

# LESSON 1 NATURE AND SCOPE OF VERTICAL GROWING

*Vertical growing takes on many different forms including green walls and facades through to productive systems such as those found in hydroponics and vertical farming. Some of these are concerned with aesthetics by beautifying a street or building, others emphasise the health benefits of green spaces like green walls located in and around hospitals and care homes, and there are those which are primarily concerned with making the most use of restricted space to grow food. Whatever the purpose, vertical growing or gardening is now something most people are aware of.*

## NATURE OF VERTICAL GROWING

When it comes to enhancing buildings with greenery, a distinction is often drawn between green walls and green facades. Here, we'll describe what each of these entails, but the reality is that often these terms are used interchangeably, and many designers and installers of green walls don't make these distinctions. If you think more broadly in terms of vertical growing or vertical gardening, then any means of sustaining plants upwards can be included.

### Green Walls

Green walls used to be something of a novelty and perhaps whilst greeted with curiosity, they were often considered to be difficult to install and maintain. With advances in technology and an array of possible installation options, they are more commonplace. In recent times, they are also becoming part of building design

and their many benefits to people and the environment are now recognised.



*Mass planting of one species of plant is used to great effect here with a section of wall softened using a large leaved plant.*

A green wall is a wall which is totally or partially covered with plants which are growing in soil, or some sort of substrate, which is also incorporated into the wall. Where the growing medium is loose it is housed in some sort of container, like bags, which are fixed directly to the wall, are part of the wall's structure, or which are supported by frameworks which are separate

from the wall but often anchored to it. If a substrate is used it can be in the form of mats (e.g. coir), sheets (e.g. polyurethane), or blocks which are manufactured to size to fit a particular wall. In most situations green walls have some sort of irrigation system hooked up to them since it is difficult to water the plants higher up.



Different layers and textures of plants can be used to create greater depth in a green wall.

Green walls may also be called 'living walls' since the plants are actively growing on the wall. They are also called 'vertical gardens'. However, green walls are not the same thing as vertical farming which is a means of growing produce usually inside a large structure such as a greenhouse or some other building e.g. a disused industrial building. That said, many owners of green walls may choose to include food plants as part of a green wall especially where there is limited space, or no other garden space, to grow fruit and vegetables.

Although most green walls are on the outside of buildings, they can also be on inside walls. The foyers of large hotels, high rise apartments and commercial offices offer potential for these types of inner green walls since they are often spacious and bright which allows good access for maintenance as well as more suitable environmental conditions for plants in the way of better ventilation and natural light.

## Suggested Tasks: ▼

*Throughout this course you will be provided with suggested tasks and reading to aid with your understanding. These will appear in the right hand column. Remember: these tasks are optional. The more you complete, the more you will learn, but in order to complete the course in 20 hours you will need to manage your time well. We suggest you spend about 10 minutes on each task you attempt, and no more than 20 minutes.*

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### Suggested Tasks

Take a walk or drive around your local neighbourhood or your nearest town. Look for examples of green walls. Consider the following:

- Are they aesthetically pleasing?
- Do the plants look healthy?
- Had you noticed them before you went looking for them?

## Green Facades

A wall which has climbers growing up it from garden beds or containers at the base of the wall is not strictly speaking a 'green wall' since it is really only using the facade for supporting the upper part of the plant, but when it comes to greening up a garden (or even a part of a town or city) most proponents of green walls would welcome all attempts to provide greenery. Green facades therefore have a large role to play in vertical gardening and offer an opportunity to grow plants in difficult spaces which may otherwise be off-limits. For example, a wall in a narrow alleyway could be made use of without restricting the passage of people or machinery. It can also be used to embellish the walls of a small inner city courtyard without reducing free space.

In other instances, green facades can be created by installing a series of planters set in horizontal levels up the face of a building. These can be placed behind supportive trellis for climbing plants, so that as the climbers grow the wall becomes a mass of green vegetation.

