn off to allow heat to build in and around the plants under the grow lights.

MEASURING AIR TEMPERATURE

There are numerous instruments available for monitoring air temperature and humidity. You can use a handheld digital combination device that measures temperature and relative humidity in your grow room, such as the device below, or you can get more sophisticated technology that provides continuous readings, such as the app on the right in combination with monitoring devices.

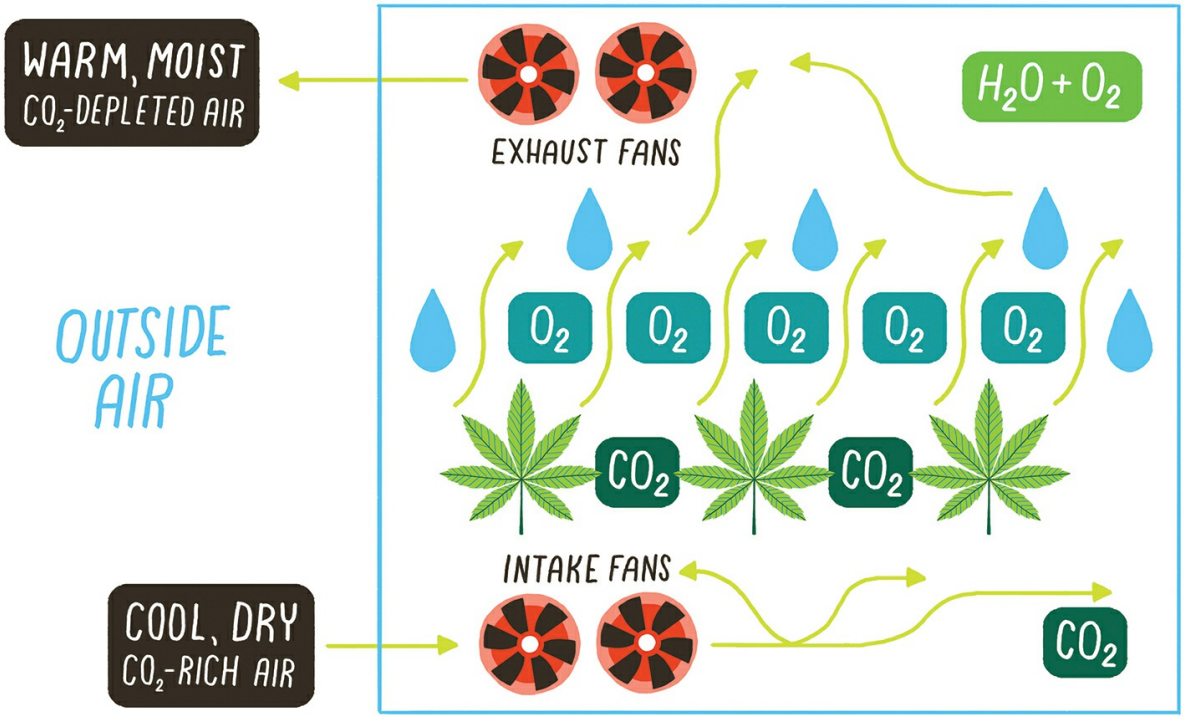


Many devices also have apps that provide real-time readings, trends, and alarms when a set point is exceeded. As much as you love your plants, you can't be with them 24/7, so remote monitoring capability can be a real benefit. You can also use smartphone apps to compare air conditions over an entire grow cycle or several cycles. Devices connected to apps even allow you to monitor and read conditions during dark periods, when you normally wouldn't be able to access the grow space

due to light infiltration.

Air Ventilation & Circulation

Proper air temperature and humidity are important but are only part of the recipe for a happy plant environment. Because fans only move existing air around, the basic goals of your grow room's air supply should be to bring in enough fresh air for the plants' needs and to exhaust spent air as quickly as possible while maintaining slightly negative air pressure.



Ventilation Needs

Ventilation is key for balancing the intake of fresh air and the removal of spent air. The general airflow in a grow space is shown in the illustration above. An intake system brings in cool, dry, CO_2 rich air. During the process of photosynthesis, plants convert water, light, and CO_2-into food and produce O_2 and water vapor. The spent air from your grow space will

be warm, moist, and O_2-rich. Ventilation challenges are typically solved through the use of intake and exhaust fans integrated into ductwork and controlled by a thermostat.

Circulation Needs

You'll also want to make sure your air is effectively circulated to minimize the impact of microclimates in your grow space, as some areas may be prone to either cooler or warmer air or to increased or decreased humidity. For example, closets underneath stairwells are notorious for collecting heat and humidity under the first few stairs, where height is limited. And in grow spaces that share an exterior wall, the plants closest to said wall may experience cooler, moister air conditions. It's important to evenly distribute the air in the room in order to provide a consistent growing climate and thus consistent growth, regardless of the exact position of a plant. A couple of household fans placed in a standard grow space will usually provide adequate circulation to stave off any ill effects.

Using Wall Fans

Oscillating fans create airflow inside a grow space with their side-to-side movement. Those in tight quarters may find wall-mounted oscillating fans to be a good solution for their needs. They have a small footprint, but they are unmovable. Wall-mounted fans typically provide decent circulation for the outer perimeter of plants but can have trouble pushing air through dense vegetation, especially when plants are fully developed and in the flowering stage. If using wall-mounted fans, opt for modular, clip, or track systems that allow the fans to be repositioned easily. Keep in mind that the purpose of fans is to mimic the wind outdoors. Avoid applying too much wind to any given plant or pointing fans directly at plants. Your goal is to create a nice, breezy environment, so position fans just below and above the main canopy to get the right amount of air rustling through your leaves.

Using Ductwork

You may need to use in-line air movers and ducts to bring air in and out of your grow space. What size air mover do you need, and what size

ductwork will it accommodate? You'll need to know your target cubic feet per minute (CFM), which is calculated by dividing the volume of your grow space in cubic feet by the number of minutes it takes to evacuate the air. A rule of thumb is to aim for full evacuation every three minutes and to size up your air mover by at least 25 percent to allow for future expansion.

So, if your space is three feet by four feet by five feet, then it contains 60 cubic feet of air. You'll need to move 20 cubic feet of air every minute, as 60 cubic feet divided by three minutes is 20 CFM.

But it's not that simple. This number is actually only what we call your Base CFM. Any light source, ducting, inline filters, elbows (bent ducting), or silencers (which reduce noise) added to your air system reduce the velocity of the moving air, requiring you to obtain an air mover with a higher CFM rating—which we call your CFM Need—to actually evacuate air from your space at the desired rate.

Assume your system has 1,000-watt HID lighting, 10 linear feet of ducting, two 90-degree elbows, a carbon filter, and a silencer. If, for example, the impact on air mover efficiencies (or resistance) of HID lighting is 10 percent for every 1,000 watts, 1 percent for every linear foot of ducting, 3 percent for every 90-degree elbow, and 20 percent for carbon filters or silencers, you would use the following equations to determine your CFM Need (the CFM rating of air mover you would need to accommodate your system):

Base CFM = (Length x width x height of room in ft.) / 3 min.

(3 ft. x 4 ft. x 5 ft.) / 3 min. = 20 Base CFM ($ft.^3$/min.)

CFM Need = Base CFM x (1 + resistance of device 1) x (1 + resistance of device 2) x (1 + resistance of device 3) and so on

20 Base CFM x (1 + .1) x (1 + (.01 x 10)) x (1 + (.03 x 2)) x (1 + .2) x (1 + .2) = about 37 CFM Need

If you want to ensure the system can scale up, say by 25 percent, multiply your CFM Need by 125 percent (which gives about 46 CFM in this example) to get your true Target CFM.

Target CFM = CFM Need x 1.25

37 CFM Need x 1.25 = about 46 Target CFM

Because fans are often rated in intervals of 5 CFM, we'd round up to the

next closest rating when purchasing an air mover, so a CFM rating of 50 for each of the intake and exhaust fans would be appropriate.

Airtight

You want your air system to be as sealed up as possible because gaps or leaks will make it have to work harder. When using ducting, fans, and filters, make sure all connections are fitted with appropriate airtight and lightproof collars and fasteners. Ensure any punctures in the ductwork and other connections are well taped with appropriate light-blocking material to prevent the leakage of air and the introduction of light into the grow space during dark periods. With your air system fully on, you should not be able to feel any movement of air while standing outside the grow space.

ALL ABOUT CO_2

CO_2 is a key requirement for plant growth. There is a relatively small amount of CO_2 in ambient outside air, so adding CO_2 artificially to your grow space may help. Up to a certain point, the more CO_2 that is available, the faster your plants can grow. In grow spaces with high light intensity, additional CO_2 allows plants to process more light than naturally possible, amounting to more and faster growth. Research shows CO_2 can increase growth by up to 25 percent in the vegetative state. This relationship is limited by the maximum amount of light a marijuana plant can process. CO_2 is normally present in the air at about 400 ppm, but plants can benefit from CO_2 levels up to 1,600 ppm. Supplemental CO_2 is typically dispersed inside the growing space during light times only, as photosynthesis ceases during dark periods and additional CO_2 could be harmful to humans entering the space. Supplemental CO_2 can be rather expensive, so you should determine your estimated usage and costs early in the planning process. CO_2 generators and compressed cylinders are the most common methods of introducing CO_2 into indoor operations. CO_2 should always be delivered at the topmost area of the grow space. Supplemental CO_2 is best suited for grow rooms that are hermetically sealed so air can't leak out.

Battling Humidity

Achieving the right humidity level is key to making happy plants and buds. Too little humidity will stunt growth and can lead to nutrient toxicities, and too much humidity can create issues with bud rot, powdery mildew, and other pests and diseases.

Humidity Needs

Plants adapt to the humidity level of their environment. When humidity is high, plants tell their roots to take up less water because their leaves will take in moisture from the air. When humidity is low, plants force their roots to take up more liquid from the soil. The ideal level of humidity depends, like many things, on the growth stage of the plant. In general, humidity needs are highest for seedlings and clones, then taper off throughout the plant's life cycle as it progresses through vegetative and flowering stages. During the seedling or clone stage, plants are focused on root development and require around 70 percent relative humidity (RH). (Relative humidity indicates what percentage of the air is saturated with water vapor.) Maintaining humidity at this level usually requires the use of plastic domes or similar accessories that create a small microclimate by trapping the moist air produced by the young plants around them. Once the plants transition to the vegetative state, the humidity should be lowered to 50 percent RH, the ideal level to build strong stems, leaves, and branches. As the plants proceed to flowering, you'll want to reduce humidity to 40 percent RH to force trichome and cannabinoid development in the buds (see Anatomy 101.) Trichomes contain cannabinoids like THC and CBD and represent the essence of the marijuana plant's properties.

This table shows the target humidity levels required for each growth phase:

Stage	**Seedling/Clone**	**Vegetative**	**Flowering**
Ideal RH	70 percent	50 percent	40 percent

Using a Dehumidifier

In most indoor grow rooms, humidity will naturally rise due to

evaporation from the plants. The challenge for the indoor grower after the seedling stage typically is to reduce humidity. This can be accomplished through the use of a dehumidifier, which pulls in air and removes the water vapor, returning dry air back to the grow area. Some dehumidifiers double as humidifiers, which can add moisture to the air, a helpful feature during the seedling/clone stage assuming seedlings and clones are in a space separate from vegetative or flowering plants. Dehumidifiers can be relatively loud and sometimes require you to run a condensate line or manually remove the captured water. If you pursue dehumidification, check out humidistat units that operate like thermostats, turning on automatically when humidity increases and turning off automatically when humidity falls.

TAKEAWAYS & EQUIPMENT LIST

All right! Another notch in your headboard.

Keep in mind, the ideal environmental conditions we discussed in this section of the book apply to any type of plant enclosure, whether they be grow tents, closets, or distinct rooms. It may be slightly more challenging to manage temperature and humidity in a grow tent because of the relatively thin material and impact of the environment outside the tent. That said, and with all things being equal, it is quicker and easier to manage air quality in a smaller space than in a larger one.

In Step 4: The Environment, we focused on air quality and condition, including:

- How to measure, monitor, and manage air temperature
- The ventilation and circulation of air inside your grow space
- The pros and cons of CO_2 addition
- The importance of proper humidity for your plants
- How to manage humidity in your operation

SHOPPING LIST FOR CONTROLLING TEMPERATURE & HUMIDITY IN YOUR GROW SPACE

- [ ] Air-temperature & relative-humidity monitor
- [ ] CO_2 gas cylinder or generator (optional)
- [ ] CO_2 monitor (optional)
- [ ] Dehumidifier and/or humidifier
- [ ] Ductwork with light-blocking accessories
- [ ] Exhaust fan
- [ ] Intake fan
- [ ] Oscillating fan—floor or wall mount

In Step 5, we'll don our tool belts and start putting together what we've learned to set up your physical grow space.

Step 5
The Build-Out

At this point, you've learned all the fundamentals of setting up a grow space. You should have a solid plan for which type of enclosure you'll use to house your plants and what lighting, ventilation, and accessories will make up the basic infrastructure of your indoor grow. In this section, we'll talk about constructing and outfitting your grow space. If you feel uncomfortable with any of the tasks described here or if permitting is required, consult a licensed contractor.

Time to Construct Your Space

First, you need to decide whether you are using an existing room or closet, a grow tent, or creating a room within an existing space. Here's what to know when starting each of these build-outs:

A Room within a Room

The room within a room approach is the most energy intensive of the options during the build-out period. It requires building walls or partitions, installing ductwork and fans for ventilation, running electricity to power everything, and installing lights.

Construction/Framing: If you want your grow space to last for several

years, consider spending a little more for quality materials and craftsmanship. Because the grow space is part of your home, you'll most likely want to continue with the same basic level of construction and aesthetics, which for many homes means wooden wall frames covered with drywall and painted or otherwise sealed. Setting walls properly requires experience, so lean on a qualified friend or utilize a contractor if this is new to you. The last thing you want is a wall to fall in on your plants. You'll need to put a cap on your grow space to seal it from the outside. Think about using an appropriate surface for the ceiling, such as fiber reinforced plastic (FRP), that can seal and will be easy to maintain and keep clean. You'll want to seal around the area between the floor and wall with silicone or caulk as well so there are no gaps. If money is limited, many growers have had success with reflective plastic sheeting for walls. Although plastic walls are not the best looking and are prone to cleaning and maintenance issues, they can be effective and are cheap to repair and replace.

Circulation/Ventilation: Lay out exactly where your air movers will go and determine the specific path for the ducting. As discussed in Step 4: The Environment under Using Ductwork, you'll want to have calculated the length of ductwork and rating of air mover required. This is the stage where holes may need to be cut out of walls for the airflow system. Measure twice and cut once, making sure to create holes prior to installing wall coverings. As a general rule, make your runs as short and straight as possible. Ensure ductwork installation features lightproof collars and accessories, and tape over any holes with Mylar or black electrical tape.

Electrical: This is the most dangerous part of the build-out. We recommend consulting a licensed electrician to ensure you have adequate, reliable power that won't create a hazard. You can calculate the power you need by adding up the wattage requirements of all of your devices as discussed in Step 3: The Light under Power Requirements.

Lighting: Lighting needs to be vertically adjustable so you can tweak the distance as the plants grow. For this reason, most lighting systems put lights on some type of assembly that can be raised and lowered via a pulley system. Your lighting apparatus could be of considerable weight,

so make sure you anchor it appropriately to the rafters or another integral supporting structure. If your lighting system doesn't come equipped with a pulley system, you may have to get creative in designing one for your space. A variety of after-market solutions exist to help novice growers suspend their grow lights.

Material List:

The following list is general and not all-inclusive. You may require other items depending on your chosen space and design:

- Drywall, FRP, or other wall covering
- Electrical connectors
- Electrical junction boxes
- Electrical wire
- HVAC ducting with lightproof accessories
- Outlets
- Paint, epoxy, or sealant for wall covering
- Plastic sheeting
- Pulley system for lights
- Silicone caulk
- Stainless steel metal screws for ducts and ventilation
- Tape to install sheeting or seal things up
- Two-inch-by-four-inch wooden construction studs or metal studs
- Wood screws

A Closet/Space Bucket

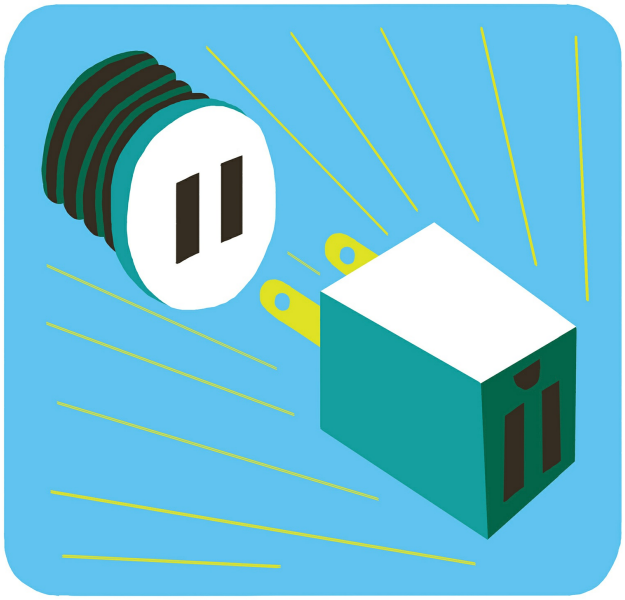
If you are trying to grow on the cheap, taking over an existing closet or fashioning your very own "space bucket" are options to look at.

A typical space bucket

Construction/Framing: Closets will usually be ready to use once you apply a suitable wall covering. Space buckets are a type of do-it-yourself mini grow space you can create from five-gallon plastic buckets, inexpensive fans, and CFLs. If you remember back to Step 3: The Light, CFLs are Compact Fluorescent Lights. They use little energy and put out little heat, so they are perfect for the small environment of a space bucket. You will typically use multiple buckets, some to create layers that handle drainage of soil, one main bucket to house the plant, and a top or lid to hold the lighting. Many open-source designs for space buckets are available on the internet.

