STUDY GUIDE - *Ch. 36.1 - Adaptations for Acquiring Resources (from above and below ground) were Key Steps in the Evolution of Vascular Plants (Plants with Xylem & Phloem).* - *Ch. 37.3 - Plant Nutrition Often Involves Relationships with Other Organisms*

NAME: _____

- **PHYSICALLY PRINT OUT** or **OPEN IN YOUR iPAD's GOOD NOTES** **this PDF and HANDWRITE (with a pen or stylus) your answers directly on this PDF.** *Typed work will not be accepted. Do not answer questions on separate paper.*
- **Importantly, study guides are NOT GROUP PROJECTS!!!** *You, and you alone, are to answer the questions as you read your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.*
- **Get in the habit of writing LEGIBLY, neatly, and in a MEDIUM-SIZED FONT.** *AP essay readers and I will skip grading anything that cannot be easily and quickly read so start perfect your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.*
- **SCAN physical documents with good resolution and upload your final work as PDFs to Archie.** *Avoid taking photographs of or uploading dark, washed out, side ways, or upside down scans of homework. Keep completed guides organized in your biology binder or a iPAD digital biology folder to use as study and review tools.*
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** *Though all the answers are in your textbook, you should try to put answers in your own words, maintaining accuracy and the proper use of terminology, rather than blindly copying the textbook whenever possible.*

1. a. What do **land plants collect from above the ground**?

   b. What do **land plants collect from below the ground**?

2. **Plants evolved from photosynthetic protists.** Why did these multicellular algal ancestors, unlike many modern land plants today, **not** need extensive vascular tissue (such as xylem) in order for all its cells to acquire the resources - water, CO_2, minerals *(other dissolved ions and polyatomic ions)* they needed?

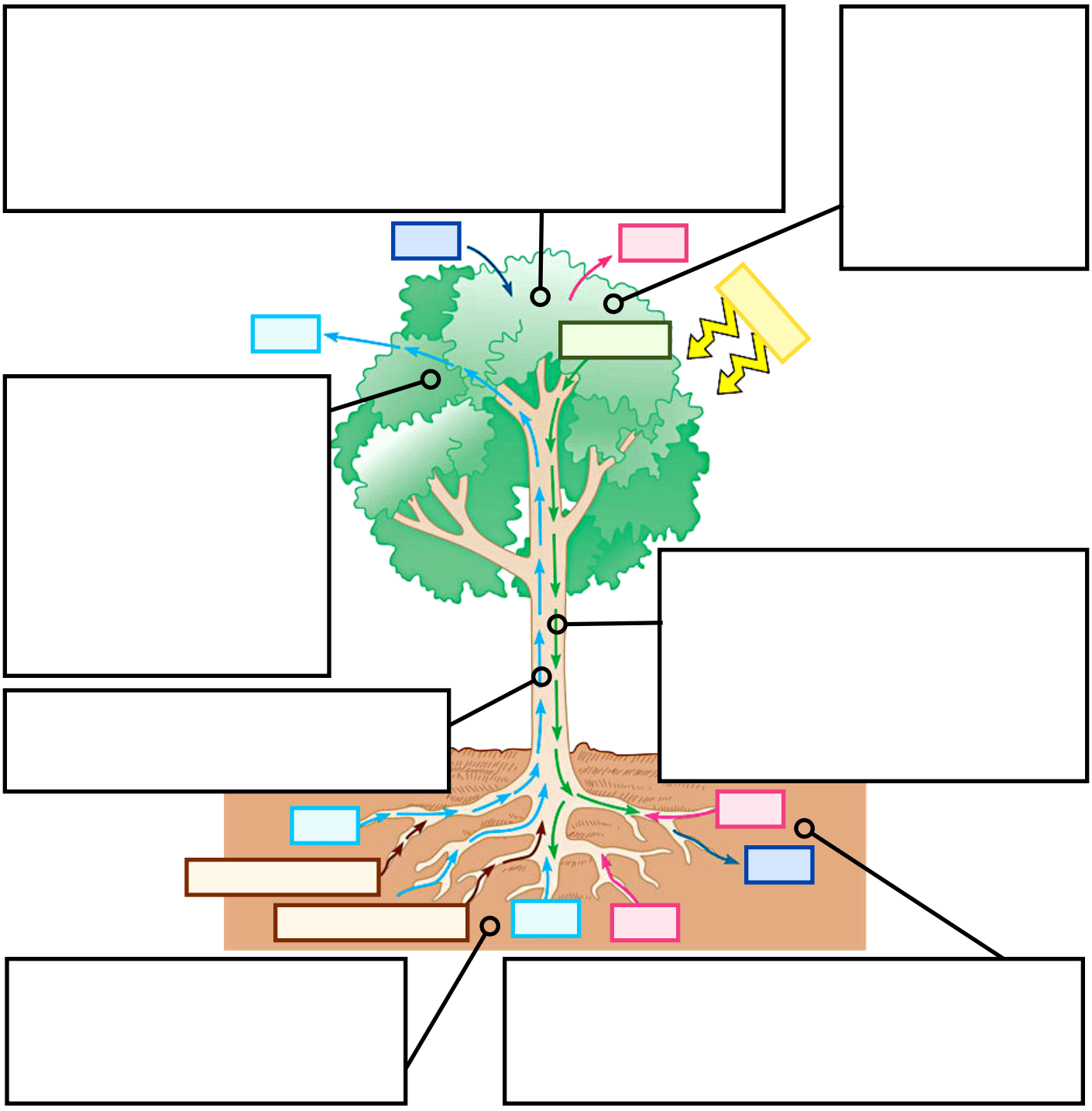
3. Make a numbered list below that explain in a logical, step-by-step, **sequential** manner how **competition** for resources drove the evolution of modern day vascular plants from the earliest nonvascular plants that had no leaves or roots.

