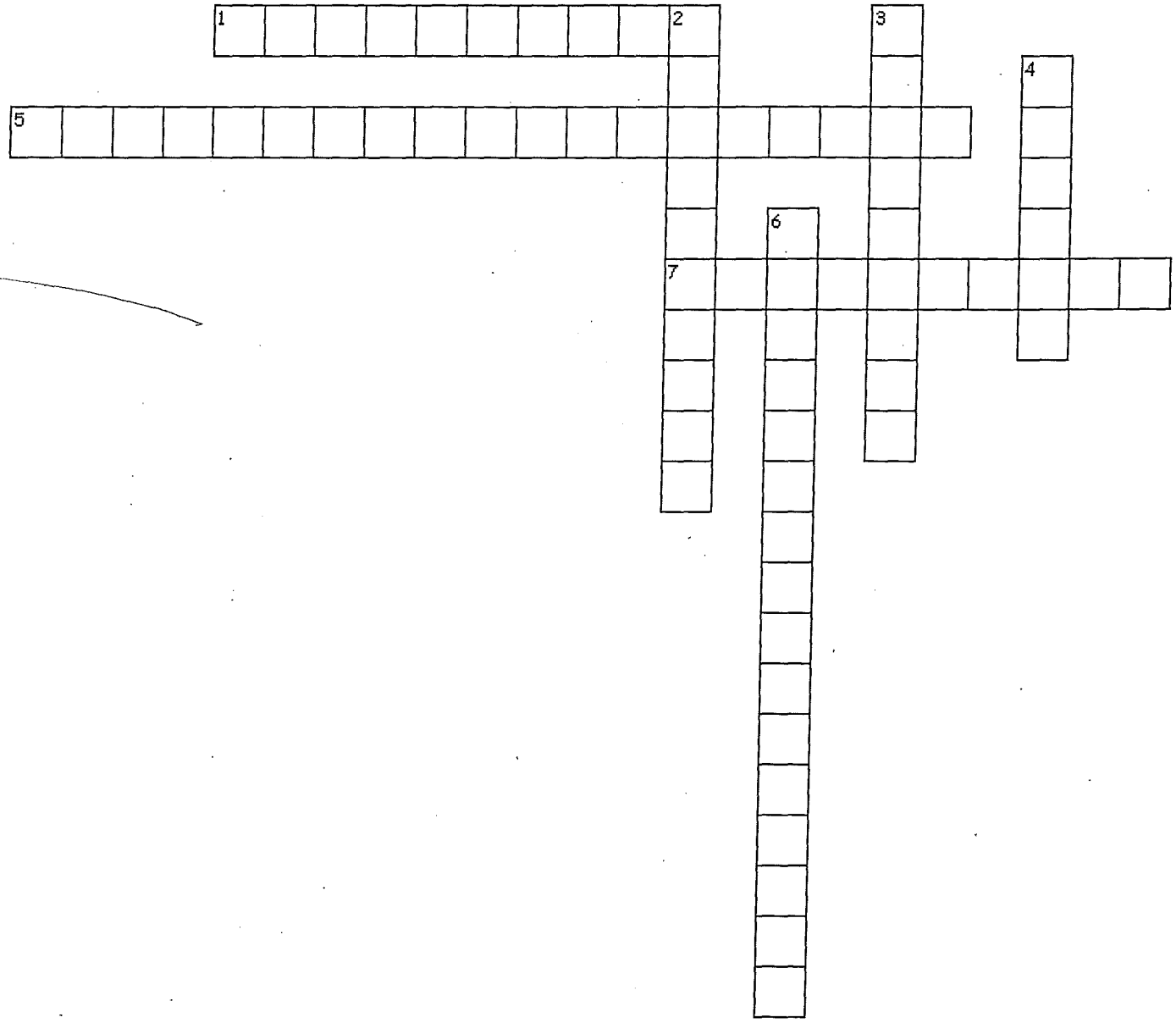
Ch 16 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard for each term with the word on one side and the definition on the back



Across

1. describes a character that is shared by a group of species because it is inherited from a common ancestor
5. the human practice of breeding animals or plants that have certain desired traits
7. a trait that improves an organism's ability to survive and reproduce; the process of becoming adapted

Down

2. the formation of new species as a result of evolution
3. the process of change by which new species develop from preexisting species over time
4. the trace or remains of an organism that lived long ago; most commonly preserved in sedimentary rock
6. the process by which individuals that are better adapted to their environment survive and reproduce more successfully than less well adapted individuals do

Chapter 16 Darwin/ evolution

Vocabulary Review

In the space provided, write the letter of the term or phrase that best completes each statement.

_____ 1. The process in which organisms with traits well suited to an environment are more likely to survive and to produce offspring is
a. trait mechanisms. c. genetic principles.
b. origin of species. d. natural selection.

_____ 2. The process of change by which new species develop from preexisting species over time is called
a. radioactive dating. c. camouflage.
b. evolution. d. natural selection.

_____ 3. A trait that improves an organism's ability to survive and reproduce is
a. industrialization. c. an adaptation.
b. not an advantage. d. destructive to its survival.

_____ 4. Similar structures in two or more species that have been inherited from a common ancestor are
a. not related. c. analogous.
b. homologous. d. young in origin.

_____ 5. Traces of organisms that lived in the past are
a. evolution. c. fossils.
b. adaptations. d. useful to the organism.

_____ 6. Selection for desired traits that is done by humans is called
a. sexual selection. c. artificial selection.
b. natural selection. d. observational selection.

_____ 7. The process by which new species form is called
a. biological change. c. speciation.
b. reproduction. d. divergence.

Chapter 15 Darwin/ evolution

Vocabulary Review

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Chapter 16 Evolutionary Theory

I. DARWIN'S IDEAS FROM EXPERIENCE-Darwin's experiences provided him with evidence of evolution at work. In Darwin's time, most people did not think that living things had changed over time. In fact, many doubted that Earth itself had ever changed. But Darwin saw evidence of gradual change.

Individuals and Ideas that Influenced Darwin

Individual(s) and field	Major ideas	Importance to Darwin's theory
Jean Baptiste Lamarck (natural history)	• proposed that organisms change over time as they adapt to changing environments • thought (incorrectly) that changes due to use or disuse of a trait would be passed on to offspring	suggested that inheritance plays a role in evolution
Thomas Malthus (economics)	• noted that the human population was growing faster than the food supply • predicted that limited resources would cause deaths from disease, war, or famine	Darwin proposed that all populations, not just human populations, are limited by their environments.
Georges Cuvier (geology)	argued that fossils in rock layers showed: • differences in species over time • that species from the past differed from those of the present	showed that species change over time
James Hutton and Charles Lyell (geology)	thought that geologic processes, such as those that form rocks and fossils, work gradually and constantly	showed that Earth's history was long enough for species to have evolved gradually

II. THE VOYAGE OF THE _____

A. Darwin's first evidence was gathered during a global voyage on a ship called the Beagle.

B. Darwin also visited the Galápagos Islands in the Pacific Ocean.

C. he collected several different species of birds called _____. – Each of the finches is very similar, but differences can be seen in the size and shape of the bill (or beak).

