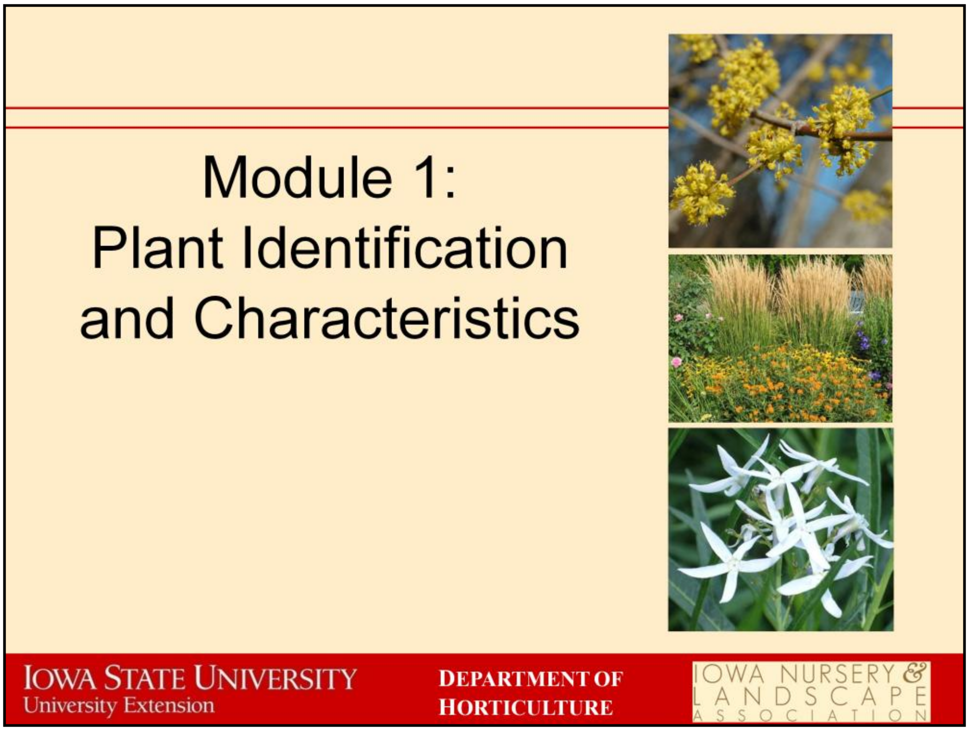
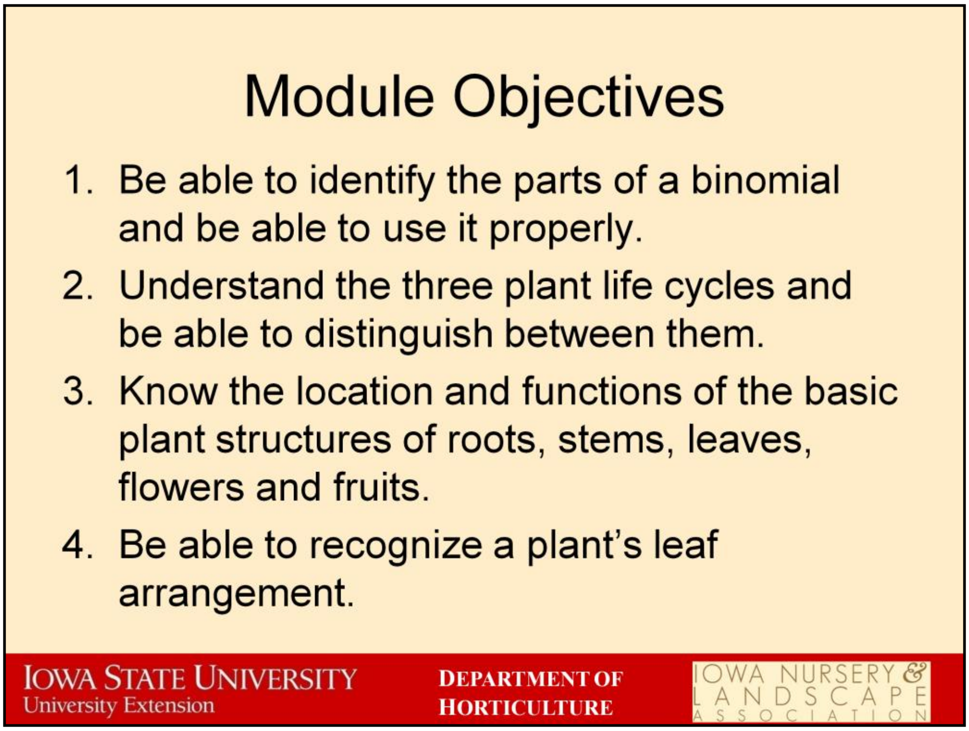
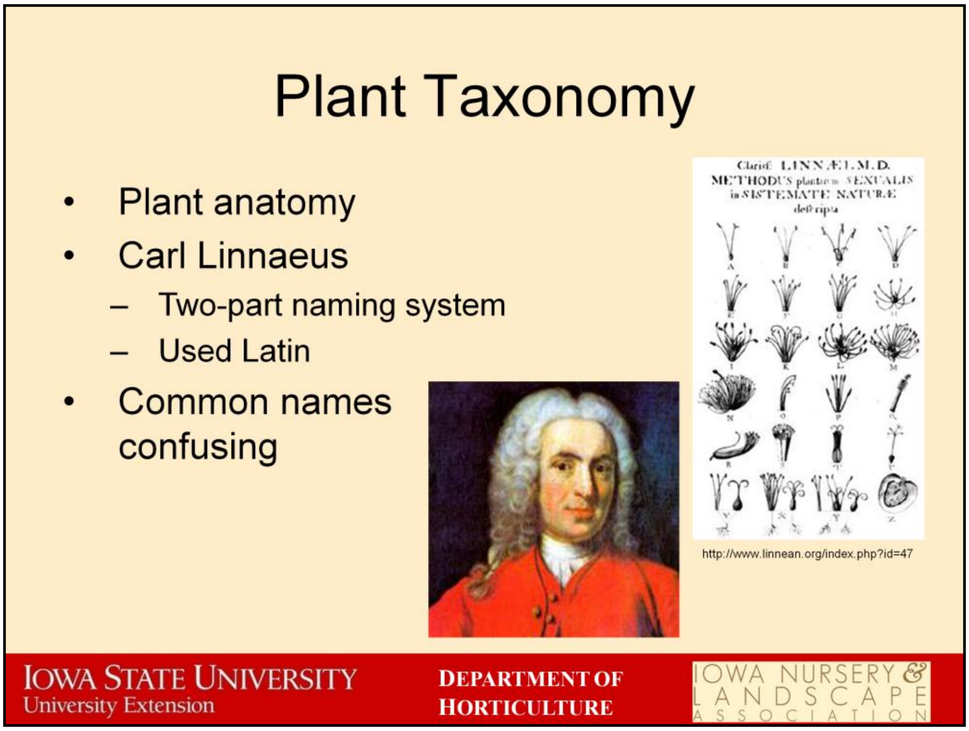


Welcome to the Iowa Certified Nursery Professional Training program Module 1: Plant Identification and Characteristics.



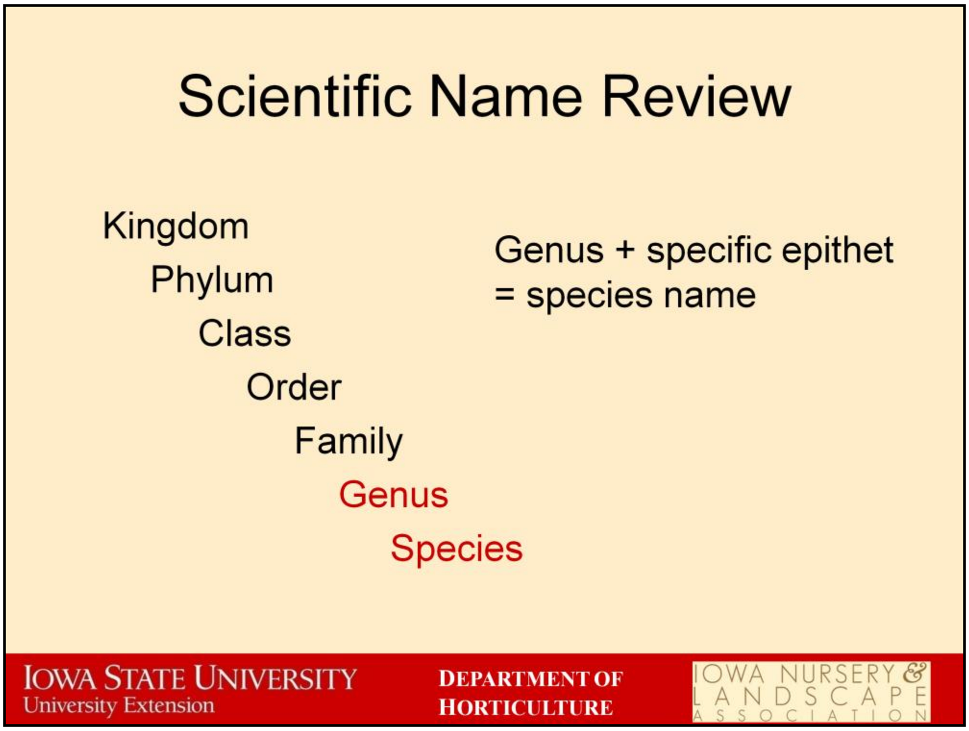
This module has 4 objects and upon completion you will be able to fulfill each of the objectives listed below.

1. You will be able to identify the parts of a binomial and be able to use it properly.
2. You will understand the three plant life cycles and be able to distinguish between them.
3. You will know the location and functions of the basic plant structures of roots, stems, leaves, flowers and fruits.
4. You will be able to recognize a plant's leaf arrangement.



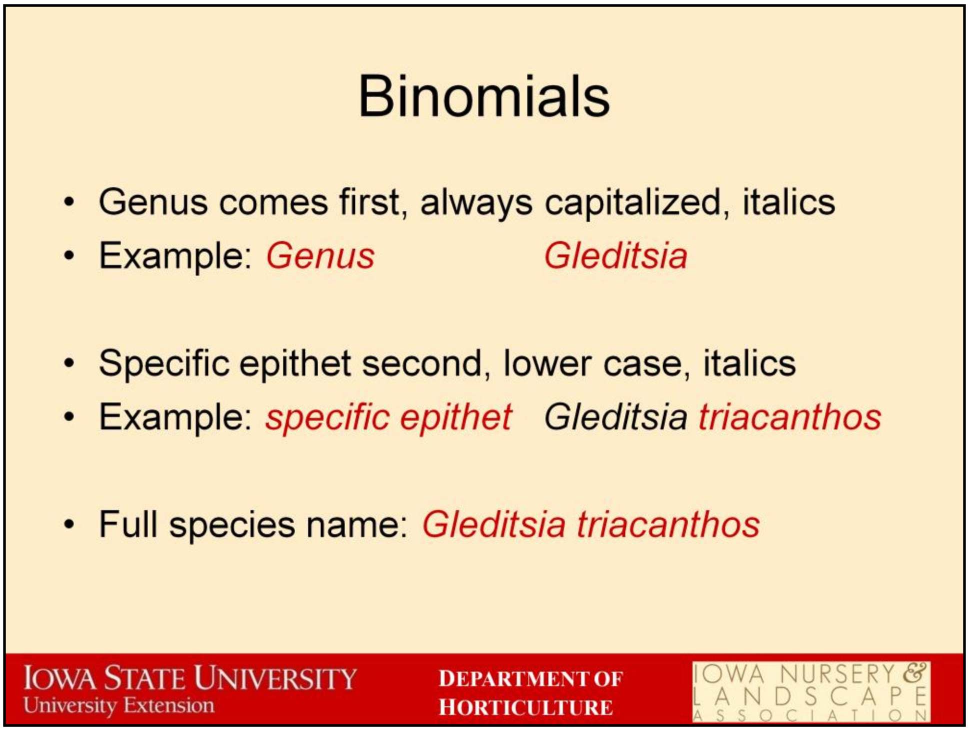
The scientific binomial naming system used in botanic fields today was developed by Carl Linnaeus. Linnaeus was a Swedish botanist who refined the plant classification system of the time into the Latin based, more familiar form today.