4. a. In today's vascular plants, **vascular tissue is composed of Xylem and Phloem**. What does **Xylem** do?

   b. What does **Phloem** do?

   c. **Adaptations are an inherited characteristics [anatomical, physiological - chemical - or behavioral] that enhance the chance of a species' SURVIVAL & REPRODUCTIVE SUCCESS.** What does vascular tissue, an adaptation, allow?

5. Study Ch.36.2, which highlights **what is transported in vascular plants, DURING THE DAYTIME**, until you have it memorized. **Pay attention to the direction of item flow.** Then, see if you can recall it all as you fill in the figure below.

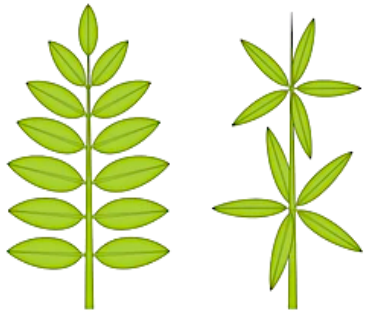


6. Most plants are photoautotrophic. **Plants are photoautotrophs**, meaning they obtain their **energy from light** ("Photo") and their **carbon from the inorganic molecule CO_2** ("Auto"). Animals, like humans, in turn are considered chemoheterotrophic. **Animals are chemoheterotrophs**, meaning they obtain their **energy from organic molecules** ("Chemo") and their **carbon from an organic molecules like carbohydrates and lipids** ("Hetero"). Plants engage in photosynthesis to obtain the energy and carbon they need. Natural selection favors those variation in plant structure that maximize the amount of photosynthesis a plant can perform in the different environments they inhabit. Plants thus vary in shoot length and size, shoot branching patterns, leaf position, size, and shape, and more, all variation affecting the amount of light captured.

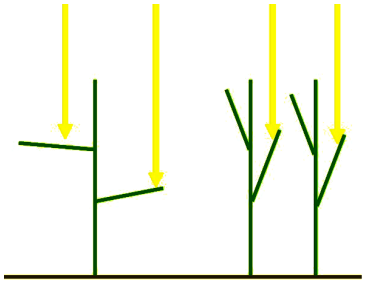
   a. **Why is there so much variation in branching patterns**, for example? What compromises do plants make?

   b. What **correlation is noted between water availability and leaf size/surface area**?

   c. The arrangement of leaves along the stem is known as phyllotaxy. Why might natural selection have favored leaves being positioned in a spiral along a branch in some environments, but have favored leaves being positioned directly above others along branches in still environments?



   d. Why might natural selection have favored leaves in certain species being oriented horizontally, so their largest surface area lies perpendicular to the light energy waves descending upon them during the hottest portion of the daytime, but have favored leaves in certain species being oriented vertically (like grasses), so their largest surface area lies parallel to the light energy waves descending upon them during the hottest portion of the daytime?



7. a. In order to complete **photosynthesis**, plants need carbon dioxide (along with water and light energy). **Opening the stomata (the stomatal pores) increase the efficiency of carbon dioxide diffusing into the mesophyll cells in the leaves**, but what **other activity also takes place when stomatal pores are opened** during daylight hours?

b. What **compromise exists that leads to evolution of certain shoot adaptations in plants** in different environments?

