# GENERAL INFO
# ON LIGHTING

Light is the most important factor in any indoor growing environment. It is also the limiting factor in any indoor growing environment. Without good and plentiful light, a plant will not be able to perform photosynthesis, the nitty-gritty process that occurs when a plant converts food into energy. Fortunately, plants are able to use artificial light, as long as there is plenty of it and it is of the correct growing spectrum.

## Photosynthesis

Of the many light-absorbing pigments within a plant's leaf structure, the most active is chlorophyll. Chlorophyll absorbs light from the blue and red wavelengths of the visual spectrum, turning plants into that stunning green our eyes have come to know and love. The absorbed radiant energy is used to convert ingested carbon dioxide, water and nutrients, to make carbohydrates which nourish the plants and promote new cell growth. This allows for strong, vigorous tissue production and the release of the oxygen. Correct lighting will result in healthy, happy plants that are resistant to infections or colonizing hordes of insectoid pests.

## Spectrums

Plants are under the spell of the seasons, and subject to seasonal changes in light. The blue end of the spectrum is associated with spring and lengthening days, promoting vegetative growth and short stocky stature. The red end of the spectrum is reminiscent of autumn, with shortening days and long harvest sunsets. Autumn usually promotes plants to finish up, creating flowers and seeds. It also gives plants a sweet, poetic feeling, like one gets upon seeing a beautiful sunset. We are not making this spectrum stuff up. Ask any plant.

## Light particles

Inexperienced growers often make the mistake of cramming too many plants under insufficient light. Without enough light particles to go around, plants will not have enough energy to grow. Plant growth will be spindly and weak and the grower will be sad, disappointed and confused. To avoid this happening to you, we suggest the use of a light meter to learn exactly how much light your plants are receiving. A light meter uses a photo-sensitive cell that creates an electric current when light particles fall on it and displays it in foot candles. From there, you can figure out if plants are getting the optimum amounts of light they need. Different plants require different amounts of light. Lettuce and herbs will need far less light than peppers or tomatoes, which must flower to produce their fruit. Plants that require hot sunny days to grow well will need quite a lot of artificial light to produce satisfactory results indoors - don't starve them!

## Lighting cycles

One of the most important jobs of the indoor grower is reproducing the daily and seasonal flow of light. For vegetative growth, in addition to a bluer spectrum, plants are exposed to long growing days such as they might experience in spring and early summer . Plants that are meant to produce veggies, fruits or flowers are encouraged to begin the budding process by a change in the light cycle, and optimally a change of spectrum. In general, 18 hours of light is best for vegetative growth and 12 hours of light is the best stimulus for flowering (although, some plants do work on the exact opposite schedule).

Just about all plants need a regular period of light and a regular period of dark. During the light stage they absorb energy. In the dark period they build organic molecules from the energy they have absorbed. As you reproduce the cycle of nature, consistency is very, very important. Plants love a dependable pattern and will get stressed if the pattern becomes erratic. A good timer should be used in order to create regular lighting intervals of Lights On / Lights Off. The periods can be scheduled conveniently, as long as plants receive their light and dark at the same time every day. The general range is 6-12 hours of darkness every day. It is important not to disturb the dark periods, so be careful about visits that may add unwanted light to the room during that time.

# WHICH LIGHT
# IS RIGHT FOR ME?

Many lights on the market simply aren't suitable for really growing plants. Incandescent lighting (ordinary light bulbs, spot lights, "plant lights," etc.) shouldn't be considered. They're inefficient, not bright enough and have an incorrect color spectrum. If you want to grow plants using artificial light, there are two kinds of lights to be aware of: High-Intensity Discharge (HID) lights and fluorescent lights.

## HID Grow Lights

High-Intensity Discharge lights come as close to natural light as technology allows. However, they're not so sophisticated as to completely reproduce the full spectrum. Consequently, two types of HIDs have been created to blend into a cohesive spectrum -- the Metal Halide and the High Pressure Sodium. These lamps produce four to six times as many lumens as any incandescent light of the same wattage-- and they last much longer. As close to natural sunlight as possible and even safer than a star? We guarantee these lights will never burst into a supernova or collapse in on their own gravity becoming a black hole and destroying the Earth. Nope. Never ever.

