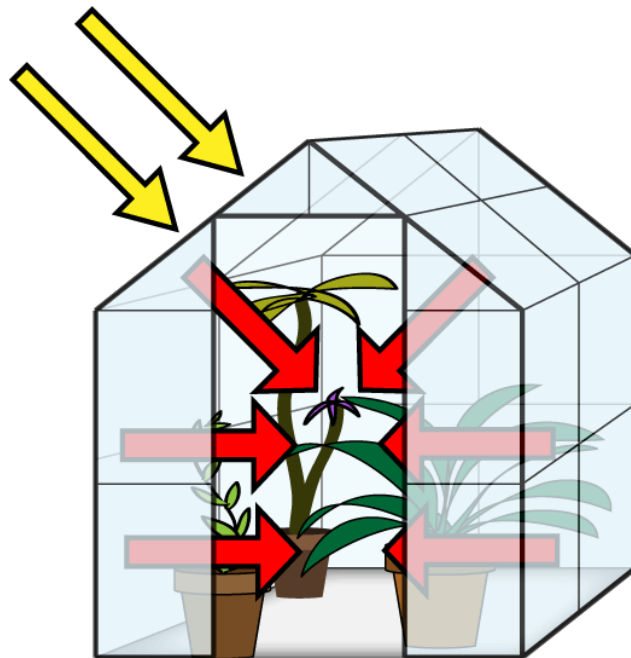


# GREENHOUSE

PRESENTATION  
BUILDING GUIDE  
USEFUL TIPS



The glass lets the sunlight in but stops  
the heat from escaping

# PRESENTATION

A greenhouse is a structure with different types of covering materials, such as a glass or plastic roof and frequently glass or plastic walls; it heats up because incoming visible solar radiation (for which the glass is transparent) from the sun is absorbed by plants, soil, and other things inside the building. Air warmed by the heat from hot interior surfaces is retained in the building by the roof and wall. In addition, the warmed structures and plants inside the greenhouse re-radiate some of their thermal energy in the infra-red, to which glass is partly opaque, so some of this energy is also trapped inside the glasshouse. However, this latter process is a minor player compared with the former (convective) process. Thus, the primary heating mechanism of a greenhouse is convection. This can be demonstrated by opening a small window near the roof of a greenhouse: the temperature drops considerably. This principle is the basis of the autovent automatic cooling system. Thus, the glass used for a greenhouse works as a barrier to air flow, and its effect is to trap energy within the greenhouse. The air that is warmed near the ground is prevented from rising indefinitely and flowing away.

Although there is some heat loss due to thermal conduction through the glass and other building materials, there is a net increase in energy (and therefore temperature) inside the greenhouse.



**Inside a hoop  
Greenhouse**

The idea of growing plants in environmentally controlled areas has existed since Roman times. The Roman emperor Tiberius ate a cucumber-like vegetable daily. The Roman gardeners used artificial methods (similar to the greenhouse system) of growing to have it available for his table every day of the year. Cucumbers were planted in wheeled carts which were put in the sun daily, then taken inside to keep them warm at night. The cucumbers were stored under frames or in cucumber houses glazed with either oiled cloth known as "specularia" or with sheets of selenite (a.k.a. *lapis specularis*), according to the description by Pliny the Elder.



The first modern greenhouses were built in Italy in the 13th century to house the exotic plants that explorers brought back from the tropics. They were originally called *giardini botanici* (botanical gardens). The concept of greenhouses soon spread to the Netherlands and then England, along with the plants. Some of these early attempts required enormous amounts of work to close up at night or to winterize. There were serious problems with providing adequate and balanced heat in these early greenhouses. Today the Netherlands has many of the largest greenhouses in the world, some of them so vast that they are able to produce millions of vegetables every year.



**Ventilation** is one of the most important components in a successful greenhouse. If there is no proper ventilation, greenhouses and their plants become prone to myriad problems.