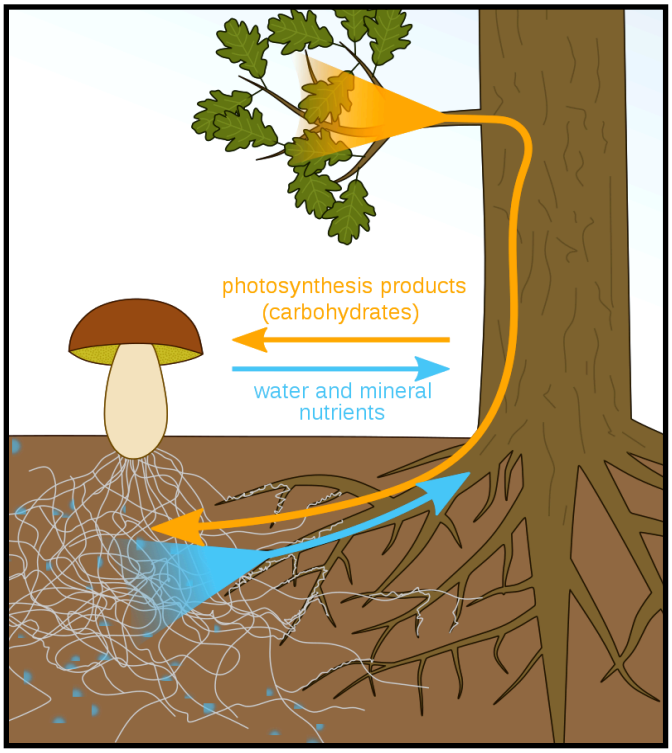
8. Plant root length and branching patters are also adaptations to maximize the ability for the plant to absorb water and minerals in relation to the energy spent to construct new root tissue. Plants have also often evolved mutually beneficial relationships with non-photosynthetic bacteria and with fungi. Remember again that an **adaptation is an inherited characteristics [anatomical, physiological, or behavioral - in this case even an association with another species] that enhances the chance of the species' SURVIVAL & REPRODUCTIVE SUCCESS.**

   What are **mycorrhizae**?

9. Let's jump over to read **Ch.37, Section 3** in your textbook for a little bit. **Several plant species have formed close, mutually beneficial relationships with certain soil bacteria or certain soil fungi. A mutualism is a relationship between two different species in which each species benefits from the interaction with the other species.**

   a. Study **Figure 37.9** to learn about **examples of mutualism** noted in nature. Remember that **fungi cannot perform photosynthesis**. What **benefit do certain species of fungi, who are part of plant root mycorrhizae, have** from forming close associations with plants?

   b. What **benefit does the plant have, in return, by forming a close association between its roots and the fungi**?



   d. Read the remainder of the portion of Ch.37. Section 3, labeled "**Fungi and Plant Nutrition,**" focusing especially on the **Evolution of Mycorrhizae** and the **Agricultural and Ecological Importance of Mycorrhizae.**

10. Now, let's read the earlier portion of Ch.37. Section 3, labeled "**Bacteria and Plant Nutrition,**" focusing especially on the **Rhizobacteria** and the **Bacteria and the Nitrogen Cycle.** and **Nitrogen Fixing and Agriculture.**

    a. Some of soil non-photosynthetic bacteria are free living, but others have evolved close associations with plant structures like roots, while still playing an important role in the nitrogen cycle. What are **rhizobacteria**?

    b. What **benefits do rhizobacteria experience** from forming close associations with plant roots? *What resources to these bacteria obtain from plants (instead of having to locate them in their environment otherwise)?*

    c. Some of these bacteria live just outside the plant roots in the region of soil referred to as the **rhizosphere**. Others actually live **within** the plant root structure itself. What **FOUR possible benefits do plant gain by forming close associations with rhizobacteria**?

        1.

        2.

        3.

