



# HOW TO BUILD A GREENHOUSE



## MATERIALS

- Three 4"x4"x8' pressure treated wood
- Thirty-five 2"x4"x8' pressure treated wood
- Ten 1"x4"x8' pressure treated wood
- Six 1"x4"x8' furring strip boards, untreated
- Four 4'x8' sheets of T1-11 siding
- Eight 2'x8' clear multicell polycarbonate roofing panels
- Six joining strips for roofing panels
- 16 feet of end caps for roofing panels
- 3" exterior screws, rated for treated lumber, or hot-dipped galvanized nails
- 1-1/4" exterior screws, rated for treated lumber
- 1-1/4" pocket hole screws, exterior, rated for treated lumber
- 1" screws with washers designed for roofing panels
- A hinge and gate latch kit for each door
- Landscape fabric
- 8 cubic feet of gravel (16 bags)
- Shed anchors
- Gutter, end caps, downspout adapter, downspout and hangers
- Louvered foundation vents
- One tube exterior caulk
- Two contrasting colors of exterior paint. (White is the most efficient color for the interior of the greenhouse.)

## TOOLS

- Circular saw
- Jig saw or hand saw
- Impact driver
- Drill
- Pocket hole kit (guide, drill bit, driver)
- Nail gun (optional)
- Router with pattern cutting bit (optional)
- Hammer
- Chisel
- Rubber mallet
- Tape measure
- Level
- Speed square
- Painting supplies
- Step ladder
- 2 solid ground stakes, wooden
- Caulk gun

## IF LEVELING THE GROUND

- Four stakes (in addition to the heavy stakes under tools)
- Hammer
- Mason's string
- 2-4 line levels
- Shovel, mattock, hoe, tamper (depending on the ground and how you like to work)

A note on ladders: Falls from ladders are a leading cause of serious injuries in the home. Please only use a ladder that is in good working condition and rated to hold the weight of the person and the tools or materials they are carrying. Ladders should always be set up according to the manufacturer's instructions. At no time should a ladder be leaned against this greenhouse before construction is finished. Use a self-supporting step ladder.

A note on painting treated wood: If you will be painting the treated wood in this project, buy it several weeks or months ahead of time to give it time to dry before construction. If treated wood is painted while it is still wet from the treatment process, the paint may bubble and peel. Alternatively, the building can be constructed immediately after purchase and the treated wood can be painted later.

## INTRO

This guide will show you how to build a freestanding greenhouse. It's small enough that it doesn't need a foundation. It can be built on a deck or concrete slab if desired, but it can easily be constructed on a patch of level ground.

Throughout this guide, the term "nail" will be used, but the appropriate screws should be used instead. If you don't have access to a nail gun, this project would be a great time to try out tool rental from The Home Depot. A power nailer speeds up this job considerably. Call 811 to check for underground utilities before you dig.



## CHOOSE A LOCATION

In the Northern Hemisphere, a greenhouse should face south. The ideal space for the greenhouse should not be shady. The purpose of a greenhouse is to extend the growing season by concentrating the sunlight that is available on shorter, colder days. It also allows for more control of temperature and light by shading windows and venting warm air.

The site should be level or close to level. It can be difficult to judge this by eye alone if you aren't

experienced. Use a long level or use a long board with a short level if that's what you already have. There should be no more than 4 to 6 inches of grading prep needed. Otherwise, your site will need extensive prep work before you can begin building.



## GATHER MATERIALS & TOOLS AND ENLIST A HELPER

Many of the operations in this guide require two people. Find a good helper. Maybe offer them tomatoes from your first greenhouse crop as payment.

Each person on the job will need personal protective equipment, including safety glasses, hearing protection and dust masks. Gloves are also a necessity.



