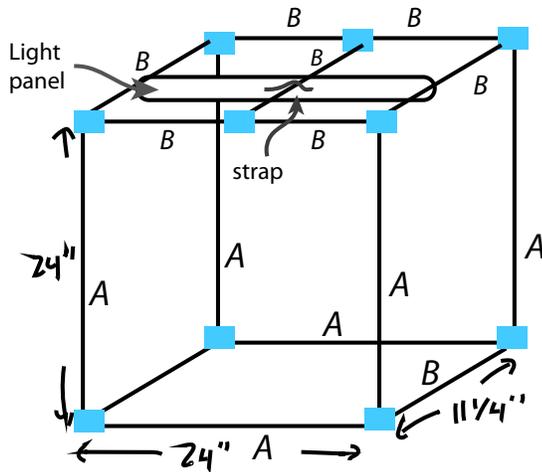


Lightbox assembly instructions
Caleb Farny, GLOBE Mission EARTH

Completed Light box assembly:



Order/parts list:

■ Couplers: 10x

Pipe: 11x

Order details:

Pipe: 2' x .75" Schedule 40 (A)

■ Couplers: 4-way 3/4 PVC fitting 90 degree JMIATRY (18 pack)

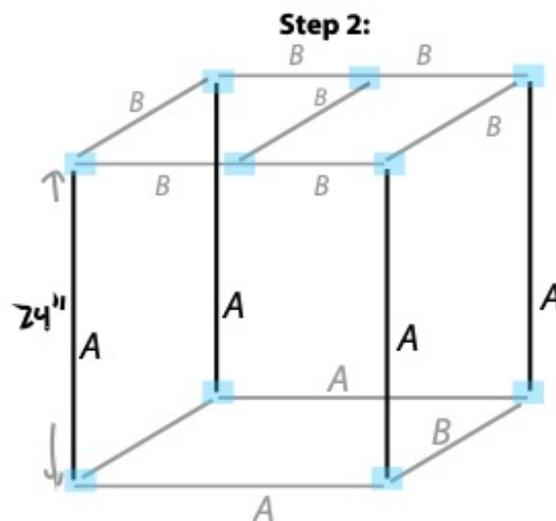
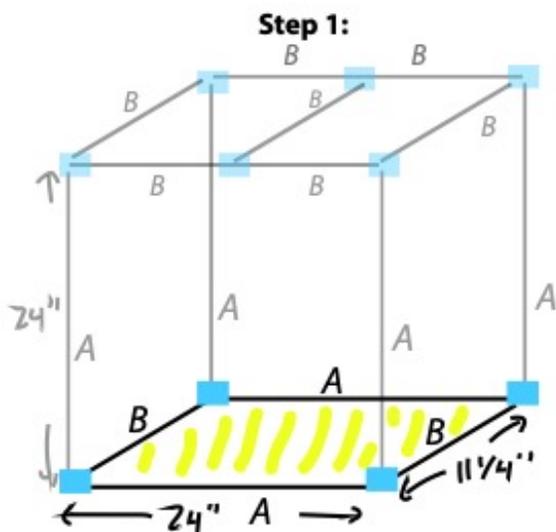
Cut list:

9 x 11.25" (B)

- Six 2-ft "A" PVC pipes
 - Ten 4-way PVC connector joints
 - Nine 11 ¼" "B" PVC pipes
 - One light panel and strap(s)
- Optional wall panels (recommended):* foil-lined bubble wrap or tin foil

Kit contents:

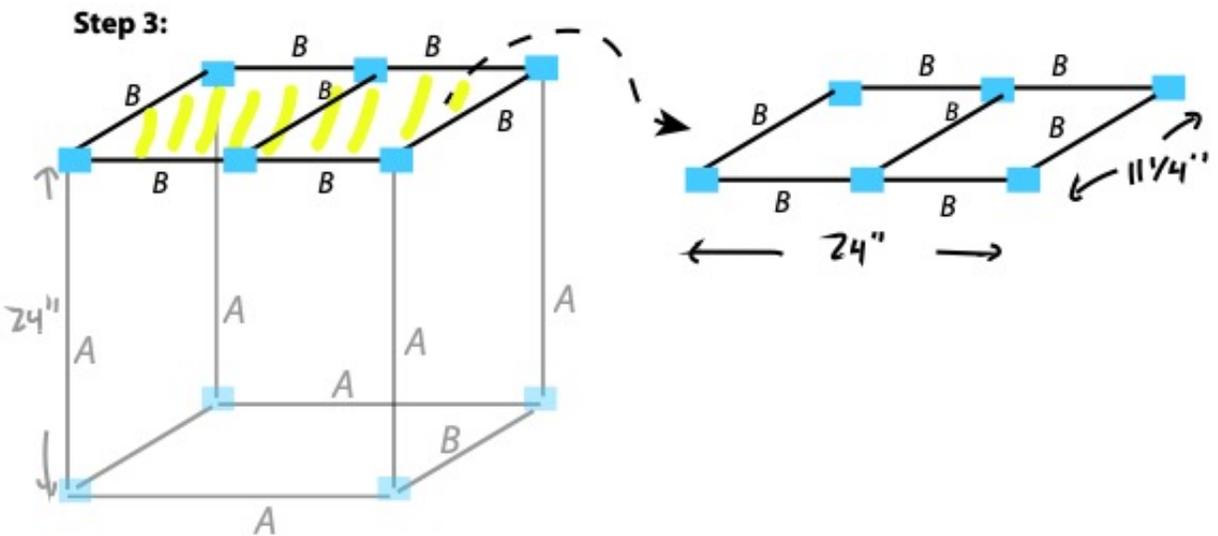
Step 1: Construct the frame floor. Insert one A pipe to a joint at each pipe end. Insert a B pipe to the other side of each joint. Insert a second A pipe to a joint at each end. Finish the floor by connecting the free end of each B pipe to the open joints of the second A pipe.



