

**Faculty Training Module
for Greening the
Landscape Construction
Trade**

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the Landscape
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Faculty Training Module for Greening the Landscape Construction Trade



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Acknowledgements

Land

The Vancouver Island University (VIU) community acknowledges and thanks the Snuneymuxw, Quw'utsun, Tla'amin, Snaw-naw-as and Qualicum First Nations on whose traditional lands we teach, learn, research, live and share knowledge.

Associations / Institutions / People

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Introduction



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Welcome learner,

Regenerate (to renew/restore/respect)

As Landscape Horticulture Instructors and Faculty, a major *element* of our job is to prepare students with theoretical knowledge and practical skills to support their successful

integration and leadership in the landscape horticulture industry. Let's get straight to it, the landscape industry is facing the challenge of adapting to the changing climate, and as such, the skills and practices taught in Technical, Vocational, Education and Training (TVET) programs need to evolve to present solutions that prepare students for a changing industry. It is crucial to incorporate sustainable and regenerative practices to mitigate the effects of climate change and equip the future landscape industry workforce with the necessary skills to address the challenges ahead.

The Landscape Construction Faculty Training Module was created to support horticulture faculty members to raise awareness, knowledge, and skills about greenhouse gas emissions and climate change. In addition, this module was created with the hopes of providing faculty members with recommendations for alternative and regenerative landscape practices that may be used to supplement the current landscape horticulture curriculum. Landscape horticulture is a pan-Canadian harmonized certification program administered through the [Canadian Council of Directors of Apprenticeship](#) (CCDA) which is responsible for apprenticeship training and trade certification, and the federal government. The pan-Canadian harmonization process aims to align apprenticeship systems across Canada by making apprenticeship training requirements more consistent in the [Red Seal trades](#). The CCDA comprises 15 members including one official from each province and territory and two federal government representatives from the Department of Employment and Social Development Canada. The CCDA as a body does not have any regulatory powers regarding training and certification in the skilled trades. However, the individual CCDA directors of apprenticeship and their organizations may hold regulatory powers through specific provincial/territorial legislation.

Provinces and Territories have individual certification bodies that support the credentialling of trades, for example, in British Columbia (BC) the trades certification body is [Skilled Trades BC](#).

By building the capacity, skills, and confidence of trades' faculty instructors, the hope is to also inspire and support instructors to integrate Indigenous ways of knowing in their courses to support the development of green skills in their students, the future green economy workforce of Canada.

In the Landscape Construction Faculty Training Module, the learner is invited to engage with the story of regenerative landscaping. This module presents the story of regenerative landscaping, which showcases a renewal and restorative lens that can guide the landscape construction industry toward reflective and greener skills development. The module is divided into five chapters, which cover the planning, construction (soft and hardscape), and maintenance of a landscape using green thinking, practices, and skills. One of the module's goals is to highlight Indigenous ways of knowing and emphasize the interconnectedness of ecosystems. It also aims to showcase the influential role that landscape horticulturalists have in partnering with the ecosystem toward sustainability.

United Nations Sustainable Development Goals (SDGs)

The United Nations Sustainable Development Goals were used for guidance and direction in the development of the Landscape Construction Faculty Training Modules.



United Nations Sustainable Development Goals

“[The 2030 Agenda for Sustainable Development](#), adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries – developed and developing – in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.

The SDGs build on decades of work by countries and the UN, including the [UN Department of Economic and Social Affairs](#)

- In June 1992, at the [Earth Summit](#) in Rio de Janeiro,

Brazil, more than 178 countries adopted [Agenda 21](#), a comprehensive plan of action to build a global partnership for sustainable development to improve human lives and protect the environment.

- Member States unanimously adopted the Millennium Declaration at the [Millennium Summit](#) in September 2000 at UN Headquarters in New York. The Summit led to the elaboration of eight [Millennium Development Goals \(MDGs\)](#) to reduce extreme poverty by 2015.
- The Johannesburg Declaration on Sustainable Development and the Plan of Implementation, adopted at the [World Summit on Sustainable Development](#) in South Africa in 2002, reaffirmed the global community's commitments to poverty eradication and the environment and built on Agenda 21 and the Millennium Declaration by including more emphasis on multilateral partnerships.
- At the [United Nations Conference on Sustainable Development \(Rio+20\)](#) in Rio de Janeiro, Brazil, in June 2012, Member States adopted the outcome document "[The Future We Want](#)" in which they decided, inter alia, to launch a process to develop a set of SDGs to build upon the MDGs and to establish the [UN High-level Political Forum on Sustainable Development](#). The Rio +20 outcome also contained other measures for implementing sustainable development, including mandates for future programmes of work in

development financing, small island developing states and more.

- In 2013, the General Assembly set up a 30-member [Open Working Group](#) to develop a proposal on the SDGs.
- In January 2015, the General Assembly began the negotiation process on the [post-2015 development agenda](#). The process culminated in the subsequent adoption of the [2030 Agenda for Sustainable Development](#), with [17 SDGs](#) at its core, at the [UN Sustainable Development Summit](#) in September 2015.
- 2015 was a landmark year for multilateralism and international policy shaping, with the adoption of several major agreements:
 - [Sendai Framework for Disaster Risk Reduction](#) (March 2015)
 - [Addis Ababa Action Agenda on Financing for Development](#) (July 2015)
 - [Transforming our world: the 2030 Agenda for Sustainable Development](#) with its 17 SDGs was adopted at the [UN Sustainable Development Summit](#) in New York in September 2015.
 - [Paris Agreement on Climate Change](#) (December 2015)
- Now, the annual [High-level Political Forum on Sustainable Development](#) serves as the central UN platform for the follow-up and review of the SDGs.

Today, the [Division for Sustainable Development Goals \(DSDG\)](#) in

the United Nations [Department of Economic and Social Affairs \(UNDESA\)](#) provides substantive support and capacity-building for the SDGs and their related thematic issues, including [water](#), [energy](#), [climate](#), [oceans](#), [urbanization](#), [transport](#), [science and technology](#), the [Global Sustainable Development Report \(GSDR\)](#), [partnerships](#) and [Small Island Developing States](#). DSDG plays a key role in the evaluation of UN systemwide implementation of the 2030 Agenda and on advocacy and outreach activities relating to the SDGs. In order to make the 2030 Agenda a reality, broad ownership of the SDGs must translate into a strong commitment by all stakeholders to implement the global goals. DSDG aims to help facilitate this engagement” (United Nations, n.d.).

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=45#oembed-1>

Please join us.

SUSTAINABILITY AND CLIMATE CHANGE

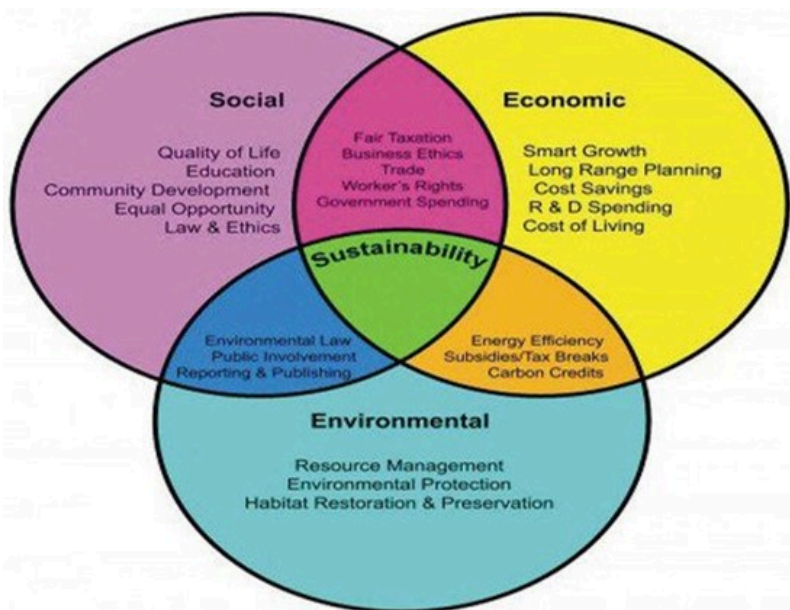
A Summary to Promote General Literacy **CONTENTS**

- Foundation
- Climate Change
- Greenhouse Gas Emissions
- Protocols and Regulations
- Greenhouse Gas Accounting
- Lifecycle Assessment
- Circular Economy
- Additional Resources
- Definitions – a Glossary of Terms

FOUNDATION

At the heart of climate change exists 3 factors – they are the three “pillars” of sustainability: Social, Economic, and Environmental. The 3 pillars must be in balance for true sustainability to occur. Hence if you are building homes but are focusing only on cost-saving measures, and you are over-exploiting forests, mining, and other natural resources and land, in order to cut down costs, then

that is not sustainable. Likewise, if you are spending exorbitant amounts to achieve perfect environmentally-conscious developments, they could be unaffordable for homebuyers and therefore, not meeting social requirements, and therefore are not sustainable.



However, when we are dealing with the 3 pillars of sustainability, we must always remember, that without calculating the true costs to the best of our abilities, then we are not accurately assessing sustainability. For example, when we convert wetlands into housing, this may seem affordable, and good for the social and economic pillars, however, without properly calculating the economic loss of all of the green infrastructure the wetland provides, (e.g. air, water, soil filtration, pollinator habitat, biodiversity protection, flood mitigation, cooling in summer, heating in winter), then it may first appear to be sustainable, but only later when the impacts from the loss of those services

are finally felt, are we able to understand then that building in wetlands, is not actually sustainable.

Climate change that we are feeling now, is the downstream effect of the industrial revolution and ongoing use of fossil fuels and other carbon-intense activities. Our current economic model may seem affordable, however, as time progresses, climate change increases and ensuing weather events become more intense, is it only then, that we realize, affordable economic practices now have a very steep cost attached to them later.

In this summary, we will look at what is climate change so we can start to better understand how to live, work, and play in a truly sustainable way.

Learn more about true cost allocation:

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=864#oembed-1>

Here you can learn more about how forgetting to include all costs in a product can have a serious impact on overall sustainability – in this case, the case study is food:

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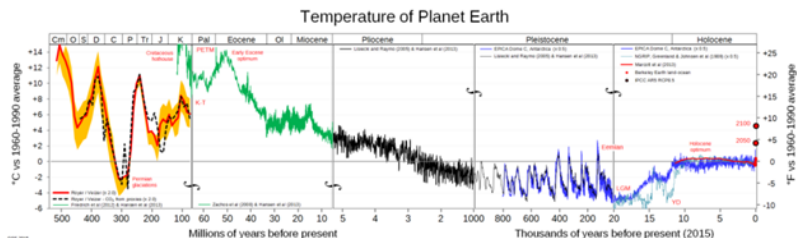
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CLIMATE CHANGE

Introduction

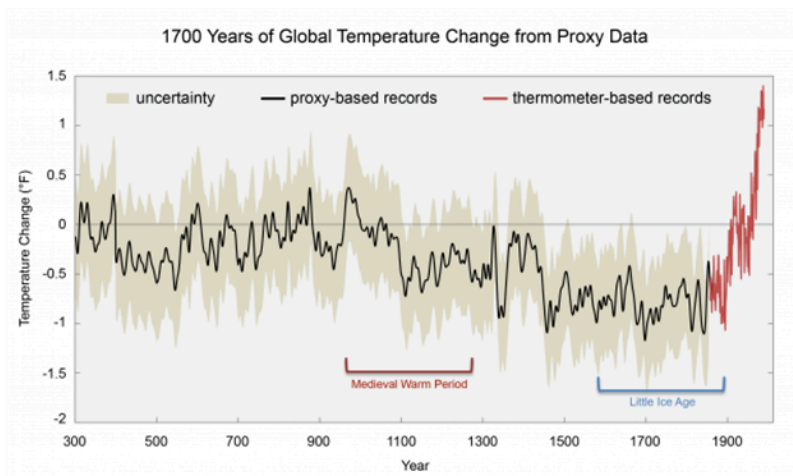
Climate vs Weather: <https://basinclimatesource.ca/climate-science>

Climate change is defined as a change in weather over an extended period of time. It is a completely natural process, and over time, the planet has experienced multiple ice ages and warming periods, including the one we live in today.



Source: <http://www.wrsc.org/>

The difference over the last 100 years is the speed at which this warming is occurring. The flora and fauna that call this planet home cannot adapt fast enough to the environmental changes resulting from this rapid rise in temperature.



Source: <https://www.globalchange.gov/>

The main cause of this rapid rise in global temperatures is the release of greenhouse gas emissions through human activities, predominantly burning of fossil fuels, deforestation, and animal agriculture. To distinguish between the natural process and human process, the term anthropogenic climate change is sometimes used. Generally, when we speak of climate change, we are speaking of anthropogenic climate change.

When greenhouse gases are released into the atmosphere they contribute to the greenhouse effect. The greenhouse effect is the heating of the planet's surface due to the absorption of outgoing infrared radiation from greenhouse gases such as methane, carbon dioxide, and water vapour. This is a natural process, and is in fact a vital component of an inhabitable Earth as it keeps the surface at a livable temperature, without which the Earth would have an average temperature of about -18°C (the average temperature is currently $+15^{\circ}\text{C}$).

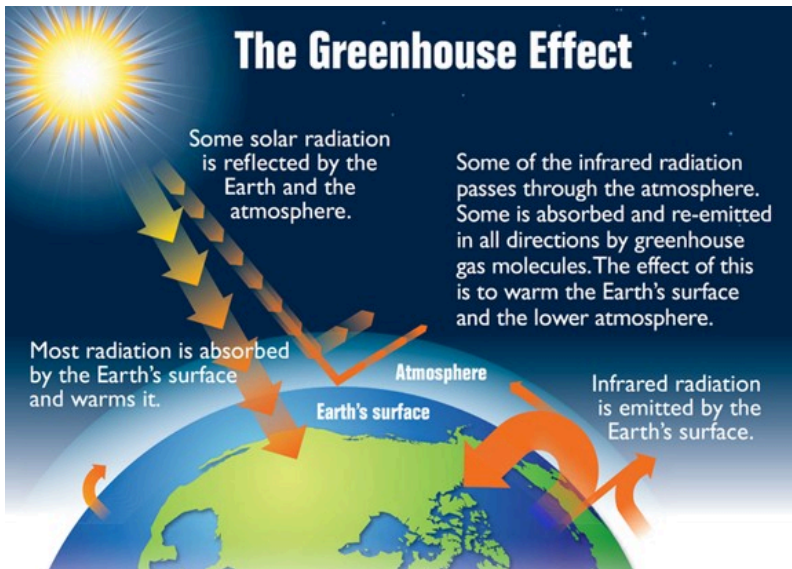
Greenhouse gases include methane, nitrous oxide, refrigerants, and of course carbon dioxide.

When it comes to the effects that greenhouse gases have on the climate, we refer to them in carbon dioxide equivalents. So 1 tonne of methane, for example, is equal to 25 tonnes of CO_2 equivalent (25 t CO_2e); or put another way, methane is 25 times more potent in its Global Warming Potential (GWP) than carbon dioxide. It is also common language to speak of greenhouse gases just as 'carbon'; this is meant in reference to carbon dioxide and carbon dioxide equivalents.

Suggested video:

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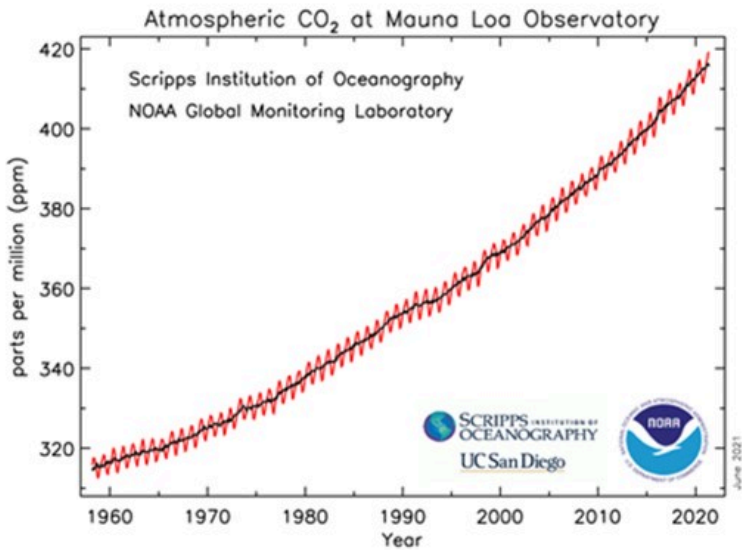


Source: https://energyeducation.ca/encyclopedia/Greenhouse_effect

CO₂e and Atmospheric Makeup

CO₂e can also be measured in their atmospheric makeup in parts per million (ppm). So when we talk about 350ppm as the ideal CO₂e content – we are referring to how much CO₂e should be in the atmosphere in relation to the other gases.

Currently, we are at 420ppm CO₂, we need to get back down to 350ppm CO₂.



Keeling curve measured at Mauna Loa Observatory – NOAA.

The Effects of Climate Change

The accelerated rate of climate change is disrupting the usual balance of nature, causing several issues around the globe. These include hotter temperatures, more severe storms, increased droughts, a warming and rising ocean, glacial melt, loss of species, declining food crops, increased health risks, and poverty and displacement. Many of these impacts are interrelated.

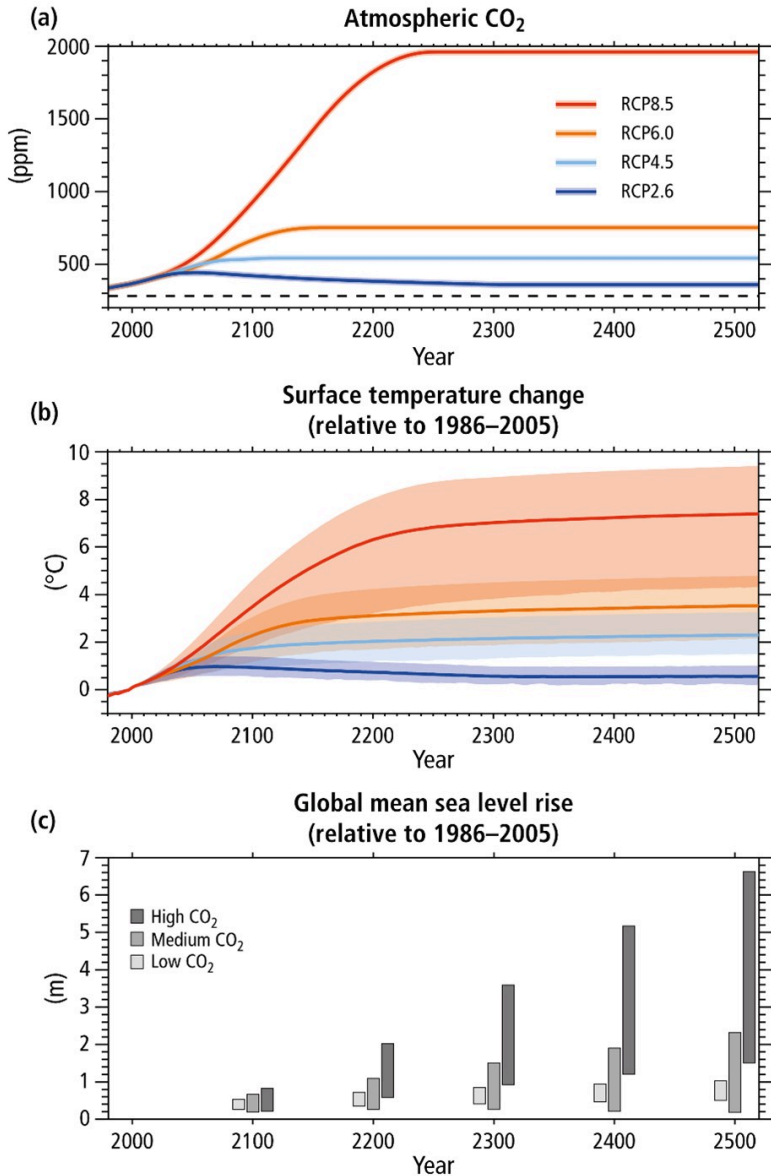
External Links: <https://climate.nasa.gov/effects/>
<https://changingclimate.ca/>
<https://www.climate.gov/maps-data>

Another way to review and understand climate impacts is through storytelling and mapping, when we combine our understanding of natural cycles through Indigenous Knowledges and community-based research, along with climate data for a 2-Eyed Seeing Approach, we get a fulsome view of the way our

world is changing and what we can do about it:
<https://climateatlas.ca/>

Modelling Climate Data

Scientists use climate modelling to try to predict how anthropogenic activity will result in greenhouse gas emissions, and then what those impacts are in terms of temperatures and sea level rising. Those models further inform additional modellings, such as weather events, water levels, impacts on viruses, bacteria, and parasites, as well as potential predictions of financial loss and climate casualties and refugees.



Source: https://ar5-syr.ipcc.ch/topic_futurechanges.php

Again, by combining this data with Indigenous Knowledges and

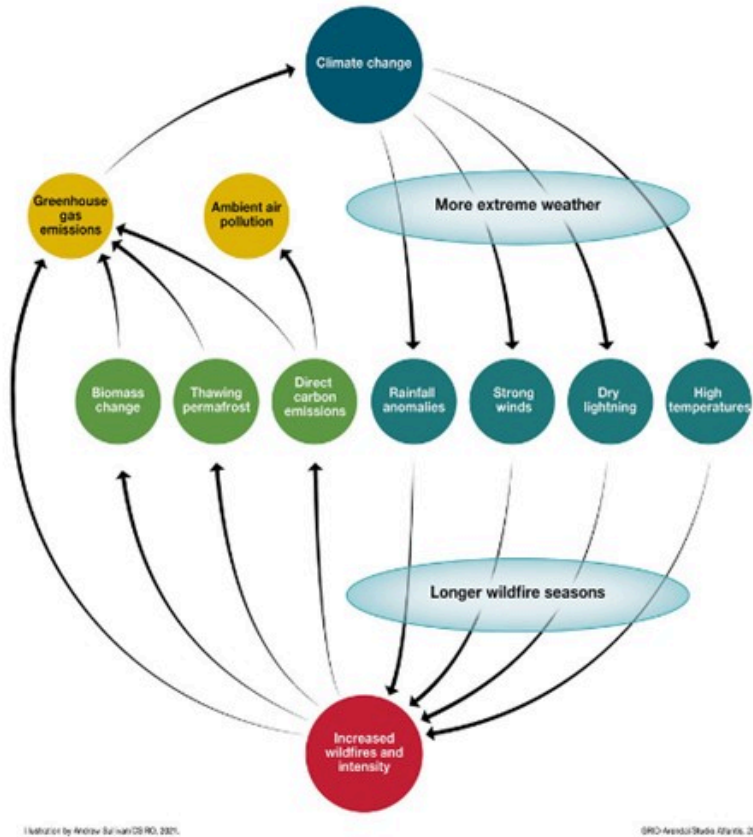
community-based research, we can get a full picture of impacts on our atmosphere, our planet, our ecosystems, our communities, and on ourselves.

Positive Feedback Loops

Climate change has been even further accelerated by resulting Positive Feedback Loops. While these sound like they would be a good thing, it refers to the fact that the impact increases over time – moving more and more along the positive scale. One example of a simple positive climate feedback loop is as CO₂e increases and water cycles are disrupted, less moderate rainfalls may occur, which means that forests can get drier, resulting in an increase in forest fires, which results in more CO₂e entering the atmosphere as trees, plants, and topsoil burns.

Positive feedback loops are not always easy to predict which is why sometimes climate modelling cannot be so easy to predict – all of the variables may remain unforeseen. However, the general consensus is the above modelling is generally correct.

Potential reinforcing feedback loop of climate change on wildfires

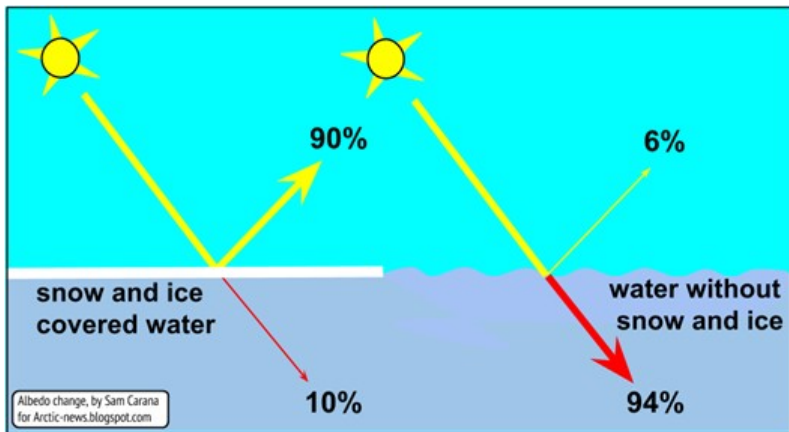


Source: <https://www.grida.no/resources/15559>

Albedo Effect and its Positive Feedback Loop

Another positive feedback loop that is concerning is the decreasing Albedo Effect of our planet as more ice melts. The Albedo Effect is the earth's ability to reflect heat/ solar radiation back into space. Our ice caps, glaciers and frozen surfaces make up the planet's ability to perform the Albedo effect. With warming temperatures, more ice melts, reducing the Earth's Albedo Effect,

further trapping more solar radiation in the atmosphere, increasing temperatures, resulting in further ice melt.



