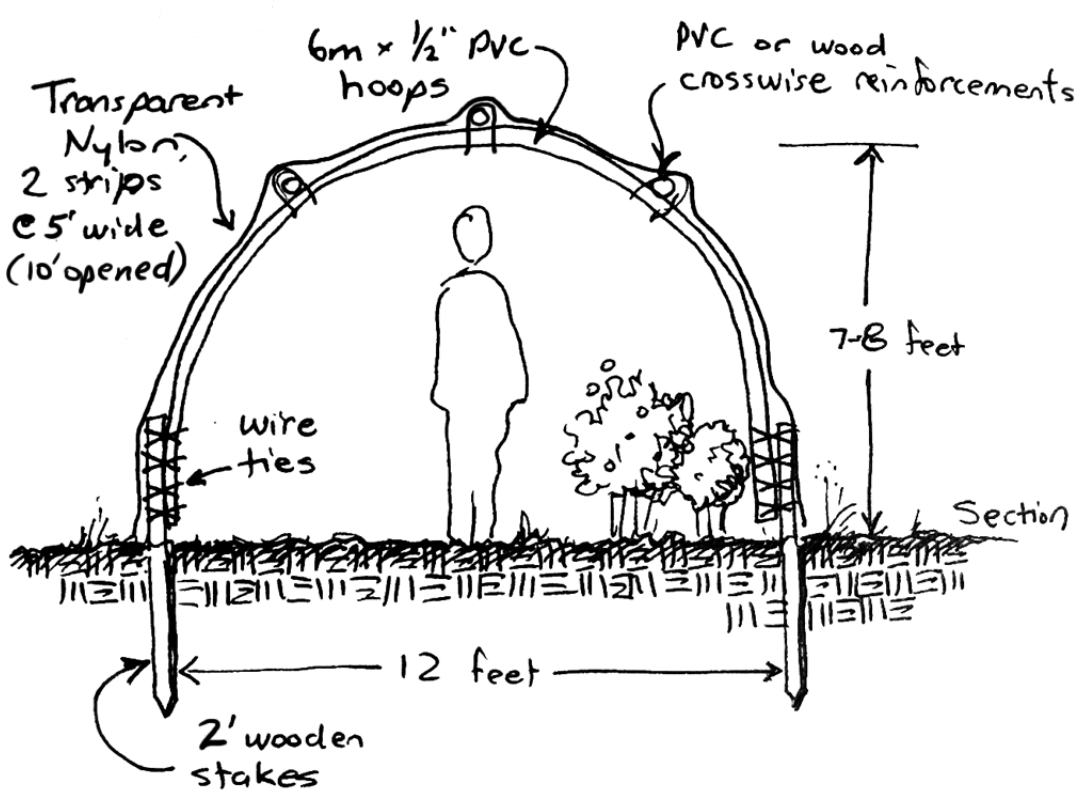
The $100 Greenhouse

by Jim Fanjoy, PCV Guatemala, Rural Home Preventive Health
based on original experiments by Laura & Justin Kohl



Greenhouses (*invernaderos*) are a great, low-cost project you can do in your site. In colder climates, it allows families to grow vegetables that have a positive impact on their nutrition and heath but normally only grow in hotter regions: tomatoes, melons, peppers, cucumbers, etc. Even if these things are available in the local market, growing them yourself can save money over the long run and ensures a secure food supply.

We built our greenhouse in an aldea of Santa Eulalia, Huehuetenango at about 9,000' above sea level. Though many hot-climate vegetables are available in the market, we wanted to demonstrate to the locals that they could grow these things themselves. Heck, we also wanted to have a garden with something besides corn and broccoli. What started out as a demonstration project ended up drawing the community together, as passers-by stopped to ask questions or to lend a hand with construction.

This project can be realized for under $100. I recommend haggling with local ferreterias to get the best prices, and many will give you a discount if you're buying large quantities of materials (such as with the nylon). For tools, everything you need should be in your Peace Corps toolbox: wire cutters, saw, hammer, machete. If not, one of your neighbors can probably lend them to you.

The basic idea

The greenhouse is supported by 1/2" PVC tubes, bent into an arch. The standard length for a PVC tube is 6 meters (about 20 feet), and if it spans 12 feet on the ground, it gives you about 6 feet of clearance in the middle. That's enough to keep you from getting a sore back when you work.