## LEVEL THE GROUND, IF NEEDED

This design doesn't require a perfectly level spot, but it should be close to level. You don't need to grade the whole site. You only need to dig a level trench for the 4x4 base to sit in. Here's a quick rundown of the process:

Measure the 4x8-foot area where the greenhouse will stand. Drive a wooden stake at each corner, deep enough so that it can withstand being pulled with string. The stakes should be "plumb," which means they should be standing straight up and down. Measure diagonally, across the area, to check for square. Each corner-to-corner measurement should be the same. If not, adjust the position of the stakes.

Find the highest spot on the ground and start at the stake closest to it. Tie the end of the mason's twine to that stake, 10 inches off the ground. Go to the next stake and pull the string tight. Hang a line level on it, then raise or lower the string until the bubble shows level. Wrap the string around the stake with three or



four wraps, making sure the working end of the string comes off the stake in the same plane it entered. Move on to the next stake and follow the same procedure until the whole rectangle has been strung and then tie the string securely.

Once the string is level, measure straight down from the string to the ground in several places to find the lowest spot. For example, if the lowest spot is 12 inches below the string, you will need to dig every spot that's less than 12 inches below the string down to 12 inches.

Dig the trench almost to the corners, but not close enough to weaken the stakes. Once everything else is level, the string is no longer needed. Pull the stakes out of the ground and finish the corners.



**STEP 4**

## BUILD THE BASE

The base of the greenhouse is made from three 4"x4"x8' timbers. Cut one of them in half to make two 48-inch pieces.

- The half lap joints should all be cut on the same face of each timber.
- Set the circular saw's depth of cut to 1-3/4 inches.
- From the end of the timber, measure 3-1/2 inches and mark a line with the speed square.
- Use the speed square as a guide to help ensure a square cut and cut this line.
- From this line, and out towards the end of the timber, make a cut every 1/4 inch or so. This can be judged by eye, as you only need to weaken the wood so it can be removed. These cuts don't have to be straight, but the depth is important. Pay close attention to keeping the sole plate of the saw flat against the face of the timber.
- Once all the relief cuts have been made, use the hammer to break out the waste wood.
- Use the chisel to remove the remaining waste wood and to smooth the surface.
- Repeat this on each end of all 4x4 pieces.
- Lay the shorter pieces on 4x4 on the ends of the building site with the joints facing upward.
- Connect them together with the longer 4x4s, joints facing down.
- Measure across the diagonal to check square.
- Connect each corner with one screw or nail.
- Re-check square, then add two more fasteners to each corner.



**STEP 5**

## FRAME THE WALLS

The front wall of the greenhouse will be lower than the rear wall to give the roof its pitch. Roof pitch is important for rain and snow runoff. It can also allow for more usable sunlight. For this project, the roof is a relatively steep 25 degrees with a pitch of around 5-1/2:12. This should be sufficient for most areas. If you live in a place that receives a large amount of snow, check local sources to see if the pitch should be steeper.

Cut five 2x4s to 77-3/8 inches long for the front wall. The rear wall will use five 2x4s at their full 96-inch length. Check the length to make sure they're all the same. Trim the ends if necessary.

Lay four of the best 2x4s on edge, face-to-face, making sure all the ends are flush. Measure and mark a line at the following inches 1-1/2, 24, 48, 72, and then 1-1/2 inches from the other end. At the 24-, 48- and 72-inch marks, measure 3/4 inch to the side of each mark and make a line with the speed square. These marks will show where the studs go.

Building the wall frames on the ground and then standing them up is the easiest way to go. Lay the bottom plate (2x4) on one end and the top plate (2x4) about 8 feet apart from each other. Lay the studs between them and line them up according to the marks that were made earlier. Hold the studs square to the plates and attach them with 2 or 3 nails or screws through the plate and into the stud.

Repeat this for the second wall.



**STEP 6**

## STAND THE WALLS UPRIGHT

This is a two-person job.

Have a level, 1x4x8, heavy ground stake, hammer, screw gun and screws ready to go.

