

As always...

- **PHYSICALLY PRINT OUT this PDF and HANDWRITE (with a black or blue pen) your answers directly on this PDF.** Typed or digitally-written work is **not** 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 read so start perfecting 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 in color and with good resolution. Then, upload your final work as PDFs to Archie.** Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** Reading is **CRITICAL** and makes a difference when trying to build a solid understanding of complex topics and when trying to build vocabulary and writing skills. Paraphrasing in your own words is a better strategy than blindly coping the book. **First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced.

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## INDEPENDENT STUDY: KINGDOMS PROTISTA

Read through this chapter to understand the big picture. Use the questions as a guide to what information is more important. Your goal is to learn the terms and knowledge needed to understand what is unique about this Eukaryotic group of organisms.

**The "kingdom" Protista is no longer technically recognized as an official taxon and kingdom.**

Work in *Protista* systematics (genetics) has revealed that the kingdom is paraphyletic and in need of extensive reworking. The kingdom formally known as Protista is in the process of being divided eventually into many separate kingdoms as protists are not all genetically and behaviorally similar enough to be grouped in one kingdom. They are less closely related at times to each other than the other species grouped together into other kingdoms.

Though we still refer to Protista as one of the four kingdoms in this course (Animalia, Plantae, Fungi, & Protista) under the domain Eukarya, biologists now use the term Protista in a general, non-technical way to refer to Eukaryotes that are neither plants nor animals nor fungi.

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1. Protists are eukaryotes, which means that they contain certain structures in common with prokaryotes like having ribosomes and a plasma membrane, but they do differ in that they contain organelles. What is the benefit of having **organelles** again?
2. Protists, like other eukaryotes, have well-defined cytoskeletons. What are two benefits of having a cytoskeleton?
  - 1.
  - 2.

Remember, as you learned in Ch.6, we know now cytoskeletons can even help transmit information from the external environment to the inside of the cell.

3. **Protists vary in structure & function more than any other group of organisms.** Some protists are multicellular while others are single-celled organisms. Protists vary in the types of organelles they possess. Some reproduce asexually using mitosis. Others can reproduce sexually utilizing meiosis instead. They also vary in their ways of acquiring nutrients. Differentiate between photoautotrophic protists, heterotrophic protists and mixotrophic protists.

