



# Rooftop GardENS

Rooftops are one of our cities' greatest untapped resources. They account for hundreds of acres of empty, under-utilized space, contributing to problems like the "heat island effect" and increased storm-water run-off. But rooftops could easily be turned into valuable green spaces, by creating green roofs of wildflowers, trees and shrubs or vegetables on schools, apartments, homes and places of work throughout the city. Green roofs can be divided into two types: the vegetation-covered or "inaccessible roof" where the soil and plants form another layer of the roofing system, and the rooftop garden or "accessible" roof that can become an outdoor space for studying plants and wildlife, participating in group activities or for reading and quiet reflection.

Green roofs and rooftop gardens can provide many benefits, including:

- Increased access to safe outdoor green space;
- A venue for urban food production;
- Promotion of individual, community and cultural diversity;
- Areas for study and horticultural therapy;
- Improved air quality and absorption of carbon dioxide;
- Minimization of stormwater run-off, and support for a rainwater collection system;
- Increased habitat for birds, butterflies and insects; and
- Reduced heating and cooling costs by providing a layer of insulation on buildings.

*did YOU  
know...*

*Rooms under a green roof are three to four degrees Celsius cooler than the outside air, when temperatures are 25 to 30 degrees Celsius.*

## Design details

### Before Starting

- **Assess Your Roof** — Can your roof support a rooftop garden? What is the orientation of your roof - shaded or sunny south exposure? What kind of roof does your school have? Is the roofing membrane able to hold people, soil and plants? Will you need to provide protection with wood decking, pavers, rigid insulation, gravel or grass? Is the roof being replaced in the next few years? Ask your School Board's Design Department for assistance. They will be able to help you with the logistics of building on your roof and provide you with the structural details you require to determine whether you can create a green roof or a rooftop garden.
- **Safety first** — You will need to address the amount of weight your roof can support; access to and from your rooftop area (for people and transported materials, plants and water), emergency exits; the number of people who will be using the rooftop garden; lighting; the height and location of railings and whether the school's liability insurance covers use of the roof.

# Key Things to Consider in the Design of Your Rooftop Garden

1. Calculate the loading capacity of your roof.
2. Plan for drainage from rainfall and from watering plants.
3. Plan for access to the roof membrane for maintenance and repair.
4. Choose the right plants for your rooftop garden.
5. Incorporate built features in your garden to suit the goals of your school garden project.



**1 Loading Capacity** — You will need to assess the amount of weight your roof can support. The weight of soil, decking, people and planters - and where they are placed - will all depend on the load bearing capacity of your roof. Typically roofs are designed for a combined load of 40 pounds per square foot. Wet soil weighs 100 pounds per cubic foot, so six inches of soil across a roof would add a load of 45 to 63 pounds per square foot.

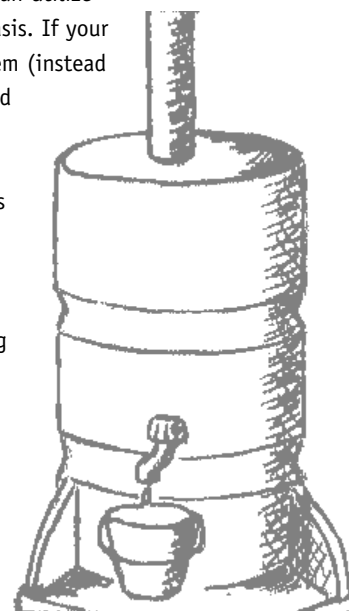
Consider these ideas to reduce the load on your roof:

- Mix your soil with organic and inorganic matter to lighten its weight, or use lightweight growing mediums, such as pre-mixed planting soils found at your local garden centre (typically a combination of peat moss, compost or other organic matter, and vermiculite or perlite).
- Plan for heavier items to be aligned with the building's bearing walls, columns and shear walls, which have the added support of the footings below.
- Control the amount and type of use on your rooftop garden by having designated class or activity times; or
- Build a green roof. Green roofs are lighter in weight since they use less soil, do not require the use of planters and are not designed for access besides occasional maintenance requirements. Green roofs can still be accessible for study — plant a bird or butterfly garden and observe from an overlooking or nearby window.

**2 Drainage** — Keeping access to the drainage system free and clear is a priority. This can be done on green roofs by maintaining a gravel ring and filter cloth layer around roof drains and overflow scuppers. On rooftop gardens, ensure that any deck strapping or containers are aligned in such a way that they don't block the flow of water to the drain or eavestrough. Watch and determine where water flows to on your roof and ensure those areas and drainage paths are maintained.

