1. Compare and contrast woody and non-woody plants. Describe the annual growth habits of each and explain how those habits impact/shape the overall structure and habit of the plant. Provide three ornamental examples of each. How would a gardener use these different growth habits in the garden?

Woody plants have a hard trunk and bark that lets the plant to grow tall compared with non-woody plants. A woody plant's trunk and branches persist for many years and continue to grow, compared with non-woody plants with thin flexible stems that only live for one year. Woody plants have buds for future growth and have scars on branches from prior growth. Non-woody plants may have some limited branch structure, but have no persistent buds or scars.

Woody plants add new wood each year to the stem and the wood remains in future years. This enables the branches and leaves to grow high and be spread wide. Non-woody, herbaceous, plants have relatively short stems that die to the ground after the growing season. Woody plant roots persist over many years, but herbaceous plant roots may or may not persist, depending on the type of plant. For example, perennials have roots that persist many years and annual roots live only one year. Since herbaceous plants do not use resources to make wood, more of those resources can be used to make flowers and seeds. Some herbaceous plants have stem cross sections that are not round, compared with woody plants that all have round cross sections because they grow from a ring of vascular cambium cells.

Perennial, woody gymnosperms and dicots have secondary growth in their vascular and cork cambium, allowing the stem to add girth or diameter and strength to support the plant's height. Young woody plant stems start out herbaceous and become woody with age. Wood is produced over time by the living vascular cambium (lateral meristem) cells that separate the xylem and phloem vascular tissues. The vascular cambium ring produces new secondary xylem cells on the inner side. These xylem cell walls thicken and strengthen, adding the material lignin (they lignify), until they are no longer alive. The vascular cambium also produces smaller secondary phloem cells toward the outside that form the inner bark. The vascular cambium forms the dividing layer between wood and bark. A separate cork cambium produces cork, the outer tissue of a tree's bark. Herbaceous plants either lack the vascular and cork cambium or it is inactive so that wood and bark are not produced.

Three woody ornamental examples are: Cherry tree, Eastern Redbud tree, and Mountain Laurel. Three herbaceous examples are: Kentucky Bluegrass, Iris, and tulip flowers.

Uses in the Garden:

Woody trees and shrubs– shade in summer, large showy specimen, borders and wind breaks, branch and bark interest in winter.

Herbaceous – low flowers and beautiful colors, ground cover, decorative pots, window boxes, and hanging baskets.

2. Compare and contrast the orders Hemiptera and Coleoptera. Describe distinguishing physical characteristics and how each damages plants. Provide three common examples of each.

Hemiptera are called the true bugs and have piercing-sucking mouthparts. Hemiptera means half wing and refers to the two-part wings that are toughened at the base and membranous at the tip. Hemiptera have large compound eyes and 4 or 5 antenna segments. The suborder Homoptera is sometimes included, even though they lack the toughened area on the first pair of wings. Many of the most common damaging insects are in Homoptera. These bugs damage plants by piercing the leaves and sucking fluids out. Common examples of Hemiptera are: stink bugs (brown marmorated, for example), lace bugs, cicadas, and leafhoppers.

Coleoptera are the beetles with more than a quarter million known species. Beetles have hardened forewings, elytra, which serve as a protective cover for the hindwings. Beetles have an identifying characteristic of an elytral suture, a straight line down the back that separates the elytra. Beetles have chewing mouthparts both as larvae and adults. Common examples are: ladybird beetles, Japanese beetles, Colorado potato beetle, scarab beetle, and lily leaf beetle. Depending on type of beetle and life stage, beetles damage plants by eating leaves, flowers, or roots. Some species do damage in both adult and larval stages.

3. Compare and contrast the plant processes of photosynthesis, respiration, and transpiration. What does each process do for the plant, how does it happen, and when?

Photosynthesis is the process by which green plants combine water and carbon dioxide in the presence of light to form carbohydrates (glucose) that are stored and later converted to the energy needed to support cell functions. Six carbon dioxide (CO_2) molecules are combined with twelve water molecules to produce a glucose (carbohydrate, $C_6H_{12}O_6$) molecule, 6 water (H_2O) molecules, and 6 oxygen (O_2) molecules.