Circulation/Ventilation: If using a closet with standard HVAC, you'll want to remove the register or damper and seal the hole up with plastic, Mylar, or reflective tape. Your operation is sensitive to environmental changes, so you want to be able to control the temperature inside the closet independently of your home's thermostat. You may need to cut a hole in a closet wall to effectively ventilate the grow room area. An option to consider in lieu of making holes in the walls is attaching ductwork to the access door with just enough slack to open the door as needed. This will reduce the effective air movement, so make sure your air movers are

sized accordingly. For a space bucket, cutting a hole in the bucket and attaching a fan should be adequate for the small amount of space being ventilated and circulated.



A standard light-socket-to-plug adapter with two-prong-to-three-prong adapter

Electrical: Closets often have an existing outlet inside them or one near enough to run an extension cord from. Be careful if you attempt to run an outlet from the closet light itself, as this will usually be limited in capacity. A typical device is shown above. These are often neither properly grounded nor able to accommodate grounded (three-prong) plugs, so be aware of the increased risk of electrical shock and blowing fuses.

Space buckets are usually powered by a single electrical outlet strip attached to the side of the bucket that provides enough juice for all of the devices being used, including fans, lights, or pumps.

Lighting: For a closet setup, you'll want to arrange a pulley system to adjust the height of lights, and you'll need to have enough power to run your lights, just as with the room within a room. Closets often have a top shelf under which you can suspend lights or an oscillating fan. Check the sturdiness of your light setup with the light in the lowest position, as this causes the most stress on the apparatus. For a space bucket, you'll typically use four to six 23-watt CFLs with a broad spectrum for vegetative and flowering plants. Affix the appropriate number of sockets

to the top of the space bucket, and attach a plug end in order to plug the lights into the electrical strip. Even though this is just a modified bucket, electricity can be hazardous, so enlist the help of a licensed contractor or an experienced friend.

Material List:

The following list is general and not all-inclusive. You may require other items depending on your chosen space and design:

For a closet: See Room within a Room Material List here

For a space bucket:

- 12-volt power supply for fans
- Automated timer for lights
- E23 sockets, same number as CFL bulbs used
- Electrical strip
- Electrical tape
- Extension cord
- Four to six 23-watt CFL bulbs
- Mylar or reflective tape
- Three or more five-gallon buckets
- Two computer fans

A Tent

Tents are the simplest to set up and the most "off the shelf" of the room enclosure options. The major benefit of tents and their related gear is that they provide self-contained grow spaces that require relatively less thought and ingenuity to build out than rooms, closets, and space buckets.

Construction/Framing: Tents typically use pole systems as frames to provide structure and rigidity. The grower pulls or sets the tent fabric around the frame. Be careful not to rip or puncture the tent during the initial setup process.

Circulation/Ventilation: Most grow tents have zippered ports at the

bottom and top for intake and exhaust purposes. Most manufacturers also offer fans that integrate with the frame of the tent. A small oscillating fan can usually be clipped onto the pole frame system to ensure adequate airflow and circulation within the tent.

Electrical: You can calculate your power need by adding up the wattage requirements of all of your devices as discussed in Step 3: The Light under Power Requirements. The average grow tent can be powered by one or two standard home electrical outlets, assuming they are on separate breakers; this may or may not be true of your specific grow tent depending on how many accessories you've added.

Lighting: Most grow tents are outfitted with a top bar to suspend the lighting apparatus from. Many tents also come equipped with a pulley system to adjust the vertical height of the lights. Depending on the size of your tent, a 400- to 600-watt lighting system is usually all you'll need.

Material List:

The following list is much of what you'll need. You may require other items depending on your chosen grow tent:

- Automated timer
- Ducting, as required
- Electrical strip
- Exhaust fan
- Extension cords
- Grow tent material and structural supports
- Intake fan
- Mylar or reflective tape
- Oscillating fan, depending on size of tent
- Pulley system for lights

THE COLLECTION RACK

BENEFITS OF A COLLECTION RACK

A collection rack can provide you with better ergonomics in your grow space, helping you avoid stooping over your plants on the floor for long periods of time. It can also allow you to separate plants in different stages of growth, as seen in the illustration to the right. But its main benefit is that water runoff, leaves, and plant debris collect on the floor of the collection rack instead of the floor of your grow space, keeping the space clean and sanitary.

HOW TO BUILD A COLLECTION RACK

Growers use a rule of thumb that a collection rack should take up no more than 75

percent of the horizontal growing area in a grow room so that there is space to move around. For example, if your grow space is 20 square feet large, then, according to this rule of thumb, your collection rack should take up no more than 75 percent of 20 square feet, or 15 square feet of horizontal growing area. For that size, a collection rack that is 3½ feet by 4¼ feet (for a total of about 15 square feet) might work nicely.

You should also allow at least six inches of vertical space between the top of the collection rack and the grow space ceiling for cords, ducting, and the pulley system. Also, set the bottom layer of your collection rack at least six inches from the ground for inspection and cleaning. If you opt for casters, make sure they can accommodate the maximum expected weight of fully grown plants and lights.

Once you've determined the ideal dimensions and number of layers for your collection rack, you can get to work constructing it. (A variety of manufactured carts can be easily outfitted if you'd rather not create the rack itself.) PVC pipe is an ideal material for a collection rack. It only requires a hacksaw and glue to work with, is easy to clean, and can keep electrical cords neatly contained. PVC board makes great shelving but needs to be supported by PVC pipe or a metal frame to hold weight evenly.

Basic Setup Safety

As you set everything up, here are a few things to keep in mind:

- Isolate grow light heat

Your grow lights will get very hot to the touch and can cause fires if left too close to flammable materials.

- Separate electricity and water

Water and electricity do not mix. Keep electrical cords off the ground in case of standing water.

- Check wiring and installation

Make sure your wiring and extension cords are properly insulated and that connections don't show bare wire. Ensure power is off prior to any electrical work.

- Keep things neat and tidy (especially wiring)

The tidier your craftsmanship, the easier it will be to maintain. Route wires appropriately and use hangers periodically as necessary.

- Read all safety information

Yeah, it can be a drag to read all those manuals for your lights, ventilation, and other equipment, but it is highly recommended to get the most out of and protect your investment.

- Install a fire extinguisher

Keep a fire extinguisher in your grow space just in case.

- Secure all weight

Your lighting apparatus may have considerable weight, so ensure your pulley system can accommodate it. Don't position yourself directly under your lights in case they ever become unsecured.

- Clean the floors

Keep the floor clean and free of debris. A cluttered area can cause slips, trips, and falls.

TAKEAWAYS & EQUIPMENT LIST

Great job making it through another step! You're on your way to marijuana freedom!

In Step 5: The Build-Out, we discussed:

- How to construct your grow space
- Tips for building each type of plant enclosure, with a focus on construction & framing, circulation & ventilation, electricity, and lighting
- The benefits and construction of collection racks
- Basic safety for your grow room setup

SHOPPING LISTS FOR BUILD-OUTS BASED ON ENCLOSURE TYPE

Room within a Room

- [ ] Automated timer
- [ ] Drywall, FRP, or other wall covering
- [ ] Electrical connectors
- [ ] Electrical junction boxes
- [ ] Electrical wire
- [ ] HVAC ducting with lightproof accessories
- [ ] Outlets
- [ ] Paint, epoxy, or sealant for wall covering
- [ ] Plastic sheeting
- [ ] Pulley system for lights
- [ ] Silicone caulk
- [ ] Stainless steel metal screws for ducts and ventilation
- [ ] Tape to install sheeting or seal things up
- [ ] Two-inch-by-four-inch wooden construction studs or metal studs
- [ ] Wood screws

Space Bucket

- [ ] 12-volt power supply for fans
- [ ] Automated timer for lights
- [ ] E23 sockets, same number as CFL bulbs used
- [ ] Electrical strip
- [ ] Electrical tape
- [ ] Extension cord
- [ ] Four to six 23-watt CFL bulbs
- [ ] Mylar or reflective tape
- [ ] Three or more five-gallon buckets
- [ ] Two computer fans

Grow Tent

- [ ] Automated timer
- [ ] Ducting as required
- [ ] Electrical strip

- [ ] Exhaust fan
- [ ] Extension cords
- [ ] Grow tent material and structural supports
- [ ] Intake fan
- [ ] Mylar or reflective tape
- [ ] Oscillating fan, depending on size of tent
- [ ] Pulley system for lights

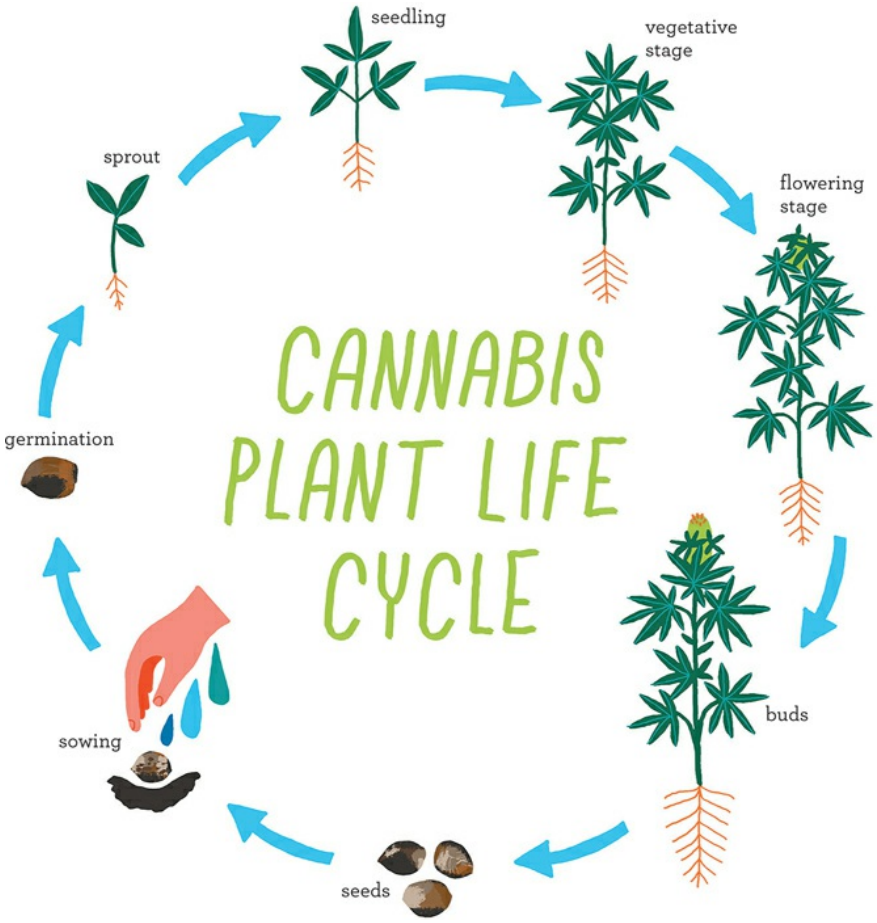
In the next step, we'll learn all about the magic kernels of life that make the process of growing the amazing marijuana plant possible.

Step 6
The Seeds

In this section, we'll delve into the exciting world of seeds, those hardy capsules that are the predecessors of life for the plant world, including cannabis species. We'll discuss the role of seeds, the life cycle of the marijuana plant, how to pick a marijuana strain, types of seeds, and how to acquire them. Marijuana seeds can be a complicated topic for the beginner, but we'll help you figure out the best type of seeds for your grow.

The Marijuana Life Cycle

Here we're going to cover the basics of the marijuana plant life cycle. (What to do in each phase will come later.) As a reminder, here's the cycle we outlined in Anatomy 101.



Seeds

Marijuana plants begin with a seed or a clone. Seeds contain all the genetic material that defines how the plant will grow and the specific traits exhibited by that variety, or strain, of marijuana. Seeds should be brown and hard. They often have distinct patterns, such as the ones shown in the illustration to the right. Seeds that are rubbery in texture or white or light green in color are not fully developed and will most likely not germinate. Germination is the process of the seed coming alive and the baby seedling inside breaking through. This can take anywhere from a few days to as many as 12 days. Specific instructions for germinating seeds will be covered later in Step 7: The Germination.

Much of the success of your indoor grow will depend on the selection of the right seeds. A seed's genes can have as much to do with yield and potency as do the tender loving care you give it and the optimal conditions you provide.

When a seedling first emerges, it has one set of rounded leaves known as the cotyledon. These leaves will fall off later in the plant's life. Once the germinated sprout is comfortable in growing media, it will send down its main root, called a taproot. The young seedling will start to grow vertically and produce its first set of true leaves, which have the distinctive serrated edges of the marijuana plant.

Shoots and Leaves

About 10 days after sprouting, your plants are considered true seedlings. They will develop a strong root system before shifting energy into production of stems and leaves. After a couple weeks as seedlings, the plants will transition to the vegetative stage. During the vegetative stage, they will focus on growing strong leaves, stems, and branches. After all, something has to support all those huge buds you're going to help bring to life! The vegetative stage will last anywhere from two to eight weeks or

more depending on your seeds' genetics. We'll cover how to care for your plants in the vegetative stage in Step 9: The Care.

The first true serrated leaves of the young seedlings will be singular. Additional nodes will produce sequentially greater numbers of blades per leaf, typically 3 blades, then 5 blades, and ultimately 7 to 13. The seven-bladed marijuana leaf is the classic icon of marijuana culture.

Flowers

Cannabis is considered an annual, meaning it completes its life cycle during one growing season. When cannabis grows naturally outside, the approaching autumnal equinox signals to the plant that the days are getting shorter and it is time to flower before winter conditions set in. We mimic this signal indoors by adjusting the grow space's light schedule to 12 hours of light and 12 hours of dark once plants complete the vegetative stage. As mentioned earlier in this book, marijuana plants are either male or female, and it's during pre-flowering or flowering that structures first

appear allowing you to determine the sex of your plants. The illustration below on the left shows a female with characteristic thin white stigmas, and the illustration on the right shows a cluster of pollen sacs on a male plant (specific guidance for sexing plants will be discussed in Step 10: The Maintenance).

If you opt for autoflowering seeds, you don't need to worry about sexing or forcing flowering via a light schedule. Autoflowering seeds are a type of feminized seed that will flower after a short vegetative stage independent of light and dark periods.

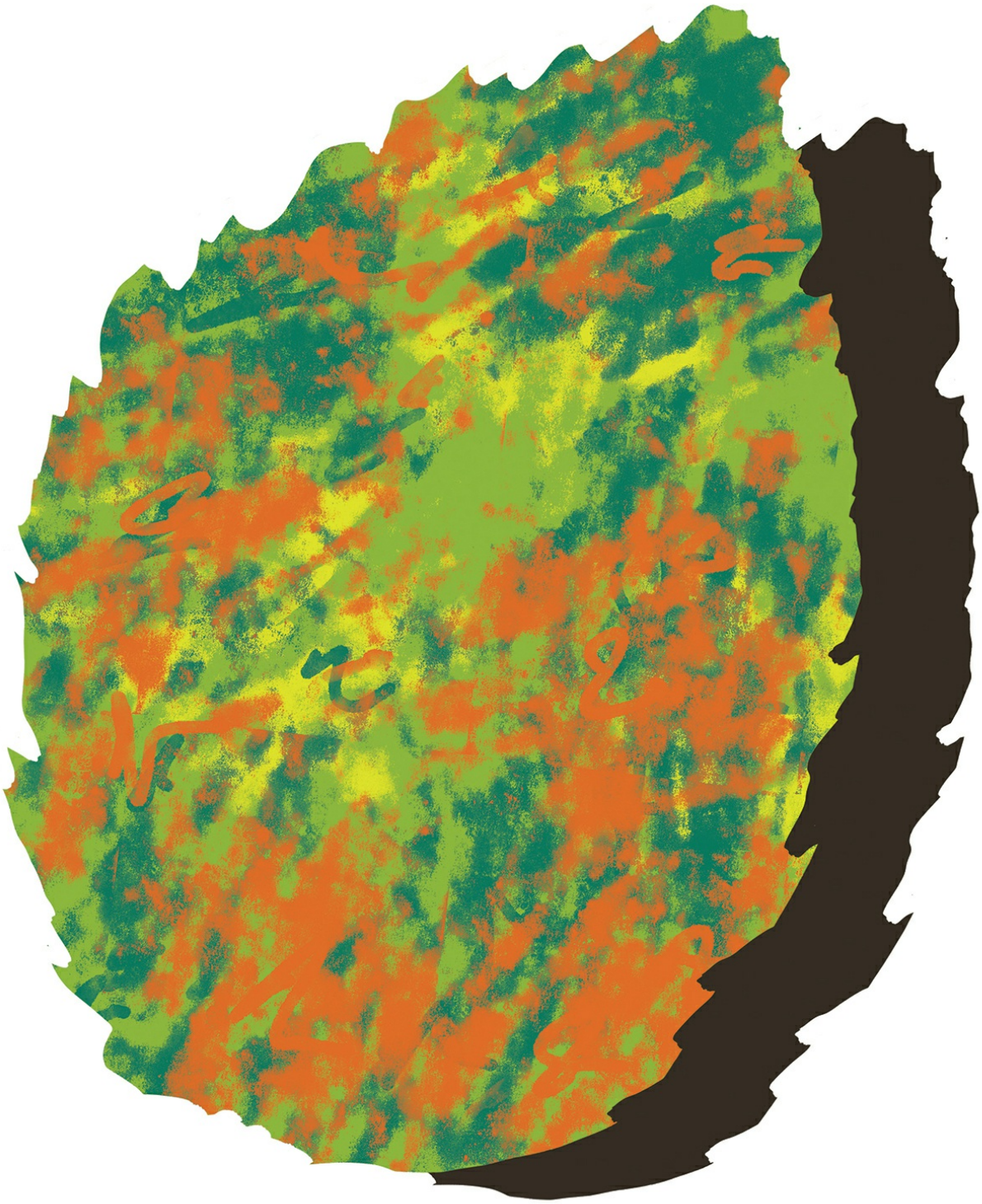
Buds

Example of a cola

Marijuana buds are the finished, fully developed form of marijuana flowers that grow throughout the flowering stage. Buds contain high concentrations of cannabinoids and terpenes. Terpenes are compounds found in cannabis plants that give strains their particular aromas, flavors, and medicinal benefits. In finished marijuana flowers, terpenes can degrade, causing a significant reduction in flavor, aroma, and effect. Cannabinoids are substances found in cannabis like THC, CBD, and CBN that can help with sedation, mitigating pain, and reducing seizures. During the flowering phase, THC, CBD, and other cannabinoid concentrations increase in the developing trichomes of the plant, producing the signature sticky resin that is the intended output of your indoor grow. Trichomes are tiny, gel-like structures found on leaves and buds that are the heart of the plant's machinery for cannabinoid

production. When we say bud is sticky or sugary, we're referring to resin composed of the trichomes.

