Red Seal Landscape Horticulturist Identify Plants and Plant Requirements (F2 - 3&4)

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LINE F APPLY HORTICULTURAL PRACTICES: F2 - LEVEL 3 AND 4

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Red Seal Landscape Horticulturist Identify Plants and Plant Requirements

Line F Apply Horticultural Practices: F2

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Michelle J. Nakano

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About This Book

Red Seal Landscape Horticulturist Identify Plants and Plant Requirements is an editable, open access learning resource with interactive web based experiences customized for horticulture students studying plant identification.

This edition supports student achievement of the Level 3 and Level 4 learning goals for Red Seal Landscape Horticulturist Line F2:

- Identify plant and plant requirements for a range of woody and non-woody plants
- Use botanical terms to identify and describe plants
- Identify and describe plants according to cultural and maintenance requirements
- Recognize plants suitable for common tropical, floral and interior landscape situations
- Identify plants suitable for planting in difficult situations
- Describe native plants common to the horticulture industry
- Describe seasonal plants common to the horticulture industry in BC
- Describe plants suitable for green infrastructure projects
- Describe plants suitable for edible landscapes

PART I

PART 3 PLANTS FOR DIFFERENT PLANTING SITUATIONS

CHAPTER 1

Introduction to Interior Landscaping

Learning Objectives

- Describe the benefits of interior landscaping.

The domestication of wild plants for food crops about 10,000 years ago was a major factor in the development of human civilization. However, art and archaeological evidence from early civilizations in Egypt, China, Iran, Greece, and Rome reveal that plants were also selected and cultivated for ornamental purposes. Foliage and fruit plants in containers adorned the inner courtyards and rooftop gardens of homes, and flowers were cultivated in hothouses for bouquets and garlands. Figure 1.1 shows an example of a fresco tomb painting of the courtyard garden of a wealthy Egyptian homeowner.

Figure 1.1 Tomb painting of an ancient Egyptian garden

From the 15th to the late 19th century, European world explorers collected many plants for ornamental interest and enjoyment by the wealthy. Exotic plants from the tropics that were cultivated indoors in northern regions became the forerunners of modern-day foliage, flower, fern, climber, and succulent house plants. By the mid 19th century, indoor gardening was a popular hobby of the wealthy and the emerging middle class. The impact of the Industrial Revolution on building lighting and heating increased the number of plants that could be grown indoors. Developments in building construction methods and heating and ventilation systems in the early to mid 20th century expanded the use of plants to beautify the indoor environments of offices, hospitals, public spaces, and private homes. In response, the horticultural production and hybridization of foliage and flowering plants increased and landscaping companies specialized in interior landscape design, installation, and maintenance services.

In addition to providing visual interest and softening the hard edges of structures with foliage texture, studies have shown that plants can improve indoor air quality. For example, during the energy crisis in the late 20th century, the construction of air tight buildings and use of synthetic materials were intended to reduce energy costs. However, toxic air pollutants such as trichloroethylene, benzene, and formaldehyde given off from paint, plywood, insulation, plastic, carpet and fabrics became concentrated in the air tight spaces and made inhabitants feel sick. The NASA Clean Air study demonstrated that indoor plants purified air by removing and trapping air

pollutants in leaves, roots, and soil. Learn more about the study at this link to *Indoor Air-Wolverton Environmental* [New Tab][1]

Human civilization has developed in conjunction with nature and the psychological and physical health benefits of integrating vegetation into our habitats is well recognized in the 21st century. Research suggests that for people who spend significant time indoors at work, the presence of plants can improve mood, contribute to contentment, and promote motivation and productivity. Read more about the benefits of indoor plants at this link to *Houseplants: to support human health* [New Tab][2].

The benefits of indoor plants have become part of the design of living and working environments in the 21st century. Interior landscapes or plantscapes have diversified the use of tropical foliage and flowering plants in atria and large conservatories, indoor and vertical gardens, potted office plants and hanging baskets, as well as color bowls, dish gardens, and terrariums. Figure 1.2 shows an example of interior landscaping using vertical gardens vegetated with tropical plants.

Figure 1.2 Interior vertical gardens vegetated with tropical plants

1. https://www.wolvertonenvironmental.com/IAQ.html
2. https://www.rhs.org.uk/advice/profile?PID=949

CHAPTER 2

Plants for Tropical and Interior Landscaping

Learning Objectives

- Recognize plants suitable for common tropical and interior landscape situations.

Plant species that are native to regions around the equator are described as tropical. They are adapted to climate conditions with an average temperature of 18^{O}C (64.4^{O}F), no chance of frost, and considerable precipitation at least part of the year. Depending on the latitude, plant species may be adapted to tropical humid (rain forest) or tropical dry (savanna) conditions.

Rain forest vegetation is lush with tall trees and thick lianas forming a dense canopy that filters sunlight from the smaller trees, vines, palms, orchids, and ferns growing in the understory. Examples of plant adaptations for high humidity and competition for light include large leaves with waxy surfaces and pointed tips that shed water. More information about interesting plant adaptions for this hot, humid climate is available at this link to *The Tropical Rainforest* [New Tab][1].

Grasses, shrubs and trees of the tropical savanna are well adapted for climate extremes. Long tap roots, thick fire resistant bark, tree trunks that store water, leaf drop during the dry season, and storage organs like bulbs and corms allow plants to survive an extremely hot, long dry season and a very wet season. Learn about some of these unique plants at this link to *The Savanna* [New Tab] [2].

Many tropical rain forest plants are available year round in temperate climates for use in interior landscaping. Some common indoor plants include *Codiaeum variegatum* var. *pictum* (croton), *Dieffenbachia seguine* (dumb cane), *Dypsis lutescens* (Areca palm), and *Epipremnum aureum* (devil's ivy, golden pothos). The morphology of these plants can be readily recognized as belonging to particular family groups and related genera share identifiable morphology. It is often possible to use vegetative features alone to identify these family groups, relying on reproductive features only when needed. For example, the square stems and opposite leaf arrangement of *Solenostemon* x *hybridus* (coleus), an indoor house plant and outdoor bedding plant, can be recognized as a member of the mint family, Lamiaceae. The morphological characteristics used to identify some plant families and genera commonly used in interior landscapes are summarized below. Access to images of the genera is available at this link to the *KPU Plant Database* [New Tab][3].

1. http://www.mbgnet.net/bioplants/troprf.html
2. https://savanna2012.weebly.com/unique-plant-adaptions.html
3. https://plantdatabase.kpu.ca/plant/search.gsp

Araceae – arum family

Members of the arum family are called aroids. There are over 100 genera and 2500 species distributed on every continent, with the majority in North Africa and Mediterranean regions. These moncots are known as much for their magnificent foliage as for their characteristic inflorescence. In natural habitats, they range from shrubs such as *Dieffenbachia seguine* and climbers such as *Epipremnum aureum* to enormous herbs with corms or tubers.

The leaves are mostly spirally arranged and often parallel but sometimes net-veined and either simple or compound. The petiole has a membranous, sheathing base. The roots of all species are adventitious (i.e., they can arise anywhere on the stem) and are without root hairs. Climbing and epiphytic aroids have two kinds of roots, ones that are absorbent and grow downwards into the soil, and clasping roots that grow into crevices, away from light.

Individual flowers are tiny, and are borne on specialized inflorescence called a spadix. In the majority of species the spadix is surrounded by a leaf-like bract called a spathe. The spathe is frequently colored and serves as a pollinator attractant. In most cases, aroids are pollinated by flies; the resultant fruits are typically berries. Species grown in interior landscapes will prefer bright, indirect light and moist, well drained fertile soils, and evenly warm temperatures. The ARACEAE family has many familiar shrubs and climbers for indoor containers, including:

- *Aglaonema* (Chinese evergreen)
- *Anthurium* (flamingo flower)
- *Caladium* (elephant ear)
- *Dieffenbachia* (dumb cane)
- *Epipremnum* (devil's ivy)
- *Monstera* (split-leaf philodendron)
- *Philodendron* (philodendron)
- *Scindapsus* (silver pothos)
- *Spathiphyllum* (peace lily)

Arecaceae – palm family

The palms comprise a large family (more than 200 genera and 2650 species) of evergreen trees and rattans (climbers) with primarily tropical and warm temperate distribution (few in Africa). Palms such as *Dypsis lutescens* are immediately recognizable to most people, having spirally arranged, often very large leaves in terminal rosettes.

The slender, unbranched stem of the coconut palm (of tropical-island-paradise fame) is typical of many palms, but there are other distinctive shapes and sizes of palms. Palms are usually categorized as either feather palms (pinnate leaves) or as fan palms (palmate leaves), and may be stout or slender, solitary or suckering, and from dwarf to full-size.

Flowering is rare in indoor cultivation, except with some smaller species (especially *Chamaedorea*). Flowers are usually small, yellow, 3-parted and partially embedded in the flower stems. After successful pollination, palms generally produce a rounded, fleshy or fibrous drupe (seldom as large as a coconut nor as succulent as a date). Depending on the species, palms grown in interior landscapes will prefer indirect bright to low light and loose well drained soil with regular fertility. Genera commonly cultivated indoors in atriums and containers include:

- *Caryota* (fishtail palm)

- *Chamaedorea* (parlour palms)
- *Chamaerops* (european fan palm)
- *Chrysalidocarpus* (butterfly palm)
- *Dypsis lutescens* (areca palm)
- *Howea* (Kentia, sentry palms)
- *Phoenix* (date palm)
- *Ravenea* (majestic palm)
- *Rhapis* (lady palm)
- *Trachycarpus* (windmill palm)

Euphorbiaceae – spurge family

The spurge family is large with more than 300 genera and 7500 species of annual and perennial flowering herbs, shrubs, trees, and some climbers growing in tropical and temperate climates. Some species are succulent and cactus-like and some are characterized by milky sap that may be poisonous. Genera are commonly used in both indoor and outdoor landscapes for their colorful bracts and unusual forms. Tender species such as *Codiaeum variegatum* var. *pictum,* an ornamental shrub with attractive, multicolored foliage, is commonly used in interior landscaping.

Family members usually have simple or sometimes palmately compound leaves that may be sessile or petiolate, often with stipules, and alternately arranged on the stem. Species are frequently monoecious with a raceme or cyme inflorescence and often a radially symmetrical cyathium that is composed of 5 colorful bracts surrounding the reproductive flower parts. The fruit is usually a capsular schizocarp. Euphorbs grown indoors will prefer bright light and well drained soil with moderate to low moisture and fertility. Some examples of genera used for interior landscaping indoor include:

- *Acalypha* (chenille plant)
- *Codiaeum* (croton)
- *Euphorbia* (spurge)

CHAPTER 3

Plants for Floral Landscape Situations

Learning Objectives

- Recognize plants suitable for common floral landscape situations.

Worldwide, the floriculture industry grows an enormous range of tropical species in greenhouses and nursery fields for interior and exterior landscape situations. In addition to improving everyday life, potted flowering plants and cut flowers have significance for the celebration of cultural traditions and events. Examples of potted plants used in traditional seasonal displays include *Euphorbia pulcherrima* (poinsettia), *Chrysanthemum morifolium* (garden mum), and *Lilium longiflorum* (Easter lily). Events such as weddings, graduations, and funerals are usually celebrated with cut flowers and greens in arrangements, garlands, and bouquets. Among the many types of cut flowers available, the tropical species *Alstroemeria* cvs. (alstroemeria) and *Antirrhinum majus* (snapdragon) are frequently used in floral design.

Key morphological characteristics that distinguish these plants within their family taxon are summarized below. View detailed images of the plant examples available at this link to the *KPU Plant Database* [New Tab].[1]

Alstroemeriaceae – alstroemeria family

- Erect herbaceous perennial with tuberous roots
- Leaves are alternate and simple with parallel veins, an entire margin, and are resupinate (twisted)
- Inflorescence is an umbel
- Flowers are zygomorphic (bilateral symmetry), funnel-form, the inner whorl of tepals are spotted
- Fruit is a capsule
- Example: *Alstroemeria* cvs. (alstroemeria) for growing conditions of part sun to part shade and well drained fertile soils

1. https://plantdatabase.kpu.ca/

Plantaginaceae – plantain family

- Erect herbaceous perennial
- Leaves are alternate, simple, with pinnate veins and an entire margin
- Inflorescence is a raceme
- Flowers are zygomorphic, tubular and bilabiate (two-lipped)
- Fruit is a capsule
- Example: *Antirrhinum majus* (snapdragon) for growing conditions of full sun part sun/part shade and well drained soils

While tender tropical members of plant families, such as *Solenostemon* x *hybridus* (coleus) in the mint family are typically grown in interior landscapes in northern regions, some are used in exterior containers and bed plantings for summer interest. A few examples of the many tender tropical annual species grown for bedding and container displays are *Ageratum houstonianum* (floss flower), *Celosia argentea* (cockscomb), and *Cleome hassleriana* (spider flower). Examples of tropical herbaceous perennials grown for exterior displays include *Lantana camara* (lantana), *Pelargonium* spp. (geranium), and *Salvia* x *superba* 'May Night' (salvia cultivars). As a result of extensive hybridization, tender herbaceous perennials such as *Begonia* x *semperflorens-cultorum* (fibrous begonia), *Canna* x *generalis* (canna), *Pelargonium* x *hortorum* (zonal or bedding geranium), *Solenostemon* x *hybridus* (coleus), and *Salvia* x *superba* 'May Night' (salvia cultivars) may be described as being of garden origin.

Key morphological characteristics that distinguish these plants within their family taxon are described below. View detailed images of the plant examples available at this link to the *KPU Plant Database* [New Tab].[2]

Amaranthaceae – amaranth family

- Erect herbaceous annual
- Leaves are alternate, simple, with pinnate veins, an entire margin, and without stipules
- Inflorescence is a spike (dense plume or crested)
- Flowers are radial and small, with colorful persistent bracts below each flower
- Fruit is a capsule
- Example: *Celosia argentea* (cockscomb) for growing conditions of full sun part sun/part shade and well drained soils

Asteraceae – aster family

- Compact, mounded herbaceous annual
- Leaves are simple and opposite, with pinnate venation, a crenate margin, and hirsute (hairy) blade
- Inflorescence is a head (capitulum), arranged in corymbs
- Flowers are ligulate (ray flowers)

2. https://plantdatabase.kpu.ca/

- Fruit is a cypsela
- Example: *Ageratum houstonianum* (floss flower) for growing conditions of full sun part sun/part shade and moist, well drained soils

Begoniaceae – begonia family

- Upright, mounded annual with succulent tissue and fibrous roots
- Leaves are alternate, simple, waxy, with pinnate veins and an asymmetrical base
- Inflorescence is a cyme
- Flowers are monoecious, single or double blooms
- Fruit is a capsule
- Example: *Begonia* x *semperflorens–cultorum* (fibrous begonia) for growing conditions of full sun part sun/part shade and well drained soils

Cannaceae – canna family

- Erect, unbranched herbaceous perennial, with rhizomes
- Leaves are alternate, simple, with a sheathed base and pinnate venation
- Inflorescence is a raceme
- Flowers are asymmetric, with 3 unequal petals basally fused into a tube, 3 sepals are not fused, the modified fertile stamens are petal-like
- Fruit is a capsule
- Example: *Canna* x *generalis* (canna) for growing conditions of full sun and moist, well drained soils

Capparidaceae – caper family

- Erect, branched herbaceous annual
- Leaves are alternate, palmately compound, with glandular hairs and stipules, pinnate venation, and entire, ciliate margins
- Inflorescence is a raceme
- Flowers are held on upright pedicels, petals are held above long-exerted stamens
- Fruit is a cylindrical capsule held spreading or pendulous on the plant
- Example: *Cleome hassleriana* (spider flower) for growing conditions of full sun and well drained soils

Geraniaceae – geranium family

- Rounded to spreading tender herbaceous perennials and hybrids, with succulent tissue
- Leaves are alternate, simple, orbicular with banded markings, palmate venation, and round or acutely lobed margins, leafy stipules are present
- Inflorescence is umbel-like
- Flowers are zygomorphic, the upper 2 petals differ in shape and/or size from lower 3 petals, with single, semi-double or double blooms
- Fruit is an achene or schizocarp, it is often aborted or absent
- Examples: *Pelargonium* spp., *Pelargonium* x *hortorum* for growing conditions of full sun and well drained soils

Lamiaceae – mint family

- Erect to rounded herbaceous perennials and hybrids with squared stems
- Leaves are opposite, simple, with pinnate venation, a crenate margin, and are often aromatic
- Inflorescence is a spike-like verticillaster
- Flowers are zygomorphic and bilabiate
- Fruit is a nutlet
- Examples: *Solenostemon* x *hybridus (coleus), and Salvia* x *superba* 'May Night' for growing conditions of full sun and well drained soils

Verbenaceae – verbena family

- Upright, arching perennial shrub, stems with prickles, many annual cultivars
- Leaves are simple, opposite, with pinnate venation, a serrate margin, and a rough blade surface
- Inflorescence is a compact raceme (umbel-like head)
- Flowers are small, tubular to salverform opening in four rounded lobes, with variable coloring
- Fruit is a berry, it is often aborted in cultivars
- Example: *Lantana camara* (lantana) for growing conditions of full sun part sun/part shade and well drained soils

Practice: Recognize plants suitable for common floral landscape situations.

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://kpu.pressbooks.pub/plantidentification/?p=329#h5p-1

CHAPTER 4

Introduction to Plants for Difficult Planting Situations

Learning Objectives

- Describe plant tolerance for difficult planting conditions.

Few landscapes and gardens will contain the perfect planting conditions. Environmental stress from variable combinations of light and moisture levels, exposure to wind and cold, soil characteristics, site slopes and drainage can create difficult situations for planting. Some plants will be better suited to tolerate environmental stress because of morphological and physiological adaptations developed in their native habitat. For example, *Berberis buxifolia* (box leaf barberry), *Gleditsia triacanthos* f. *inermis* (thornless honey locust), and *Ginkgo biloba* (maidenhair tree, ginkgo) are able to tolerate a fairly wide range of planting conditions. When planting in difficult situations such as the examples described below, select plants from similar habitats that are naturally adapted to grow under the existing conditions.

Sunny arid conditions

Environmental stress associated with arid (xeric) conditions can severely limit plant growth. Climate characteristics include full light exposure, high summer temperatures, low and unpredictable precipitation, and low humidity with drying winds. Soils with poor structure, minimal organic matter or soil biology and low water holding capacity and nutrient availability are common in arid conditions. Where hardiness is a limiting factor for plant selection, local regional native plants adapted to the existing climate, soils, and moisture regimes are often the most suitable choice.

Shallow, extensive root systems allow species such as *Rudbeckia fulgida* (black-eyed Susan) to survive in drought and poor soil conditions. Plant characteristics such as small, compound, and modified leaves and stems, and light or gray colored leaves with hairy or waxy surfaces reflect sunlight, moderate the temperature at the leaf surface, and reduce water loss. *Achillea filipendulina* 'Gold Plate' (Gold Plate yarrow), *Artemisia schmidtiana* (silver mound), *Festuca ovina glauca* (blue fescue), *Rosa rugosa* (rugosa rose), and *Abies concolor* (white fir) are some examples of plants with these characteristics. Read more about plant adaptations at this link to *Plant Adaptations to Arid Environments* [New Tab][1]

1. https://www.redbuttegarden.org/gardening/plant-adaptations-to-arid-environments/

Shade

Shaded areas that may seem problematic are in fact ideal for plants that occur naturally in habitats with low light, such as woodlands and ravines. There are many shrubs, trees, climbers, bulbs, ferns, and ground cover plants that either tolerate or prefer partial to full shade. For example, evergreen species and cultivars of *Rhododendron* spp. prefer deep to part shade while *Rhododendron* Northern Lights Group (azalea) prefers full sun to part shade. Characteristics of shade plants such as branched habits, two-ranked leaf arrangement, and broad, thin leaf blades are suited to capture available light. A strategy of some herbaceous plants, such as *Crocus* cvs. (crocus) is to emerge early, flower, set seed, and die back to resting structures before tree and shrub leaves fill in completely. Some shade tolerant trees, such as *Tsuga heterophylla* (western hemlock) and *Acer saccharum* (sugar maple) will germinate and grow as understory species until openings in the canopy allow them to grow to full size.

There is a wide array of ornamental plants suitable for planting in partial to full shade. Examples of ferns are *Athyrium niponicum* var. *pictum* (Japanese painted fern), and *Matteuccia struthiopteris* (ostrich fern). Shrubs for shade include *Aucuba japonica* (Japanese aucuba), *Kalmia latifolia* (mountain laurel), *Kerria japonica* (Japanese kerria), and *Leucothoe fontanesiana* 'Rainbow' (Rainbow leucothoe). Shade tolerant ground covers include *Pachysandra terminalis* (Japanese spurge) and *Sarcococca hookeriana* var. *humilis* (dwarf sweet box). The woodland understory tree, *Cornus florida* (Eastern flowering dogwood, pink flowering dogwood) is adapted to growing in partial shade. Learn more about shade gardening at this link to *RHS Shade Gardening* [New Tab][2]

Dry soil

Multiple factors can contribute to dry soil conditions on a site. Soils with high sand or aggregate content that drain quickly move available water below the plant root zone, and surface slopes with rapid runoff reduce water infiltration into the soil. Overhead structures that block rainfall, such as building eaves or tree canopies with competing roots below ground can also create dry areas. While few plants will survive in permanently dry areas, drought tolerant native and garden plants can flourish in dry soil once established. Examples include ground covers, *Arctostaphylos uva-ursi* (bearberry, kinnikinnick) and *Thymus serpyllum* (mother of thyme), and herbaceous perennials, *Arabis caucasica* (rock cress) and *Echinops bannaticus* (globe thistle). A few examples of adapted deciduous shrubs and trees are *Chaenomeles japonica* (flowering quince), *Crataegus laevigata* cvs. (English hawthorn), *Pyrus calleryana* (ornamental pear) and *Quercus robur* (English oak). A conifer example, *Juniperus virginiana* (eastern red cedar) is tolerant of dry soil. Read more about suitable species for dry soil conditions at this link to *Drought Tolerant Plants For Your Garden* [New Tab][3].

Dry shade

A combination of shade and dry soil can create a difficult planting situation. Dry shade is typically found under tree canopies where dense fibrous roots close to the surface compete with other plants for water. While plants will not survive extended periods of drought without some watering, there are some such as *Berberis* spp. that will tolerate dry shade once they are properly established. *Alchemilla mollis* (lady's mantle), *Epimedium* hybrid cvs. (hybrid barrenwort), and *Pachysandra terminalis* (Japanese spurge) are suitable herbaceous ground covers for planting in dry shade. Learn about some practical approaches to planting in dry shade at this link to *RHS The Garden Dry Shade* [New Tab][4]

2. https://www.rhs.org.uk/advice/profile?PID=934
3. http://www.artsnursery.com/blog/drought-tolerant-plants-for-your-garden
4. https://www.rhs.org.uk/about-the-rhs/publications/the-garden/2014-issues/december/rhs-problem-solver-on-dry-shade.pdf

Wetlands

Natural wetlands with soil that is permanently or seasonally saturated often have anaerobic (low oxygen) conditions. Wetlands are typically vegetated with hydrophytic plants that are adapted to grow wholly or partially in water. Some hydrophytic species float on the surface of water, while others are completely submerged. Emergent species that root in soil underwater and grow shoots up and out of the water are usually found along the shoreline or margin of a wetland.

While the roots of many garden plants would rot when deprived of oxygen, hydrophytic plants are suitable choices for sites with water features as well as low areas with seasonal poor drainage or a high water table. Examples of herbaceous perennials suitable for wetland planting include *Acorus gramineus* 'Variegatus' (variegated sweet flag), and *Matteuccia struthiopteris* (ostrich fern). *Aronia melanocarpa* (black chokeberry), and *Sambucus nigra* (elderberry) are adaptable deciduous shrubs for wet conditions as are the deciduous trees *Liquidambar styraciflua* (American sweetgum), and *Salix* x *sepulcralis* var. *chrysocoma* (weeping willow). Depending on the available space, the large conifer *Metasequoia glyptostroboides* (dawn redwood) may be a suitable choice. Learn more at this link to *RHS Gardening on Wet soils* [New Tab][5].

Compacted soils

Compacted soils are common in urban areas that undergo construction damage, or repeated machinery use and foot traffic. Damage to soil structure from tilling or working heavy clay and loam soils when they are too wet or frozen, and crusting of bare soils from the impact of rainfall contribute to compaction. As soil particles become densely packed together pore space is reduced and the movement of air, water, organisms, and plant roots is impeded. Once compacted, poor soil drainage, water logging, low oxygen, and hard surface conditions inhibit plant root growth. Plants symptoms may include poorly formed or rotted roots, stunted growth, discolored leaves, and drought stress.

While the addition of compost is a long term solution for compacted garden soils, there are a number of species that are able to tolerate compacted soils reasonably well. For example, *Catalpa speciosa* (western catalpa) is a tough tree that tolerates poor soils and compaction as well as dry and wet soils. *Acer saccharhinum* (silver maple), *Juglans nigra* (black walnut), and *Ulmus americana* (American elm) tolerate some compaction as do *Amelanchier canadensis* (serviceberry), *Juniperus communis* 'Green Carpet' (Green Carpet juniper), and *Matteuccia struthiopteris* (ostrich fern). Read more about adapted species available at this link to *Plants for Compacted soils* [New Tab][6]

Slopes

Sloped embankments and hillsides can be difficult planting situations. Successful plant growth will be influenced by soil type, the north to south aspect, the amount of rainfall, and the degree of incline and length of the slope. Steeper slopes increase the risk of erosion and soil loss that exposes roots or buries small plants. In addition, the run off of sediment from eroded slopes can adversely affect drainage systems and waterways that connect to fish habitat.

Planting slopes with grasses and shrubs is an effective way to protect soil and prevent erosion. Fast-growing, adaptable species with dense fine roots that hold the soil together and take up water help stabilize slopes and

5. https://www.rhs.org.uk/Advice/profile?PID=303
6. https://extension.umaine.edu/gardening/manual/plants-compacted-soils/

keep soil in place. Complete vegetation coverage will reduce the impact of rainfall and the potential for soil disturbance and erosion. Methods such as planting pockets and terraced steps will slow surface run off and facilitate the infiltration of irrigation for plant establishment.

Plants for slopes typically include native and ornamental grasses and low, spreading shrubs and ground covers that leave no areas of bare soil exposed to the elements. On hot, dry southern aspects, drought-tolerant shrubs and grasses such as *Juniperus sabina* 'Tamariscifolia' (tamarix juniper), *Rosa rugosa* (rugosa rose), and *Festuca ovina glauca* (blue fescue) are suitable options. Cooler, moister northern aspects are better suited for shade-tolerant understory shrubs and ground covers such as *Gaultheria shallon* (salal), and *Pachysandra terminalis* (Japanese spurge). Read more about slope gardening at this link to *Pacific Horticulture Society Dry Slope Gardening in Seattle* [New Tab][7].

7. https://www.pacifichorticulture.org/articles/dry-slope-gardening-in-seattle/

CHAPTER 5

Recognize Plants Suitable for Planting in Difficult Situations

Learning Objectives

- Recognize plants suitable for planting in difficult situations.

Practice: Finish the sentences by selecting the matching growing condition for each plant. Click the images for a larger view. Review the detailed information about each plant available at this link to the *KPU Plant Database* [New Tab][1].

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://kpu.pressbooks.pub/plantidentification/?p=707#h5p-25

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CHAPTER 6

Plants for Favorable Planting Situations

Learning Objectives

- Identify plants for favourable planting situations.

Horticulturists understand and use the climate and conditions of a given site to select and grow healthy plants. While growing conditions can be optimized by choosing the right plant for the right place, temperature will remain the least controllable of the environmental factors in exterior landscapes. Given suitable plant hardiness, average conditions of full to part sun or part shade, and well drained, moist soils with appropriate pH will provide favourable growing conditions for many garden plants.

Species that prefer average growing conditions are found in a wide range of plant families. Some familiar plant families with members that thrive in average growing conditions include:

- Caryophyllaceae – *Arenaria verna* (Irish moss)
- Cupressaceae – *Callitropsis nootkatensis* 'Pendula' (weeping Nootka false cypress)
- Ericaceae – *Rhododendron* Northern Lights Group (azalea)
- Fabaceae – *Wisteria sinensis* (Chinese wisteria)
- Lamiaceae – *Callicarpa bodinieri* var. *giraldii* 'Profusion' (beautyberry)
- Ranunculaceae – *Clematis* cvs. (clematis)
- Rosaceae – *Prunuslaurocerasus* 'Otto Luyken' (Otto Luyken laurel), *Prunus serrulata* 'Kwanzan' (flowering cherry)
- Sapindaceae – Acer *macrophyllum* (bigleaf maple)
- Pinaceae – *Picea abies* 'Nidiformis' (nest spruce), *Picea abies* 'Pendula' (weeping Norway spruce), *Picea glauca* (white spruce), *Picea glauca* 'Conica' (dwarf Alberta spruce), *Pinus contorta* var. *contorta* (shore pine), and *Pinus nigra* (Austrian pine)

View the images of plant family members available at this link to the *KPU Plant Database* [New Tab][1].

In addition to shared morphological patterns in flowers and reproductive structures, family members tend to

1. https://plantdatabase.kpu.ca/plant/search.gsp

have similar growth characteristics, nutrient needs, and often the same pests. Key characteristics that distinguish members of some additional plant families are summarized below.

Adoxaceae – moschatel family

- Mostly deciduous shrubs
- Buds are conical
- Leaves are opposite in arrangement, simple, with prominent pinnate venation and serrate margin
- Inflorescence is a cyme of showy florets
- Fruit is a drupe
- Example: *Viburnum plicatum* cvs. (doublefile viburnum)[New Tab][2]

Betulaceae – birch family

- Deciduous trees and some shrub species
- Plant stems are mostly smooth, the genus *Betula* (birch) has bark peeling in layers
- Leaves are alternate in arrangement, simple, with double serrate margin and pinnate venation
- Inflorescence is a long pendulous catkin (male flower) and short, cone-like pendulous or erect catkin (female flower)
- Fruit is a small, single-seeded indehiscent nut in a short-winged samara
- Example: *Betula papyrifera* (paper birch)[New Tab][3]

Brassicaceae – mustard family

- Herbaceous perennial, and annual and biennial species
- Leaves are alternate in arrangement, simple and pinnately lobed, without stipules
- Inflorescence is a raceme
- Flower structure is uniform throughout the family with 4 sepals and 4 petals in a cross-like arrangement (note the historical name ‘Cruciferae’)
- Fruit is a silique formed by two valves joined by a thin flat membrane that often persists
- Example: *Arabis caucasica* (rock cress)[New Tab][4]

2. https://plantdatabase.kpu.ca/plant/plantDetail/188
3. https://plantdatabase.kpu.ca/plant/plantDetail/16
4. https://plantdatabase.kpu.ca/plant/plantDetail/864

Cannabaceae – hop family

- Herbaceous perennial, climbing vine, a dioecious plant
- Leaves are opposite in arrangement, simple and three-lobed with a serrate margin and prominent venation
- Inflorescence is a catkin (male) and cone-like spike (female)
- Flowers are small, without petals (wind pollinated), with aromatic glands at the base
- Fruit is an achene subtended by a papery floral bract
- Example: *Humulus lupulus* (common hop)[New Tab][5]

Caprifoliaceae – honeysuckle family

- Deciduous and broadleaf evergreen shrubs, twining lianas, and some herbaceous perennials
- Stems have pith inside
- Leaves are opposite in arrangement, often simple
- Inflorescence a panicle-like corymb in the example. Solitary flowers occur in pairs or in cymes, spikes and racemes in some species
- Flowers are tubular, funnel-shaped, or bell-like often with five outward spreading lobes or points
- Fruit is a capsule or berry in pairs
- Example: *Kolkwitzia amabilis* (beautybush)[New Tab][6]

Cornaceae – dogwood family

- Mostly trees and shrubs, rarely rhizomatous perennial herbs
- Leaves are opposite in arrangement, simple with undivided, entire margins, and 6-7 pairs of veins
- Flower buds are flattened and globose, vegetative buds are narrow and conical
- Inflorescence is a dense head of inconspicuous true flowers surrounded by 4-8 showy bracts
- Fruit is a drupe, may be multiple in some species
- Examples:
    - *Cornus* 'Eddie's White Wonder' (Eddie's White Wonder dogwood)[New Tab][7]
    - *Cornus florida* (eastern flowering dogwood, pink flowering dogwood)[New Tab][8]
    - *Cornus kousa* var. *chinensis* (Chinese kousa dogwood)[New Tab][9]

5. https://plantdatabase.kpu.ca/plant/plantDetail/538
6. https://plantdatabase.kpu.ca/plant/plantDetail/260
7. https://plantdatabase.kpu.ca/plant/plantDetail/681
8. https://plantdatabase.kpu.ca/plant/plantDetail/38
9. https://plantdatabase.kpu.ca/plant/plantDetail/39

Hamamelidaceae – witch hazel family

- Deciduous shrubs and trees
- Leaves are alternate in arrangement, simple with prominent pinnate venation, serrate margins, and a pubescent surface
- Inflorescence are clusters of 4-parted cross-shaped florets with small triangular sepals and thin, ribbon-like petals
- Fruit is a woody capsule
- Example: *Hamamelis mollis* (Chinese witch hazel)[New Tab][10]

Hydrangeaceae – hydrangea family

- Deciduous shrubs
- Leaves are opposite in arrangement, whorled in some species, simple, with netted venation and serrate to toothed margins
- Inflorescence a raceme in the genus *Deutzia*
- Flowers are rotate with 5 separate petals
- Fruit is a capsule
- Example: *Deutzia gracilis* (slender deutzia)[New Tab][11]

Iridaceae – iris family

- Herbaceous perennial monocot from a bulb, other species from bulbs, corms and rhizomes
- Leaves are typically basal, sheathing and linear with parallel veins and entire margins
- Inflorescence a solitary, 3-parted flower other species, may be a raceme or spike
- Fruit is a capsule
- Example: *Crocus* cvs. (Dutch crocus, crocus)[New Tab][12]

Magnoliaceae – magnolia family

- Deciduous tree, other species are evergreen trees and shrubs
- Leaves are alternate in arrangement, simple, with an entire margin

10. https://plantdatabase.kpu.ca/plant/plantDetail/242
11. https://plantdatabase.kpu.ca/plant/plantDetail/898
12. https://plantdatabase.kpu.ca/plant/plantDetail/1852

- Inflorescence is a solitary flower
- Flowers have tepals, with stamens and pistils on a conical receptacle
- Fruit is an aggregate of woody follicles
- Example: *Magnolia stellata* (star magnolia)[New Tab][13]

Rutaceae – rue or citrus family

- Mostly trees and some shrubs
- Leaves are opposite in arrangement and trifoliate compound in the genus *Choisya*. Leaves are alternate and simple in the genus *Citrus.* Foliage is aromatic, the leaf blade dotted with glands.
- Inflorescence a cyme
- Flower is rotate with 5 petals, fragrant
- Fruit is a capsule
- Example: *Choisya ternata* (Mexican mock orange)[New Tab][14]

Theaceae – tea family

- Mostly broadleaf evergreen shrubs and trees, few deciduous.
- Leaves are alternate and spiral in arrangement, simple, usually glossy, with serrate margin and a gland (hyathode) that excretes water at serration tips
- Inflorescence is solitary flower
- Flower is radially symmetric, rotate with 11+ petals
- Fruit is a capsule
- Example: *Camellia japonica* (common camellia, Japanese camellia)[New Tab][15]

Tiliaceae – basswood or linden family

- Deciduous tree, some species are shrubs
- Leaves are alternate in arrangement, simple with a pubescent surface and hair tufts in vein axils, a serrate margin and a heart-shaped, asymmetrical base
- Buds are alternate, oval in shape with 2 scales.
- Inflorescence is a cyme with an elongated yellow-green bract
- Flowers are small 5-parted, highly scented

13. https://plantdatabase.kpu.ca/plant/plantDetail/269
14. https://plantdatabase.kpu.ca/plant/plantDetail/218
15. https://plantdatabase.kpu.ca/plant/plantDetail/211

- Fruit is a nut-like drupe
- Example: *Tilia cordata* (little leaf linden)[New Tab][16]

Practice: Identify plants for favourable planting situations.

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https://kpu.pressbooks.pub/plantidentification/?p=752#h5p-61

16. https://plantdatabase.kpu.ca/plant/plantDetail/180

PART II

PART 4 PLANTS FOR HORTICULTURAL APPLICATIONS

CHAPTER 7

Native Plants

Learning Objectives

- Describe native plants common to the horticulture industry.

Biodiversity is described as the variety of plants and other living organisms that interact with the non-living environment of a particular habitat or ecosystem. Regardless of the size or type, each organism is dependent on every other, either directly or indirectly through food webs and the natural processes of nutrient cycling and energy flow that sustain ecosystems. Plant biodiversity has an invaluable role in the function of ecosystems and the services that people obtain from them including:

- provision of clean air, water, food, materials, and medicines,
- regulation of climate, carbon storage, water and waste treatment, and erosion and disease control,
- support for pollination, biodiversity and habitat, and
- cultural benefits for health, education, recreation, relaxation, and spiritual well being.

Read more about the importance of ecosystem services at this link to *The Economics of Ecosystems & Biodiversity* [New Tab][1]

Regardless of whether a plant occurs naturally in a place or has been planted indoors or outdoors for ornament or food value, as a species, it has a native home somewhere in the world. Native plant species originated and co-evolved in communities with other organisms in fourteen identified biomes around the world. Biomes are composed of groups of ecosystems with distinct vegetation types and climate patterns. They are typically named for the dominant vegetation type, such as a forest or grassland. Figure 7.1 shows a map of the distribution of the major biomes around the world.

1. www.teebweb.org/resources/ecosystem-services/

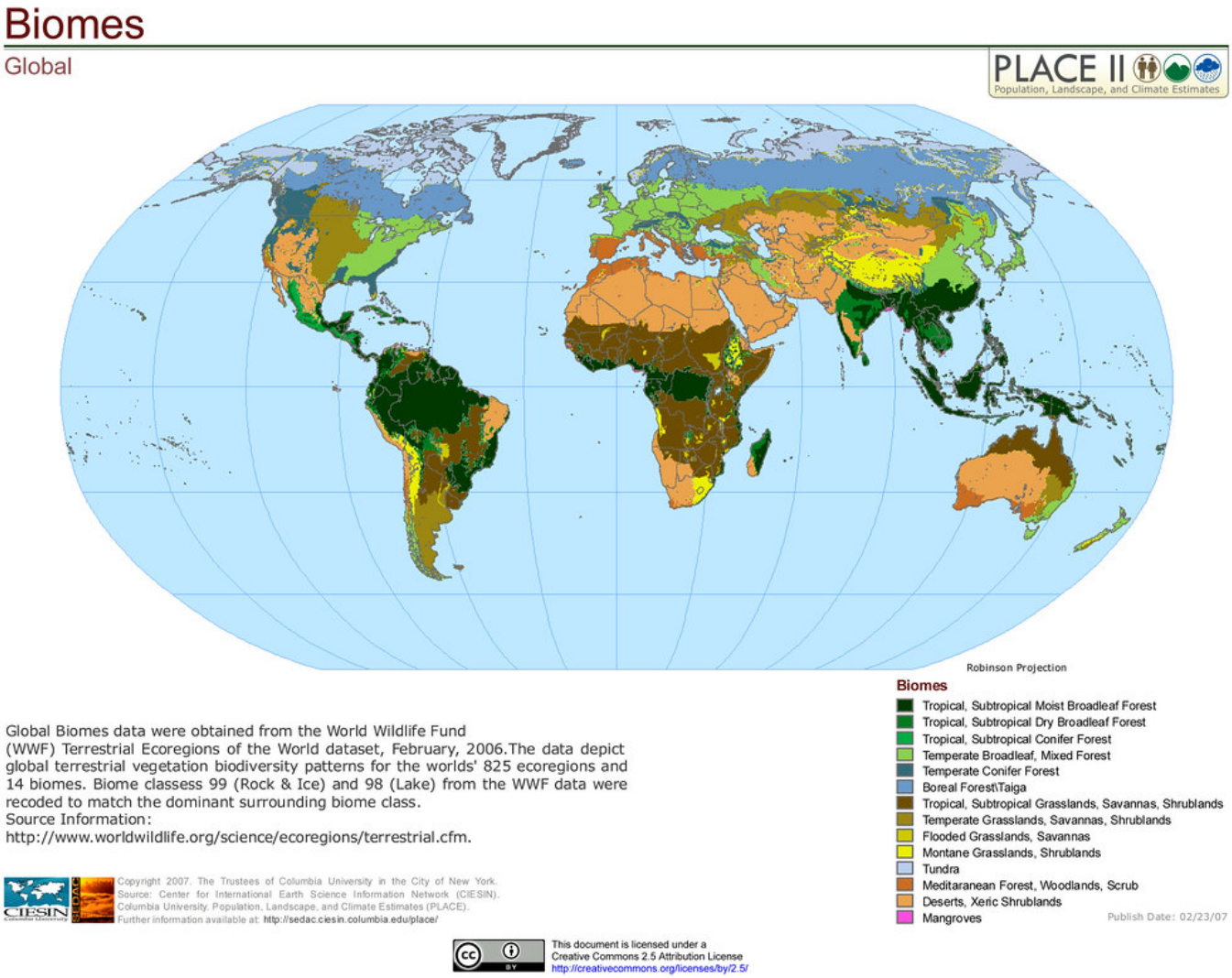

Figure 7.1 Map and legend showing locations and types of global biomes.

With an understanding of plant biology, hardiness, and interactions with soils and climate, native species from different biomes can be successfully grown in landscapes and gardens around the world. For example, *Gunnera manicata* (gunnera) from South America and *Impatiens walleriana* (impatiens) from South Africa that originated in the Tropical, Subtropical Broadleaf Forest biome are often grown as ornamental garden plants. The magnificent specimen tree, *Cedrus deodara* (Deodar cedar) is native to the Tropical, Subtropical Conifer Forest while hedging plants *Thuja occidentalis* (white cedar) and *Taxus cuspidata* 'Capitata' (upright yew) originated in the Temperate Conifer Forest biome. Many species of the Temperate Broadleaf Mixed Forest biome are commonly grown in landscapes and gardens. Examples of deciduous specimen trees include *Acer tataricum* ssp. *ginnala* (Amur maple, Tatarian maple) and *Syringa reticulata* 'Ivory Silk' (Japanese lilac tree) from Eastern Asia, *Cercis canadensis* (redbud) and *Quercus alba* (white oak) from Eastern North America, and the European species *Prunus padus* var. *commutata* (European bird cherry), and *Sorbus aucuparia* (European mountain ash). *Viburnum trilobum* (highbush cranberry) is an understory shrub from northern North America while the closely related *Viburnum opulus* (European snowball) is native to Europe and Asia. Some familiar garden plants that originated in the Mediterranean Forest, Woodlands, Scrub biome are *Cyclamen persicum* (cyclamen), *Helictotrichon sempervirens* (blue oat grass), *Lithodora diffusa* 'Grace

Ward' (blue lithospermum), and *Rosmarinus officinalis* (rosemary). View images of the plant examples available at this link to the *KPU Plant Database* [New Tab][2]. Now, complete the practice exercise.

Practice: Recognize plants native to world biomes.

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Individual ecosystems within larger biomes are characterized by the naturally occurring communities of native plants and animals and the distinct soil types, land forms, and climate of the area. For example, a plant community of the Temperate Conifer Forest biome located in the Pacific Northwest region of North America would include conifers such as *Pinus contorta* var. *contorta* (shore pine), *Pseudostuga menziesii* (Douglas Fir), *Thuja plicata* (western red cedar), and *Tsuga heterophylla* (western hemlock). Depending on the specific site conditions, deciduous and broadleaf evergreen trees may include *Alnus rubra* (red alder), *Arbutus menziesii* (arbutus, madrona), *Frangula purshiana* (cascara), and *Populus trichocarpa* (black cottonwood, western balsam-poplar). Associated deciduous shrubs may include *Ribes sanguineum* (flowering currant, winter currant), *Rubus spectabilis* (salmonberry), *Salix discolor* (native pussy willow, pussy willow), and *Symphoricarpos albus* (snowberry). Some deciduous and evergreen native ferns are *Adiantum pedatum* (maidenhair fern) and *Polystichum munitum* (western sword fern). A few examples of the many native herbaceous flowering plants are *Asarum caudatum* (western wild ginger), *Erythronium americanum* (trout lily, adder's tongue), *Vancouveria hexandra* (inside-out flower), and the semiaquatic *Sagittaria latifolia* (wapato, arrowhead, duck potato). Read more about plant communities and their distinct ecosystems at this link to *Vegetation Regions, The Canadian Encyclopedia* [New Tab][3]

Historically, horticultural activities have had a significant impact on the geographic distribution of native plant species. Currently, landscape contractors, nurseries, garden centres, and mass-market chain stores are the largest distribution channels of native plants in addition to ornamental and floriculture products. The import and export of species for use in arboriculture, landscape horticulture, floriculture, turf, and food production sectors continues to shape the distribution of species in plant communities and ecosystems. While constructed landscapes and gardens may be considered artificial ecosystems, it is possible to plan and maintain communities of local native species and appropriate ornamental plants that support natural processes and ecosystem services.

2. https://plantdatabase.kpu.ca/plant/search.gsp
3. https://www.thecanadianencyclopedia.ca/article/vegetation-regions

Practice: Match the images of plants native to the Pacific Northwest.

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CHAPTER 8

Seasonal Plants

Learning Objectives

- Describe seasonal plants common to the horticulture industry.

Planning combinations of woody and herbaceous plants with different life cycles and high visual impact generates year round interest in exterior and interior plantings. When visual interest is planned for one period such as early summer, borders and containers can have a poor appearance the rest of the year. Optimizing the use of grasses, bulbs, perennials, annuals, biennials, shrubs, climbers, and trees can provide a succession of plant forms, colours, textures, and habits throughout the seasons. In temperate regions, year round interest is maximized by selecting plants with at least two, and even three or four seasons of interest.

Conifers and broadleaf evergreens shrubs are often used for year round colour and spatial structure. For example, *Taxus cuspidata* 'Capitata' (upright yew) provides reliable winter colour and a framework that can be enhanced with other shapes, textures, and colours. On the other hand, a planting of broadleaf evergreens such as *Skimmia japonica* (Japanese skimmia) offers winter colour and structure as well as showy spring flowers and colourful fruit in the autumn. Distinctive plant shapes and the bark of trees such as *Cryptomeria japonica* (Japanese cedar) and *Morus alba* 'Pendula' or species with persistent fruit like *Sorbus aucuparia* (European mountain ash) also contribute structure and winter interest.

Practice: Recognize woody plants for winter interest.

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Some deciduous shrubs and trees like *Caryopteris* x *clandonensis* (bluebeard), *Cercidiphyllum japonicum* (katsura), and *Rhus typhina* (staghorn sumac) have interesting branching patterns throughout all seasons. The bark and buds of *Ribes sanguineum* (flowering currant, winter currant), *Magnolia* x *soulangeana* (saucer magnolia), *Liriodendron tulipifera,* and *Styrax japonicus* (Japanese snowbell, Japanese snowcone) provide winter interest and interesting buds forecast the appearance of foliage and flowers. Climbers with variegated or textured foliage and colourful flowers like *Actinidia kolomikta* (actinitdia) and *Campsis radicans* (trumpet vine) also contribute vertical structure. View the images seasonal plant characteristics available at this link to the *KPU Plant Database* [New Tab][1]

The appearance of plants before, during, and after flowering is an important consideration for planning seasonal interest. For example, the herbaceous specimen plant *Gunnera manicata* (gunnera, giant rhubarb) provides a bold shape and texture for at least half to perhaps three quarters of the year. With planning, the eye catching winter stems and seed heads of grasses and perennial species such as *Pennisetum alopecuroides* (fountain grass), *Pennisetum setaceum* 'Rubrum' (red fountain grass), and *Perovskia atriplicifolia* (Russian sage) can serve as distractions from seasonal voids. Layering various heights of ground covers, bulbs, annuals and perennials under and around woody shrubs and trees allows a succession of foliage shapes, sizes, textures, and colours to become prominent as the year progresses. In this way, emphasis is placed on year round interest and not only the seasonal show of flowers. A planting calendar is a useful tool for working out the succession of flowers and colour palettes as well as other planting design features. Figure 8.1 shows an example of a basic planting calendar that allows the planner to visualize the times of the year that are most colourful and interesting and those that could use additional development.

1. https://plantdatabase.kpu.ca/plant/search.gsp

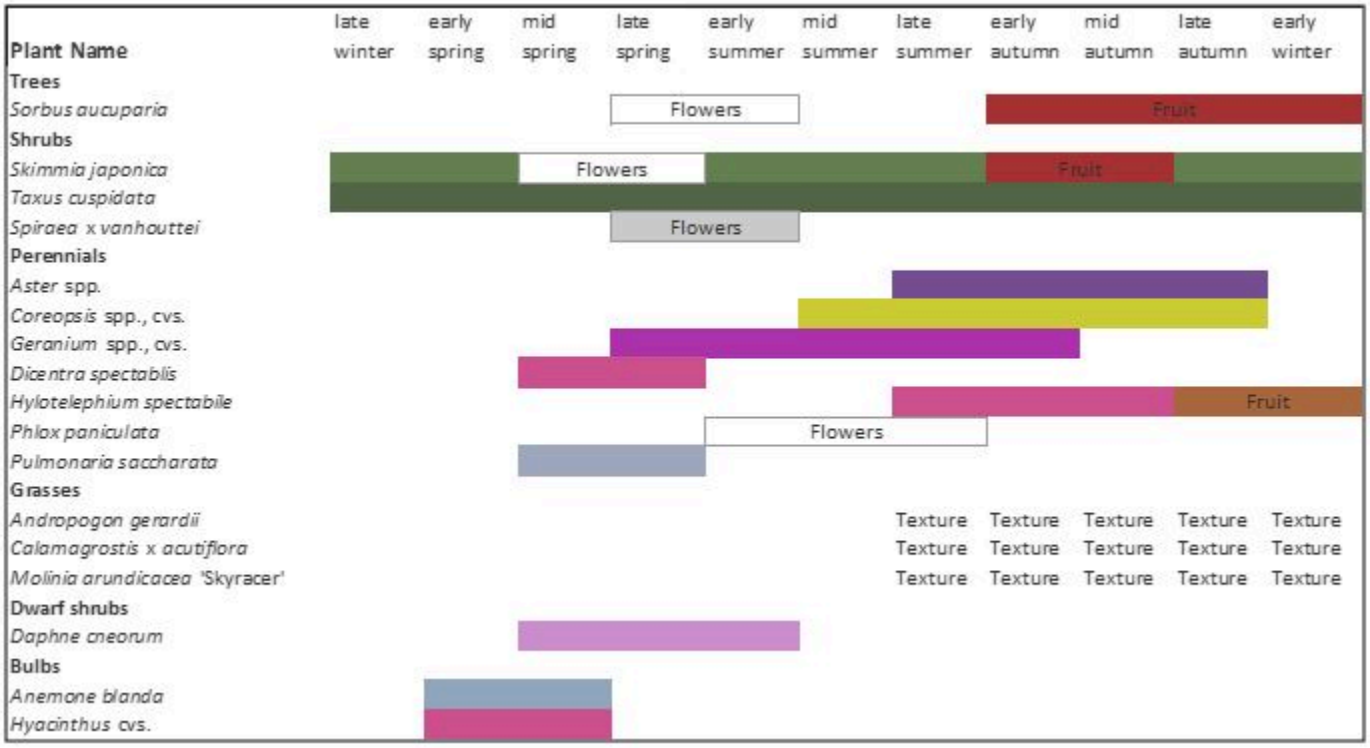

Figure 8.1 Sample planting calendar

As the succession of spring bulbs like *Anemone blanda* (Greek windflower, blue wood) and *Hyacinthus* cvs. (hyacinth) finish flowering and foliage fades, deciduous shrubs such as *Spiraea* x *vanhouttei* (bridal wreath spirea) and an array of herbaceous annuals, biennials and perennials come into flower in early and mid spring. Examples of spring blooming perennials include *Aubrieta* x *cultorum* (common rock cress), *Brunnera macrophylla* (Siberian bugloss), *Papaver orientale* (oriental poppy), *Pulmonaria saccharata* (lungwort), and *Dicentra spectabilis* (bleeding heart). From late spring and early to mid summer, the flowers and foliage of broadleaf evergreen shrubs such as *Daphne cneorum* (garland daphne) and herbaceous species like *Thymus pseudolanuginosus* (woolly thyme), *Heuchera* cvs. (coralbells, alumroot), and *Phlox paniculata* (common phlox) take prominence. The progression of seasonal foliage and bloom continues in mid to late summer and through autumn with perennials such as *Actaea simplex* Atropurpurea Group (cimicifuga), *Aster* spp. (common aster), *Astrantia major* (masterwort, astrantia), *Coreopsis* spp. & cvs. (coreopsis), *Geranium* spp. & cvs. (geranium), and *Gaillardia* cvs. (blanket flower). The texture and seed heads of perennials like *Hylotelephium spectabile* (autumn joy sedum, stonecrop), and grasses such as *Andropogon gerardii* (big bluestem), *Calamagrostis* x *acutiflora* (feather reed grass), and *Molinia arundinacea* 'Skyracer' (tall moor grass) extend the visual interest from late autumn into winter. Year round interest is fulfilled by evergreens and the flowers of winter blooming shrubs and perennials. View images of the seasonal plant characteristics available at this link to the *KPU Plant Database* [New Tab][2]. Read more about seasonal plant combinations at this link to *Gardenia Seasonal Garden Ideas* [New Tab][3].

2. https://plantdatabase.kpu.ca/plant/search.gsp
3. https://www.gardenia.net/gardens/seasons

Practice: Recognize plants for seasonal interest.

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https://kpu.pressbooks.pub/plantidentification/?p=1023#h5p-65

CHAPTER 9

Plants for Green Infrastructure Projects

Learning Objectives

- Describe plants suitable for green infrastructure projects.

The basic infrastructure that supplies a plant with water and food is made up of roots, stems, and leaves. By comparison, an infrastructure that supplies a community with drinking water is made up of a network of parts that include wells, reservoirs, water mains and smaller pipes. Other familiar examples of infrastructure found in communities are transportation, communications, and electrical networks. These constructed networks are often called grey infrastructure. In nature, networks of rivers, streams, lakes, and oceans make up a natural infrastructure that supports the function of ecosystems and the plants and animals that live there. Where human activities lead to the loss of ecosystems and biodiversity, green infrastructure can be planned and managed to conserve ecosystem services and reduce negative environmental impacts. Green infrastructure is made up of vegetation, soils, and bioengineered technologies that provide communities with a wide range of environmental, social, and economic benefits. When connected in a larger framework of natural and urban forests, habitats, streams and rivers, constructed wetlands and floodplains, as well as parks, residential yards, edible landscapes, community gardens, green roofs, green walls, bioswales, and rain gardens, a green infrastructure network is created.

