# BOTANY, PLANT PHYSIOLOGY AND PLANT GROWTH

## Lesson 3:

## PLANT PARTS AND FUNCTIONS

## Overview and Stems

**PART 1**

**Script to Narrate the PowerPoint, 03_Stems_PowerPoint.ppt**

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PowerPoint Slide 1: Title Slide,
"Plant Parts and Functions, Part One: Overview and Stems"

In order to gain a working knowledge of horticulture, it is necessary to understand the structure and function of plants and the environmental factors that affect plant growth.

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PowerPoint Slide 2: Photograph

In the greatly diversified kingdom of plants, all flowering plants have certain structures and functions in common. These similarities are the basis for the lessons on Botany and Plant Growth.

QUESTION: If you would list the basic parts of an animal as head, torso, arms and legs, how would you list the basic parts of a plant?

STUDENT RESPONSE: *For about 1 minute, students can submit their ideas.*

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PowerPoint Slide 3: Plant Parts and Functions

- Lesson One – Overview and Stems
- Lesson Two – Leaves
- Lesson Three – Roots, Flowers, and Fruits

There are three lessons in the series "Plant Parts and Functions". We'll discuss stems in this lesson, leaves in the next lesson, then roots, flowers, and fruits in the third lesson.

PowerPoint Slide 4: Plant Parts and Functions

- Lesson One – Overview and Stems
  - Segment One - Plant Parts and Functions
  - Segment Two – Parts of the Stem
    - Interior
    - Exterior
  - Segment Three – Modifications of the Stem
    - Above-ground modifications
    - Below-ground modifications
- Lesson Two – Leaves
- Lesson Three – Roots, Flowers, and Fruits

In Segment One of this lesson we'll discuss the parts of a typical plant, the parts of a stem, and then stem modifications above and below ground.

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PowerPoint Slide 5: Overview – Classification by Life Cycle

| | |
|---|---|
| Annuals | one growing season |
| Biennials | two growing seasons |
| Perennials | many growing seasons |

Plants are classified by the number of growing seasons required to complete a life cycle. Annuals pass through their entire life cycle from seed germination to seed production in one growing season and then die.

Biennials are plants that start from seeds and produce vegetative structures and food storage organs the first season. During the first winter a hardy evergreen rosette of basal leaves persists. During the second season, flowers, fruits and seeds develop to complete the life cycle. The plant then dies. Carrots, beets, cabbage, celery and onions are biennial plants that flower and produce seed during the second year of growth. Hollyhock, Canterbury bells, and sweet William are biennials that are commonly grown for their attractive flowers.

Perennial plants live for many years and after reaching maturity typically produce flowers and seeds each year. Perennials are classified as herbaceous if the top dies back to the ground each winter and new stems grow from the roots each spring. They are classified as woody if the top persists, as in shrubs or trees.

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PowerPoint Slide 6: Overview – Classifications by Scientific Division

Kingdom: Plants
- Division: Ferns
- Division: Conifers (Gymnosperms)
- Division: Ginkgo (Gymnosperm)
- Division: Flowering Plants (Angiosperms)
  - Class: Monocots
  - Class: Dicots

The classification of plants is complex, but an excerpt showing the more familiar plants would like look this:

Kingdom: Plantae - Plants
- Division: Ferns
- Division: Conifers (Gymnosperms)
- Division: Ginkgo (Gymnosperm)
- Division: Flowering Plants (Angiosperms)
  - Class: Monocots
  - Class: Dicots

Botanical organisms are classified into several Kingdoms, and one of them includes these four Divisions, and several other Divisions. Conifers are the cone-bearing plants like pine and spruce. They are described as Gymnosperms, or "naked seeds", because the seed is not enclosed by a mature ovary.

The flowering plants group has the largest number of species of any plant group. They are described as Angiosperms ("covered seeds") because the seed is enclosed by a mature ovary. The flowering plants group has two classes: monocots and dicots, depending on the number of cotyledons or seed leaves. Monocots include grasses, palms, orchids, and lilies. Dicots include most trees and shrubs other than conifers.

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PowerPoint Slide 7: Overview – Classification by Seed Leaf

| | Monocots | Dicots |
|---|---|---|
| Cotyledons | 1 | 2 |
| Leaf Venation | Parallel (usually) | Netlike (usually) |
| Flower Parts | 3's (usually) | 4's or 5's (usually) |
| Vascular Tissues | Scattered Bundles | Rings |

Although monocots and dicots are similar in many ways, differences with respect to number of seed leaves, number of flower parts, leaf vein pattern, vascular system and root structure exist. In addition, physiological dissimilarities exist which, for example, result in different responses to weed killers.