The top, central bud of the plant is known as a cola and can often contain 50 percent or more of the useable bud the plant produces. Buds, now covered in trichomes, will grow very thickly and fill in a dense pattern. Trichomes are sensitive and easily degraded by heat, light, and air, which impacts potency and terpene content. This is why great care should be taken during harvest, processing, and storage of marijuana buds in order to maintain their quality and potency.



A sample of manicured sinsemilla or seedless bud

Marijuana Strains

Long before the modern age of marijuana breeding, there existed only three main subspecies of cannabis: indica, sativa, and ruderalis. For the last several decades, breeders have crossbred these plants to create over 1,000 hybrids. Indica, sativa, and hybrids are the most common strains you'll see today. Ruderalis is weak in potency and is only utilized to make the resulting autoflowering hybrids.

Heirloom strains were the "big bang" of the world of marijuana strains. In the late 1960s and 1970s, breeders took potent "heirloom" strains (the result of breeding plants that share a parent to produce a homogenous line in which all seeds grown largely share the same characteristics as the parent plant) such as Durban Poison and Colombian Gold and crossed them with Mexican and Jamaican strains. The goal was to produce a variety with high potency that also finished flowering in time to harvest before winter set in. (Prior to 1970, the vast majority of weed sold in the United States was grown outdoors.) Since then, a multitude of hybrids have been produced, creating a world of options for the indoor grower. Some hybrids have been developed with ease of cultivation in mind, and others have positive qualities such as anti-inflammatory properties or the perfect odors and flavors.

Ruderalis

The ruderalis strain originated in Central Asia and Russia and evolved to live in colder climates with limited sunlight. Ruderalis plants are considered autoflowering because they automatically flower once they go through a relatively short vegetative stage independent of light periods. Ruderalis plants are the original source of all autoflowering seeds, which are merely hybrids of ruderalis.

Indica

Indica plants are typically shorter and squatter, reaching heights of four to eight feet with a woody stalk and broad leaves. They have shorter flowering periods than sativa. Indica plants originated in the Middle East. They are thought to produce more relaxing, slowing, or sedating effects

than sativa. They also take longer to grow and produce less bud than sativa. This is a major driving force of the recent hybridization trend. Though exceptions exist, flowers from indica plants tend to smell earthier and more organic.

Sativa

Sativa is the tallest and slimmest of the strains. Sativa plants can grow to 12 feet or greater in height and tend to have relatively larger spaces between nodes and a fibrous stalk. Their leaves have longer, thinner blades that come to a sharp point. Sativa plants originated in the warmer climates surrounding Central and Southeast Asia and can have flowering periods lasting several months. Sativa is believed to have more energizing and uplifting effects than indica. It also tends to smell and taste more spicy, fragrant, or fruity.

Hybrid

Hybrid strains are crosses of parent plants, often indica and sativa varieties, bred with the goal of capturing the best properties of both parents. Hybrids can be 1:1 sativa to indica, sativa-dominant, or indica-dominant. You might sometimes see a hybrid with a dominant strain listed as something like "70/30 sativa/indica." The more than 1,000 hybrid strains developed over the years have mostly been bred in an attempt to combine the "mind" high common to sativa with the "body" high of indica. This combination is ideal for medicinal and daily users who want the mental benefits of marijuana without the urge to pass out in the middle of the day or the feeling that they are glued to the couch. Breeders have taken this pursuit a step further by including terpenes as additional traits. Terpenes primarily affect things like flavor and aroma, but they can also have direct medicinal effects, such as the sedating effects of the terpene myrcene. Indica plants, by definition, contain more than half of 1 percent myrcene. If a plant's myrcene level is less than half of 1 percent, it is classified as a sativa.

If you're still unsure of what varieties to try in your grow, start out with autoflowering seeds of some of the classics, such as Green Crack, Durban Poison, Blue Cheese, and OG Kush. These and many other varieties have

decades of proven success in indoor grow operations.

PICKING A STRAIN

HERE'S WHAT TO LOOK FOR WHEN YOU'RE PICKING A STRAIN:

Hardiness: The strain selection process should start with plant hardiness. In general, seeds optimized for indoor grows are less hardy than their outdoor counterparts, but there's a silver lining for indoor growers: Genetic enhancement of outdoor varieties focuses on resistance to weather changes, pests, and varying conditions, but indoor varieties don't need to combat these factors and can therefore be optimized for more important aspects such as yield, potency, or blend of terpenes. Indoor varieties also often have cola structures that facilitate evenly dispersed airflow and prevent internal mold growth.

Size: The next consideration is size. Different strains have different expected growth rates and maximum plant sizes. However, most plants, outside of autoflowering varieties, can be trained and pruned to dictate their exact size and shape regardless of their natural tendency. This can also have a major impact on yield, manipulating the plants to put their energy into growing buds and colas instead of stems, leaves, and branches.

Ease of cultivation: Your goal is to get the maximum amount of bud from the smallest operational footprint. So make sure your seeds are optimized for indoor growth. Take into consideration the time you have to put into your grow. You may prefer feminized or autoflowering seeds so you don't have to determine sex and cull males or induce flowering by changing photoperiods.

Yield: Certain strains have a higher yield of flowering parts per harvested plant. Here again, careful pruning and plant training can typically overcome any genetic predispositions. That said, the closer the seed genetics match your desired traits, the better your ability to manipulate the plant in the way you want. All things equal, larger plants tend to produce larger yields. But remember, the strain you select must balance this characteristic with the limited floor space available in your grow space. Yield can also be affected by the plant shape of the type of marijuana selected. Indica plants are often shorter and squatter in configuration than taller, more sparsely filled out sativas.

Potency: Besides big yields, the main goal you should be aiming for with your bud is high potency, or high effect on the end user. The more potent the material, the less is needed. You should be aware that THC concentration is not the only factor to consider here. Terpenes, as mentioned here, are compounds found in cannabis plants that give strains their particular aromas and flavors. These compounds can also work with cannabinoids like THC and CBD in what is called the "entourage" effect, which can enhance their potency. Some people may prefer very high THC, and others may prefer a more moderate level of THC coupled with a terpene such as myrcene, which can mimic a tranquilizer. Higher potency is generally sought after but not always what a given individual wants in terms of a therapeutic effect. You want your crop to match your specific motivation and preferences so you get the best return on the blood, sweat, and tears put into your operation.

Types of Seeds

There are three basic types of seeds: regular, feminized, and autoflowering. These names refer to the sexing and initiation of flowering of the resulting plants, independent of the particular strain you pick. The type of seed you choose will have a big impact on how long it takes to go from seed germination to harvest and how much work you'll have to do in between. Autoflowering seeds require the least amount of work and get the fastest results compared to feminized or regular seeds.

Regular Seeds

In olden times, a grower would sow seeds, determine the sex once visible, remove the males, and focus their energy on inducing flowering in the remaining females. Periodically they would intentionally let their crop be pollinated and "go to seed" in order to collect and harvest the seed for future sowing and to purify the genetic line. The seeds harvested from this process are regular seeds. Advances in genetics and breeding have streamlined this process and eased the burden on cultivators.

Feminized Seeds

Cannabis is dioecious, meaning a given plant will have either male or female reproductive machinery but not both. Feminized seeds are treated to exclusively grow into females so the need for sexing and the culling of males is eliminated. Amateurs and experts alike now have access to feminized and autoflowering seed varieties that take much of the guesswork out of growing marijuana.

Autoflowering Seeds

Certain types of feminized seeds are autoflowering, which means they have short vegetative stages and quickly shift to the flowering stage, often just a few weeks after germination. These seeds come from hybrids of ruderalis (here). They can be ideal for the indoor grower looking for short harvest cycles and maximization of bud yields. Autoflowering seeds

are highly recommended for first-time growers. Because autoflowering seed varieties are also feminized, there is no need for sexing or the culling of males.

How to Get Seeds

Instead of planting those seeds from that friend of your brother and seeing what you get, select the optimal seed strain based on your specific growing conditions and desired effects. Getting seeds can be inconvenient or expensive or both, but it's worth it to get your desired effect in the end.

How to Pick Good Seeds from Bud

Most commercial marijuana is "sinsemilla," or seedless, so seeds are hard to find by design, especially feminized or autoflowering seeds. If you get a hold of some schwag weed with seeds in it or you let your own crop go to seed, you can easily separate the seeds from the useable material. Even if the weed you take the seeds from isn't that great, remember that quality stems as much from how you care for your plants and handle them after harvest as it does from the genetic strain. Oftentimes, marijuana purchased on the black market may have better genetics than you would think based on the apparent quality of the weed. On the other hand, even an award-winning strain, if not cared for and handled properly, will produce poor-quality buds.

Where to Buy

The best way to obtain seeds is to get them for free from a fellow grower or your own crop. After your first harvest of seedless buds, consider letting the next batch go to seed. If you can sacrifice a full grow cycle to focus on seeds, it may help you in the long run. And even though the bud of a crop that's been pollinated will be of lesser quality and potency, you'll still get useable material from it.

If you need to purchase seeds, be warned that they can be very expensive. You might spend anywhere from $2 to $20 per individual seed, so shop around before you make a decision. There are a plethora of high-

quality seed suppliers no more than a Google search away.

Dispensaries, trade associations, and marijuana co-ops often sell seeds directly or can assist in sourcing your perfect strain as well.

What to Look For

Keep an eye out for older seeds that have been sitting around for a long time or that look like they probably won't germinate properly. You want to focus your energy on propagating seeds with a good chance of success.

If you find seeds with these signs, separate or discard them:

- White or light-green color, or small, malformed shape (these seeds often will not germinate)
- Brittleness; giving or cracking under moderate pressure (these seeds are most likely dehydrated due to age or storage conditions)
- Damage, such as cracks or punctures (which will usually prevent these seeds from germinating or developing correctly if they do germinate)

TAKEAWAYS

Kudos to you. You've made it over halfway through this book! You'll be smoking doobies and enjoying edibles with family and friends in no time.

In Step 6: The Seeds, we learned all about seeds, including:

- How seeds fit into the marijuana plant's life cycle
- The different historical cannabis subspecies and hybrid strains
- The factors to consider when picking a strain
- The different types of seeds
- How and where to get seeds

The type of plant enclosure you choose has little to do with your seed selection. All you need to select the right seed is the knowledge you just gained in this chapter. We'll go over the items you need to care for

germinating seeds in the next chapter, but you can put away your wallet now, as most, if not all, will be common household items. You'll probably spend a pretty penny on seeds, so try to use items already available to you to care for germinating seeds whenever possible.

In the next section, we'll discuss everything you ever wanted to know about the germination process, including how to sprout your seeds, which growing media to use, and how many of the little ones you should "pop."

Step 7

The Germination

Germination is one of nature's miracles and signals the beginning of your marijuana garden. Once you start the germination process, you are making a commitment to a new batch of plants, so make sure your space, your infrastructure, and *you* are ready. Exactly how your marijuana plants fare over the course of their lifetimes will be determined by the success of your germination process. Plants that get off to a rough start will likely never catch up to their peers. It's important the germination process go smoothly to produce healthy and productive plants in the shortest amount of time possible.

How to Sprout Seeds

Sprouting or "popping" your seeds is the first step of the germination process. Getting a seed to sprout can be an easy and fun activity. After all, it happens naturally in the wild without any humans trying to help. Seeds only need moisture, warmth, and darkness in order to sprout. No matter which sprouting method you choose, make sure to never let sprouted seeds dry up. Keep in mind that sprouting will not go perfectly for all seeds. If you achieve 90 percent germination, you are doing well. Let's briefly discuss each of the three basic methods for sprouting seeds:

Paper Towel Method

The paper towel method is tried and true. I often sprouted seeds under my bed when I first started growing marijuana. Occasionally, in or around my bedroom, an earthy, almost musty smell would hit me. I considered it the smell of new life. The smell of hope. Ah, the joys and freedom of marijuana cultivation. But I digress . . .

For the paper towel method, you'll need the following items:

- 4 standard-size paper towels
- 2 cups distilled water
- 2 disposable plates
- Tape or rubber bands

Make sure your hands are clean, and use disposable gloves if available. To start, completely saturate four paper towels with the distilled water. They should be fully saturated but not dripping wet. Stack two of the saturated paper towels on one of the plates. Arrange your seeds so they are all an inch apart, and place them directly on top of the saturated paper towels on the plate. Put the other two saturated paper towels on top of the seeds, and gently press down so the paper towels above and below create a seal with the moisture. Put the other plate on top, upside down, and secure the plates together with rubber bands or tape. The plates should touch around the rims and not let any light inside. Leave this contraption in a warm, dark place, such as under a bed or near a heat vent. Check your seeds every 10 to 12 hours, making sure the paper towels stay wet throughout. In low-humidity climates, the paper towels may need to be rehydrated with distilled water every few days to prevent them from drying out. Seeds can take up to 12 days to sprout, so be patient.

Once they have sprouted, you can wait a day or two to transfer the seeds to your chosen growing media. Be careful not to touch or damage the small white root with fine hairs that first emerges from the seed. This is the taproot, which will become the central root of the plant. Make holes about half an inch deep in your growing media with a pen, use tweezers to grab the sprouted seeds, and place them root down, one sprout per hole, in your growing media. Cover lightly with growing media and

monitor/keep moist until the sprout emerges.

Plant Seeds in Soil

Sowing directly into soil is often the best-performing method, as it reduces stress on young sprouts and doesn't require any handling or manipulating of the popped seeds with their sensitive taproots exposed. But one downside of this method is that you won't know if the seed has popped until it presses up through the soil. With direct sowing, you have the added challenges of correctly positioning the seed and preparing the soil as well. Placement too high or too low in the soil will prevent successful germination, as will soil that is too loose or overly compacted. That said, overall germination rates for first-time growers are typically highest with the direct-sowing method.

For this method, use a seed-starting soil or sterile potting mix. Do not use topsoil from your backyard, as it will contain a variety of microbes, pests, and/or soil chemistry complications that could be harmful to young seedlings. Sow your seeds in a container such as a small paper cup with holes in the bottom or a three-inch pot. After placing soil inside the container, water it completely so that water drains from the bottom of the container.

Use a pen to make holes about half an inch deep in the soil. Place one seed in each hole, and lightly fill in the holes with soil. Be careful to avoid compacting the soil, as the watering process will take care of this. Keep the soil moist and make sure it drains well. It shouldn't be saturated or soggy. Use plastic wrap or plastic domes over your container to create a

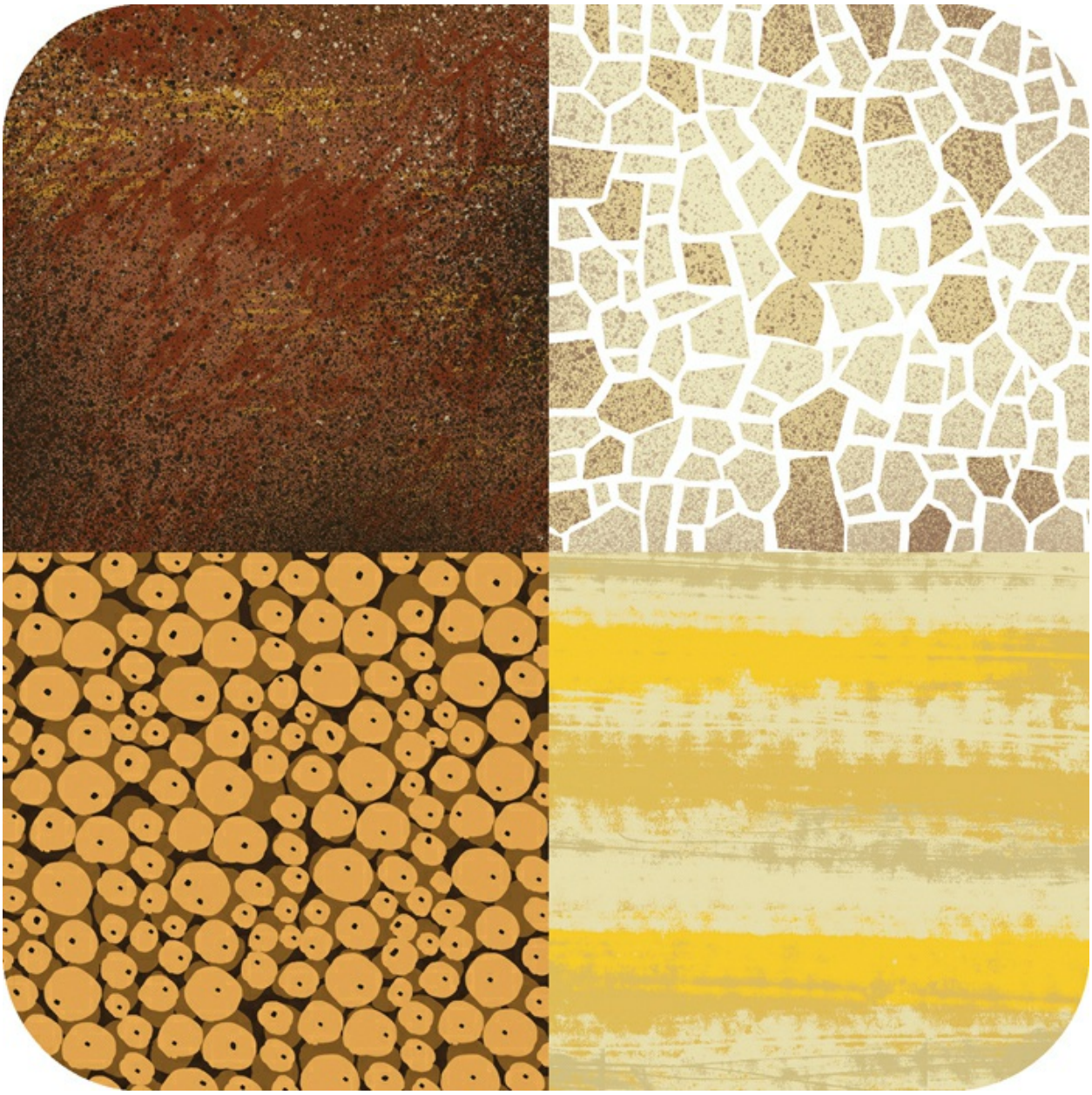
humid environment and retain soil moisture. As we discussed in Step 4: The Environment, the relative humidity for a seedling should ideally be 70 percent. Lights should be turned on as soon as the sprout emerges. The cotyledon leaves will often be yellow until they've absorbed enough light for photosynthesis and the development of chlorophyll, the chemical pigment responsible for the green color of plants.