D. Darwin noticed that many of the islands' plants and animals were similar, but not identical, to the plants and animals he saw in South America.

E. Later, Darwin proposed that the Galápagos species had descended from species that came from South America.

F. Then, the descendant finches were modified over time as different groups survived by eating different types of food.

G. Darwin called such change _____. This idea was a key part of his theory.

III. BREEDING AND SELECTION-Darwin took interest in the practice of breeding, especially the breeding of exotic pigeons.

A. Eventually, Darwin gained a new insight: breeders take advantage of natural variation in traits within a species.

B. If a trait can be inherited, breeders can produce more individuals that have the trait.

C. Breeders simply select individuals that have desirable traits to be the parents of each new generation.

D. Darwin called this process _____ because the selection is done by humans and not by natural causes.

IV. LAMARCKIAN INHERITANCE -In 1809, the French scientist Jean Baptiste _____ proposed an explanation for how organisms may change over generations.

A. He proposed that organisms change over time as they adapt to changing environments.

B. However, Lamarck had an incorrect idea about inheritance. He proposed that changes due to use or disuse of a character would be passed on to offspring. He believed that offspring inherited these kinds of changes.

V. POPULATION GROWTH-Another key influence on Darwin's thinking about evolution was an essay by _____. In 1798, this English economist observed that human populations were increasing faster than the food supply.

A. Malthus pointed out that food supplies were increasing linearly. More food was being produced each year, but the amount by which the food increased was the same each year.

B. In contrast, the number of people was increasing _____. More people were added each year than were added the year before.

C. Malthus noted that the number of humans could not keep increasing in this way, because many people would probably die from disease, war, or famine. – Darwin simply applied Malthus's idea to all populations.

D. A _____ is all of the individuals of the same species that live in a specific place.

E. Darwin saw that all kinds of organisms tend to produce _____ offspring than can survive. So, all populations must be limited by their environments.

VI. EVOLUTION BY NATURAL SELECTION- Darwin's theory predicts that over time, the number of individuals that carry advantageous traits will increase in a population.

A. Every living thing has the potential to produce _____ offspring, but not all of those offspring are likely to survive and reproduce.

B. Darwin formed a key idea: Individuals that have traits that better suit their environment are more likely to _____

C. Furthermore, individuals that have certain traits tend to produce _____ offspring than others do.

D. These differences are part of _____.

E. Darwin proposed that natural selection is a cause of evolution.

F. In this context, evolution is a change in the _____ characteristics of a population from one generation to the next.

VII. STEPS IN DARWIN'S THEORY- Darwin's explanation is often called the _____. – This theory can be summarized in the following four logical steps—_____. Each species becomes adapted to its environment as a result of living in it over time. An adaptation is an inherited trait that is present in a population because the trait helps individuals survive and reproduce in a given environment. Darwin's theory explains evolution as a gradual process of adaptation. Note that Darwin's theory refers to populations and species—_____—as the units that evolve.

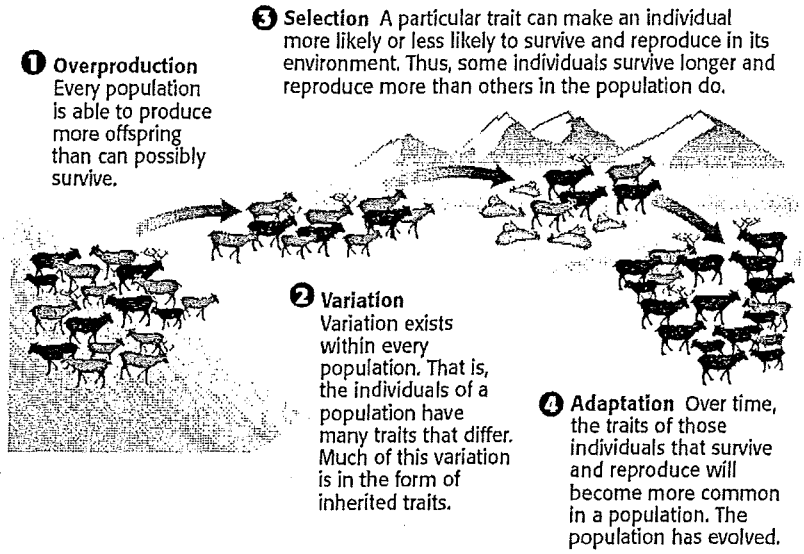
A. Step 1 Overproduction: Every population is capable of producing more offspring than can possibly survive.

B. Step 2 Variation: Variation exists within every population. Much of this variation is in the form of inherited traits.

C. Step 3 Selection: In a given environment, having a particular trait can make individuals more or less likely to survive and have successful offspring. So, some individuals leave more offspring than others do.

D. Step 4 Adaptation: Over time, those traits that improve survival and reproduction will become more common.

The Theory of Evolution by Natural Selection



VIII. DARWIN'S THEORY UPDATED- Discoveries since Darwin's time, especially in genetics, have been added to his theory to explain the evolution of species. Modern biologists have tentative answers to the following questions:

A. Can an individual evolve?

Darwin correctly inferred that individuals do not evolve. They may respond to outside forces, but individuals do not pass on their responses as heritable traits. Rather, populations evolve when natural selection acts (indirectly) on genes.

B. Is evolution the survival of the fittest?

Natural selection can act only on the heritable variation that exists in a population. Chance variations do not always provide the best adaptation for a given time and place. So, evolution does not always produce the "fittest" forms, just those that "fit" well enough to leave offspring.

C. Is evolution predictable?

Evolution sometimes results in larger or more-complex forms of life, but this result cannot be predicted. Many forms of life are simple yet successful. Mostly, scientists cannot predict the exact path that evolution will take.

IX. STUDYING EVOLUTION AT ALL SCALES-Because it affects every aspect of biology, scientists can study evolution at many scales. Generally, these scales range from _____ to _____, with speciation in between.

A. Informally, microevolution refers to evolution as a change in the genes of populations, whereas macroevolution refers to the appearance of new species over time.