PowerPoint Slide 8: Segment One - Plant Parts and Functions,

Sexual parts

- Flowers
- Fruits
- Flower buds
- Seeds

Vegetative parts

- Leaves
- Roots
- Shoot buds
- Stems

The parts of a plant can be divided into two groups, sexual (reproductive) and vegetative parts. Sexual (reproductive) parts are those involved in the production of seed. They include flowers, fruits, flower buds, and seeds. The vegetative parts include leaves, roots, shoot buds, and stems and are not directly involved in sexual reproduction. However, they are often used in asexual or vegetative forms of propagation such as cuttings.

The functions of these parts are rather basic. Roots anchor the plant in the soil, and equally important, they collect inorganic ions and water which is required for photosynthesis and maintenance. The stems conduct water and minerals up to the leaves; equally important, they provide support for the leaves, which are the chief structures of photosynthesis; stems raise the leaves toward their source of energy. A continuous flow is set up as water moves into the root hairs, upward through the stems, through the leaves and outward. Stems also conduct Photosynthates and other compounds up and down within the plant.

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PowerPoint Slide 9: Segment Two – Parts of the Stem

A look at the interior of a stem will help understand its function. Stems are structures that support buds and leaves and serve as conduits for carrying water, minerals and sugars. Three major internal parts of a stem are the xylem, phloem, and cambium. The xylem and phloem are the major components of a plant's conducting system, called the vascular system. The vascular system transports food, water and minerals and offers support for the plant. Xylem tubes are the channels conducting water and minerals upward, while phloem tubes are the food conducting channels.

The vascular systems of monocots and dicots differ. While both contain xylem and phloem, they are arranged differently. In the stem of a monocot, the xylem and phloem are paired into bundles; these bundles are dispersed throughout the stem. The vascular

system in a dicot is said to be continuous because it forms rings inside the stem. The ring of phloem is near the bark or external cover of the stem and is a component of the bark in mature stems. The xylem forms the inner ring and is the sapwood and heartwood in woody plants.

The cambium is a meristem, which is a site of cell division and active growth. It is located between the xylem and phloem inside the stem and is the tissue responsible for a stem's increase in girth, as it produces both the xylem and phloem tissues. Other sites of meristem tissue include the growing tips of shoots and roots.

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**Time Check: PowerPoint half-way mark.**

- You should be about 10 minutes into this presentation.

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PowerPoint Slide 10: Node and Internode

Now let's shift focus to the exterior of a stem. The point on the stem where leaves are attached is called a node. Nodes are areas of great cellular activity and growth. Buds which develop into leafy shoots or flowers are also found at the nodes. The area between nodes is called an internode.

The length of an internode may depend on many factors. Decreasing fertility will decrease internode length. Too little light will result in a long internode, causing a spindly stem. Growth produced early in the season has the greatest internode length. Internode length decreases as the growing season nears its end. Vigorously growing plants tend to have greater internode length than less vigorous plants. Internodes also tend to be longer during wet years and shorter during dry years.

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PowerPoint Slide 11: Types of Stems
Trunk
--Branch
----Twig
------Shoot

A shoot or twig is a young stem with leaves present. A branch is a stem, which is more than one-year old, and typically has lateral stems. A trunk is a main stem of a woody plant. Most trees have a single trunk.

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PowerPoint Slide 12: Shrubs vs. Trees
Shrubs Branches from or near base – usually multi-stemmed
Tree Branches from well-defined trunk – usually single-stemmed

A shrub is a woody-stemmed plant, which usually branches from the base or near the base. On the other hand, a tree usually has a well-defined trunk, sometimes a multiple trunk, with a crown of branches above. Trees are usually taller than shrubs, but no distinct height separates a tree from a shrub; there are certain trees that mature at 15 feet, while some shrubs reach 20 feet.

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PowerPoint Slide 13: Vines

| | |
|---|---|
| Twining | honeysuckle |
| Climbing | |
| aerial roots | English ivy |
| tendrils | cucumber |
| holdfasts | Virginia creeper |
| Clematis | Clasping Leaf Stalks (Petioles) |

A vine is a plant that develops long trailing stems that grow along the ground, or must be supported by another plant or structure. Some twining vines circle the support clockwise (hops or honeysuckle) while others circle counter-clockwise (pole beans or Dutchman's pipe vine). Climbing vines are supported by aerial roots as in English ivy and poison ivy; or by slender tendrils that encircle the supporting object such as in cucumber, gourds, grapes, and passionflowers; or by tendrils with holdfasts such as Virginia creeper. Some vines also climb with clasping leaf stalks (Petoiles) as for Clematis.

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PowerPoint Slide 14: Segment Three – Modifications of the Stem
Above-ground modified stems
- Spurs
- Crowns
- Stolons

Below-ground modified stems
- Tubers
- Rhizomes
- Bulbs
- Corms

Although typical stems are above-ground trunks and branches, there are modified stems that can be found above ground and below ground. The above-ground modified stems

are spurs, crowns, and stolons. The below-ground stems are tubers, rhizomes, bulbs, and corms. All stems must have buds or leaves present to be classified as stem tissue.