Move the rear wall into place, with the bottom plate on the rear 4x4. Lift the wall into place. Bump it with a hammer to get it into the right spot. While one person holds the wall in place, the other should secure the bottom plate to the 4x4 with nails.

With one person still holding the wall, the other should drive the stake into the ground, about 4 feet from the wall and away from the building. It should be aligned with the center stud in the wall. Attach the 1x4 to the stake by driving one screw about 6 inches from the end of the 1x4, about halfway down the stake. The other end of the board should be held close to the center stud, as high as you can reach. The person holding the wall should use the level to bring the wall plumb. When it is straight up and down, attach the 1x4 to the center stud with 2 to 3 screws. Now add another screw to the 1x4 and stake.

Follow this same procedure with the front wall. Leave these supports in place until it's time to attach the siding.

Cut two 1x4s roughly in half. On the inside of the walls, attach a 1x4 to the edge of the first stud, then run the 1x4 at an angle to the second stud. Get the other person to hold a level against the side of the wall and push or pull it into plumb. When it's good, drive two screws through the 1x4 into the second stud. Do this on the other end of the wall, and then put two of these angled pieces into the front wall, using the same procedure.



**STEP 7**

## CONNECT THE WALLS

If everything is square and level, the interior edges of the walls should be 41 inches apart from the top of the front wall across to the back wall. Check this measurement as it could be slightly different. Cut a 2x4 to the width of the opening.

The outer measurement of the walls should be 48 inches. Again, check to be sure and then cut a 2x4 to that length. On one end of this 2x4, use a scrap piece of 2x4 to mark a notch to accommodate the top plate. Use the jigsaw to cut this notch.

Nail the 48-inch notched board to the inside of the first stud on the wall, with the top plate in the notch. Use the level to hold the board level and then nail it face-to-face into the inside of the first stud on the rear wall. Toenail (drive nails at an angle) this board into the studs on either end. If the nail head protrudes, drive it flush with a hammer.

Now put the 41-inch 2x4 between the first stud on each wall, face-to-face with the 2x4 you just nailed up. Align the second board so that it's flush with the first one and square between the studs, then nail it to the first board to form the first door header. Repeat this operation on the other end of the greenhouse, even if you're only installing one door.



## STEP 8



### MARK AND CUT THE RAFTERS

Rafters are normally cut and marked with a “speed” or “rafter” square. Instead of using a speed square, you can mark the rafters an easier way.

Cut two pieces of 2x4 to 6 inches long to create the measuring and marking blocks.

Use a piece of the untreated 1x4 to make a template rafter. Cut it to 56-1/2 inches long with each end a 25-degree angle. The ends should be parallel to each other, so that they will be perpendicular to the ground when the board is placed across the front and back walls.

Place each measuring block on top of a wall, 1-1/2 inch from the end. Now, place the 1x4 across both walls, pushed up tightly against the measuring blocks. If the blocks won't stay in place, secure them temporarily with clamps or screws. The front end of the rafter template should be flush with the front wall. On the 1x4, mark a line across the top of the front block and around the front and top of the rear block.

Take the rafter template down and use a jigsaw to cut out the notches, which are often called a “bird's mouth.” Check for fit. If everything fits, use this template to mark and cut five 2x4 rafters.

## STEP 9



### INSTALL THE RAFTERS AND ATTACH FACIA

Install the center rafter first. It will go in place directly above the center studs. Set it onto the top plates and attach with 4 nails on each end. Drive them through the rafter and into the top plate at an angle from both sides.

The placement of the next two rafters may not be directly above the studs. They will need to be placed according to the width of the roofing material. Nail as before.

Attach the last two rafters directly above the end studs. The roofing will extend past them to create a small overhang on the sides. Nail as before.

Attach the joining strips for the roofing to the middle three rafters, leaving an inch of overhang in the front.

but do not install the roofing yet. The roofing will eventually be screwed directly to the end rafters.

Nail a 1x4x8 fascia along the end of the rafters. On the back, it should be flush with the top of the rafters. On the front, it should almost touch the joining strips.