B. The link between microevolution and macroevolution is _____. Speciation, the _____, can be seen as a process of genetic change or as a pattern of change in the form of organisms.

X. _____ - To study microevolution, we look at the processes by which inherited traits change over time in a population. Five major processes can affect the kinds of genes that will exist in a population from generation to generation—natural selection, migration, mate choice, mutation, and genetic drift.

A. Natural selection can cause an increase or decrease in certain _____ in a population.

B. _____ is the movement of individuals into, out of, or between populations. Migration can change the numbers and types of alleles in a population.

C. If parents are paired up randomly in a population, a random assortment of traits will be passed on to the next generation. However, if parents are limited or _____ in their choice of mates, a limited set of traits will be passed on.

D. Mutation can change the numbers and types of alleles from one generation to the next. However, such changes are rare.

E. The random effects of everyday life can cause differences in the survival and reproduction of individuals .Because of these differences, some _____ may become more or less common in a population, especially in a small population.

Processes of Microevolution	
Process	**Description**
Natural selection	Individuals with a particular trait are more likely to survive and reproduce than those without the trait.
Migration	Individuals with different alleles may move into or out of a population.
Mate choice	Parents that are limited or selective in their choice of mates pass a limited set of traits to the next generation.
Mutation	Mutations are the source of completely new alleles.
Genetic drift	Random effects of everyday life can cause differences in survival and reproduction of individuals.

XI. _____ - To study macroevolution, we look at the patterns in which new species evolve. We may study the direction, diversity, or speed of change. Patterns of change are seen when relationships between living and fossil species are modeled.

1. _____Organisms are part of one other's environment, so they can affect one another's evolution. Species that live in close contact often have clear adaptations to one another's existence.

2. _____Over time, species may split into two or more lines of descendants, or lineages. As this splitting repeats, one species can give rise to many new species. The process tends to speed up when a new species enters an environment that contains few other species.

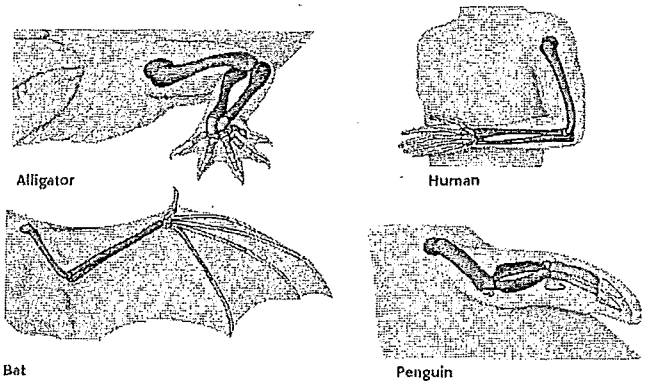
3. _____If all members of a lineage die off or simply fail to reproduce, the lineage is said to be extinct. The fossil record shows that many lineages have

arisen and radiated, but only a few of their descendants survived and evolved into the species present today.

4. _____ In Darwin's day, the idea of slow, gradual change was new to geology as well as biology. Darwin had argued that large-scale changes, such as the formation of new species, must require many small changes to build up gradually over a long period of time. This model is called gradualism.

5. _____ Some biologists argue that species do not always evolve gradually. Species may remain stable for long periods until environmental changes create new pressures. Then, many new species may "suddenly" appear. This model is called punctuated equilibrium.

Patterns of Macroevolution	
Pattern	**Description**
Convergent evolution	Species living in similar environments may evolve similar adaptations.
Coevolution	Two or more species that live in close contact may affect how each species evolves.
Adaptive radiation	A species may give rise to many new species after it enters an environment that contains few other species.
Extinction	All members of a lineage die off or fail to reproduce.
Gradualism	The formation of some new species requires many small changes to build up gradually over time.
Punctuated equilibrium	Many species remain stable, or unchanged, for a long time. If environmental changes create new pressures, many new species evolve rapidly.



Although they look very different from one another on the outside, the forelimbs of these four vertebrates have very similar groups of bones. This suggests that all vertebrates descended from a common ancestor.

HOMEWORK DATE DUE

CH 16 SEC 1

1. What were Darwin's two major contributions to modern evolutionary theory?

2. How did Darwin explain the similarities among finches in the Galápagos Islands and in South America?

3. What is *descent with modification?*

4. How does artificial selection provide evidence that species can change over time?

5. What idea did Lamarck and Darwin share?

6. What evidence from fossils and rock layers influenced Darwin's ideas?

7. What idea of Malthus did Darwin extend to all populations?

BELLRINGER QUESTION CIRCLE M T W TH FRI DATE

ANSWER

HOMEWORK DATE DUE

CH 16 SEC 2

1. What does Darwin's theory of evolution by natural selection predict?

2. What are the four steps of Darwin's theory of evolution?

3. Complete the table below to summarize how evidence supports

Source of evidence	What the evidence indicates
Fossil record	
Anatomy	
Biogeography	
Developmental biology	Species with embryos that show similar patterns of development probably share a common ancestor.
Biochemistry	

4. What are three major strengths of Darwin's theory of evolution by natural selection?

BELLRINGER QUESTION CIRCLE M T W TH FRI DATE

ANSWER

HOMEWORK DATE DUE

CH 16 SEC 3

1. Name one field of study that has contributed discoveries that support Darwin's theory of evolution.

2. How does microevolution differ from macroevolution?

3. How does migration cause a change in the genes in a population?

4. How does genetic drift differ from natural selection?

5. According to the punctuated equilibrium model of speciation, what causes many new species to evolve rapidly?

6. How do you think adaptive radiation and extinction are related?

7. A scientist observes that a particular species of butterfly has a very long tongue. The butterfly feeds on a flower that has nectar at the bottom of a long tube. What pattern of macroevolution best explains the traits that the scientist observed? Explain your answer

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

Chapter 16 Review

What is a theory?

What does evolution mean in biology?

Who was Darwin? WHat was his theory?

What is evolution?

What is artificial selection

Darwin's observations of finches indicated descent with _____

According to Malthus, human populations grow in what mathmatical way?

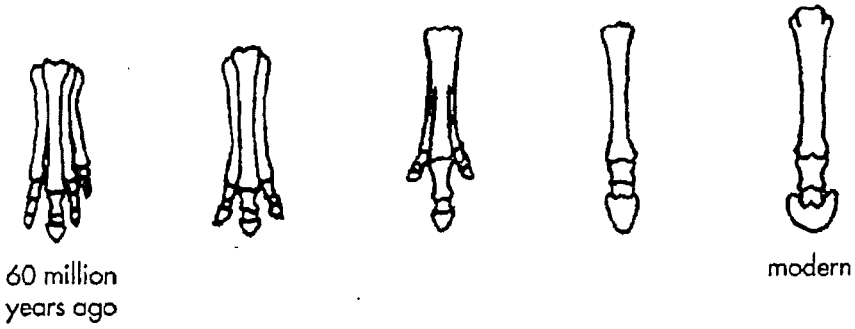
What is overproduction? Selection? Adaptation?