Whilst a green facade typically refers to growing climbers up the face of a wall, it doesn't have to just rely on climbing plants. There are other ways you can complement climbers or other means of making a facade green. For example, espaliered fruit trees or topiary box plants along a house wall, or pencil pines either side of an entrance are some of the different ways you can use vertical gardening techniques to enhance the facades of buildings. In many ways, a green facade created from in-ground plants gives

greater scope than growing plants on walls since you can include trees and climbers with large root systems.

Window boxes, hanging baskets, and planters on balconies are all other means of greening up a building's exterior. Often, it is a mixture of green wall and facade techniques that will be utilised, particularly for home gardens, to make the best use of the existing infrastructure.



Espalier fruit trees to grow them two dimensionally where space is limited (also grown this way in orchards with rows closer together).

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### Suggested Tasks

Go back to the green walls you appraised earlier. Take a closer look.

- a) How have they been created?
- b) Would you class them as a green wall or green facade?

## Crop Production

Vertical growing is not restricted to the walls and facades of buildings. In fact, greenhouse growers have long made use of what space they have available inside their protective structures to harvest the most amount of produce possible. In taller structures this has led to methods for growing upwards, such as shelving and stacking systems, and the use of A- frames.



Grow strawberries vertically to increase production per square metre.

with their roots trailing into channels through which nutrient solutions are passed. Often these are secured with A-frames or tiered shelving systems and they can be several metres high. The past decade has seen greater adoption of aquaponics systems whereby fish or crustaceans are incorporated into a hydroponics system. Vertical aquaponics systems are used where the fish effluent provides nutrients for the plants so that little or no additional plant fertiliser is required. Generally, the fish tanks are at the base of the vertical aquaponics system.

In recent years vertical farming has taken on another guise in an attempt to feed large city populations with fresh locally grown produce. Many disused industrial buildings such as warehouses have been turned into inner city or urban farms. Even old high rise buildings have been kitted out as farms. In these enterprises, herbs and vegetables are grown under fluorescent lighting. Many of these structures already have frameworks inside which can be adapted to vertical growing. In others, shelving systems can be installed relatively easily.

## SCOPE OF VERTICAL GROWING

### The Uniqueness of Vertical Gardening

Apart from the obvious advantage that it is possible to grow more biomass on a small footprint, there are some other unique attributes associated with vertical gardening - as well as some possible limitations.

Hydroponics is no different. Over the years a range of innovative hydroponics systems have emerged which also make use of shelving systems. One particular type of hydroponics system known as NFT requires plants to be suspended

For instance, in a green wall plant foliage and flowers are higher than they might otherwise be. Whilst this clearly means that gardeners, garden designers and architects can make use of space which may have been unavailable previously, it also means the high foliage may be exposed to different environmental conditions than plants grown at ground level. At higher altitudes there are changes in wind and light; plants higher up may be buffeted by stronger winds causing them to dry out faster as well as the risk of mechanical damage. They may also be exposed to higher light levels

which may burn some plants or cause others to grow too quickly. The foliage further down below may be shaded or sheltered by the higher foliage. When it rains, the foliage of plants higher up the wall may catch and hold water on the leaf surface in light rainfall, and an excess of water might not even develop enough to filter through to the foliage and roots below. These differences in environmental conditions at the base or summit of walls may be subtle or dramatic depending on other factors like the orientation of the wall, the presence of other buildings or nearby trees, the height of the wall, and so forth.

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### Suggested Tasks

Think of a building you know well. It could be your home, a friend's home, your workplace or somewhere you used to live. Imagine one of the walls is to be made into a green wall. Write a list of advantages and a list of disadvantages specific to making that wall a green wall in that location. Consider things like climate, shade, presence of other buildings, height, etc. Decide whether or not it would be a worthwhile project.



Grow more in a small space with a green wall

When disused buildings are adopted for farming, one of their unique attributes is that they require significantly less fertiliser than traditional farming methods. Also, the crops are not exposed to the same environmental fluctuations in temperature and humidity which means crops can be harvested throughout the year. Some claims suggest that twice as much food can be produced per square metre than using traditional agriculture methods. The main drawback, of course, is the cost of running artificial lighting.