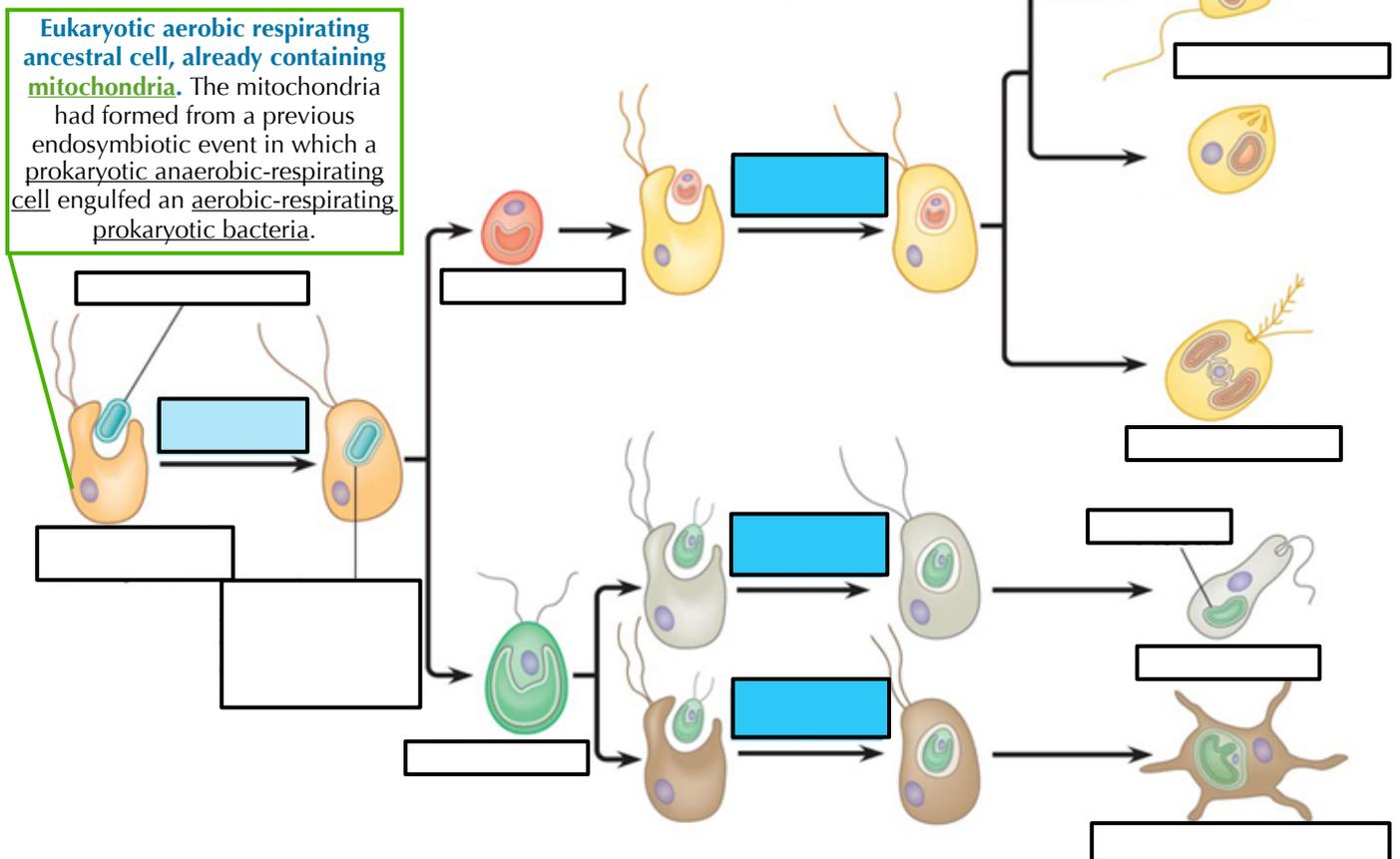
**Photoautotrophic Protists =**

**Heterotrophic Protists =**

**Mixotrophic Protists =**

4. What event gave rise to the great diversity of protists? \_\_\_\_\_
5. **Endosymbiosis is a key component of eukaryotic cell evolution.** All eukaryotic cells contain mitochondria no matter which Kingdom the organism belongs to. Protists with mitochondria are the ancestor not just to modern day protists, but also animals, plants, and fungi. Some protists, and plant cells that descended from these protists, also contain plastids like chloroplasts. How did the **mitochondrial organelle come into existence that helped create the first eukaryotic cells on Earth?**

6. Many plastid-containing protists are also the result of **Secondary Endosymbiosis.** Using Figure 28.3, label the figure below to show the key steps in several secondary endosymbiotic events that led to the plastid-containing protists.



7. What are **two pieces of evidence to support the claim that plastids formed from once free-living cyanobacteria?**
- 1.
  - 2.
8. So, to review, based on what you learned in Figure 28.3 and in your readings, red and green algae also formed from a process known as **Primary Endosymbiosis**, when a mitochondria-containing eukaryotic cells engulfed a cyanobacteria, which evolved into the plastid organelles. (FYI: Green plants are thought to have evolved in turn from one type of green algae). Explain, in words, **what took place in the process known as Secondary Endosymbiosis that allowed for additional protist species to form** (which followed endosymbiosis).
9. Let's try to work through the Scientific Skills Exercise: Interpreting Comparison of Genetic Sequences in Ch.28.1. Remember, **prokaryotes contain ribosomes in their cytoplasm while eukaryotes contain two slightly differing types of ribosomes, the eukaryotic ribosomes in the eukaryotic cells' cytoplasm, as well as more-prokaryotic-like ribosomes in their mitochondria (and plastids).**
1. a.
  - b.
  - c.
  - d.
2. a.
  - b.
10. a. Diplomonads and Parabasalids contain mitochondria that are considered "highly reduced." What does this mean?
- b. Like any other cell, Diplomonads and Parabasalids need to extract energy from high-energy organic molecules, like glucose. This energy is then stored on ATP molecules, this energy being used to do work with in the cell. Why does having highly reduced mitochondria not hinder these protists' ability to stay alive and do work?