Step 2: Build the sides. Lay the frame from step 1 flat on a surface. Build the frame up by inserting an A pipe to each joint in the vertical direction. Adding 3 more A pipes, one to each corner joint, will complete the wall columns.

Step 3: Construct the frame ceiling

- a.) Use a joint to connect two B pipes in a straight line, and attach a joint to the end of both pipes. Orient each joint such that each has an open end facing in the same direction and that the third open end on each end joint is oriented in the same



direction (eventually these will connect to the vertical pipes from **Step 2**).

- b.) Repeat step a.)
c.) Connect the completed sections from a.) and b.) with the final 3 B pipes. The middle of these cross pipes will support the light bank.

Attach the frame ceiling: Connect the frame ceiling to the vertical A pipes from **Step 2** via the corner joints. The frame is now complete.

Step 4: Hang the light bank. This depends on the type of light bank you have. **If the unit has metal clips** (as shown on the left image), use a Velcro strip or zip tie to support the unit by threading the strip or through the middle B pipe and one of the B pipes at the end of the frame's ceiling section.



If the unit doesn't have a metal clip and instead has 2 chain attachments (see right image), make sure the hook end of each chain is attached to each end of the light bank, and wrap each chain around each of the end pipes of the frame ceiling. Pull both chains tight and over the middle pipe, and thread a twist-tie/zip tie/strong metal wire through the overlapping chains to keep them secure against each other.

Step 5: Attach the insulation around the sides. This step is variable, as it depends on the insulation material that you have on hand and your learning goals. The plants will grow best if the top and sides of the frame are enclosed, so as to maintain a constant temperature and humidity level for the plants. You will want to leave a seam open along one of the sides in order to access the interior space; the bottom surface/floor can be left unwrapped.

Teaching and implementation strategies

Insulation material: If you're investigating energy, engineering design, or materials, you could base an activity around the impact of different materials used to insulate the growing environment and cover of the frame. What is the impact of a thermally-insulating material (such as packaging commonly used in cold storage bags for food) vs light-reflecting material (such as tin foil) vs a simple barrier to circulating air (such as thin plastic or cardboard)?

Measurements and protocols:

- **Air temperature:** How does the air temperature inside the light box change with time? How does it compare with the air temperature outside of the light box?
- **Humidity:** How does the air humidity inside the light box change with time? How does it compare with the humidity outside of the light box?
- **Soil temperature:** How does the soil temperature change with time?
- **Phenology:** How does the rate of plant growth and its development compare with plants grown in different conditions (insulation; light; watering)?

Engineering design: There is more than one way to design a frame for a lightbox and there's more than one way to assemble the above design. Considerations for *this* design include:

- use of readily-available, inexpensive, and waterproof materials that can be assembled without tools
- dimensions that will accept a common size for a plant tray, light source, and growth height for the Wisconsin fast plants protocol
- use of insulation material that is otherwise deemed disposable (home delivery food storage bags) but is still useful

Depending on the grade level and student ability, you can either provide detailed guidance on assembly of this design, or you can challenge the students to come up with their own design, based on a set of PVC pipes and joints, and the basic goal of supporting a light over a plant tray.

If students need further guidance on assembly of the design above, you could consider color-coding each pipe length and the corresponding insertion point on each joint (i.e. use a sharpie or a sticker to identify the *A* pipes and joint locations in Step 1 as blue and the *B* pipes and joint locations in Step 1 as green; the *A* pipes and joint locations in Step 2 as red; the pipes and joint locations in Step 3 as yellow). The down side of color-coding is that it minimizes the opportunity for the students to try a certain orientation and re-think their approach if it doesn't result in the desired outcome.

Last update: 07/12/24