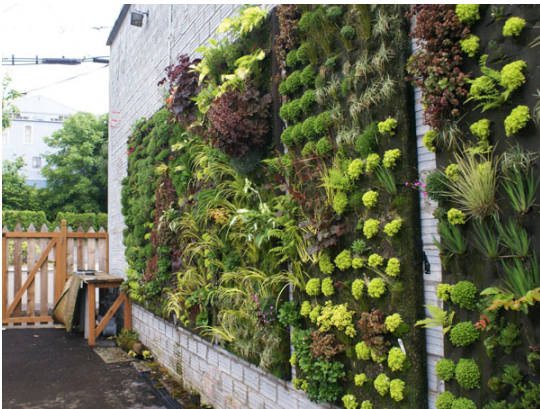


Vertical and rooftop Gardens

What they are:

Vertical gardens allow you to grow vegetables, fruits and colorful flowers up on a trellis, on garden netting, in a tower of pots, and over garden structures, while enjoying the benefits of easier maintenance, healthier plants, effortless harvesting, and higher yields.



How to implement a vertical garden:

- 1.) **Start by choosing what kind of structure you want to use.** You can use a trellis, garden netting, a tower of pots, or a wall. A wall is recommended. The good news is that almost any wall will do, and unless you want to build a very large vertical garden or plant trees, you don't need to worry about weight load. What plants you should choose will depend upon the wall you pick and how much sunlight it receives. However, if you'd like to try particular plants, then choose a wall that will provide the best growing conditions for them.



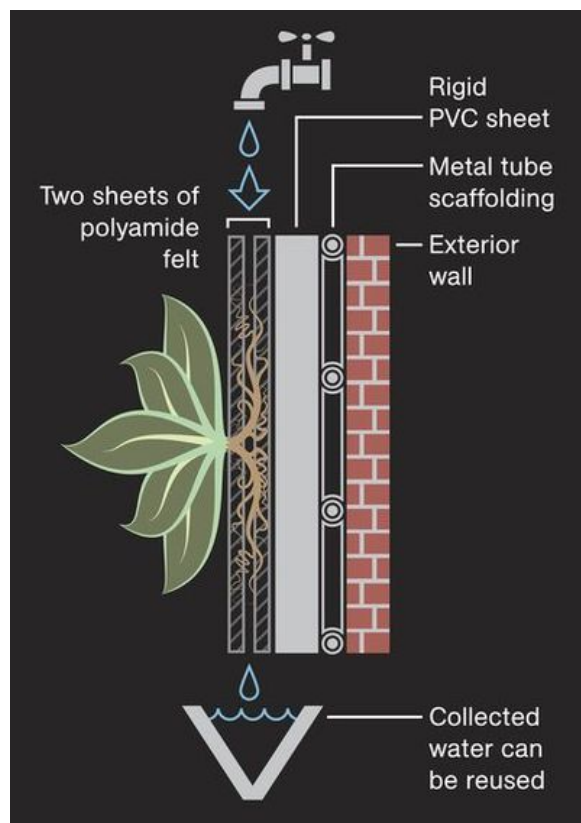
2.) Build a frame. The basic structure of a vertical garden wall is a three-layer sandwich made of frame, plastic sheeting, and fabric. Build the whole setup before hanging it. While you can actually attach it directly to a wall, building a frame to hang on the wall means taking it down will be much easier. It is suggested to use 3/4-inch PVC pipe, elbows, and four-way joints to build a frame. I would advise against using metal (because of the additional weight and expense) and wood (it requires pressure-treating to protect against moisture rot—you don't want water trapped between a wood wall and the frame's plastic).



3.) Attach plastic sheeting. Attach a sheet of plastic to the frame. The plastic acts as a backing for the fabric layer, plus keeps the water off the wall. It is recommended to use expanded PVC sheets. (Note: If you want to try this on a wood wall, you'll need to ventilate behind.)



4.) Attach the fabric. Attach the layer of fabric to the frame. This is the material in which your plants will live, and which will hold water for them. You can use basic felt carpet padding, but you can use just about anything that will retain water without rotting. You'll need two layers of fabric at least. Attach them directly to the frame with galvanized screws and stainless-steel staples as if you were stretching canvas across a frame. As long as the fabric is secure and taut, with no buckling or wrinkles, you're good to go. You just need to attach it some way so it doesn't come off and it looks pretty.