The tubes are wired to wooden stakes driven into the ground to keep the greenhouse from flying away in a wind-

Invernadero Materiales

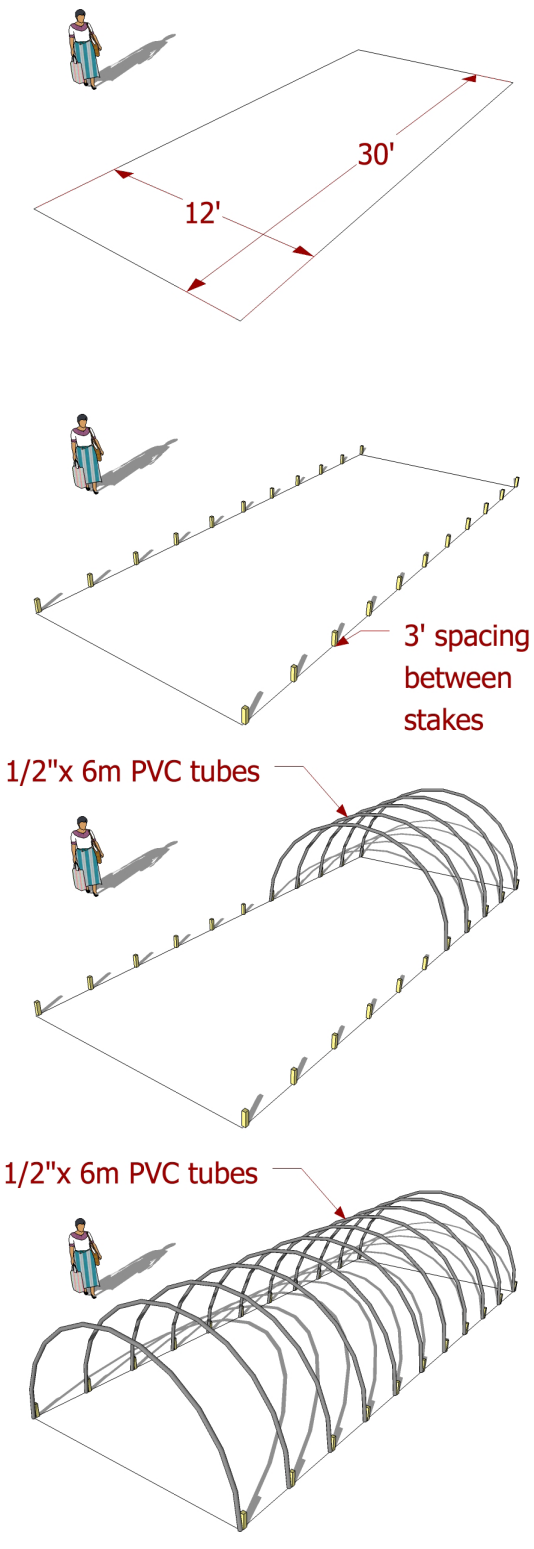
Material	Precio	Cantidad	Total (q)
tubo PVC ½" x 6m	18	17 c/u	306
nylon transparente doblado, 5' ancho	12	30 yardas	360
alambre	8	1 rollo	8
hilo	7	2 rollo	14
estacas, 2" x 24"	0	22 c/u	0
regla de madera 2x4x8'	5	4 c/u	20
		total:	**708**

Notas:
Puede substituir madera del monte por las reglas.
Precios de Abril 2009

storm. Arches are added spaced three feet apart, as many arches as you want, depending on how long you want your greenhouse. Three sets of PVC tubes are then wired to the arches running the length of the greenhouse to keep the tube spacing at the top.

Transparent nylon covers the entire framework, sealed on all sides to keep in the heat that collects from the sun. It is sewn to the frame with string. A Guatemalan friend of ours made a similar invernadero with black nylon instead of transparent, to grow mushrooms.

Tools Required	
martillo	hammer
tenaza	wire cutter
machete	machete
metra	tape measure
hilo	mason's string
sierra	wood saw



This is how we do it

The first step is to select a site. The more sun exposure, the better. In this example, we used a small part of a neighbor's field close to our home. Other examples have been built over paving to cover tire gardens, using tires or cans filled with concrete instead of stakes.

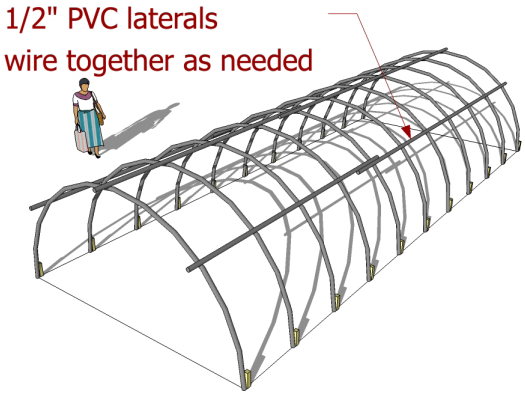
Once you have selected a site, you should lay out the area for the greenhouse. You can do this easily with a tape measure, 4 temporary stakes, and some string. This example is 12' by 30', but you could probably make it as long or short as you wanted by adding or subtracting hoops. The 12-foot dimension is best not to change if you want the height to come out right. Leave the string in until you have all of the permanent stakes in place. If you are going to till the ground and add abono, now is a good time to do it because it's going to be really hot inside the greenhouse once the nylon is in place.