The botanic names or scientific names are used all around the world. Having this one name that is common across all languages helps people talk about a plant or animal and know exactly what they are talking about. Common names are confusing because several different plants can have the same common name or one plant can have several common names.



As you probably learned in high school biology class, there are several different levels of classification for scientific names. Genus and species are the two most narrow categories of the scientific classification sequence. In ornamental horticulture we are generally only concerned with the genus and species, sometimes the family. Knowing where these 3 levels fall in relation to the other levels of classification is important, because sometimes you will need to know the order or class.

In botanic nomenclature the species name is comprised of the genus name and the specific epithet. Botanists and horticulturalists use the specific epithet as a very unique descriptive characteristic. Having some understanding of the Latin root words can help you understand why certain plants have a certain specific epithet.



The first part of the scientific name is the genus. The genus always comes first, is capitalized, and in italics when typed or underlined when hand written. The genus of the honey locust tree is *Gleditsia*.

The second part of the scientific name is the specific epithet. The specific epithet is often particularly descriptive of the plant being named. Many specific epithets describe a color or origin of the plant. When writing the specific epithet, always use lower case and italics or underlined when hand-written.

The full species name for this honey locust tree is *Gleditsia triacanthos.* The species name is only used when referring to this particular tree; no other plant has that combination of words.

Varieties and Cultivars

- Variety
  - Natural genetic variance
  - Passed on via sexual reproduction
- Cultivar
  - "Cultivated variety"
  - Natural genetic variance
  - Passed on via asexual propagation by people

IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Varieties and cultivars are natural variations that have occurred through sexual reproduction and the mutation capabilities that come with genetic recombination during sexual reproduction. Varieties are passed on from one generation to another by seeds. Thornlessness is a trait that can be passed on this way.

Cultivars are cultivated varieties. These changes or mutations must be asexually propagated in order to continue having that trait. Leaf variegation or purple colored foliage are often traits that are passed on this way. When cultivars are reproduced via seeds the unique trait may be lost.

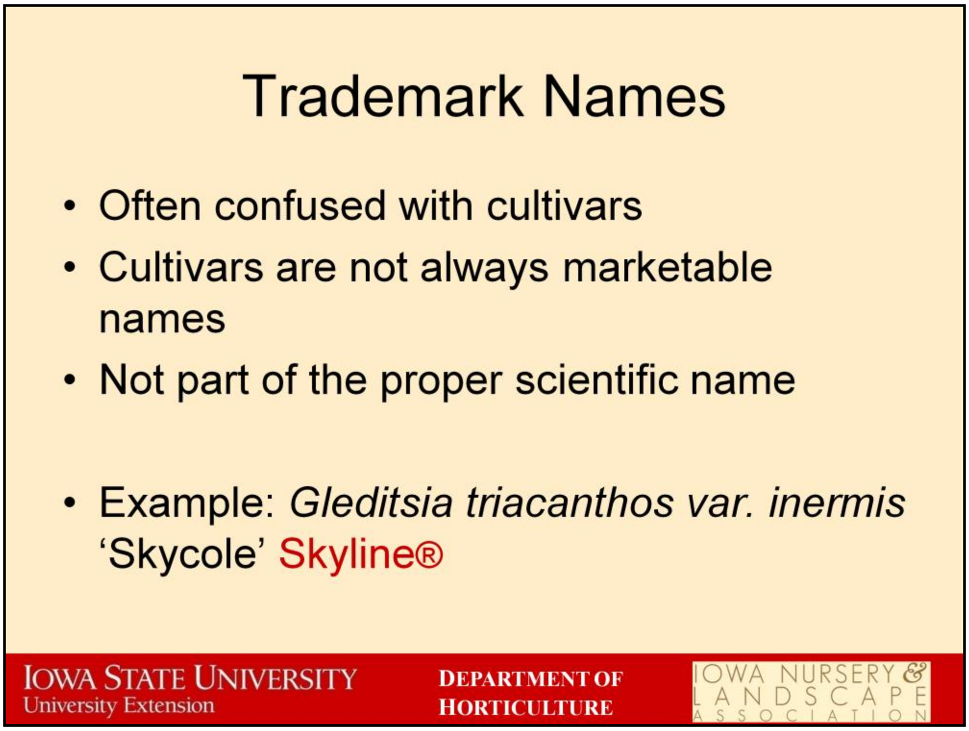
Varieties and Cultivars

- Variety
  - Designated by var. abbreviation
  - Example: *Gleditsia triacanthos var. inermis*
- Cultivar
  - Designated by single quotes
  - No italics
  - Example: *Gleditsia triacanthos var. inermis* 'Skycole'

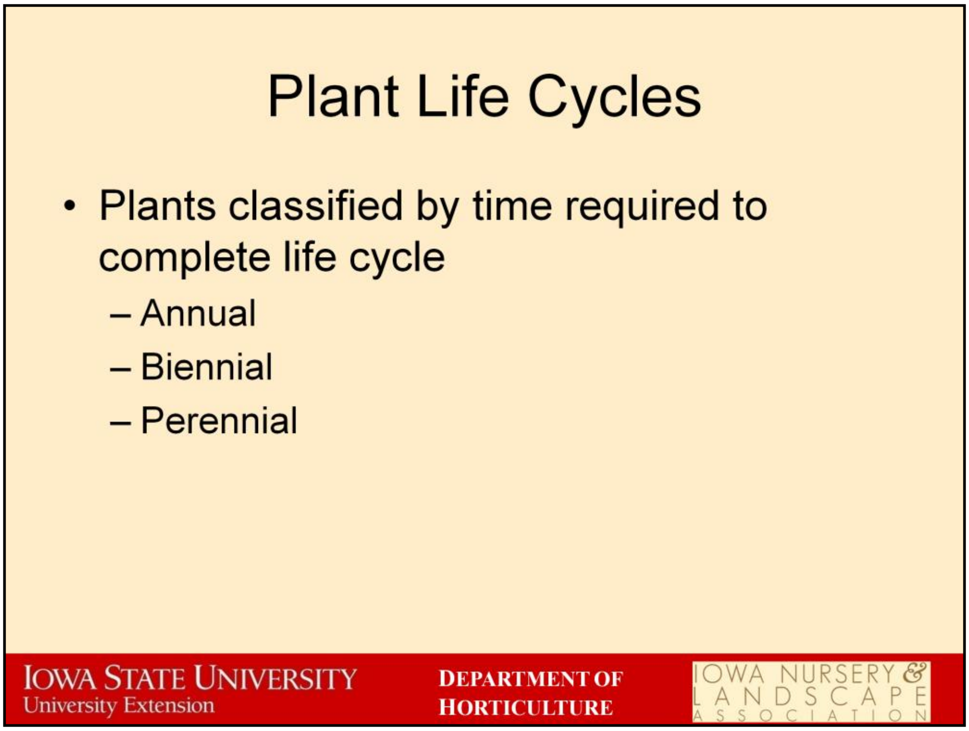
IOWA STATE UNIVERSITY
University Extension
DEPARTMENT OF HORTICULTURE
IOWA NURSERY & LANDSCAPE ASSOCIATION

When writing or typing botanic names with varieties, the proper way is to use the abbreviation var. to designate the variety. The variety follows in italics. The example of honey locust is *var. inermis*. This variety is a naturally occurring thronless tree. Honey locust trees usually have huge thorns, but there are natural mutations that have resulted in thornless varieties. The thornless trees are usually much preferred by homeowners over the thorned trees.

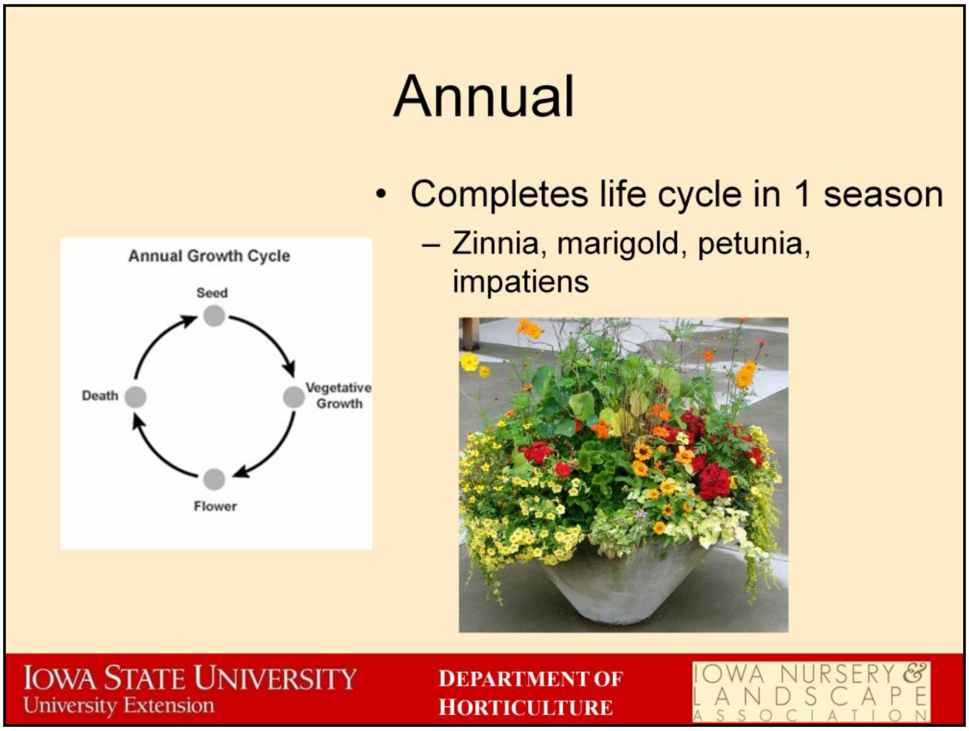
Cultivars are designated with single quotation marks. The cultivar is not italicized. The honey locust example is 'Skycole'.



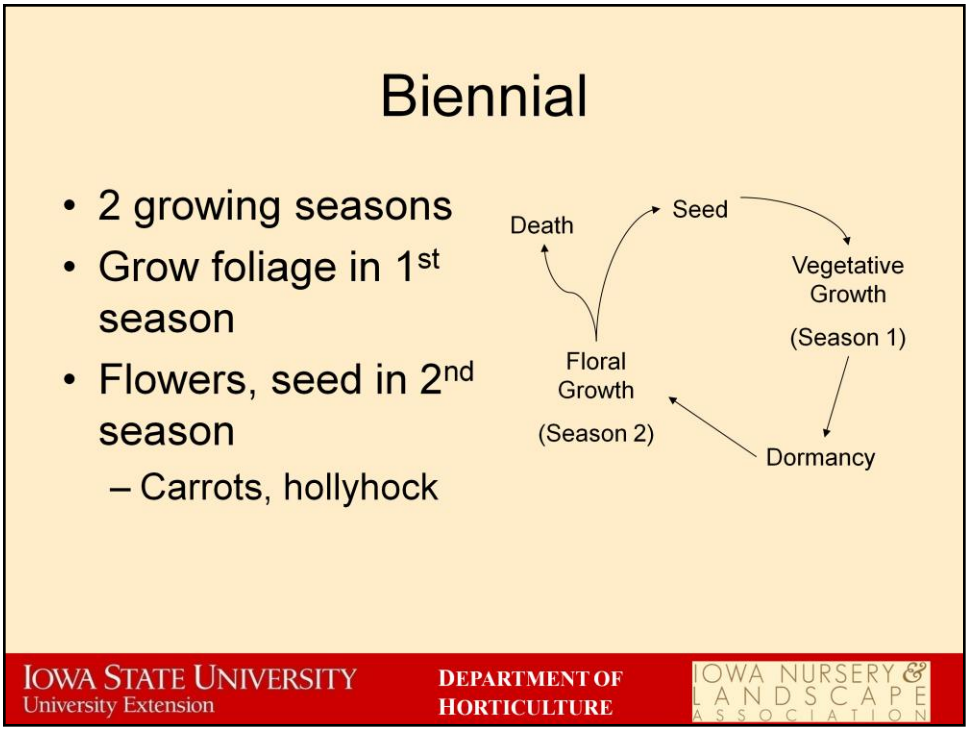
Trademark names are names used by nursery people to better market and sell a particular tree. The trademark name is not part of the proper botanic name. It is common that the cultivar name and trademark are used interchangeably, which is incorrect. The honey locust *Gleditsia triacanthos var. inermis* 'Skycole' has been given the trademark name Skyline® to make is more attractive from a marketing standpoint.