11. a. When it comes to **euglenozoans**, what **human disease** is **caused by the euglenozoan in the genus trypanosoma**?
- b. How do **trypanosomes evade the vertebrate immune system**?
12. DNA sequence data for a diplomonad, a euglenid, a plant, and an unidentified protist suggest that the unidentified species is most closely related to the diplomonad. Further studies reveal that the unknown species has fully functional mitochondria. Based on these data, at what point on the phylogenetic tree in Figure 28.5 did the mystery protist's lineage probably diverge from other eukaryote lineages? **Explain all your logic.**

*(Check your answer to question #12 by going to the [Ch.28.2 Concept Check Question #2](#) answers in Appendix A)*

13. a. What are **diatoms**?
- b. When photosynthetic organisms engage in photosynthesis they convert inorganic, gaseous carbon (CO<sub>2</sub>) into solid carbon in the form of organic molecules that make up the body of the photosynthetic organism. Many consumers that obtain their nutrients by feeding on these photosynthetic producers, however, engage in cellular respiration, breaking the organic molecules obtained down back into gaseous CO<sub>2</sub>. **How can populations of diatoms then potential still be used to counteract some of the rise in atmospheric CO<sub>2</sub> levels?**
14. **Brown algae is a type of multicellular Stramenopile protist.** Certain brown algae engage in the complex life cycle known as **Alternation of Generation**, which is also seen in plants. Read about the Alternation of Generation of Brown algae and Figure 28.14, and see if you can understand how the life cycle uses mitosis and meiosis.
15. Which organism is responsible for the devastating Irish famine of the 19<sup>th</sup> century that killed millions of people **and** how did this organism wreak its havoc?
16. a. What are the general physical characteristics of the **dinoflagellates**?

b. What are **red tide** blooms?

c. Why are red tides **dangerous**? (How do they influence ecosystems and the diversity of life?)

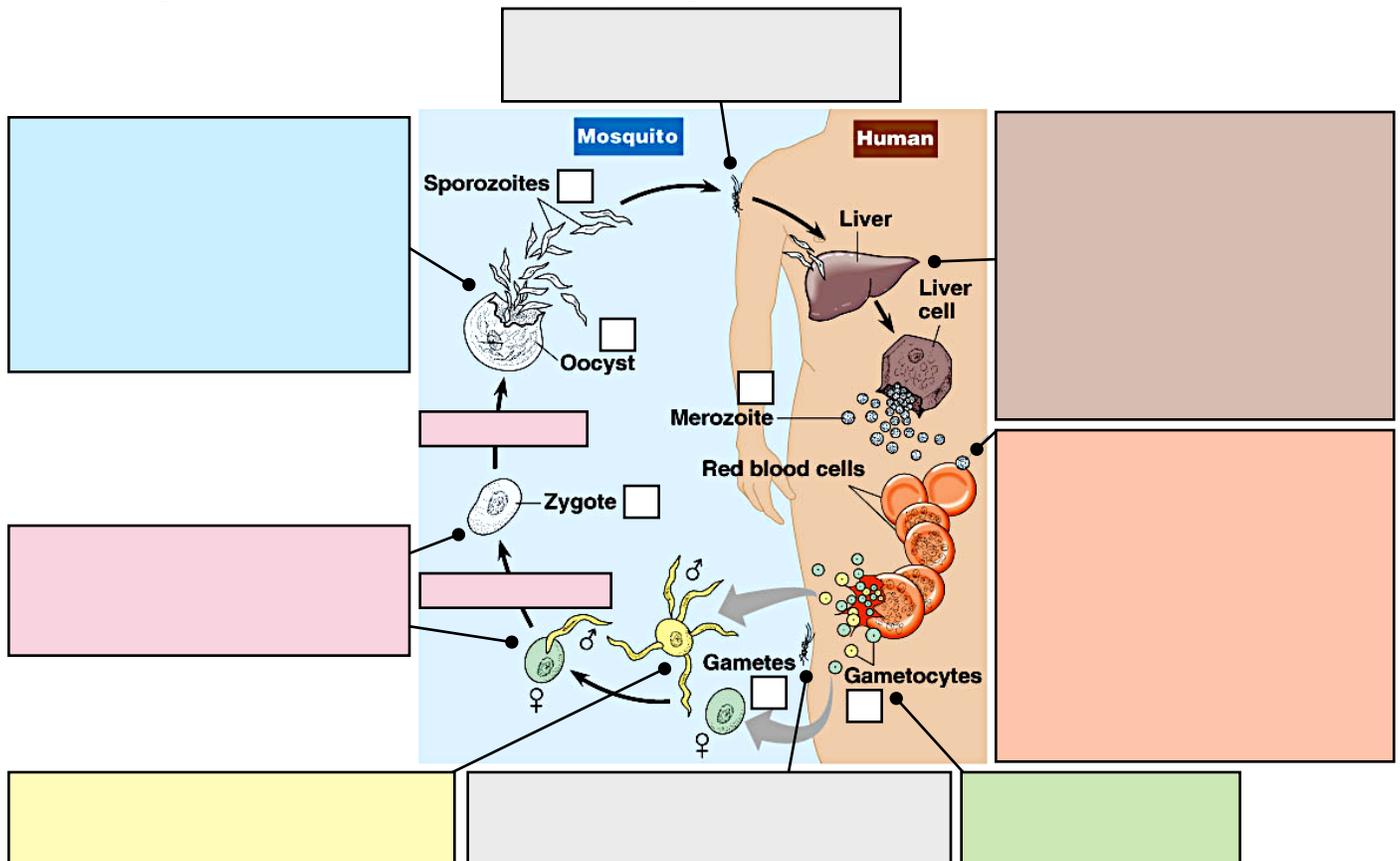
17. Microscopic organisms called **PHYTOPLANKTON** exist in marine habitats. They are important producers in marine ecosystems, capturing solar energy through photosynthesis and storing that energy in the sugars made as well as the macromolecules made from these sugars. Which **2 types of organisms make up the group known as phytoplankton?**