Source: <http://arctic-news.blogspot.com/p/albedo.html>

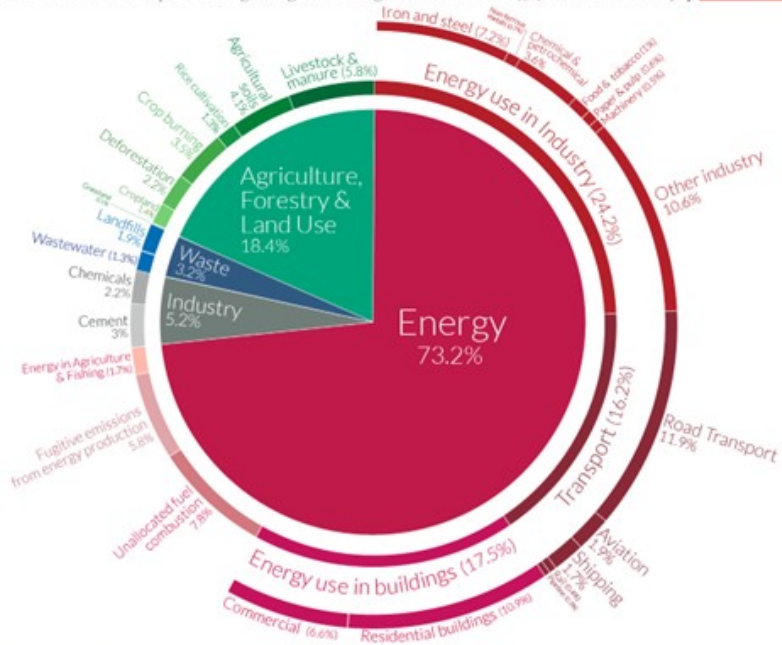
With all of these complicated exchanges of gases and heat, it's important for us to keep track of how much CO₂e we are putting into the atmosphere in order to make sure we are not going out of our desired CO₂ ppm range in order to avoid a detrimental path forward.

Emission Sources

The below graphic shows a breakdown of emission sources by sector. Nearly three-quarters of emissions come from energy used for buildings, transportation and industry.

Global greenhouse gas emissions by sector

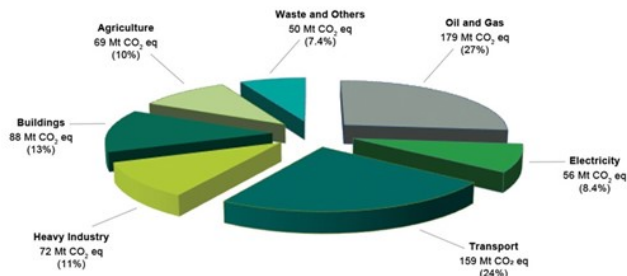
This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO₂eq.



OurWorldinData.org – Research and data to make progress against the world's largest problems.
 Source: Climate Watch, the World Resources Institute (2020). Licensed under CC-BY by the author Hannah Ritchie (2020).

Source: <https://ourworldindata.org/emissions-by-sector>. The breakdown of emissions in Canada shows similar values.

Breakdown of Canada's greenhouse gas emissions by economic sector (2020)



Source: <https://www.canada.ca/en/environment-climate-change/services/climate-change/greenhouse-gas-emissions/sources-sinks-executive-summary-2022.html>

This helps to provide an indication of where greenhouse gas reduction strategies can be targeted and what their relative impact may be. For example, by improving the efficiency of buildings, the building trades can affect 13% of Canada's GHG emissions, and also have an impact on the supply of electricity, which is an additional 8%. By building smarter, we can influence a fifth of our total emissions. Similarly, land use change is a major driver of climate change, and by improved landscaping approaches, we could significantly reduce how much emissions are potentially released during land conversion or reduce current atmospheric emissions through greater natural carbon sequestration,

To learn more about the building trades and sustainability, please refer to Learning Module XYZ.

Emissions Reductions

Emissions can be reduced at the source, as discussed earlier through choices in energy sources. Or emissions can be sequestered through carbon stores. Lands conversion is a significant source of GHG emissions but so can ongoing maintenance of lands such as lawns. It's important to seek out opportunities to reduce emissions at the outset of an activity (e.g. building a house clearing land such as cutting down trees or filling in wetlands to create a parcel on which to build), as well as the ongoing maintenance of the property (e.g. regular cutting of grass, use of gas-powered lawn mowers, applying fertilizers, pesticides – all activities which emit GHGs).

There are GHGs associated with so many of our human activities, such as using a plastic bag, driving to the store, cutting the grass, and eating a burger, it's important to assess where our

opportunities for reducing our personal and professional GHG emissions are.

Protocols and Regulations

Climate change international agreements to reduce and address greenhouse gas emissions and coordinate their reduction on a global level first came into play through the 1997 Kyoto Protocol – a global pact that when signed by a country becomes binding, and that country must create legislation, funding opportunities, partnerships, oversight and other legal, financial, mercantile, social, and government mechanisms by which to support the agreed limits of CO₂, temperature changes, and responsibility of emissions reductions according to country and emission-production. The latest version, the Paris Agreement, an evolution of the Kyoto Protocol, was adopted in 2015.

One thing of note, the Paris Agreement outlines how Indigenous people's resiliency, creativity, stewardship, and general rights should be protected and upheld as vital, integral components of climate change mitigation and GHG reductions. Their ways of knowing and doing are also integral to climate change adaptation.

This video by climate expert and activist Ariel Tchekwie Deranger highlights the need to respect and honour Truth and Reconciliation not just because it's the only way to a just society, but because our collective survival depends on it.

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[facultytrainingmodulesforgreeningthelandscape/?p=864#ocmbed-4](https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=864#ocmbed-4)

Resources: https://www.edf.org/sites/default/files/textreferences_ips_adopted_paris_agreement.pdf

Greenhouse Gas Accounting

Greenhouse gas accounting quantifies the amount of greenhouse gases produced by an organization, building, or operation over the course of a year – we cannot effectively reduce our greenhouse gases until we know how much we need to and the sources of those emissions. Thanks to the Paris Agreement, it's everyone's responsibility to take ownership and inventory of their own greenhouse gas (GHG) emissions. The resulting total is known as a greenhouse gas inventory or carbon footprint (recall greenhouse gas and carbon are often used interchangeably). A GHG inventory allows an entity to first understand where its emissions are coming from, and then be able to target reduction strategies that may have the largest impact.

To conduct a GHG inventory, boundaries must be set to determine the extent of influence you are interested in measuring. In the GHG accounting world, these are broken down into three scopes. Scope 1 emissions are direct emissions that include onsite combustion (i.e. natural gas in boilers) and fleet vehicles. Scope 2 emissions are indirect emissions that result from the production and distribution of electricity. Scope 3 emissions are indirect upstream and downstream sources of emissions that include the transport and distribution of products, business travel, waste management, and the end-use of products.

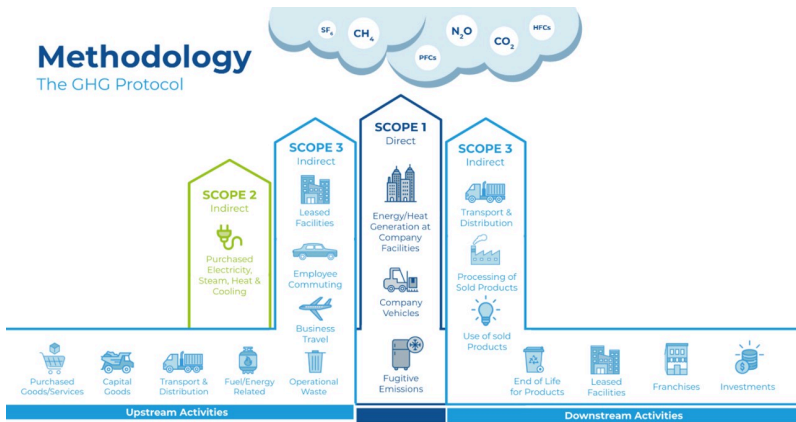


Image source: <https://www.southpole.com/sustainability-solutions/ghg-accounting>

Generally, GHG inventories take into account scopes 1 and 2 as these are where an entity can have the greatest influence over these emissions. For example, scope 1 emissions can be reduced with more efficient heating systems and/or reducing thermostat set points.

References:

ISO 14064-1:2018 provides the standard for quantifying and reporting GHG emissions at the organizational level.
<https://www.iso.org/standard/66453.html>

ISO 14064-2:2019 provides the standard for quantifying and reporting activities designed to reduce GHG emissions.
<https://www.iso.org/standard/66454.html>

The GHG Protocol provides the standard for quantifying and reporting GHG emissions at the corporate level. It is more commonly becoming the Canadian standard for GHG accounting.
<https://ghgprotocol.org/>

To illustrate an example, consider a house. The two main sources of GHGs are the consumption of electricity and natural gas.



To calculate the amount of GHGs emitted, the usage is multiplied by what is called an emissions factor (EF). These can be found in Canada's [National Inventory Report](#). Particular attention needs to be paid to the electricity EF as this varies significantly between provinces. Year-to-year fluctuations can also be significant as the energy mix of the electrical grid changes.

Net Zero

The concept of net zero is in reference to greenhouse gas emissions and there are a few different types: net zero energy, net zero carbon, and zero carbon. Net zero energy means the electricity used by a site is also generated on-site. In this case, the entity can continue to use fossil fuels for space heating, such as in boilers.

To achieve net zero carbon the systems that use fossil fuels need to either be converted to use electricity, which is generated on-site, use a non-emitting alternative fuel, or balanced through the purchase of carbon offsets. This is also referred to as carbon neutrality. Zero carbon means there are indeed zero emissions being produced by the entity. Terms such as true carbon zero and real zero mean the same thing. Finally, carbon positive means an entity actually removes additional carbon, overtop of achieving

net zero, from the atmosphere. Oddly, carbon negative actually means the same thing.

Life-Cycle Assessment

A Life-Cycle Assessment is a methodology that assesses the total environmental impacts associated with all the stages of a product, process, or service. This includes impacts beyond the release of greenhouse gases, such as geological impacts of mining (ex. displacement), resource depletion, waterborne waste, solid waste, acidification, eutrophication, radiation, and ecotoxicity.

Conducting an LCA allows for a better understanding of the total impacts of a product or service, and knowing this information also allows for more informed decision-making. This information can allow a company to select a product with minimal environmental impacts, one with a focus on certain environmental indicators that align with their corporate priorities, or ones that help meet certain ESG targets.

The main LCA models are Cradle-to-Grave and Cradle-to-Cradle.

In the cradle-to-grave approach, the boundaries of assessment starts at the raw material extraction of a product and end at disposal. Cradle-to-cradle follows a similar path but includes other methods of disposal including recycling and remanufacturing some, or all, of the original product.

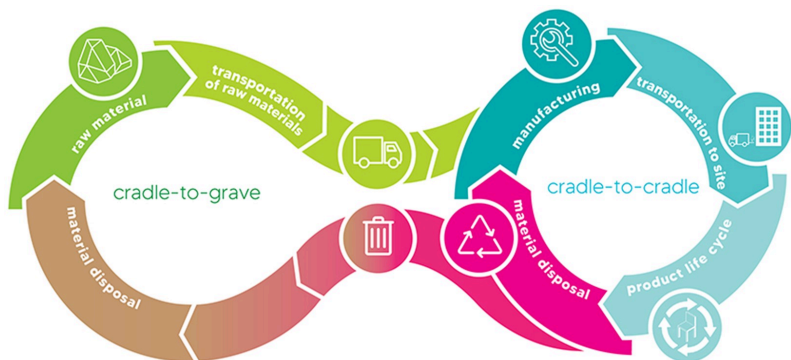


Image Source: <https://www.numberten.com/blog/31-working-in-the-industry/370-life-cycle-analysis>.

Circular Economy

The concept of a circular economy is an economy in which waste does not exist. The term is sometimes used interchangeably with cradle-to-cradle. In this economic model, products are designed to be used longer, reused, or reimagined before being recycled. Any remaining components are treated in some manner to prevent them from reaching landfill, for example as a source of energy in an incinerator.

This concept is in contrast to our current linear model of take-make-waste, where we continuously take raw materials to produce products, use them until we're done with them, and throw them away. Other factors that contribute to this model are a limited ability to fix things, items are created to break to encourage society to keep buying, items like small appliances are often cheaper to buy new rather than fix a component, and technology fads encourage people to throw away an old model just because there is a new one out.

The benefits of moving toward a circular economy are numerous and widespread. Reducing raw material extraction has obvious natural conservation benefits, but also reduces the energy,

and emissions, associated with the material extraction and processing, and can eliminate labour exploitation issues (ex. Blood diamonds or sweatshops). The ingenuity required to reimagine our economy will create jobs and open opportunities for new industries such as improved recycling processes or alternative resource extraction (ex. Vanadium from oil tailings ponds). And being able to purchase and maintain goods for longer will lead to economic savings for all end users.



Image Source: <https://unctad.org/topic/trade-and-environment/circular-economy>

Suggested videos:

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=864#oembed-5>

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=864#oembed-6>

Now you understand the basics of climate change, what causes it, the complexities that further contribute to it, and the various social/ economic/ environmental pillars that we have at our disposal to try to address it.

Resources to learn more about climate change in general:

1. <https://climate.nasa.gov/> – NASA has one of the most comprehensive databases and objective/ scientific platforms providing information on climate change, data, metrics, mitigation, impacts, and solutions.
2. <https://www.ipcc.ch/> – home of the Intergovernmental Panel on Climate Change, the IPCC provides a platform for global scientists to share their findings in reports, data, graphs, and other resources, as well as provides information on what governments are doing to address the issues.
3. Power to the People – a television documentary series that explores the renewable energy revolution

empowering Indigenous communities across Canada and around the world: <http://powertothepeople.tv>

4. www.waterbear.com – free streaming service without ads where you can watch award-winning documentaries and series dedicated to the future of our planet.

DEFINITIONS – Glossary of Terms

Anthropogenic Climate Change – human-induced climate change; the activities that humans do which release greenhouse gases.

Carbon Credit – a tradeable certificate that represents 1 tonne of carbon dioxide removed from the atmosphere.

Carbon Dioxide Equivalent (CO₂e or CO₂eq) – a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential, by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential.

Carbon Footprint – the amount of greenhouse gases that are produced by an organization, building or operation.

Carbon Positive – an organization, building, or operation's activities sequestered more greenhouse gas emissions than it produces.

Circular Economy – a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products for as long as possible.

Climate Change – long-term shifts in temperatures and weather patterns.

Climate Change Mitigation – means avoiding and reducing emissions of heat-trapping greenhouse gases into the atmosphere to prevent the planet from warming to more extreme temperatures

Climate Change Adaptation – means altering our behavior, systems, and—in some cases—ways of life to protect our families, our economies, and the environment in which we live from the impacts of climate change.

Embodied Carbon – to the greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials.

Emissions Factor (EF) – representative value that relates the quantity of a pollutant released to the atmosphere associated with a given activity.

Global Warming Potential (GWP) – metric that examines each greenhouse gas's ability to trap heat in the atmosphere compared to carbon dioxide measured over a specified time horizon.

Greenhouse Gas (GHG) – a gas that absorbs and emits radiant energy at thermal infrared wavelengths, causing the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapor (H₂O (v)), carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), and ozone (O₃).

Greenhouse Gas/Carbon Accounting – the process of quantifying the amount of greenhouse gases produced directly and indirectly from an organization, building, or operation's activities within a set of boundaries.

Greenhouse Gas Effect – warming of the earth that results when gases in the atmosphere trap heat from the sun that would otherwise escape into space.

Life-Cycle Assessment (LCA) – a methodology for assessing environmental impacts associated with all the stages of the life cycle of a product, process, or service.

Low Carbon Resilience (coordination of mitigation and adaptation to ensure maximum impact, avoid maladaptation, and access co-benefits).

<https://www.sfu.ca/act/low-carbon-resilience.html#:~:text=What%20is%20low%20carbon%20resilience,planning%20>

Net Zero Carbon (True Carbon Zero/Real Zero/Carbon Neutral) – an organization, building, or operation's activities produce greenhouse gas emissions that are offset utilizing carbon credits.

Net Zero Energy – the electricity used for a building, organization, or operation is also generated on site.

Operational Carbon – The amount of carbon emitted during the operational or in-use phase of a building. This includes the use, management, and maintenance of a product or structure.

Sustainability – meeting our own needs without compromising the ability of future generations to meet their own needs.

United Nations Sustainable Development Goals (UN SDGs) – 17 goals that were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity.

Zero Carbon – an organization, building, or operation's activities produce zero greenhouse gas emissions.

Zero Energy Building (ZEB)/ Net Zero Energy (ZEB) Building – a building with net zero energy consumption.

A Brief Note on Why We are Approaching Climate Change in the Building Trades through 2-Eyed Seeing

In our current world, we find ourselves facing, among many, 2 undeniable truths:

- 1) We urgently need to take climate action
- 2) We urgently need to act regarding Truth and Reconciliation.

But people may wonder – why are we doing these together in the same professional development module? Aren't these two different issues? Are they both not meriting their own separate and distinct approach?

While both issues are exceedingly and vitally important each on their own, we cannot ignore the fact that there are many opportunities for overlap when we start to integrate both into the building trades. That is because:

1. A) The institutional mechanisms that resulted in the colonizing and genocide of our Indigenous communities and their individuals is the same that resulted in the

devaluation and degradation of our environment and the destruction of our climate stability. AND

2. B) If we start to address one of those issues properly and coherently, we will also automatically start our journey toward addressing the other issue.

That is why these professional development modules for building instructors aim to be a starting point for Greening the Building Trades through Two-Eyed Seeing. Through these modules we call upon our members to take steps toward Truth and Reconciliation as well toward Net-Zero in several ways. Truth and Reconciliation in Canada is about telling the truth of how settlers have treated and continue to treat Indigenous people, and committing to reconciling through making reparations and moving forward in a respectful manner, which includes making space for Indigenous people, voices, bodies, choices, customs, and approaches. The goal of Net-Zero refers to running a society/economy while emitting no greenhouse gas emissions or offsetting any emissions.

Thus, with these modules, we aim to make a start of both integrating Net-Zero and Truth and Reconciliation in the building trades and the way they are taught, and rationalize that it makes sense to do both at the same time:

- 1) In Truth and Reconciliation, we are called upon to create opportunity for Indigenous people to be educated in a way that Indigenous people choose. Which means, in Canada, we must ensure our institutions are inclusive for all, thus if we are to green the trades, we must make space for Indigenous approaches to greening the trades as well and Indigenous approaches to learning in general.

- 2) We are called upon to welcome Indigenous communities, approaches, and ways of thinking, which means we are supporting communities, approaches, and ways of thinking that are responsible for protecting more than 80% of global biodiversity. This is important because biodiversity is one of our greatest tools in mitigating climate change – through protection of forests and ecosystems and protecting their intricate biology that ensure survival of these ecosystems, we simultaneously maintain the atmospheric balance that allows us to live and survive.
- 3) We are called upon to make space for Indigenous voices and approaches, that promote reciprocity and valuing of relationships, which are intrinsically aligned with Net-Zero – a climate action goal the world over has committed to. As Darrion Letendre, a Land-Based Educator at NorQuest College puts it (and as he learned from his Kokum Shirley Letendre), “When you take something, you give something back. So when we take carbon out of the ground, what can we do to give something back?” Thus, incorporating Indigenous Approaches means we are embedding fundamental perspectives that support a sectoral shift as we strive for Net-Zero in our buildings.
- 4) We are called upon to protect and support the health and sustainability of Indigenous lands, as a direct connection to supporting and protecting Indigenous culture and traditions. However, climate impacts create

difficulties and change historical relationships people have with the land – thus addressing climate change means better protecting Indigenous lands and traditions.

- 5) We are called upon to respect and regard valid Indigenous knowledge, science, and stories that have been passed down for generations. We regard these as equal to settler/ Western approaches to science in their importance and validity to understanding our world, our climate, and our environment – that is, when we integrate ALL of the information we see so much more than if we only use one eye – this fulsome view is also known as 2-Eyed Seeing.
- 6) Lastly, as we are opening our minds, behaviours, and hearts to a new way of seeing things, and making room for either Indigenous viewpoints, or prioritizing an ecological future, we open a door for change. We should not waste this chance at deconstructing our current ways of thinking and doing – we should reorganize our approaches to the building trades in a way that includes Indigenous perspectives AND the environmental perspective.

But this is just the start and we encourage you to continue to listen, be open, and have courage and faith.

Disclaimer

This resource is just the start. Reading this is not enough and to truly embrace Indigenization and Decolonization it starts with unpacking your own understanding, biases and inherited knowledge about the true history of Canada and Indigenous Peoples. This is an ongoing process and for each person, their journey will look different. This resource is a guide to support you on your own journey and can be and should be referred back to multiple times.

As part of your journey with Indigenization and Decolonization, you must find ways to listen and to engage with the traditional territories of where you live work and teach as well as, Indigenous students, staff, faculty, Indigenous communities, and Elders/Knowledge Keepers.

Institutions must champion a continuous and never-ending process of Indigenization and Decolonization. This starts with supporting and empowering Indigenous people and Indigenous voices.

Treat this resource as a supplement to the Truth and Reconciliation (2015) Calls to Action: https://ehprnh2mwo3.exactdn.com/wp-content/uploads/2021/01/Calls_to_Action_English2.pdf

This resource is currently awaiting peer review as well as Elder/Knowledge Keeper input.

Please share your thoughts and especially, flag anything that may be viewed as harmful to the mission of Decolonization and Indigenization. Further resources and/or stories are something we continue to interweave with the content – if you have any stories to share, references, or recommendations, please reach out.

To start a dialogue or discussion, please email Adrian Granchelli, Grey & Ivy: adrian.granchelli@greyandivy.ca

Acknowledgements

I acknowledge that this land, Turtle Island (Canada), was inhabited by countless Indigenous Nations for thousands of years before colonization. Settlers stole the land through politically ceded treaties, often not honoured, or by unceded means. This history of colonization has inflicted trauma that continues to be felt today. We live in a settler-colonial world that was built upon the tragedies of the past. The policies and practices put in place by the Canadian government, like residential schools and the Sixties Scoop, perpetuated harm and trauma on Indigenous communities for generations. The effects of these policies are still felt today as intergenerational trauma, discrimination, and racism as they continue in the form of mental health issues, substance abuse, and a breakdown of traditional cultural practices. Addressing the ongoing impact of these policies on Indigenous peoples is necessary for reconciliation. This involves implementing the calls to action outlined by the Truth and Reconciliation Commission, supporting Indigenous-led initiatives and movements, and educating ourselves and others about Indigenous history and ongoing struggles. Only through these ongoing efforts can we hope to build a more just and equitable future for all Canadians.

This resource was developed by Grey & Ivy and Grounded Architecture.

Grey & Ivy and Grounded Architecture

Grey & Ivy and Grounded Architecture are a team of thinkers, social impact entrepreneurs, researchers, educators, and architects located across various territories of Turtle Island (Canada), including the traditional territory of the Anishinaabe (Ojibwe), Ininew (Cree), Dakota peoples, Métis, Blackfoot Confederacy, x^wməθk^wəyəm (Musqueam Indian Band), Sk̓wx̓wú7mesh (Squamish Nation), səliłwətał (Tsleil-Waututh Nation), Pentlatch, and K'ómoks.

It is crucial we deeply understand and acknowledge the histories of the lands we stand on and what cost the Indigenous peoples have suffered. We are companies founded on the notion of empowering people, especially Indigenous peoples, and to the absolute best of our abilities, all of our work is conducted in partnership with communities, Elders, and Knowledge Keepers.

Our team consists of diverse perspectives with a mix of settler and Indigenous heritage, diverse personal backgrounds, personal location, education, and expertise.

We would like to express our gratitude to all those who shared their stories and perspective in the creation of this resource. This resource was made possible with the [Colleges & Institutes Canada: ImpAct Climate Program](#).

Decolonizing and Indigenization

If we want to contribute to systemic change, we need to

understand the concepts of decolonization, Indigenization, and reconciliation.

Decolonization

Decolonization is the process of deconstructing colonial ideologies of the superiority and privilege of Western thought and approaches. On the one hand, decolonization involves dismantling structures that perpetuate the status quo and addressing unbalanced power dynamics. On the other hand, decolonization involves valuing and revitalizing Indigenous knowledge and approaches and weeding out settler biases or assumptions that have impacted Indigenous ways of being. For non-Indigenous people, decolonization is the process of examining your beliefs about Indigenous Peoples and culture by learning about yourself in relationship to the communities where you live and the people with whom you interact.