An HID lighting system includes a ballast that runs a light socket, powering a bulb. A reflective hood sits around the bulb and focuses light onto plants that would otherwise be lost. Reflectors are either painted white inside or plated with a highly reflective aluminum or brilliant chrome. Some reflectors allow for air cooling, which exhausts hot air out from the bulb and out of the room.

## Metal Halide (MH)

These lamps bathe plants in light from the blue end of the spectrum. They are commonly used in the early vegetative stages of blooming plants' growth to create a strong plant which has large leaves and a thick stems to feed the fruit. One of the major benefits of MH lamps is that they promote tight internodal spacing between branches, keeping plants from stretching. MH light is used for plants that are expected to grow many leaves and become bushy, such as lettuce, spinach, cabbage and herbs. Recent strides in lighting technology have begun to produce MH bulbs that will reproduce a deeper more balanced "Blue" spectrum . The **Hortilux Blue** is an amazing "Full Spectrum" bulb with a CRI rating of 90+.

## High Pressure Sodium (HPS)

HPS bulbs reproduce light from the red/orange end of the spectrum. Plants use this light in reproductive processes, which means that HPS bulbs help your plants to produce more fruits and flowers. Exposing plants solely to a red spectrum light tends to make them stretch, lose their color and start to look downright unnatural. New HPS bulbs are available to include blue light to promote better vegetative growth. Our personal favorite is **Ushio Opti-Red.** If you're only going to use one lamp, we recommend an balanced spectrum HPS, especially for plants that flower.

## Fluorescents

For most of plant growing history, fluorescents have best been used during early plant stages - when using a larger wattage light would be a bit like frying an egg on the sidewalk. They are mainly used to sprout seedlings and initiate rooting in cuttings. They cover a wide spectrum, but until recently they were not capable of growing healthy plants full term.

# WHICH LIGHT
# IS RIGHT FOR ME?

## Digital Lighting


Electronic (Digital) Ballasts are ushering in the new age of indoor grow lighting, proving equal or increased light compared to the conventional core and coil Magnetic ballasts. Digital ballasts do this at a more affordable cost (due to their greater efficiency and less power usage.) Digital Ballasts offer less heat production and virtually silent opperation. They are also much lighter and smaller than their archaic hulking brethren. There are many different Digital Ballasts to choose from on the market today. All come from China (not a single Digital Ballast is made in the U.S. or any other country for that matter,) and most are faulty or poorly crafted. What makes Digital Lighting really special is that they are 15-20% brighter than standard Magnetic Ballasts. **Pandora Ballast,** along with **Galaxy** from Sunlight are our Digital Ballast of choice.

## Double-Ended (DE) Digital Light Systems

The newest Technology to come to our industry is the Double-Ended (DE) HPS Lamp. Along with being capable of up to 1150 watts of output (compared to the 1050 Watts for the Standard HPS bulb), the DE lamp reduces harmonic disortion (aka: Vibration), resulting in less physical wear on the lamp and its internal components. DE lamps also run at a higher frequency, which allows for a more complete spectrum. This all adds up to the most usable (PAR) light for the plants. DE HPS lamps retain over 90% of their output after 10,000 hours of use. Also worth noting: to run a DE bulb optimall, a higher frequency output is needed from the ballast. Currently there are only a few high frequency ballasts on the market. **Pandora** and **Galaxy Grow Amp** are our remote ballast of choice. The **Gavita** Comple systems are another good option wht it comes to complete DE systems. Make sure you pair your DE bulb with teh high frequency ballast.

## Enhanced Spectrum Bulbs

Enhanced Spectrum bulbs produce a richer and more complete spectrum of light that is more accessible by plants. An enhanced spectrum HPS bulb (like **Ushio**) is one that puts off more Blue light when compared to a standard High Pressure Sodium, which only emits Red and Orange light. An enhanced spectrum Metal Halide bulb puts either more Red or Orange light when compared to a standard MH (as in the **Plantmax Metal Halide**) or conversely a rich spectrum of Blue light (for example, the **Hortilux Blue**). Enhanced bulbs will promote overall vitality of the plant, keep the internodes tighter, and the leaves larger and greener.