Plant Seeds in Soilless Potting Mix

Soilless potting mixes have risen in popularity with the indoor growing community. They are usually composed of sphagnum (peat moss) or bark and may also include perlite, vermiculite, or coco coir to help with water retention. These materials are often mixed with sterile soils to provide drainage and prevent compaction. Soilless mixes tend to contain only a small amount of nutrients on their own, so you'll find nutrients have been added to many purchasable premixes. Most soils provide enough nutrients to sprouts for the first four or five weeks of their lives, but soilless mixtures require extra feeding of sprouts early in the seedling stage. In soilless mixes, there is virtually no restriction on nutrient uptake by plant roots. This means you can control the exact amount of nutrients supplied to your plants, but it also means soilless mixes can't act as a buffer against nutrient toxicities. In the event of an overdose, soil will retain some amount of nutrients and compounds, but soilless mixes will give everything up readily to the plants.

Many growers choose to use seed-starting plugs made of soilless potting mixes. Seed-starting plugs provide an easy way to germinate seeds and facilitate transplanting of the young seedling. Other materials such as Rockwool and clay pebbles are also considered soilless mixes, though they are almost exclusively used in hydroponic systems (see Soil vs. Hydroponics).

To plant seeds in soilless potting mix, follow the directions here for planting in soil or the directions from the manufacturer of your chosen mix.

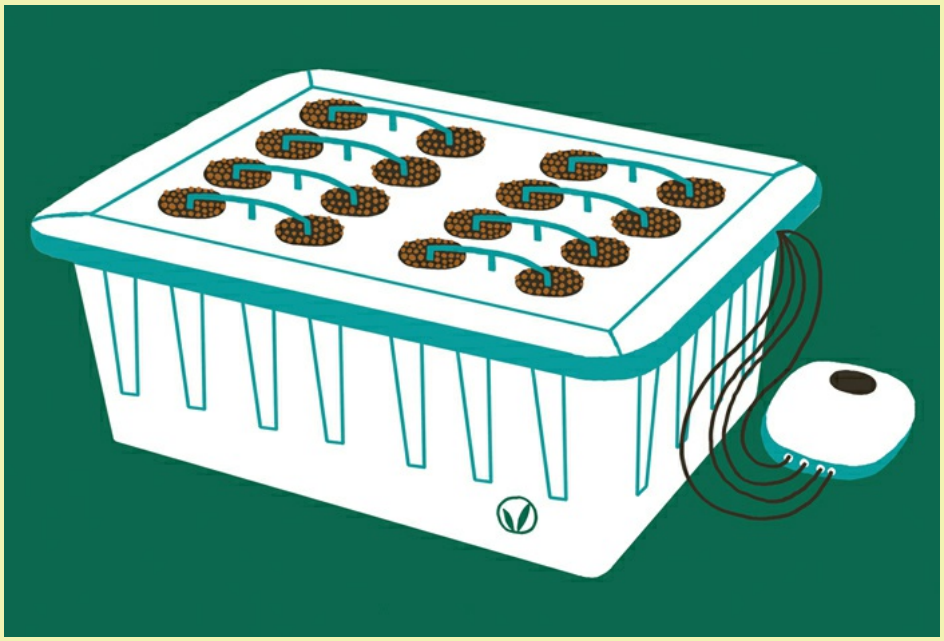


SOIL VS. HYDROPONICS

This book is focused on the use of soil or soilless mixes for growing marijuana indoors, but undoubtedly some of you intrepid first-timers are entertaining the idea of hydroponics. Hydroponics is said to grow marijuana faster with larger yields than soil does, though most agree the best aroma and flavor come from soil-grown varieties of marijuana (and soil is far easier and more straightforward for a first-time grower).

Hydroponics involves placing the roots of your plants in a nutrient solution. Typically, Rockwool or clay pebbles are used as the growing media for these systems.

They provide a skeleton for the root system to infiltrate and allow roots to quickly grow through to the bottom of the media. Soil has microbes that break down organic matter into nutrients for the plant, as well as minerals and micronutrients, but soilless mixes do not. This requires the hydroponic grower to give plants exactly the right nutrients in precise amounts, making the process more challenging, especially for first-timers. Once you're a proficient soil grower, making the move to hydroponics has a much higher chance of success than it does right out of the gate. But don't overlook the fact that hydroponic systems are also more expensive than soil-based grows.



Growing in Soil/Soil-Type Mixes

Once a seed has sprouted, it needs some type of growing media in which to build its root system and anchor the plant. The growing media may also provide nutrients. Here are the pros and cons of a few of the most popular soil-type growing media:

Soil

Marijuana literally grows like a weed in the wild in a variety of soils. Many seed-starting "soils" are actually soilless mixtures or topsoil that has been sterilized.

Pros:

- Soil contains organic matter like minerals and nutrients and an active microbiome, which can support growth and development
- Cheapest and most widely available growing media
- Acts as a buffer against absorption of toxicities

Cons:

- Microbiome is only helpful in the later stages of growth; plants in the cotyledon and seedling stages are susceptible to disease from microbes and pests

Coco Coir

Coco coir comes from the processed husks of coconuts. Coconuts are composed of an inner kernel and an outer husk. The inner kernel is used for a variety of food and dietary products, and the outer husk is a by-product, which makes coco coir a sustainable product.

Many soil mixtures use coco coir in combination with soil to great success. Coco coir comes in three main forms: coco pith, coco fiber, and coco chips. Coco pith is a dense material. Coco fiber is loose and stringy with much better airflow properties. Coco pith can be used with coco fiber to obtain the best properties of each. Coco chips are something of a hybrid of coco pith and coco fiber and provide an ideal substrate for your plants' roots.

Pros:

- Fibrous material provides a great substrate for cannabis plant root systems
- Cheap and readily available; can easily be purchased online or at your local nursery
- Typically sterile, so you don't need to worry about it introducing pests
- Remarkable water-retention properties in addition to ability to prevent compaction of soils

Cons:

- Coco pith's water-retention properties are so great that, if used exclusively, it can leave roots saturated and prone to rot and disease
- Does not contain nutrients

Peat-Based Soilless Mix

Peat is also known as sphagnum peat moss. Soil mixes containing peat provide a nutrient-rich option for your plants with a few drawbacks. There has been a recent shift from peat-based mixes to coir-based mixes based on sustainability concerns. Peat is slightly acidic, having a pH of 5.5 to 6. Most cannabis strains prefer a pH of just under neutral to neutral: 6 to 7 (see pH Levels).

Pros:

- Excellent drainage, airflow, and water-retention properties
- Provides microbiome and nutrients similar to soil

Cons:

- Takes decades to form, so sustainability is a challenge
- Soil pH must be raised with lime or similar product into a more suitable range for optimal flowering
- Hazardous to work with

Grow Rocks

Grow rocks, also known as expanded clay pebbles or lava rock, are used primarily in hydroponic systems, though they may help enhance soil-based systems as well. When manufactured for cultivation purposes, small clay pebbles are heated, causing air bubbles to be trapped and expanding the clay. These air bubbles are the basis of the special properties of grow rocks.

Pros:

- Good drainage, airflow, and water-retention properties

Cons:

- Better for the more advanced or hydroponic grower

CHOOSING THE RIGHT CONTAINER

Your chosen container will hold the growing media that anchors your root system and supplies it with oxygen, moisture, and airflow. Your containers should be cleanable, durable, and reusable as your plants will need different-size containers throughout the grow process. Once the root system has filled out a container, the plant is then transplanted to a larger container (a process called "up-potting"). This approach produces the most robust and healthy root systems in indoor grows.

For starting seeds, consider the use of a germination chamber. This is a domed plastic tray with many partitions that can provide small pockets of soil or contain starter plugs perfect for germination of seeds through the young seedling stage.

Once your plant needs to be put in a pot, you have several options:

CLAY OR TERRA-COTTA POTS, WHICH OFTEN HAVE SAUCERS TO COLLECT DRAINAGE LIQUID

PROS:

- Cheap
- Material helps with moisture retention and cooling

CONS:

- Crack or break easily
- Heavy
- No airflow through sides of container

PLASTIC POTS, WHICH OFTEN HAVE SAUCERS TO COLLECT DRAINAGE LIQUID

PROS:

- Cheap

CONS:

- Crack easily
- No airflow through sides of container

FABRIC OR SMART POTS

PROS:

- Airflow through sides of container stimulates root development
- Most have handles, so are better ergonomically
- Last the longest

CONS:

- Can be expensive
- Dry out faster
- Typically require twice as much growing material as other containers
- Liquid seeps from the bottom and sides of the containers, so their use is not appropriate for all setups

How Many Plants?

The number of plants you can grow to full maturity will depend on the number of plants your grow space can accommodate during the final weeks of flowering—and the laws in your area.

If space allows, you may want to consider partitioning your grow room so you can keep plants in different growth stages to achieve a "perpetual harvest." In this kind of arrangement, when you perform a harvest, you will already have vegetative plants on hand to take the place of the harvested plants. Likewise, there will be young seedlings available to repopulate the vegetative plants and germinating plants to repopulate the seedlings. You need to maintain a balance between the number of plants in each phase. Some states and countries allow four to six plants to

be grown per adult, but others, even some with recreational programs for adult use, may not allow cultivation within certain city limits.

Room within a Room/Large Closet

There are many factors involved in determining the floor space needed for each plant in a room within a room or a large closet, including the size and shape of your containers and the strain and ultimate size of your chosen plant in the flowering stage. A general rule of thumb is to allow at least 1½ square feet per plant. If you are using a room within a room, try not to let plants exceed 60 percent of total floor space to allow room for storage of containers, nutrients, growing media, cultivation tools, and a cart or rack to hold them.

For example, a room that is five feet by five feet has 25 total square feet. Sixty percent of that is 15 square feet. Divide 15 square feet by the 1½ square feet needed for each plant, and you get 10 plants maximum for this space.

There are trade-offs to having a greater or lesser number of plants in your grow space. One is your time and energy. The more plants you have, the longer it will take to perform all the necessary tasks of cultivation, harvesting, and post-harvest care. On the other hand, the more plants you have, the greater your harvest. Keep in mind that in most small grow spaces, one or two plants may fill up the canopy space, even though you could choose to have four to six plants in that same space. The formula here is meant only as a general baseline. You'll want to evaluate all these factors to determine the ideal number of plants to grow in your operation. For many beginners, all things being equal, fewer plants are preferred to more plants so you can perfect your methods without risking the investment in time and money required to rear many plants.

Space Bucket

Space buckets will typically only accommodate one mature flowering plant. A series of space buckets can still accommodate a perpetual harvest if different buckets are designated for different growth phases. The number of plants you can raise will be limited by the number of space buckets available.

Grow Tent/Small Closet

Unlike rooms or large closets, the floor space in a grow tent or small closet can typically be filled out with just plants. Supplies are often stored outside the grow tent, and so the full real estate inside the grow tent can be used exclusively for plants. Small closets and grow tents can usually be accessed and the plants maintained without the grower physically entering the grow space itself.

So, to calculate how many plants you can fit in a grow tent or small closet, simply divide the full area of your grow space by the full plant size. For example, a grow tent or closet that is three feet by four feet has 12 square feet total. Dividing this by 1½ square feet per plant equals eight plants maximum.

Again, this formula should be used only as a baseline because, at the end of the day, the canopy size and shape determine the amount of bud you get, regardless of the specific number of plants.

TAKEAWAYS & EQUIPMENT LIST

Nice work! You've survived another section.

In Step 7: The Germination, we showed you the ins and outs of germinating your seeds and getting your plants off to a running start, including:

- The keys to sprouting seeds in paper towels, soil, or potting mix
- How to make the decision between soil or hydroponic growing systems
- How to select the right growing media from soil, peat, coco coir, or clay pebbles
- How to choose the best container for your plants, whether clay, plastic, or fabric
- How to determine the optimal number of plants based on available space

SHOPPING LIST FOR GERMINATION AND SEEDLING CARE

- [ ] Disposable plates
- [ ] Distilled water
- [ ] Paper towels
- [ ] Pots or containers of choice for seedlings, starting with three-inch diameter
- [ ] Seed-starting tray
- [ ] Sterile soil, growing media, or seed-starting plugs
- [ ] Tape or rubber bands

In the next section we'll discuss the role of nutrients. You'll learn how to make sure your plants are getting everything they need, and what to look for when they're not.

Step 8

The Nutrients

In this section, we dive into watering your plants. (Get it?) Anyway, we're going to discuss how and when your plants should be watered, along with what nutrients to feed your little ones to keep them growing strong. Nutrients are classified as either macronutrients, which plants need in large amounts, or micronutrients, which plants only need in small amounts. You'll also learn how to troubleshoot and correct basic nutrient deficiencies your plants may experience during their growth cycles.

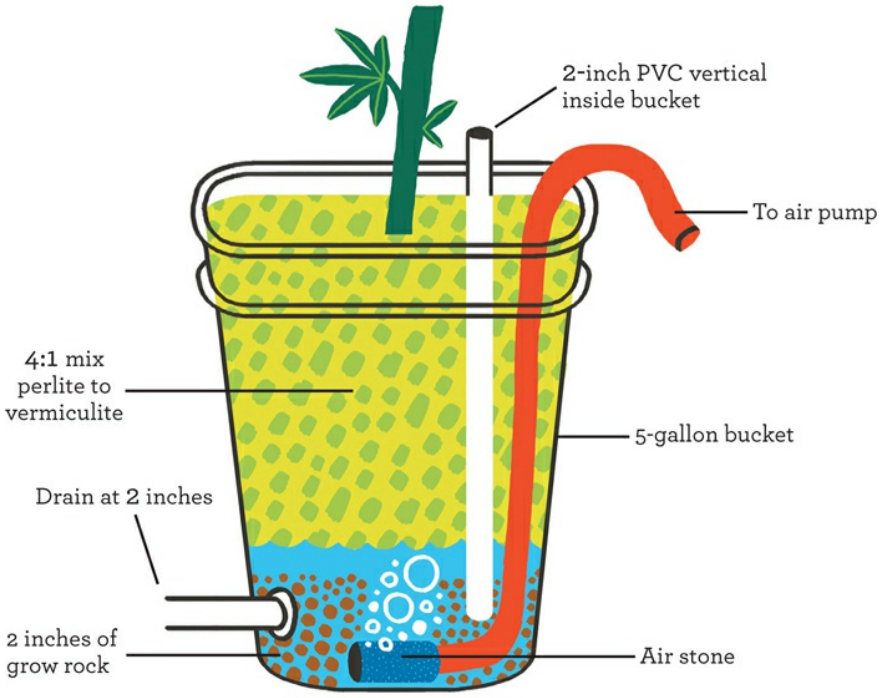
Watering Your Plants

Unlike we humans, who eat and drink for nourishment, plants can only drink, either by taking in water through their roots or moisture from the surrounding air via their leaves. They use nutrients found in the soil and carried through water to power their cellular machinery, and they produce energy from sunlight, water, and CO_2 during photosynthesis. Water is critical to proper plant growth and health, but it must be the right type administered in the correct amount and at the proper frequency. One of the biggest mistakes first-time growers make is overwatering and overfeeding their plants. When it comes to watering and feeding your

plants, more is definitely not better.

Choosing a System

Cannabis roots prefer a balanced wet and dry cycle. During dry spells, plants extend their roots farther out searching for water, so regular periods of wet and dry soil are necessary to produce strong and expanded root systems.



Example of a passive watering system

Watering systems can be active or passive. Active systems actively deliver water to the growing media or directly to the plant roots. Passive systems typically employ some type of water reservoir that the roots can access as needed. An example of a passive system is the hempy bucket, which is a container filled with growing media. Instead of drain holes at the bottom of the container, there is a drain hole a few inches from the bottom. This allows the bottom layer of soil to remain wet, providing a buffer against drying out and inviting roots to this moist area. Active watering can be drip irrigation, hydroponic, or aeroponic. We've talked about hydroponics briefly, and how a nutrient solution is supplied directly to the plant roots, which dangle in water. Aeroponic systems

allow roots to hang in the air; nutrients and moisture are sprayed on them in a fine mist. Drip irrigation systems, which can provide a steady flow of water for a set amount of time, have been used for decades in the landscape and gardening industries. A reservoir, a timer, and a pump are all that are needed to start a basic drip irrigation system. Most indoor growers will want to start off by hand watering or using a simple drip irrigation system.

Amount of Water

Unless you are running an automated system that has been optimized through trial and error, it can be a challenge to know how much water to use when watering. With most non-succulent potted plants, you want to water until some liquid emerges from the drain holes. Water contains nutrients, which cost money, so you want to get enough to the plants while giving the floor as little as possible. During the seedling phase, you want to make sure your plants are getting enough water without saturating their roots. Many indoor growers water with half the amount of water that would fill the growing container. For example, a plant in a one-gallon pot would get half a gallon of water each watering. Cannabis roots are highly susceptible to fungal diseases that occur when conditions are too wet or stagnant. It's for this reason you want to avoid overwatering or using poor soils that won't drain or lack appropriate airflow.

Temperature

Though often overlooked, the temperature of the water used for your cannabis plants is critically important. Your watering solution should be between 68°F and 74°F. If it's too cold or too hot, it can shock the root system and prevent it from developing. Warmer water contains less dissolved oxygen, which is a major carrier of nutrients. Fewer nutrients generally means less growth. More often, at least in much of the United States, your irrigation water will be too cold for the plants. When the water is too cold, the plant may have dark leaves or stems and branches that turn purple. Although they are often pretty to look at, these are signs the plant is not converting phosphorus, a macronutrient critical to growth and flower development. Typically, micronutrient deficiencies will follow.