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PowerPoint Slide 15: Above-Ground Modifications

SPUR: A spur is a compressed fruiting branch. A branch is a stem that is more than a year old. Spurs are short, stubby, side stems that arise from the main stem and are common on such fruit trees as pears, apples, and cherries where they may bear fruit.

CROWN: On plants such as strawberries, dandelions, and African violets, a crown is a region of compressed stem tissue from which new shoots are produced, generally found near the surface of the soil. Crowns have leaves and flowers on short internodes.

STOLON: A runner, or stolon, is a specialized stem that grows on the soil surface and forms a new plant at one or more of its nodes; a stolon can be fleshy or semi-woody. Strawberry runners are examples of stolons. Remember that all stems have nodes and buds or leaves. The leaves on strawberry runners are small but are located at the nodes, which are easy to see.

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PowerPoint Slide 16: Below-Ground Modifications

Below-ground stem variations store food for the plant. Examples include the iris rhizome, the potato tuber, and tulip bulb. It is important to note that the dividing line between a root and a stem is not always the soil line: often stem tissue is found below the soil surface. Even though we refer to potatoes and ginger as root vegetables, they consist of stem tissue, not roots.

RHIZOME: A rhizome is a specialized stem that grows horizontally at or just below the soil surface and acts as a storage organ and means of propagation in some plants. Rhizomes are similar to stolons, but grow underground rather than above ground. Some rhizomes are compressed and fleshy such as bearded iris or ginger; they can also be slender with elongated internodes such as bentgrass.

TUBER: A tuber is an enlarged portion of an underground stem. The tuber, like any other stem, has nodes that produce buds. The eyes of a potato are actually the nodes on the stem. Each eye contains a cluster of buds. Other tuberous plants include a sunflower called Jerusalem artichokes or sunchoke. Also, yam tubers can form below and above the ground. If not dug up, yams can keep growing for years; a yam weighing 137 pounds has been recorded.

Some structures that resemble tubers are not stem tissue. Some plants such as the dahlia and the sweet potato produce an underground storage organ called a tuberous

root that is often confused with tubers. However, these are roots, not stems, and have neither nodes nor internodes.

BULB: A bulb is a large bud composed of a small conical underground stem surrounded by numerous modified fleshy leaves. Tulips, lilies, daffodils, onions and garlic produce bulbs. In November, if you cut through the center of a tulip or daffodil bulb, you can see all the flower parts in miniature within the bulb.

CORM: Bulbs and corms have similar shapes, but a corm is a compressed stem with reduced scaly leaves. While a bulb is mostly leaf tissue, a corm is mostly stem tissue. Examples of corms are gladiolus and cyclamen.

PowerPoint Slide 17: Stems vs. Roots

Stems Have nodes

Roots Have no nodes

It may sometimes be difficult to distinguish between roots and stems but one sure way is to look for the presence of nodes. Stems have nodes, roots do not.

Stems are one of the most commonly used parts for plant propagation purposes. Above-ground stems can be divided into sections that contain internodes and nodes. They are can be used to make cuttings and will produce roots thus giving rise to new plants. Below ground stems are also good propagative tissues: rhizomes can be divided into pieces; bulbs form small bulblets at the base of the parent bulb; cormels are miniature corms that form under the parent corm; and tubers can be cut into pieces containing eyes and nodes. All of these will produce new plants.

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PowerPoint Slide 18: Stems as Food

The edible portion of cultivated plants such as asparagus and kohlrabi is an enlarged succulent stem. The edible parts of broccoli are composed of stem tissue, flower buds and a few small leaves. The edible part of the white or Irish potato is a fleshy underground stem called a tuber. Although the name suggests otherwise, the edible part of the cauliflower is proliferated stem tissue.

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PowerPoint Slide 19: Review

Segment One - Plant Parts and Functions

Segment Two – Parts of the Stem

- Interior
- Exterior

Segment Three – Modifications of the Stem

- Above-ground modifications
- Below-ground modifications

QUESTION: What are the main parts of a plant and their functions?

STUDENT RESPONSE: *Students provide answers; then show answer with slide 20.*

PowerPoint Slide 20: Review
Text: Same as Slide 8

QUESTION: Looking at the cross-section of a trunk, name the three main parts and their functions.

STUDENT RESPONSE: *Students provide answers; then show answer with slide 21.*

PowerPoint Slide 21: Review

QUESTION: Can you describe four types of below-ground stem modifications?

STUDENT RESPONSE: *Students provide answers; then show answer with slide 22.*

PowerPoint Slide 22: Review

PowerPoint Slide 23: Closure

A stem is a critical part of a plant's anatomy. Functionally, it is important to the plant's physiology; aesthetically, it is central to the beauty of the landscape.

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