What is natural selection? What are the steps involved?

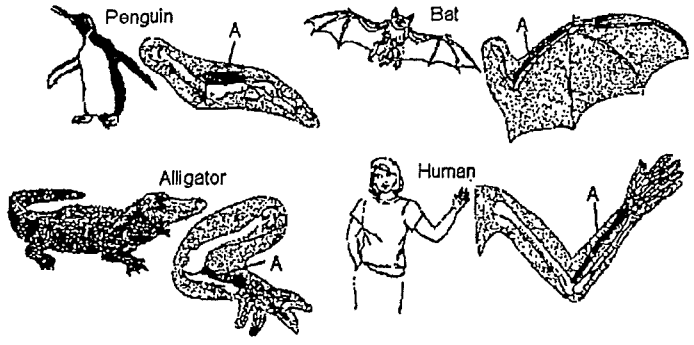
What are the major points of Darwin's view of natural selection?

What is genetic variation in populations? Why are they important?

What is an adaptation? A variation?



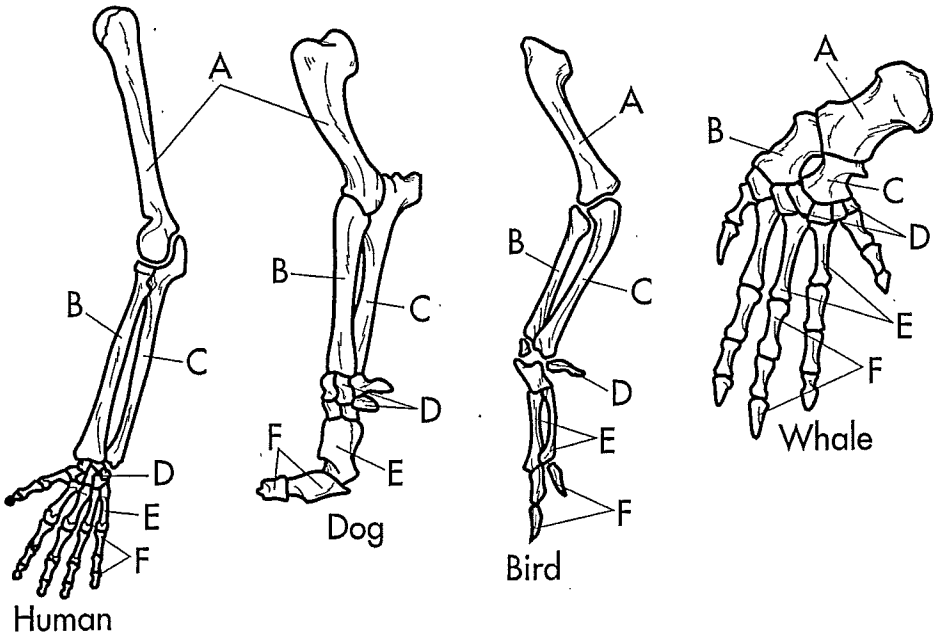
What is adaptive radiation? What is punctuated equilibrium?



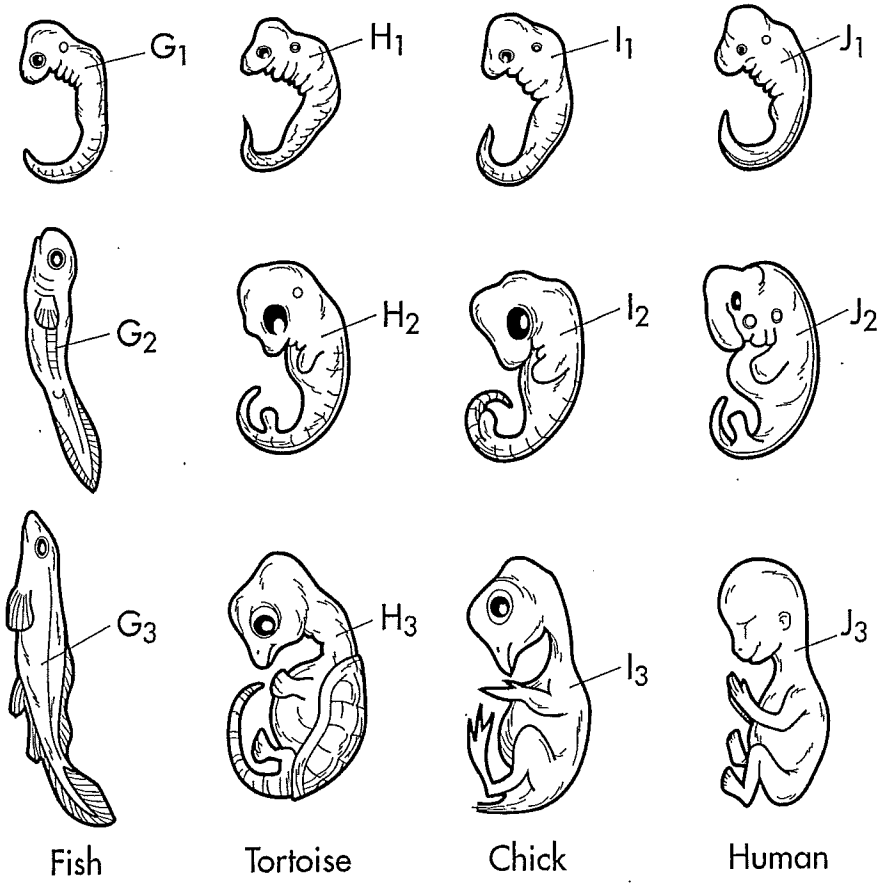
The similarity of these structures suggests that the organisms _____