We work in systems that perpetuate colonial ideals and privilege Western ways of doing. For example, many student services use forms and procedures instead of first initiating relationships with students. This is a colonial process that excludes rather than includes. Also, how libraries catalogue knowledge is Western and colonial.

Decolonization is an ongoing process that requires all of us to be collectively involved and responsible. Decolonizing our institutions means we create spaces that are inclusive, respectful, and honour Indigenous Peoples.

The call for decolonizing education and including Indigenous ways of knowing and being in education was first articulated in 1972 in “Indian control of Indian education” [PDF] by the National Indian Brotherhood (now the Assembly of First Nations).

“We want education to give our children the knowledge to

understand and be proud of themselves and the knowledge to understand the world around them.” (p. 1)

Indigenization

Indigenization is a collaborative process of naturalizing Indigenous intent, interactions, and processes and making them evident to transform spaces, places, and hearts. In the context of post-secondary education, this involves including Indigenous perspectives and approaches. Indigenization benefits not only Indigenous students but all students, teachers, staff members, and community members involved or impacted by Indigenization.

Indigenization seeks not only relevant programs and support services but also a fundamental shift in the ways that institutions:

- Include Indigenous perspectives, values, and cultural understandings in policies and daily practices.
- Position Indigenous ways of knowing at the heart of the institution, which then informs all the work that we do.
- Include cultural protocols and practices in the operations of our institutions.

Indigenization values sustainable and respectful relationships with First Nation, Métis, and Inuit communities, Elders, and organizations. When Indigenization is practiced at an institution, Indigenous people see themselves represented, respected, and valued and all students benefit. Indigenization, like decolonization, is an ongoing process, one that will shape and evolve over time.

Indigenization is not an “Indigenous issue,” and it is not undertaken solely to benefit Indigenous students. Indigenization benefits everyone; we all gain a richer understanding of the world and of our specific location in the world through awareness of

Indigenous knowledge and perspectives. Indigenization also contributes to a more just world, creating a shared understanding that opens the way toward reconciliation between Indigenous and non-Indigenous people. It also counters the impacts of colonization by upending a system of thinking that has typically discounted Indigenous knowledge and history.

Indian control of Indian education: <http://www.oneca.com/IndianControlofIndianEducation.pdf>

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Pulling Together: A Guide for Front-Line Staff, Student Services, and Advisors by Ian Cull; Robert L. A. Hancock; Stephanie McKeown; Michelle Pidgeon; and Adrienne Vedan is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.

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Cull, I., Hancock, R.L.A., McKeown, S., Pidgeon, M. & Vedan, A. (2018). Decolonization and Indigenization. Pulling Together: A Guide for Front-Line Staff, Student Services, and Advisors. Victoria, BC: BCcampus. Retrieved from <https://opentextbc.ca/indigenizationfrontlineworkers/>

Introduction

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=886#oembed-1>

Steele, K. (2018). *Why Indigenization Matters: Vianne Timmons at the University of Regina.* <https://www.youtube.com/watch?v=iLe1mxiT4rM>

Practicing Indigenous Knowledges is an **active and never-ending process**. It is more than the Western construct of knowledge that one can attain, it is a practice of relating to and with the world (Brayboy, 2009). Indigenizing and Decolonizing our educational institutions and society at large is a way in which we can elevate Indigenous Knowledges. “For too long the settler worldview has dominated everything,” (Johnson, 2020 as cited by Hyslop, 2020). Calls to Action have been formalized across various organizations and levels of government all the way up to the Government of Canada (2023).

Although societal ideology is gradually shifting, the voices of Indigenous peoples continue to be silenced. Systemic racism continues to oppress Indigenous peoples not only does it destroy opportunities for leadership and advocacy it often develops into feelings of anxiety, depression, and low self-esteem (Rees, 2020). It is everybody’s obligation to stand up for marginalized individuals to allow them to have a voice.

This resource was created for people to gain a working understanding and empowerment to continually learn about how to incorporate Indigenous ways of knowing, local community, and the Land into our institutions in an effort to Indigfenize and Decolonize. The true learning will occur outside of this resource, from discussions with peers, interacting with communities, and sharing with Elders/Knowledge Keepers. Ultimately, to truly empower Indigenous peoples, it is essential to ensure their representation in leadership positions, from instructors to Elders-in-Residence, as this can have a profound and lasting impact.

Our world is currently facing a human-induced climate crisis, which is causing widespread disruption in nature and affecting the

lives of billions of people around the world (Intergovernmental Panel on Climate Change, 2022). Most capitalistic practices have been identified as a major contributor to climate change often prioritizing corporate profits while disregarding the needs of the Land, the Land from which they profit (Rich, 2019). Capitalism has the funds and power to tackle climate change but will need to adopt a value system that respects and places value upon the unquantifiable elements of our natural environment (Turner, 2019).

Indigenous people have a deep connection to the land, and their traditional practices are often based on living in harmony with nature. Indigenous Knowledges do not see dichotomies between human and non-human, natural and supernatural; instead, they stress interrelatedness and connectivity – a holistic perspective (Cousins, 1996).

“When people recognize a spiritual essence shared by the world around them, their interactions with the land take on a quality of reverence and respect. Instead of being one-sided, with the humans taking what they need and not giving back, these relationships become mutual, based on reciprocity.”

– Cousins (1996)

Sustainability or ‘greening’ is not simply an add-on to our current practices, they do not occur as individual tasks. Sustainable practices must be integral to everything that we do.

Mi’kmaq Elder Albert Marshall developed the idea of Etuaptmumk, which translates to “Two-Eyed Seeing” (Bartlett et al., 2017). Two-Eyed Seeing is described as the ability to see through one eye with the strengths of Indigenous Knowledges and from the other eye with the strengths of Western knowledges (Marshall as cited by Bartlett et al., 2015). Imagine what society may look like if it were to adopt the pluralistic approach of Two-Eyed Seeing.

Integrating Indigenous ways of knowing with education requires a deep and thorough approach. It is not sufficient to simply add Indigenous content to the current Western curriculum. Instead, Indigenous ways of knowing must be intrinsically woven into the very fabric of education, influencing all aspects from content knowledge to meta-cognitive skills and pedagogy. Superficially including Indigenous content is not enough and may even impede the reconciliation process. Only through a comprehensive and holistic approach can we truly integrate Indigenous ways of knowing into education. It becomes all educators' responsibility to engage in Truth, Indigenization, and Decolonization as part of reconciliation.

Education, business, and industry have been identified by the Truth and Reconciliation Commission of Canada (2015) as key components for advancing reconciliation. The trades play a fundamental role in our society, and introducing the concepts of Indigenizing and Decolonizing to new graduates in these fields can have a ripple effect on the broader world. As educators, leaders, students, and citizens, we are and/or inspire the future of education, business, and industry and therefore have the responsibility to understand the Land we live on and the teachings that it provides. We have the duty to empower communities, Elders, and Knowledge Keepers. If mainstream society allows it, Indigenous Knowledges can play "a central role in mitigation and adaptation actions against climate change," (Jerez, 2021). We must commit to standing up for marginalized individuals and amplifying their voices, while also recognizing the value and importance of Indigenous leadership and representation. Only then can we truly achieve a world that honours the land, its peoples, and its diverse ways of knowing.

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=886#oembed-2>

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<https://vimeo.com/46515750>

Learning Objectives

After interacting with this resource, you should be able to

- Defend why Indigenizing and Decolonizing are necessary and valuable
- Manage a safe space for marginalized peoples and culture
- Practice the 4R's – Respect, Relevance, Reciprocity, Responsibility
- Employ a holistic perspective on education
- Develop partnerships with Indigenous peoples and communities
- Articulate how you participate in Truth and Reconciliation
- Practice Indigenizing and Decolonizing with the understanding that it is an active and never-ending process

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Accessibility of This Textbook

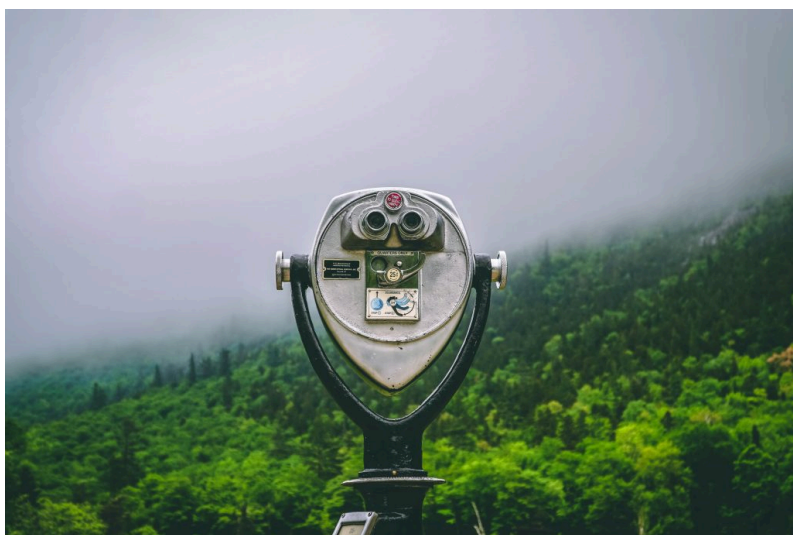


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The web version of this resource aims to meet [Web Content Accessibility Guidelines 2.0](#), level AA. In addition, it aims to meet the guidelines in [Appendix A: Checklist for Accessibility](#) of the [Accessibility Toolkit – 2nd Edition](#). It includes:

- **Easy navigation.** This text has a linked table of

contents and uses headings in each chapter to make navigation easy.

- **Accessible videos.** Whenever possible, videos in this text have captions.
- **Accessible images.** All images in this text that convey information have alternative text. Images that are decorative have empty alternative text.
- **Accessible links.** All links use descriptive link text.

Textbook Details

Textbook title: Faculty Training Modules for Greening the Landscape Trade

Prerequisites: Horticulture Instructor Certification

Time commitment: The textbook is designed to be completed within a five-hour timeframe, providing learners with the flexibility to access it at their own pace and convenience. Learners are encouraged to take breaks as needed to optimize their learning experience.

Completion criteria: None

Completion award: The authors of this textbook thank you for caring about the earth.

Registration fee: None

Audience

While this textbook was originally designed for horticulture instructors and faculty members teaching horticulture students across Canada, the authors recognize the benefits of sharing it

with a wider audience interested in learning about greening skills and practices in the landscape industry.

Delivery details

This textbook is structured as a single module consisting of five chapters covering separate but interdependent topics. While it is recommended to follow the lessons in consecutive order to fully engage with the scaffolding design used for learning, it is not mandatory.

Disclaimer

This open educational resource is not being monitored and may not include up-to-date information.

Assessments for Learners in this Module



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We hope that this faculty training module (FTM) will support horticulture instructors and faculty members to engage in conversations and prepare activities, assignments, and assessments that recognize their role in the ecosystem and duty to promote sustainable practices and learning for horticulture students.

At the heart of this FTM lies the belief that our personal perceptions and identities influence the teaching methods we choose and that these methods become a fundamental aspect of what we teach. To that end, we encourage horticulture instructors and faculty members to commit to constantly exploring and experimenting with new approaches to teaching and learning, in order to better meet the evolving needs of students. We recognize that our teaching styles can have a significant impact not only on individual learners but also on the horticulture industry as a whole.

The two assessments included in this module for learners (that's you!) have been selected to emphasize the important role of horticulture instructors and faculty members in discussing the impact of landscape construction and maintenance on the environment and guiding students toward sustainable skills and practices. As educators, we have a responsibility to instill in our students a sense of environmental awareness and encourage them to make a positive impact on the world.

The *Final* Assessment

- For the **final** assessment, you will be asked to initiate a conversation and/or design a lesson plan or learning activity utilizing the material and concepts covered throughout the chapters in this module. This module is designed to prepare you for a discussion that encompasses the key topics presented in each chapter. These topics include but are not limited to climate change, Indigenous knowledge systems, and the environmental, economic, and societal impacts of landscape construction and maintenance. Through this assessment, you will be able to demonstrate your understanding of the course material and your ability to communicate effectively about these important issues.

The *First* Assessment

- In order to assist you in completing the final assessment, the **first** assessment asks you to record your reflections in a personal journal throughout the chapters. This

journal should contain words, concepts or images that resonate with you as you progress through the material. The objective of this journal is to help you identify, describe, and interpret your thoughts and understanding of the key topics covered in the module, and to develop the ideas and language needed to initiate a conversation and/or learning activity. Each chapter will provide guiding questions and examples to prompt your reflective writing or sketching and help you track the evolution of your thinking and perceptions as they may change throughout the module. By keeping a reflective journal, you will gain a deeper understanding of the material and be better prepared to engage in meaningful conversations and/or learning activities about the key topics covered in the course.

Supply list

- Digital reflection booklet available here:
https://docs.google.com/document/d/1BHNfid7vBsFG7v_4AvdE740YHM97ECYYE4CIV_uf_gw/edit?usp=sharing
- Journal, notepad or digital tool to record your thoughts
- Pen/pencil

This module has been designed to provide a comfortable and flexible learning environment that caters to your individual learning needs. You can complete the module at your desk or on your mobile phone, and we encourage you to engage with

the content and reflective questions while surrounded by nature whenever possible. We believe that being immersed in nature can enhance the learning experience and help you develop a deeper understanding of the relationship between humans and the environment. Whether you choose to learn indoors or outdoors, we want you to feel comfortable and supported throughout the module.

Let's practice! Here's an example of what the guiding questions look like:

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. What is your current perception of climate change and Indigenization/decolonization?
2. How are you currently incorporating climate change and Indigenization/decolonization?
3. How do you expect this faculty training module will help you understand climate change and Indigenization/decolonization?
4. Write 5-10 sentences or sketch your favourite landscape. What do you enjoy the most about it? What are the design and installation features that inspire you?

Teaching and Learning Examples for Instructors

Within each chapter and topic, there will be examples of how to include climate change and Indigenous ways of learning in the existing horticulture curriculum, through various assignments and materials. Like this entire Faculty Training Module, the assignment and learning material examples are [open educational resources \(OER\)](#), which means learners can use and adapt the examples to suit their student's learning needs [while giving appropriate credit](#).

Here is an example of a horticulture-specific OER created by Michelle Nakano that is free for anyone to use and learn from: [Red Seal Landscape Horticulturist Identify Plants and Plant Requirements \(F2 – 1&2\)](#)

Let's get started!



Photo by [Osama Khan](#) on [Unsplash](#)

Chapter 1: Planning with Purpose

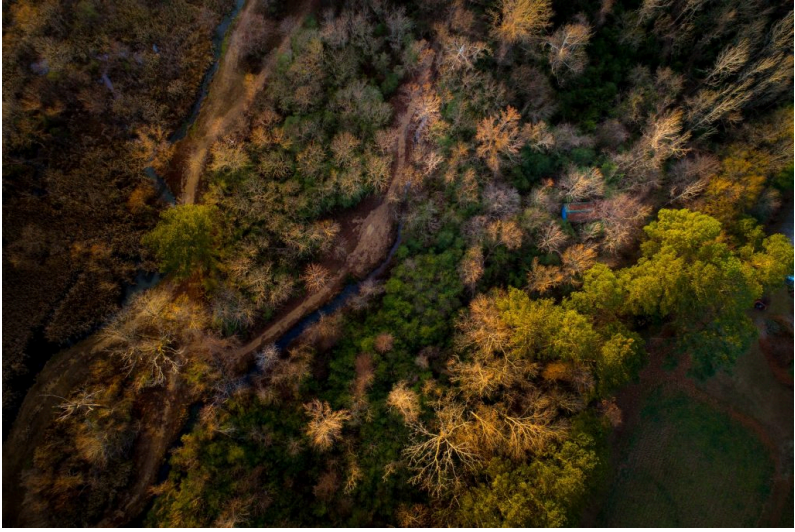


Photo by [StockSnap](#) on [Pixabay](#)

Learning Outcomes

By the end of this chapter, you will be able to ...

- Reflect on your personal experiences and perceptions of climate change, Indigenous ways of knowing, and regenerative landscaping and explain how they influence your choices in the horticulture industry.
- Describe the characteristics of climate change, Indigenous ways of knowing, and regenerative landscaping, and explain how they are interconnected.
- Communicate your perspectives on climate change,

Indigenous ways of knowing and regenerative landscaping.

Introduction

Welcome to Chapter 1: Planning with Purpose. As you know, the horticulture industry is significantly impacted by the consequences of climate change including changes in temperature, precipitation, and extreme weather events that can influence the design, construction, and maintenance of exterior landscapes. Here are some examples of how the horticulture industry is connected to the consequences of climate change:

- 1. Changes in Temperature:** Rising temperatures can affect the design of outdoor spaces, as they may become too hot and uncomfortable for people to use. This can impact the types of plants and materials used in landscaping, as well as the design of shading structures such as pergolas or shade sails. In addition, heat stress can cause damage to outdoor furniture, hardscaping materials, and other outdoor features. Landscape Horticulture professionals can adapt to these changes by selecting materials and plants that are more heat-tolerant or by incorporating water features or misting systems to provide relief from the heat.
- 2. Changes in Precipitation:** Changes in precipitation patterns can impact the design and maintenance of outdoor spaces. Drought conditions can lead to reduced water availability for plants and can impact the stability

of hardscaping materials such as retaining walls and paved surfaces. Heavy rainfall events can cause erosion and flooding, which can damage landscaping and infrastructure. Landscape Horticulturalists can adapt to these changes by incorporating permeable paving materials to allow for better water infiltration, designing rain gardens or bioswales to capture and absorb excess water, and selecting more drought-tolerant plant species.

3. Extreme Weather Events: Extreme weather events such as hurricanes, tornadoes, and hailstorms can cause significant damage to outdoor spaces and infrastructure. Landscape Horticulturalists can take steps to mitigate the impact of these events by incorporating wind-resistant plant species, selecting materials that can withstand extreme weather conditions, and designing landscape features such as berms or retaining walls to provide protection from flooding and erosion.

4. Energy Efficiency: Climate change is driving increased demand for energy-efficient outdoor lighting and heating systems. Landscape Horticulturalists can help clients reduce their carbon footprint by incorporating LED lighting, solar-powered lighting, and energy-efficient heating systems into their outdoor spaces.

In summary, the horticulture industry is closely tied to the natural environment, and climate change can have significant impacts on our design, construction, and maintenance practices. In addition, the landscape construction and maintenance practices chosen by

Landscape Horticulturalists can contribute to further climate change consequences through the selection of supplies, equipment, and practices.

In support of contributing to sustainable environmental, economic and social ecosystems, this chapter introduces key topics such as climate change, Indigenous ways of knowing, and the first stages of planning a regenerative landscape. As you progress through this module, you will have access to information in various formats, such as writing, videos, infographics, and activities. We recommend that you choose the materials that best support your learning of the key topics presented in this chapter.

Climate Change

Keywords: climate change, conversation, greenhouse gas emissions, CO₂, global warming, ask, listen, reflect, agree, share, future-proofing



Photo by ([United Nations](#), n.d.)

What is Climate Change?

According to the United Nations, “climate change refers to long-term shifts in temperatures and weather patterns. These shifts may be natural, such as through variations in the solar cycle. But since the 1800s, [human activities have been the main driver of climate change](#), primarily due to burning fossil fuels like coal, oil and gas. Burning fossil fuels generates greenhouse gas emissions that act like a blanket wrapped around the Earth, trapping the sun’s heat and raising temperatures...There are seven gases classified under GHGs: Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs), Sulfur hexafluoride (SF₆), Nitrogen trifluoride (NF₃). Among these gases, carbon dioxide and methane are the largest contributors ... These come from fossil fuel combustion eg., using gasoline to drive a car or coal to heat a building.

These come from using gasoline to drive a car or coal to heat a building, for example. Clearing land and forests can also release carbon dioxide. Landfills for garbage are a major source of methane emissions. Energy, industry, transport, buildings, agriculture and land use are among the [main emitters](#).” ([United Nations, n.d.](#)).

In addition, the Nature Conservancy of Canada states that “climate change is a major threat to wildlife and ecosystems in Canada and around the world. Limiting the amount of warming and adapting to the negative impacts of climate change are critical, not only to protect biodiversity but also to support human health and well-being” (Nature Conservancy Canada, n.d.).

But, what’s the difference between climate change and global warming? The David Suzuki Foundation states that “although the terms “climate change” and “global warming” are often used interchangeably, some experts note a difference: global warming

is the overall phenomenon whereby global average temperatures are slowly increasing. Climate change is the result of global warming. That is, as global temperatures increase, climatic conditions change in various ways” (David Suzuki Foundation, 2023).

“Everyone’s talking about climate change but what is our climate? And why is it changing? Our climate has been changing much faster and there are many ways you and I can make a difference”.

(Environment and Climate Change Canada, 2021)

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=5#oembed-1>

Video credit: What is Climate Change? (Environment and Climate Change Canada, 2021)

“This video is a short, sweet, and pragmatic summary of climate change – what the problem is, why, and what you can actually do about it”.

(Kniberg, 2017)

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=5#oembed-2>

Video credit: Friendly Guide to Climate Change – and what you can do to help [#everytoncounts](#) (Kniberg, 2017)

How to Talk about Climate Change

So, we know that climate change is an ongoing phenomenon, and it is primarily caused by the decisions humans make. This includes the choices we make regarding horticulture practices used in landscape construction and maintenance. The first step in facing the challenging consequences of climate change is to inform ourselves and select adaptive and mitigative strategies to apply in our daily horticulture work – and that starts here, with you! Another essential task is communicating alternative and more sustainable landscape construction and maintenance practices to our students and customers. So, how can we navigate through challenging conversations about climate change and bring the reality of climate change into classrooms? Equally important, how can we prepare students for conversations with employers, suppliers or customers about the impacts of climate change?

The David Suzuki Foundation recommends nine (9) essential resources for climate change conversations. This module includes two examples from the David Suzuki Foundations’ resources on how to talk about climate change however, a [full list of resources on how and why to talk about climate change can be found by clicking on this link.](#)

Climate Change Conversation Resource: Conversation Cheat Sheet

“This five-step conversation cycle was developed by Karin Tamerius of [Smart Politics](#). Drawing on expertise in social and political psychology and extensive experience with online dialogues, she developed this conversation technique to help people have difficult conversations. This cheat sheet gives you a summary of each of the five steps in a handy graphic that you can save to your phone for when you need it” ([David Suzuki Foundation, 2023](#)).



ASK open-ended, genuinely curious, non-judgmental questions.

LISTEN to what people say and deepen your understanding with follow-up questions.

REFLECT back their point of view by summarizing their answers and noting underlying emotions.

AGREE before challenging them by pointing out your areas of common ground.

SHARE your thinking by telling a story about a personal experience.

Photo by [Karin Tamerius](#).

Climate Change Conversation Resource: How to Turn Climate Anxiety into Action

“It’s normal to feel anxious or overwhelmed by climate change, says psychologist Renée Lertzman. Can we turn those feelings into something productive? In an affirming talk, Lertzman discusses the emotional effects of climate change and offers insights on how psychology can help us discover both the creativity and resilience needed to act on environmental issues”. ([TEDWomen, 2019](#)).

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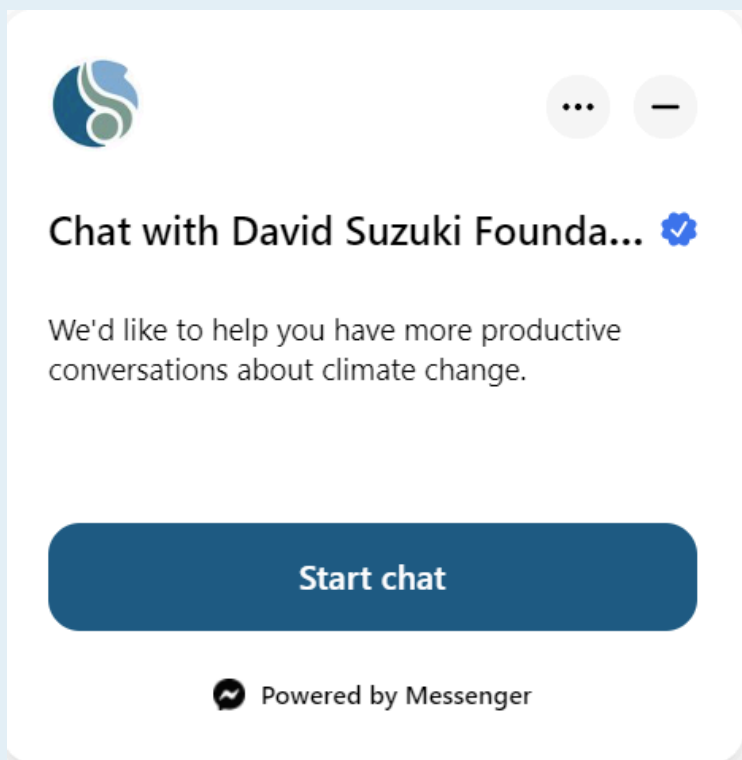
Video credit: How to turn climate anxiety into action,
([TEDWomen, 2019](#)).