5.) Set up an irrigation system. To keep plants growing on a vertical surface, you'll need an irrigation system that can provide moisture throughout the fabric layer. You can make one out of poly tubing with fittings that lock. It's basically a tube across the top of your panel with emitters that drip water down. Your best bet is to get them from an irrigation supplier. You can buy a standard valve and irrigation drippers, but you'll need a propagation timer that can be set for seconds rather than minutes. You want a quick flow of water for 10 to 15 seconds from three to six times a day, depending on weather conditions and your particular setup. Attach an emitter every 2 to 3 inches along the top irrigation tube and experiment to find the right balance between keeping the wall wet while not overwatering the plants. Attach the frame to the wall using stainless-steel hardware (to avoid rusting). Hooks are fine if you think you'll want to remove the frame; otherwise, brackets screwed into the wall and the frame will also work.



6.) Add Fertilizer Injector and Attach Irrigation System to Water Source. To fertilize your wall, attach a fertilizer injector, such as Add-It, with a simple irrigation valve that sends liquid fertilizer into the irrigation system. Then hook up the irrigation system and connect to your water source. You'll need to filter the water with an irrigation water filter, which is cheap and available at most hardware stores. Remember, there will be some runoff; one way to deal with it is by planting a flower bed underneath your vertical garden.



7.) Choose your plants. As with any gardening, take into account sun, shade, humidity, wind, and cold when choosing plants that you're going to leave outside all year. If you intend to leave the garden out during the winter, it is recommended selecting plants for a colder zone than the one you live in. If you're building a detachable wall and planting it with evergreens, you could try storing it in a cool, dry place for the winter while the plants are dormant. Some plants that do well on walls are hostas, iberis, phlox, ferns, weigela, and even blueberries. Native plants seem to do better than nonnative.



8.) Insert Plants. To insert plants into the outer layer of fabric, use a razor blade to make a horizontal cut in the material. Get as much soil off the plant's root ball as possible (to help stave off root rot), and insert it into a cut. Using a staple gun, insert three to five stainless-steel staples to attach the cloth to the plastic backing in a semicircle around the root ball, creating a secure envelope.



9.) Plant Design. The fun part, is designing your plantings, and the height of a vertical garden offers lots of possibilities. Choose plants that will grow 2 to 3 feet out from the wall, and plant them at the top so they create shade underneath. If you do this, though, keep in mind you'll have to plant shade-tolerant species underneath, such as ferns. Also, a plant that's 8 feet off the ground will often droop, Yates says. That gives a nice waterfall effect but also smothers whatever's underneath, so you'll have to trim it back. Planting in vertical strips, with green shade plants in one strip and sun-loving flowers in another, is a good idea.



Pros and Cons of having your own vertical garden:

Pros:

- Growing plants up, not out, in beds with a small footprint
- Less soil preparation and digging from Day 1
- More plant variety in much less space
- Many opportunities to create bottom-up and top-down plantings
- Less weeding in vertical beds, spaces, and pots
- Many space-saving container and stacking options
- Fewer maintenance chores
- Improved air circulation and less risk of plant diseases and pests
- Easier tending and harvesting—all at eye level
- Less bending and less backbreaking work
- Larger yields in a compact space
- Top-performing vertical vegetables, fruits, and flowers—especially vining types
- Eat what you grow, food goes straight from garden to plate