Ventilation serves four major purposes within the greenhouse:

- Regulating the temperature
- Ensurance of plenty of fresh air to photosynthesize
- Good ventilation prevents pest infestations
- Encouraging important pollination within the greenhouse

In greenhouses recirculation fans can be used in parallel or series ventilation.

### **Greenhouse Watering - Automatic Systems**



These systems rely on gravity or electricity to deliver water in controlled amounts to individual plant pots. These systems can supply water (or water with liquid feed in it) to many plant pots at the same time. They are great timesavers and can also be used to automatically water plants when you are not at home

## Greenhouse Watering - Capillary Matting



This system of watering is covered in another section of our site but we repeat it here because it is probably the cheapest method of automatic watering. It is also surprisingly accurate given its simplicity. Again, this system is good for

saving time and for watering plants automatically when you are not at home.

A special purpose greenhouse staging, called a capillary bench, is also widely available. This bench has a surface with edges raised a couple of inches (5cm). The surface is lined with capillary matting which goes over the side of the bench into a vat of water. The capillary matting will suck up the water and remain damp at all times. Pots placed on the surface of the capillary matting will then suck up the water and remain automatically watered.

This is very useful at any time of the year because the potted plants will remain evenly watered. It is especially useful if you plan to leave the plants uncared for whilst you go on holidays. Add some liquid fertilizer to the water vat and the plants will be automatically fed and watered.

## The Major Components:

### Foundation

The foundation is what the frame of your greenhouse is going to rest upon so starting with a square and level foundation is very important. Some plastic framed lightweight greenhouses can be set up over bare ground as long as the site has good drainage. Most glass greenhouses will require a concrete foundation. There are several materials to consider when deciding what kind of foundation to use for

your greenhouse. Wood timbers, concrete or concrete block, and brick are all suitable choices. Follow the recommendations of the manufacturer of your greenhouse or your construction plans for the best results.

### **Flooring**

Flooring is a personal preference. Commercial growers prefer a well-drained concrete floor because it eliminates dirt and weeds that can attract insects and harbor diseases. The light color of concrete also reflects light back on the plants. In a home greenhouse dirt is the cheapest option, but can be problematic for the home gardener for the same reasons as the professionals, not to mention be messy. Wood can be used as well, but it will also harbor insects and deteriorate over time. Brick is more expensive but it drains well and looks good. Gravel and rock are inexpensive, drain well and can be watered down in the morning and the heat of the day will cause evaporative cooling. It is also easy to install.

### **Framing**

Framing comes down to what is suitable for your area and what you can afford. Most frames will be made from steel, aluminum, plastic or wood.

- 1.** Steel is very strong and permanent and preferred by most commercial growers, but because of the high cost of shipping it is usually not available in home greenhouse kits.
- 2.** Aluminum is long lasting and especially good for wet climates because it will not rust or rot. It can withstand extreme weather and is very low maintenance. It is frequently used in glass or polycarbonate greenhouses. Aluminum can be expensive and it is a conductor of the outside cold air unless the frame is made to include thermal breaks that keep the outside metal from directly touching the inside metal frame.
- 3.** A greenhouse framed in wood is very attractive but will require more maintenance than other frames. It can deteriorate sooner because of the moist air in the greenhouse and will require a chemical sealant periodically. Wood is a natural insulator so it absorbs heat during the day and can release it at night. Wood frames are especially good for dry climates.
- 4.** Plastic has become very popular in recent years because of its low cost and easy installation. A plastic framed greenhouse is also portable. It is a good choice for mild climates, but can be a problem in high winds and heavy snow. Plastic is a

poor heat conductor so heat loss is minimized compared to a similar metal frame. The main disadvantage of plastic is that even with UV protection treatment the ultraviolet rays from the sun will eventually cause it to break down.