## STEP 10



### FRAME THE DOORS

On the rear corner of the doorway, measure the vertical opening. Cut a 2x4 to this measurement. Nail it in place, with one of the faces facing into the doorway and the outer edge flush with the outside of the 4x4 and door header. Measure 31 inches from this board across the header and threshold of the doorway. Make a mark on each. Now, measure vertically between these marks and cut a 2x4 to this length. Set the 2x4 in place and nail it top and bottom to form the rough opening for the door.

If building a door on both ends, repeat on the other side. If not, cut and nail two studs in a similar manner, but attach them evenly spaced in the wall.

## STEP 11



### INSTALL SHED ANCHORS AND THE SIDING

Follow the manufacturer's instructions on the shed anchor kit. In the example, a cable type anchor is being used.

For the siding, measure the actual length of the panels to ensure the measurements are correct. Adjust if the panels you have differ.

On the rear wall, measure 96 inches from the roofline down each end stud and mark a line. Just below those lines, attach a treated 1x4x8 across all the studs. Use the lines that you marked and a level to get the board into the correct placement.

Take the first sheet of siding and stand it on top of the 1x4 that was just nailed into place. If the edge of the siding doesn't align perfectly with the edge of the wall, adjust the squareness. Start by removing the single screws on the diagonal braces, then pushing the wall to make it square with the siding. Finally, drive the screws into a new location to hold the wall in square.

This 1x4 serves two purposes. It provides a ledge to help install the siding but, more importantly, it will keep water from splashing or leaching up into the bottom edge of the siding. Keeping water out of the siding will extend its life. Once the siding is in place, place a bead of exterior caulk at the joint of the 1x4 and the siding.

Nail the siding in place. Move on to the next piece of siding, align it and nail it in place.

Repeat the process of putting a 1x4 across the bottom of each side. It can run below the door opening if there is enough clearance or it may need to be notched to give clearance to the door.

The easiest way to cover the sides and allow for the doors is to nail up a full piece of siding then cut out the door with a router and pattern bit. (If you prefer, measure the pieces you need, cut them, and cover the side walls that way.)

Go to one end and lay a scrap piece of 2x4 flat on the ground, against the 4x4. Use this 2x4 as a spacer for the siding that goes on the side wall. Align the rear corner with the rear wall until the siding is in place. Be sure to put nails around the perimeter of the door. Holding the siding tight will make cutting with the router much easier.

There will be a vacant triangle up top that will be filled in later.

The pattern bit is designed to pierce the siding with its point, then follow the inside of the doorway with the smooth guide edge just below the point. The router should be set to a high speed. Start close to the edge of the door opening, then move the router over to it. Cut around the door in a clockwise direction. Have your helper support and catch the cutout piece. Save the scrap wood, we'll use it to build the shelves.

Use the router to cut off the triangle of siding that protrudes above the rafter. Take this piece and align it over the triangular hole above the sheet of siding. It should be just a bit larger than the opening. Use a pencil to mark the backside around the wall and rafter. Cut these lines with the circular saw and then nail the patch in place.

Repeat the entire process on the other end, if there will be a door. If there will be no door, only cut and fit the triangle.

## STEP 12



### BUILD THE DOORS

The roof panels will be 60 inches long. Cut four of them. Why now? The 36-inch off-cuts will be used to make the doors. Cut according to manufacturer's directions. The panels can be cut with a circular saw with a fine-tooth blade, such as one designed for cutting plywood.



Measure the height of the door opening, subtract an inch and cut two 1x4s to this length. Lay them on a work surface where they're parallel and the other edges are 30 inches apart. Measure between the inside edges and cut three pieces of 1x4 to that length. (It should be about 23 inches.)

Drill three pocket holes into each end of each of these three boards. Using pocket hole screws, attach these boards to the longer boards at the top, bottom and in the center.

