

GENERAL BOTANY, MIDTERM EXAM KEY, FALL 2003

Instructions: Please read each question **carefully** before attempting to answer it. If you have trouble understanding a question, please ask—I won't tell you the answer, but I can explain the question.

1. What is the primary molecule responsible for making plants green (i.e., for reflecting green light)?

Chlorophyll A (and/or chlorophyll B). I'd accept Chlorophyll

2. What does it mean to be an **autotroph**? Are most plants **autotrophs**?

“Self-feeding” This means that autotrophs are organisms that produce their own food.

Most plants are autotrophs. (Note: some of you listed exceptions to this—carnivorous plants are **not** exceptions to this, because they **are** photosynthetic, and only are carnivorous to supplement their nutrients—for Nitrogen. However, there are parasitic plants with no chlorophyll, and those plants are not autotrophs.)

3. Water is essential to all organisms. Water serves a particularly important function in plants, for photosynthesis. Please explain why is water necessary for photosynthesis.

Water is split after light is filtered to the reaction centers—this provides Hydrogen ions and two excited electrons—energy is reaped from those two excited electrons donated by the split water molecule (in the Electron Transport Chain)—that provides energy plants need in order to make sugars.

4. What major group of organisms was **originally** responsible for releasing most of the Oxygen in our atmosphere (circle the correct answer)?

- A. Club Mosses
- B. Archaeans
- C. Cyanobacteria**
- D. Green Algae
- E. no organisms at all—oxygen was released from the earth's crust

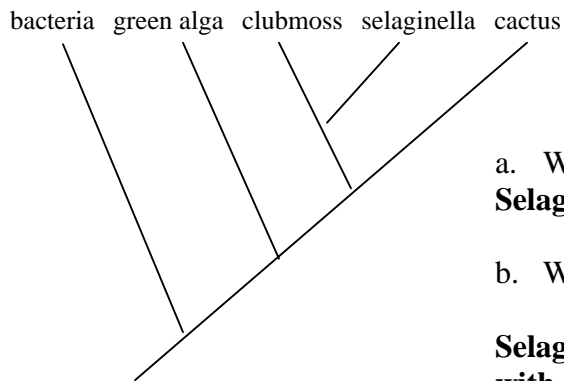
5. What major group of organisms is most like the ancestors of all plants (circle the correct answer)?

- A. Club Mosses
- B. Archaeans
- C. Cyanobacteria
- D. Green Algae**
- E. None of the above

6. What major group of organisms is most like the ancestors of chloroplasts (circle the correct answer)?

- A. Club Mosses
- B. Archaeans
- C. Cyanobacteria**
- D. Green Algae
- E. no organisms at all—they are just organelles

7. Use the following phylogeny for five organisms, to answer the following questions a, b, c, and d :



a. What is the closest relative to clubmoss?

Selaginella

b. Why is this the case?

Selaginella shares the most recent common ancestor with Clubmoss.

c. Circle the **clade** that includes the “**green alga**”.

See last page of key for this.

d. What does the vertical axis of this diagram represent? In other words, what is happening as you go from the bottom to the top of the phylogeny?

Time is passing, from sometime in the past to the present

8. a. What is one major characteristic (or evolutionary innovation) that evolved in plants that came **after** Bryophytes, and occurs in **all** plants **except** Bryophytes?

Vascular tissue/ vascular system

b. Why is this characteristic important or advantageous to plants? (use the back of this sheet if necessary)

Vascular tissues enable plants to transport water and sugars to various parts of the plant—this allowed plants with vascular tissue to grow larger than plants without it (often ****much**** larger), to better compete with other plants for light, while still getting water to their cells.

9. **Name** and **explain** three different things that membranes do that are important (and necessary) for normal cell function.

I accepted any three of these:

1. Membranes are selectively permeable—can regulate what goes in and out. This keeps the “inside” distinct from “outside”.

2. Separation of chemical reactions—reactions that would interfere with other parts of a cell can be separated from those parts.

3. Storing materials (vesicles)—cells can store energy-rich molecules for later use, or nasty chemicals can be stored until plants need them (until they are under attack), or wastes can be stored until the cell can get rid of them.

4. transporting materials (vesicles again)—from one place in the cell to another, or from a cell to the outside of a cell (secretion), etc.