## **Covering**

The covering material or glazing is usually the most expensive component of the greenhouse. It is also one of the most important because it is what allows the entry of light and heat into the greenhouse. The ability of a covering to retain or conserve heat is vital to a successful greenhouse. Each type of covering has an R-Value that represents how well a material insulates or "contains" heat. The higher the number, the more efficient the covering will be. There are many options to consider when selecting the glazing or covering for your greenhouse, each has its own advantages and disadvantages.

**1.** Glass is the most traditional covering for a greenhouse. It makes a beautiful structure that is fairly permanent. It is low maintenance once installed and can be recycled if needed. Glass can be found in single, double and triple layers with R-values ranging from .95 to 2.13, respectively. A single layer of glass is not very energy efficient. There are also many disadvantages to having a glass greenhouse. Glass is more expensive than other coverings and it is susceptible to breakage from hail and baseballs. Clear glass does not diffuse light well causing plants to burn and it can become brittle with age. It is very heavy and will require a substantial frame as well as a concrete foundation that is perfectly level and square. Professional installation may be required.

**2.** Fiberglass was the first practical substitute for glass. It is translucent instead of clear so it diffuses light and decreases shadowing. It is extremely durable and lightweight but even with a UV protected surface, it will break down overtime resulting in a decrease in the amount of light available to plants. It is made in a single thickness only and is available in flat or corrugated styles. It has an R-Value of .83. The corrugated style makes it more difficult to seal joints completely. Fiberglass is combustible and most types have an average life of about 5 or 6 years.

**3.** Polycarbonate is one of the newer options in greenhouse coverings. It is available in several widths and in single, double or triple walled sheets. The multi walled polycarbonates give strength and greater insulating values because of the air space built into the product. They also diffuse light and reduce shadows with 80

percent of the light reaching the plants. They are flame resistant and with a UV treatment on the surface can last up to 10 or 15 years depending on brand. The R-Value for polycarbonates range from 1.43 for 4mm twin walled polycarbonate to 2.5 for 16mm triple-wall polycarbonate.

**4.** Polyethylene Film is used by approximately 90% of all commercial growers. It is available in several quality grades. These coverings do not last as long as the others, but structural costs are much lower because the frame can be lighter. They need to be changed more frequently but are inexpensive, lightweight and easy to replace. Polyethylene has good light transmission and good heat retention. Two layers can be used with the air space between them inflated by a small squirrel cage fan. When used this way the polyethylene retains heat much better and the R-Value increases to about 1.5 from .83 for a 4 mil single layer. The downside to this type of film covering is its short life span of about 12 to 24 months and there is a possibility of rips or tears. Some high quality UV treated films made especially for greenhouses use can last as long as 5 years but are more expensive. Avoid using film sold at a hardware store for interior use.



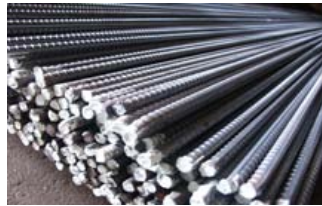


# BUILDING GUIDE

Now, it's your time to build your own greenhouse. We will do it step by step. It's best if you watch the video provided along with the book, to ensure that the greenhouse comes out perfectly.

You will need the following items in order to achieve the build you set upon:

- 3 12mm thick 12 meters long iron bars



- 1 10mm thick 12 meters long iron bar



- 40 sq meters of plastic foil



- 6 iron pipes 15-20 mm diameter, 30 cm long



- 150 cable ties



- box cutter knife



- pliers



- measuring tape



- double sided duct tape



- hand grinder



- cordless drill



- thick drill bit for wood



The first step is to measure the base of the greenhouse. Mine is 3X3 meters. So it's actually a square.



In every corner hammer the 30 cm pipes in the ground until they are at ground level.



On two opposite sides, measure half the distance between the pipes and put another two pipes in the ground. Use the drill to take out the dirt inside the pipes.



After this step is ready, cut a 12mm iron bar at 6 meters. Place one end of the bar inside a pipe, and arch it until you can put the other end of the iron bar inside the opposite pipe.