Teaching and Learning Examples for Instructors

Use a [flipped classroom teaching strategy](#) and ask your students to prepare for a climate conversation online in advance of class using the [David Suzuki Foundations CliMate bot](#). Then, during in-person class, briefly review the topic of climate change, and ask students to volunteer to roleplay as

stakeholders in a climate conversation involving a landscape construction or maintenance project.

“Introducing CliMate, your climate conversation coach



This fun, simple chatbot on Facebook Messenger will teach you how stop arguing and start understanding people. In a guided practice conversation, you'll get to choose responses from a set of options, and CliMate will provide insight on the reaction your responses might elicit.

We know that conversations about climate change can

bring up all sorts of emotions, like frustration, despair, anger and embarrassment. CliMate will help you cultivate empathy and keep your conversations productive. It's also sure to make you chuckle, especially if you've tried having these sorts of conversations already.

This isn't about winning an argument; it's about learning to have productive conversations based on common ground and shared values. CliMate is rooted in science. The approach is based on the work of Karin Tamerius of [Smart Politics](#). Drawing on expertise in social and political psychology and extensive experience with online dialogues, she developed a five-step method to help people have difficult conversations. While CliMate will help you have less polarized conversations about climate change, it can also be useful for any potentially divisive conversation topics". (David Suzuki Foundation, 2023).

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. How do human activities contribute to the release of greenhouse gases into the atmosphere, and what are some ways that we can reduce our carbon footprint and mitigate the impacts of climate change?
2. Describe your personal views of climate change and explain the ways that your actions contribute to climate change or aim to reduce the impact of climate change.

3. What strategies can be effective in communicating about climate change with individuals who may have different perspectives or levels of knowledge on the issue?

Indigenization/Decolonization

Keywords: Indigenization, respectful, meaningful, diverse, awareness, systematic change, decolonize

We begin this section of Chapter 1: Planning with Purpose with an excerpt from a collaborative project led by BCcampus on behalf of the Ministry of Advanced Education that aims to facilitate a system-wide [Indigenization of Curriculum and Cultural Awareness training project \(ICCAT\)](#) for post-secondary institutions across British Columbia (2016).

“There is a systemic change occurring across post-secondary institutions through processes and practices that support Indigenization, decolonization, and reconciliation. A guiding principle from the [Truth and Reconciliation Commission of Canada](#) process states why this change is happening. Reconciliation requires constructive action on addressing the ongoing legacies of colonialism that have had destructive impacts on Aboriginal peoples’ education, cultures and languages, health, child welfare, the administration of justice, and economic opportunities and prosperity (2015, p. 3).

We all have a role to play. As noted by Universities Canada, “higher education offers great potential for reconciliation and a renewed relationship between Indigenous and non-Indigenous

people in Canada.” (2015) Similarly, Colleges and Institutions Canada notes that “Indigenous education will strengthen colleges’ and institutes’ contribution to improving the lives of learners and communities.” (2015).

As we know, our curriculum design and delivery decisions have an impact on how and what students learn. It’s through this understanding that we encourage horticulture faculty and staff to engage with the following resources and ask themselves if or how they can indigenize or decolonize their curriculum to provide space for indigenous knowledge and learning in their classrooms.

“Jo-ann Archibald, Professor and the director of NITEP (Native Indian Teacher Education Program) at the Department of Educational Studies (EDST), as well as the associate dean for Indigenous Education at the Faculty of Education at UBC, talks about what ‘Indigenizing the curriculum’ means and how it can be practiced” (UBC Educational Studies, 2012).

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=5#oembed-4>

Video credit: Interview with Dr. Jo-ann Archibald (UBC Educational Students, 2012)

In the Faculty Training Module for Greenhouse the Landscape Construction Trade, the authors sought to Indigenize/decolonize

the curriculum by incorporating the First People's Principles of Learning. These principles, informed by Indigenous knowledge and perspectives, were carefully chosen to create a culturally responsive and inclusive learning environment. The First Peoples Principles of Learning are shown in the poster below. "This poster describes a set of learning principles specific to First Peoples. The First Peoples Principles of Learning were articulated by Indigenous Elders, scholars and knowledge keepers to guide the development of the curriculum and teaching of the English First Peoples course created by the BC Ministry of Education and First Nations Education Steering Committee in 2006/2007" First Nations Education Steering Committee, n.d).



FIRST PEOPLES PRINCIPLES OF LEARNING

Learning ultimately supports the well-being of the self, the family, the community, the land, the spirits, and the ancestors.

Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place).

Learning involves recognizing the consequences of one's actions.

Learning involves generational roles and responsibilities.

Learning recognizes the role of indigenous knowledge.

Learning is embedded in memory, history, and story.

Learning involves patience and time.

Learning requires exploration of one's identity.

Learning involves recognizing that some knowledge is sacred and only shared with permission and/or in certain situations.



For First Peoples
classroom resources
visit: www.fnesc.ca




Poster credit: First Nations Education Steering Committee, n.d

Justice Institute of British Columbia: Some Way to Indigenize and Decolonize Curriculum:

- acknowledge traditional territories of First Peoples using a variety of mediums (in lectures, course outlines and web-based course architecture, e.g. Blackboard)
- work with Elders and Knowledge Keepers to infuse cultures into the curriculum
- understand Indigenous worldviews, the distinction and diversity of Indigenous People by language, culture and regions
- include Indigenous perspectives and learn about and use Indigenous pedagogical approaches
- visit Indigenous communities for field trips, events, and feasts
- incorporate talking circles to facilitate communication (circle methodology)
- respect and recognize rights for distinctive Indigenous customs, spirituality, traditions and practices
- use Indigenous Principles of Learning such as experiential, and lifelong learning approaches
- use the oral tradition, telling stories, with guest speakers such as Elders, Knowledge Keepers and community leaders
- use Indigenous research methodologies
- use Indigenous-authored texts, articles and books
- use Indigenous film
- hire Indigenous instructors

Teaching and Learning Examples for Instructors

“The Aboriginal Mother Centre Society is growing a garden of plants with ties to Indigenous culture and customs. It features plants for food and medicinal use. They say they hope the space can provide urban Indigenous families with nourishment and comfort” (CBC Vancouver, 2022).

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=5#oembed-5>

Video credit: Cultivating Indigenous Plants (CBC Vancouver, 2021)

This video is one example of how to honour Indigenous knowledge in horticulture training. The presenters begin in a good way by acknowledging First Nation Peoples and the land they are meeting on before sharing the native and non-native plants growing in the [Justice Institute of British Columbia Garden](#).

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=5#oembed-6>

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. What are your current perceptions of Indigenous knowledge, learning and ways of knowing? In what

ways have your perceptions changed since engaging with the material in this module?

2. Given that Indigenization/decolonization is a continual process, in what ways or what resources will you use to explore how to indigenize or decolonize your curriculum?

3. Consider using the [Your identity map](#) resource.

Your identity map

“There is a strong link between culture and the way people think and learn, so an understanding of the culture of a learner is essential in maximizing learning potential. Understanding the way your own culture influences your ways of learning will help you to understand the importance of this for your students as well, Indigenous and non-Indigenous. These questions offer an opportunity to reflect on your own unique cultural standpoint, no matter where you are from in this world. These questions were developed by Rhonda Ashby in New South Wales, Australia, inspired by the work of Dr. Karen Martin, Noonuccal woman and Aboriginal researcher. The questions will help you reflect on your ways of being, ways of knowing, ways of doing and ways of valuing. In Western knowledge systems, these become ontology, epistemology, methodology and axiology. You can add or remove

any questions and use the worksheet as you wish, including with your students. Note: Questioning, challenging and resisting this document is a valid way of engaging with it. Just make sure you're not doing this as a way to avoid self-reflection or self-scrutiny..." (p.1)

Regenerative Landscape: Planning with Purpose

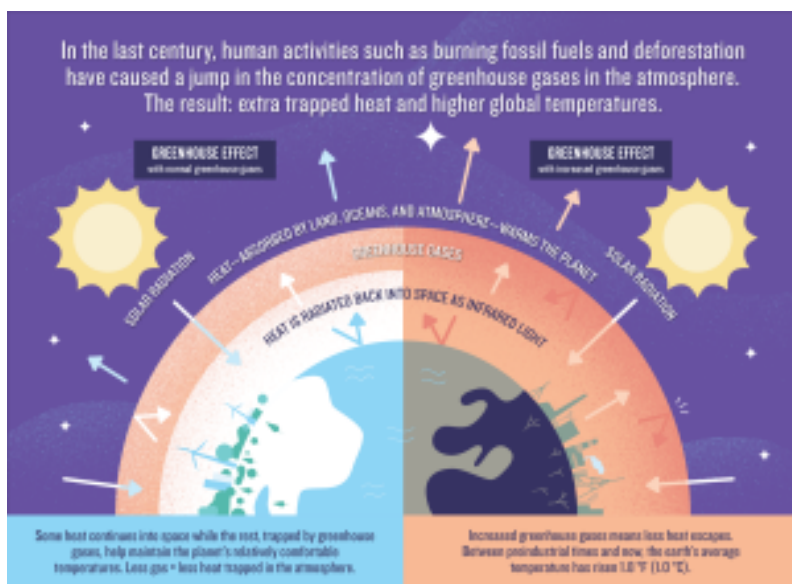
Rengerative (to renew/restore/respect)

Keywords: greenhouse gas effect, carbon footprint, carbon sequestration, regenerative landscape, food security, wildlife habitat, biodiversity, natural resources, social impact, reflection

Let's start by circling back to the greenhouse effect. The greenhouse effect is a natural phenomenon that occurs when certain gases in the Earth's atmosphere, known as greenhouse gases, trap and absorb heat from the sun that is radiated back into space. This process helps to regulate the Earth's temperature, making it habitable for life. Greenhouse gases, such as carbon dioxide, methane, and water vapour, act like a blanket around the Earth, trapping the sun's energy and preventing it from escaping into space. This causes the Earth's atmosphere to warm, which in turn warms the planet's surface and oceans. While the greenhouse effect is a natural process, human activities such as burning fossil fuels and deforestation have increased the number of greenhouse gases in the atmosphere, leading to an enhanced greenhouse effect and global warming. This has serious

implications for the Earth's climate, including rising sea levels, more frequent and intense heat waves, droughts, and extreme weather events.

So, we know that the biggest cause of climate change is **humans** and that it's also our responsibility within the landscape construction industry to change our practices to adapt and mitigate the consequences of climate change.



(Natural Resources Defense Council, n.d.)

We invite you to recall the last section, Indigenous Ways of Knowing, review the [First People's Principles of Learning](#), listed below, and look for ways that the regenerative landscape aims to connect the elements First People's Principles of Learning into the planning phase of the regenerative landscape.

First People's Principles of Learning (n.d)

- Learning ultimately supports the well-being of the self,

the family, the community, the land, the spirits, and the ancestors.

- Learning is holistic, reflexive, reflective, experiential, and relational (focused on connectedness, on reciprocal relationships, and a sense of place).
- Learning involves recognizing the consequences of one's actions.
- Learning involves generational roles and responsibilities.
- Learning recognizes the role of Indigenous knowledge.
- Learning is embedded in memory, history, and story.
- Learning involves patience and time.
- Learning requires the exploration of one's identity.
- Learning involves recognizing that some knowledge is sacred and only shared with permission and/or in certain situations.

The Regenerative Landscape: Base Plan Introduction

Regenerate: (to renew/restore/respect)

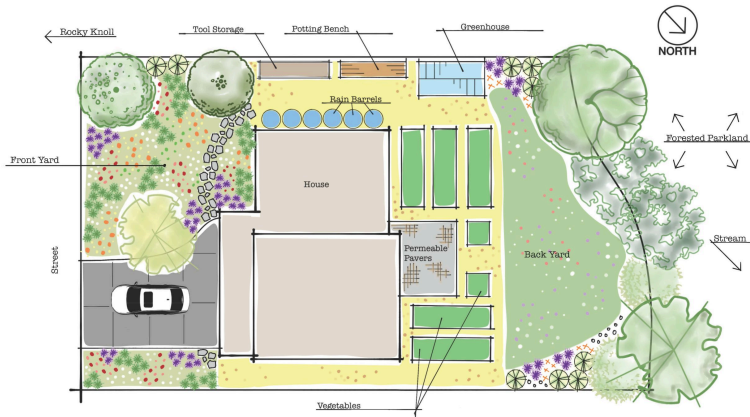
Regenerative landscaping is a holistic approach that promotes environmental, social, and economic sustainability ([review the United Nations SDGs here](#)). The regenerative landscape refers to a system of landscape design, construction and maintenance that aims to renew, restore, respect, and improve the health of ecosystems and the environment as a whole. This approach involves using natural systems and processes to **enhance soil health, promote biodiversity, increase carbon sequestration,** and create **sustainable, resilient landscapes**. A major element of the regenerative landscape is to showcase the interdependent and cyclical relationship between landscape horticulturalists and the environment. That is to say, the regenerative landscape

acknowledges that there is a reciprocal relationship between landscape horticulturalists and the environment. For example, the environment is *giving* landscape horticulturalists a canvas to construct their work and in turn, landscape horticulturalists *must give back* to the ecosystem through their work.

The regenerative landscape is introduced and used in this module as an example of how horticulturalists in landscape construction and maintenance can adapt their practices and reduce waste to reduce greenhouse gas emissions, which are the main contributors to global warming while respectfully interacting with the living environments in which they work. In each chapter of the module, a section of the regenerative landscape is *figuratively* built to illustrate ways to reduce the carbon footprint through the reflective and thoughtful selection of sustainable landscape construction and maintenance practices. A carbon footprint is the total amount of greenhouse gases (including carbon dioxide and methane) that are generated by our actions. The goal is to create self-sustaining landscapes and provide a range of ecosystem services, such as **clean air and water, pollination, resource rejuvenation, and wildlife habitat**. In addition to environmental benefits, regenerative landscapes can also provide economic and social benefits, such as **improved food security, reduced energy use and enhanced community resilience**.

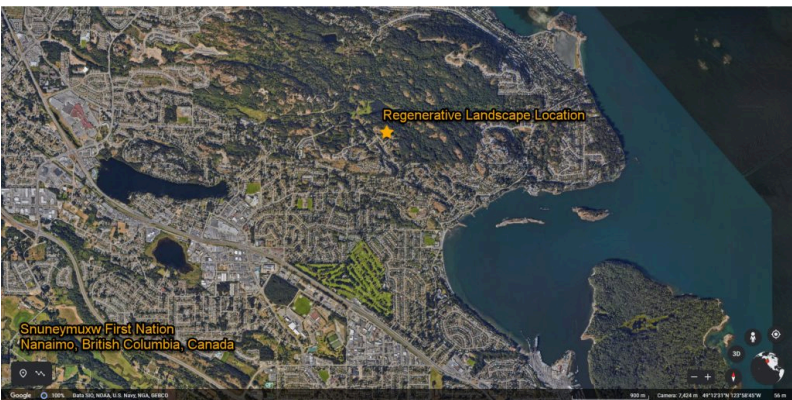
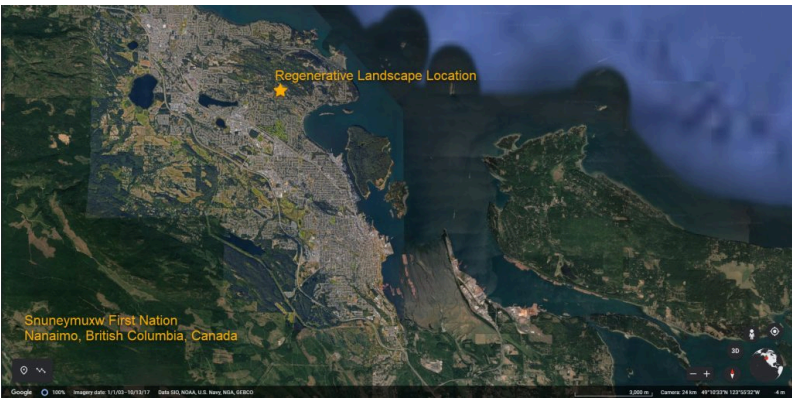
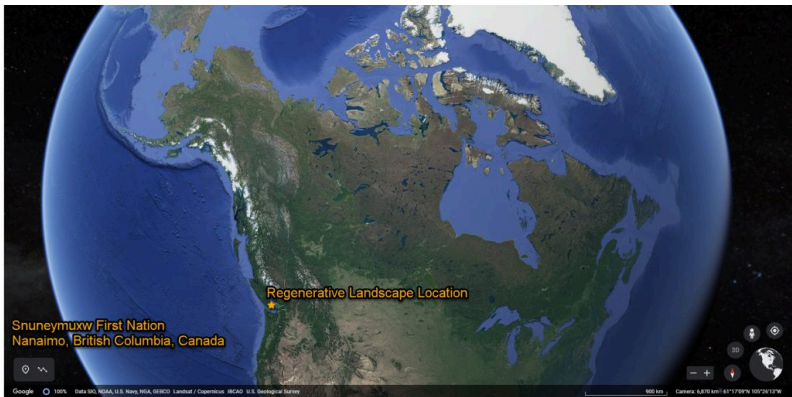
Here is our first look at the regenerative landscape base plan:

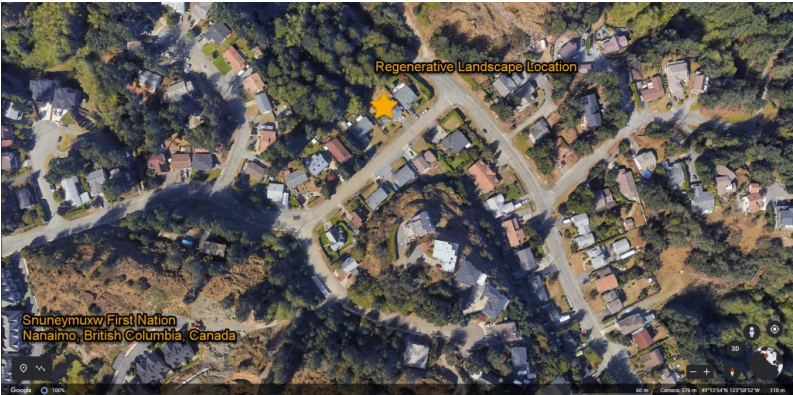
Let's first situate the base plan by acknowledging that the design and development of this landscape are located on the traditional and unceded lands of the [Snuneymuxw First Nation](#) where the residents of this landscape gratefully live as uninvited guests.



The Regenerative Landscape: a wider look

Before we get into the details of the regenerative landscape base plan, we invite you to look at the positionality of the regenerative landscape in relation to the wider ecosystem and community. Below are images to help orient you to the location of the regenerative landscape. By first using a wider scope to recognize the regenerative landscape, the aim is to become aware of the environmental and community systems that the regenerative landscape connects to, contributes to and disrupts.





The Regenerative Landscape: A closer look

Now that we understand the position of the regenerative landscape within the broader ecosystem and community, let's revisit the regenerative landscape base plan. As we consider the planning phase, it's important to acknowledge the surrounding area. To the South West, there is a rocky knoll that collects and directs water toward the forested parkland to the North of the landscape. This forested parkland serves as a habitat corridor, connecting the plant and animal species in the suburban areas to the larger Linley Valley, located to the North West of the landscape. These observations emphasize the significance of the regenerative landscape's location and the impact that the construction and maintenance phases will have on the waterways, plants, animals, and nearby residents.



Note the table below the regenerative landscape base plan that lists the regenerative features and benefits built into this landscape.

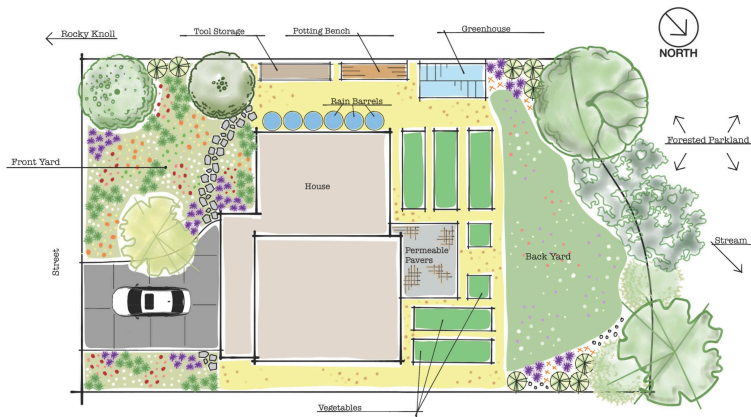
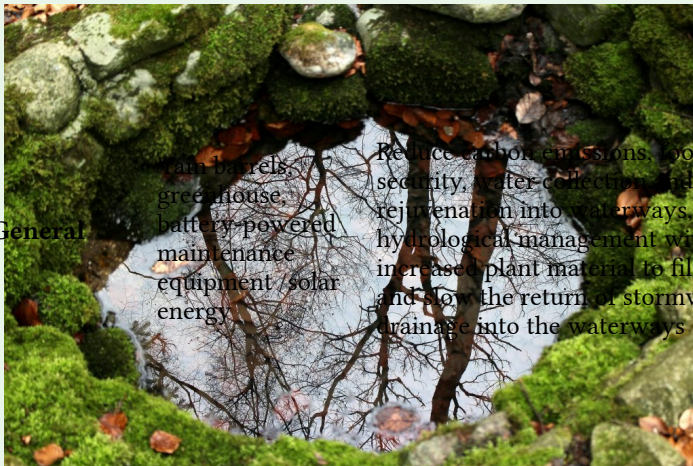


Image credit: CC BY ([North Arrow Landscapes, 2023](#))
Key Features of the Regenerative Landscape Plan

Plan Area	Regenerative Feature	Regenerative Benefit
Front Garden	Significant plant material, trees, meadow planting, drought tolerant plants, native plants, edible/ medicinal plants	Promote biodiversity, and wildlife habitat, increase carbon sequestration, improved air quality, reduced erosion, water conservation, ecosystem resiliency
Back Garden	Reduced lawn, increase plant material, native plant border, vegetable beds, permeable pavers	Enhance soil health, increased food security, enhanced community resistance, resource rejuvenation, clean air and water

Reflect

General



Rain barrels,
greenhouse,
battery-powered
maintenance
equipment, solar
energy.

Reduce carbon emissions, food
security, water collection and
rejuvenation into waterways, and
hydrological management with
increased plant material to filter
and slow the return of stormwater
drainage into the waterways.

Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. How can regenerative landscaping be used to achieve the environmental, economic, and social goals of sustainable development?
2. What is the relationship between regenerative landscaping and the UN Sustainable Development Goals (SDGs), and how can individuals contribute to this approach in the planning and designing phase of a landscape project?"

3. Imagine or draw your favourite garden that you recalled at the beginning of this chapter. Do your favourite features in your garden align with the goals of the regenerative landscape? If yes, how? If no, explain how they differ.
4. In what ways do you feel connected to your projects and what influence do you feel you have on the environment through your work?
5. Think of your upcoming landscape design project. How can the principles of regenerative landscaping be applied to the design and management of your next project, and what are the potential benefits of aligning your garden with these goals?

Additional Resources

We've compiled a list of additional resources to support your learning with the topics in this chapter. The additional resources are not required as part of this course, please engage with them as you need to support your learning.

Resource Name	Resource Description	Resource Link
Justice Institute of British Columbia	Indigenous Resources: Indigenization of the Curriculum Locate books, DVDs, articles and other electronic information related to indigenous studies	https://libguides.jibc.ca/indigenous/Indigenize-curriculum

BC Campus Indigenization Guides	<p>These guides are the result of a collaboration between BCcampus and the Ministry of Post-Secondary Education and Future Skills. The project was led by a steering committee of Indigenous education leaders from B.C universities, colleges, and institutes, the First Nations Education Steering Committee, the Indigenous Adult and Higher Learning Association, and Métis Nation BC.</p>	https://bccampus.ca/projects/archives/indigenization/indigenization-guides/
Canadian Architect	<p>Article/Example:</p> <p>Decolonizing the Design Process with Five Indigenous Land-Based Paradigms</p>	https://www.canadianarchitect.com/decolonizing-the-design-process-with-five-indigenous-land-based-paradigms/

Chapter 2: Design for Biodiversity



Photo by [James Wheeler](#) on [Unsplash](#)

Learning Outcomes

By the end of this chapter, you will be able to ...

- Recognize contemporary approaches in landscape construction and maintenance that enhance biodiversity.
- Explain the concept of biodiversity and assess how landscape construction and maintenance practices can impact the environment.
- Analyze the advantages of planting biodiverse landscapes as a means of fostering ecosystem health and

promoting environmental, economic and social sustainability.