## Where to Grow

There really is no limit to where you can grow plants vertically, and often you are only limited by your imagination. Sometimes costs can be prohibitive, particularly for start-up vertical farming enterprises.



Greenery and colour in containers can be swapped around so your best plants are always on show.

Facades are the obvious choice for most people who wish to venture into vertical growing. Many gardens have walls which can be used to support climbers and creepers. If not wooden fences and trellis offer good support save for

the heaviest climbers. Green walls, whether inside or outside, take a little more planning, and especially those in confined spaces such as alleyways.

## How to Grow

In order to grow, all plants need soil or a suitable substrate which holds air and moisture. Whether they are grown in hanging baskets, pots, pouches, or on substrate boards or mats they will also need fertilising from time to time.

Preformed substrates made from coir or similar materials are lightweight and so are ideal for securing to walls or for creating walls supported in metal frameworks. As the plants grow their roots become entwined in the substrate, so most will last about five years or so before they need replacing.

For green walls and vertical farming water can be supplied through irrigation systems, and in most cases will be a requirement. In some cases, it may be possible to water plants on walls using handheld watering devices such as telescopic watering lances. Self-watering pots are also a possibility.

Fertiliser can be applied several times a year in granular form to plants in green walls, which means accessing them from ladders, scaffold or from balconies or other vantage points. Fertiliser can also be supplied in liquid form directly through irrigation systems, a practice often called 'fertigation'.

Additional lighting will be required for indoor vertical growing and green walls inside buildings because plants rely on light in order to photosynthesise and grow.

# BENEFITS OF VERTICAL GARDENING

Green walls have many benefits to human health. Some are more aligned with mental health and others with physical health. However, since our physical and mental health is intertwined, many mental health problems are exacerbated by physical conditions, and vice versa. If, for example, you feel less stressed having greenery around your windows and balconies you will have lower blood pressure and lower risk of cardiovascular disease.

## Mental Wellbeing

Some of the benefits to mental health, such as the calming nature of plants and foliage, have been recognised for a long time but others like our innate need to connect with nature are only just being realised.

## Stress and Fatigue

Although more research is needed in this area, it would seem that the presence of plants in our homes and working environments can help us to recover from stress and fatigue. Having greenery around us has been linked with lowered blood pressure and blood toxin levels, enhanced cognitive performance and memory, as well as recovery from stress-related health complaints. Two theories in particular – the ‘stress recovery theory’ and the ‘attention restoration theory’ both emphasise the role of the environment in coping with stress. Natural environments are seen as restorative. That is, they allow people

to change to more positive cognitive, emotional and behavioural states and are calming for physiological arousal. Conversely, environments which have few or no plants are less beneficial in reducing stress levels or helping us to overcome stress.

## Biophilia

More recently, biophilic design has emerged in architecture and landscaping which suggests that we have an innate desire, even if watered down, to connect with nature. When we are able to connect with nature we feel better, we are healthier and happier, and lead more productive lives.

Links between the presence of plants or green spaces and mental health have been examined in research and this is a relatively new area of investigation. For example, a self-report study in the Netherlands by De Vries et al. (2003) found that people living in greener environments were significantly healthier than their built environment counterparts and reported fewer symptoms of ill health during the preceding 14 days. Just a 10 percent increase in green space was associated with health benefits as evidenced by reduction in symptoms equivalent to a reduction in age of five years.

A survey study in Adelaide, South Australia by Sugiyama et al. (2008) found that after adjusting for socioeconomic variables, people who perceived their neighbourhood as being very green had 1.37 times better physical health and 1.6 times better mental health compared to those who perceived their neighbourhoods as being less green.

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### Suggested Tasks

Conduct an internet search to look up the terms “biophilia” and “biophilic design”. Try to find out:

- Who first coined the name “biophilia”?
- What language is the word derived from?
- What exactly does biophilia mean?
- What are biophilic patterns and principles in design?