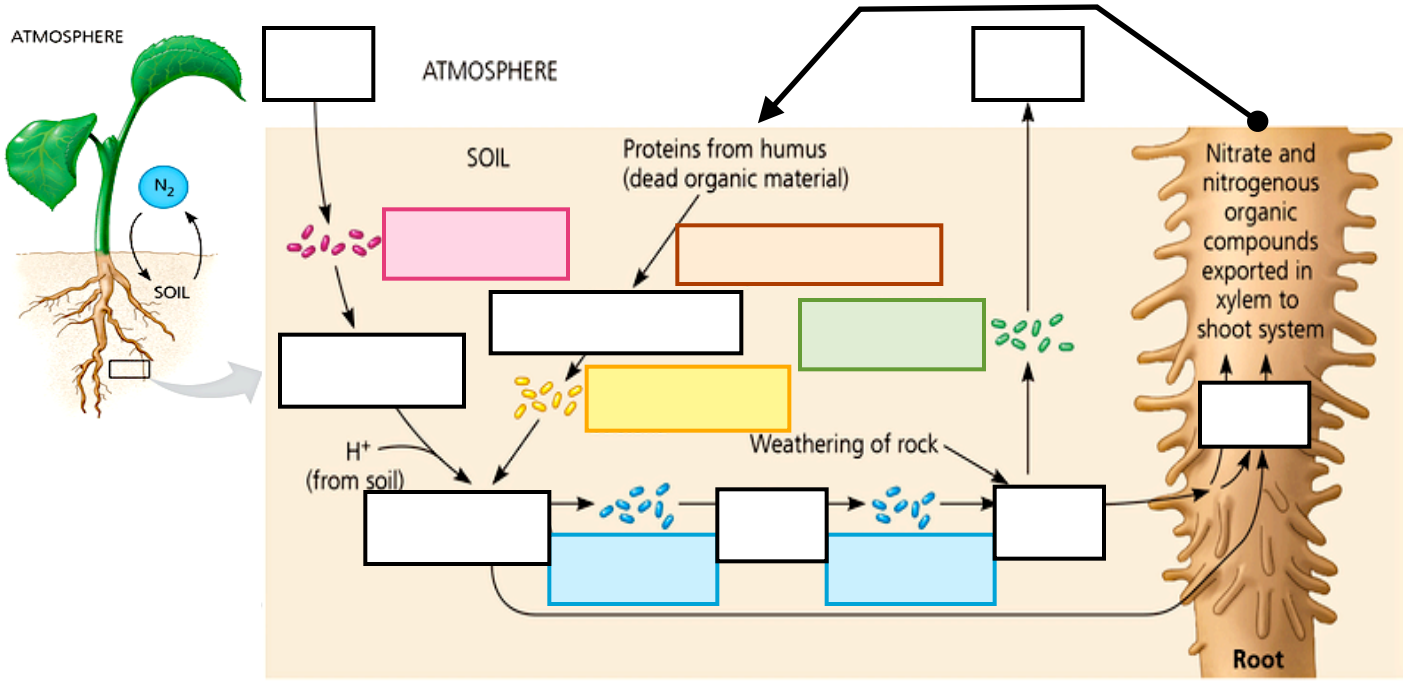
        4.

    d. Why is **Nitrogen such an important element** for plants to obtain in high enough quantities?

    e. By absorbing **which two soil minerals (polyatomic ions) can plants obtain the nitrogen they need**?

    f. The nitrogen cycle involves a series of process that occur in nature through which nitrogen moves from inorganic to organic and back to inorganic form. Remember, all nutrients (elements) on Earth are recycled. The nitrogen cycle helps nitrogen become available to living organisms like plants, and it relies on the presence of different types of bacteria. **Plants cannot use N_2 gas form in the air as a source of nitrogen**. The fist step in preparing nitrogen to be in a mineral form plants can absorb requires an activity known as nitrogen fixation. What is **nitrogen fixation**?

g. Some bacteria that engage in nitrogen fixation, which benefits all plants and fungi, life freely in the soil. However, in **some of these nitrogen-fixing bacteria have formed a mutually beneficial close relationship with plant roots, living as Rhizobacteria INSIDE the plant roots themselves.** Study the **Nitrogen Cycle** below by labeling the figure.



11. Almost all plants exhibit some mutualistic relationship with bacteria or fungi, or both, which help them obtain the nutrients they need while benefiting the bacteria or fungi. Some plants, however, have evolved still different ways to obtain necessary nutrients. Some evolved symbiotic associations with other plant or animal species that **benefit the plant species in question but do not harm or help the other plant species** (an example of **commensalism** between two species) or **help the plant species in question while harming the second living plant species** (an example of **parasitism** between two species). Some plants even evolved unique ways of **obtaining nitrogen when it is not found in the environment in high quantities by digesting animal parts and absorbing key nutrients.**

Review Figure 37.15 and then describe the following plantstypes and their adaptation to obtain nutrients:

Epiphytes =

Parasitic Plants =

Carnivorous Plants =