Refer to the illustration above. The bones labeled A are known as _____

Comparative Anatomy



Comparative Embryology



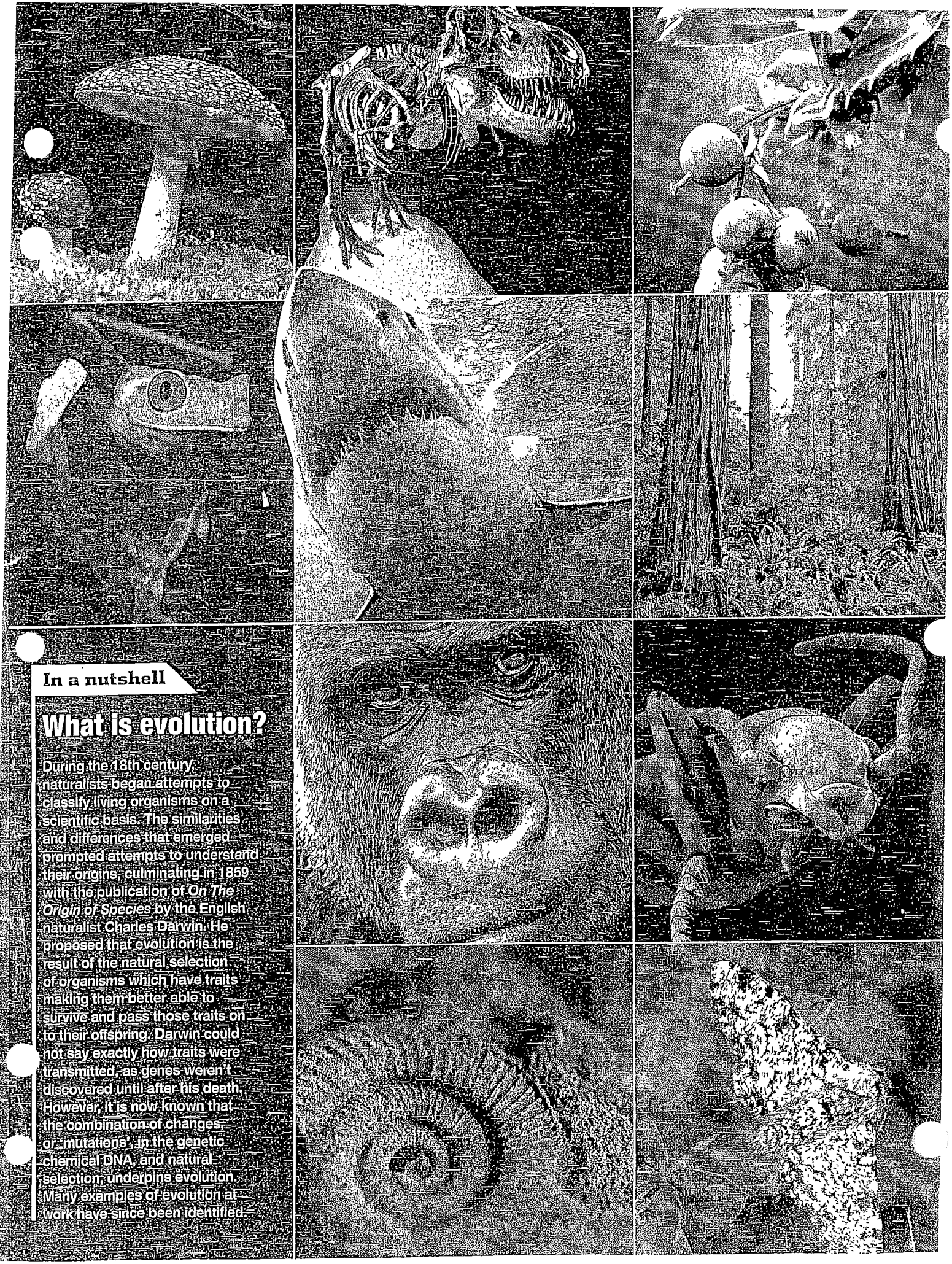
Evidence for Evolution

Comparative Anatomy

- ○ Humerus .....A
- ○ Radius.....B
- ○ Ulna C
- ○ Carpals .....D
- ○ Metacarpals .....E
- ○ Phalanges .....F

Comparative Embryology

- ○ Fish Embryo.....G_1
- ○ Tortoise Embryo....H_1
- ○ Chick Embryo .....I_1
- ○ Human Embryo .....J_1
- ○ Fish Fetus .....G_2
- ○ Tortoise Fetus ....H_2
- ○ Chick Fetus.....I_2
- ○ Human Fetus.....J_2
- ○ Fish Newborn .....G_3
- ○ Tortoise Newborn ..H_3
- ○ Chick Newborn.....I_3
- ○ Human Newborn.....J_3