- 1.
- 2.

18. Within the group of **alveolate protists** we also **find the apicomplexans, some** of which are **parasites of animals and cause serious human disease**. Many have intricate life cycles with sexual and asexual stages that often require two or more different host species. You are familiar with one apicomplexan parasite already, mainly the protist **Plasmodium**.

a. What disease does the **plasmodium parasite** cause **in humans**? This disease is a leading cause of human death by infectious disease. Over 220 million people in the tropics are infected each year, and 450,000 die annually.

b. Let's study the **life cycle of Plasmodium**. It is a parasitic protist (meaning it derives part of its nutrients from and reproduces in organisms it lives on or in, harming those host organisms in the process of benefiting itself). Plasmodium uses both mosquitoes and humans as alternate hosts in its complex life cycle. Number and explain the eight steps in the **Plasmodium life cycle by filling all the colored boxes** below.



- c. On the image above add the **ploidy (n or 2n) of each type of cell** that forms in the Plasmodium's life cycle in the small white boxes.
- d. If the Zygote (which matures into the oocyst) is 2n and undergoes meiosis to form sporozoites, as you indicated in the figure above hopefully, what type of cell division, meiosis or mitosis, is used to produce multiple merozoites from sporozoites, to produce the gametocytes from the merozoites, and to produce the multiple male gametes from the male gametocyte?
- e. As is typical with protists, does the **plasmodium's life cycle involve cells existing mostly in haploid or diploid forms?**

**FYI:** Though this is a unicellular parasite that lives part of its life inside human cells, it is **different from viruses** because **1. it is a living organism** and **2. it is not high-jacking the host cell's machinery to copy itself as it is a fully-functioning living cell capable of dividing by itself**, even though as a heterotrophic parasite it does obtain its carbon (and other nutrients) from the host's cells, including the red blood cells' cytoplasm and hemoglobins.

f. Based on what you learned in question #14 about the life cycle of Brown algae (which behaves similar in life cycle to that of plants), **does the plasmodium's life cycle involve Alternation of Generation?**

g. Study your answers to #18.a-f. When done, let's take a little self-quiz to see if you fully memorized and understand the Plasmodium's life cycle, the plasmodium being the causative agent of the serious disease malaria, which can cause anemia and jaundice (yellow coloring of the skin and eyes) because of the loss of red blood cells, and if not promptly treated, can become severe, causing kidney failure, seizures, mental confusion, coma, and death.