Plants can be classified by the length of their life cycle. There are three plant life cycles: annual, biennial, and perennial.



Annuals complete their life cycle in one growing season. In the spring they sprout from a seed, they grow and mature, flower and produce seed. In the fall they die. The next spring new plants sprout from the seeds that were produced. Examples of annual plants include zinnia, marigold, petunia, impatiens.



Biennial plants require two growing seasons to complete their life cycle. During the first season they sprout from seed and grow vegetatively until frost. During the second season, they sprout from the crown and grow a smaller amount of foliage. They flower and produce seed during the second growing season. After producing seed the plant will die. Examples of biennial plants are carrots and hollyhock.

Perennial

- Grow over many seasons
- Produce flowers and seed over many seasons
- Woody or herbaceous
  - Hosta, daylily, oak trees, honeysuckle bush

IOWA STATE UNIVERSITY
University Extension

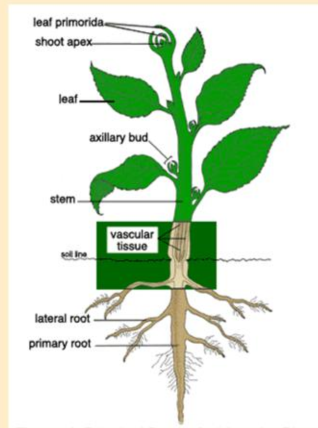
DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Perennial plants continue to grow over several seasons producing leaves, flowers, fruits and seeds. Herbaceous perennials are those that die back to the ground in the winter. Hosta and daylilies are herbaceous perennials. Woody perennials or woody plants are those that have a woody stem structure that persists through the winter. Trees and shrubs are woody perennials.

Basic Plant Anatomy

- 5 Plant Organs
  - Roots
  - Stems
  - Leaves
  - Flowers
  - Fruits



IOWA STATE UNIVERSITY
University Extension

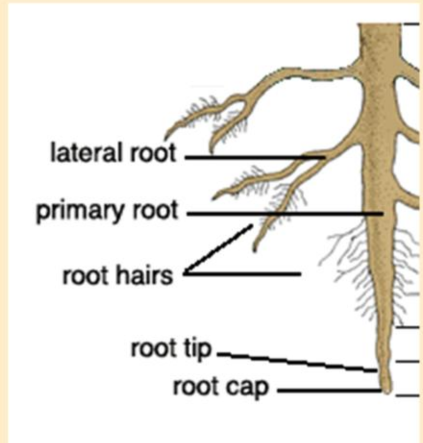
DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

In the plant anatomy section we will cover the functions, parts and types of roots, stems, leaves, flowers and fruits that can be found within the plant kingdom.

Roots

- Functions:
  - Anchor, support
  - Absorbtion
- Adventitious roots



IOWA STATE UNIVERSITY
University Extension

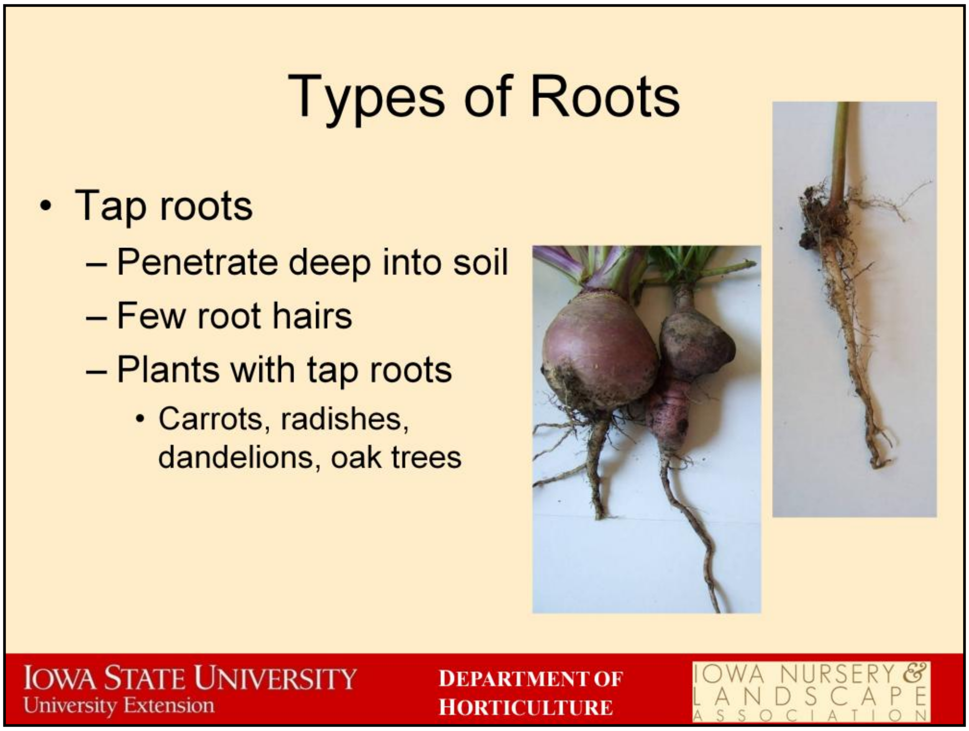
DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Roots are the underground part of the plant we often forget about. The roots are essential for plant to grow. Roots have 2 main functions: to anchor the above-ground portion of the plant and to absorb water and nutrients for the plant to use while it's growing.

Anchor and support are provided by fibrous roots that spread out from the center of the plant and tap roots that penetrate deep into the soil. Water and nutrient absorption is done through branch roots and root hairs.

Roots may also arise from non-root portions of the plant. Those roots are called adventitious roots. Adventitious roots may also form when the growing root tip is damaged.



Tap roots are important in anchoring plants in the ground so they can grow up. Tap roots penetrate deep into the soil and tend to have relatively few root hairs or branching roots. Examples of edible tap roots are carrots and radishes.

Types of Roots

- Fibrous roots
  - Netted, fine roots
  - Absorb nutrients and water
  - Examples
    - Grass, dogwood, purple cone flower

IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

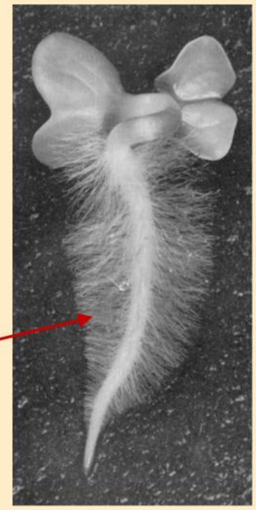
IOWA NURSERY & LANDSCAPE ASSOCIATION

Fibrous roots are netted, fine and absorb a lot of nutrients and water for the growing plant. Most plants have fibrous root systems. Grasses, dogwood shrubs, and purple cone flowers are just a few examples.

Types of Roots

- Root hairs
  - Fine, fibrous
  - Responsible for water and nutrient absorption
  - Short-lived

Root hairs on radish seedling!

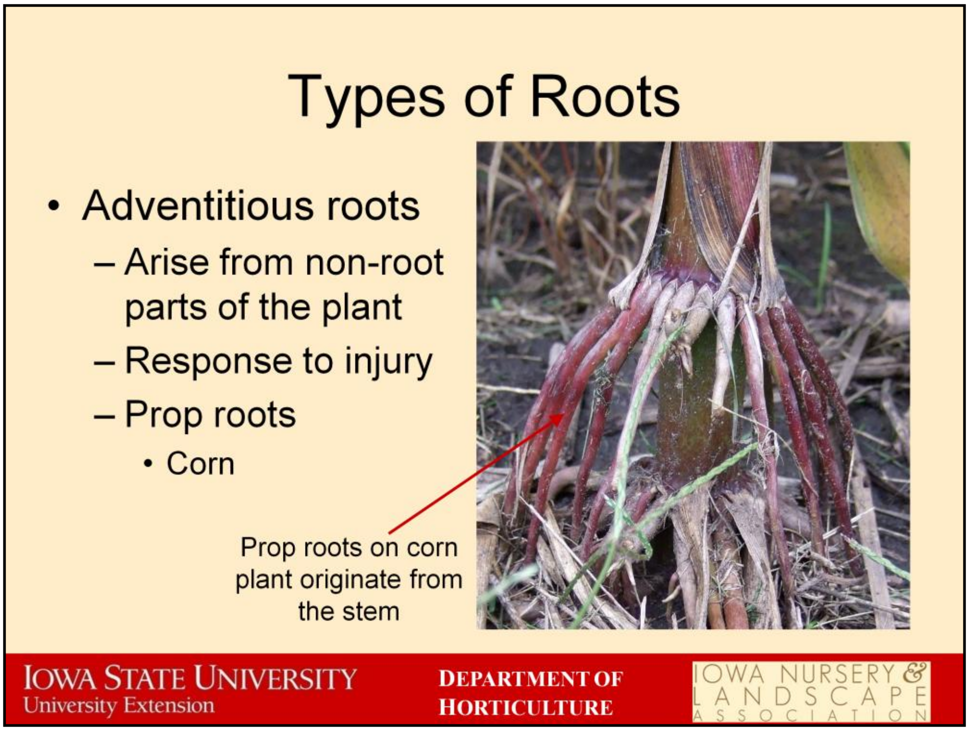


IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

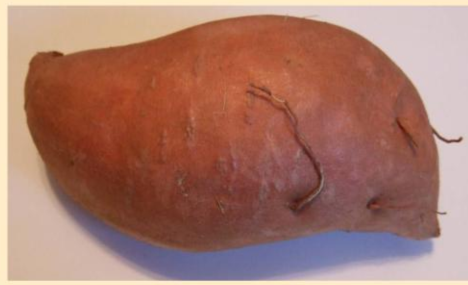
Root hairs are very important to water and nutrient absorption. Root hairs only live for one day. The plant is constantly growing new root hairs at the growing ends of the root system. If you dig up a plant, you will likely not see the root hairs because they are so fragile.



Adventitious roots are produced from non-root parts of the plant. Often they occur after the plant has been injured. Prop roots on corn plants are adventitious roots that are not in response to an injury. These roots develop from the stalk of the corn and help keep it up right in high wind situations.

Types of Roots

- Tuberous roots
  - Swollen root tissue
  - Stores extra nutrients and food
  - Examples
    - Sweet potato, dahlia



IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Tuberous roots are swollen root tissue that stores food for the plant to use the following growing season. The root tissue of tuberous roots become swollen with the extra nutrients because the plant sends the sugars it makes during photosynthesis to the roots to be stored. Some tuberous roots we eat, like sweet potatoes. Others, like dahlias, we don’t.

Test Your Knowledge

Match the image of the root with the proper name.

IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Match the image of the root with the proper name.

Stems

- Functions:
  - Support leaves, flowers, fruits
  - Transport water and food
    - Xylem and phloem
  - Store water and food

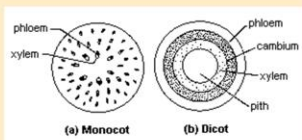
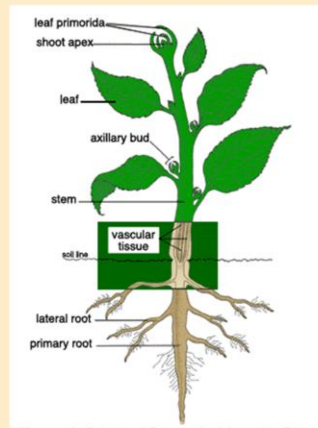


Figure 5. Cross sections of stems:
(a) discontinuous vascular system of a monocot stem.
(b) continuous vascular system of a woody dicot stem.



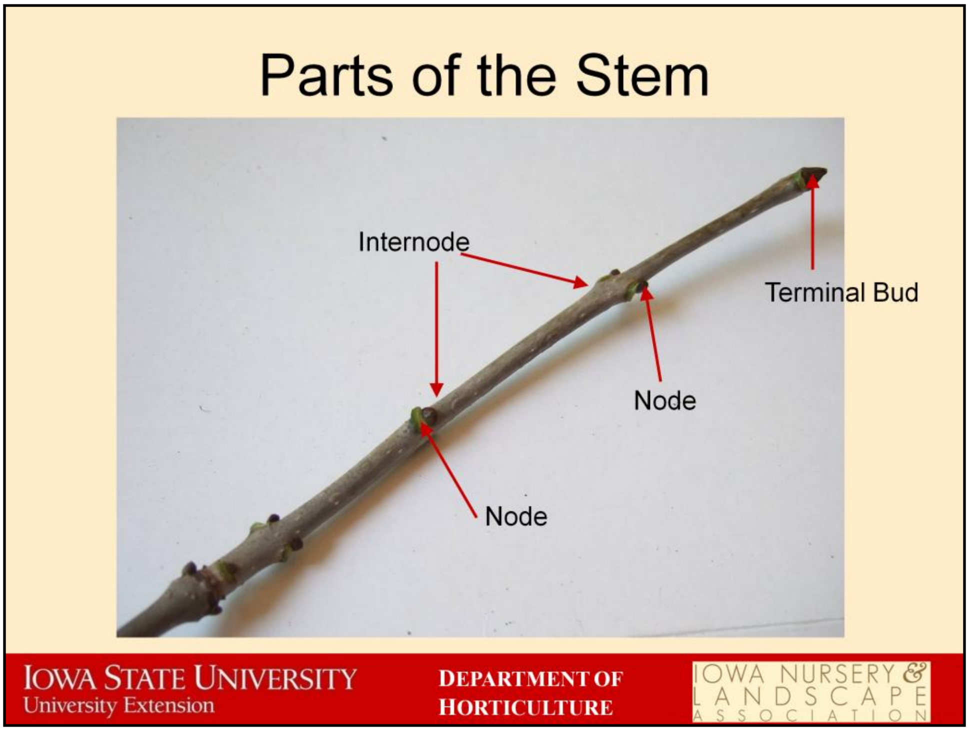
IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

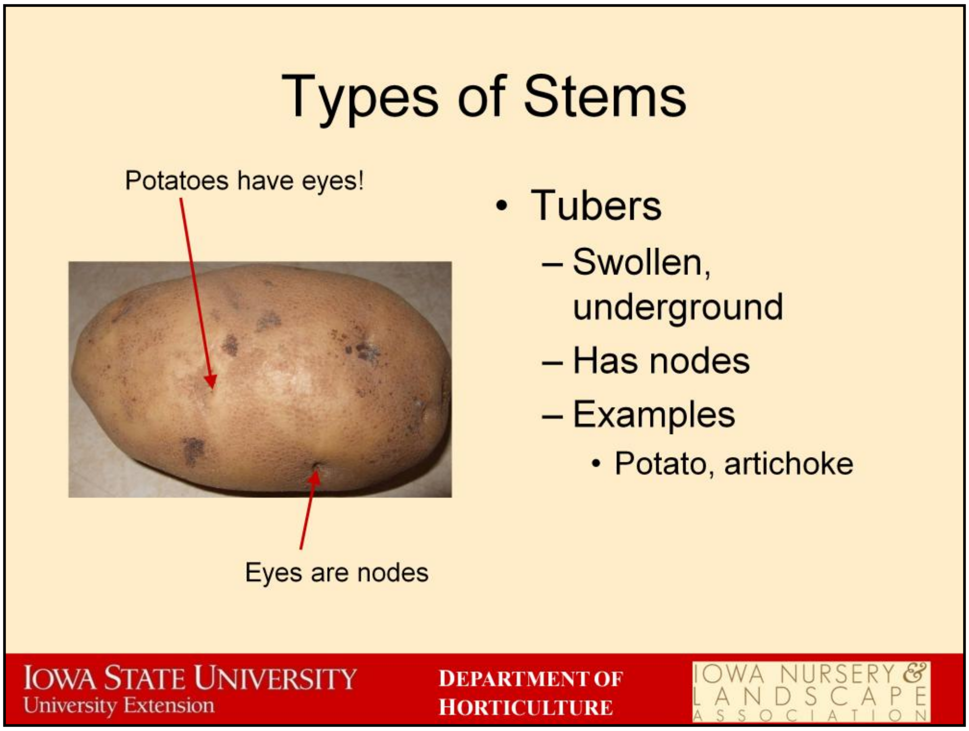
Stems serve several critical functions for a growing plant. Stems support the leaves, flowers, and fruits. Inside the stems are the water and food conducting tissues (xylem and phloem). Stem tissue can also produce and store food. We do eat some stems; asparagus for example is a stem that we eat.

The xylem and phloem are tube-like structures within the plant stems that are the pipes for moving water and food throughout the plant. The xylem moves water and dissolved minerals through the plant, while the phloem moves the sugars produced during photosynthesis.



Nodes are places along the stem where buds will open and produce branches, leaves, or flowers. Nodes are the points where the plant will grow; if there is no node, the plant won't grow from that point. The internode is the space between two consecutive nodes. Internode length is an indication of growth rate.

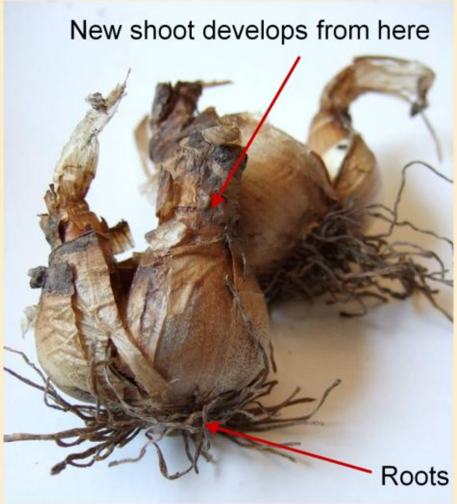
The terminal bud at the tip of the branch is where the stem will continue to grow in the following growing seasons.



Not all stems are found above ground. Tubers are swollen, underground stems. Tubers are different than tuberous roots because tubers have nodes. Examples of tubers are potatoes and artichokes.

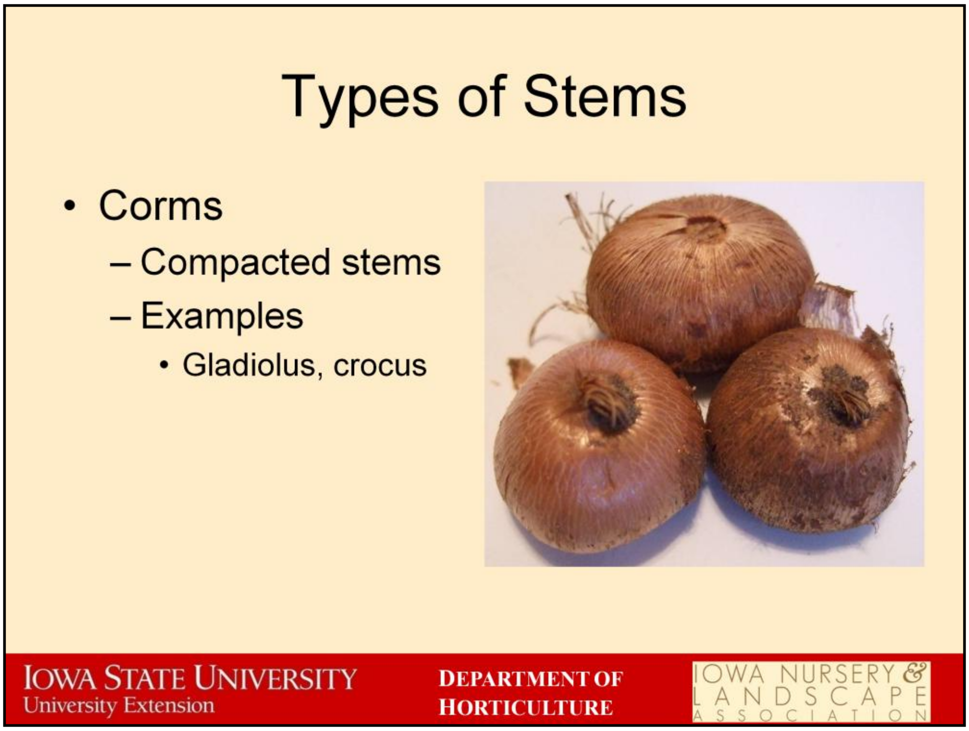
Types of Stems

- Bulbs
  - Compacted stems
  - Leaves overlap
  - Very short internode
  - Examples
    - Onion, tulip



IOWA STATE UNIVERSITY
University Extension
DEPARTMENT OF HORTICULTURE
IOWA NURSERY & LANDSCAPE ASSOCIATION

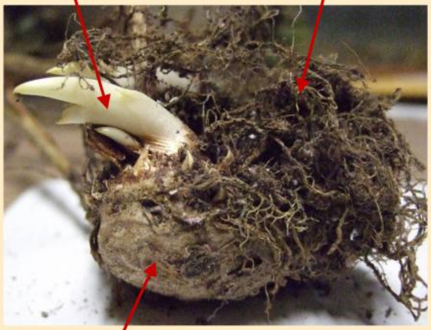
Bulbs are compacted stems that have very short internodes. The leaves of bulbs are overlapping. The papery covering of some bulbs, called the tunic, is there to protect the bulb from drying out. Examples include onions and tulips.



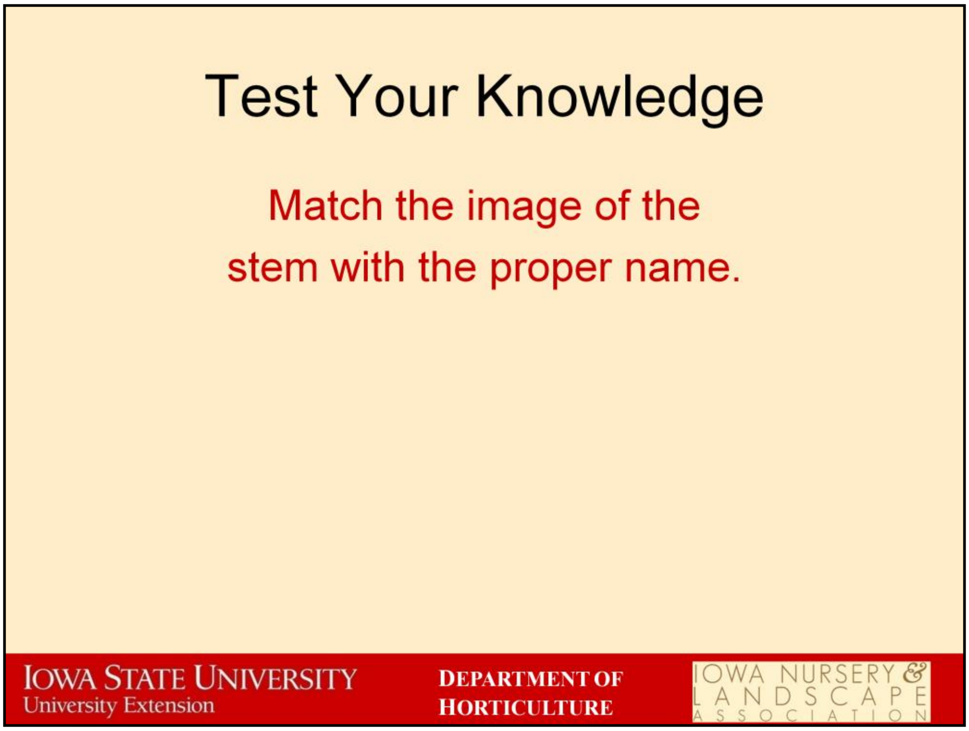
Corms are compacted stems with distinct internodes. Examples include gladiolus and crocus “bulbs”.

Types of Stems

- Rhizomes
  - Underground stems with nodes
  - Help spread plant
  - Examples
    - Iris, calla lily, grass species



Rhizomes are fleshy, underground stems with nodes. As the rhizome grows, leaves develops at the nodes and push up through the soil. Many grass species have rhizomes and use them to colonize an area. Another plant that has a rhizome is an iris.