Let's Review

Let's begin with a review of [Chapter 1: Planning with Purpose](#). In Chapter 1 our key topics were climate change, Indigenous ways of learning and the regenerative landscape. We looked at the role of humans in the production of CO₂, methane and other harmful emissions (greenhouse gases) through burning fossil fuels and the release of carbon through practices such as deforestation and urbanization. While a natural process that helps regulate the earth's temperature, making it habitable for humans plants and animals, the greenhouse effect is amplified by the increase of greenhouse gas concentrations being released into the atmosphere. In other words, the increased greenhouse gas concentration in the atmosphere traps heat and has resulted in a warming planet.

Due to global warming, there are significant consequences that we refer to as climate change. Climate change refers to the long-term alteration of global temperatures, precipitation patterns and sea levels. In addition, the consequences of climate change include more frequent and severe heat waves, droughts, floods, wildfires, and hurricanes, as well as the loss of ecosystems and biodiversity. It is one of the most pressing environmental and societal issues facing the world today, with significant implications for public health, food security, and economic development. To conclude Chapter 1, the reflection guiding questions asked you to reflect on how our choices to use certain practices in landscape construction will influence the environment, economy and wider society.

Introduction

Welcome to Chapter 2: Designing for Biodiversity. In this chapter, we will introduce how biodiversity in landscape horticulture refers to the incorporation of diverse plant and animal species in outdoor spaces such as gardens, parks, and natural areas. This approach to landscaping aims to create a sustainable and resilient environment that supports the coexistence of multiple species and promotes ecosystem health. By incorporating biodiversity in landscaping, we can create habitats that provide food, shelter, and nesting sites for wildlife, as well as improve soil quality, air and water filtration and overall environmental health. Additionally, biodiversity in landscaping can create aesthetically pleasing and dynamic outdoor spaces that offer numerous recreational and educational opportunities.

Biodiversity

Keywords: biodiversity, ecosystem, habitat, relationship

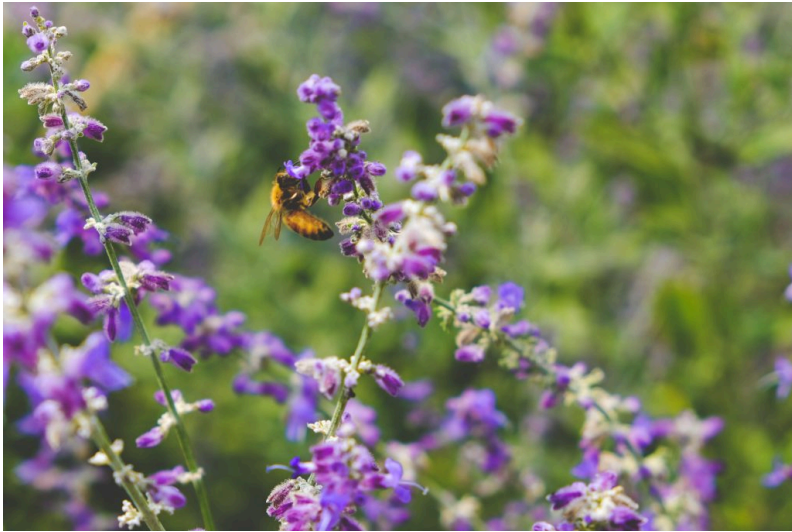


Photo by [Scotty Turner](#) on [Unsplash](#)

“Biodiversity (short for “biological diversity”) refers to the number, variety, and variability of all living things. Biodiversity is the variety of life in an area, which can range from life in a pool of water that collects between the leaves of a plant to the all-encompassing biosphere. There are many levels of organization that identify biodiversity. These include the genetic diversity of populations, the number and types of species, the distribution and abundance of species communities and ecosystems, and the interactions between organisms with their physical environment.

In the last several years, major flooding, extreme weather and wildfires have propelled climate change into the mainstream. But despite our increased awareness of environmental issues, the vitally important topic of [biodiversity loss](#) has received comparatively little attention. [Biodiversity](#) is the incredible variety of organisms on our planet, including the diversity between individuals, species and ecosystems. Biodiversity provides humans

with so many invaluable services such as clean water, medicines, abundant food and shelter.

Loss of habitat is one of the major factors leading to the loss of biodiversity in BC and worldwide. As human populations continue to increase around the globe, so does the amount of urbanization and subsequently the loss of habitat and biodiversity. Urban development has been shown to produce some of the greatest extinction rates worldwide.

Urban development separates natural habitat into numerous, small patches surrounded by human-altered landscapes like cement, grass, crops, and other degraded land types. These small greenspaces often lack native species, which are important for supporting local biodiversity. Instead, they are dominated by exotic species and highly manicured vegetation used for aesthetic purposes. Urban-gradient studies have found that with many species of plants, birds, and butterflies, the number of non-native species increases toward centers of urbanization while the number of native species decreases. In fact, the flora and fauna of cities, even across vastly different parts of the world, are incredibly similar, irrespective of geography or climate” ([Nature Trust British Columbia, 2022](#)).

“The food we eat, the air we breathe, our climate—everything that makes Earth inhabitable—all depends on the interplay of billions of species around the world. This is biodiversity. And unfortunately, it is rapidly declining. But it’s not too late. We’re at a pivotal moment when we can still reverse the loss of nature—for the sake of all life on Earth”.

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=32#oembed-1>

Video credit: Why is Biodiversity so Important? ([The Nature Conservancy, 2021](#))

Designing for Biodiversity

“Nature-based solutions are one of the most powerful tools we have to mitigate and adapt to climate change, while at the same time, these solutions can provide benefits for biodiversity. For example, large amounts of carbon dioxide are stored in the soil and plant life of forests, wetlands, grasslands and in oceans. Conserving these carbon-rich ecosystems allows carbon to be absorbed and prevents carbon from releasing into the atmosphere, while simultaneously supporting biodiversity” (Government of Canada, 2023).

“In the life of a forest, we are here for a very short time” ([Habitat Acquisition Trust, 2022](#)). So, how can landscape horticulturalists connect with nature, develop a relationship with the *land they are on* and acknowledge their role in changing the environment through construction activities? The next videos are an example of people who have been inspired and feel connected to spaces and places and developed a relationship with the environments that they contribute to and disrupt.

“What is the connection between nature and art?
How do you find inspiration in your surroundings?”

Join Australian Indigenous artist Grant Malony as he explores rainforests, ocean and wildlife in his search for inspiration in British Columbia. While exploring the Pacific rainforests with Mike Willie (T'łalis) of the Kwikwasut'inuxw Haxwa'mis First Nation, and Sea Wolf Adventures owner, Grant Malony spots deer in the wild, and photographs a variety of trees covered in moss and plants. The rainforests living Canada's west coast are filled with ancient trees stretching well above the ground, providing visitors an opportunity to connect with the land" (Canada Explore, 2019).

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=32#oembed-2>

Video credit: Finding Inspiration in the Rainforests of British Columbia, Canada, (Canada Explore, 2019)

"This virtual short film screening & discussion offered an opportunity for attendees to watch and learn about some of the habitat stewardship projects landowners in the community are working on, while connecting with these amazing individuals ... Property owners have many

questions about how to find a balanced approach working on the land (in harmony) with nature, rather than against it. From gardening to tree care, invasive species removal to wildlife monitoring, the Good Neighbours Program provides landowners with the tools to be habitat stewards of natural ecosystems around them. Each year, HAT meets with the landowners in a particular community, watershed, or neighbourhood to discuss habitat stewardship options. This short film features four inspirational stories of landowners on their journey through stewardship, and what they discovered along the way” ([Habitat Acquisition Trust, 2022](#))

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=32#oembed-3>

Video credit: Being a Good Neighbour to Nature, ([Habitat Acquisition Trust, 2022](#))

Teaching and Learning Examples for Instructors

Title: [My Favourite Plan](#) | **Objective:** To encourage

participants to share their favourite plants and the family connections they have with them.

Pollinator assessment

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. What does biodiversity mean to you and how do you incorporate biodiverse practices in your work?
2. What role do you feel you have in changing the landscape and how can you promote biodiversity

and restore and rejuvenate the ecosystem and environmental health?

3. How can you be a good neighbour to your ecosystem in your role as a Landscape Horticulturalist?

Regenerative Landscape: Designing for Biodiversity

Regenerative: (to renew/restore/respect)

Keywords: biodiversity, wildlife habitat, indigenous (*native*), pollinators, community resistance, interconnected, interdependent

As we continue the story of the regenerative landscape, we now shift our focus to promoting biodiversity, creating wildlife habitats, supporting pollinators, and enhancing community resilience during the construction phase. This chapter explores the front garden, which deviates from traditional lawn installations and instead features a meadow planting that showcases sustainable practices. In addition, the chapter also showcases the back garden where a non-traditional lawn installation with the addition of alternative lawn mixes and bulbs. It's worth noting that several landscape construction activities impact biodiversity and ecosystem health ranging from least (pavement) to most (complete ecological restoration of a site) environmentally sustainable.

Regenerative Landscape Base Plan

Let's review the regenerative landscape base plan again.



Design credit: CC BY ([North Arrow Landscapes, 2023](#))

Key Features of the Regenerative Landscape Plan

In this module, we will explore the benefits of meadow installations as an alternative to traditional lawns, which have been a common feature in front yard landscapes for many years. As the climate changes, we are seeing enhanced watering restrictions that limit homeowners to watering on certain days or times, and often lawn watering isn't allowed. While lawns are often viewed as low maintenance, it is important to consider the impact they have on the environment. Every spring, lawns require annual maintenance practices such as dethatching, coring, liming, fertilizing, and reseeding, all of which require equipment that is typically fossil-fuel-powered. Additionally, the turf grass seed used to reseed lawns is often grown on a commercial scale and transported back to the consumer, adding to the carbon footprint. Throughout the season, the use of herbicides and fertilizers is also common, but these chemicals can leach out of the soil and

travel through storm drains into larger bodies of water, harming the environment and potentially impacting human health. In this chapter, we will discuss how meadow installations can increase biodiversity, wildlife habitat, and carbon sequestration, and support a healthier environment.

The decision to include a meadow in the front garden of the regenerative landscape was not only based on the goal of increasing biodiversity but also guided by the growing number of drought-enforced bylaws in [Southern communities](#) in the United States that limit the building or remodelling of lawns to a small percentage of the available landscape area. These recent lawn-size restrictions aim to reduce water usage, lower maintenance and fossil fuel consumption, and promote biodiversity. In light of these restrictions and the environmental benefits of meadow plantings, it is recommended that lawn installation be reconsidered in favour of restoring natural resources, supporting native pollinators, and increasing biodiversity through meadow installations. Meadows not only provide wildlife habitat in both urban and non-urban areas but are also low maintenance and have a high impact on the ecosystem

Another theme to discuss with regard to meadow installation is the increase of diverse and productive plant materials used that can offer year-round biodiversity benefits. It's possible to use a mix of native or non-invasive ornamental perennial and woody shrubs or trees in a meadow installation to increase diversity and habitat. A benefit of biodiverse meadow plantings is their effectiveness to remove carbon from the atmosphere and provide cooling through evapotranspiration. Carbon sequestration and evaporative cooling have proven to be effective and efficient methods to reduce global warming and the effects of climate change.

Although lawns have their drawbacks, they also offer some

regenerative benefits. In the back garden of the regenerative landscape, an alternative lawn mix has been used, along with bulbs interplanted throughout. This lawn contributes to carbon sequestration, and infiltration of water into the soil, and provides slope and soil stability through plant root systems. Lawns are also safe spaces for children and pets to play. To boost biodiversity in lawns, it is recommended to use alternative lawn mixes that include native and non-invasive non-native seed mixes, which can increase plant diversity and provide food sources for pollinators when flowering. Bulbs can be interplanted throughout the lawn in the regenerative landscape providing diversity in plant species to support native pollinators. Since bulbs typically bloom in spring and fall and go through a period of dormancy in the summer, they do not require additional water during typically drought periods



Photo credit: Kelsey Cramer

More Ways to Increase Biodiversity

Barwon Water Education Officer Fernando shows you how to build a bug hotel to encourage insects into your garden”. (Barwon Water,2021).

Tip – to make your bug hotel more sustainable, save the plant debris such as leaves, stems and bark from the landscape that your bud hotel will be

placed in to ensure the bug hotel reflects the space it will permanently reside .

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=32#oembed-4>

Video credit: How to Make a Bug Hotel, (Baron Water, 2021)

STANLEY PARK BREWING

HOT TOPIC: CLIMATE CHANGE AND POLLINATORS

POLLINATOR PARTNERSHIP CANADA

Climate change impacts plants, pollinators, people, and the planet. But **YOU** can make a difference

- Managed and wild bees are facing challenges due to climate change
- Invasive plants can spread to new areas with climate change, crowding out native plants, and reducing plant diversity and food for bees
- Bee populations are harmed by extreme weather events such as heat waves and storms
- Warming weather can make it harder for some bees to be active at the right time
- The warming climate is causing some mismatches between when bees and flowers are out, resulting in less food for bees and less pollinators for the flowers
- Increasing CO₂ levels are resulting in pollen to have less protein

Credit: Tyson Harrison

Credit: Kristen Miskelly

WHAT YOU CAN DO:

- Include plants that support bees in your garden, in pots, or in your community spaces
- Convert lawn areas to low-growing, hardy native plant meadows or naturescapes
- Creating these types of pollinator habitat can help sequester carbon, reducing climate change
- Using native plants rather than ornamental plants reduces the need for watering and mowing, saving you time, water, and reducing emissions
- Climate smart activities can help pollinators, too. Reduce your carbon footprint by reducing consumption, buying local, and using only recyclable and reusable containers.
- Have fun in the garden and enjoy the beautiful butterflies, bees, flower flies, and other wildlife that you attract with your pollinator plantings

Your donation to Pollinator Partnership Canada will go towards habitat for bees, creating a better world for plants, pollinators, and people.
To find out more about pollinators visit Pollinator Partnership Canada at www.pollinatorpartnership.ca

**STANLEY PARK BREWING IS A PROUD SUPPORTER
OF POLLINATOR PARTNERSHIP CANADA**

8901 Stanley Park Dr., Vancouver, BC, CAN V6G 3E2 | 604-681-0460 | info@stanleyparkbrewpub.ca



Credit: Kristen Miskelly



(Pollinator Partnership Canada, n.d)

How to Install a Meadow from Seed

Please see the additional resources section for existing meadow installation guides specific to your region. Keep in mind that the meadow installation guide provided in this module is tailored to Vancouver Island. If a guide for your region is not available, the authors encourage you and your students to take the initiative and develop meadow makers guide to promote biodiversity, support pollinators, and enhance community health in your area. By doing so, you can become a champion for your region and make a positive impact on the environment.



**Satinflower
NURSERIES**

native plants, seeds & consulting



Sowing Your Seed **INSTRUCTIONS**

SEEDING WITH NATIVE SPECIES

WHAT ARE SEEDS?

Seeds are the embryos of a plant that will grow into a new plant. They are usually wrapped in a tough exterior layer for protection (seed coat) and contain some stored food (endosperm).

TIMING

Different species vary on when best to be sown from seed. Some species are adapted to germinate with the first rains at the end of summer and grow throughout the warm, moist fall season. These seeds should be planted at the end of summer or early in the fall to maximize the growing season. Others are adapted to germinate after winter has passed and require a period of cold, moist stratification. These seeds should be planted in the early fall so that they can stratify naturally. Stratification length varies between species.

SEEDING STRATEGY

Seeding can be a cost-effective way to cover larger areas and result in a natural assemblage of native plants. Seeding done well can function to minimize soil erosion and prevent invasion by weedy species. Sometimes a phased seeding plan is effective to introduce a few species

first that can quickly establish, and then in following years or seasons, other species can be interseeded to increase native plant diversity. In some cases, a "nurse plant" can be introduced first to facilitate the establishment of other species that are planted later (e.g. seeding of sun-loving species while shade is created). As part of a phased seeding approach, less vigorous species can be planted ahead of vigorous species to ensure their establishment. In future years, the more vigorous species can be added.

SITE PREPARATION

Good preparation is critical to the establishment and survival of plants sown by seed. In general, seeds require good seed to soil contact, steady moisture, and to remain undisturbed during their establishment. Surface roughening prior to seeding can improve germination success by allowing for seed to soil contact...



WHEN TO SOW YOUR SEED?

Most native wildflowers are adapted to be sown in the fall, to mimic when the seed naturally drops after the dry summer. Despite this, some species can also be sown in the early spring. The species listed below will still germinate if sown in the early spring (Feb/March), but the most successful germination of native seed is done by fall sowing.

PERENNIALS

Entire-leaved Gumweed
Yarrow
Pearly Everlasting
Woolly Sunflower (below)
Field Chickweed
Spring Gold
Coastal Sage



ANNUALS

Sea Blush
Small-flowered Blue-eyed Mary
Farewell-to-Spring (left)
Small-flowered Forget-me-not
Miner's lettuce



On compacted soils, the ground can be roughened, raked, or tilled **before seeding** to break up the surface and allow seeds to fall into crevices, which help retain moisture for germination. There are a diverse array native plants that will thrive in any soil type, including nutrient poor, gravelly, or clay soils. Site preparation also includes dealing with undesirable plants and weedy seed banks ahead of seeding. Approaches will vary depending on the site but may include methods such as hand weeding, solarization, mulching, tilling, smothering, and herbicides. Sometimes minimizing soil disturbance can help reduce problems associated with weedy seed banks.

SEEDING DEPTH

It is essential that seed is sown at an appropriate soil depth to ensure germination and successful growth. Different seeds have different light, moisture, and temperature requirements. **Seeding onto the surface of the soil is best** for the majority of species we carry (see site prep above). As a general rule of thumb, **seeds should only be buried as deep as they are long**. Sowing on the surface and raking lightly can be effective.

Dilute that seed! We recommend **1/2 cup carrier** for every **1 m² of area** to cover

SEED STORAGE

Seeds should be stored cool and dry if they're not planted right away. Paper envelopes prevent moisture build-up. Seeds in paper envelopes can be stored in a dry place away from sun like a cupboard if they're sown relatively soon after purchase.



For longer shelf life, place the paper envelope in a sealed plastic bag and keep in the refrigerator. In general, we recommend sowing within the first year after purchase, though some seeds can be stored much longer.



BROADCASTING SEED

Broadcasting places seed on the soil surface instead of underground, whether by hand or with a seed spreader. Using an inert "carrier" such as vermiculite, perlite, sand, or sawdust with the seed can allow it to be spread easier, distribute more evenly, and help you visually track where the seed has already fallen. **A general ratio to follow is 1/2 cup of carrier for every 1m² of area to cover.** Seed spreaders are commonly used to distribute lawn seed or agricultural seed, but they can be effective tools for broadcasting larger amounts of seed over your site. If using a spreader, ensure the unit has settings to accommodate small-sized seed. Other techniques like drill seeding and hydroseeding may become available in our area over time for native seed blends.

COLD STRATIFICATION

Some perennial seeds need a period of moist and cold conditions before they will germinate, which is called cold stratification. Some perennial seeds need a period of moist and cold conditions before they will germinate, which is called cold stratification. This is how native plants have adapted to the local climate. Germinating in cool/moist conditions prevents seedlings from drying out in the hot summer or freezing in the winter. **Great Camas, Common Camas, California Oatgrass, Nodding Onion, Red Columbine, and Broad-leaved Shootingstar** are just some examples of species that require cold stratification and should be sown in the fall.



CHOOSING THE RIGHT SPECIES

This is one of the most important factors in developing an appropriate seed combination for a given site. Numerous factors must be taken into account such as project goals, budget, and maintenance abilities, as well as a suite of biological factors such as light, moisture, soils, and other environmental conditions. These considerations will influence species composition, grass-to-flower ratios, ratios of different species in the blend, seeding rates, and timing of inclusion for particular species. An understanding of the ecological behaviour of the various species and germination rates as well as site preparation and seeding techniques must also be considered when designing a seed blend. Consultation with an expert is often necessary when choosing and designing an appropriate seed blend.

TIMELINE

Starting a plant from seed can take time but can be very rewarding and yield a natural-functioning space. The timeline of events depends almost entirely on the type of species in the

blend and is impacted by a range of factors like site preparation methods and competition by invasive species as well as competition among the native species themselves. Weather patterns and timing of seeding dramatically affect seeding success and other outcomes as well. In general, a diverse seed blend sown in fall will show some germination in the fall of the sowing and then go through a period of relative dormancy through the winter. The following spring there will be a second flush of germination from species that require cold stratification. Some species flower in their first year, while others may quietly put on growth through several seasons before flowering. Patience is key and minimizing disturbance through the fragile periods is essential. Some seed blends can be sown in the spring if they include spring-germinating species (these same species can be sown in the fall as well). Because spring rain may be intermittent, spring sowing will be more successful if the site can be watered and if the sowing is done early (February/March).

Plants like White Fawn Lily (right) and Great Camas (left, above) can take up to seven years to bloom from seed and require patience. They are certainly well worth the wait!



MAINTENANCE

Native plants have a reputation of being little-to-no maintenance, but the truth is that almost all planted spaces require at least some maintenance to thrive continually or to meet various project objectives. Most native plants are susceptible to deer-grazing, so using deer-resistant species or otherwise protecting from deer may be required, particularly in the early-establishment phase. Rabbits, slugs, and birds can also pose a threat. All plantings, big and small, require a certain level of preventative and adaptive maintenance. For meadow spaces, periodic mowing or burning is required to reduce thatch buildup and open up space for new recruitment, particularly by annual species. Watering may also be necessary for some types of planting or to meet objectives. However, there are a variety of plantings that can be done without any supplemental watering, particularly when sown in the fall.

LOOKS CAN BE DECEIVING

Seed size varies tremendously depending on the species. From a speck of dust to the size of a pea, the volume of seed you receive may appear much less than what you were expecting. Contact us for more information on seed volume.

BENEFITS OF GROWING FROM SEED

- ✓ Learn multiple stages of plant life cycle
- ✓ Complete coverage & natural balance
- ✓ Reduced cost & labour; beneficial for larger scale projects
- ✓ Preserved genetic diversity
- ✓ Reduced waste

CHALLENGES OF GROWING FROM SEED

- ✓ Timing is critical; Many native seeds must experience a winter to germinate (cold stratification)
- ✓ Patience; some species take a long time to flower
- ✓ New seedlings are fragile and susceptible to damage by birds, slugs, trampling, frost and even our own weeding errors!

HELPFUL TERMS TO LEARN AS YOU GROW



STRATIFICATION is a process of treating seeds to simulate natural conditions that the seeds must experience before germination can occur.



GERMINATION is the stage of plant growth when the seed begins to sprout. Each seed is triggered to germinate from a combination of water, temperature, and sunlight.



INTERSEEDING means to add seed to an already vegetated area.

WHY PURCHASE SEED FROM US?

Satinflower Nurseries offers one of the largest native plant seed selections on Southern Vancouver Island. Did you know the genetics of our seeds is local? Our seeds originate from field grown plants (not wild collected) and grown without the use of herbicides, pesticides (including neonicotinoids), or chemical fertilizers. This parent stock has been grown from wild seed sources in the Victoria area.

Field grown plants are carefully tended throughout the year and seeds are harvested by hand through the spring and summer. Once collected, seeds are sold in pre-made blends, packages, and in wholesale quantities.

We specialize in custom blends to suite your specific project needs. Some of our seeds are readily available at the nursery during our regular business hours, but for a full selection, visit our website or contact us by e-mail.



LOOKING FOR CUSTOM PACKET LABELS?

We offer seed in custom pre-packaged seed packets for special events (wedding favours), promotional giveaways, business gifts, and more. Send us an email to get started!

Spring Gold *Lomatium utriculatum* (below)



FOR MORE INFO...

satinflower.ca
778-679-3459
info@satinflower.ca

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. What does biodiversity mean to you and how do you already incorporate plant diversity into your work?
2. Which bioclimatic zone do you live in and what are the Indigenous (native) plants that inhabit this area?
3. What role do you feel you have in changing the landscape and how can you promote biodiversity

and restore the ecosystem and environmental health?

4. How can you be a good neighbour to your ecosystem and environment in your role as a landscape horticulturist?

5. Which plants make up meadows in your region? What growing conditions do they prefer and how might you create those conditions in a residential landscape?

Teaching and Learning Plan

In this lesson, students examine the local territory by observing what is growing and assessing what should be growing to encourage pollinators.

Lesson Plan: [Planting with Purpose](#)

Resources

- [Habitat Gardens – pollinators template](#) [PowerPoint]
- [Working with Elders](#) [PDF]
- [Territory Acknowledgements](#) [PDF]
- [Medicine Walk](#) [3min Video]

Additional Resources

We've compiled a list of additional resources to support your

learning with the topics in this chapter. The additional resources are not required as part of this course, please engage with them as you need to support your learning.