1. How do multiple **malaria sporozoites (haploid n stage) enter human blood?**

2. What **organ do the sporozoites invade first?**

3. Once the **sporozoites divide** (asexually) several times, they **leave the liver as merozoites**. What do they **invade next?**

4. Inside the blood, the **merozoites divide again asexually**. What causes the **symptoms** of fever, malaise, nausea, and chills experienced during malaria infection?

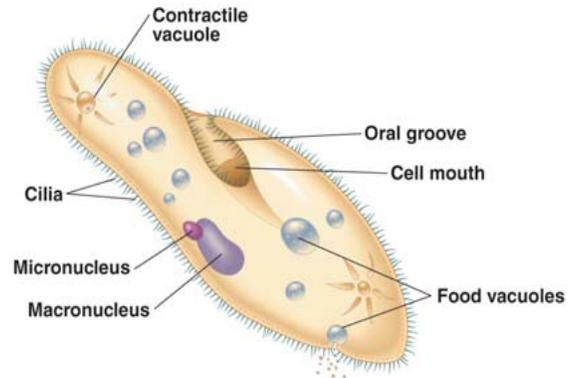
5. Some merozoites form gametocytes, which mature into gametes. *(Note that these are gametes, which are not made directly by meiosis as is the case in animal life cycles (review Ch.13) since the merozoites they originated from are already haploid!).*

These male and female **gametes infect the digestive tract of mosquitoes where they combine**, a process called \_\_\_\_\_ to form a **diploid zygote**.

6. What happens to this zygote that causes the **newly parasitized mosquito to become infectious itself?**

19. If you were to study a drop of pond water, it is likely you will watch a *Paramecium* whirling about and pumping water out its contractile vacuole. Answer these questions about the ciliate *Paramecium*. Read about ciliates and **study Figure 28.19** before answering the following questions.

- a. What are **Ciliates**?
- b. What do ciliate *Paramecium* feed mostly on?
- c. How does the **ciliate *Paramecium* move food into its cell?**



- c. How do **food vacuoles and lysosomes help with nutrition?**

d. The ***Paramecium* is hypertonic** to its fresh water, low osmolarity (low solute concentration) environment, so how does this organism **maintain water balance** (and avoid lysing)?

20. How do **amoebas** move? Explain.

21. Which type of algae, red, brown, or green, do researchers believe **plants evolved from?**

22. Why are **cellular slime molds** model organisms for **studying the evolution of multicellularity?**

23. Importantly, **many protists are producers, organisms that use energy from light or inorganic chemicals to convert carbon dioxide to organic compounds.** These form the base of ecological food webs.

- a. Besides protists, what are the other **main producers in aquatic ecosystems?**
- b. Which **protists make up a significant portion of the photosynthetic aquatic phytoplankton**, producers in oceans, rivers, and lakes? *P.S. phytoplankton includes photosynthetic protists, photosynthetic eubacteria, and photosynthetic archaeabacteria.*

- c. Why might global warming be negatively affecting population sizes of photosynthesis protists and prokaryotes living in the surface waters?

24. *Think:* **Protists play key roles in ecological communities. Many protists live in symbiotic relationships with other species.** Corals have a close relationship with certain types of algae. The mutually beneficial relationship between algae and modern corals — which provides algae with shelter, gives coral reefs their colors and supplies both organisms with nutrients — began more than 210 million years ago. Corals are invertebrate multicellular animals. Many marine organisms, like fish, marine worms, barnacles, crabs, snails, and sea stars feed on corals. Algae belonging to the group known as dinoflagellates live inside the corals' tissues. The algae use photosynthesis to produce nutrients (sugars), many of which they pass to the corals' cells. The corals in turn emit waste products in the form of ammonium, which the algae consume as a nutrient. A phenomenon termed Coral Bleaching occurs when rising ocean temperatures and pollution causes **corals** to expel the **symbiotic photosynthetic dinoflagellates** that live in association with the coral animal cells. **Predict and explain** how coral bleaching events would affect corals **and** the other consumers living in marine habitats?