## Compact Fluorescents

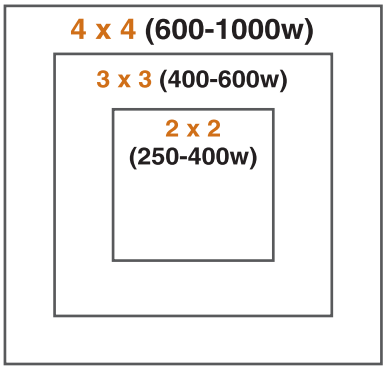
Compact Fluorescents are great at providing a good light with little heat. They are also affordable when compared to HID lights. The light emits from a single source as opposed to long banks of light like those found in normal (T12) fluorescents or those found in High Output (T5) Fluorescent banks. A 100-125 watt Compact Fluorescent is good for a 1x1 to 1.5x1.5 Grow Space and a 250 watt can provide enough light for a 2x2 Grow Space housing either Parents or Vegetative Plants. In our experience these bulbs do NOT do well with Blooming/Flowering Plants.

## High Output (T5) Fluorescents

High Output (T5) Fluorescents put off twice the amount of light when compared to normal (T12) Fluorescents for the same electrical costs. An example would be a standard, two-foot T12 fluorescent bulb, which gives off 1000 lumens compared to a T5 two-foot bulb which gives off 2000 lumens - both use the same wattage. High Output Fluorescents, like Compact fluorescents do really well with Vegetatively growing plants or keeping Parent plants healthy. They can spread the light out over a square area (as in the the two-foot, 8 bulb fixture, taking up 2 ft. x 2 ft. of space) or over rectangular areas (as in the four-foot. 4 bulb or the four-foot. 8 bulb light fixtures) very well. High output Fluorescents put off very little heat compared to the great amount of light that they produce. Not recommended for Fruiting or Flowering. These T5s need to be run in specific fixtures with special electronic ballasts that can power their output such as the **SunBlaze** units.

# HOW MANY LIGHTS **IS RIGHT FOR ME**

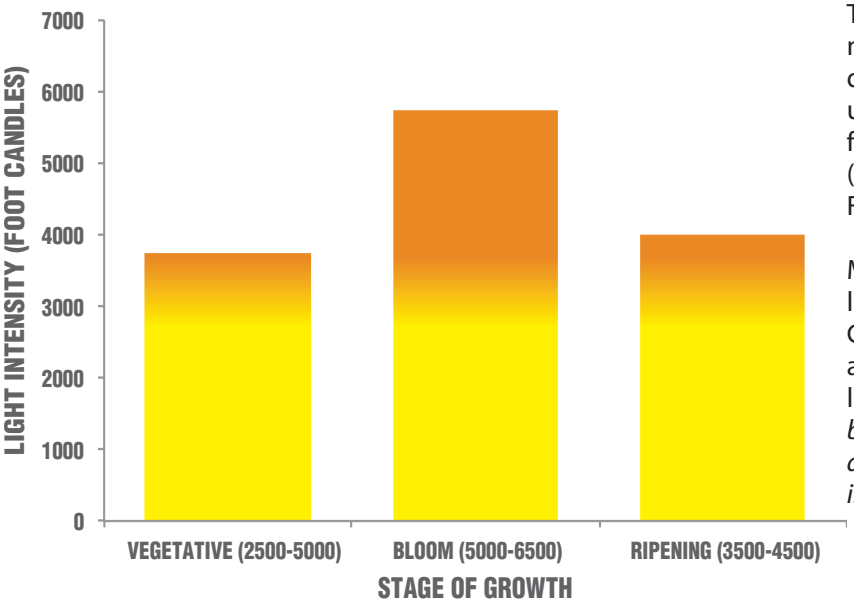
This is an age-old question that we feel needs some special attention. Of course no one can fully answer how many lights is right for any one grower. But, what we can offer is some useful information that will help you come to a decision that is right for you. The more light you add into a grow space, the more fruit / flowers you will produce. Light is directly proportional to yield (up to a point of full saturation). You cannot produce more light than what the sun would produce on its brightest day. So how do we decide what too much light is? Or how much light is enough for a given grow space? Below, we have gathered information that you can utilize to make your decision.