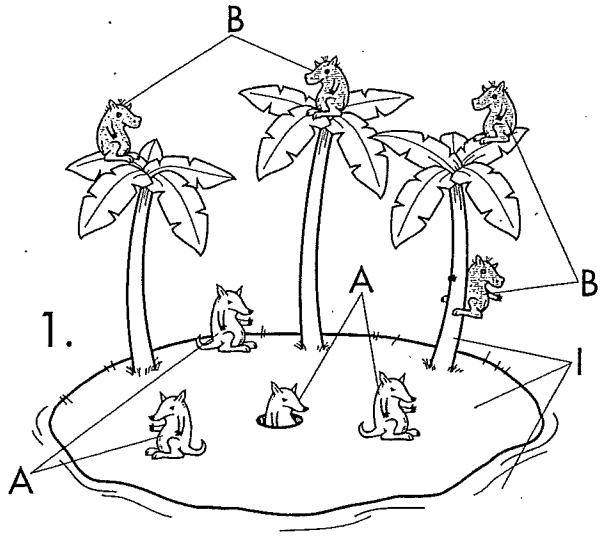


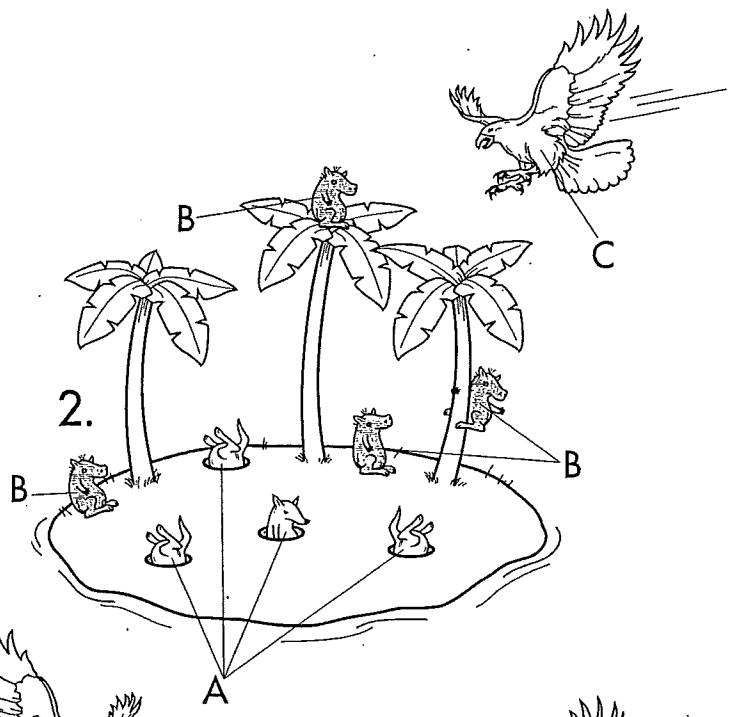
In a nutshell

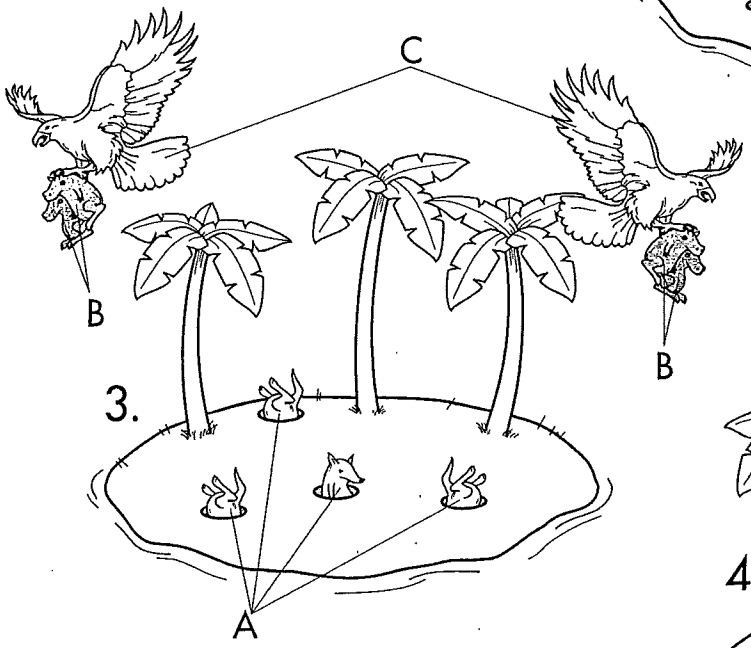
What is evolution?

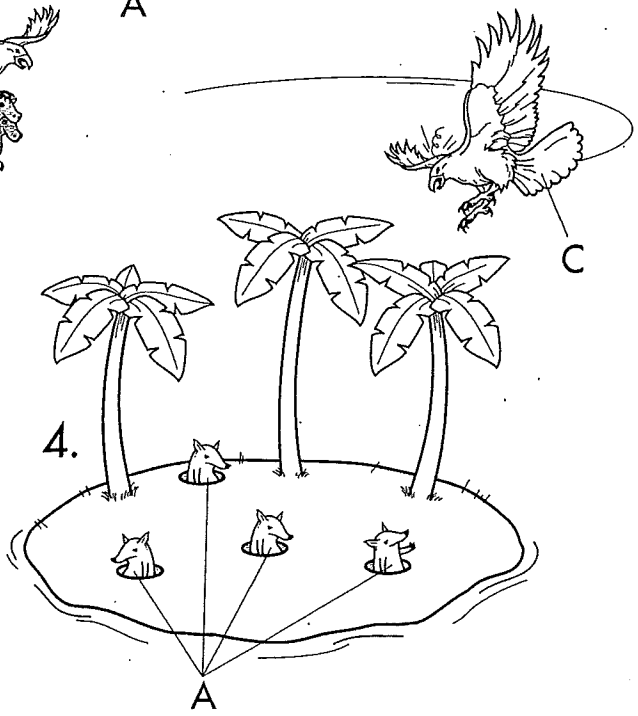
During the 18th century, naturalists began attempts to classify living organisms on a scientific basis. The similarities and differences that emerged prompted attempts to understand their origins, culminating in 1859 with the publication of *On The Origin of Species* by the English naturalist Charles Darwin. He proposed that evolution is the result of the natural selection of organisms which have traits making them better able to survive and pass those traits on to their offspring. Darwin could not say exactly how traits were transmitted, as genes weren't discovered until after his death. However, it is now known that the combination of changes, or 'mutations', in the genetic chemical DNA, and natural selection, underpins evolution. Many examples of evolution at work have since been identified.