Repeat this process for the next two bars.



Cut the 10mm bar to size for making the traverses. Put one on top of the three arches, and bind it to the arches using cable ties.



Tighten the cable ties using a pair of pliers. Careful not to tear the ties apart.

Repeat the process for the next two bars.



It's time now to make the outline of the door. Drill two holes in the ground on the line connecting the endings of an arch at 70-80 cm apart.



Put 2 iron bars in, cut them to size if necessary and tie them to the arch with cable ties.



For stretching the plastic foil on the greenhouse frame, you will need someone to help you.

Make sure you stretch it from both ends properly and tie it to the iron bars using the cable ties. In order to do so, make holes with a pointy object in the foil and run the ties through the holes.



Cut the excess foil using a box cutter knife. Be careful not to cut the covering foil.



Place double adhesive duct tape on to edge of the straight walls. The top foil will cover the joints, and the holes made.



The door of the greenhouse it's actually a strip of foil. Use one that is wide enough to cover the entrance and long enough to touch the ground. Take a piece of wood and roll the door foil on it. When you reach the top, hang it from both sides from 2 pieces of wire, just like you see in the video. If the foil is too wide, cut it to size after you roll it up.





Now, ask for a friend's help again because it's time to stretch the big piece of foil on top. Stretch it from both ends, and make sure you don't have too much or too little left at the bottom.



Do it exactly like you see in the video and everything will be ok. Stick the foil to the double adhesive strips you placed earlier. At the base of each arch, you can use some cable ties. Water won't leak because it's near ground level. Puncture holes in the foil and stretch it for the last time before using the ties.



Cut the excess foil except the one from the base of the arches.



Roll that one up in 2 pieces of wood , one for each side, to keep the foil firmly to the ground.



**And congratulations!!!** From now on you can enjoy tasty organic food grown in your own **greenhouse**.



# USEFUL TIPS

Anyone who has done gardening in the open will be applying their knowledge to the greenhouse, just altering it a little to garden under glass. A greenhouse is not always a "hot house", as it is sometimes called. Plants usually do their best at temperatures slightly lower and with a much higher humidity than is usually maintained in our houses. A small greenhouse can have its temperature regulated relatively easy.

There are six main reasons an amateur uses a greenhouse:

- (1) Raising plants for winter use.
- (2) Holding over garden plants to be used as "parent" plants next season.
- (3) Getting an early start for tender plants started from seed.
- (4) Increasing the possibilities of a greater variety and continuous supply.
- (5) Easier culture of small vegetables for winter use.
- (6) To propagate, and experiment with various plants as a hobby, or to develop new varieties.

## **Choosing A Site For Your Greenhouse**

Choose a level, clean site in a low-traffic area. Your greenhouse should receive the maximum amount of winter sunlight available. Be sure to consider the following:

- the change in angle of the sun between summer and winter
- shadows cast by existing structures and/or trees
- growing trees: will they shade the greenhouse in the future?
- existing deciduous trees will allow winter sun; evergreens will not

If possible, align your greenhouse with the long side facing south, for two reasons:

- the angle of the roof is engineered for catching the maximum amount of the sun's rays in the winter with the least amount of loss by reflection.
- if you end up using shade cloth during the warm days in spring and summer, you will need to shade only one side, instead of both sides

### **Light**

Orient your greenhouse so that the sun will reach it the maximum number of hours during each day. The most important time for the sun to reach any greenhouse is during the spring and fall when the sun is lowest in the southern sky. Find the place where there is clearing towards the southeast through the southwest or as much sun is available.

### **Workspace**

Your greenhouse interior should allow enough room for potting plants and moving about comfortably. Also take into consideration the height of the benches and tables you plan to use. If you want a sink, where will you put it? Will you have storage space for tools? All of these questions should be dealt with before you begin to build your greenhouse.