Photosynthesis occurs in chloroplast cells that contain light-absorbing chlorophyll pigment. Photosynthesis is two processes, light reactions and dark reactions. The light reactions take place in photosynthetic membranes (thykaloids) at two functional clusters, photosystems I and II, which are part of the electron transport chain (ETC). Electrons are excited to a higher energy level by absorbing photons and this energy is used in a series of oxidation-reduction reactions producing adenosine tri-phosphate (ATP) and reduction of nicotinamide adenine dinucleotide phosphate ($NADP^+$) to NADPH. These light reaction products are used in a series of dark reactions (Calvin cycle) that catalyze the reduction (or fixation) of CO_2 to glucose, which takes place in the stroma of the chloroplast (outside of thykaloids). The light reactions of photosynthesis take place when the leaves are exposed to light (daytime). Dark reactions do not require light, but need to be performed within minutes of the ATP and NADPH formation (before ATP breaks down to ADP).

Respiration is the opposite reaction to photosynthesis where glucose is used along with oxygen to form carbon dioxide, water, and energy. Respiration occurs in all living cells, including leaves and roots, to maintain metabolic processes. It takes place all the time, both day and night.

Transpiration occurs in the mesophyll (middle) cells of leaves that are drawing water from the xylem to use in photosynthesis. Liquid water is heated by sun energy and turned to water vapor. The water vapor escapes from stomata that are open to bring in carbon dioxide. The water lost by transpiration results in a pull of water, transpirational pull, which helps draw water and minerals up through the roots and stems. Transpiration occurs whenever water vapor is present in the leaves and the stomata are open.

4. Compare and contrast soil texture and soil structure. How does knowing the soil structure help a gardener? What is the process of obtaining a soil test sample?

Soil texture describes the relative proportions of particles of sand, silt, and clay in soil. Soil texture classes group soils with similar distributions of particle sizes (sand=large, silt=medium, clay=small). Sand, silt, and clay are both soil texture classes and particle sizes. Loam is a desirable soil texture class that has equal influence of sand, silt, and clay. Soil texture can be measured by feel or by how quickly particles drop out of suspension.

Soil structure describes the aggregation and arrangement of primary soil particles into secondary units called peds. Soil structure is characterized by its size, shape, and degree of distinctness (grade). Examples of soil structure are: granular, platy, blocky, crumb, prismatic, columnar, and structureless (massive and single-grain). Aggregates can be created by freezing and thawing, wetting and drying, fungal activity, tillage, and by plant roots.

Knowing soil structure helps a gardener because soil structure affects water and air movement, nutrient availability to plants, root growth, and microorganism activity. Larger spaces created by peds (granular, for example) allow greater air and water movement and better root growth. They also make passageways for organisms and hold water and nutrients better.

The process of obtaining a soil sample starts by collecting a sample when the ground is not frozen from a particular area of interest. Cores or thin slices of soil are collected from 10 or more random, evenly distributed locations to a depth that depends on the desired soil use: 3-4" for grass, 6-8" for flowers, vegetable, small fruits, and 8-10" for trees and shrubs. The soil samples are placed in a clean container and thoroughly mixed. One cup of soil is transferred to a zip locked plastic bag and sealed. The plastic bag is labeled on the outside in permanent marker with a name for the sample area. The sample submission form is filled out and placed along with the plastic bag sample in a mailing envelop or small box. The sample, form, and check payable to University of Connecticut are mailed to the UConn Soil Nutrient Analysis Lab in Storrs, CT.

5. Compare and contrast signs and symptoms of plant disease. How does each manifest in biotic and abiotic diseases?

Signs are the actual physical agent or its parts on or near the plant that are causing disease. Symptoms are a visible reaction or alteration of a plant due to disease. In biotic diseases, signs are things such as fungal fruiting structures, mycelium (fungal growth), sclerotia (resting body of fungi), bacterial ooze, parasitic plants, or nematodes. Symptoms may be the same or similar for biotic and abiotic diseases. Example symptoms are: wilt, dead leaves, brown leaf tips (scorch), leaf spots or stippling, chlorosis/yellowing, abnormal growth, galls, cankers, rotting fruit or roots, flagging, and stunted growth. Since signs are the visible living biological organism (pathogen) causing disease, signs will be absent for abiotic diseases. Abiotic disease is often caused by the lack or excess of something the plant needs.