If possible, after mixing it with nutrients (see Plant Food), allow your watering solution to remain in the growing environment for 8 to 12 hours, out of direct light, to acclimatize it prior to watering your plants. You should monitor the temperature of the watering solution to verify it's within the appropriate range before you water. A standard kitchen probe thermometer is all that is needed. Watering at the wrong temperature, even once, can take a long time for a plant to recover from, so taking this step is good insurance.

pH Levels

The pH scale runs from zero to 14. Seven is neutral. Substances with levels from zero to 7 are considered acidic, like vinegar and tomato juice. Substances with levels from 7 to 14 are considered basic or alkaline, like baking soda, soap, and many cleaning products. Cannabis plants prefer soil pH levels just under neutral, around 6 to 7. Soil pH will largely be determined by the pH of the watering solution you use. Depending on your grow, you may be using water alone or with added nutrients. Nutrient uptake is pH dependent. Not only must you supply your plants with the correct nutrients in the right amounts, but you must also provide the right pH range so the roots are able to take up those nutrients from the soil. To test pH, you can use disposable color-change test strips or invest a few dollars in a digital pH meter. Meters are nice if you do a lot of testing but require periodic recalibration with chemical pH standards. There are dedicated soil pH meters available. To use these, you stick the probe directly into the soil for a continuous reading. These tend to be somewhat inaccurate or unreliable, though, so it's best to focus on the pH of your watering solution.

PPM Levels

Water hardness is another fundamental concern. This often has to do with the particular region you live in and where your water is sourced from. Hardness measures the degree of mineralization of the water in the parts per million (ppm) scale. Water with a hardness of zero ppm is pure and contains no solids whatsoever. Water with a hardness of 100 ppm has 100 parts dissolved solids, mostly minerals and nutrients, for every 1 million

parts of water. Minerals are helpful, but plants only need them in minute amounts. Hard water leads to alkaline soils, preventing nutrient uptake and normal growth of the plant. Buildups of calcium and magnesium in the root zone are common to plants watered with hard water. If you live in an area with hard water, you might want to consider using a deionizer or reverse osmosis system on your water, which reduces the presence of solids to nearly zero ppm. Starting with a baseline hardness of zero ppm for your water allows you to precisely monitor the ppm levels of your watering solution, as nutrients, as well as minerals, are reflected in the ppm measurement. You can then compare these initial solution readings to readings from your runoff or drainage to ensure the plants are taking up the right amount of nutrients. In general, the level of nutrients in your watering solution should be lower after it traverses the root zone. If it is the same, it means the roots are not taking up the nutrients properly, most likely due to the pH level. If the level of nutrients in your watering solution is higher after going through the root zone, this signifies nutrient accumulation, also often due to improper pH. If this is the case, you should thoroughly flush the soil with zero-ppm water.

DOES MY PLANT NEED WATER?

How frequently you should water your plants changes with the conditions of the grow room, the growth phase, the container, lighting, and other factors. During germination, you want to keep the soil and air conditions very moist; you can start to dry things out in the seedling phase, during which you should have moist soil an inch or two below the surface. Once it starts to feel dry deeper than this, it is time to water. Stick your finger in the soil about two inches down. Is the texture moist or dry and crumbly? If it feels dry or the texture is crumbly and doesn't cling to your finger, it's probably time to water. If it's moist and sticks to your finger, you can probably wait a day or two. When you water in larger pots, be sure to water in concentric rings outward from the main stem and not just at the base of the stem.

You should also look at the leaves. How is the color? Are they a bright, vibrant green or starting to yellow or fade? How do the leaves hang? Are they full and sticking out, or are they drooping and starting to curl? Drooping leaves are the most obvious sign of a plant needing water. Check the container weight to confirm by lifting it if you can do this safely and ergonomically. Growing containers lacking water are remarkably light compared to those holding water within the soil. Oftentimes, in as little as minutes after watering, previously drooping leaves will have already returned to their full, upright, and extended posture.

As your plant matures into the vegetative phase, you can allow the top few inches of

soil to dry out between waterings and maintain this level throughout flowering. You'll still want to monitor closely, as changes in lighting or growth phase may require the plant to take in more nutrients and thus water from the soil. Overwatering can also occur and is often indicated by leaves curling under.

An overwatered plant An underwatered plant

Feeding Your Plants

What, when, and how you feed your plants has a major impact on plant health and bud yields. Cannabis plants require varying levels of macronutrients and micronutrients depending on their stage of growth. Many ambitious amateurs tend to err on the side of overfertilization when starting new indoor grows, often with disastrous results. Fertilizers and plant food are beneficial and often necessary for rapid growth and development, but using too much can stunt growth, misalign soil chemistry, and injure plant tissues.

The Big Three

Macronutrients are the "Big Three" nutrients needed in relatively large amounts by your plants: nitrogen (N), phosphorus (P), and potassium (K). When you purchase nutrients and fertilizers, they will typically have a nutrient profile consisting of three digits corresponding to the

percentages of N, P, and K respectively in the product. For example, a nutrient mix with a 5-5-60 profile consists of 5 percent nitrogen, 5 percent phosphorus, and 60 percent potassium. Nitrogen is important for vegetative growth and building strong leaves, stems, and branches and is needed in large amounts by young plants increasing in green biomass. Phosphorus and potassium are critical to root development and are crucial during the flowering stage.

Most quality soils contain enough nutrients to sustain a seedling for the first four to five weeks of its life. Most growers will then switch to a nitrogen-rich product for the first few days of flowering, then to another product more conducive to flowering, containing higher levels of phosphorus and potassium and lower levels of nitrogen. This is then maintained until 7 to 10 days prior to harvest.

STAGE	RECOMMENDED NPK PROFILES
Seedling	N/A
Vegetative	6-4-4 or 10-5-7
Flowering	3-10-10 or 2-8-4

Keep in mind that the NPK profile is a ratio, so a 3-1-1 profile is proportionally the same as a 9-3-3 profile, and each provides the same relative amount of nutrients. The difference is the amount of the product used per volume of growing media. The nutrient profile is discussed more in Step 9: The Care.

Plant Food

When growing in soil, food for your plants will come in two basic forms: amendments that are mixed in with the soil, such as humus, peat, and synthetic fertilizers; and concentrated liquid nutrients that are diluted with water and used to irrigate the plants. Many growers use a combination of the two, allowing the soil amendments to act as a foundation of nutrients and the liquid nutrients to act as an added blast of nutrients every so often. Liquid nutrient fertilizers, when used in conjunction with soil, should typically only be applied every second or third watering or as little as three or four times throughout the plant's

growth stage. Check the manufacturer's instructions for dilution and watering frequency based on your plants' growth phase. Consider a small investment in an EC/TDS meter to check the level of nutrients in your soil. EC stands for "electrical conductivity" and is a measurement of the ions in the soil. The more nutrients present in the soil, the higher the EC/TDS value will be. Many cultivators will check the EC/TDS and fertilize accordingly. For example, if a ready-to-use liquid fertilizing solution targets 1,200 ppm TDS and the soil shows a 400 ppm TDS reading prior to watering, you would deduct the 400 ppm from the 1,200 ppm and only feed an 800 ppm solution. This would most likely require diluting the 1200 ppm solution or making a new solution at 800 ppm. Remember that soils like to trap and accumulate both macronutrients and micronutrients. This unique property provides soil with life-giving powers, but excess accumulations of nutrients in pots or other containers can quickly lead to toxicities for your plants.

Secondary Macronutrients

Another main nutrient category is secondary macronutrients, which consists of three minerals and elements that are needed in relatively smaller amounts. These are calcium, magnesium, and sulfur.

- **Calcium** (Ca) is found naturally in soil and plays a big part in the formation of the cell walls of roots.
- **Magnesium** (Mg) is also found naturally in many soils. It can be temperamental in terms of uptake conditions. Soil pH and temperature need to be just right to allow roots to take in the needed micronutrients. Cannabis plants use considerably more magnesium than many other plants to keep their lush, bright-green appearance.
- **Sulfur** (S) plays a key role in the creation of enzymes and amino acids and comes from the sulfite in soil.

Room to Grow

Your plants' roots need room to grow throughout their container. If roots lack adequate space, they may start to grow in and on themselves, and your plants will become "root-bound," which is detrimental to the

production of quality buds. Make sure your plants have adequate room to expand, and transplant as often as necessary to accomplish this. Periodically check the bottom drain holes for signs of root crowding, such as the emergence of thick roots or blockages of many crisscrossed roots.

Keep Them Company

If you're interested in other enhancements for your root zone, consider the use of organic compost teas or mycelium. Compost teas contain beneficial organisms that live in and break down the soil, making nutrients readily available to your plants. Using mycelium in your garden can also have big rewards and only requires a sprinkling of store-bought mycelium powder when you prepare your soil.

TAKEAWAYS & EQUIPMENT LIST

Another one bites the dust! Well done.

In Step 8: The Nutrients, we made a splash talking about watering and feeding your plants.

Here is what we covered:

- How to use active and passive watering systems
- The optimal temperature, pH, and purity of irrigation water
- What signs to look for to determine if your plant needs water and an ideal watering schedule
- What and how to feed your plant
- The role of macronutrients and micronutrients in a plant's overall health
- How to create a healthy root system with good oxygen, warmth, and moisture

SHOPPING LIST FOR NUTRIENTS

- [ ] EC/TDS meter for water/soil

- [ ] High-quality soil mix with beneficial organisms and/or high-quality nutrients
- [ ] Measuring cups for nutrients
- [ ] pH meter for water/soil
- [ ] Water—reverse osmosis (RO) or deionized (DI) preferred

Now you're ready for Step 9, which will detail how to care for your growing plants. You've got the basics of your setup down, now it's time to learn what your routine will look like.

Step 9
The Care

Throughout this book, we've discussed the three primary growth stages of marijuana plants—seedling, vegetative, and flowering—and how a plant's needs change throughout these phases. Much like hormonal teenagers require a special brand of diplomacy, your plants require a special mix of light, water, nutrients, and temperature depending on their growth stage. In this section, we'll arm you with specific knowledge of each of these factors so you're ready to manage each stage.

The Seedling Stage

In Step 7: Germination, after the seeds were popped and/or transplanted, we ended up with a cotyledon. Once the cotyledon produces the first set of serrated leaves, it's considered a seedling. It remains a seedling until it produces a growth with five or seven blades. This typically takes about 10 days from germination. The seedling is highly sensitive and only starting to form the root system that will act as an anchor for the plant above it.

Lighting

The seedling stage can also be called the early or pre-vegetative stage. Like in the vegetative stage, plants in the seedling stage prefer light in the cooler, blue part of the spectrum. The seedling stage is ideal for the use of compact fluorescent lights or CFLs, discussed previously in Step 3: The Light. If using high-intensity lighting at the seedling stage, make sure there is enough distance between the light and your plants. Many growers use lighting schedules of 18 hours on (light) and 6 hours off (dark) or 20 hours on and 4 hours off. Start with 18 hours on and 6 hours off during the seedling stage. Once the plants have grown hardier, they'll be able to take more intense light in greater amounts. Your seedlings should experience somewhere between 4,000 and 7,000 lux during this early stage of growth.

Water

You'll want to use water with as close to zero ppm TDS and a pH of 7 as

possible during the seedling phase to eliminate mineralization of your water or improper nutrient uptake. Your plants should generally need watering every two to three days. Pot sizing can have a big impact on how often you water. Avoid having your plant in too large a container where the soil stays wet for long periods of time or too small a container where the soil dries up too quickly from an overabundance of roots. Be careful not to overwater at the seedling stage, as it's easy to do. Allow the top inch of soil to dry out between waterings. This forces the roots to go seeking water, expanding their network and stabilizing the plant in the growing media.

Nutrients

Your growing media should have all the necessary macronutrients and micronutrients your plant needs to thrive for its first couple of weeks. Some growers opt to use a mild starter solution such as Clonex to give their seedlings an additional edge. Beyond this, wait until the vegetative stage to start any fertilizing program. Young seedlings can easily be given too much fertilizer and suffer from toxicities. Rarely will a plant that suffers during the seedling stage reach its full potential in size and bud yield. Remember that less is more at this stage, especially when it comes to nutrients.

Temperature

Seedlings like a warm, humid environment. Air temperatures should be between 75°F and 78°F, with relative humidity around 70 percent. Depending on your setup, the heat from your lighting may be enough to bring about these temperatures, or you may need some additional help. Many growers leave their seedlings under domes, and others use small space heaters or heaters in their ductwork. The air temperature shouldn't fall below 60°F during the dark periods, so factor this in if you are relying on heat from the lights.

The Vegetative Stage

Once your plant has been established for a couple of weeks, developed its

root system, and produced true leaves with seven blades or more, it is officially in the vegetative phase. During this phase, the plant will put all its energy into increasing its biomass: the leaves, stems, and branches that make up the basic structures of the plant. This main growth stage will determine how big your plants get and how much bud weight they'll be able to support. Your plants will remain in the vegetative stage for as little as 2 weeks or as long as 14 weeks, depending on the strain or inherent features such as autoflowering. Most plants can remain in the vegetative state in perpetuity if the photoperiod doesn't change. With purchased seeds, you'll know the breeder's recommendation as to the length of the vegetative stage, so you can schedule when to make the switch to flowering. The key is that the plant be sexually developed and strong enough to support and carry the weight of the flower. Also consider the height available in your grow space. Cannabis plants will often grow 60 to 70 percent or more in size during the flowering stage. For example, if you have 6 feet of available height, you should switch to flowering when your plants are 3½ to 4 feet in height if possible.

Lighting

As we discussed in Step 3: The Light, your marijuana plants are looking to receive 10,000 to 50,000 lux of blue spectrum light throughout the vegetative stage. It is at this point many growers will switch their lighting from the CFLs used on seedling to HIDs, such as metal halide or high pressure sodium, or LEDs. Vegetative plants require intensive lighting to grow their fullest and fastest. Some growers maintain the 18 hours on and 6 hours off lighting schedule of the seedling stage, but many switch to 24 hours on and remain with this schedule until flowering. Remember that plants will not flower until lighting has been adjusted to 12 hours on and 12 hours off. This means you can keep cannabis plants in vegetative states in perpetuity by giving them at least 13 hours of light time. Some growers keep "mothers" in a constant vegetative state this way and take cuttings as needed in order to create flowering plants.

Water

You should find a rhythm to watering your plants in the vegetative stage.

As mentioned, there are various factors that compete to dictate the watering needs of your plants. As they grow, their roots will take in water more quickly. Familiarize yourself with the weight of a recently watered plant by safely picking up the pot periodically. You'll only need to elevate the pot a few inches to get a sense of the weight. When you have an idea of the weight the plant should be, use this as a benchmark to determine if your plants need watering. Set a regular watering schedule, such as watering every two to three days, and follow it throughout the vegetative stage. But still continue to monitor individual plants, and adjust your schedule if and when necessary.

Nutrients

The vegetative phase relies heavily on nitrogen for new growth and biomass. You'll remember that nitrogen is the first of the macronutrients indicated in the standard nutrient profile (see The Big Three). A good profile for a fertilizer for the vegetative state might be 6-4-4 (containing 6 percent nitrogen, 4 percent phosphorus, and 4 percent potassium) or 10-5-7 (containing 10 percent nitrogen, 5 percent phosphorus, and 7 percent potassium). In addition to nitrogen, your plants need a complement of micronutrients too. Most nutrient fertilizers with an NPK ratio also contain micronutrients, as do many soil mixtures. Elements such as boron, iron, magnesium, and molybdenum are critical to the metabolic processes of cannabis plants but are only needed in minute amounts.

Temperature

Your air temperature should remain where you set it in the seedling stage, namely 75°F to 78°F, but you can lower humidity to the 50 percent RH level (humidity was discussed in Step 4: The Environment). These are the perfect environmental conditions to grow happy, healthy "vegging" plants. You'll want to maintain these balmy conditions until flowering, as they are ideal for biomass growth. Avoid any large temperature swings in your environment during the dark periods, if applicable. Your plants should never experience air temperatures lower than 60°F. Temperatures above 80°F will result in slower growth for most strains.

HOW TO UP-POT YOUR PLANT

Once your plants' roots have fully expanded in the soil, you will want to transplant or "up-pot" them. Do this when your plants have four or five sets of leaves, and again about two weeks before the vegetative stage ends. If you're unsure when to transplant, check the root development. The roots should penetrate the soil in a tight network but not be too dense. Also check drain holes to see if roots are outgrowing the container. Use clean hands or gloves and keep the process and work area as sanitary as possible.

FOLLOW THIS PROCESS:

1. **Prep the larger pot.** Select the appropriate size of pot, and fill it with growing media. Make a hole in the medium that will allow the plant to maintain the same surface level it had in its original pot.
2. **Wet the media.** It should be moist throughout but not overwatered and soggy.
3. **Remove the plant from the original pot.** Try to transplant when your plant is midway between watering cycles (when the soil is slightly moist but not dry and crumbly). Turn the plant on its side, grip it by the base of the stem, and gently extract the root ball.
4. **Place the plant in the bigger pot.** Place the plant in the center of the hole in the new pot. Do not force it or you could damage the delicate roots. Make the hole bigger if you need to.
5. **Fill it up with your media.** Fill in the gap around the circumference of the plant. Do not add soil on top of the existing soil in the root ball; plants will suffer if they experience a change in soil depth.
6. **Add water.** Water lightly but thoroughly with a mild rooting solution, and return the plant to its enclosure. Wait at least two weeks after transplanting before initiating flowering.

EQUIPMENT LIST:

- Clonex or similar rooting solution (optional)
- Growing media
- Large containers—typically one to five gallons, depending on what you are transplanting
- Water—reverse osmosis (RO) or deionized (DI) preferred; as close to zero ppm TDS as possible

The Flowering Stage

You've had a successful vegetative stage, and your plants are big, lush, and ready for bud. Exactly when you initiate flowering will depend on the conditions of your operation and the specific strain and type of seed you chose.