Potting benches can be designed to fold down when not in use. They're usually slotted so dirt can fall to a collection bin below. Redwood is a good choice for the interior benches, but if you're concerned about the use of this wood, ask your local lumber yard about other rot-resistant woods. Avoid pressure-treated lumbers, since they are impregnated with highly toxic arsenic. To make the job easier, try a do-it-yourself bench kit with aluminum framework pieces-just add wood.

### **Temperature**

The more sun that is provided, the more heat the greenhouse will produce. The more heat is produced the more need you will have to provide ventilation. Place a thermometer in the shade near the middle of your greenhouse and monitor the temperature at different times during sunny and cloudy weather. If the temperature is reaching 80 degrees-90 degrees or higher and the plants you are growing need a moderate range of 60 degrees-70 degrees then you will have to compensate by ventilating. The temperature readings you record should be used to determine what plants you can grow, when.

## **Ventilation**

Adequate ventilation is achieved when air can freely circulate among the plants. Spread your plants evenly throughout the greenhouse, rather than jamming them all onto one bench, so the air is distributed evenly. Greenhouses overheat easily, and in the middle of summer in the southern part of the US, you're more likely to cook your plants than to nurture them if you don't have a way to get rid of the excess heat. Choose your ventilation system by which region you live in and the size and design of your greenhouse.

The simplest option is to open up one or both doors in the morning depending on the weather report and leave them open until late afternoon. This will allow frost protection at night and some increased warming during the day.

Another alternative for cooling is the simple principle of water evaporation. Hose down your greenhouse floor and open your ceiling vents, and the entire unit will cool down quickly.

## **Soil And Irrigation**

Commercial potting soil is good for the average home garden greenhouse, especially if you're growing veggies in large beds rather than smaller houseplant pots. These soil mixtures should include sand, peat moss, perlite, vermiculite, and fir bark for adequate drainage.

The only time you need to water is when the soil is dry. Over watering in a climate-controlled greenhouse environment has been the death of many a plant or seedling. While many greenhouse owners prefer the control of hand watering, drip irrigation systems are effective and also prevent the leaves from getting too much water on them. Drip systems are gentle on seedlings, too.

You may not need to water every day. It's wise to study the water requirements of your particular greenhouse and document your regime in a gardening notebook. This makes it easier for a friend or neighbor to take care of your plants when you're busy or out of town.

## **Maintenance**

Each type of greenhouse will have its own maintenance requirements. One general rule is to regularly disinfect the entire greenhouse-with a scrub brush and a mixture of diluted bleach, being careful not to get any on your plants. Open up any

vents to let the fumes out, scrub down all the walls and floor, then rinse with clean water.

Periodically, between disinfectings, spray the walls and corners with a hose set on the jet nozzle. This will keep the spider mites and whiteflies to a minimum.

### **Produce Tips**

Carrots, beets, turnips, and other root crops do well in deep boxes which fit well under benches.

Tomatoes, peas, cucumbers, and pole beans need tub-type containers. Lettuce, or other low leafy vegetables may be planted in the tub with the taller vegetables.

For corn, you've never seen the likes of, plant directly in the floor of the greenhouse, in a bed prepared for it. Plant pumpkin between the rows of corn to save space.

Water your indoor plants with room temperature water, so not to injure your plants. Tap water should stand for 1 day to rid water of chlorine. This will avoid brown tips on plants.

For good drainage, use any of the following in the bottom of your boxes or pots: broken clay pots, cracked walnuts, marbles, charcoal, or gravel. Clay pots should be soaked in water a few minutes before using. This will prevent the clay from absorbing the moisture from the potting soil.

Indoor trellises can be made out of coat hangers. Bend to any shape you desire (heart, star, or other) and insert into pot.

Herbs are nature's insecticides. Be sure to include a variety of them in your garden. Make an effective and natural insecticide by adding onions and garlic to a jar of water. Let it stand for a week and then spray your plants.

Throw crushed egg shells on your garden for plant growth. To add acid to the ground, use dried coffee grounds.