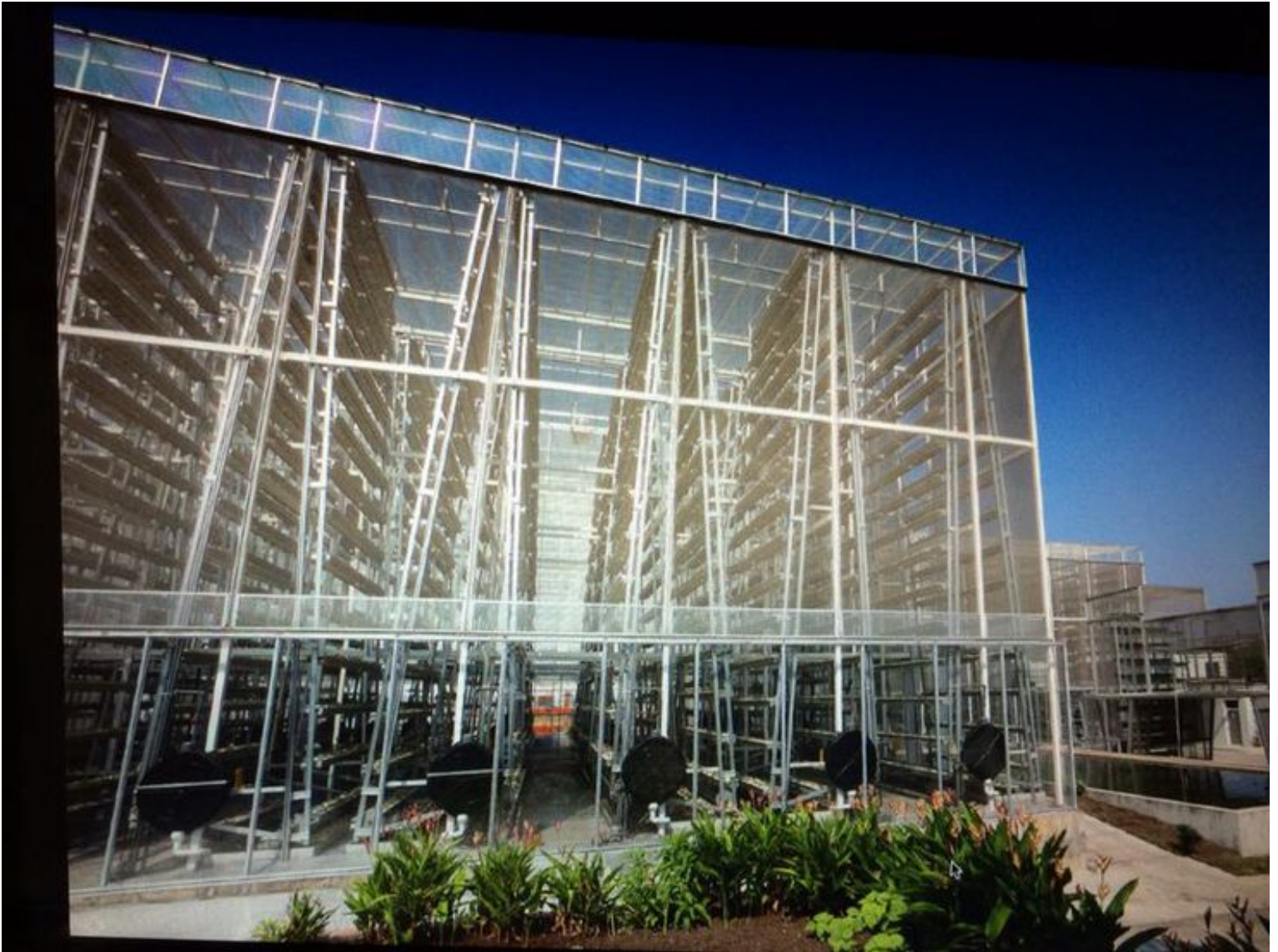
Cons:

- High initial cost- Costs are varied depending on the project, but on average the cost for installing a living wall system, complete with plants, is \$95 - \$165 per sq ft.
- Higher energy bills
- Requires a lot of time and maintenance in the beginning

Other types of vertical gardens:

1.) Commercial Gardens

a. Sky Greens Farm-Singapore



b. Farmedhere-Chicago, Illinois



c. Green Spirit Farms-Scranton, Pennsylvania



d. Nuvege Vertical Farms-Fukushima, Japan



2.) Rooftop gardens:

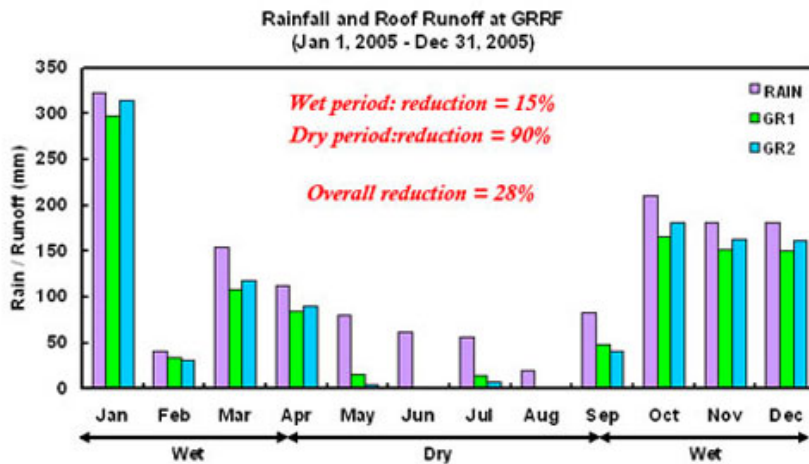




The benefits of rooftop gardens:

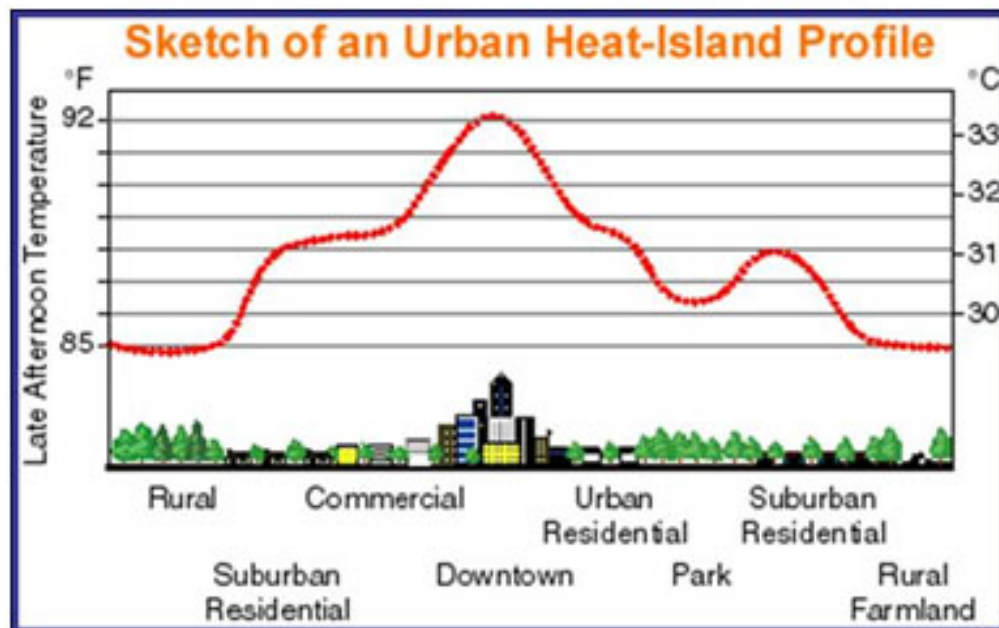
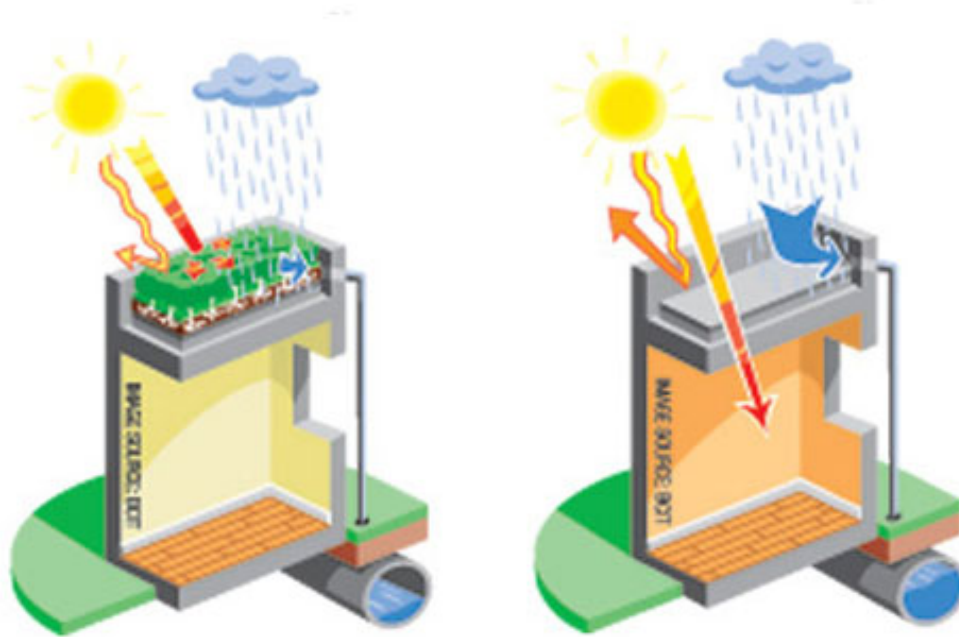
- **Benefit: Green roofs restore storm water runoff:**

- Green roof growing media retain rainwater and, together with plants, return a portion of this water to the atmosphere through evaporation and transpiration (evapotranspiration).
- Storm water that does leave the roof is delayed and reduced in volume.
- Storm water that runs off a green roof is cleaner than runoff from a conventional roof.
- Retention and delay of runoff eases stress on storm water infrastructure and sewers.
- Cost savings from decentralized storm water mitigation reduces the need to expand or renovate related infrastructure.