Resource Name	Resource Description	Resource Link
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**Unesco's
Commitment
to
Biodiversity
(Global)**

“This publication highlights some of UNESCO’s biodiversity-related actions and solutions, based on the Organization’s unique mandate and its diverse normative instruments, networks, programmes and partners. These actions have reduced biodiversity loss and improved the lives of many people around the planet. For each thematic challenge, the publication highlights current actions and solutions that have been successfully implemented, as well as suggestions for improvement and innovation. This publication is an invitation to positive action and to trust in our collective capacity and creativity to transform our relationship with biodiversity, by sharing values, solutions and knowledge for our common future”

**Unesco’s Commitment to
Biodiversity**

Pollinator Partnership Canada: Pollinator Planting Guides (Canada)	<p>“Our ecoregional planting guides, Selecting Plants for Pollinators, are tailored to specific areas of Canada. Whether you are a farmer of many acres, a land manager of a large tract of land, or a gardener with a small lot, you can increase the number of pollinators in your area by making conscience choices to include plants that provide essential habitat for pollinators”</p>	<p>https://pollinatorpartnership.ca/en/ecoregional-planting-guides</p>
Satin Flower Nurseries (Victoria, BC)	<p>Planting guides for encouraging pollinators, and butterflies and designing hedgerows and meadows.</p>	<p>https://satinflower.ca/blogs/learn/tagged/pollinators</p>

“Creating a
naturescape (native
plant garden) on your
land is **part of the
solution** to habitat
loss. The actions of
many individual
landowners can make
a **big difference** for
wildlife in our region.
A changing climate
and booming
population growth
are forcing
communities to
rethink our prolific
outdoor water use.

**Habitat
Acquisition
Trust
(Victoria, BC,
Canada-wide
resources in
“Learn”)**

Using showy native
plants in your garden
can also save you
time and money;
forget about
watering, artificial
fertilizers, and toxic
pesticides. Because
native plants have
evolved in this
climate for
countless generations,
they attract local
songbirds and insect
pollinators. The
various plants in this
guide fit into any
type of garden
setting”

<https://hat.bc.ca/>

Chapter 3: Plants with Benefits

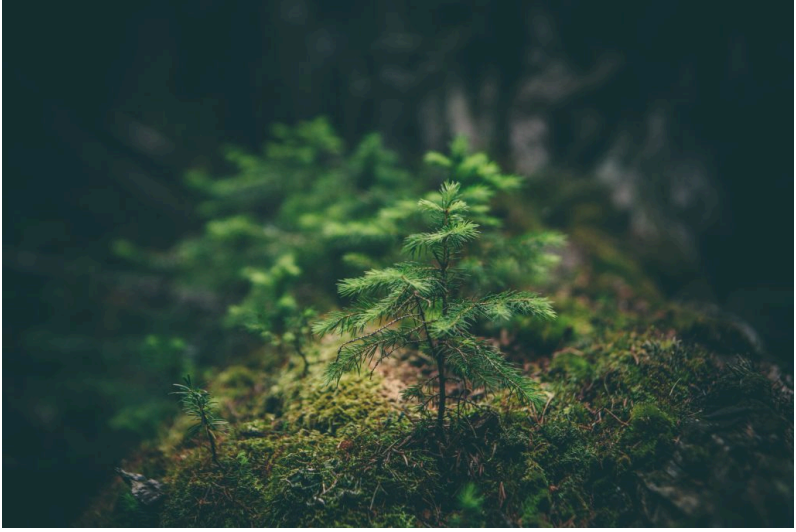


Photo by [Matthew Smith](#) on [Unsplash](#)

Learning Outcomes

By the end of this chapter, you will be able to ...

- Identify and describe plant selection characteristics to promote environmental, economic and social sustainability.
- Identify native and invasive species local to your region.
- Describe your role as a landscape horticulturist in the spread of invasive species and evaluate tools and practices to stop the spread of invasive species.

Let's Review

Let's begin with a review of [Chapter 2](#) where we looked at biodiversity and how it refers to the variety of plant and animal species that exist in a given landscape. Biodiversity is important for maintaining a healthy and sustainable ecosystem, and landscape horticulturists can promote biodiversity by using native plants, creating habitats for wildlife, and avoiding the use of harmful chemicals. Overall, prioritizing biodiversity in landscape horticulture can help create resilient and thriving landscapes that regenerate and reciprocate to the local environment. The guiding questions in Chapter 2 asked you to reflect on your role in the wider ecosystem as a landscape horticulturist and describe how you may influence the landscape, and be influenced by the landscape, through your choices and actions.

Introduction

Keywords: drought tolerance, heat tolerance, provenance,

Our theme in Chapter 3: plants with benefits is how selecting the *right plant for the right place* is essential for long-term plant health and plant success in the landscape and wider ecosystem in a warming climate. In this chapter, we will look to the natural ecosystems for examples of landscape management strategies and discuss the damaging role of invasive species have on natural ecosystems. Finally, this chapter will also introduce alternative considerations for selecting plants and the benefits these plants have on the environment and society.

The concept of the right plant for the right place is threaded throughout the pan-Canadian harmonized landscape horticulture competencies across Canada. When selecting plant material for a landscape we know to consider certain *characteristics* such as:

1. **The environmental conditions:** when selecting plants for a particular area, it's important to consider the environmental conditions of that area. Factors such as sunlight, temperature, soil quality, and moisture levels should be taken into account. for example, a plant that requires full sun and well-draining soil will not thrive in a shady and moist location.

2. **The mature size:** another important factor to consider is the mature size of the plant. Some plants grow very tall and wide, while others remain small and compact. Choosing the right size plant for the space you have will help prevent overcrowding and ensure that each plant has enough room to grow and thrive.

3. **The plant's specific requirements:** before selecting a plant, we do some research to learn about its specific needs and requirements. This includes things like soil pH, watering frequency, and pruning needs. By selecting plants that are well-suited to the conditions of the landscape, we help ensure their long-term health and success.

4. **Choosing plants that suit the *purpose*:** we think about the purpose of the plant in the landscape. We consider if we want or need the plant to provide shade, attract pollinators, or serve as a focal point. Different plants serve different purposes and choosing the right one will help ensure an appropriate feel to the landscape and that the landscape function the way we want it to.



This image was created with the assistance of [DALL·E 2](#)

Due to the emanant effects of climate change, it's becoming increasingly important to select plants that can adapt to changing weather patterns and extreme weather events. Recent adaptive trends for plant selection in the landscape industry include choosing or considering plants based on:

1. **Drought Tolerance:** as temperatures rise and rainfall patterns change, drought conditions are becoming more common in many regions. Choosing plants that are adapted to low-water conditions can help ensure that your garden thrives even during dry spells. Look for

plants that have deep roots and can store water, such as succulents and cacti, or those with waxy leaves that can reduce water loss.

2. **Heat tolerance:** with higher temperatures becoming more common, it's important to choose plants that can withstand extreme heat. Look for plants that are native to warmer climates or those that have been bred for heat tolerance.

3. **Ability to handle flooding:** (i.e hydrology restoration) as rainfall patterns change, some regions may experience more frequent and intense flooding. Select plants that can handle wet soil conditions, such as ferns, cattails, and non-invasive irises. Additionally, consider planting in raised beds or using rain gardens to help mitigate the effects of flooding.

4. **Ability to handle extreme weather conditions:** climate change can also bring more extreme weather events, such as strong winds and hailstorms. Look for plants that are resistant to damage from these events, such as shrubs with flexible branches or plants with thick, waxy leaves.

5. **Geographic provenance or Indigenous (native) plants:** plants that are native to your region are more likely to be adapted to the local climate and can often withstand the effects of climate change better than non-native species. additionally, planting native species can help support local ecosystems by providing food and habitat for local wildlife.

6. Pollinators: the video below from Pollinator Partnership Canada provides reasons why landscape horticulturalists should choose plants to support pollinators and how we can apply these practices in the landscape.

Overall, choosing plants that can adapt to a changing climate is an important part of creating a resilient and sustainable garden. By selecting the right plants, you can help ensure that the plants in landscapes thrive even in the face of climate change.

“We are excited to share with you a short animated video about the importance of pollinators, their relationship with native plants, and ways to help! This short video is perfect for sharing with friends, family, and colleagues to get them excited and talking about pollinators”. ([Pollinator Partnership, 2022](#)).

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=34#oembed-1>

Video credit: Native Plants and Pollinators: A Symbiotic Partnership, ([Pollinator Partnership, 2022](#))

Plants with (Alternative) Benefit(s)

Keywords: carbon source, carbon sink, photosynthesis, carbon sequestration, hydrological restoration, wildlife habitat

To select appropriate plant material, landscape horticulturalists need to consider the potential benefit of plants to humans and more importantly, to the wider ecosystem network.

Landscape horticulturalists can look to their local and natural ecosystems for examples of how to effectively select plants and manage landscapes. Let's first look at the role of forests, also known as the lungs of the earth, as an example of the ecological roles and benefits of plants.

“Forests can act as either carbon sources or carbon sinks.

- A forest is considered to be a **carbon source** if it releases more carbon than it absorbs. Forest carbon is released when trees burn or when they decay after dying (as a result of old age or of fire, insect attack or other disturbance).
- A forest is considered to be a **carbon sink** if it absorbs more carbon from the atmosphere than it releases. Carbon is absorbed from the atmosphere through **photosynthesis**. It then becomes deposited in forest biomass (that is, trunks, branches, roots and leaves), in dead organic matter (litter and dead wood) and in soils. This process of carbon absorption and deposition is known as **carbon sequestration**” ([Government of Canada, 2022](#)).

“Woods and trees are one of the best ways to capture and store atmospheric carbon. But how do they do it? Here’s the science made simple. Take a journey into the leaf of a tree with our animation and discover how they capture and store carbon”.
([The Woodland Trust, 2021](#)).

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=34#oembed-2>

Video credit: How Trees Capture and Store Carbon, ([The Woodland Trust, 2021](#))

“Climate change is expected to have a profound impact on the carbon balance of Canada’s forests. The biggest short-term impacts will result from changes in disturbance regimes. For example, scientists at Natural Resources Canada’s Canadian Forest Service predict that the forest area annually burned in Canada is likely to double by the end of the century, resulting in large emissions of carbon. More frequent and longer-lasting droughts are expected to contribute to this increase. Similarly, increases in the area and intensity of insect outbreaks are expected to cause carbon losses. Already, climate change, in the form of warmer winters, has contributed to the major infestation of the mountain pine beetle in British Columbia and its recent spread over the Rocky Mountains into Alberta. A key question is whether the insect will be able to expand its range through Canada’s boreal forests.

Some aspects of climate change, such as longer growing seasons or greater concentrations of carbon dioxide in the atmosphere, are expected to increase tree productivity (at least initially). A warmer, wetter climate may also enhance decomposition rates. Northern regions of Canada are expected to warm faster than more southerly areas, resulting in the melting of permafrost; this may release methane from frozen soils and initiate the decomposition of previously frozen organic carbon” ([Government of Canada, 2022](#)).

Now, let’s take a look at an example from Forestry, a horticulture-adjacent industry for factors to consider when making land management decisions and the impact of decisions on the environment, economy and society.

“Forest management is not one size fits all. Different forest types, different ownership and different objectives create a vast mosaic of forest management across the Oregon landscape. In 2015 the City of Astoria entered into a voluntary carbon project that sold carbon credits from the management of their watershed. The purpose of this forest carbon project was to generate non-timber revenue that diversified income streams from traditional timber harvest within the watershed. Managing a forest for carbon credits takes a specific kind of management that requires a lot of planning upfront, along with a number of partners to make it all come together”([Oregon Forests, 2022](#))

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Let's think about a few of the most common work environments for a landscape horticulturist. Some typical work environment for landscape horticulturalists includes residential gardens, commercial/industrial greenways, city or municipality boulevards/parks or even botanical gardens. Wherever the work environment is, it's part of our role as landscape horticulturalists to contribute to the ecosystems that we disrupt through our work. Equally important, it's essential for landscape horticulturalists to advocate plant selections that **sequester carbon**, improve **hydrology restoration** and promote **wildlife habitat**. So, how can landscape horticulturalists support carbon sequestration in our plant selection process? The answer is obvious, plant more plants and in particular plant more trees! However, with changing climates and unpredictable climatic events, it can be challenging to select plants that will survive in the landscape long term.

Two resources to support landscape horticulturalists' plant selection choices are:

1. Canada's Plant Hardiness Zones which now include climate modelling projects for plant species: [Canada Plant Hardiness Zones – Climatic Modelling](#)

This site explores the relationship between plants and climate across Canada. One portion of the site is dedicated to plant hardiness zone maps, which have traditionally been used by gardeners to help select which

plant species to grow in their area. Another part of the site presents maps and models that summarize the climatic requirements of thousands of plants from across North America. A final aspect of the site gathers data and provides summaries about plants that occur in your area.

2. i-Tree Species, this tool helps you select the most appropriate tree species based on their potential tree benefits and your geographic area: [i-Tree Species](#)

Users can start by choosing their location, then select and rank the importance from 0-10 of desired tree benefits such as carbon storage, air pollution removal, stormwater impacts, building energy conservation, air temperature reduction, ultraviolet radiation reduction, pollen allergenicity and wind reduction.

Holistic Plant Selection

Keywords: edible/medicinal plants, Indigenous (native) plants, land management strategies

In addition to supporting environmental and environmental pillars of sustainability, selecting plants from a holistic lens can support social and cultural pillars of sustainability.

“In this profoundly hopeful talk, Diné musician, scholar, and cultural historian Lyla June outlines a series of timeless human success stories focusing on Native American food and land management

techniques and strategies. Lyla June is an Indigenous musician, scholar and community organizer of Diné (Navajo), Tsétséhéstâhese (Cheyenne) and European lineages. Her dynamic, multi-genre presentation style has engaged audiences across the globe towards personal, collective and ecological healing. She blends studies in Human Ecology at Stanford, graduate work in Indigenous Pedagogy, and the traditional worldview she grew up with to inform her music, perspectives and solutions. Her current doctoral research focuses on Indigenous food systems revitalization” (TEDx Talks, 2022)

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Video Credit: 3000-year-old solutions to modern problems, Lyla June, (TEDx Talks, 2022)

Other considerations when selecting plants for the landscape and ecosystem are the historical medicinal or edible purposes of plants used by Indigenous peoples. By investigating and understanding the historical and cultural context of plant use, horticulturalists can make respectful decisions when selecting plants that reflect a particular landscape that will then influence and become part of the environment in which they plant.

We invite you to read this short article, [Traditional Plants and Indigenous Peoples in Canada](#) authored by Turner et al., (2021) which shares the relationship between traditional plants and Indigenous peoples in Canada.

Traditional Plants and Indigenous Peoples in Canada

“Indigenous peoples in what is now Canada collectively used over a 1,000 different plants for food, medicine, materials, and in cultural rituals and mythology. Many of these species, ranging from [algae](#) to [conifers](#) and flowering [plants](#), remain important to Indigenous communities today. This knowledge of plants and their uses has allowed Indigenous peoples to thrive in Canada’s diverse environments. Many traditional uses of plants have evolved to be used in modern life by Indigenous and non-Indigenous peoples alike.

Food Plants

Before the arrival of Europeans to what is now Canada, Indigenous peoples practised the cultivation of food crops in a variety of fertile areas. In terms of scale, this cultivation was at its most elaborate in Southern [Ontario](#) and the [St. Lawrence Lowland](#). Crops included the “Three Sisters” — corn, beans and squash — as well as [sunflowers](#), [tobacco](#) and possibly sunchokes (the tuber of a species of sunflower). The Three Sisters were often planted together, in what is known as companion planting, where each plant supported the growth and nutrition of the others.

Over 500 species of wild plants provided food for Indigenous peoples in Canada. Some of these foods are similar to those eaten today: root and green vegetables, fruits, [nuts](#), [berries](#), seeds and [mushrooms](#). Traditional foods like [maple](#)

syrup, wild rice and wild fruit are now enjoyed in Canada by Indigenous and non-Indigenous peoples alike.

Other wild foods — some types of lichens, marine algae, and the inner bark tissues of some trees — are not normally part of the modern diet. Indigenous peoples also used plants as sweeteners, flavourings and beverages; many wild plants provided more than one type of food.

Medicinal Plants

Plants were, and still are, an important component of Indigenous medicine. Herbal specialists were usually responsible for curing disease and maintaining health. Although administering herbal medicines was sometimes associated with ritual and in many cultures herbal curing and magical curing were virtually inseparable, these specialists were not necessarily shamans who invoked supernatural powers in healing. Sometimes, special curative and spiritual organizations existed, like the Ojibwa Midewiwin (Grand Medicine Society) in which initiates passed through stages, eventually learning the ritual and herbalism for curing disease.

More than 500 plants were used in Indigenous medicine. Specialists could administer such medicines as herbal teas, preparations to be chewed and swallowed, poultices, inhaled vapours, or a variety of other applications. Specialists could prescribe any part of a plant, either alone or in combination with other herbs.

Indigenous practitioners were skilled in the selection, preparation and dosage of herbal medicines, and traditional treatments were effective in treating a host of ailments, including wounds, skin sores, gastrointestinal disorders, coughs, colds, fevers and rheumatism. A famous example is the curing of Jacques Cartier's men of scurvy in the winter

of 1535–36. The [St. Lawrence Iroquoians](#) of [Stadacona](#) treated them with a conifer tea high in vitamin C content (probably Eastern white pine).

Utility Plants

Wood was an important fuel, and as a major component of utilitarian items: buildings, [dugout canoes](#), boxes, [totem poles](#) and implements like paddles, digging sticks, spear shafts, bows, arrows, and snowshoe frames. Indigenous peoples turned sheets of bark, especially birch, into containers and canoes. They also used bark to cover roofs and line storage pits.

Fibrous tissues from stems, roots, bark and leaves served for twine, rope and weaving materials for baskets, mats and clothing. Indigenous peoples used tree resin as glue and for waterproofing. Plants provided dyes and pigments, scents, absorbent materials, abrasives, linings and wrappings, insect repellents, toys, recreational items, and personal adornment.

Spiritual Importance

By representing a spiritual connection with the earth, many plants provide more than just corporeal or utilitarian benefits. For example, the [Haudenosaunee](#) hold several ceremonies — like the Sap, Seed, Strawberry, Bean, and Green Corn ceremonies — that honour the interconnectivity of plant and human life.

[Tobacco](#) is of major importance to many peoples, figuring prominently in ceremonies, everyday life, and creation stories. Indigenous peoples use tobacco, sage, [sweetgrass](#) and [cedar](#) for various spiritual purposes in smudging ceremonies, where smoke is fanned over the face and head”.

Teaching and Learning Examples for Instructors

Title: Investigating Indigenous Names and Uses of Plants Assignment

Objective:

This assignment aims to encourage learners to research and learn about the indigenous names and uses of plants, and to appreciate the cultural significance of plants in different indigenous communities.

Reflect



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Please use the following questions to guide your reflection:

1. Which native plants are endemic to your region and what relationship do they have with the endemic local pollinators?
2. What are the optimal growing conditions for the native plants endemic to your region today, in 10 years and in 50 years?
3. What role do you have as a horticulturist to support Indigenous plant populations through your plant selection decisions?
4. Draw a picture of how you see your plant selection choices shaping the environment and influencing the wider ecosystem.

Invasive Species

Keywords: invasive, environment, economy, community, competition, deteriorate, ecosystems.

In recent decades, provincial governments have been working to increase industry and public awareness about the negative impacts invasive species have on the environment, economy and communities across Canada. “Invasive plants are harmful non-native trees, shrubs, and herbaceous plants that are spread by global trade, human and animal transport, and gardening. They invade forests and prevent native plants from growing, which can have negative impacts on how ecosystems function, on native vegetation, and on native wildlife. Many invasive plants cannot be used by wildlife for food which puts grazing pressure on the few native plants that remain. Invasive plants also pose threats

to agriculture due to their ability to spread quickly, out-compete crop and forest plants, and deteriorate soil quality. Once they have taken hold, the thick spread of invasive plants makes them costly and time-consuming to remove” (Invasive Species Centre, n.d.).

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Invasive species degrade natural ecosystems, impact agriculture practices, interfere with forest productivity, and have social and aesthetic impacts and economic impacts. [The Canadian Council on Invasive Species \(2023\)](#) state the following:

Degradation of Natural Ecosystems

“Natural areas such as forests, prairies, wetlands and lakes provide many ecosystem services and benefits. Natural areas provide shelter and food for wildlife, remove pollutants from air and water, produce oxygen and provide valuable recreational and educational opportunities. Invasive species threaten and can alter our natural environment and habitats and disrupt essential ecosystem functions. Invasive plants specifically displace native vegetation through competition for water, nutrients, and space. Invasive species threaten many rare and endangered species and now those species are at risk of extinction. Once established, invasive species become costly and difficult to eradicate. Often, the impacts are irreversible to the local ecosystem. Once established, invasive species can:

- reduce soil productivity
- impact water quality and quantity
- degrade range resources and wildlife habitat

- threaten biodiversity
- alter natural fire regimes
- introduce diseases

Impact on Agriculture

Invasive plants can have a wide range of impacts on the agricultural industry. Invasive plants can act as new or additional hosts for new or existing crop diseases and crop pests, they can cause reductions in crop yields and may require increased use of pesticides to control them. This increases costs for farmers and reduces crop values. Estimated crop losses in BC agriculture industry of over \$50 million annually. Species such as knapweed infest rangelands and reduce forage quality. Many other species out-compete desired species in cultivated fields (Source: BC Ministry of Agriculture, Food and Fisheries. 1998. Integrated weed management—an introductory manual). The estimated annual economic impact of invasive plants on Canadian agriculture is \$2.2 billion (Environment Canada, 2010).

Interference with Forest Productivity

Invasive species, specifically invasive plants, can interfere with forest regeneration and productivity through direct competition with tree seedlings, resulting in reduced density and slowed growth rate of tree saplings. Reduction in forest regeneration and productivity results in the loss of wildlife habitat, and decreases the diversity of a stand, making it more vulnerable to insects and disease.

Social and Aesthetic Impacts

When established in crops or natural areas, invasive plants and/or species can result in:

- lost income

- reduced water quality and quantity (increased erosion and sedimentation)
- reduced property values
- damage to private property and infrastructure
- loss of traditional food and medicinal plants
- reduced land and water recreational opportunities
- increased control and management costs
- export and import trade restrictions imposed

Some invasive plants, like giant hogweed (*Heracleum mantegazzianum*) and wild parsnip (*Pastinaca sativa*), cause human health concerns because their sap is toxic to skin. Other plants can cause physical injuries to the body; common buckthorn (*Rhamnus cathartica*) branches end in a short, sharp thorn which may inflict injury. Human safety may also be impacted by fast-growing invasive plants. For example, *Phragmites australis* (hereafter referred to as Introduced *Phragmites*) grows large and rapidly and may reduce visibility at rights of ways, increasing the risk of car accidents. Dead, dry stalks of Introduced *Phragmites* are also highly combustible and can become a fire hazard.

Natural areas in municipalities support a wealth of recreational activities including hunting, fishing, swimming, hiking, bird watching, and mountain biking. Invasive plants that invade recreational areas often reduce the area's attractive and enjoyable qualities. For example, invasive plants may reduce native plant biodiversity, affecting the number of songbirds in the area; walking through dense vegetation can prove difficult; and popular swimming areas may become unusable with the presence of invasive aquatic plants. Seeds and other plant parts can hitch rides on hiking boots, clothing, pets, birds and vehicles, resulting in new infestations, potentially over great distances.

Economic Impacts

Invasive plants can have a large economic impact on individual landowners and municipalities. A recent study shows that property values for shoreline residences in Vermont affected with Eurasian water-milfoil (*Myriophyllum spicatum*) were down as much as 16.4 % (OMNRF, 2012). Due to the explosion of leafy spurge (*Euphorbia esula*), Manitoba has experienced a \$30 million reduction in land values (CFIA, 2008). Leafy spurge infests 340,000 acres of land in Manitoba, costing taxpayers an estimated \$19 million per year to protect grazing land, public land, and rights-of-way (CFIA, 2008). In Ontario, the MNRF has been involved with invasive *Phragmites* control pilot projects since 2007 and to date control costs range between \$865 and \$1,112 per hectare (OMNRF, 2012). Invasive species have an impact on approximately 20% of Species at Risk in Ontario (OMNRF, 2012).

Invasive plants directly affect municipalities with reforestation projects and recreational trails. They increase management costs (e.g. project planning and monitoring) and they increase operational costs (e.g. mowing, pruning and hand pulling). They also complicate reforestation projects as they need to first be removed, and then the gaps created through removal must be addressed by using large, potted plant stock, or additional site maintenance to prevent the risk of re-invasion.