Match the image of the stem with the proper name.

Leaves

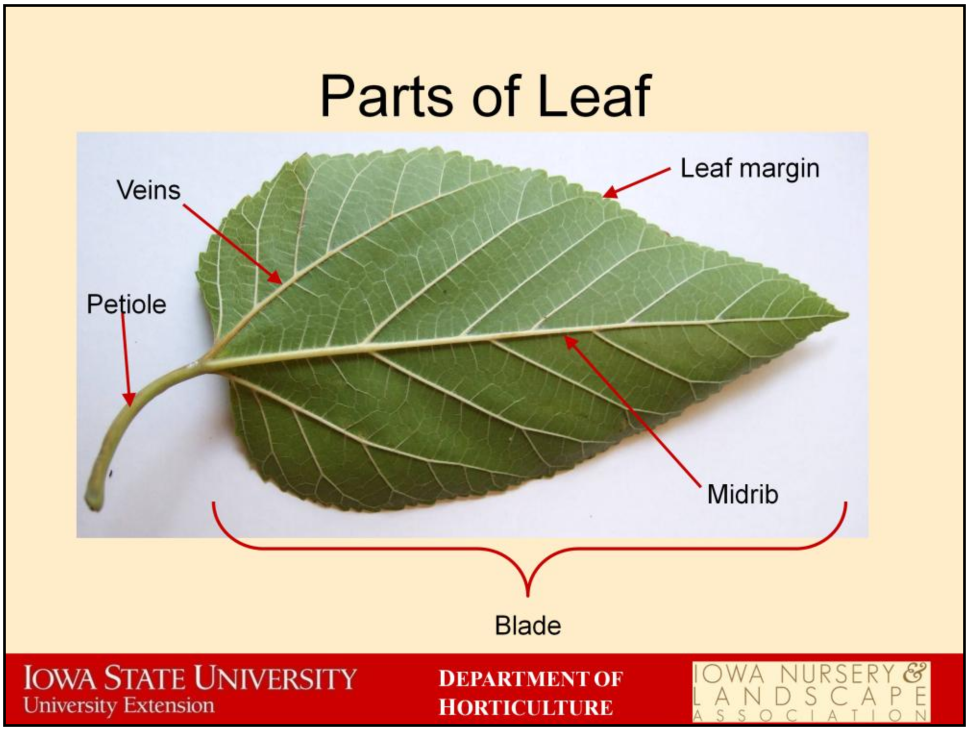
- Functions
  - Absorb sunlight to make food (photosynthesis)
  - Make food (respiration)
  - Loose water (transpiration)

IOWA STATE UNIVERSITY
University Extension
DEPARTMENT OF HORTICULTURE
IOWA NURSERY & LANDSCAPE ASSOCIATION

Leaves serve three main functions for a plant. They absorb sunlight to manufacture plant sugars through photosynthesis.

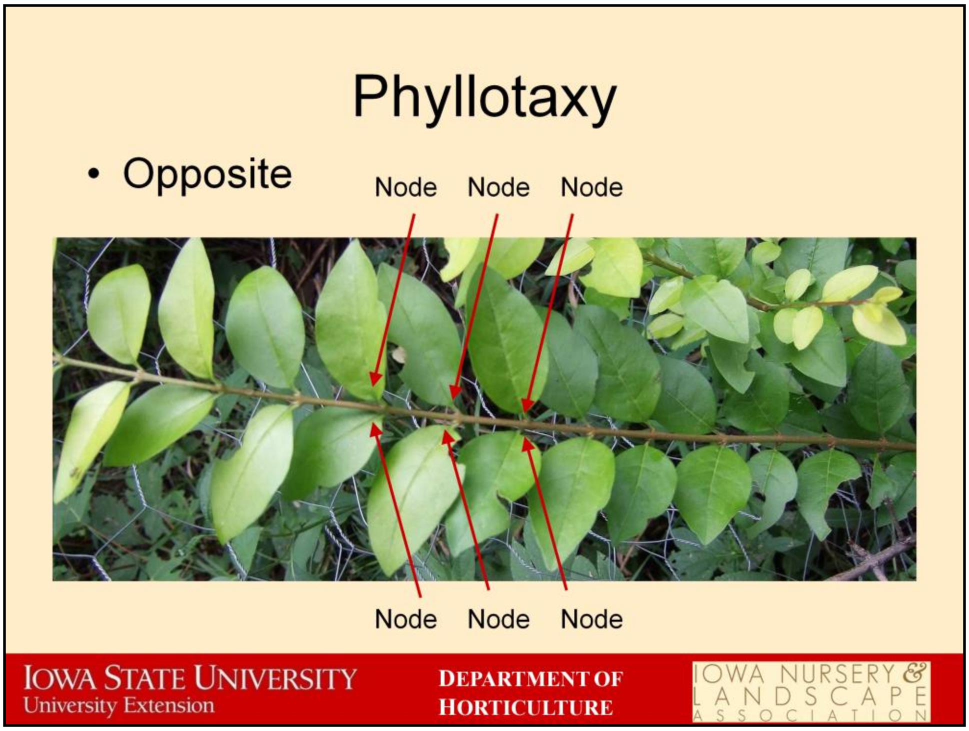
They are also a sight of respiration which is the process where the “food” they make for themselves is broken down to create energy for plant growth and development.

And they are the sight of the vast majority of transpiration in plants, which is the loss of water (in the vapor form) from plant tissue.

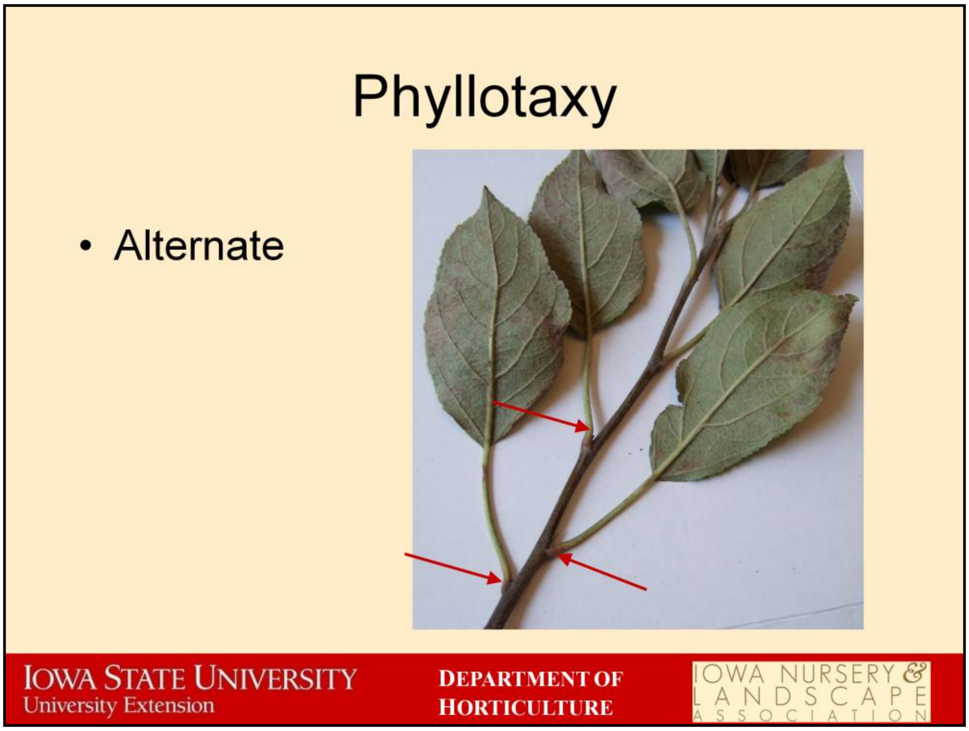


Leaves occur at nodes along the stem. At the node there is often a bud for next year's growth and a petiole. The petiole attaches the leaf blade to the stem. The blade has a midrib vein and a margin. The margin is often a unique identifiable characteristic of the species.

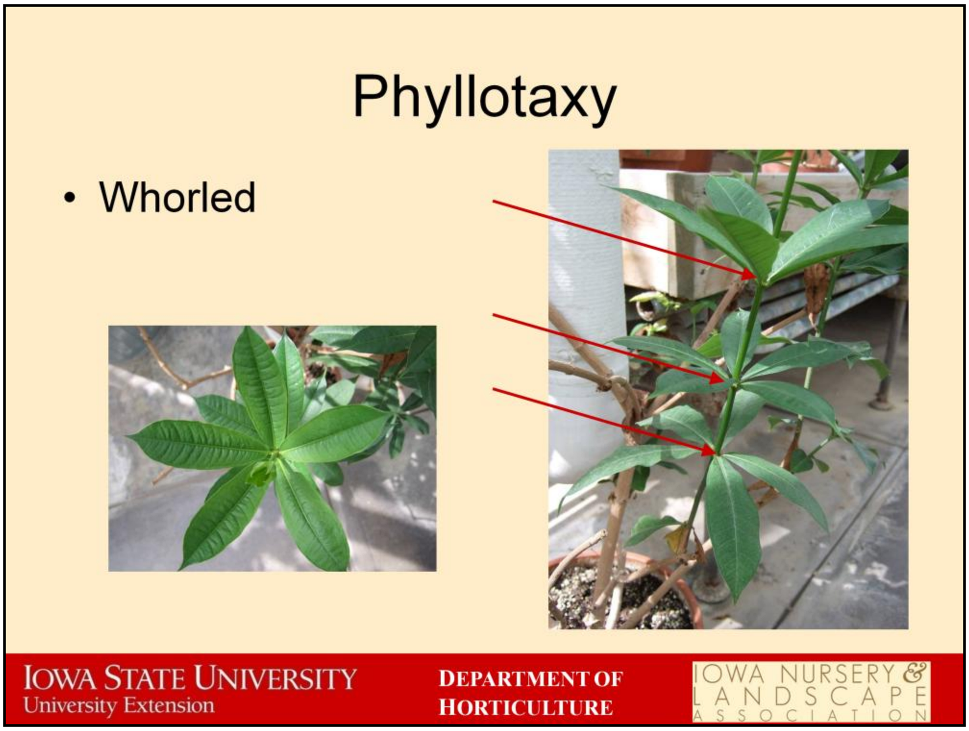
Needles on conifers or evergreens are also leaves. They are modified in shape to reduce the amount of water lost through the leaf surface during the winter because they hold onto their leaves all winter. Deciduous plants loose their leaves in the autumn and grow new leaves in the spring.



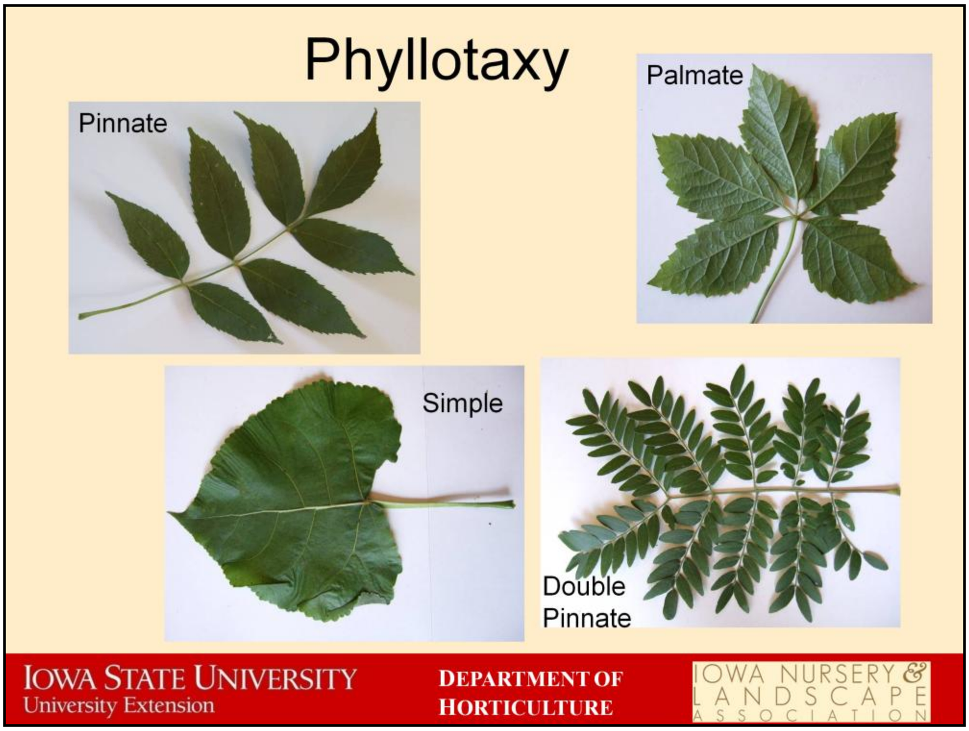
Phyllotaxy is the scientific term that refers to how the leaves, nodes, and buds are arranged along the stem. Opposite phyllotaxy means that two leaves arise from the same point on the stem on opposite sides of the stem. Above is a branch of a golden privet with opposite leaf arrangement.



Alternate phyllotaxy is when one leaf is on one side of the stem, the next leaf is on the other side of the stem at the next node up or down the stem creating a staggered appearance.



Whorled phyllotaxy is when three or more leaves originate at one point on the stem. The leaves look like they are clustered in layers along the stem. Whorled phyllotaxy is rare and therefore a helpful identification trait. The example in this picture is Oleander.



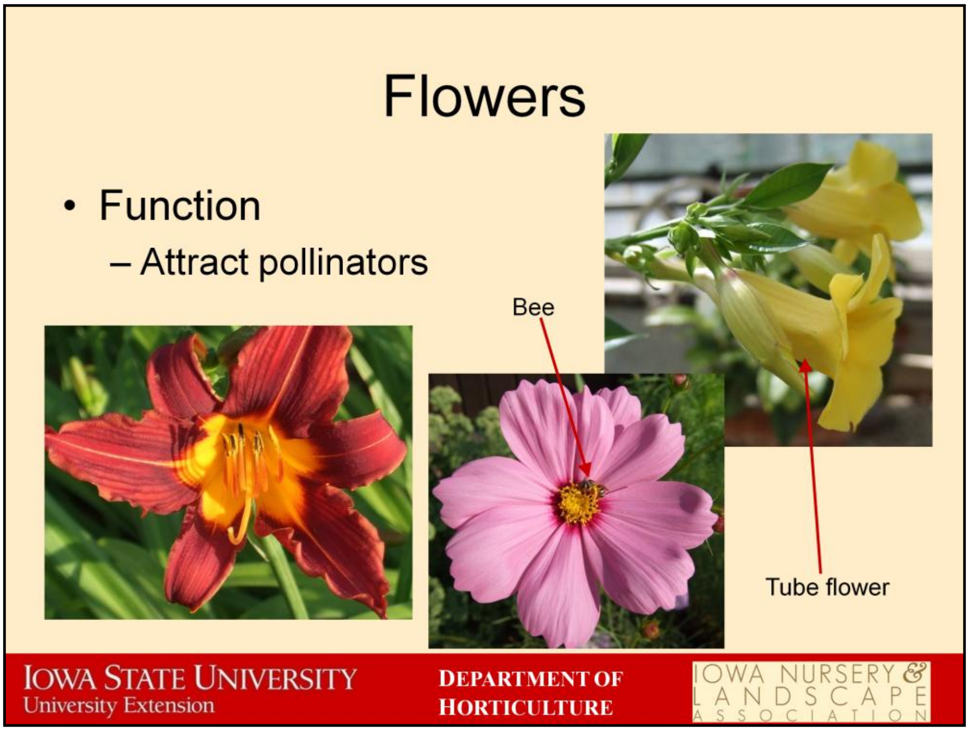
There are simple leaves which have a single leaf blade attached to a petiole. Simple leaves are common.

Compound leaves have multiple leaflets attached to single petiole. The compound leaves pictured are one complete leaf. Palmately compound leaves usually have 5 to 7 leaflets arranged like fingers on your hand. Pinnately compound leaves have leaflets aligned opposite one another along the petiole with a single leaflet at the end. There can also be twice pinnately compound leaves!

Test Your Knowledge

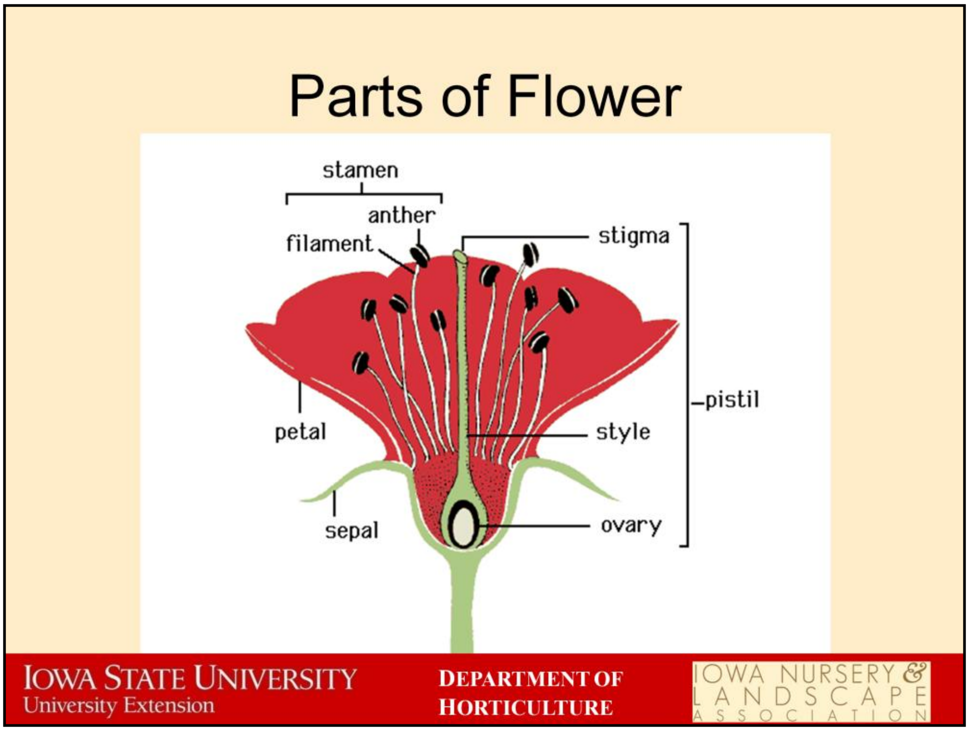
Match the image of the leaves with the proper name.

Match the image of the leaves with the proper name.



Flowers serve one purpose for plants: to attract pollinators. Pollination can be done by insects, animals, rain, and the wind. The type of pollination that is required determines the shape of the flower. To attract the particular pollinators, flowers could be brightly colored, smell attractive to the pollinator (not just us!), and some flowers trick insects into pollinating them by looking like a female of the pollinator’s species. Some flowers do not smell nice to us at all, but smell like lunch to the insects or animals that pollinate them.

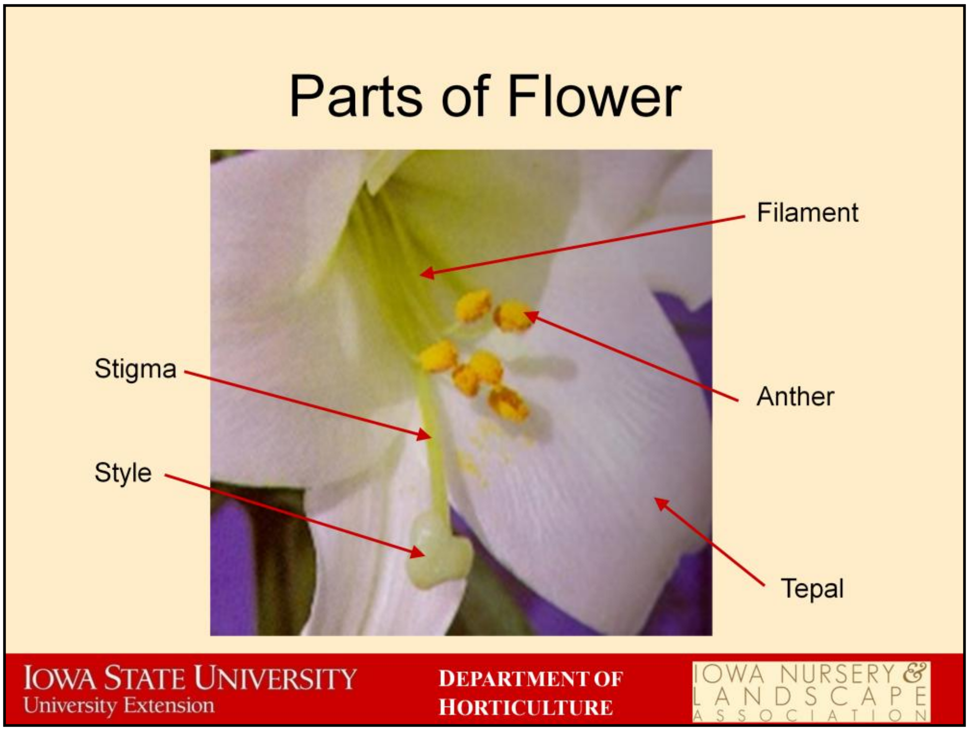
Flower shape can give you a clue as to who might be pollinating that flower. Flat ray flowers, like those of zinnia and daisies, are “landing pads” for bees to stop by and pollinate them. Tubular flowers, like oleander and trumpet vine, are pollinated by butterflies, moths, and humming birds. Butterflies and moths have long, straw-like tongues they use to drink the nectar in the flower. Hummingbirds also have long, straw shaped beaks.



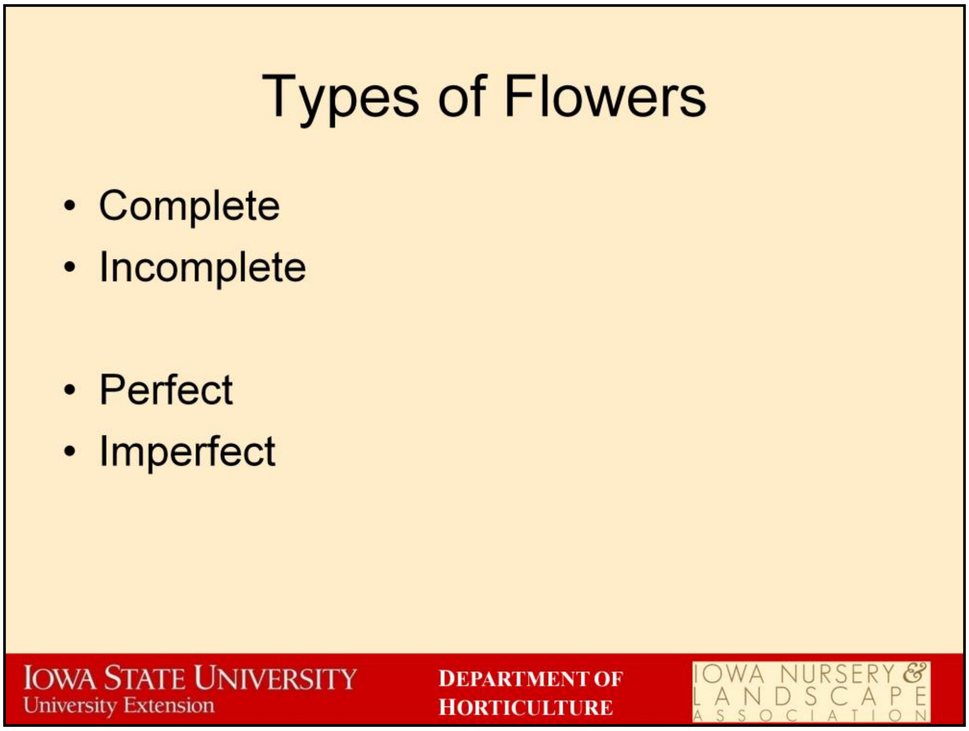
Flowers differ greatly between plant species. The ‘typical’ flower has the following four parts: sepals, petals, stamens, and pistils. These four tissues are arranged in whorls and are attached to the stem via the receptacle. The sepals are leaf-like and enclose the flower bud. Collectively the sepals are referred to as the calyx. The petals are typically brightly colored and collectively are referred to as the corolla.

The stamens, the male part of the flower, are composed of anthers and filaments. The filament is thread like stalk that holds the anther up where the pollinators can reach it. The anther is where the pollen is.

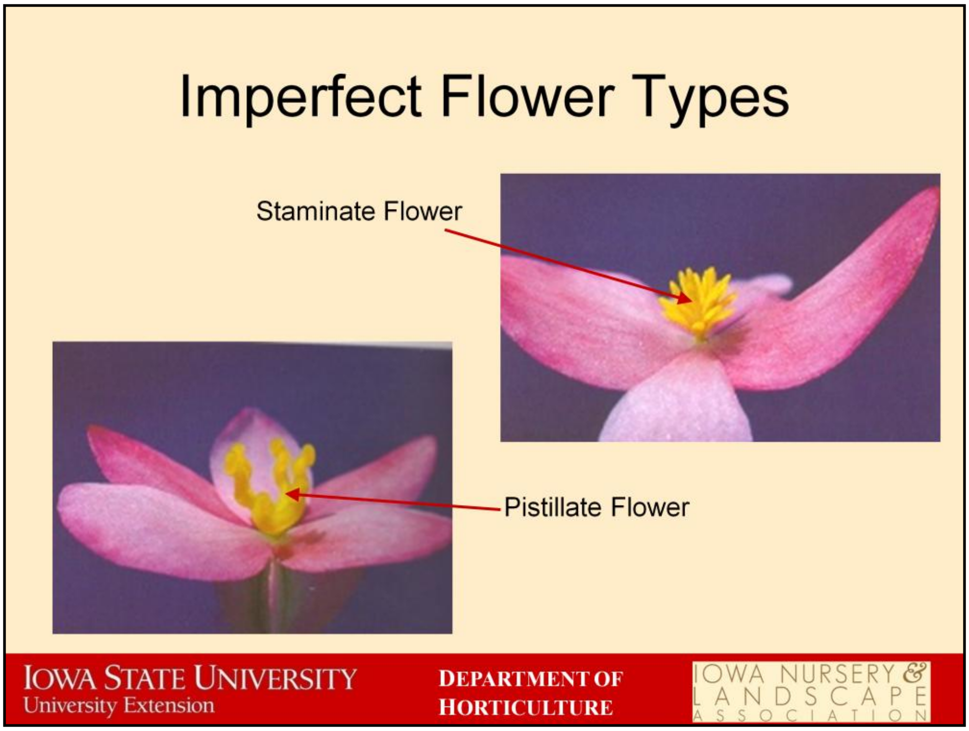
The pistil is the female part of the flower. The pistil is composed of the stigma, style, and ovary. The stigma is a flattened surface with a sticky substance that traps pollen grains for fertilization. The style is a tube that conducts the pollen grains from the stigma to the ovary. The ovary is where the seeds develop after fertilization. The tissue surrounding the ovary and the ovary itself become the fruit.



Here is a picture of a lily flower. Here you can see the stigma and style, the filament and anthers. Sometimes the sepals and petals are both colorful and hard to distinguish. In this case they are called tepals instead of sepals and petals. Tepals can be found in flowers like tulips and lilies.



Complete flowers have all four parts of the ‘typical’ flower: sepals, petals, pistil, and stamen. Incomplete flowers are missing one or more of those four floral parts. Perfect flowers have both the male and female parts in the same flower. Imperfect flowers have male parts or female parts.



Imperfect flowers have separate male and female parts. Staminate flowers are flowers that have only the male reproductive organs: filament, anther, and pollen. Pistillate flowers are flowers that have only the female parts: stigma, style and ovary.

Plant species that have both the male and female flowers on the same plant are called monoecious plants (*mono*- meaning one). These plants include birch trees, pecan trees, begonias and squash plants.

If the male flowers are on one plant and the female flowers are on a separate plant these species are called dioecious plants (*di*- meaning two). Examples of dioecious plants include ginkgo trees, holly shrubs, pistachio and kiwi. With dioecious plants, you need to have both a male and a female plant in order to have fruit production. This makes growing certain fruits and nuts tricky because you have to grow both genders!

Test Your Knowledge

Match the image of the flowers with the proper name.

IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Match the image of the flowers with the proper name.

Fruits

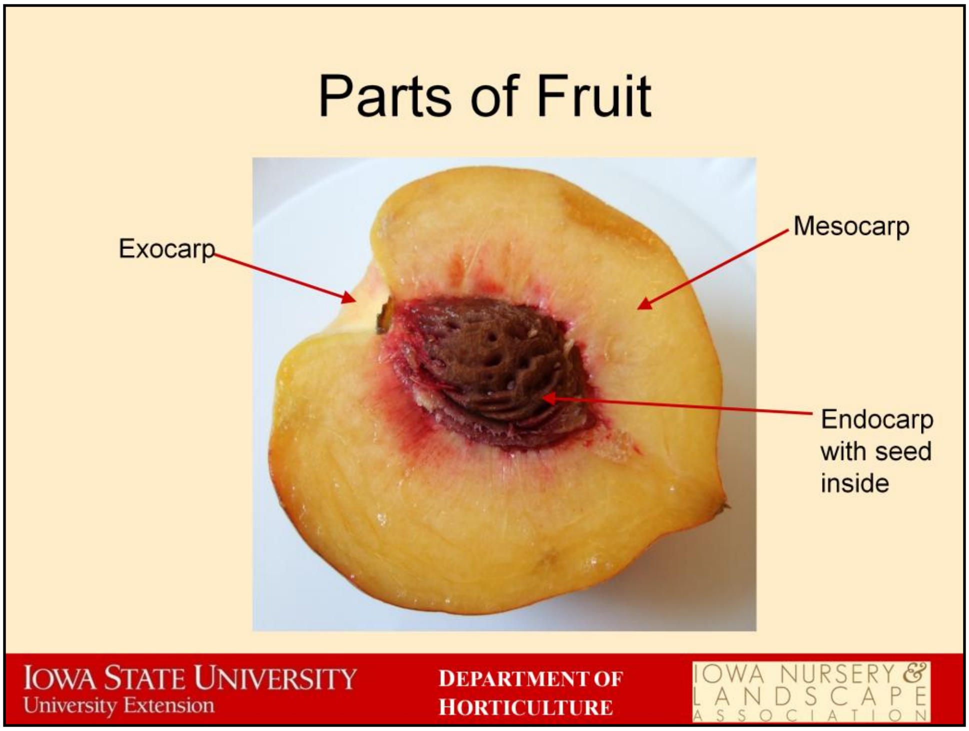
- Mature ovaries with fertilized seeds
- Function:
  - Distribute seeds to new habitat
- Different types of fruits
  - Multiple, aggregate, simple

IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Fruits are ripened ovaries with fertilized seeds and all the associated parts. Technically speaking that is. Most people think fruits are sweet, juicy, dessert or breakfast foods. The sole function of the fruit is to disperse the mature seed to a new location where it will germinate and grow into a new plant.



The fruit has 4 parts. The seed is the most internal part. The endocarp is the next most internal part; the endocarp protects the seed. Sometimes the endocarp is hardened like in a peach. The fleshy, juicy part that we typically eat is called the mesocarp. The exocarp is the outer most layer. Sometimes that layer is thickened or hardened, like a watermelon or orange, to protect the seed within. When referred to collectively, the endo-, meso- and exocarp are called the pericarp.

Multiple Fruits

- Multiple flowers, multiple fruits
- Fruits clustered on core
- Mulberry, pineapple

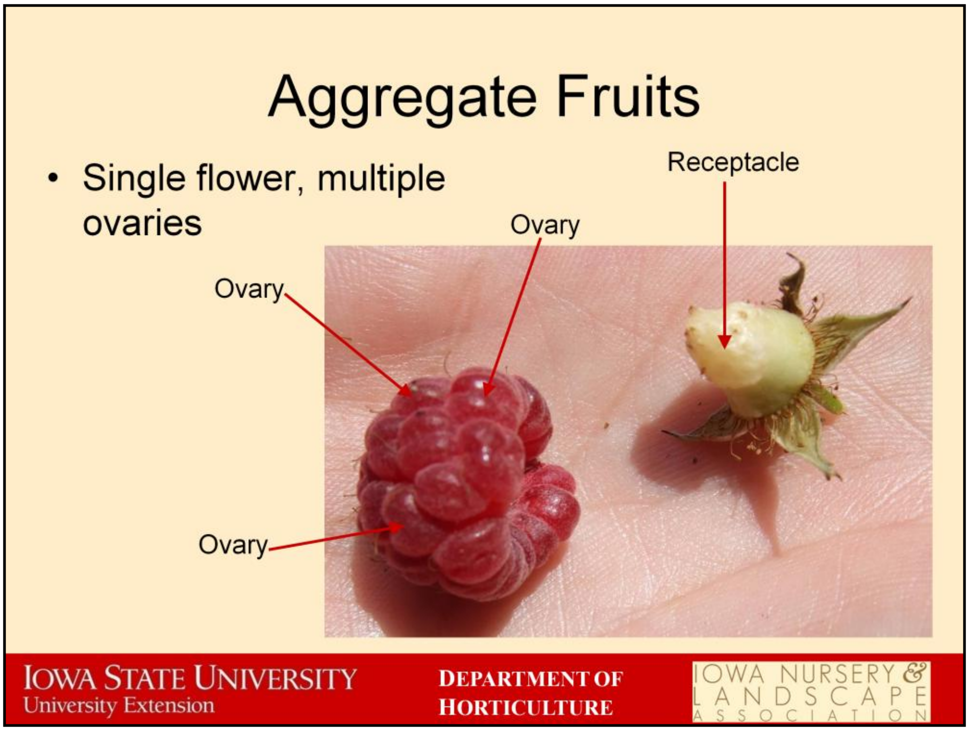
Stays attached to core tissue

IOWA STATE UNIVERSITY
University Extension

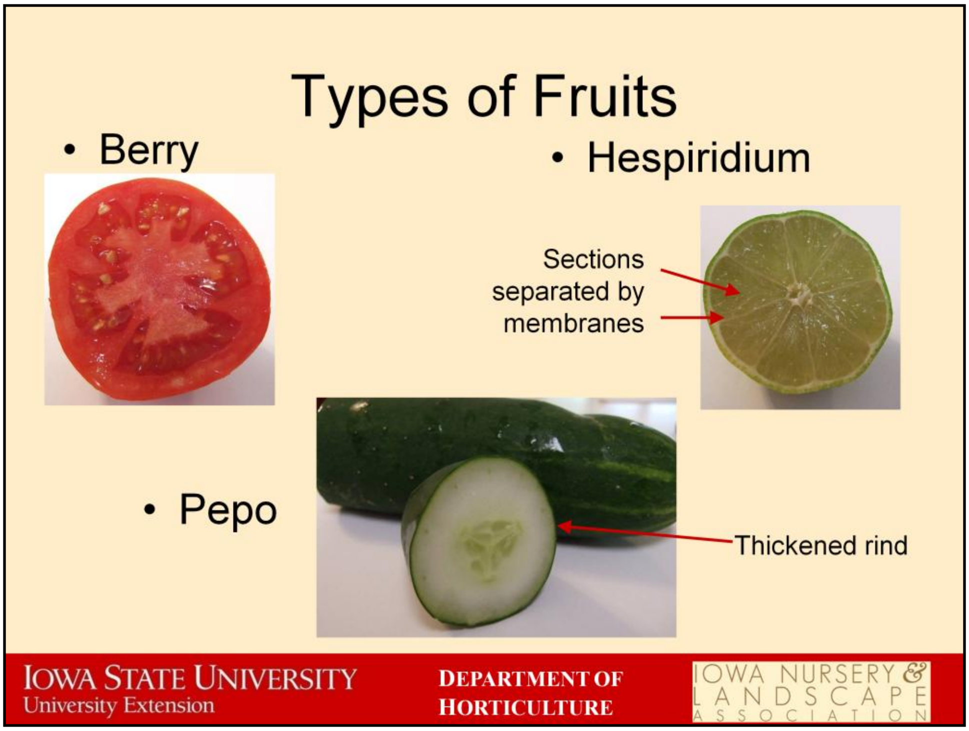
DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Multiple fruits develop from multiple flowers; each flower produces its own fruit. All the fruits are clustered around a core structure. Examples of multiple fruits include pineapple and mulberry.