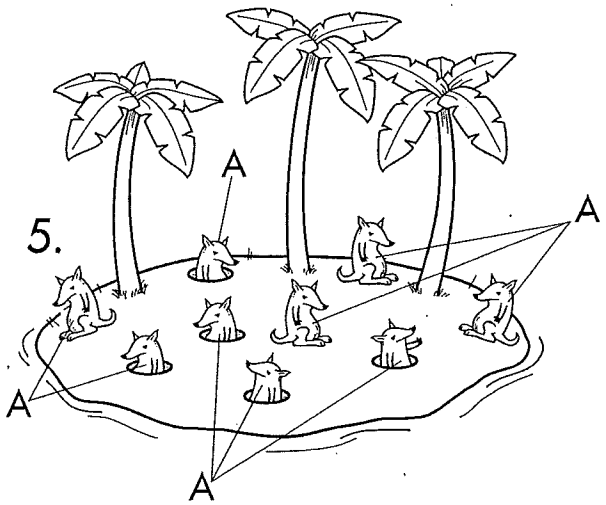
Natural Selection





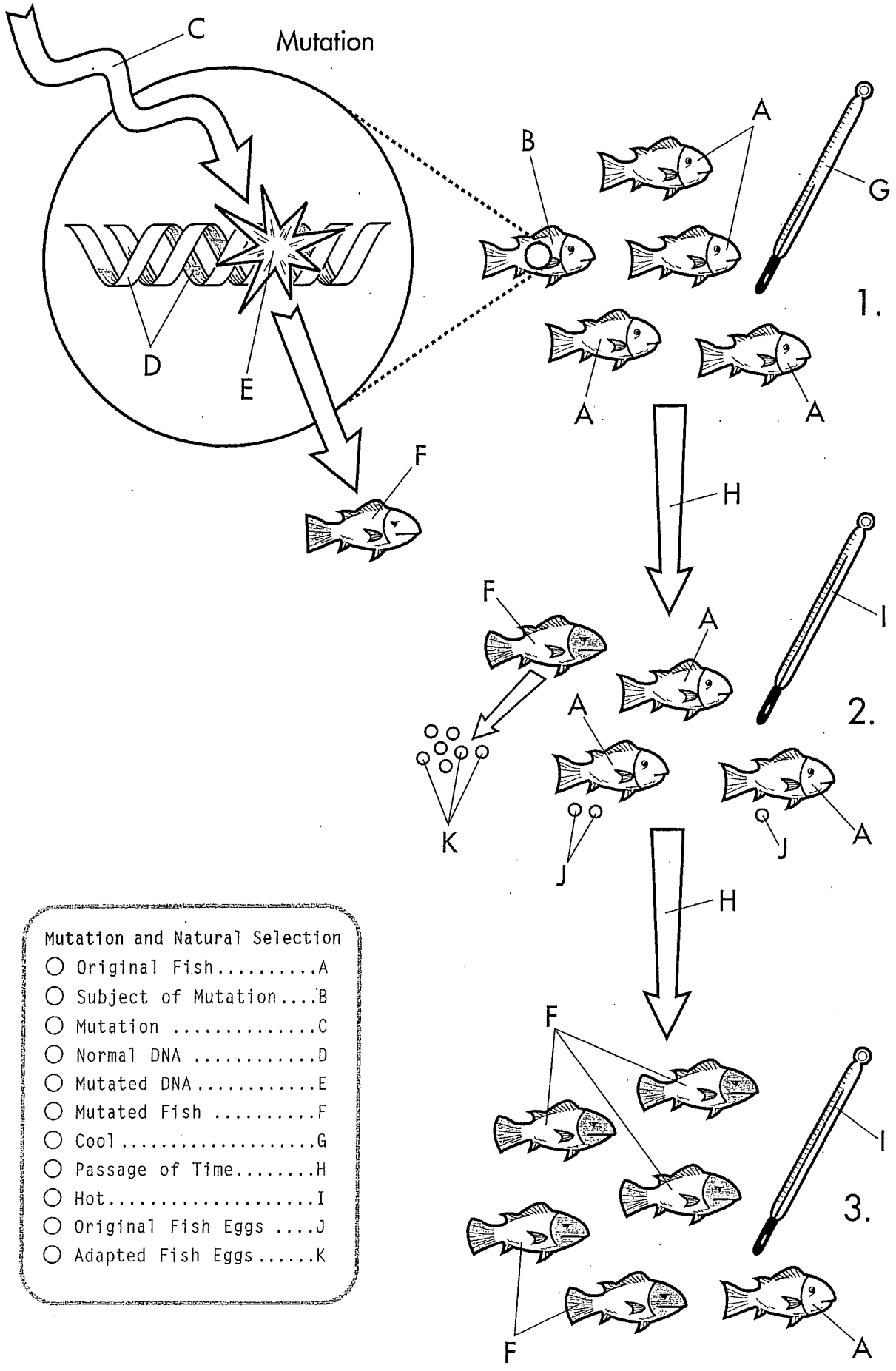






Natural Selection

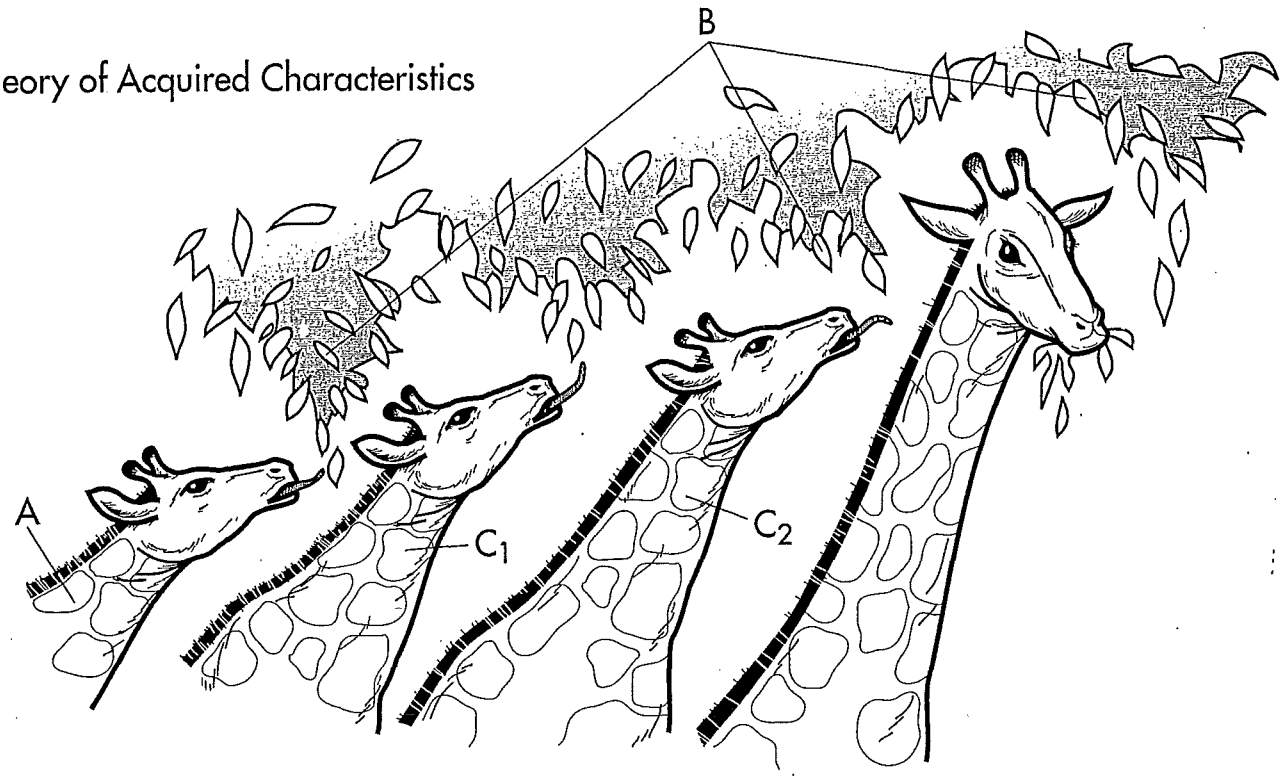
- Isolated Island.....I
- First Animal .....A
- Second Animal .....B
- Predator C