The economic impact of invasive species in Canada is significant. According to Environment and Climate Change Canada:

- The estimated annual cumulative lost revenue caused by just 16 invasive species is between \$13 to \$35 billion.
- Invasive species that damage the agricultural and forestry industries result in an estimated \$7.5 billion of lost revenue annually”.

Invasive Species Management for Horticulturalists

Landscape horticulturalists play a crucial role in restoring and maintaining ecological sustainability by removing and preventing the spread of invasive species. By taking these proactive measures, Horticulturalists can help preserve the ecological balance and ensure the long-term health of our natural environments.

1. Education: one of the most effective strategies that we can use is to educate ourselves and our clients about the dangers of invasive species and the importance of choosing native plant species or non-invasive species.
2. Monitor: we can also regularly monitor landscapes for signs of invasive species and quickly respond to any outbreaks by removing or controlling them before they can spread.
3. Sanitation: we can implement proper sanitation practices to prevent the accidental spread of invasive species through equipment or plant material.
4. Advocacy: we can work with local governments and organizations to advocate for policies that restrict the import and sale of invasive plant species and promote the use of native or non-invasive plants instead.

Teaching and Learning Examples for Instructors

Assignment: **Invasive Species Management Plan for Local Pest, Disease, or Weed.** This assignment was created

by Chatgpt and can be adapted to your region and class learning outcomes.

Here is an example of a clean equipment protocol to reduce the spread of invasive species from the [Ontario Invasive Plant Council \(2023\)](#) to use as an example when building a clean equipment protocol with students in your class.

Clean Equipment Protocol for Industry – Summary

Invasive species are plants, animals and microorganisms that have been accidentally or deliberately introduced into areas beyond their normal range, that out compete native species. Invasive species are a major threat to Ontario's natural areas, and are very costly to deal with once established.

Invasive species can be spread to new areas by contaminated mud, gravel, soil and plant materials on vehicles and machinery.

The best practice is to prevent the spread of Invasive species. By inspecting and cleaning equipment and following some simple guidelines, the risk of spreading Invasive plants is greatly reduced.

- Identify invasive plants and plan activities accordingly (i.e. schedule work in areas without invasive plants first, leaving infested areas till the end, to reduce the risk of unintentionally moving plants into a new area).
- Record & report sightings of invasive plants (Invasive Species hotline at 1-800-563-7711 or online www.invasivespecies.com/report/ or www.eddmaps.org/Ontario)
- Inspect vehicles and machinery before and after entering sites or conducting work along roadways & waterways.

How to Inspect

Before leaving the site, inspect the vehicle thoroughly inside and out for where dirt, plant material and seeds may be lodged or stuck to interior and exterior surfaces. Remove and clean any guards, covers or plates that are easy to remove.

Pay attention to the underside of the vehicle, radiators, spare tires, foot wells and bumper bars. If clods of dirt, seed or other plant material are found, remove immediately and discard where the contamination occurred or in the garbage.

When Cleaning is required

- Safely locate the vehicle and equipment away from any hazards, ensure engine is off and the vehicle or equipment is immobilized.
- Clean the vehicle/equipment in an appropriate area where contamination and seed spread is not possible (or limited).

The site should be:

- Mud free, gravel covered hard surface, or, if this is not available, a well maintained grassy area.
- Gently sloping to assist in draining water and material away from the vehicle or equipment. Care should be taken to ensure that localized erosion will not be created.
- At least 30m away from any watercourse, water body and natural vegetation.
- Large enough to allow for adequate movement of larger vehicles and equipment.

Continued

Equipment Required

- ☐ A pump and high pressure hose OR High pressure water unit
- ☐ Air compressor and blower OR Vacuum
- ☐ Shovel
- ☐ Pry bar
- ☐ Stiff brush or broom

Final Inspection Checklist

- ☐ No clods of dirt should be visible after cleaning.
- ☐ Radiators, grills and the interiors of vehicles should be free of accumulations of seed, soil, mud and plant material parts including seeds, roots, flowers, fruit and or stems.

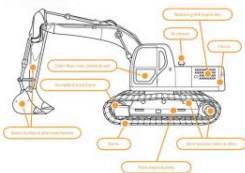
2WD and 4WD Vehicles

4WD VEHICLE WITH KEY SPOTS TO CHECK AND CLEAN



Excavator

EXCAVATOR WITH KEY SPOTS TO CHECK AND CLEAN



Backhoe

BACKHOE WITH KEY SPOTS TO CHECK AND CLEAN



Bulldozer

BULLDOZER WITH KEY SPOTS TO CHECK AND CLEAN



Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. What are the major invasive species in your region and what is their impact on the regional ecosystem?
2. How can you identify the major invasive species in your region and what environment do they grow in?
3. How can landscape horticulturalists stop the spread of invasive species in your region through their work?

4. What resources are available in your region to raise awareness of invasive species to industry or the public?

Regenerative Landscape: Plants with Benefits

Regenerative (to renew/restore/respect)

Keywords: food security, community, Indigenous (native) plants, invasive species,

Regenerative Landscape Base Plan

Let's take another look at the base plan for the regenerative landscape for reference with the topic of plants with benefits. During this phase of construction, the forested border has been left untouched, to provide wildlife habitat and encourage native plants. We chose to install large raised vegetable beds for the family to produce food on-site. This not only enhances food security for the family but also for the surrounding community (due to prolific zucchini and tomato production) by reducing carbon emissions from the transportation of food over long distances. Furthermore, the local community can gather and share in the locally produced food, which promotes social relationships and strengthens the community ecosystem.

Another feature to showcase at this stage of production is the informal and natural forested border between the back garden and the city park neighbouring the residential lot. When the homeowners first moved in, the border area and slope into the park were covered with invasive species. The homeowners were shocked to find some of the worst invasive species including

Fallopia japonica (Japanese Knotweed), *Daphne laureola* (Daphne), *Rubus armeniacus* (Himalayan blackberry), *Ipomoea purpurea* (morning glory), *Lamium maculatum* (spotted dead nettle) and *Hedera helix* (English ivy).



Design credit: CC BY ([North Arrow Landscapes, 2023](#))

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. Which plants are you most attracted to in your favourite garden?
2. What sort of benefits do these plants give you and the surrounding environment?

Additional Resources

Listed general and then West to East.

Resource Name	Resource Description	Resource Link
Canadian Council of Invasive Species	The Canadian Council on Invasive Species (CCIS) serves as a national voice and hub to protect Canada from the impacts of invasive species. The website contains free educational resources for the identification and management of invasive plants.	https://canadainvasives.ca/invasive-species/
Invasive Species Centre (Canada)		https://www.invasivespeciescentre.ca/
Invasive species reporting (BC)	“Invasive species are plants and animals not naturally found in B.C. that can potentially harm the province’s natural environment or adversely affect people’s health. Report invasive species before they cause harm through the invasive plant database or through the mobile apps”.	https://www2.gov.bc.ca/gov/content/environment/plants-animals-ecosystems/invasive-species/reporting-invasive-species

Invasive Species Council of BC	<p>“Watch out for the following invasive species which have been found in BC but are not yet established in our province. Familiarize yourself with these invasive species, be on the lookout and report any suspected sightings”.</p> <p>Free resources and courses on invasive species identification and management in BC.</p>	<p>https://bcinvasives.ca/take-action/identify/</p> <p>https://bcinvasives.xactlms.com/courses</p>
Invasive Plants (Alberta)	<p>“Introduced plants that grow on land and in water that have no natural means of control and will spread quickly and reduce biodiversity”.</p>	<p>https://abinvasives.ca/invasive-plants/</p>
Invasive Species Council (Manitoba)	<p>Resource for invasive plants and animals in Manitoba. “Prevention, early detection and rapid response are critical for saving habitats from invasive species”.</p>	<p>http://invasivespeciesmanitoba.com/site/index.php?page=about-invasive-species</p>

Invading
species
reporting
(Ontario)

“The Invading
Species Hotline
serves as a
valuable resource
for the public,
especially during
times of increased
public concern.
Members of the
public are able to
call and speak
with an invasive
species expert to
report a sighting
or to inquire
about invasive
species
information”.

[http://www.invadingspecies.com/
programs/invading-species-reporting/](http://www.invadingspecies.com/programs/invading-species-reporting/)

Chapter 4: Flow

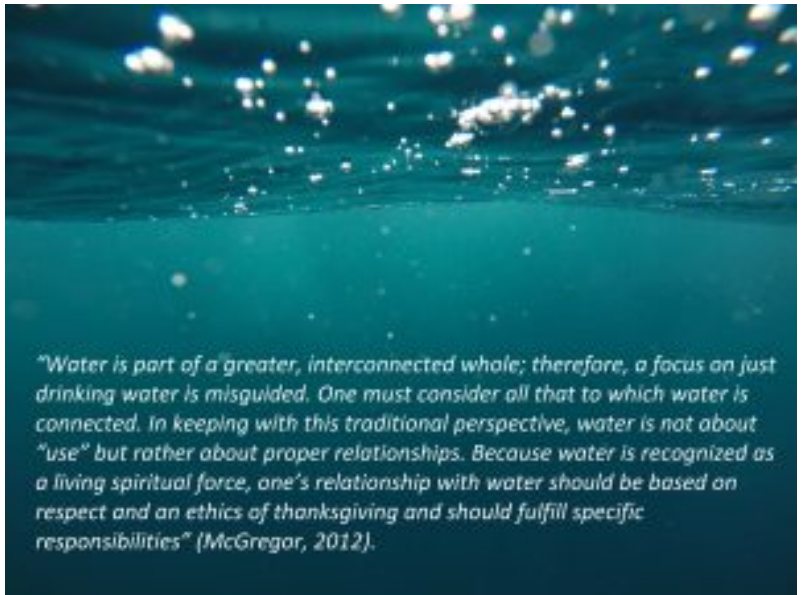


Photo by Jeremy Bishop on [Unsplash](#). The quote is from [Water Teachings](#), based on an article written by Dr. Deborah McGregor.

Introduction

In this chapter, we aim to explore the interconnectedness of life, land and water. This module provides an opportunity to reflect on your relationship with water, the impacts of horticultural activities on water, and the responsibility to care. By adopting sustainable landscape practices and working towards decolonizing water, we can contribute to a more equitable and sustainable future.

Learning Outcomes

By the end of this chapter, you will be able to:

- Identify the water sources in your watershed and reflect on your relationship with water. Understanding the flow of water and how to care for water is crucial to developing responsible landscape practices.
- Evaluate current construction practices and practice skills to create landscapes that mimic nature, such as rain gardens and permeable paving (also known as green infrastructure). Green infrastructure is becoming increasingly important in mitigating the impact of urbanization and climate change on water resources.
- Influence the landscape horticulturalist students and industry to adopt low-impact landscape construction practices considering the broader impact on water. By taking a holistic approach to landscape construction, to work towards mitigating the effects of climate change and protecting water resources.

Decolonizing Water

Although Indigenous perspectives regarding water are diverse, certain traditional understandings and approaches towards water are shared across Nations. For example, water is considered life and interconnected ([Guessous & Antone, n.d.](#)). The Indigenous Peoples' Kyoto Water Declaration (2003), the Tlatokan Alahuak Declaration (2006), and the United Nations Declarations on the Rights of Indigenous Peoples (UNDRIP) (2007) highlight the

comprehensive aspects of water as the foundation of physical, cultural, and spiritual existence. They also describe the potential of traditional knowledge in addressing worldwide water challenges (Guessous & Antone, n.d.).

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Video credit: Water is Knowledge (Water Teachings).

The following links offer lessons about the role of traditional knowledge and practice in protecting water

- [Water is Knowledge — Water Teachings](#)
- [Decolonizing Water: A Conversation with Aimée Craft – Centre for International Governance Innovation \(cigionline.org\)](#)
- [Indigenous Leadership Initiative](#)
- [Indigenous Watersheds Initiative](#)

“As Indigenous peoples, First Nations recognize the sacredness of our water, the interconnectedness of all life and the importance of protecting our water from pollution, drought and waste” (Assembly of First Nations: Honouring Water).

Water Regeneration

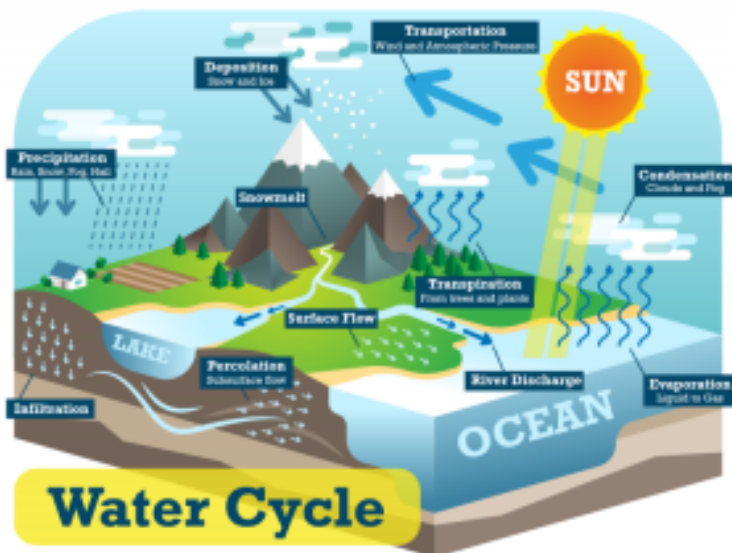
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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=36#video-36-1>

The Water Cycle. “Water is essential to all being – humans, animals, plants, insects, fish. Water is constantly and naturally recycled through what we call the water cycle. There is never any new water on Earth. It’s all ways the same old water, recycled and cleaned all over again” (Canadian Space Agency, NASA).

Connecting Water Cycles and Watersheds

The water cycle refers to the continuous process by which water moves from the earth’s surface to the atmosphere and back again – there is never any new water; instead, water is recycled. Water moves through different parts of the environment in a cycle, constantly changing from one form to another (evaporation, transpiration, precipitation, and surface flow or runoff).



The Water Cycle (Let's Talk Science).

The water cycle and watersheds are closely related because the water cycle drives the water movement through a watershed. A watershed is an area of land that drains into a particular river or body of water. When water falls as precipitation, it can soak into the ground, evaporate into the atmosphere, or flow over the land and into streams and rivers. As the water moves through the watershed, it can pick up pollutants and nutrients from the land and carry them downstream.

Common pollutants in rain runoff include:

1. **Sediment and soil erosion:** runoff from construction sites or areas with exposed soil can carry significant amounts of sediment and soil particles, which can harm

aquatic ecosystems by blocking sunlight and reducing water clarity.

2. Nutrients: fertilizers, manure, and other organic material can enter runoff and cause an overgrowth of algae and other aquatic plants, leading to low oxygen levels and harm to fish and other aquatic life.

3. Bacteria and pathogens: animal waste, human waste, and other sources of bacteria and pathogens can contaminate runoff and cause illness in humans and animals.

4. Chemicals: pesticides, herbicides, and other chemicals used in agriculture and urban areas can contaminate runoff and harm aquatic life, as well as pose a risk to human health.

5. Heavy metals: pollutants such as lead, copper, and zinc can enter runoff from industrial areas or areas with old infrastructure and can harm aquatic life and pose a risk to human health if consumed (Deng, 2021).

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Healthy watersheds are essential for maintaining the balance of the water cycle. When watersheds are intact, the land naturally cools and cleans the water that flows through them, helping to

protect and enrich downstream water resources. However, when the natural land in watersheds is colonized and damaged by activities such as deforestation, urbanization, or pollution, they can become less effective at regulating water movement and filtering out pollutants. The water cycle and watersheds are intimately connected, with the water cycle driving the movement of water through watersheds and watersheds playing a crucial role in maintaining the health of the water cycle.

Healthy watersheds are crucial for climate change mitigation and adaptation, as they are interconnected with aquatic ecosystems and can store carbon through natural vegetation and intact soil. By maintaining healthy watersheds, we can create resilient ecosystems that mitigate the impacts of climate change ([EPA, 2021](#)).

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. Think about your relationship with water daily. Journal about your relationship with water.
2. Visit a river, lake, or shoreline in your community. Find the Indigenous place name. Reflect on the current name for that place and its previous Indigenous name. How did the location acquire these names? What are the differences between the two names? Is there any connection between them?

Green Infrastructure for Healthy Watersheds

Green infrastructure involves strategically designing and managing landscapes using nature-based solutions to address various challenges, particularly those related to water management and climate resilience. Landscape horticulturists are crucial in implementing and sustaining green infrastructure because they have expertise in plant selection, landscape installation, and maintenance. In addition, they understand the importance of integrating vegetation, such as trees, shrubs, and green spaces, into the built environment to create functional and sustainable landscapes.

One significant aspect of green infrastructure is its ability to maintain healthy watersheds. Using vegetation and natural features, such as rain gardens, bioswales, and green roofs, permeable paving, helps manage rainwater or stormwater runoff. These features capture, absorb, and filter rainwater, allowing it to gradually infiltrate into the ground, replenish groundwater sources, and reduce the burden on stormwater systems. This process helps prevent water pollution by removing contaminants and sediment before they enter rivers, lakes, and other bodies of water.

Furthermore, green infrastructure contributes to the development of resilient ecosystems. Mimicking natural processes, such as the water cycle and nutrient cycling, enhances biodiversity, promotes habitat creation for wildlife, and supports ecological connectivity. By incorporating diverse plant species and creating green corridors, green infrastructure provides food and shelter for birds, insects, and other animals, allowing them to thrive in urbanized areas.

Regarding climate resilience, green infrastructure mitigates the adverse effects of climate change. For example, vegetation and

green spaces help regulate temperature, reduce heat island effects, and improve air quality. Trees, in particular, offer shade, cool the surrounding areas, and sequester carbon dioxide, mitigating the urban heat island effect and contributing to carbon reduction efforts. Additionally, green infrastructure helps manage extreme weather events, such as heavy rainfall and flooding, by absorbing and storing excess water, minimizing the risk of infrastructure damage and flooding in urban areas.

Overall, green infrastructure works with natural processes to provide a range of benefits. It improves water management, promotes ecological health, contributes to climate resilience, and enhances the quality of life in communities. Through the expertise and efforts of landscape horticulturists, the integration and maintenance of green infrastructure can create sustainable and thriving environments.

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=36#oembed-3>

Rain gardens are sunken gardens that are designed to receive rainwater, and function to clean, cool, and slowly release rainwater to seep down into the ground.

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=36#oembed-4>

As climate change alters the pattern of rain, communities like

Vancouver are building green infrastructure to manage better and appreciate rainfall.

Introduction to Permeable Pavement

Permeable pavement, also known as pervious or porous paving, is a type of green infrastructure. Permeable pavement functions as a hard surface, but allows rainfall to percolate to an underlying reservoir base where rainfall is either infiltrated to underlying soils or removed by a subsurface drain ([Capital Regional District, n.d.](#)). The following videos describe how permeable paving works, as well as the benefits and constraints.

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscapetrade/?p=36#oembed-5>

Teaching and Learning Examples for Instructors

Download the lesson plan for [FLOW case study](#)

Resources

- [LID reading for Case Study](#)
- [TBLconcise guide](#)
- [FLIP_handout_FNL_Web](#)
- [Gallery_walk](#)

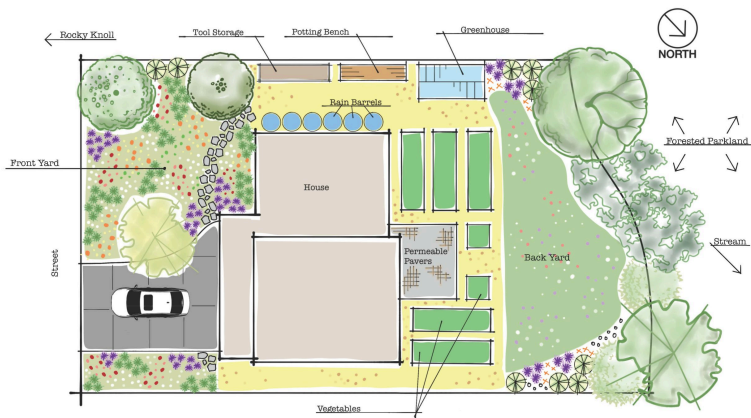
Regenerative Landscape: Water Regeneration

Regenerative (to renew/restore/respect)

Keywords: alternative hardscape materials, permeable paving, pervious paving, porous paving, green infrastructure

Regenerative Landscape Design

Let's review the regenerative landscape base plan again. This landscape design envisioned through a regenerative lens, embraces the vital concept of water infiltration by eliminating any hard surfaces that don't allow water to infiltrate into the soil and regenerate the natural water systems. *Note the driveway was existing when the residents purchased the property. Every aspect of this design fosters the natural process of water percolating into the soil, thus rejuvenating the hydrological cycle at a larger scale. The absence of impermeable surfaces such as concrete or asphalt ensures that rainwater can freely infiltrate the ground, replenishing groundwater reserves and nourishing the ecosystem. The landscape showcases a harmonious integration of diverse elements, including permeable pavers, alternative lawns, meadows, and mixed woody shrub hedges, all strategically placed to capture and retain water. This conscious approach not only nurtures the local flora and fauna but also mitigates the negative impacts of stormwater runoff, reducing the strain on urban infrastructure and promoting a balanced and sustainable water cycle. By facilitating water infiltration, this landscape design connects directly to the wider hydrological cycle, contributing to the replenishment of aquifers, the maintenance of stream flows, and the overall health of our precious water resources.



Design credit: CC BY ([North Arrow Landscapes, 2023](#))

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. How can you demonstrate care and respect for water?
2. Before working on the land, what will you acknowledge, examine and plan for? As a horticulturalist, how can you nurture your relationship with water?
3. Reflect on a landscape of significance to you. Describe the water journey and responsibilities of water. How can you, as a horticulturalist work with

this natural process to enhance the ecosystem's health? How can landscape make a measurable difference in improving water quality and mitigating climate change?

Additional Resources

Resource Name	Resource Description	Resource Link
Water is Knowledge	The role of Traditional Knowledge (TK) in protecting water	https://www.waterteachings.com/water-is-knowledge
Dirt: The Erosion of Civilizations	The importance of protecting soil, highlighting the soil erosion triangle that relates soil and water quality (water depth, water velocity and water volume).	https://www.ecologyartisans.com/blog/soil-erosion-meadowview-case-study
Rain Gardens 101	The video that explains how to install and maintain a raingarden [17 min].	https://youtu.be/ZHeY6CUAS8s

Permeable Pavements	The factsheet provides and overview of design and installation guidelines for pervious pavements.	https://files.cvc.ca/cvc/uploads/2012/02/lid-swm-guide-apdxa-permeable-pavement.pdf
Permeable Pavements Factsheet	Permeable pavement maintenance guide.	https://sustainabletechnologies.ca/app/uploads/2018/02/Permeable-Pavement-Fact-Sheet.pdf

Chapter 5: Restore and Regenerate

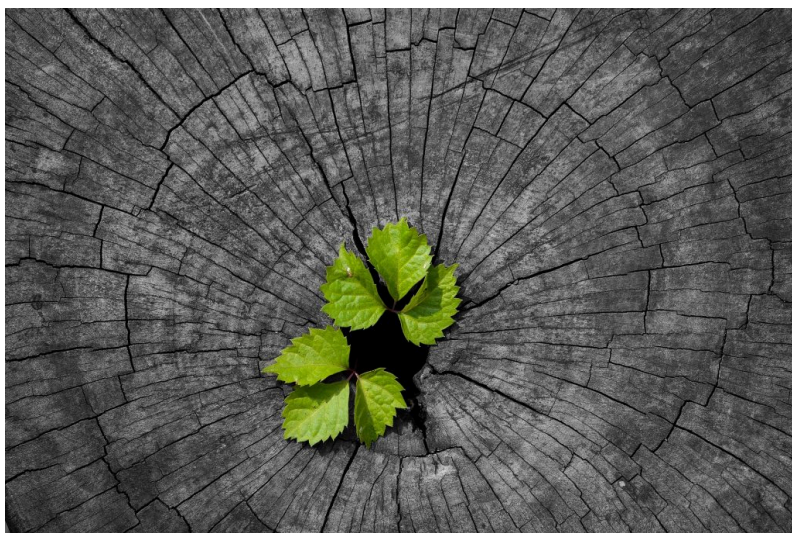


Photo by [Zhugher](#) on [Pixabay](#).

Learning Outcomes

By the end of this chapter, you will be able to ...

- Apply natural systems theory to select and describe

sustainable landscape construction and maintenance practices contributing to ecosystem health.

- Identify and select technology relevant to the landscape industry to reduce waste, increase efficiency, and increase environmental and personal health.