Prediction & explanation for prediction of Coral Bleaching's effect on corals (growth, reproduction, population size etc) =

Prediction & explanation for prediction of Coral Bleaching's effect on other consumers' in this marine ecosystem (reproductive success, population sizes etc) =

(Check your answer to question #24 by going to the [Ch.28.6 Concept Check Question #2](#) answers in Appendix A)

25. Describe one mutualistic relationship and one parasitic relationship involving protists.

**Mutualistic example =**

**Parasitic example =**

26. **Producers form the base of all food chains and food webs in our ecosystems.** These consumers convert light energy into chemical energy stored in organic sugars built from CO<sub>2</sub>. These consumers use these sugars not just as a source of energy, but also as precursors for making all other organic monomers and molecules (proteins, lipids, nucleic acids). Consumers, organisms that cannot engage in photosynthesis, obtain the energy they need for doing work and their carbon from these organic molecules constructed by producers. **Scientists have estimated that 50% of the world's photosynthetic organisms are plants. What is the make up of the other 50% of producers worldwide?**

27. In Chapter 55, you will learn about **algal blooms and lake and ocean eutrophication** and the resulting loss of life. This is a very important concept to understand. *Please read and study the series of events described below so you understand the role Algal protists can play in the loss of biodiversity.*

When fertilizers and nutrient waste trickle into ground water and then into lakes and oceans (a process known as **eutrophication**), algae multiply into a huge population known as an **Algal Bloom**. Of course, like all life, when the nutrient levels decrease again, the alga start dying. When they do, **decomposers**, certain species of bacteria, feed off the bodies of these dead protists. The decomposer populations then in turn grow tremendously as a result of this greater food source. With such a large number of decomposers all using up oxygen for their own cellular respiration, soon these lakes or that area of ocean starts to suffer from oxygen depletion (**hypoxia**). In turn, other animals living in these lakes and areas of the ocean, who require oxygen themselves, start dying off in large quantities, creating large areas known as **Dead Zones**. In this way, nutrients and fertilizers that drain into water systems and the resulting large population of protists eventually result in the massive loss of biodiversity and life in these waters.

Understood? \_\_\_\_\_

28. This is a large chapter with a great deal of information about many different protists. Here are some quick facts.

***Giardia intestinalis*** = causes “hiker’s diarrhea”. This is the reason you should always treat your water before drinking!

***Trichomonas vaginalis*** = a sexually transmitted infection.

***Trypanosoma sp.*** = causes African sleeping sickness and Chagas’ disease.

***Euglena*** = common in pond water, where they exist as tiny flagellated green cells with a red eyespot.

**Dinoflagellates** = blooms cause “red tides” that kill other organisms. Others are bioluminescent as well.

***Plasmodium*** = the causative agent of malaria.

**Ciliates** = *Paramecium* and *Stentor* are examples. They can be dinucleated with a micro- and macronuclei.

***Amoeba*** = move and, in carnivorous species, engulf other organisms by extending their cytoplasm into pseudopodia.

**Diatoms** = unicellular with a two-part, glass-like wall made of hydrated silica.

**Brown algae** = One example is kelp, a favorite food source for sea otters.

**Oomycetes** = water molds and their relatives, which include the causative agent of potato blight.

**Red algae** = multicellular organisms, some of which are found at great depths in the oceans and are popularly used to wrap sushi.

**Green algae** = Includes *Chlamydomonas*, *Ulva*, *Volvox* (a genus of charophytes). Charophytes are the closest relative of land plants.

**Slime molds** = plasmodial slime molds are large unicellular organisms that are not fungi despite looking alike, while cellular slime molds are unicellular organisms that can cooperate as a multi-cellular structures when nutrient levels are low as an adaptation to find resources more effectively and survive as a species.

29. Proceed to the TEST YOUR UNDERSTANDING section at the end of the chapter. **Study your Ch.28 study guide first!** Then, do your best to try to answer these from memory first in order to test how well you grasped the material before. If you are unsure, return to the relevant section of your chapter and restudy any pertinent material to refresh your memory. (Check some of your answers by going to the Ch.28 Test Your Understanding answers in Appendix A)

1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_ 4. \_\_\_\_\_ 5. \_\_\_\_\_