Lighting

That powerful moment when you decide to induce flowering is upon you. Make sure your plant is in a big enough pot for the roots to continue to develop for the next two to eight weeks (throughout the completion of the flowering stage). For autoflowering varieties (see here), flowering will start automatically sometime after two weeks into the vegetative stage, so you don't need to worry about inducing flowering. For regular seed varieties, when you change your lighting schedule to equal light and dark periods (12 hours on and 12 hours off), you'll be changing the direction of the life cycle of your plant. Your formerly vegetative plant will transition to flowering and start producing buds. This is an exciting milestone. Your plant should be experiencing greater light intensity than in previous stages; up to 75,000 lux is appropriate for the flowering stage. Be certain you have no light leaking in during the dark period of your lighting schedule, as this can confuse the plant and induce hermaphroditism, in

which the plant will have both male and female reproductive parts. A single “hermie” can pollinate and ruin an otherwise great crop (see Sexing Plants).

Water

Continue to water with your growth solution from the vegetative stage for the first week of flowering to allow your plants’ nitrogen need to fade before switching over to the blooming solution you will primarily use throughout the flowering stage. Your plants are getting bigger, with more developed root systems, and now they need to bring in enough water to support those huge buds they’re growing. Because of this, your plants will take in more water than they did in the vegetative stage and will tend to dry out faster. Stick to a regular watering schedule, but continue to monitor for signs of underwatering, such as droopy leaves or a slight yellowing of fan leaves. Keeping the humidity lower for pristine bud development will also increase the need for watering. Your plants are pretty hardy at this stage, so, depending on your container, you can usually let the top two to three inches of soil go dry between waterings. You want to be careful not to overwater because standing water can lead to bud rot.

Nutrients

Remember that flowering plants have less of a need for nitrogen and more for phosphorus and potassium. Phosphorus and potassium are major players in the development of buds and trichomes, so you want to give your plants copious amounts of these elements throughout the flowering stage. For impressive flowering, try a fertilizer with a 2-8-4 or similar nutrient profile. Be sure to flush your plants with water one week prior to harvesting. Flushing removes salts and other compounds that have built up throughout the cultivation process and has been shown to greatly improve the quality and flavor of bud. Keep a healthy dose of micronutrients available to the plant through the growing media or fertilizer.

Temperature

In the flowering stage, your plants will prefer conditions a little cooler and drier than in previous stages. The ideal temperature range is 68°F to 75°F. You'll want to bring humidity down to about 40 percent RH to encourage buds to develop with as much resin and as many sticky trichomes as possible. Some growers reduce RH all the way to 30 percent for the final week of flowering prior to harvesting to force even more resin. Be careful not to shock your plants with cold in dark hours. Hours of cold temperatures can slow or stop bud development. Continue to make sure the air temperature doesn't fall below 60°F, but keep in mind your average temperature is lower in the flowering stage, so you have less room for error.

TAKEAWAYS & EQUIPMENT LIST

Great job! You're in the homestretch. Just another couple of steps to go and you'll be smokin' with the big dogs!

In Step 9: The Care, we talked about:

- The lighting, water, nutrients, and temperature needed for the seedling, vegetative, and flowering stages
- The right time and method for up-potting your plants

SHOPPING LIST FOR PLANT CARE

- ☐ Clonex or similar rooting solution (optional)
- ☐ Growing media
- ☐ Large containers—typically one to five gallons, depending on what you are transplanting
- ☐ Water—reverse osmosis (RO) or deionized (DI) preferred; as close to zero ppm TDS as possible

In the next step, we will start to get into more advanced topics, including pruning, sexing, cloning, and pest management. You're doing a great thing by learning to cultivate marijuana for yourself and at this point should have a decent understanding of a complete

growing operation. This is a good time to go back and review anything you want to know more about. Stick with us, and we'll soon have completed this first and most important book in your journey in the knowledge of cultivation.

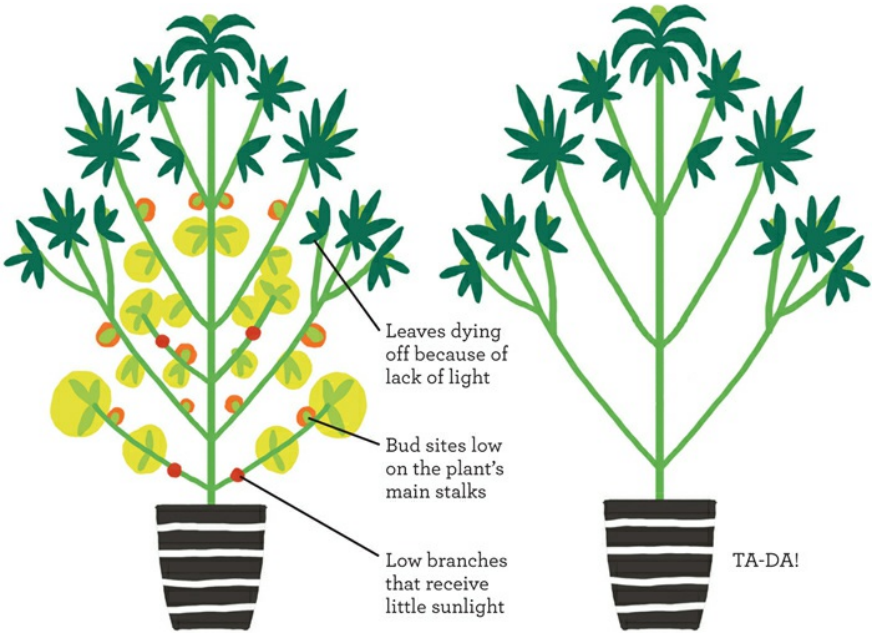
Step 10

The Maintenance

Kudos for making it this far! Now that your plants are growing and flowering, let's look at a few other tricks of the trade to help you maintain your crop, including pruning, sexing, and cloning. Each can have a great impact on the quality and yield of your crop. Alongside watering, lighting, and feeding, these activities represent much of the real hands-on work of the indoor grower.

All about Pruning

Pruning is the process of trimming or removing dead or dying leaves and unnecessary plant matter. It may feel strange, but cutting off bits of your marijuana plant is important to improving both the quality of the plant and the yield. Pruning, when performed correctly, increases airflow and helps plants make better use of available light and energy. You can prune *too much*, however, and cause irreparable harm to your crop. For this reason, pruning should be taken on in stages once you are comfortable growing and maintaining a crop and have seen how the plants grow naturally. For the grower new to pruning, it's suggested to start with one or two plants and see the results before extending to your entire crop.



HOW TO PRUNE

Pruning is as much an art as it is a science and should largely be left to more experienced growers. If you are going to take a leap into pruning, here's what to know:

What to look for: Look for leaves that are dead or dying, yellowing or discolored, or decaying. Look for bud flowering sites that are too low on the plant to get enough light to produce significant buds. Pruning, in general, can be hard to swallow, and some growers feel that removing buds specifically, even potential baby buds, crosses the line even further. The rationale for pruning such buds is that it is better to remove them and have the plant shift its energy to bud flowering sites with better potential due to their position on the plant.

How often: Pruning should only be done once your plant is at least 12 inches tall and has several nodes or leaf pairs. Pruning stresses the plant, so you need to be careful to allow for recovery periods. It's recommended to prune once as soon as possible and one or two more times while the plant is still in the vegetative state. Pruning while the plant is in the flowering stage is not recommended.

Cleanliness: Wash your hands and/or wear gloves when pruning, as it's easy to infect a plant during this process. Keep your tools visibly clean and sanitize often with isopropyl alcohol.

Procedure: Determine which plant matter you want to remove. Use sanitized shears or scissors to cut large branches from the bottom and middle of the plant that are blocked from light by the canopy, and remove dead and dying leaves. Discard pruned material, making sure it doesn't become incorporated into the soil, as decaying plant matter can attract pests.

TOOLS:

- Clean, sharp pruning shears or scissors
- Disposable or cleanable gloves

Light

One of the main goals of pruning is to allow otherwise hidden bud sites or growth areas to be bathed in light and thus grow and develop faster. By removing unnecessary plant matter, you allow the remaining foliage to fill in the spaces and gather that light that would have been wasted. Your lights and the energy to run them are the highest cost of your personal indoor grow operation. Because of this, you'll want to make sure that the light you produce is effectively captured by the right parts of your plants. Fan leaves, the large, many-fingered leaves that tend to grow from older branches, are often removed during pruning. This frees up significant available light in the grow space.

Energy

Pruning doesn't just increase lighting efficiency. It also reduces the amount of water, nutrients, and ventilation power wasted on growing unnecessary plant matter. Because these resources have a cost, you want to be as efficient as possible and get them to the right parts of the plant. Keep in mind the ultimate goal of your indoor grow is to produce buds. You want the lighting, nutrients, and ventilation delivered to your grow

room to be focused on making buds instead of simply growing plant matter.

Dead Leaves

The process of removing dead or dying leaves is called defoliation and is the simplest form of pruning. Some cultivators limit their pruning to defoliation due to the risks involved with improper pruning. Dead or dying leaves pose a threat because they can attract pests and facilitate microbial infections. A small fraction of leaves will yellow and die naturally throughout the course of a plant's life. Individual leaves showing symptoms—for example, a single, older fan leaf on a lower branch showing yellowing, some curling of the leaf, and brittleness—are often in this category and are not to be confused with leaves indicating nutrient deficiencies or excesses. These are a prime target for your defoliation, especially if nearby leaves show no similar symptoms. If nearby leaves *do* show similar symptoms, evaluate your nutrient program for excesses/deficiencies before performing any pruning.

Airflow

When you prune away plant material, you not only increase available light but also enhance airflow, allowing air to penetrate into the plant where it couldn't before. Marijuana plants like access to plentiful fresh air. The additional airflow allows the plant to respire more often and more effectively, increasing the plant's growth rate and cannabinoid potency. Increased airflow also helps keep diseases like bud rot at bay.

Sexing Plants

As discussed in Step 6: The Seeds, marijuana plants are dioecious and, when grown from regular seeds, are either female or male. If you opted to purchase feminized seeds, there is a 99 percent chance they will produce females. Autoflowering seeds are a type of feminized seed that flower at a predetermined stage of growth independent of light or dark periods. Although it is rare, males and hermaphrodites may appear even when using feminized or autoflowering seed varieties. On the off chance they

do produce a male, the following information will be useful to detect and eliminate it. It only takes one pollen producer to spoil a crop, so be aware of what to look out for.

Preflowers are small structures that appear after about four to six weeks of vegetative growth in many strains of cannabis. They indicate the sex of the plant prior to the flowering stage and can be hard to see with the naked eye when fresh. They are found at the nodes, in the crook where a lateral branch emerges from a main stem. Grab an inexpensive magnifying glass if needed—it's great for general plant inspection as well. Preflowers for both females and males are shown below.

Here's how to identify them:

- **Male** preflowers look like a cluster of small green berries or one small green berry on a stick
- **Female** preflowers appear as two tiny bracts with thin white stigmas emerging

Female preflowers

Female Plants

Females plants are desired by growers because only females produce useable marijuana buds. As mentioned, flowering is initiated by changing the amount of light to mimic the autumnal equinox, when an equal number of daylight and dark hours occur. Once flowering commences, changes to the plant's reproductive parts take place. Female plants exhibit characteristically thin white stigmas. Notice the fine frills that are

perfect for attracting and capturing pollen floating through the air. If left unpollinated, these will continue to develop, swell, and produce sticky resinous buds. The goal of the buds, much like the stigmas before them, is to capture any pollen in the air and thus propagate their species. It's one of the main jobs of the indoor grower to prevent this from taking place.

Male preflowers

Male Plants

Male plants exhibit "stick and ball"–type structures or cluster sacs that are easily distinguished from the female's stigmas. These are the pollen sacs that contain the male's pollen. If allowed to develop and deploy, the pollen will be released and attach to the delicate stigmas of the female. At this point your crop is said to be pollinated or to have "gone to seed." This is because the formerly seedless buds, or sinsemilla, will rapidly create seeds, leaving you with low-quality, low-potency, seedy bud. When the female plant is pollinated, she shifts her energy into producing seeds, and so the bud quality suffers. When smoked, seeded bud, besides being generally lower in potency, tends to be bitter or harsh compared to its seedless counterparts. Unless you are actively breeding plants, males should be culled as soon as they are identified. Growers of regular seeds will often plant quantities of 50 to 100 percent extra seeds to allow for culling of male plants.

Hermaphroditic Plants

Hermaphrodites are genetically mutated plants that contain both male

and female reproductive parts. Although this may sound like fun, hermies are a major problem for the indoor grower. A single hermaphrodite can pollinate your crop just as easily as a male can. The challenge with hermies is identifying them because the female parts sometimes mask the male parts early on in development. Hermaphroditism can occur due to stresses in the environment, especially issues related to lighting, such as light leaks during dark periods. Looking for hermaphrodites with the goal of removing them should be part of your standard maintenance of your grow room.

HOW TO SEX PLANTS

WHAT TO DO WHEN YOUR PLANTS ARE FLOWERING:

Most growers rely on preflowers to determine sex and then make the appropriate adjustments for males long before the males' pollen sacs are developed enough to break open and pollinate the crop. By waiting until the flowering stage to sex your plants, you risk a male pollinating the crop before you've identified it. If you must wait until the flowering stage, check for the following:

Male: Male flowers look like clusters of closed seed pods. Check the junctions where lateral branches or petioles (leaf stalks) come off the main stem. Male flowers tend to show and develop faster than female flowers, which helps the grower identify males sooner.

Female: Female flowers have many white stigmas emerging from a multitude of calyxes. Calyxes combine to form what we recognize as bud, which grows and thickens from the base throughout the flowering stage. Flowers are not to be confused with stipules, which are thorn-shaped structures found at internodes on both male and female plants.

To Clone or Not to Clone

There are two basic ways to create a new cannabis plant. One method is the seed method, which has been the focus of this book as it's most appropriate for beginners. With the seed method, you germinate and plant a seed, rear it through the seedling and vegetative stages, determine the sex, cull the males, take the females through the flowering stage, and so on. The other method is to make a clone. A clone is merely a cutting from an existing plant, known as the "mother," that is encouraged to

produce roots and thereby become a new plant. Whereas a seed is the combination of its mother and father plants' genetics, a clone has exactly the same genetics, and therefore sex, as its mother plant.

Pros and Cons of Cloning

Pros:

The number one advantage of cloning is that it is practically free! Other than a little labor and some manageable stress on the mother plant, cloning costs you no more than the rooting hormone and grow blocks you use. Cloning allows you to create exact copies of your best-performing plants. Clones will not only grow the same but will also produce the same quality of bud in terms of aroma, flavor, and effect. Compared to buying seeds or sacrificing a crop just to produce seeds, cloning is the obvious way to go for many growers. Clones also lend themselves nicely to perpetual harvesting, making it easy to produce and keep plants in each of the various growth phases to cycle as needed. Clones will always be the sex of the mother plant, so the need for sexing and culling males is eliminated, saving additional labor hours in your garden.

Cons:

When you take a cutting, you face the risk of the clone not producing roots and failing to become a new plant. Both the clone and the mother plant are also susceptible to infection due to the wound from the cutting. Clones can experience "transplant shock" as well, where they fail to take root properly and do not become viable plants. For these reasons, cloning should be done in as sterile a manner as possible. Many growers take one cutting at a time and convert that cutting into a clone before taking additional cuttings in order to minimize the environmental exposure of the wound site.

Do Clones Change?

Because clones are genetically identical to the mother, they should exhibit exactly the same properties. If this is true, you should be able to take clones from clones forever and maintain the exact same genetic status, with all the aromas, flavors, and potency that go along with it.

Although this sounds magical, some growers insist that a phenomenon called clonal degradation exists, which is said to cause the genetics of clones to "drift" away from the sought-after characteristics of the mother plant. For now the jury remains out on this discussion, but the majority of industrial indoor cannabis processors in the United States choose clones as the bedrock of their plant propagation programs.

Pest Management and Other Woes

There are bound to be issues that pop up as your plants grow. The key is dealing with each issue as soon as it arises. Pest management starts with having strong, healthy plants able to fight off pests and pathogens. Weak plants are easy prey. But even the healthiest of gardens will at times experience one or more pests.

Pest Prevention

Keep them out! The first line of defense for pest management focuses on excluding the pests from your grow. Make sure your area is sealed up against any access from outside the plant enclosure. Check for gaps in walls, floors, and ceilings that could allow pests to gain entry. Use caulk to seal any gaps, or hang plastic sheeting, and use tape as necessary. Remember, *you* can be the biggest culprit of introducing pests into your indoor grow. Be careful not to wear clothing that was worn outside or at a friend's grow. Hitching a ride on the grower's clothes, shoes, and hair is a common route of pest entry. Some growers keep a smock or similar garment and boots inside the grow space and only use them for cultivation purposes while inside the grow. If you purchase clones, take precautions to not introduce any pests or diseases to your grow space. Some growers put newly purchased clones in a separate area for 10 to 14 days prior to introducing them into the grow space.

HOW TO CLONE

MATERIALS NEEDED:

- Dome and tray setup

- Isopropyl alcohol (70 percent)
- Pruning shears
- Razor blade or scalpel
- Rooting hormone
- Rooting media such as soil, Rockwool, or coco coir plugs

Make sure to wash your hands and wear gloves. Wet your growing media and prepare the rooting hormone, if necessary, according to the manufacturer's instructions. Find a suitable cutting from a female marijuana plant in the vegetative state: a branch with at least two nodes above the cut. Sanitize pruning shears by spraying with alcohol, then cut the branch above the mother's node. Sanitize a scalpel by spraying with alcohol, then cut the bottom of the cutting at a 45-degree angle to the stem below the lowest node. This increases the surface area from which roots will emanate and encourages root development. Immediately dip the end of the cutting into the rooting hormone, and place the cutting in the growing media. Trim the cutting by removing all but the top set of fan leaves and growth site. Lastly, square off the tips of the remaining fan leaves by making a straight cut perpendicular to the long axis of the leaf about one inch down from the tip. This encourages photosynthesis and reduces evaporation of water from the leaves. You can now relocate your clone to the tray and cover with the dome to keep humidity high. The rooting media will sit in the tray, which will retain some water.