On a terraced green roof you could make the most of the water falling on your rooftop by directing it to planted areas or reservoir areas where plants can utilize the water on an as needed basis. If your roof has an eavestrough system (instead of an internal drain) you could retain and store rainwater in covered reservoirs or cisterns for later distribution to plants by hand watering.

Make sure your roof is designed to withstand pooling of water. You may need to provide an added layer of protection (a drainage layer) over the roofing membrane to protect it from standing water that may collect from watering plants.



*Always consult your School Board's Design Department or consult a professional engineer or architect to properly determine how much weight your roof can hold and how that weight should be dispersed on your roof.*



**Maintenance** — To maintain clear access to the roofing membrane and drains for maintenance and repair, you may need to install your rooftop garden in sections. This can easily be done using containers of any height or size, arranged in sections on your roof. Designing your rooftop garden in sections will avoid removing the entire garden area each time the roof needs some repair work. Remember to factor in the weight of each container and its wet soil weight when designing the garden. For information on growing plants in container gardens refer to the *Container Gardening* fact sheet in Gardening Techniques. Or, you may choose to install a green roof that will protect your school's roof, reduce the need for maintenance and extend its life span.



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## Choosing plants

Gardening on a roof is quite different from gardening at ground level. Rooftops have unique and often extreme microclimates.

The amount of sun and wind your roof receives will have a direct effect on what will grow, how often you have to water and whether your plants will survive the winter. You will need to take these conditions into consideration when selecting plants for your roof garden. You will also have to consider the amount of time and resources you have for watering and maintaining plants, especially during the summer.

☛ **Sun and Wind** — The height and location of your building in relation to surrounding buildings can affect the amount of sun your rooftop garden receives, as well as the exposure to wind. Determine the wind and sun conditions on your roof and select hardy plants that can flourish under the conditions your rooftop garden provides.

☛ **Soil depth** — Most plants can grow on a roof as long as they are provided with an adequate amount of soil to stabilize and flourish. However, soil depth may be a limiting factor on some roofs. Make sure you study the depth of soil required for different species of trees, shrubs and wildflowers so you match the right species with the conditions provided on your roof.

☛ **Availability of water** — Watering during the summer months should be addressed well in advance. Summer is when your garden and plants need the most attention, yet no one is at school. Ask for support from your school's maintenance staff, the local community or daycare programs. Your rooftop garden could be a great resource for these groups as well. Make sure they will have access to the rooftop garden, water and maintenance supplies. If installing a hose or irrigation system on your roof proves problematic, you may choose to create a xeriscape garden, which utilizes plant species that are specially adapted to drought conditions.

# 5

**Other Features** — Seating, composting bins, weather stations, bird feeders, greenhouses and coldframes are just some of the built features you could choose to incorporate on your rooftop garden.

- a) **Composting** — Before composting on a roof make sure you have adequate drainage, that the roof can support the weight of the compost, your rooftop structures are tolerant of composted material, and maintenance, monitoring and collection issues have been addressed. For general information on composting refer to the *Compost and Mulch* fact sheet in Gardening Techniques.
- b) **Seating** — As with any garden, seating is an important consideration. Make sure you plan for seating when determining the load bearing capacity of your roof. Remember, containers can also function as seating areas as long as the fence or railing on your roof still meets safety codes above the container height, or you set your containers and seating areas at least one metre (three feet) away from railings and roof edges.
- c) **Greenhouses** — Greenhouses and cold frames can extend the growing season on your rooftop and provide year-round areas for study. Make sure your roof can support the addition of a greenhouse and then plan for orientation, placement, insulation and solar paneling to optimize heat collection and to minimize shading.
- d) **Weather Stations and Wildlife Features** — Weather stations and bird baths, feeders and houses can also be included on your green roof or rooftop garden. Place wildlife features in a sheltered corner where you can observe from a nearby window or seating area. For more information on weather stations see the *Weather Study* fact sheet in Built Features.

# Materials Needed to Create a Rooftop Garden

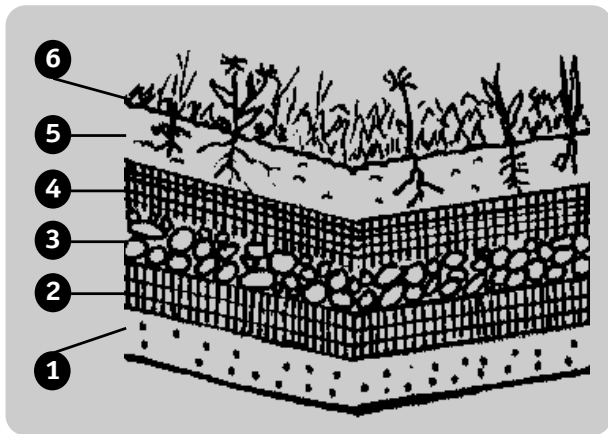
The materials needed for your project will depend on the type of roof you have and whether you create a green roof or a rooftop garden.