Traditional stormwater infrastructure that collects, drains and discharges water from sites as quickly as possible can increase the potential for flash flooding, pollution, and scouring damage downstream. Sealed surfaces like rooftops, parking lots, and roads accelerate surface water runoff and prevent infiltration into soil for cleansing, groundwater recharge, and plant use. In contrast, green infrastructure for stormwater management mimics natural landscapes that intercept, retain, absorb, filter, and slowly release stormwater by evapotranspiration and controlled runoff. Combinations of green infrastructure components such as green roofs, green walls, bioswales, rain gardens, and permeable paving reduce the quantity and improve the quality of stormwater before its release from a site. Read more about the potential benefits of green infrastructure available at this link to *Introduction to Green Infrastructure*[PDF][New Tab][1]

Green infrastructure is designed to optimize the beneficial services provided by plants. Plants and their processes of photosynthesis, water uptake, and respiration contribute to:

- oxygen production and carbon sequestration,

1. https://s3-ca-central-1.amazonaws.com/trcaca/app/uploads/2016/08/17163548/Introduction-to-Green-Infrastructure_uploaded-June-2018.pdf

- pollution removal from air, soil, and water,
- flood control, and groundwater and stormwater management,
- surface shading and cooling of air temperature by evapotranspiration, and
- wildlife and pollinator habitat, and green space for human well being.

Plants for green infrastructure projects are often locally available native species, but not always. Both native and non-native plants are used for the ecosystems services a species or plant community provides. Plants suitable for the growing conditions, function, appearance, and maintenance levels associated with green roofs, green walls, bioswales and rain gardens will be selected within the constraints of a particular project.

Plants for green roofs

Green roofs that are partly or completely covered with vegetation and growing media provide many ecosystem services in urban settings. Services include reducing the volume of rainfall runoff through plant uptake, providing wildlife habitat and green space, and reducing the urban heat island effect through shading and plant evapotranspiration. In addition, the insulating properties of vegetation and growing media dampen noise levels, reduce the heating and cooling costs in buildings, and extend the life of roofing materials. Read more about the benefits of green roofs at this link to *Green Roofs for Healthy Cities, About Green Roofs* [New Tab][2]

Green roofs are categorized as either intensive or extensive depending on the depth of growing media. Intensive green roof systems with growing media depths greater than 150 mm (6”) can support many plant types including ground covers, herbaceous species, shrubs, trees, and climbers. The high structural loading capacity of intensive green roofs also allows for access to amenities like paths, patios, and water features. Like a traditional garden on a roof, intensive plantings have high requirements for maintenance and inputs. In contrast, extensive green roofs with light weight growing media less than 150 mm (6") in depth support plants with shallow roots and low requirements for maintenance and inputs. Extensive green roofs provide habitat for wildlife but their lower structural loading capacity may restrict human access to maintenance visits. Figure 9.1 shows an example of an extensive green roof that provides visual access to green space in an urban setting.

2. https://greenroofs.org/about-green-roofs

Figure 9.1 Example of an extensive green roof

Almost any plant type can be grown on a green roof however, the shallow depth and low organic content of extensive green roof growing media will be the limiting factor for plant selection. In general, suitable species are determined by examining the microclimate of the green roof and comparing it to a species' native habitat. Extensive green roof features that influence plant selection will include water availability, wind speeds, soil depths and temperatures, as well as solar exposure and climate. Plant growth characteristics for extensive green roofs include fast establishment, long lived with dense coverage, pest and disease resistance, shallow rooting, self-regeneration from seed and vegetative parts, tolerance for extreme weather and very dry to saturated conditions, and low requirements for maintenance and inputs. Examples of native habitats that match the extreme conditions found on extensive green roofs include:

- dry grasslands, cliffs and coasts,
- arid mountain ranges,
- steppe, heath, and alpine communities,
- sandy, talus, and cliff communities, and
- wastelands, gravel and sand pits, rocky outcrops, other hard surfaces.

Plants suitable for extensive green roofs may include succulents, bulbs and corms, annual or biennial self seeders, bunch and stoloniferous grass-like plants, and some wetland and perennial herbs. Succulents, in particular *Sedum* cvs. (stonecrop) have been extensively used because they are well adapted for growing in the extensive green roof microclimate. Learn more about the interesting characteristics of the genus *Sedum* at this link to *Living Architecture Monitor, Sedum: The Workhorse of Green Roofs Plants* [New Tab][3]. In addition to planting sedums, diversified communities may include adapted species such as *Aster* spp. (common aster), *Campanula carpatica* (Carpathian harebell, canterbury bells), *Heuchera* cvs. (coral bells, alumroot), *Penstemon* cvs. (beardtongue), *Phlox subulata* (creeping phlox), as well as sedges and grasses like *Andropogon gerardii* (big bluestem), and *Panicum virgatum* (switch grass).

Practice: Match the images of plants suitable for green roofs.

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https://kpu.pressbooks.pub/plantidentification/?p=1227#h5p-66

Plants for green walls

Green walls composed of vertical systems of vegetation, growing media, irrigation, and drainage are increasingly used in exterior and interior landscapes for their aesthetic and environmental benefits. The shading, water management, screening, buffering, and insulating properties of green walls can reduce air temperature, noise levels, and the energy costs for cooling buildings. The three major categories of green walls are green facades, living walls, and retaining living walls. Green facades of cable systems, trellises, arbors, and fences offset from a building face support the growth of vines and lianas or cascading plants that are rooted in ground level or above ground planters. Living wall systems of vegetated modules, panels, or bags containing growing media that are freestanding or attached to structural walls or frames support shallow fibrous rooted and creeping herbaceous and woody plants. Retaining living wall systems that are designed to stabilize slopes incorporate vegetation within interlocking geotextile fabric bags, mats, precast concrete units, or in woven wattles of *Salix discolor* (native pussy willow, pussy willow). Figure 9.2

3. https://livingarchitecturemonitor.com/news/2018/2/19/sedum-the-workhorse-of-green-roof-plants

shows an example of a living green wall on a building. Read more about the properties and benefits of green walls at this link to *Green Roofs for Healthy Cities, About Green Walls* [New Tab][4].

Figure 9.2 Example of a living green wall

Similar to green roofs, green walls have unique growing conditions that will influence plant selection. Factors for consideration include an indoor or outdoor climate, specialized soil requirements and wall orientation, the green wall design and level of maintenance required. Where green walls are not connected to groundwater, irrigation and intensive maintenance are necessary to ensure appropriate appearance and function. In situations where wall height and desiccation by wind and lack of shade limit plant growth, species adapted to cliff-faces, extreme slopes and thin soil habitats offer suitable choices. Depending on the type of green wall, suitable plants may range from annuals to herbaceous and woody perennials. Some examples of suitable species are *Heuchera* cvs. (coral bells, alumroot), *Penstemon* cvs. (beard tongue), *Cotoneaster apiculatus* (cranberry cotoneaster), *Fragaria* x *ananassa* (garden strawberry), and *Gaultheria procumbens* (wintergreen), as well as succulents and tropical species. Depending on the need for seasonal shading on buildings, green facades may include evergreen or deciduous climbers such as *Actinidia kolomikta* (actinidia) and *Campsis radicans* (trumpet vine).

4. https://greenroofs.org/about-green-walls

Practice: Recognize plants suitable for green walls. Move cursor over images for plant names.

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https://kpu.pressbooks.pub/plantidentification/?p=1227#h5p-67

Plants for bioswales and rain gardens

Green infrastructure uses the process of bioretention to manage stormwater quantity and quality. Bioretention structures such as bioswales and rain gardens are designed to capture, detain, convey, infiltrate, and evaporate water from a planting. Vegetated bioswales are broad shallow straight or meandering channels with porous soil and gently sloped sides and bottom that collect and convey stormwater from one location to another while maximizing soil infiltration and plant uptake. Bioswales are designed to manage short intense periods of rain and flooding followed by dry periods. They reduce the impact of stormwater events and capture the first flush of pollutants from paved and sealed surfaces for remediation by plants and soil microorganisms. Figure 9.3 shows an example of how a vegetated bioswale captures and conveys stormwater runoff from the sealed pavement as well as the turf area.

Figure 9.3 Example of a vegetated bioswale

Rain gardens are shallow infiltration basins located in depressions and low lying areas that capture and temporarily retain water for infiltration and groundwater recharge. Porous soil filters pollutants and allows for uptake and transpiration by plants to reduce air and water temperatures. Figure 9.4 shows an example of a rain garden. Note that the roof downspout enters the rain garden, and when combined with porous pavement, the site becomes an absorbent landscape.

Figure 9.4 Example of a rain garden

Learn more about the components and characteristics of green infrastructure for stormwater management available at this link to *Capital Regional District, Green Stormwater Infrastructure* [New Tab][5].

In addition to specific growing conditions and appearance expectations, plants for green stormwater infrastructure projects must fulfill basic functional requirements that include:

- tolerance and resilience to flooding, sediment events, drought, and wilting,
- extensive and deep root structure for resistance to heavy water flows,
- dense foliage and spreading growth that prevents erosion and increases evapotranspiration,
- reliable, vigorous growth without becoming invasive, and
- an ability to tolerate and accumulate contaminants from water or saturated soil.