Clones are similar to seedlings in their maintenance. They prefer high humidity and temperature: around 70 percent RH and 75°F to 78°F. Lighting should be similar to what is used for seedlings: often CFLs or other mild-intensity lights focused in the blue spectrum on a schedule of 18 hours on/6 hours off. In order to maintain clones continuously, many growers dedicate a small area of their grow to clones and/or seedlings that is light-blocked and isolated from the primary growing area. Keep the soil moist but not saturated by spraying water once per day. Roots should be one to two inches long after 10 to 14 days, at which point the clones can be transplanted and returned to the vegetative state or sent to flowering. Most growers wait at least one week after transplanting to shift into the flowering stage.

Pest Control

No intervention against pests is 100 percent effective, and managing them requires constant vigilance. Controlling your pests begins with monitoring for pests. You should check each of your plants for pests at least every few days. With the grow lights off, use a head-mounted light and magnifying glass to inspect the entire surface of the plant—the stem, branches, leaves, underside of leaves, and buds, including nooks and

crannies—looking for any pests or signs of pests. Signs may include chewed plant material, dead pests, or waste matter. Many growers regularly use a prophylactic spray. If you're not into spraying harsh chemicals, try organic alternatives such as neem oil or insecticidal soaps. No matter what you apply, make sure it is legal and you're following the manufacturer's instructions. Flowering plants can be sensitive to many foliar sprays, so spraying should be timed to avoid leaving residue at harvest. You'll want to avoid spraying the buds directly unless absolutely necessary, as this can change the aroma and flavor of the finished bud.

Pest Identification

Many pests like the sweet stickiness of marijuana plants and buds. Some insect species with a craving for your pot garden are whiteflies, aphids, caterpillars, leaf miners, and thrips, among many others. If a general prophylactic spray is still allowing some pests to get through to your plants, identifying the species can help you target your efforts. A quick Google search reveals many websites that can assist with pest identification and mitigation.

Aphids: like the underside of leaves; can be small, soft-bodied, wingless youths or winged adults

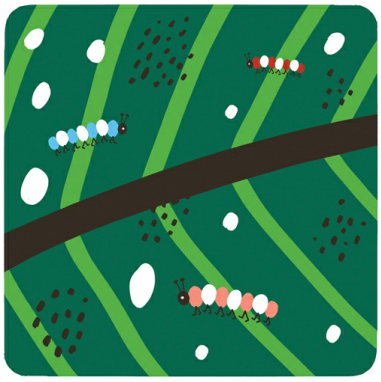
Caterpillars/worms, including loopers and budworms: eat leaves and plant material and deposit waste

Leaf miners: live inside leaves and eat from the inside out; winding, discolored trails are telltale sign

Mites, including spider mites and russet mites: very small and often only seen once an infestation is present

Whiteflies: look like small white moths; like the underside of leaves

Whiteflies



Caterpillars/worms

Leaf miners

Fungi and Mold

While not technically pests, fungi like molds and mildew can infect your cannabis plants. They like warm, humid environments, so your grow room provides optimal conditions. The same type of biocontrols mentioned under Pest Prevention (here), with dedicated shoes and garments, should be used to control molds as well. White powdery mildew (WPM) is a common pathogenic mold that affects cannabis plants. The disease manifests as a white powdery substance seen on leaves and plant matter. If left unchecked, it can break down your marijuana plants and produce unusuable bud. Be sure to clean and sanitize your grow room and any tools and vessels used at the end of a cultivation cycle, in preparation for

the next cycle.

Bud Rot

Bud rot, aka gray mold, is caused by another type of fungi, Botrytis, which infects the leaves and buds of cannabis plants. This often occurs due to ineffective air circulation and ventilation, when the air around the colas stays excessively warm and humid. The first signs of bud rot are yellowing or paling of bud leaves or small patches of mold appearing at the base of the bud. Bud rot starts internally at the stem, so by the time you see external signs, you often already have dead or moldy bud on the inside. Marijuana buds with mold should be discarded, not ingested.

TAKEAWAYS & EQUIPMENT LIST

Holy smokes! You made it through Step 10: The Maintenance!
In this step, we showed you some more advanced techniques for caring for your grow. We covered:

- The importance of pruning to increase yield, improve airflow, and keep your plant's energy focused on making buds of the highest quality and potency
- The advanced process of cloning by taking and growing a cutting of a plant
- How to use preflowers to determine the sex of your plants and remove any males
- The importance of inspecting your plants often to look for pests

SHOPPING LIST FOR CLONING, PLANT INSPECTION, AND PEST CONTROL

- [ ] Dome and tray setup
- [ ] Head-mounted lamp or similar hands-free light source
- [ ] Isopropyl alcohol (70 percent)
- [ ] Magnifying glass

- [ ] Neem oil, insecticidal soaps, or prophylactic spray
- [ ] Pruning shears
- [ ] Razor blade or scalpel
- [ ] Rooting hormone
- [ ] Rooting media such as soil, Rockwool, or coco coir plugs

Maintaining a healthy grow is no small feat, but it's the final step before the best part: the harvest. In the next step you'll learn how to harvest your bud after all this hard work.

Step 11

The Harvest

Congratulations! Not only have you almost made it through this book, but it's here. That special moment you've been waiting for. Harvest day.

You've managed to create your grow space and care for your plants throughout their entire existence. You're excited to reap the rewards. The cultivation process can seem long and will often test a grower's patience, especially first-timers. Before you go hacking away at your plants like some pot-crazed lunatic, make sure the time is right for harvest. In this final step, we'll talk about when and how to harvest and how to cure, trim, and store your crop properly.

Is the Time Right?

THC, the psychoactive chemical in marijuana, degrades into CBN, or cannabinol. CBN is a sedative-type cannabinoid with fewer psychoactive properties than THC. How you time your harvest will determine whether you have the highest-possible THC levels, the highest-possible CBN levels, or a balance of the two cannabinoids.

There are three factors that dictate when the best time to harvest is: the flowering time, the color of the stigmas, and the appearance of the

trichomes. Flowering time is a baseline set by the grower after observing the strain's growing habits. Stigmas are the white, hairlike structures that are the visible part of pistils, and they typically turn red or brown when THC levels are at their highest. Trichomes are those resinous, mushroom-shaped structures on bud and bud leaves that produce terpenes and cannabinoids like THC, CBD, and CBN.

Stigmas and trichomes are key in determining the level of marijuana potency, aroma, and flavor and thus your crop's readiness for harvest. Keep in mind that the amount of marijuana you are able to harvest and the potency, aroma, and flavor all peak at about the same point toward the end of the flowering stage. The goal of most home growers is to hit this sweet spot in yield before potency starts to drop off.

Equipment Required

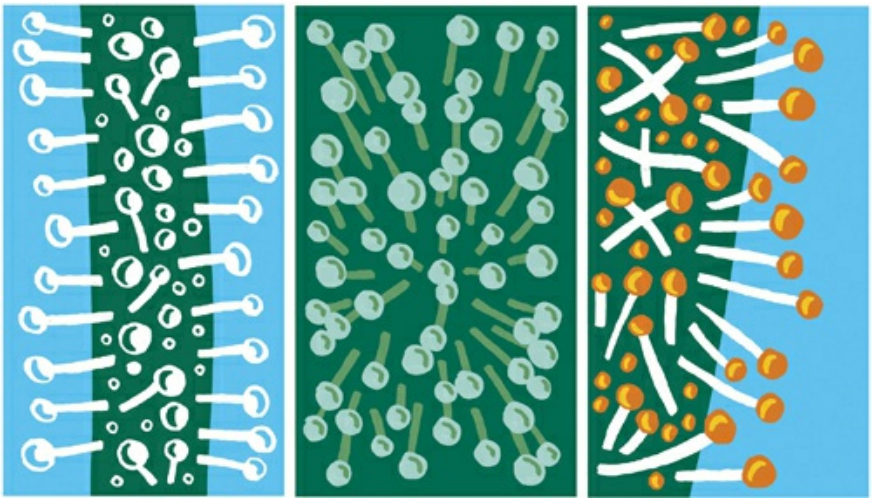
Stigmas are large enough to be viewed with the naked eye, but trichomes are rather small and require magnification to get a proper view. You can use a magnifying glass, a jeweler's loupe, a digital microscope (which can cost as little as $30), or even your smartphone's camera. No matter what magnification tool you choose, the key is to be able to see in color and high enough resolution to evaluate trichome development for color and clarity.

Reading Stigmas

Changing stigmas will be the first sign that harvest is approaching. Stigmas start out white, sticking straight out from the bud, but as they develop, they darken in color, often to a red or brown hue, and start to curl. Once a majority of stigmas have started to change color and curl, you can evaluate the trichomes. For maximum THC levels, wait until 75 to 85 percent of stigmas have changed color. If you want to let some of that THC convert into CBN to create a sleep aid with little to no psychoactive properties, wait until 90 to 95 percent of stigmas have changed color. By the way, you will typically always have a few fresh, white pistils. This is expected, as the plant is actively flowering. Base your decision to harvest on when the vast majority of stigmas have changed and disregard random new ones.

Reading Trichomes

Trichomes are those resinous glands that are workhorses of terpene and cannabinoid production. The ones we're focusing on look like small, long-stalked mushrooms. Like stigmas, trichomes change in color as they develop and mature through three basic phases during the flowering stage. In the first phase, the trichomes are young and undeveloped and have produced few terpenes or cannabinoids; this phase is characterized by clear, glossy trichomes. If your trichomes are still clear, it is most likely too soon to harvest. The next phase represents maximum THC potency and is characterized by cloudy or opaque trichomes. This is the ideal harvest state for many indoor growers looking to garner the largest amount of THC and CBD from their plants. The final phase is characterized by a majority of trichomes turning brown or amber, indicating oxidation and the creation of degradation products like CBN. This would be considered late to harvest unless you were seeking a lower THC/higher CBN product.



Different Bud Sites

The cola bud and upper-level buds will make up the bulk of your harvest and contain the highest-quality, most potent parts of your plant. It's for this reason you want to base your decision to harvest on the development level of the colas and higher-positioned buds. It's completely normal to have buds that are lower down on the plant or blocked by dense foliage

be less developed than the colas and upper-level buds. You can only cut the plant down once, so you want to get the best overall bang for your buck. If you wait for the lower buds to develop before harvesting, you might miss the high-potency window for the colas and more developed buds. Less-mature buds can be used for butter or other concentrates. Some growers harvest in stages in order to allow their immature buds to develop. For example, you could harvest only the top half of a plant and allow the buds below to mature for another week to 10 days prior to harvesting them.

CBD

Cannabinoids are substances found in cannabis such as THC, CBD, and CBN. Over 110 different cannabinoids have been isolated from cannabis plants to date. Arguably, THC and CBD are the most popular cannabinoids today, with CBN and CBG becoming more popular. CBD, or cannabidiol, has proven therapeutic effects and is the active ingredient in the FDA-approved drug Epidiolex, which is the only FDA-approved, cannabis-derived medicine on the market. CBD lacks any psychoactive properties and is said to give the consumer a "body high" versus the "mental high" associated with THC. CBD is said to offer relief from a variety of ailments, from digestive issues to arthritis.

Most CBD produced and sold in the form of topicals, tinctures, and edibles is sourced from high-CBD hemp strains that contain little to no THC. Marijuana and hemp are both cannabis plants. Because it's a type of cannabis, hemp can be grown indoors in a similar way to marijuana, but hemp strains are often optimized for outdoor cultivation and tend to be much taller than indoor grows will allow. If CBD is what you seek, try a high-CBD strain of marijuana, such as Pennywise or Deadlights. These will yield high CBD while maintaining a smaller size and profile.

How to Harvest

So, you've decided your plants have been in the flowering stage for long enough. A high percentage of the stigmas have darkened and curled, and most of the trichomes are milky white, with a few amber heads here and there. And you flushed your plants with plain water as early as one to two weeks ago to produce a cleaner product with better flavor and aroma.

Your hard work is about to pay off. Take a deep breath and follow these steps to ensure your harvest session is clean and efficient and your buds

are treated with care.

Prep

Before you jump into harvesting, make sure you and your area are ready. The cleaner you work, the less chance of the product becoming damaged or contaminated. You should have the following on hand for your harvest:

- [ ] Drying rack or equivalent
- [ ] Isopropyl alcohol (70 percent)
- [ ] Manicuring tray or tub
- [ ] Paper towels
- [ ] Sharp pruning shears
- [ ] Small brush and dustpan
- [ ] Trash bags

We recommend having a large table or other work surface to break down the plant on once you've cut it. Line the table with plastic or trash bags for easy cleanup. Try to clean as you go, and only start what you know you can finish processing. Dispose of leaves and unwanted plant matter as soon as practical so they don't become an attractant for pests and to help reduce contamination.

Light

Hand trimming, unless you're attempting to manicure to perfection, doesn't require any special lighting. Natural light or standard fluorescent home lighting works nicely. Don't try to use your grow lights, as they'll be too bright. Keep in mind that trichomes degrade in response to light and oxygen, so you want to avoid any high-intensity light like the light used during the vegetative and flowering stages. Once your bud is separated from the plant, it can't continue to develop or grow, so light is no longer beneficial.

Climate

You can harvest at room temperature or a little cooler with relatively low RH, ideally 60 percent or less. The harvesting and preliminary breakdown of your bud can take a few hours, depending on the number of plants and

yield. The next phase after harvest is drying, during which the optimal temperature is around 68°F with low relative humidity, about 50 percent. The sooner you can get your buds into these conditions, the better. However, a couple of hours spent around room temperature with slightly higher RH shouldn't be detrimental as long as the buds move through the process and are cooled down and dried quickly.

Time

Though the cut to the main stalk only takes a few moments, breaking down, trimming, and preparing your cannabis for drying can take considerably longer, often up to 30 minutes per plant. You want all the plants you cut down to begin drying immediately. Sitting for several hours or overnight can allow moisture to start breaking down the bud and encourage mold growth. If you have many plants, consider breaking your harvest up so you can harvest, trim, and set to dry only two or three plants at a time. Be careful not to cut down more plants than you can process in two or three hours.

Allow ample time for cleanup and reorganization of the grow area as well. Cleaning and sanitizing the grow area after harvest eliminates pathogens and fungi and gives you a clean starting point for your next batch of plants.

How to Trim Properly

Harvesting and trimming can be intimidating, but they don't need to be. The goal is to get all the flower, including the cola, separated from the plant and pre-trimmed to facilitate drying. After drying, individual nuggets are cut from the larger stem and manicured to your preference prior to curing and storage.

Remember to wear protective eyewear and clothing as well as gloves during the harvest, trimming, and curing stages because many individuals, even chronic users, can develop skin sensitivities, rashes, and other allergic-type reactions.

Cutting the Cola

Start by removing the top cola from the plant with your pruning shears, cutting an inch or two below the bottom of the cola. If the shears get sticky with resin, use isopropyl alcohol to dissolve the residue and get them moving again. The cola often contains 50 percent or more of the total useable material from a plant, so you want to be careful when handling it and breaking it down. If the colas are very dense, consider cutting them into three or four pieces to improve airflow during the drying phase. You want your buds to be of relatively similar density and volume so they dry at the same rate.

Top-Down or Bottom-Up Harvest Method

If you're limited on space, consider processing one plant at a time, starting with the cola and working your way down in a top-down fashion, removing bud stems as you go. If you invert and hang your plant while working on it, you will most likely work in a top-down fashion as well, even though this corresponds to working bottom-up for the plant. It doesn't matter which direction you go in. Whatever method works for you and doesn't leave behind any usable bud is a good one.

Removing the Leaves

Your buds need some cleanup before they can be dried. This step can be considered "pre-trimming." Your goal is to clean up the buds so they dry as evenly and consistently as possible. Remove any remaining fan leaves or yellow leaves while wet. These will dry and start to hug the buds, making them difficult to trim away later. The sugar leaves, which are the small resinous leaves embedded in and around the bud, should be left on at this stage. They are soft and sticky due to the trichomes that are present. If desired, you can manicure the finished buds more and remove some sugar leaves in a later step. Removing the fan and yellowing leaves will allow the cola to dry out nicely.

Hanging to Dry

Now that your plants are broken down into stems with several buds, you can move to the drying step. Most growers hang their plants upside down by attaching them to hangers or a clothesline. The area you use for drying should be clean to prevent mold and fungal infections. Temperature should be set to 68°F with RH around 50 percent. The more airflow you have, the better and faster your buds will dry out. Fans can help circulate the air, but make sure there is adequate air exchange because the air contains all the water being sucked out of the buds. High humidity levels during drying lead to the risk of introducing molds and pathogens. Small buds that can't be hung directly can be left on a mesh drying rack suspended in the air. Drying usually takes one to two weeks.

You can check the humidity of the bud as an indicator of the progress of the drying process by placing some bud in a mason jar with a humidistat. Your bud is dried enough once its humidity falls to 65 percent. You can also test dryness by breaking off a small bud with your fingers. If the stem snaps off, your bud is at a good dryness level. If the stem tears and splinters without breaking, you probably need some more time. Drying is best performed in the dark so as not to degrade precious cannabinoids and terpenes.

Cutting the Bud

After the drying process is complete, your buds should be cut down to manageable nuggets to cure properly and for long-term storage. Your

finished buds might be anywhere from one to four grams in weight depending on your preference and how the plant breaks down naturally. If your goal is perfectly manicured buds, this is the point at which you should spend that extra time to trim, shape, and remove sugar leaves. We suggest doing this as little as possible because your trimmings will contain a significant level of cannabinoids. You can always put them into butter, concentrate, or some other product, but why not leave them on the bud? Be sure your curing/storage container is the right size and provides an airtight seal like a mason jar or a container with a gasketed lid.

Curing

Curing is a critical step for giving you the potency, aroma, flavor, and shelf life you've worked so hard for. Curing involves keeping your buds in climate-controlled storage while frequently "burping" them—releasing built-up gases and allowing fresh air into the storage container. Once your buds are transferred to airtight containers, place them in a cool, dark area. To burp them, open the container, leave the buds exposed for several minutes, and reseal at least once per day. The curing process can last 3 to 12 weeks. Just as with drying, you can check for the curing process endpoint with a humidistat. Your ideal long-term storage humidity for bud is between 62 and 65 percent RH. Once your bud falls to this level, you can officially end the curing process and transfer your product to storage.