Typical materials for a rooftop garden may include:

- 🌿 Plants;
- 🌿 Growing containers;
- 🌿 Growing medium;
- 🌿 Decking or other material that can be walked on; and
- 🌿 Seating, wildlife features, greenhouses or composters.

***Make sure the material on your roof is separate from the growing medium for your plants to ensure your roof does not become the root bed. For example, bitumen is a food source for micro-organisms as well as for plants; therefore any roofing product that contains bitumen is subject to root damage and penetration.***

## Cross-Section of a Green Roof



Starting from the bottom:

1. Roofing membrane;
2. A layer of filter cloth to prevent the roots from penetrating the roofing membrane;
3. A drainage course of gravel or expanded clay pellets;
4. A layer of filter cloth to prevent soil, growing medium or organic matter from eroding or clogging the drains;
5. Growing medium; and
6. Plants

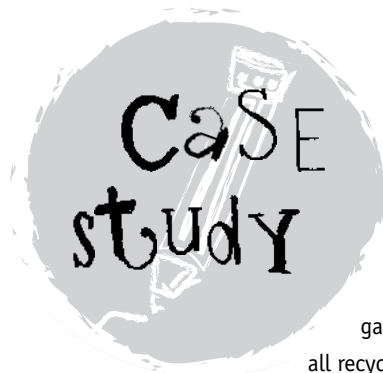


## Codes and Safety Standards

Inaccessible green roofs are regulated under provincial building codes as part of the roofing system. However, because rooftop gardens are built as outside spaces on your school building they have specific restrictions with respect to public safety. The Design Department at your School Board will need a building permit from the municipality to assist you in the creation of your rooftop garden. To obtain a permit, your school will have to address certain issues in the design and construction of your rooftop garden, including:

- 🌿 occupant load;
- 🌿 load bearing and structural capacity of the building;
- 🌿 size of the garden;
- 🌿 exiting requirements for fire and other safety considerations;
- 🌿 barrier free design and accessibility;
- 🌿 enclosure requirements (guards, railings, walls, terraces); and
- 🌿 drainage and waterproofing requirements.

For more details, consult the building department at your local municipality, or a professional engineer or architect.



# The Rainbow Classroom

## St. Francis Xavier School, Brockville, Ontario

"In 1996 we began a project that has turned the roof of our gymnasium into an outdoor classroom. The rooftop garden was built using primarily all recycled materials and the hard work

of many volunteers. Two architects assessed the structural stability of the roof, and then an architect provided the basic design. The rooftop was covered with a membrane to prevent deterioration of the roof material. Parents covered the roof using re-fabricated skids, and then added a 7-foot wall built out of 2'x4's around the perimeter. We re-used conveyor belt material as a final surface

before putting planters and benches in the outdoor classroom. Five planters were placed on the roof, making use of the space where the housing for the old ventilation system from the gym once sat. This raised the planters a little and made good use of space. Water and electricity have been added to this area to maintain the garden, with the aid of a timer. A 12'x14' shed was also added to house a workbench and tools for the kids. Other classes have built bird feeders and use the roof to study bird species. Tomatoes and pumpkins have been growing in our planters. Future plans include a lean-to greenhouse and pergolas with canvas panels to block the mid-day sun. The roof was designed in segments to spread the load and help with installation of the pieces. Safety was the biggest factor. We discovered the minimum standard for the perimeter wall was three feet, but decided to make ours 7 feet and create a small set back for added assurance. As well, we have imposed a limit to the number of students in the garden at a time: 60 for normal use and zero during heavy snowfalls."



St. Francis Xavier School



## Where to *go* from here?

### Sources for this fact sheet

Kuhn, Monica. "Roof Gardens." *An article in Grant, Tim and Littlejohn, Gail, eds.*

*Greening School Grounds: Creating Habitats for Learning.* Gabriola Island, British Columbia: New Society Publishers, 2001.

Kuhn, Monica. "Roof Greening." *Ontario Eco-Architecture.*

Rooftop Gardens Resource Group. Fact Sheet Series.

### Organizations and Web sites

Green Roofs for Healthy Cities: [www.peck.ca/grhcc/main/htm](http://www.peck.ca/grhcc/main/htm)

Rooftop Gardens Resource Group: [www.interlog.com/~rooftop;rooftop@interlog.cm](http://www.interlog.com/~rooftop;rooftop@interlog.cm)

### Example projects

The Boyne River Natural School, RR #4, Shelburne, Ontario: (519) 925-3913

Brock Junior Public School, Toronto, Ontario: (416) 393-9245

St. Francis Xavier School, Brockville, Ontario: (613) 342-0510