The diagram on the left indicates effective coverage areas for various light wattages. A 1000w light will blanket a 4x4 area with light; even up to a 5 x5 or larger depending on the reflector and the stage of growth a plant is in. A 600w ligh can cover anywhere between a 3x3 and 4x4 area of light depending on the reflector and the stage of growth a plant is in. A 400w light can spread up to a 3x3 area (even a 4x4 for plants in Veg. growth), but works well in a 2x2 area for plants in the bloom stage with higher foot candle / lux requirements. A 250w light will cover up to a 2x2 area. From these simple measurments one can effectively decide how many lights are needed to light up any given grow space. For a more exact coverage area, come talk to us about the different reflectors we stock and how they can be best applied to your given grow space. We are here to help and more than happy to answer any of your questions or help with the design and fulfillment of your given grow space requirements.

## Light Requirements for the Major Stages of Plant Growth

Different light levels are required for the different stages of plant growth. A general rule of thumb has it so that 1/4-1/3 of the wattage you are using for the Bloom Stage is necessary for use in the Vegetative Stage of Plant Growth. An example would be 41000w lights are to be used in the Bloom Stage - Anywhere from (2) 400w lights to (3) 600w lights can be employed for the Vegetative Stage. Beyond this, it also about spreading the available light as evenly as possible. This depends on the incorporation of the above layout diagram as well as the use of a good reflector. Please see our "info sheet" on Reflectors for more information on how to pick the best reflector for you.




To the left is a graph with foot candle/lux measurements which can be used to help dial in your system. As the graph shows, using 55-60,000 lux or 5500 Foot Candles for optimum growth in the main part (usually weeks 1-6 of the Bloom (Fruit / Flower) Stage).

Max Sunlight on earths surface is 90,000 lux and is not good for plant growth. Generally speaking over 70,000 lumens and you are beyond the optimum level of light for photosynthesis to occur. *Don't become a grower who just doesn't believe and over does their lighting. Just becuase it is cool doesn't mean it is not too intensely lit.*

# LIGHTING QUESTIONS **ANSWERED**

## What is the difference between HPS and MH?

Although High Pressure Sodium (HPS) and Metal Halide (MH) are both types of HID (High Intensity Discharge) lights, they emit different color spectrums. HPS bulbs emit very bright light that is concentrated in the red to yellow side of the spectrum and weak in the blue-violet end. In contrast, MH bulbs emit a very balanced light, containing all the energy peaks of the visible spectrum, although they lean more towards the blue end. Another difference is the lumens per watt of both bulbs. (Lumens is the measurement for the efficiency of the bulb or how much light you're producing for the amount of electricity you're using.) Sodium bulbs are the brightest and are more efficent, producing between 97 and 150 lumens per watt. Halide lights produce 65-115 lumens per watt.

## What type of light is better, High Pressure Sodium or Metal Halide?

There are several things to consider when picking the right light for your gardening needs. First, what type of natural light are you working with? When supplementing natural sunlight, use a HPS light to extend daylight in the early spring and fall. You can also use them on low light cloudy days. When no natural light is available at all, a HPS light is the most frequently used. HPS is a very wide spectrum lamp perfect for indoor growing, especially for plants that will produce fruit or flowers at some point. MH lights are excellent for vegetative growth and leafy plants such as lettuce or basil. A second factor is bulb efficiency and life expectancy. HPS bulbs are superior to MH bulbs in terms of efficiency. They put out more light per watt and last about twice as long. MH lights however, definitely have their place in the grow room, so the decision about what's best depends on what's most important to you.

## Why do people use a MH for vegetative growth and HPS for flowering?

HPS bulbs can make some plants grow "leggy" and stretched out due to the high yellow to red spectrum they give off. MH bulbs tend to keep plants "tighter", with less space between internodes. Consequently, some people use MH lights during vegetative growth to keep the structural growth of the plant nice and tight, but switch to HPS during the flowering stage when plants need more light. Although HPS bulbs don't have as balanced a spectrum as MH bulbs, the intense light they provide promotes flower and fruit development. HPS bulbs will give you about 30-35% more yield in the Bloom Phase when compared to Metal Halides. If you are going to use only one light, we suggest an HPS bulb with increased blue in the spectrum like the **Hortilux** or **Ushio.**

## What are Conversion Bulbs? How do they work?

Conversion bulbs are designed to allow MH systems to produce HPS light and HPS systems to produce MH light. This type of bulb allows the tailoring of the light source to the growth stage of the plant (again, using MH blue light for growth and HPS red light for flowering/budding) merely by changing bulbs.

## Are there ballasts which can burn both MH and HPS bulbs?

Yes, we offer "switchable" lighting systems - The **Harvest Pro** is our switchable ballast of choice. It is much cheaper than an equivalent digital ballast and comes with a 5 Year Warranty. And lastly, some digital ballasts like the **Galaxy** can run either a MH or HPS bulb. Just screw in your appropriate bulb and you're off. . .

## What size light should I purchase?

What is the size of the plant area that you need to cover? Multiply length x width to get square footage. For optimum lumens, you need between 20 (min) and 60 (max) watts per sq ft. For example: if you have a 4' x 4' area, which equals 16 sq ft, multiplied by 30 watts you get 480 watts. That means you need at least a 400 watt light; but would do much better with a 600 watt or 1000 watt Grow Light. Keep in mind, the actual amount of light you'll need depends on the requirements of the type of plants you are growing. There may be several different arrangements that will give you optimum light energy. For example: for 2400 watts, you could use (2) 1000 watt lights and a 400 or (4) 600 watt lights, etc. We will be happy to offer you a suggestions.

# LIGHTING QUESTIONS **ANSWERED**

## What is the difference between 120 volt and 240 volt?

Both 120 volt and 240 volt lights operate with the same 100% output and use roughly the same amount of electricity. A 600 watt light uses the same amount of current in 120 volt as in a 240 volt light. The standard outlet you see in your house is 120 volt. You may want to get a 240 volt if you plan on running several lights off of one circuit breaker. The maximum wattage on a 120 volt circuit is 1500 watts, per National Electric Code. With proper wiring, 240 volt circuits can carry up to 5760 watts. This means that you can plug several high powered lights into a lighting timer that will turn them all on and off on the same circuit. 240 volt is also considered to be more 'stable' because it uses half the amps. The equation: Amps x Volts = Watts. There is some savings using 240 Volt - Because there is less Amperage, there is less heat and less conductance. This begins to add up as more power is consumed.

## What is the life cycle of HID bulbs?

MH bulbs should be changed at least every 6 to 12 months if you're burning them 18 hours per day. We recommend changing most HPS bulbs every 6-9 months, because the available lumens begin decreasing after that point.

## How long should I leave my light off before I turn it on again?

When MH bulbs are turned off they should be left to cool for 20 minutes before re-starting. Turning a Metal Halide bulb on when it is already hot severely shortens the life of the bulb and it can affect the intensity of the light. Metal Halides should be replaced after a year of heavy use. High Pressure Sodium bulbs can be restarted after only 2 or 3 minutes after being turned off, and they should be replaced every 6-9 months.

## How much does it cost to run a HID lamp?

To calculate how much it will cost to run different HID lamp wattages you will need to determine how much you pay for electricity per kilowatt hour. Refer to your electric bill to find this number - it is usually anywhere from .05 to .10 cents per kilowatt hour. A 400 watt light running for 12 hours a day costs between $25.0 and $40.0 per month. A 1000 watt light running for 12 hours a day costs anywhere from $70.00 to $90.00 per month. It depends on how much you pay for electricity. One light is not a large drain on your electricity bill.

## What precautions should I take with my light?

Keep remote ballasts elevated on a cinder block or shelf in case you end up with a lot of water on the floor. Do not use extension cords with the 250, 400 or 1000 watt light systems and be sure to use a three prong grounded timer. To protect your investment from power surges and spikes, use a surge suppressor. It is not advisable to run your lamp on extension cords. Young plants are more prone to heat damage from your light system. Keep lights at least three feet away and more for the larger lights. As plants get older they can handle the extra heat and the plant to light distance can be decreased.

## Why are Digital (Electronic) Ballasts Soooo Special anyhow?

Good digital ballasts, like the **Galaxy**, will give you more available light (20% more lumens) and use less electricity (10-15% less) when compared with a "standard" magnetic coil ballast. Resin-sealed electronic ballasts are also lighter, produce less heat, and are absolutely silent. **Galaxy** allow the use of both MH and HPS.

## Do you guys sell a "Good" cheap remote Ballast?

We have the **Harvest Pro** which is well made, affordable, and comes with a 5 yr Warranty. Most sizes come in a switchable form which allows the use of both a Metal Halide or High Pressure Sodium bulb. We also offer a "loaner ballast" program which assures the user that if his / her ballast goes down (stops working) that he / she is back up and running without any delay. We then send in the faulty ballast for repair at no cost.