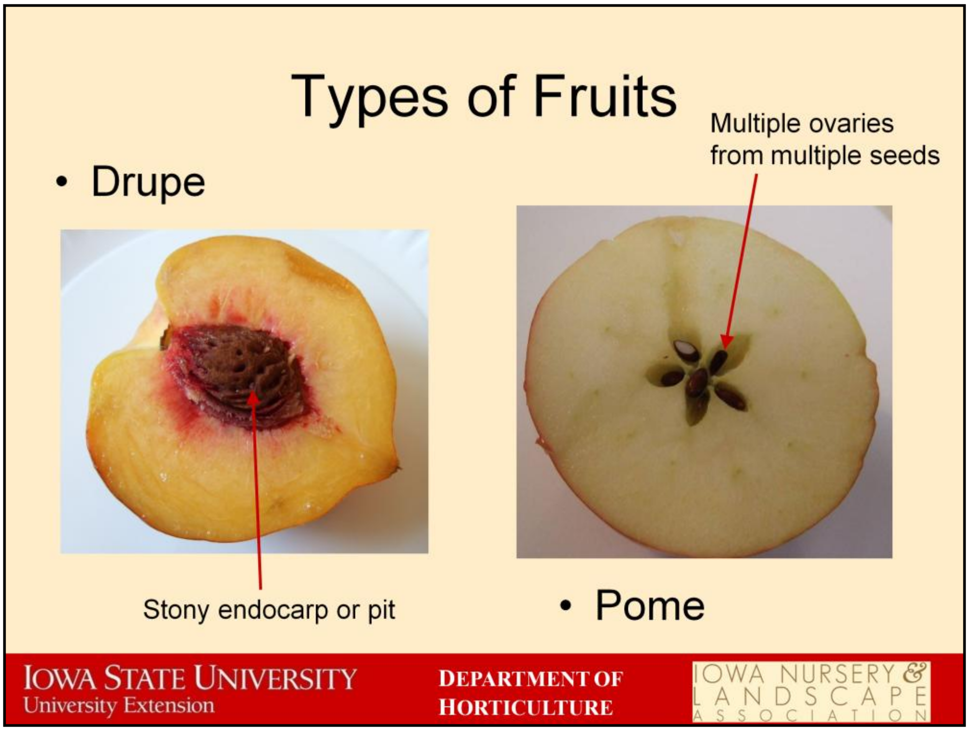


Aggregate fruits develop from a single flower with multiple ovaries. Examples include raspberries and blackberries. When blackberry fruits are harvested the fleshy receptacle is harvested too. When we harvest raspberries the receptacle is left on the plant.



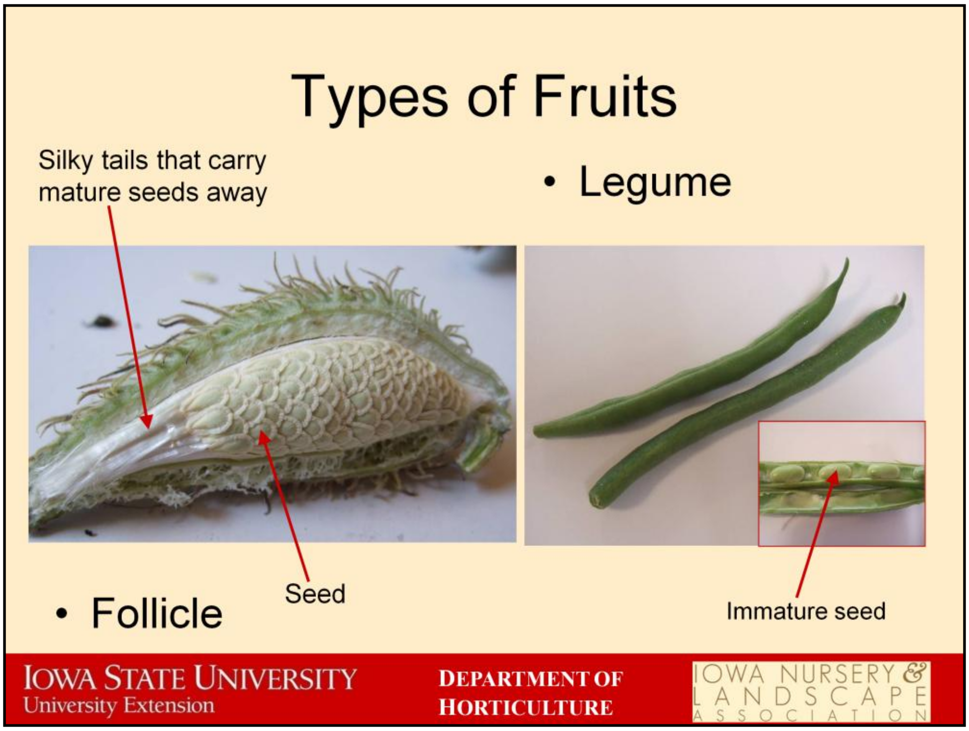
Simple fruits develop from a single ovary.

Berries are fleshy fruits. Some fruits that are berries include tomato, blueberry, eggplant, cranberry. Within the group berry, there are two specialized types of berries. The first is the pepo. A pepo has a thick, hardened exocarp or rind when the fruit is mature. Examples of pepos include: cucumbers, watermelons, muskmelons, and squash. The second specialized berry is a hespiridium. A hespiridium has a leathery exocarp and mesocarp and a very juicy endocarp with distinct sections. Examples include: orange, lime, lemon, grapefruit.



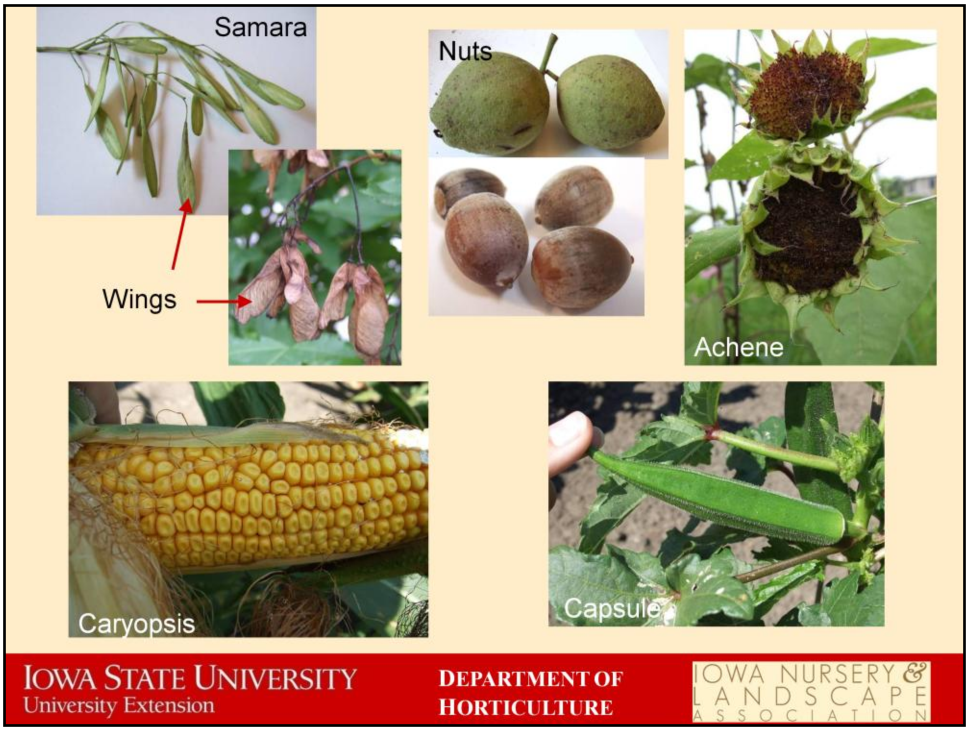
Drupes are fleshy fruits with a single seed enclosed in a stony endocarp. Examples include: cherry, plum, peach, and olive.

Pomes are produced from flowers with compound ovaries. Examples of pomes are apples, pears, and quince.



Follicles contain multiple seeds that are dry and are released when the pod around them splits open along a single suture line. An example of a follicle is a milkweed pod. The picture above is of an immature milkweed pod that has been cut open to reveal the seeds and silk tails.

The legume is only found in the Legume family. Legumes are pods that split along two suture lines at maturity. Examples include beans, peas, and honey locust.



Here are some other types of fruits that you might not have thought were fruits! Starting in the upper left corner: Samaras, or helicopter from maple trees, are fruits. Ash trees also produce samaras, but they don't fly as well.

Caryopsis are the fruits of grasses and corn (which is a grass). Caryopsis are unique because the pericarp and the seed coat are fused together.

Capsules split along multiple sutures, exploding with seed when they are mature. Okra is a capsule, although okra used in Cajun food isn't mature yet when it is harvested.

Achenes are kind of the opposite of a caryopsis; the pericarp and seed separate easily. Sunflower "seeds" are achenes. So are strawberry "seeds"!

And last, but not least nuts. Nuts are fruits, not seeds. The pericarp in a nut is extremely hardened. There are other types of fruits plants produce to disperse their seeds, however they are uncommon and therefore will not be discussed here.

Test Your Knowledge

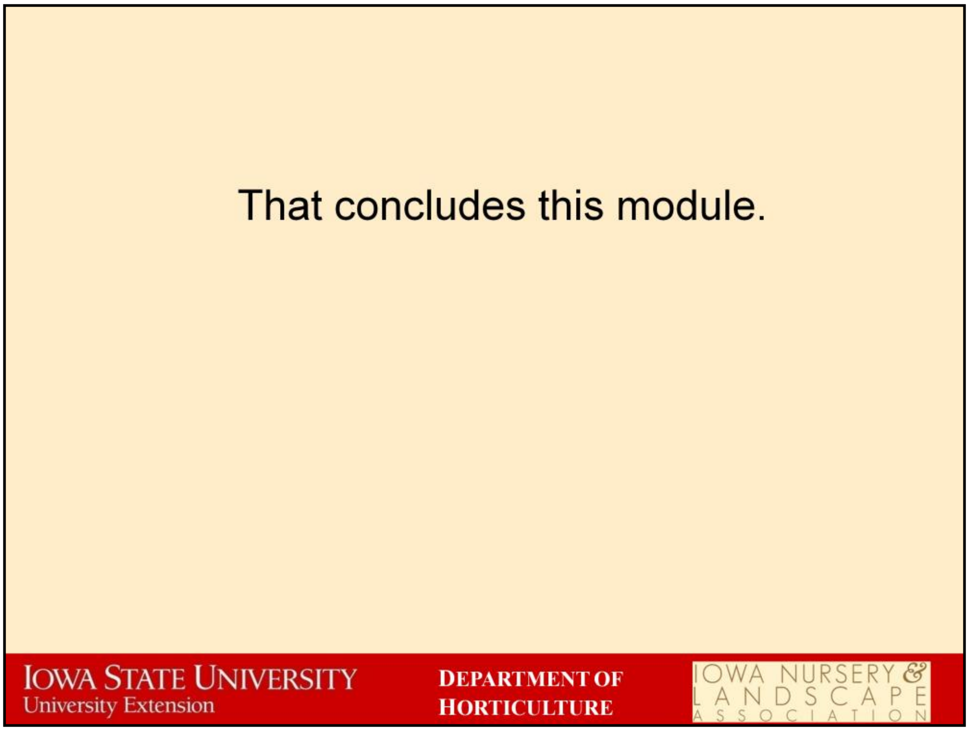
Match the image of the fruits with the proper name.

IOWA STATE UNIVERSITY
University Extension

DEPARTMENT OF HORTICULTURE

IOWA NURSERY & LANDSCAPE ASSOCIATION

Match the image of the fruits with the proper name.



That concludes this module.