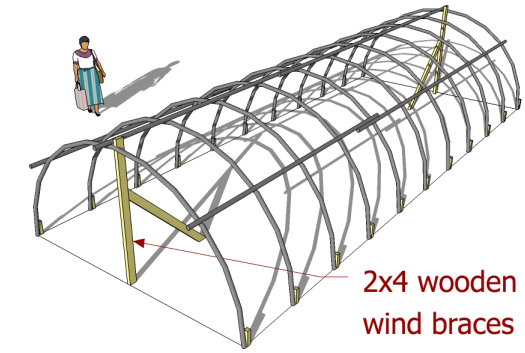
Next you will put the stakes into the ground, leaving about 8 inches showing. Space them three feet apart, along the long side of the greenhouse. Ask some locals what wood they use for fences, and try to get that for the stakes. It will last longer. If that is not available, the harder the wood the better. When you put the stakes in, they will be stronger if you make them pointy and drive them in with a hammer.

Once the stakes are in, wire the ends of the PVC tubes to the protruding tops of the stakes. To keep the tubes spaced correctly at the top and to add rigidity to the structure, we will now use the wire to tie lateral PVC tubes at the top

Hints from David Castillo

-Open the greenhouse from 10am to 2pm, to let the air circulate and prevent fungus growth. This also lets bees inside to pollenate.
-Use a 2x4 stapled to the plastic to weigh down the door and prevent if from coming open in the wind.
-Rust from the tie wires is acidic, and will eat away the nylon after a while. Wrap joints with strip cut from inner tubes to keep the rust from touching the nylon.





and sides. If your greenhouse is longer than 20 feet, you will need to connect tubes together. You can overlap them and tie with wire, or you can glue them together with PVC plumbing cement if they have bell ends or if you have couplers. [Note from David: wrap the wired joints with strips of plastic bag or rubber innertube, to prevent the high-pH rust from the wires from harming the nylon.

All we need now is a way to keep the greenhouse from lying down flat in a high wind. Dig a hole about 18 inches deep at each end of the greenhouse as shown, and plant a 2x4 in it. Then, dig a second hole 4 or 5 feet back and plant a second 2x4 at an angle to brace the upright one. Connect them firmly with nails or wire or both, then wire the upright 2x4 to the intersection of the outermost tube and the topmost lateral tube. If your greenhouse is small and you live in a sheltered area (in town, amongst trees, etc.) you can probably leave out the wooden braces. Have a beer because you are halfway done.

Once the framework is finished, you will want to enclose the greenhouse to keep the heat in. Nylon comes in several sizes as a roll good, cut to the length you want. It's best to have as few seams as possible, so make sure you have at least two pieces that are as long as your greenhouse, plus about a yard for seam allowance. If you bought the 5 foot wide doubled nylon in the materials list, you will then need to take a knife or scissors and slit one edge of the nylon so you can open it up to the full 10 foot width.

Now comes the tricky part. Using the thread and a makeshift needle (see inset), sew the first panel of nylon over half of the greenhouse. The idea is to wrap a spiral of cord around the tubes, passing through the nylon and holding it down. Do the top lateral tube first; you will probably need some friends to hold the plastic in place until you get the top secured. The nylon should reach the ground;

Sewing the nylon onto the tubes is WAY easier if you make yourself a makeshift sailmaker's needle. This can be easily done with about a foot of alambre. Bend it in the middle, grab the bend with a pair of pliers, then twist the wire into a double-stranded braid, leaving an eye when the pliers are holding. Then, cut off the end of the "needle" at an angle with wire cutters. Experiment; I found that sewing some seams was easier with a straight needle, but sometimes it works better if you bend the needle into a curve.

that's important to keep the heat in. If it doesn't, you will need to go back and drive the stakes in a little further, or loosen the wire ties and push the PVC down into the earth a little more. Next, work down each hoop. At the ends, double the nylon back on itself to tidy up the loose ends and make it stronger.

Once you've got one side on, repeat the process with the other side, covering all the hoops.

The ends are similar to the sides, but will drape straight down like a curtain. If you know you won't be using one of the ends as a door, you can just use one sheet of nylon all the way across. Cut it so it's a semicircle about a foot larger than the end of the greenhouse, then sew it on much as you did the other panels. If you want a door, cut two quarter circles, and leave enough so they can overlap a foot or two in the middle. Sew one onto the wooden wind brace, and hold the other closed by putting some weights on the extra material at the bottom (rocks, log, etc.)

It's important that the greenhouse is tight against drafts, so you should go back and pile dirt on top of the nylon at all the edges to seal it up. The exception is the door, and I just leave the plastic long and lay some rocks on top of it when I'm not inside gardening.

Good luck, and don't forget to water your garden. The rain has a terrible time getting inside.