Let's Review

Let's start with a review of [Chapter 4: Flow](#). In the last chapter, we investigated how to identify water sources in the watershed and develop a personal connection with water, understanding its flow and the importance of responsible landscape practices. We also aimed to evaluate current construction practices and acquire skills to create landscape designs that mimic nature, incorporating features like rain gardens and permeable paving (green infrastructure) to mitigate the impact of urbanization and climate change on water resources. And finally, we aimed to discover the influence of landscape horticulturalist students and industry professionals to adopt low-impact landscape construction practices, considering the broader impact on water. Encourage a holistic approach to landscape construction to mitigate climate change effects and protect water resources. Now, let's take a look at the final chapter of this faculty training module, Restore and Regenerate, to explore how natural system processes and guide our decision-making when selecting sustainable horticulture skills and practices.

Introduction

Keywords: paradigm shift, restorative, regenerative

As we seek to apply sustainable landscape practices, it's crucial

that landscape horticulturalists are aware of the impact of their practices on the greater ecosystem. By incorporating renewable and regenerative practices into the construction and maintenance phases of a project, we can have a positive impact on the environment while minimizing disruption to ecological systems.

The final chapter in the regenerative landscape module, *Renew and Regenerate*, is designed to equip learners with the knowledge and skills to apply natural systems theory to select and describe sustainable landscape construction and maintenance practices contributing to ecosystem health. The last section of this chapter will provide examples of how landscape horticulturalists can use technology to reduce waste, promote efficiency, and increase environmental and personal health. The learning outcomes of this chapter aim to empower learners to become respectful stewards of the environment and highlight the importance of preparing horticulture students for diverse and changing roles in the industry by incorporating technology in teaching and learning curriculum design.

There are several restorative and regenerative landscape maintenance practices that can be implemented to reduce environmental impact and increase sustainability. Some of these practices include topics that we have covered in this module already such as:

1. **Use of native plants:** native plants are adapted to the local environment and require less maintenance than non-native species. They also support local wildlife and biodiversity.
2. **Rainwater harvesting:** collecting rainwater in a barrel or cistern can be used to water plants instead of

using municipal water sources, which can help conserve water resources.

3. Low-maintenance design: designing landscapes with low-maintenance features that starts with selecting the right place for the right place, drip irrigation systems, and thoughtful plant placement to reduce the need for ongoing maintenance, passive energy consumption and help conserve resources.

Now, let's take a look at some natural system theories to guide our selection of sustainable landscape maintenance skills and practices.

The Nitrogen Cycle

The nitrogen cycle is a natural process that describes how nitrogen moves through the environment. Nitrogen is a key element necessary for life, as it is a component of amino acids and nucleic acids, which are the building blocks of proteins and DNA. The nitrogen cycle begins when nitrogen gas in the atmosphere is converted into a form that can be used by living organisms. This process, called nitrogen fixation, can happen through various means, including lightning strikes, certain types of bacteria, and human activities like the production of fertilizer. Once nitrogen is fixed, it can be taken up by plants and used to build proteins. When animals eat these plants, the nitrogen is incorporated into their own tissues. When these organisms die, the nitrogen is released back into the environment through the process of decomposition. At this point, the nitrogen can either be converted back into nitrogen gas through a process called denitrification, or it can be taken up by other living organisms and continue

cycling through the ecosystem. Overall, the nitrogen cycle plays a crucial role in the functioning of ecosystems and is essential for the growth and survival of living organisms.

“What are nitrogen fixing plants, and why use them over nitrogen fertilizer? This video answers this question through an explanation of the nitrogen cycle”. (Sol, 2021)

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-1>

Video credit: Understanding Our Soil: The Nitrogen Cycle, Fixers, and Fertilizer, CC BY (Sol, 2021)

The Nitrogen Cycle: Sustainable Landscape Maintenance Practices

So, how can we incorporate the principles of the nitrogen cycle into the maintenance practices we use for restorative and regenerative landscaping?

1. **Reduce or eliminate fertilizer use:** overuse of nitrogen-rich fertilizers can lead to excess nitrogen in the soil and runoff, which can contribute to water pollution. By using fertilizers in moderation and choosing slow-release or organic fertilizers, landscape

horticulturalists can reduce the amount of excess nitrogen in the environment. Or better yet, landscape horticulturalists can look to build healthy soils to eliminate the need for synthetic fertilizer additives.

2. **Use nitrogen-fixing plants:** some plants, such as legumes, have the ability to fix nitrogen from the atmosphere through symbiotic relationships with bacteria. By incorporating nitrogen-fixing plants into landscapes, horticulturalists can reduce the need for fertilizers and improve soil health.

3. **Use compost:** composting organic matter can help to improve soil health and nutrient content, including nitrogen. By incorporating compost into landscapes, horticulturalists can reduce the need for fertilizers and promote healthy plant growth.

4. **Plant cover crops:** cover crops, such as clover or rye, can be planted during fallow periods to protect the soil and improve its nutrient content, including nitrogen. Cover crops can also reduce soil erosion and improve water retention. Equally important, ensure that all loose materials are covered with a tarp or plastic when not in use to avoid leaching or washing away materials into stormwater drainage systems.

5. **Properly manage irrigation:** overwatering can lead to waterlogging, which can reduce oxygen levels in the soil and limit the availability of nitrogen to plants.

Landscape horticulturalists can promote healthy nitrogen cycles,

soil, and plants, as well as contribute to sustainable landscape management by implementing these practices as part of a reciprocal relationship with the environment.

The Carbon Cycle

Keywords: carbon cycle, carbon sequestration, photosynthesis

As landscape professionals, we have a unique opportunity to promote green practices in our work and protect the environments we contribute to and disrupt. By implementing green practices in our work, we can reduce our environmental impact and create healthy, beautiful spaces for our communities to enjoy. One key aspect of regenerative landscaping is understanding the carbon cycle and its importance in the ecosystems that we work in. Carbon is a critical building block of life, and it cycles through the air, water, soil, and living organisms in a complex web of interactions. Unfortunately, human activities like fossil fuel burning and deforestation have disrupted this delicate balance, leading to increased levels of atmospheric carbon and contributing to climate change.

But, wait, haven't we already covered the carbon cycle In [Chapter 3: Plants with Benefits](#) where we looked at the role of a forest in the carbon cycle as trees sequester carbon through the natural process of **photosynthesis**? The answer is yes, proving the importance of why landscape horticulturalists should thoughtfully consider landscape sites as highly interconnected ecosystems and acknowledge that they have a choice of how and when they will interact and act within the ecological community.

Here is a short video to help review the process of photosynthesis and how plants use the glucose produced in photosynthesis to perform internal functions such as cellular respiration, producing glucose and amino acids, and producing

and storage of starch, oils and fats. Of course, a huge benefit of the photosynthesis process is the by-product of oxygen, which all living things need to survive.

“Photosynthesis. What is it? How does it work? Why do plants do it? What is all that glucose used for?”. (Cognito, 2018)

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-2>

Video credit: GCSE Biology – Photosynthesis #48, (Cognito, 2018)

So, we reviewed the process of photosynthesis where plants take in atmospheric carbon dioxide (CO_2) through their stomata combine it with water (H_2O) and use light energy to produce glucose (and the constituent carbon), which is then used to power their internal functions and produces oxygen that is returned to the atmosphere. Below is the formula for photosynthesis, note that the carbon molecule becomes part of the glucose molecule that powers plant functions in the leaves, stems, flowers and roots.



PHOTOSYNTHESIS

Photo by (Angela, 2021).

The Carbon Cycle: Soil

Overall, plants play a crucial role in the global carbon cycle by removing carbon dioxide from the atmosphere and storing it in their tissues and transferring carbon into the soil. This helps to mitigate the effects of climate change by reducing the amount of carbon dioxide in the atmosphere. Let's explore the topic of carbon storage in the soil.

We encourage you to start by listening to Alie Ward's Ologies Podcast <https://www.alieward.com/ologies> called Indigenous Pedology (SOIL SCIENCE) with Dr. Lydia Jennings.

"Soil! Dirt! Earth. Dr. Lydia Jennings, aka Native Soil Nerd, breaks down the stuff under our feet and explains everything from mining to why soil can be different colors. Also: medicine from microbes, giving back to the land after extractive processes, collecting samples in urban rivers, elders' ecological knowledge, planting hot Cheetos, potting soil mysteries, lung fungus, the smell of rain and why gardening makes you happy.

Oh and running hundreds of miles for your science” (Alie Ward, 2022).

Soil organic carbon (SOC) is the carbon that is stored in the soil in the form of organic matter. This organic matter is derived from the decomposition of plant and animal residues, as well as from the activity of soil microorganisms. SOC plays an important role in **soil fertility and health**, can promote healthy nitrogen cycles, soil, and plants, as well as contribute to sustainable landscape management by implementing these practices as part of a reciprocal relationship with the environment for plants and microorganisms. In addition, SOC can help to improve **soil structure, increase water-holding capacity, and reduce erosion**. SOC levels can vary depending on several factors, including climate, vegetation type, soil type, and land management practices. For example, SOC levels are generally higher in soils that are covered with vegetation and have low disturbance from tillage or other practices. SOC is also an important component of the global carbon cycle, as it represents a large **carbon sink** that can help to mitigate the effects of climate change. By increasing SOC levels, landscape horticulturalists can help to sequester carbon from the atmosphere and store it in the soil, thereby reducing greenhouse gas concentrations in the atmosphere.

As landscape horticulturalists, we can look to adjacent industries, such as agriculture, for examples of how, if improperly managed, soil health is degraded over time by the land management practices chosen.

“Soils are essential for food systems. It is estimated

that 95 percent of our food is directly or indirectly produced in soils. Healthy soils allow us to grow a variety of food products needed for human nutrition and each of us depends on soil productivity. Intensive land use, unsustainable soil management practices and deforestation leads to soil sealing, pollution, increases fire frequency. All these can damage soil biodiversity and its functions. We need to focus on preserving our soils before it reaches this stage. Sustainable soil management, tailored to the type of soil and its use, is an important part of food security and our lives generally. We can all play a role and our mission is to #keepsoilalive”. (Food and Agriculture Organization of the United Nations, 2021).

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-3>

Video credit: Mission: Keep soil alive! (Food and Agriculture Organization of the United Nations, 2021)

Now, let's take a look at the positive impact that regenerative agriculture practices can have on the environment, in particular, the soil ecosystems in the next two videos.

“Narrated by Larry Kopald of Carbon Underground, The Soil Story reveals how soil can reverse climate change” ([Kiss the Ground, 2015](#)).

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-4>

Video credit: The Soil Story narrated by Larry Kopald ([Kiss the Ground, 2015](#))

“Regenerative agriculture is an effective way to restore biodiversity and stabilize the climate, but what exactly is it? This video explores three different regenerative practices that have great potential both in food production and in healing the land”. ([Sol, 2021](#))

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-5>

Video credit: What is Regenerative Agriculture? ([Sol, 2021](#))

In summary, regenerative agriculture aims to promote the health and resilience of the ecosystem by using practices that

work with nature, rather than against it. The goals of regenerative agriculture include **increasing soil fertility and biodiversity, reducing erosion and pollution, sequestering carbon, and improving the overall health of the land, animals, and people** involved in the production process.

The Carbon Cycle: Sustainable Landscape Maintenance Practices

Landscape horticulturalists can borrow and adapt practices used in regenerative agriculture to build a sustainable and mutually beneficial relationship between the land and its stewards – in part, that’s us! So, how can we incorporate the principles of the carbon cycle into the maintenance practices we use for restorative and regenerative landscaping to work with the natural cycles, and not against them?

Landscape horticulturalists have several alternative maintenance practices to choose from to improve soil organic carbon (SOC) and overall soil health. These practices aim to store carbon and promote the health of the soil and the organisms that live in it, ultimately supporting plant, animal and human health. Here are some examples:

1. **Reduced tillage:** tillage can disrupt soil structure and lead to the loss of organic matter. By reducing the frequency and intensity of tillage, landscape horticulturalists can help to preserve SOC and maintain soil health. In other words, choose landscape construction and maintenance practices that are the least disruptive to the soil.
2. **Mulching:** but, not necessarily bark mulch. Applying

an organic mulch such as compost or wood chips to the soil surface can help to increase SOC levels by providing a source of carbon and other nutrients for soil microorganisms. Mulch can also help to regulate soil temperature and moisture, reducing the need for irrigation and improving plant health.

3. Composting: composting organic wastes, such as leaves, grass clippings, and food scraps, can help to produce a nutrient-rich soil amendment that can be added to the soil to increase SOC levels and improve soil health. Or, better yet, leave the leaves! Instead of changing the aesthetic of a garden by “cleaning up” or removing leaves, flowers or debris in fall clean up, consider changing educating the clients to help change their perception of what a healthy garden is and does for the ecosystem.

4. Planting cover crops: cover crops, such as legumes, grasses, and clovers, can help to improve soil health by fixing nitrogen, reducing erosion, and adding organic matter to the soil. For example, if a landscape project is scheduled over a long period of time, consider planting a cover crop to avoid bare soils that are prone to erosion.

5. Integrated Pest Management (IPM): using IPM practices, such as physical, cultural and biological controls, can help to reduce and ideally eliminate the use of synthetic pesticides and fertilizers, which can have negative impacts on soil health and SOC levels.

6. Leave the leaves: changing the way we perceive

beauty in the landscape can have a significant impact on the carbon (re) entering the carbon cycle and regenerating soil carbon stores for microorganisms that break down the carbon into usable nutrients for plants to continue the cycle.

Overall, landscape horticulturalists can use a combination of these practices to improve soil health and SOC levels, which can lead to healthier plants, improved water quality, and healthier ecosystems. The nitrogen and carbon cycles and the process of photosynthesis are just a few examples from the harmonized landscape horticulture curriculum of how instructors can connect natural cycles and processes to sustainable landscape construction and maintenance practices. To finish off this section of the chapter, we encourage you to watch the video below. The video reviews the carbon cycle but, will help us transition into the next section of the chapter, alternative energy, which focuses on how technology can support landscape horticulturalists in making sustainable choices to reduce their environmental impact.

“Healthy lawns and landscapes help fight climate change by sequestering carbon, creating oxygen, and saving energy by keeping you cooler in the summer and warmer in the winter. Landscape and lawn care professionals play an important role in caring for the backyards, parks, ballfields, and public green spaces that help the environment. Your yard and your landscaping can help fight climate

change!” (National Association of Landscape Professionals, 2021)

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-6>

Video credit: Healthy Lawns and Landscapes Fight Climate Change, (National Association of Landscape Professionals, 2021)

“What exactly is the carbon cycle? Nathaniel Manning provides a basic look into the cyclical relationship of carbon, humans and the environment.” Lesson by Nathaniel Manning, animation by Jill Johnston.

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<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-7>

Video credit: The carbon cycle – Nathaniel Manning, (TED-Ed, 2012)

Teaching and Learning Examples for Instructors

- **Assignment:** [Connecting Natural Processes to Landscape Maintenance Practices for Sustainability](#) Note – this assignment was created by [Chatgpt](#), learners can adapt this assignment for their region and learners as needed.

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. In what ways do you currently connect natural processes to the curriculum you teach?
2. Do you think that students would be receptive to connecting natural processes to the horticulture skills and practices they choose to apply in the industry?
3. How can you help guide students to communicate natural processes and their impact on the horticulture skills and practices applied to clients?

Alternative Energy

Keywords: carbon footprint, purchasing locally, electric, solar, compass orientation (passive construction)

Reducing carbon dioxide (CO₂) emissions is widely recognized as one of the most effective ways to adapt to and mitigate the challenges of climate change. Landscape horticulturalists have more choices than ever before when it comes to selecting materials and equipment that can help reduce their **carbon footprint**. Over the past few years, the horticulture industry has been undergoing a significant shift away from fossil-fuel-powered equipment and towards more sustainable alternatives. Purchasing landscape materials from **local businesses**, using **electric-powered** equipment is becoming increasingly popular, and **solar-powered** landscape lighting and onsite power sources are also gaining in popularity as horticulturalists seek to reduce their carbon footprint and contribute to a more sustainable future.

Overall, the use of electric and solar-powered equipment can play an important role in promoting sustainability by reducing carbon emissions and reducing our reliance on fossil fuels.

Selecting local materials for landscape horticulture can have several benefits.

1. Reduce transportation: purchasing local materials can reduce transportation costs and associated emissions, as materials that are sourced from far away require more fuel for transportation. By selecting local materials, horticulturalists can reduce their carbon footprint and contribute to a more sustainable future.
2. Climate-adapted plant material: local plant material is better adapted to the local climate and soil conditions, meaning plants are more likely to thrive and require less maintenance.
3. Support local economy: selecting local materials can support the local economy by keeping money and jobs in the community.

Overall, selecting local materials can have both environmental and economic benefits for landscape horticulture businesses and businesses that support horticulturalists doing their work.

The use of electric-powered equipment can contribute to greater sustainability in several ways:

1. Reduced carbon emissions: electric-powered equipment produces fewer carbon emissions compared to equipment powered by fossil fuels. This reduction in emissions helps to mitigate the impacts of climate

change, which is a major threat to the sustainability of our planet.

2. Noise reduction: electric-powered equipment is generally quieter than equipment powered by fossil fuels, which can reduce noise pollution in communities and improve the quality of life for residents.

3. Reduced reliance on fossil fuels: electric-powered equipment can help reduce our dependence on fossil fuels, which are finite resources and contribute to air pollution and other environmental problems.

4. Access to renewable energy sources: electric-powered equipment can be powered by renewable energy sources, such as solar and wind power, which can help to further reduce carbon emissions and promote a more sustainable energy system.

The use of solar-powered landscape lighting and onsite power sources can help reduce the carbon footprint of landscape horticulturalists in several ways:

1. Reduced reliance on fossil fuels: by using solar energy instead of traditional electricity from the grid, horticulturalists can reduce their reliance on fossil fuels and lower their carbon footprint.

2. Lower greenhouse gas emissions: generating electricity from fossil fuels produces greenhouse gas emissions, which contribute to climate change. In contrast, solar energy produces no direct greenhouse gas

emissions, helping to reduce the carbon footprint of landscape horticulturalists.

3. Energy-efficient lighting: solar-powered landscape lighting is typically more energy-efficient than traditional lighting, which can help reduce energy consumption and lower the carbon footprint of horticulturalists.

4. Reduced need for grid electricity: by generating their own electricity onsite, horticulturalists can reduce their need for electricity from the grid, which is often generated from fossil fuels. This helps to further reduce their carbon footprint.

Technology and Digital Tool Use in Landscape Horticulture

Keywords: Technology, digital tools, reduce waste, business viability and operations, job tracking and scheduling, financial and digital literacy



Photo by [StockSnap](#) on [Pixabay](#)

Technology is a broad term that refers to the application of scientific knowledge to solve practical problems. It can refer to any tool or technique that is developed to make a task more efficient or effective. Technology includes a wide range of physical and digital tools, as well as methods and processes for using those tools.

Digital tools, on the other hand, are a specific type of technologies that are designed to operate in a digital environment. Digital tools are software applications or platforms that are designed to facilitate specific tasks or workflows. Examples of digital tools include project management software, communication tools such as email or text, and design software. While digital tools are a subset of technology, not all technology is digital. Some examples of non-digital technologies include irrigation systems, solar panels, and electric-powered equipment.

Technology plays a major role in increasing the sustainability of landscape horticulture businesses. Advancements in technology can help horticulturalists **reduce waste, promote business**

viability, and increase environmental health. For example, smart irrigation systems can use weather data and soil moisture sensors to optimize watering schedules, reducing water waste, and nutrient leaching and promoting healthier plants. Drones can be used to map and monitor landscapes, allowing horticulturalists to identify issues and make targeted interventions, reducing the need for broad-spectrum chemical treatments. Electric equipment can reduce the need for gas-powered equipment, which as we know emit carbon. By harnessing the power of modern technology, landscape horticulturalists can increase the sustainability of their businesses and contribute to a more regenerative and sustainable future.

While **technology** has many potential applications in the horticulture field, our focus in this chapter is on technology and digital tools for teaching and learning to prepare students for [diverse and changing roles in the industry](#). By incorporating technology and digital tools into teaching and learning, Horticulture Instructors can support student learning and in turn, influence the horticulture skills and business practices students will take with them into the industry. By using modern and innovative technology and digital tools such as job tracking and scheduling software or financial and digital literacy programs landscape horticulturalists can reduce waste and promote environmental, economic and social health, which can improve a business reputation and attracts more clients who are interested in sustainability. In today's market, where sustainability and environmental stewardship are increasingly important to consumers, horticulturalists who prioritize these values can position themselves for long-term success and viability. Ultimately, by using digital tools to increase sustainability, landscape horticulturalists can improve their business viability while also contributing to a more regenerative future.

In order to use digital tools, landscape horticulturalists need to be **digitally literate** to effectively and responsibly use digital technologies to access, evaluate, and communicate information. Digital literacy involves a range of skills, including the ability to use digital tools for tasks such as searching for information online, creating and sharing digital content, using social media, and communicating via email and other digital platforms. Digital literacy also involves an understanding of the potential risks and challenges associated with digital technologies, such as online privacy concerns, cyberbullying, and the spread of misinformation. Digital literacy involves not only technical skills but also critical thinking and ethical considerations when using digital tools and platforms. In today's increasingly digital world, digital literacy is becoming an essential skill for participation in many areas of life, including education, work, and social interactions.

So, you are keen to try out a new technology or digital tool with your students but, you're not sure which one to choose. Below are some tools to help you choose which technology or digital tool is best to communicate the learning outcome to your students.

Ask yourself:



This video explains the sections model, a decision making tool to help instructors select technology and digital tools for their learners.

One or more interactive elements has been excluded from this version of the text. You can view them online here:

<https://pressbooks.bccampus.ca/facultytrainingmodulesforgreeningthelandscape/?p=88#oembed-8>

Video credit: The SECTIONS Model – Team 5, (Sarah, 2015)

Teaching and Learning Examples for Instructors

- Add examples here of teaching with technology here.

Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. What horticulture skills and practices do you think are important to support students with

successful integration into diverse and changing roles in the horticulture industry?

2. What non-horticulture (soft skills and practices) do you think are important to include in horticulture training to support students with successful integration into diverse and changing roles in the horticulture industry?

3. What is your opinion on using technology and/or digital tools for teaching and learning in landscape horticulture? Do you think students need to use technology and digital tools to successfully integrate into the industry upon training completion?

4. What, if any, professional development do you need to seek out in order to effectively teach using modern technology and digital tools?

Regenerative Landscape: Restore and Regenerate

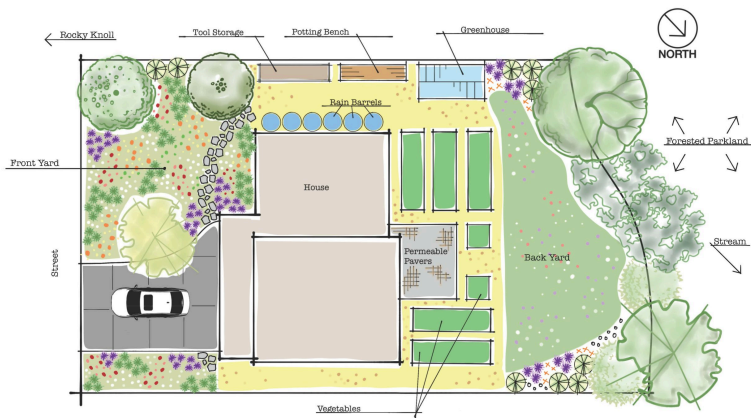
Regenerative (to renew/restore/respect)

Keywords: rain barrels, seed saving, restore, regenerate, reflect,

Regenerative Landscape Plan

Let's review the regenerative landscape design. This landscape design was approached through a regenerative lens that embodies sustainability in multiple dimensions, encompassing economic, environmental, and cultural/social aspects. From an economic standpoint, the regenerative landscape proves sustainable by reducing long-term maintenance costs through the use of resilient

and low-maintenance plantings, minimizing the need for costly inputs like pesticides and fertilizers. It also fosters local economies by promoting and purchasing plants and materials and supporting local businesses and artisans. Environmentally, the regenerative landscape minimizes resource consumption and waste generation by incorporating principles such as water infiltration, soil regeneration, and biodiversity promotion. By restoring ecosystems and improving soil health, the regenerative landscape contributes to carbon sequestration and mitigates climate change impacts. Culturally/socially, the regenerative design aims to honour local traditions, integrating elements that reflect the region's heritage, such as the use of Indigenous plants, and hope to create a sense of place. It respects and enhances the natural beauty and ecological integrity of the landscape, fostering a deep connection between people and their surroundings. Overall, a landscape design through a regenerative lens ensures sustainability by harmonizing economic, environmental, cultural/social considerations, creating a holistic and resilient landscape that benefits both current and future generations.



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Reflect



Manfred Antranias Zimmer from Pixabay

Please use the following questions to guide your reflection:

1. How can you design and propose a lesson plan to integrate Indigenous ways of learning and regenerative landscape practices into climate change adaptation and mitigation efforts into the existing curriculum?

Additional Resources

Resource Name	Resource Description	Resource Link

1

References

TBC