Native and ornamental species are usually planted according to their tolerance for the wetter bottom or drier side and upper edges of bioswales and rain gardens. Where space and soil volume permit, planting trees and large shrubs such as *Alnus rubra* (red alder), *Frangula purshiana* (cascara), and *Salix discolor* (native willow, pussy willow) will prevent erosion and transpire great amounts of water. Examples of shrubs for bioswales and raingardens include *Clethra alnifolia* (summersweet), *Ribes sanguineum* (flowering currant, winter currant), *Rubus spectabilis* (salmonberry), and *Symphoricarpos albus* (snowberry). Where space for trees and shrubs is limited, planting multiple layers of herbaceous vegetation will increase the foliage density and the benefits of transpiration. Some examples of adapted herbaceous species include *Aconitum napellus* (monkshood), *Aster* spp. (common aster), *Carex oshimensis* 'Evergold' (Evergold Japanese sedge), *Lysimachia clethroides* (gooseneck lysimachia), *Panicum virgatum* (switchgrass), and *Pennisetum alopecuroide*s (fountain grass).

5. https://www.crd.bc.ca/education/green-stormwater-infrastructure

Practice: Recognize plants suitable for bioswales and rain gardens.

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https://kpu.pressbooks.pub/plantidentification/?p=1227#h5p-68

In order for green infrastructure to provide ecosystem services as designed, maintenance practices must ensure appropriate vegetation cover for proper function and aesthetic performance. Improper maintenance can defeat the purpose of green infrastructure and lead to costly replacement or restoration. Routine maintenance involves inspection and repair for erosion, appearance, and removal of sediment and potential invasive species. Regular soil testing, weeding, and trash removal will influence the long term efficiency and effectiveness of pollutant removal and stormwater management by vegetated bioretention structures.

CHAPTER 10

Plants for Edible Landscapes

Learning Objectives

- Describe plants suitable for edible landscapes.

As part of green infrastructure, gardening for food production offers a wide range of environmental, economic, and social benefits. Growing local food within and around communities supports:

- habitat for pollinators and biodiversity,
- regulation of local climate and water management,
- reduction of energy use and carbon footprints,
- food security and local economy, and
- physical health and social connections.

Urban agriculture is the process of growing, processing, and distributing local food and food products. There are many types of urban agriculture including community gardens, boulevard planting, green roofs, vertical farms, urban chickens, bee keeping, aquaculture, and small scale faming for farmers markets. Some other forms of food production are edible landscapes, food forests, urban orchards, gleaning (public land harvest), grow a row donations and backyard sharing, and guerrilla gardening. Figure 10.1 shows an example of products of urban agriculture available for purchase at a farmers market. Read more about the benefits and different types of urban agriculture at this link to *The Urban Farmer* [New Tab][1]

1. http://www.theurbanfarmer.ca/urban-agriculture

Figure 10.1 Example of urban agriculture products for sale at a farmers market stall

Communities plan and manage urban agriculture through policies, zoning bylaws, and land use regulations that allow certain public green spaces to be used for growing food. For example, community gardens for non-commercial food production that are allowed in some or all land use designations will have guidelines for safety, accessibility, maintenance, and aesthetics. Read about an example of jurisdictional policy and regulations for community gardens available at this link to *City of Victoria Community Gardens Policy*[PDF][New Tab].[2]

Food production in residential landscapes is commonly associated with vegetable plots in backyards. Annual species grown for produce are usually arranged in agricultural patterns of straight lines in designated areas. Soil is often amended with compost, heavily irrigated, and seasonally tilled over for new planting. In contrast, edible landscapes, sometimes called foodscapes, incorporate plants for food as well as ornamental value within existing and new residential and public landscape designs. In general, plants for edible landscapes are herbaceous and woody perennial species that:

- are adapted for the climate and naturally resistant to pest and disease,
- require less intensive or similar levels of maintenance and inputs as the rest of the planting area, and
- provide multiple benefits such as food, aesthetics, shading, and water management.

Plants selected for preferred foods and the attributes of form, texture, and colour are integrated with other ornamental plants to achieve a desired garden style and aesthetic appearance. For example, the fruit producing tree, *Morus alba* 'Pendula' (weeping mulberry) serves as a specimen plant with distinctive form. Shrubs with berries and vibrant autumn foliage colour like *Vaccinium corymbosum* (highbush blueberry) may be planted as hedging. Edible spreaders like *Fragaria* x *ananassa* (garden strawberry) and *Gaultheria procumbens* (wintergreen) provide ground cover while vegetables with fine texture foliage like *Daucus carota* ssp. *sativus* (carrot) contrast coarse texture plants like *Rheum palmatum* (rhubarb). Aromatic herbs such as *Origanum laevigatum* 'Herrenhausen' and *Rosmarinus officinalis* (rosemary) provide structure, scent, and visual interest alongside edible flowers like *Impatiens walleriana* (impatiens) and *Phlox paniculata* (summer phlox, border phlox). Learn more information about the origins, benefits, maintenance, and types of plants for edible landscapes available at this link to *Foodscaping-Wikipedia* [New Tab][3]

2. https://www.victoria.ca/assets/Departments/Parks~Rec~Culture/Parks/Documents/community-garden-policy.pdf
3. https://en.wikipedia.org/wiki/Foodscaping

Practice: Recognize plants for edible landscapes.

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Techniques that maximize space use and vegetation cover such as interplanting larger, slow growing food plants with smaller, fast growing plants reduce soil erosion and suppress opportunistic weeds. Combining plants with different heights and structure, nutrient requirements, and rooting depths creates growing microclimates and reduces plant competition for soil nutrients. Certain companion plants such as members of the Fabaceae (pea) family that fix atmospheric nitrogen in available forms in root nodules can benefit nearby nitrogen feeders like leafy vegetables. Aromatic herbs can be used to repel pests attracted to other species by smell, and the deliberate planting of host plants distract pests from other plants and attract beneficial insects and predators that feed on pests. Read more information about the benefits of companion planting available at this link to *Companion planting – Wikipedia* [New Tab][4].

Edible landscapes that are intended to provide food products for human consumption are distinguished from planted habitats that are intended to attract wildlife. As areas of natural ecosystems are converted to residential, agricultural, industrial, and other uses, the loss of habitat negatively impacts native wildlife. However, where fragments or patches of habitat are not too small and are close together, they can be connected by corridors of vegetation that allow native species to access adequate food, water, shelter and protection. Planting regional

4. https://en.wikipedia.org/wiki/Companion_planting

native plants that mimic the habitat characteristics of the desired wildlife species in landscapes and gardens can provide the particular needs for food, water, shelter and protection.

Creating connections between native and ornamental vegetation and water sources in urban forests, parks, gardens, boulevards, and other plantings allows wildlife to move safely among habitat patches in urban areas. For example, evergreen trees like *Cryptomeria japonica* (Japanese cedar) with branches close to the ground and deciduous trees with open canopies and multiple branches such as *Frangula purshiana* (cascara), and *Prunus padus* var. *commutata* (European bird cherry) offer shelter and protection, as well as nesting sites and food. Interplanting layers of shrubs like *Ribes alpinum* (alpine currant), *Ribes sanguineum* (flowering currant, winter currant), and *Rubus spectabilis* (salmonberry) with herbaceous species like *Andropogon gerardii* (big bluestem), *Asarum caudatum* (western wild ginger), and *Polystichum munitum* (western sword fern) provides a range of wildlife species with food, shelter, and protection. Review images of plant examples at this link to *KPU Plant Database* [New Tab][5]w Tab]. Learn more about gardening for wildlife habitat available at this link to *Fraser Valley Conservancy Native Plants Guide*[PDF][New Tab][6]

Habitat loss and invasive species are major threats to wildlife habitats, particularly in wetlands and forests. Selecting ornamental plants for habitat planting includes examining the potential for species to escape, establish, and overtake natural ecosystems. Non-invasive ornamentals and regional native plants are the responsible alternative to invasive plants. For example, an introduced horticultural plant that has become invasive in wetlands is *Butomus umbellatus* (flowering rush). Alternate choices for this plant include the native species *Scirpus microcarpus (s*mall-flowered bulrush), *Carex* spp. (sedges), and *Sagittaria latifolia* (wapato, arrowhead). Alternate choices for another invasive, *Euphorbia esula* (green spurge, leafy spurge) include species in the genera *Delosperma* (ice plant) and *Helianthemum* (rock rose). Species in the genera *Salvia* (sage), and *Penstemon* (beardtongue) provide alternate choices for the invasive species, *Echium vulgare* (blueweed). Another invasive species, *Linaria vulgaris* (toadflax) can be replaced with selections from the genera *Penstemon* (beardtongue), *Hemerocallis* (daylily), *Antirrhinum* (snapdragon), and *Kniphofia* (torch lily). Learn more about the threat of invasive horticultural plants and alternative plant choices at this link to *Invasive Species Council of BC Grow Me Instead*[PDF][New Tab][7]

Practice: Name the invasive species. Move the cursor over the image to check your response.

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https://kpu.pressbooks.pub/plantidentification/?p=1443#h5p-77

5. https://plantdatabase.kpu.ca/
6. https://fraservalleyconservancy.ca/wp-content/uploads/2018/08/FVC-Native-Plants-guide-Aug-2018-web.pdf
7. https://www.bcinvasives.ca/documents/ISCBC-GMI-Brochure-180425-WEB.pdf