Storage

The best way to store your stuff is in airtight glass or food-grade plastic containers. You can use glass mason jars, food-grade plastic bags, or food-grade plastic tubs. Store the containers in a cool, dry place, and keep them sealed and out of the light. Remember that oxygen and light are the enemies of terpenes and cannabinoids. If cured and stored properly, your finished marijuana can last for up to one year with little degradation of THC, CBD, terpenes, or flavonoids.

Shopping List for the Harvest:

- [ ] Drying rack or equivalent

- [ ] Humidistat
- [ ] Isopropyl alcohol (70 percent)
- [ ] Magnifying glass, loupe, or digital microscope
- [ ] Manicuring tray or tub
- [ ] Sharp pruning shears
- [ ] Storage containers

Enjoying Your Hard Work

Finished marijuana buds are often referred to as "flower" to distinguish them from the other value-added forms of cannabis, such as concentrates, tinctures, creams, and edibles. These other products often include extracted distillates from marijuana or hemp as ingredients.

Concentrates

Concentrates include wax, shatter, budder, vape oil, distillate, and other products. They have high cannabinoid content, often approaching 90 percent. Distillates are very pure and typically impart no color, flavor, or aroma to the products they're utilized in. Industrially, distillates are often used to introduce cannabinoids into tinctures, topical creams, and edibles. If you are looking to extract at home, do some research and start out with a basic alcohol extraction. This involves heating your weed with 190-proof grain alcohol and reducing the mixture containing the stripped cannabinoids to a gel.

Tinctures

Tinctures in general are pure extracts of various plant compounds. In the world of cannabis, tinctures are mixtures of cannabinoids, often with carrier substances such as medium-chain triglycerides (MCT) or olive oil. There are tinctures with single cannabinoids, such as CBD, and tinctures with blends of cannabinoids, such as THC and CBN. Tinctures offer a way to ingest concentrated cannabinoids without vaping, smoking, or eating. They have grown quickly in popularity, with CBD tinctures being the most common.

Creams

A plethora of creams are sold today that include THC, CBD, or a combination of the two cannabinoids. In the United States, creams containing THC must be sold in a state-licensed dispensary, whereas CBD-based creams abound at your local pharmacy. Many consumers swear by these products. THC-based creams often cause the area where the cream was applied to warm up, which lends to the soothing effect of the THC.

Edibles

The classic "pot brownie," alongside cannabis cookies and other treats, has been around for decades as a staple of the ganja community. More recently, culinary trends featuring the use of marijuana in cooking have produced some exotic and aggressive dishes. Edibles now include gummy bears, gummy worms, and high-quality chocolates infused with cannabinoids. If you venture into the world of making edibles, make sure your weed is always decarboxylated. Decarboxylation converts THCa into THC, allowing your edibles to have an effect. Without decarboxylation, your edibles won't pack much of a punch.

Cannabutter

Can't smoke all that weed? Try making cannabutter. It can be used in any recipe that calls for butter but is most popular in baked goods. The key to making cannabutter is keeping the butter on low heat—burn it and you'll

ruin the flavor and potency.

Ingredients

2 cups fresh marijuana shake and trim
2 cups unsalted butter

Procedure

1. Preheat the oven to 250°F.
2. Bake the marijuana in the preheated oven for 30 minutes.
3. While the marijuana bakes, melt the butter in a saucepan or a skillet on low heat until foamy.
4. Grind the marijuana and add it to the butter.
5. Cook over low heat for 2 to 3 hours, stirring occasionally. Strain the mixture into a bowl using a wire-mesh strainer, cheesecloth, or paper coffee filter. Cool until solid.
6. Transfer to an airtight container. Label: "CONTAINS MARIJUANA. KEEP OUT OF REACH OF CHILDREN." Store for up to 6 months in the refrigerator.

Tip: Grab your favorite box of brownie mix, substitute cannabutter for the vegetable oil, and you'll have a batch of yummy edibles in no time!

CONCLUSION

You should be proud of yourself for starting your journey into growing marijuana indoors. Give yourself some time to digest the contents of this book, set goals, and make a plan of action for your indoor cultivation.

As you start your journey, don't be discouraged by setbacks. This is how we all learn. Lucky for you, cannabis has been growing naturally for thousands of years, so the chances of your success are pretty high (pun intended)! We encourage you to network with your indoor-growing peers online. Build a support network that can provide answers and advice, and where you can also share the knowledge and expertise you've acquired.

Growing marijuana indoors is no small feat. We merely scratched the surface of many topics in this book, but it should provide a solid foundation. When you run into a problem, ask some questions, do a little research, or talk to a fellow grower—but don't give up! A solution certainly exists, and you're probably not the first person to seek it. Growing marijuana indoors should be looked at as more of a lifetime journey than as a solitary event. We hope this book inspires you to keep learning, and we look forward to continuing this journey with you. Happy growing!

DIAGNOSING NUTRIENT DEFICIENCIES

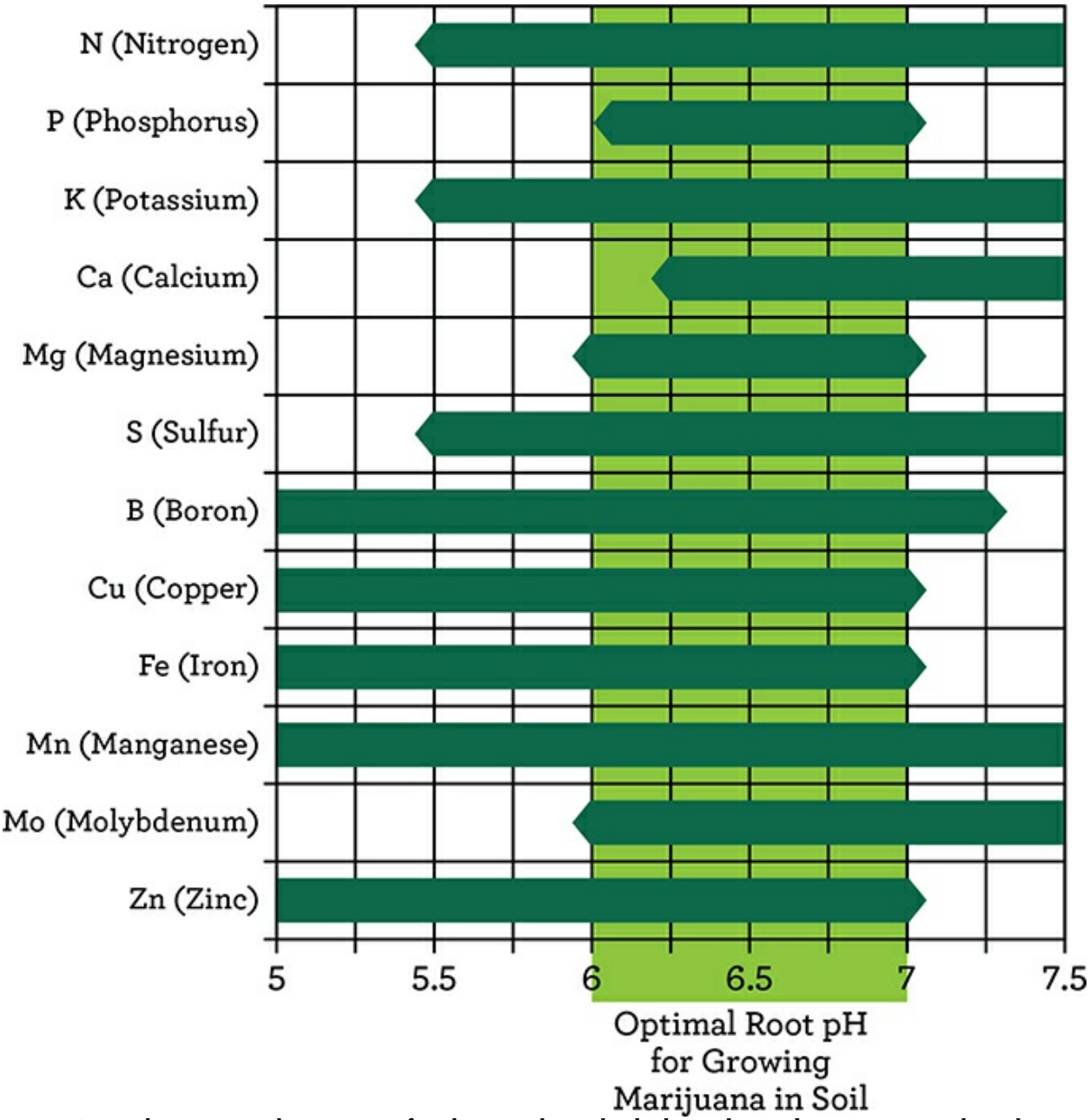
Your plants need water, sunlight, CO_2, and nutrients to grow, stay healthy, and develop. If your plants are getting plenty of water, light, and airflow but their growth or development is lacking, you most likely have a nutrient issue. Nutrients are critical factors in virtually all of the biological processes of the marijuana plant, from photosynthesis to respiration. Macronutrients are needed in large quantities throughout the plant's life, but micronutrients are needed in only minute amounts. Most soils and many added-nutrient blends contain more than enough micronutrients to bolster your plants.

But just providing nutrients isn't enough because a plant actually has to take them up for their use to be effective. There are two primary factors that determine uptake of available nutrients: soil pH and the presence of other nutrients. Most nutrients are easily taken up by plants in soil with a pH level between 6 and 7, so aim for a soil pH of 6.5. If you suspect soil pH is your issue, check the pH of your watering solution and the pH of the soil via runoff water with test strips or a pH meter (see Step 8: The Nutrients). If these readings are outside the appropriate range, you may need to adjust the pH of your soil or watering solution appropriately.

The other common issue is blocking of nutrients by other nutrients. For example, iron uptake is blocked if there is an abundance of potassium in soil. In these situations, deficiencies are more often the problem, but toxicities—where the plant has too much of a certain nutrient—can also occur.

For background on nutrients and nutrient profiles, check out Step 8: The Nutrients.

Soil pH



Note: Green bars cover the ranges of soil pH within which the indicated nutrients can be taken in by marijuana plants.

Nitrogen Deficiency

Nitrogen is key to the creation of chlorophyll, enzymes, hormones, and amino acids—the building blocks of plant proteins. Nitrogen is consumed more than any other nutrient during the early growth and vegetative stages and dictates the general size and health of your plants.

Signs of nitrogen deficiency include:

- Yellowing of leaves (often during the vegetative stage), starting with older leaves toward the bottom of the plant and migrating up if left unchecked

To fix nitrogen deficiencies:

- Check that your soil pH is in the appropriate range and adjust as necessary
- Reassess nutrient feeding products, dilutions, and schedules to determine the root cause of the deficiency.
- Add nitrogen via nitrogen-rich soil amendments or foliar feeding in the form of blood meal, worm castings, fish meal, etc.

Signs of nitrogen toxicity include:

- Leaves turning deep green
- Leaves appearing leathery in texture
- Blades of leaves curling inward
- Brittle, dry leaves

To fix nitrogen or other nutrient toxicities:

- Discontinue feeding the nutrient to the plant
- Flush soil thoroughly and modify soil pH, nutrient, dilution, and application schedules as necessary

Phosphorous Deficiency

Phosphorus is a key player in root growth, bud development, stem structure, and disease resistance. It is especially needed in the flowering stage, during which it promotes strong, dense buds.

Signs of phosphorus deficiency include:

- Slow growth and loss of vigor
- Brown spots on the largest leaves
- Darkening of stems that spreads if unchecked

- Leaf edges turning brown and curling inward

To fix phosphorus deficiencies:

- Check that your soil pH is in the appropriate range and adjust as necessary
- Reassess nutrient feeding products, dilutions, and schedules to determine the root cause of the deficiency
- Add phosphorus via phosphorus-rich soil amendments or foliar feeding in the form of bone meal or flowering-stage nutrient blend

Potassium Deficiency

Potassium facilitates water circulation, respiration, disease resistance, photosynthesis, root growth, and CO_2 regulation. Only small quantities of potassium are needed by plants.

Signs of potassium deficiency include:

- Leaves turning brown before dying
- Leaf tips and edges appearing burnt
- Abnormal growth

To fix potassium deficiencies:

- Check that your soil pH is in the appropriate range and adjust as necessary
- Reassess nutrient feeding products, dilutions, and schedules to determine the root cause of the deficiency
- Add potassium via potassium-rich soil amendments or foliar feeding in the form of wood ash or fish meal

Calcium Deficiency

Calcium plays a role in healthy root systems, strong stems and branches, and heat resistance. If you water with RO, DI, or zero ppm TDS water, you may need to find a way to include calcium in your grow. Most soil mixes

contain ample amounts of calcium from lime.

Signs of calcium deficiency include:

- Slow development of buds
- Dying leaves
- Dead patches on leaves
- Unnaturally dark-colored leaves, primarily on older growth
- Tips of leaves curling inward

To fix calcium deficiencies:

- Flush growing media with water to remove any salts or nutrients potentially blocking uptake
- Check that your soil pH is in the appropriate range and adjust as necessary
- Add calcium via dolomitic lime or similar
- Add calcium nitrate to watering solution

Magnesium Deficiency

Magnesium is a key component of the chlorophyll molecule and is essential to the plant's ability to absorb light. It assists enzymes' production of sugars, which are essential to big, vibrant buds.

Signs of magnesium deficiency include:

- Leaves yellowing between veins
- Older leaves yellowing and falling off
- Leaves curling inward
- Growing shoots that look white instead of green
- Stems and petioles turning red

To fix magnesium deficiencies:

- Flush growing media with water to remove any salts or nutrients potentially blocking uptake

- Check that your soil pH is in the appropriate range and adjust as necessary
- Add magnesium via Epsom salt, dolomitic lime, worm castings, or a calcium-magnesium supplemental product

Sulfur Deficiency

Sulfur plays a role in root-system development and the creation of chlorophyll, vitamins, and proteins.

Signs of sulfur deficiency include:

- Slowing growth
- Yellowing of new foliage
- New leaves that are thinner and smaller
- Buds dying prematurely
- Yellowing that starts at the base of the leaf and moves out to the blade tips

To fix sulfur deficiencies:

- Flush growing media with water to remove any salts or nutrients potentially blocking uptake
- Check that your soil pH is in the appropriate range and adjust as necessary
- Add sulfur via Epsom salt or potassium sulfate

Copper Deficiency

Copper plays a role in photosynthesis, flower development, and the synthesis of proteins and carbohydrates.

Signs of copper deficiency include:

- Twisted or curled-under leaves
- Decay in young leaves
- Dark, purple, or blue leaves with yellow or pale tips and edges

- A metallic hue to leaves
- Abnormal flower growth
- Leaves directly under light being most affected

To fix copper deficiencies:

- Flush growing media with water to remove any salts or nutrients potentially blocking uptake
- Check that your soil pH is in the appropriate range and adjust as necessary
- Add copper via compost, kelp, copper biocides, or watering with tap water
- Evaluate lighting intensity and adjust if necessary

Iron Deficiency

Iron is one of the more common deficiencies for indoor plants. Iron is involved in chlorophyll production and supports general plant health and vigor.

Signs of iron deficiency include:

- Pale yellow leaves with green veins (like with magnesium deficiency), particularly on new growth
- Stunted plant growth and development

To fix iron deficiencies:

- Flush growing media with water to remove any salts or nutrients potentially blocking uptake
- Check that your soil pH is in the appropriate range and adjust as necessary
- Add iron via iron chelate as a foliar spray or compost as a soil amendment

Manganese Deficiency

Manganese plays a key role in chlorophyll production and the management of enzymes and nitrates. An abundance of manganese can cause decreased iron uptake and vice versa.

Signs of manganese deficiency include:

- Leaves yellowing between veins
- Brown, necrotic spots on center of leaves
- Brittle, dry leaves
- New growth being most affected

To fix manganese deficiencies

- Flush growing media with water to remove any salts or iron potentially blocking uptake
- Check that your soil pH is in the appropriate range and adjust as necessary
- Add manganese via a water-soluble manganese spray supplement or compost as a soil amendment

Molybdenum Deficiency

Molybdenum is involved in the conversion of nitrates and ammonia and the synthesis of proteins. This micronutrient is needed in only trace amounts, so deficiencies are quite rare. Molybdenum deficiency is sometimes confused with nitrogen deficiency. The latter starts at the oldest, lowest leaves, while the former starts in the middle of the plant.

Signs of molybdenum deficiency include:

- Yellowing of leaves starting in the middle of the plant
- Abnormal growth of new plant tissues
- Leaf tips and edges turning red, orange, or pink

To fix molybdenum deficiencies:

- Flush growing media with water to remove any salts or nutrients potentially blocking uptake

- Check that your soil pH is in the appropriate range and adjust as necessary
- Add molybdenum via a foliar spray containing molybdenum

Zinc Deficiency

Zinc regulates enzymes, plant proteins, and growth factors. Zinc deficiencies typically arise when plants can't uptake the nutrient due to a high or low soil pH level. Zinc deficiencies are often accompanied by deficiencies in manganese and iron, so check for these micronutrients as well.

Signs of zinc deficiency include:

- New growth turning yellow
- Older leaves' veins turning yellow
- Abnormal new growth
- The distance between nodes shortening

To fix zinc deficiencies:

- Remove damaged leaves
- Flush growing media with water to remove any salts or nutrients potentially blocking uptake
- Check that your soil pH is in the appropriate range and adjust as necessary

RESOURCES

Helpful links to websites for cultivation help, seeds, and supplies:

Cultivation

CannabisTrainingUniversity.com

GreenBudGuru.com

GrowWeedEasy.com

HomesteadAndChill.com

ILoveGrowingMarijuana.com

Leafly.com

MarijuanaAndTheLaw.com/resources/state-cultivation-laws

Seeds

HerbiesHeadShop.com

High-Supplies.com

RoyalQueenSeeds.com

SeedsMan.com

Supplies

GrowBarato.net/en

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Thanks to the cannabis plant for providing relief to individuals for thousands of years and to you intrepid growers for taking control of your supply by growing indoors.

About the Author

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