5. Influencing communication within/among cells—receptors in the membranes can respond to signaling molecules that can tell cells to produce certain chemicals, etc.

6. Structure—allows cells to fill up their vacuoles (surrounded by a membrane) with water, which increases turgor pressure, giving some structural support.

10. Some photosynthetic organisms (for example, a separate group of algae called diatoms) that are not related to plants have chloroplasts with **three** membranes around them (green algae and plants have chloroplasts with **two** membranes around them). Knowing how **plants** acquired their chloroplasts, **propose a possible scenario by which diatoms acquired their chloroplasts.**

Diatoms probably engulfed a single-celled organism that already had acquired chloroplasts (by engulfing a cyanobacteria ancestor).

The above was a good enough answer, and was what I was looking for. However, note: If diatoms had engulfed another organism, it would have put a membrane around the organism, so there would be four membranes: the one the diatom put around it, the organism’s own membrane, and the two chloroplast membranes (one from the first organism that had engulfed the cyanobacteria ancestor, and one from the cyanobacteria ancestor itself). Thus, probably the diatoms digested one of those membranes, leaving three around the diatoms’ chloroplasts. There are some photosynthetic organisms with

four membranes around their chloroplasts—and the above explanation works for them—they engulfed a green alga.

11. a. A detective on a case finds cactus spines in a suspect's back side... Using this evidence, he linked the suspect to the scene of a crime out in the desert. But as you know, cactus spines did not evolve because they help detectives. Explain why spines might be advantageous to cactuses.

Cactus Spines evolved because they protected the plant from animals that would eat it—cactuses store water in their stems, not in their spines... but I did not take points off for that answer, if the correct answer was included.

- b. Explain how the process of natural selection works (outlining the basic steps). Specifically, use cactuses and cactus spines as your example, and propose a scenario by which spines might have evolved in cactuses (use the back of this sheet if necessary).

Natural selection operates because variation arises, through mutation, recombination (crossing over), and sexual reproduction. Thus, individuals are different from each other. Cactus ancestor individuals with some spiny structures did better at warding off predators than those individuals without those spiny structures. Because they survived better, they left more offspring, and passed the genes for those spiny structures on to their offspring through their genes.

12. Which of the following is **not** a chemical that is made from Glucose, the end product of photosynthesis (circle the correct answer)?

- A. lipids
- B. oxygen**
- C. cellulose
- D. starch
- E. lipoproteins

13. Which one of the following is **not** coded for by DNA (circle the correct answer)?

- A. chlorophyll**
- B. enzymes
- C. cell membrane proteins
- D. cytoskeleton (protein fibers)
- E. RNA

RNA was a common answer—this molecule is the intermediary step between DNA and proteins—DNA codes for RNA which makes the proteins according to the specifications of the original DNA code... so E is incorrect.

14. Which one of the following is **not** a function of meristems (circle the correct answer):

- F. Producing vascular tissue
- G. Producing ground tissue
- H. Producing epidermal tissue
- I. Plant growth
- J. Photosynthesis**

15. Name **two** problems associated with the transition of plants from life in water to life in land. For each problem, name **one** solution that evolved in mosses, and **one** solution that evolved in ferns, that help overcome each of these problems.

1. Problem__Desiccation_

Moss solution__live near water (close to the ground, if that's where the water is, or grow when water is available or thick waxy cuticle

Fern solution__live near water, or vascular system or thick waxy cuticle, or grow when water is available

-Problem_ water for fertilization (sperm must swim).

Moss solution__ live near water and/or fertilization when/where water is available or provide protected external environment

Fern solution__ live near water and/or fertilization when/where water is available or provide protected external environment

-Problem__ Getting water and nutrients to cells _

Moss solution_____ stay small—absorb water by osmosis _____

Fern solution_____ vascular tissues (xylem and phloem)_____

-Problem_____ Protection and nourishment of embryo __

Moss solution__ sterile “jacket” (layer) of cells around embryo nourishment from the mother plant____

Fern solution__ sterile “jacket” (layer) of cells around embryo nourishment from the mother plant (vascular connections)____

-Problem_____ Support __

Moss solution_____ stay small _____

Fern solution__Turgor pressure and/or Schlerenchyma and/or Lignin_

Three correct answers for 7c:

