Total Score=
100/100 plus 5 EC
Final Score =105/100 = A
Specific comments follow questions

Lauren Huntington

Exam 1

Question 4

Roots, and shoots, and stems, and leaves, oh my! Each of these parts in plants have distinct functions, allowing plants to inhabit the soil and air at the same time. The soil offers vital nutrients and water for the plant to survive. The air offers carbon dioxide and the energy from the sun. To forge a successful lifestyle, plants evolved ways to take advantage of all of these resources both above, and below ground. To make this possible, plants developed roots and shoots. From the shoots come stems and leaves.

When a seed germinates, the first structure to emerge is the root. This enables the seedling to anchor to the soil and absorb water, which are the two primary functions of the root. The growth of many roots is continuous and will only come to a halt under such conditions as drought and/or low temperatures. The **root apical meristem** is the region where active cell division takes place. There are two main types of apical organization in roots of seed plants. In the **closed type root apical organization**, the root cap, the vascular cylinder, and the cortex are traceable to independent layers of cells in the apical meristem. Each of these regions has its own initials. In the second type, all regions arise from the same group of initials. This is called "open type."

As roots develop, divisions in the initials of the apical meristem become infrequent, and cell division occurs a short distance away from the quiescent initials. The area of the apical meristem that is relatively inactive is called the **quiescent center.** The quiescent center isn't completely inactive, however. It is able to repopulate the bordering meristematic regions when they are wounded.

Depending on the age of a root and the species, the distance behind the promeristem at which most cell division takes place varies. This region of actively dividing cells is the apical meristem known as the **zone of cell division**, or the region of cell division. Behind this region is the **zone of elongation**, or region of elongation, which isn't very big (only a few millimeters in length.) The elongation of cells in this region lengthens the root below it. The root does not lengthen above this area. Beyond the **zone of elongation** is the zone of maturation. This is where most of the cells of the primary tissues mature. The zone of elongation is where the first elements of xylem and phloem mature and are often stretched and destroyed during the elongation of the root. The first-formed primary phloem elements are called **protophloem** and the first-formed xylem elements are **protoxylem.**

In the early stages of root tip development, the apical meristem can extend for a distance behind the promeristem. The cell divisions happening here overlap with the zone of cell elongation and with the zone of maturation. Distances fat which cells enlarge and develop as specific cell types happen at various distances from the apical meristem depending on their position in the root. There are three primary meristems — **protoderm, ground meristem, and procambiam** — which occur close to the apical meristem. These are the primary meristems that become the epidermis, the cortex, and the primary vascular tissues.

Most roots have a vascular cylinder that is occupied by a core of primary xylem. As was mentioned before, the first primary xylem elements are the protoxylem and they are located next to the pericycle. The part of the xylem that differentiates after the protoxylem is the **metaxylem,** which occupies the center of the vascular cylinder.

Plants that go through **secondary growth** in the roots and stems consist of secondary vascular tissues from a **vascular cambium** and a **periderm** that arrises from a **cork cambium**. Monocots do not have secondary growth, only **primary growth**, and the roots of many herbaceous eudicots undergo little or no secondary growth.

The formation of the vascular cambium begins with the divisions of procambial cells that are located between the primary xylem and the primary phloem in parts of the root that are no longer elongating. In most woody roots, the epidermis is replaced by the periderm, a protective covering on this portion of the root. Cork cambium is created when divisions of pericycle cells cause an increase in the number of layers of pericycle cells. Cork, cork cambium, and phelloderm make up the periderm.

Structurally, the root may seem slightly complex, but the shoot is even more complex than that. The shoot is the part of the plant that consists of stems and leaves and is the part we see. These parts are important for stability, transport, and photosynthesis. The stem gains stability through filling vacuoles with water and gaining **turgor pressure**. It also acts as the main transport for nutrients and water to all parts of the plant. The leaves provide a surface area where energy from the sun can be used in photosynthesis. During the development of an embryo, the shoot is represented by a plumule, one or more young leaves, and an apical meristem. It may also be represented by only an apical meristem. The apical meristem of the shoot adds cells to the primary plant body, as well as repetitively produces leaf primordia and bud primordia. The apical meristem of the shoot also gives rise to the same primary meristems found in the root: protoderm, pro cambium, and ground meristem. Just like in the root, these become epidermis, primary vascular tissues, and ground tissue.

In most flowering plants, the **shoot apical meristem** has a **tunica-corpus type of organization** that consists of one or more peripheral layers of cells called the tunica and an interior body of cells called the corpus. The tunica consists of cells that divide **anticlinally**, or perpendicular to the meristem. These divisions help with surface growth. In the corpus, which consists of a body of cells that lie beneath the tunica, the cells divide in various planes and add bulk to the developing shoot. Both the corpus and the tunic have their own initials. The initials of the corpus are beneath the tunica and add cells to the corpus by dividing parallel with the apical surface, or **periclinally.**

Secondary growth occurs in stems as it does in roots, with the increase in girth in regions that are no longer elongating. This occurs in all **gymnosperms** and in most **angiosperms** and involves the activity of the two lateral meristems — the vascular cambium and the cork cambium. During secondary growth, secondary xylem and secondary phloem are produced through periclinal divisions of the fusiform and ray initials. **Fusiform initials** are vertically oriented where ray initials are horizontal. The ray initials produce ray cells, which are composed of parenchyma cells and can be referred to as **parenchyma rays**. These rays serve as pathways for the movement of food from the secondary phloem to the secondary xylem and the movement of water from the secondary xylem to the secondary phloem. They also serve as storage for starches and proteins.