Paint the door frames. When the paint is dry, lay two pieces of 36-inch-long clear roofing over the openings and attach with their special screws.

## STEP 13



### POUR THE GRAVEL

Pour gravel into the floor, up to the top level of the 4x4 foundation. Using gravel allows water to drain and makes it easy to level with just a rake.

## STEP 14



### INSTALL DOORS

Using the hinge and latch kits, install the doors. Be sure to follow the instructions for installing an interior string pull, because you don't want to get locked inside.

To ensure that the doors open and close in all sorts of weather conditions, they are undersized for the opening. Cut strips of 1x2 to be stop moulding and close the gaps around the door. A greenhouse doesn't have to be airtight, but closing up this significant gap will help regulate temperature and keep insects out.

## STEP 15



### INSTALL CLEAR ROOF AND FRONT WALL

The joining brackets are already in place for the roof panels. Install the panels and snap the holders in place. Screw the outer panels directly into the end rafters. Install the cap along the rear end of the roofing panels. The ends should be allowed to extend beyond the wall.

Install joining panels on the three center studs on the front wall. Measure between them to find the width the panels should be cut to fit. There is some play within the joining brackets, so cut to the closest measurement that will leave a baffle intact.

Like the roof, the outer edges of the outer panels will be screwed directly into the studs. These should be measured and cut to width like the others. There should be no overhang.

## STEP 16



### BUILD INTERIOR SHELVES

Due to the small size of this greenhouse, every square inch of space will be put to use. The entire front wall and roof are transparent to maximize sunlight. Two levels of interior shelves can be built in the front. Hanging planters can be suspended inside the front window and from the back wall. Shelves and pockets can be made between the studs in the back wall for planters and storage.

Start by spanning the greenhouse with two 1x4x8s, placed 12 inches above the bottom plate. One should run along the front wall, attached to the studs, and the other should attach to the backside of the door frame. Measure and cut a shelf from the leftover siding.

Next, build a shelf at counter height, which is 36 inches off the floor. Use 2x4x8 (cut length to fit) for this one. Attach two boards in the same manner as the lower shelf. Cut a piece of 2x4 to 36 inches long and three pieces to 6 inches long. Attach these in the shape of a box to the center of the innermost 2x4 span and place one of the 6-inch pieces in the center. Cut a piece of 2x4 to 14 inches with a 45-degree angle cut at each end. Use this to brace the

workbench portion of the shelf. Measure and cut leftover siding to use for the surface of the shelf.

Install hanging planter hooks into the studs, high enough that the planters won't smack you on the head.

## STEP 17



### INSTALL GUTTER

Install the gutter across the front fascia board. It should tilt, slightly, towards the end with the downspout. Water can be collected in a bucket or watering can, since only a low volume will run off a roof this small.

Gutters are usually sold in 10-foot lengths. To fit the greenhouse, the gutters will need to be marked and trimmed. Attach the hangers to the fascia and attach the downspout adapter to the gutter. Put the gutter in place and allow the other end to overhang. Mark it with a pencil or marker. Remove the gutter and trim it to length with snips or with a cutoff wheel. Attach the end caps and put the gutter back into place and lock it into the hangers.

A flexible downspout can be used to accommodate different containers.

## STEP 18



### INSTALL VENTS & PAINT THE GREENHOUSE

The area between the top of the rear wall and the rafters will act as vents. In some areas, a greenhouse will become very hot inside and will require venting. Since heat rises, the most efficient place for vents is the very peak of the roof.

Measure the space between each pair of rafters. Cut a piece of treated 2x4 to fit in these openings. The board can stand upright to block the vent completely, laid on its side to allow some airflow, or removed altogether to provide maximum ventilation.

Once you've finished building the greenhouse, you can paint it. If using pressure-treated lumber, as seen in the video, wait a few weeks before painting.

To maximize the reflection of sunlight, paint the inside of the greenhouse white. Use exterior paint for the interior of the greenhouse, since it will often be very humid inside.