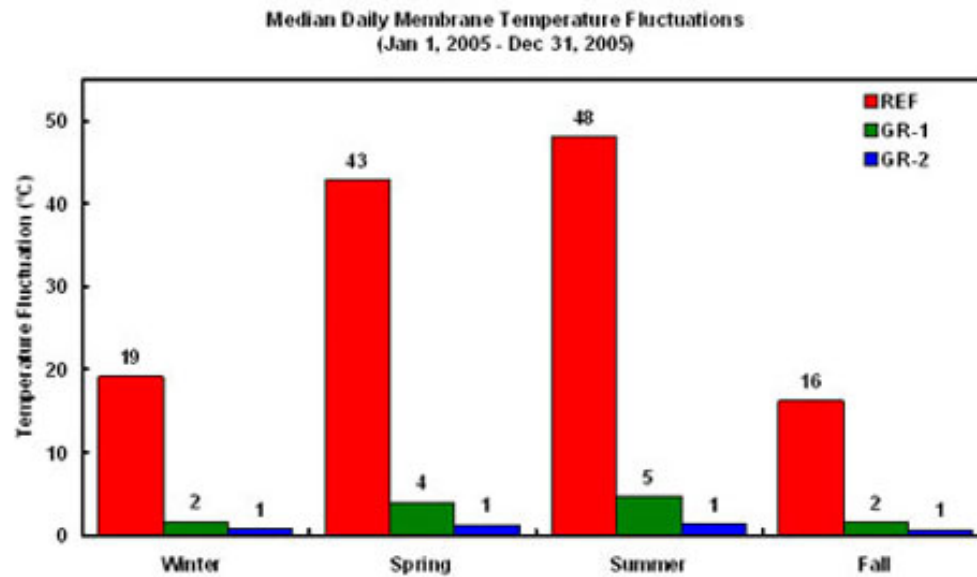
- **Benefit: Green roofs are energy efficient:**

- In summer, the green roof protects the building from direct solar heat.
- In winter, the green roof minimizes heat loss through added insulation on the roof.
- Energy conservation translates into fewer greenhouse gas emissions.
- Less ground level ozone + less heat = less smog.
- Reduced Urban Heat Island profile.
- Less need for health care services result in societal cost savings.



- **Benefit: Green roofs can serve as habitat:**
 - Less ground level ozone + less heat = less smog.
 - Reduced Urban Heat Island profile.
 - Less need for health care services result in societal cost savings.
- **Benefit: Green roofs last longer:**
 - Reduced material waste from re-roofing

- Less frequent re-roofing, less cost over time



Median daily temperature fluctuation experienced by the roof membrane of the three sections at the Green Roof Research Facility, by season (September 2006 CMHC Report).

- **Benefit: Green roofs provide extra space:**

- Amenity space for day care, meetings, and recreation.
- Improved aesthetic views for neighbors in adjacent buildings.
- Improved worker productivity and creativity.
- Potential to enhance urban food security through rooftop gardening and food production.

- **Benefit: Job Creation:**

- Supply and manufacture of roofing membranes and root repellent layers, drainage layers, landscaping cloth, curbs, irrigation systems and other specialty products.
- Supply and manufacture of substrate, light-weight soils and amendments, plants.
- Design and engineering professionals, contractors and landscapers; and companies supplying maintenance contracts.

- **Other benefits:**

- By improving energy efficiency and addressing the “Urban Heat Island Effect”, we can better prepared and adapted to climate change.

- Hospital patients with natural views require less medication and attention and may be discharged sooner.
- Opportunities to recycle aggregate and compost.
- Potential for faster approval process for new projects (e.g. Chicago).
- Potential for reduced storm water/ wastewater charges from municipality or utility.
- Potential to reduce the size of storm water management ponds or cisterns, resulting in cost savings.
- Potential for grants related to energy efficiency and/ or green roofs.
- Potential for larger floor area ratio (e.g. Portland OR).
- Potential to score more than 7 credits under the US and Canadian Green Building Council LEED certification system.
- Potential for satisfying minimum parkland / green space set aside, requirements.



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