As within roots, in secondary growth the primary phloem is pushed outward and its thin-walled cells are destroyed, the periderm replaces the epidermis of the protective covering. The periderm includes cork and the cork cambium. Bark refers to all the tissues outside the vascular cambium. The part of the inner bark that is actively engaged in the transport of food substances is called conducting phloem. The sieve elements outside the **conducting phloem** are dead, but the parenchyma cells and the parenchyma cells of the rays are alive and continue to function as storage. This is known as **non-conducting phloem**.

Perhaps the most important of all plant tissues to man kind is wood, which is made up of secondary xylem. Woods can be classified as hardwoods (angiosperm) or softwoods (conifer). Conifer's are not as complex as angiosperms. They lack vessels and long tracheids are the dominant cell type in the axial system. In some confers, such as *Pinus*, the only parenchyma cells of the axial system are associated with **resin ducts**, which are large intercellular spaces lined with parenchyma cells that secrete resin.

We learn very early on that to tell an age of a tree you can count the growth rings. This is because the activity of the vascular cambium is seasonal and grows in increments. A growth layer can represents one season's growth and is therefore called an annual ring. Abrupt changes can cause more than one growth ring in a given year, though. The visibility of these growth layers is due to the density of the wood produced early in the growth season and of that produced later. This is distinguished by **early wood** and **late wood.** Early wood is less dense and has wider cells. Late wood had narrower cells. When late wood ends in one growth layer, the early wood begins in another therefore they are clearly defined.

Roots and shoots have similarities and differences in development and structure, but both are vital to the survival of plants in the soil and above ground.

Lauren, Your essays are great to read. I see no problems in your understanding of the material, and I really enjoy reading your answers. The turquoise highlight above is a sentence i suspect got by your proof reading. It neither adds or detracts from the quality of this work. Well Done!!!
Keywords 30/30
Score = 50/50

Lauren Huntington

Exam 1

Question 1

Imagine a life without **photosynthesis**? If you can't, it's because life would simply not exist without it. This process, which is the defining **metabolism** of all plants, evolved billions of years ago when early heterotrophic organisms were so abundant that the organic molecules they depended on for life were becoming scarce. Under the pressures of competition for nutrients, cells evolved that were able to make their own energy-rich molecules from inorganic materials. Without the evolution of these autotrophic organisms, life on Earth would have ceased to exist.

These photosynthetic organisms grew in population and changed the face of the entire planet. Because the process of photosynthesis releases **oxygen**, oxygen began to accumulate in the **atmosphere**. This was not an overnight change. In fact, it took millions of years, and by 700 million years ago, atmospheric levels of oxygen began to approach modern levels.

The increase in oxygen led to the formation of the ozone layer, which absorbs ultraviolet rays from the sunlight. By 450 million years ago, the Earth was protected enough from these ultraviolet rays that living organisms could survive on the surface layers of the water, on the shores, and life came to land for the first time. The increase in oxygen, which made the Earth **aerobic**, paved the way for more efficient use of carbon-containing molecules formed by photosynthesis, thus allowing respiration. This process, yields more energy than any **anaerobic**, or oxygenless, process. The increase in free oxygen also led to the first eukaryotic cells.

As photosynthetic organisms became successful in the open waters, the mineral sources they depended on began to deplete. Because of this, life began to develop toward the shores, where the water was rich in minerals and nutrients carried down from the mountains. In this new environment, these organisms faced the challenges of a more complicated environment. These organisms were up for the challenge, and began to evolve and adapt to the new environment. They developed strong cell walls for support, as well as structures that would anchor their bodies to the rocky surfaces. This was the first step to plants colonizing the land.

As plants evolved from aquatic to terrestrial environments, several obstacles stood in the way. One challenge was the distribution of water and nutrients to each cell. In water, transport was able to occur directly from the surrounding environment. Plants also needed to find a way to withstand the forces of gravity, and provide support so it could grow tall. To solve these problems, **roots** and **stems** developed. Roots anchor the plant to the ground and collect water and nutrients to distribute throughout the plant body. Stems provide support, as well as houses the vascular system, which conducts substances between the photosynthetic and non photosynthetic parts of the plant body. The vascular system includes a **vascular bundle** has two major components: the **xylem**, which conducts water through **tracheids** in most seedless vascular plants and gymnosperms and **vessel elements** in angiosperms (some angiosperms contain both), and the **phloem**, which transports nutrients. Xylem may also contain **fibers**, which can serve as storage and support. This vascular system is surrounded by an **endodermis** and a **casparian strip**, which help regulate the movement of water, as well as protect against toxins that could potentially move into the vascular system. Stems also support the principal photosynthetic parts, the **leaves.** This efficient conduction system occurs in vascular plants. In **nonvascular** plants, called bryophytes (e.g. mosses) there is a major limit to how tall the plant can be, and the plant depends on environmental water front the air, and diffusion.

Moving to land also meant the plants needed to conserve water. To prevent desiccation, plants developed an impermeable waxy **cuticle,** which covers the **epidermis,** to hold the water in and act as a water-tight seal around the plant. However, the cuticle also seems to prevent the exchange of gases that is necessary for photosynthesis and respiration. This problem is solved with **stomata**. The stomata occur on the leaves of plants, and consist of guard cells that open and close them in response to environmental signals. The stomata help the plant maintain a balance between carbon dioxide and oxygen requirements, as well as water losses.

So imagine life without photosynthesis? You can't. It might be the single most important evolutionary phenomenon in the history of the planet. We can thank photosynthesis for life as we know it.

Lauren, thank you so much for making my day!!! excellent, excellent essay. Your understanding and delivery is spot on. May I have your permission to use this as an example essay for future classes?
Keywords = 21/21
Score = 50/50