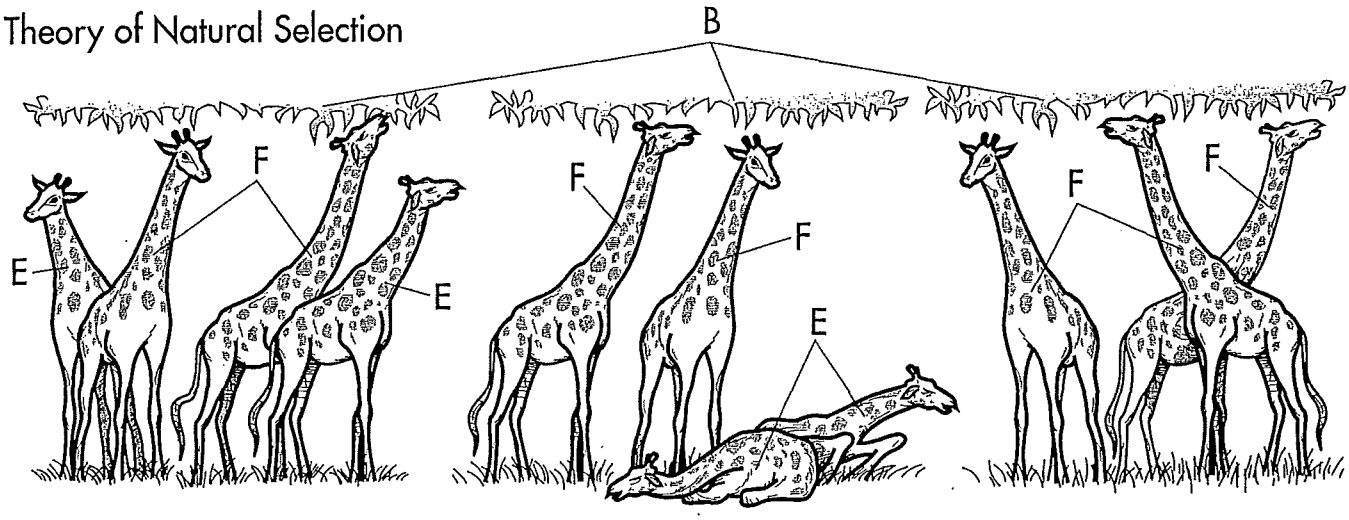
Mutation and Natural Selection

- ○ Original Fish.....A
- ○ Subject of Mutation....B
- ○ Mutation C
- ○ Normal DNA .....D
- ○ Mutated DNA.....E
- ○ Mutated Fish .....F
- ○ Cool.....G
- ○ Passage of Time.....H
- ○ Hot.....I
- ○ Original Fish Eggs ....J
- ○ Adapted Fish Eggs.....K

Theory of Acquired Characteristics



Theory of Natural Selection



Introduction to Evolution

Theory of Acquired Characteristics	Theory of Natural Selection
○ Short-necked Giraffe ..A	○ Short Giraffe.....E
○ Vegetation .....B	○ Tall Giraffe .....F
○ Intermediate-necked Giraffe .....C_1	
○ Long-necked Giraffe .....C_2	

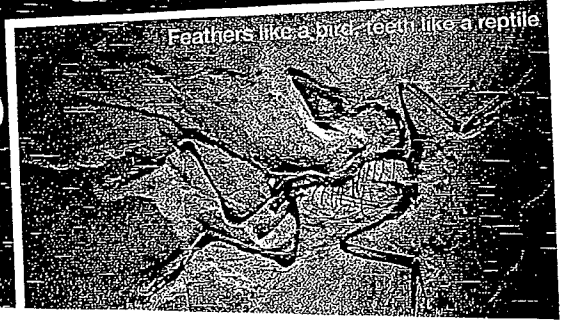
FOSSIL CONFIRMATION

The world's earliest birds

Christian von Meyer: fossil hunter

In 1860, a sharp-eyed German palaeontologist named Christian von Meyer spotted a delicately-patterned fossil in limestone deposits in southern Germany – and gave science one of its most celebrated examples of evolution in action. The fossil was of a feather from a long-extinct creature roughly the size of a modern-day raven, whose remains were found the following year, and was duly named *Archaeopteryx*, from the Greek for 'ancient feather'. Supporters of evolution pointed out similarities between the creature and both birds and reptiles – for example, feathers arranged into wings, but a toothed jaw rather than a beak. This prompted English biologist Thomas Huxley, one of Darwin's staunchest supporters, to argue that *Archaeopteryx* was some form of 150-million-year-old "missing link" between dinosaurs and modern birds. However, confirmation of the status of *Archaeopteryx* has come only within the last 20 years or so, following painstaking analysis of the half-dozen or so other specimens that have since been found. While the specimens aren't identical, they are similar enough to convince most researchers that *Archaeopteryx* is the earliest-known example of a bird.

The missing link between birds and dinosaurs?



Feathers like a bird, teeth like a reptile

▷ The identification of DNA as the carrier of inherited traits completed the scientific foundation of Darwin's theory. Where he described evolution somewhat vaguely as "descent with modification", scientists could now sum it up as "genetic mutations plus environmental pressure".

But while the mechanism of evolution may be clear, the evidence for its effectiveness remains a source of bitter dispute. According to Darwin's theory, every living creature is the result of evolution from more ancient organisms. That means that the origins of every species should ultimately be traceable through the fossil record back to the emergence of life itself, around 3700 million years ago.

Yet that evidence is far from clear. The fossil record is patchy, with gaps between different versions of some organisms spanning hundreds of millions of years. Scientists point out that this is hardly surprising since fossilisation only takes place under special conditions, and even when it succeeds in preserving some long-dead creature, geological and climatic upheaval can soon destroy the evidence.

Fortunately, despite the odds, fossil-hunters have found many impressive examples of evolution working over millions of years. One of the most spectacular emerged in a limestone quarry in Germany just months after publication of Darwin's *On The Origin of Species* in 1859. It linked ◀ **birds and dinosaurs**. Now scientists are hailing the discovery of another impressive example: fossilised versions of the modern flatfish.

Even in Darwin's time, critics believed these odd-looking fish posed a major challenge to his theory. Ordinary fish clearly benefit from having an eye on each side of their bodies, and flatfish benefit from having both eyes on the same side. Yet if flatfish really have evolved from ordinary fish as Darwin claimed, the fossil record should contain examples of fish with eye arrangements somewhere between the two extremes. But what possible evolutionary advantage could there be in such bizarre arrangements of eyes – and where were the fossil examples of it happening?

Darwin insisted there must be some benefit in having eyes positioned between the two extremes, but struggled to say precisely what it might be. His biggest problem, however, was the absence from the fossil record of any examples of flatfish with eyes in the intermediate locations. Now some scientific detective work by an American graduate student has revealed that fossils found over a century ago are the long-sought missing link.

EVOLUTION IN ACTION

The peppered moth

Evolution is not confined to the distant past, as shown by the peppered moth, *Biston betularia*. Before the Industrial Revolution swept England around 200 years ago, the most common variety had a light coloured, speckled appearance. But, by the end of the 19th century, it had been all but replaced by its black-coloured relative.

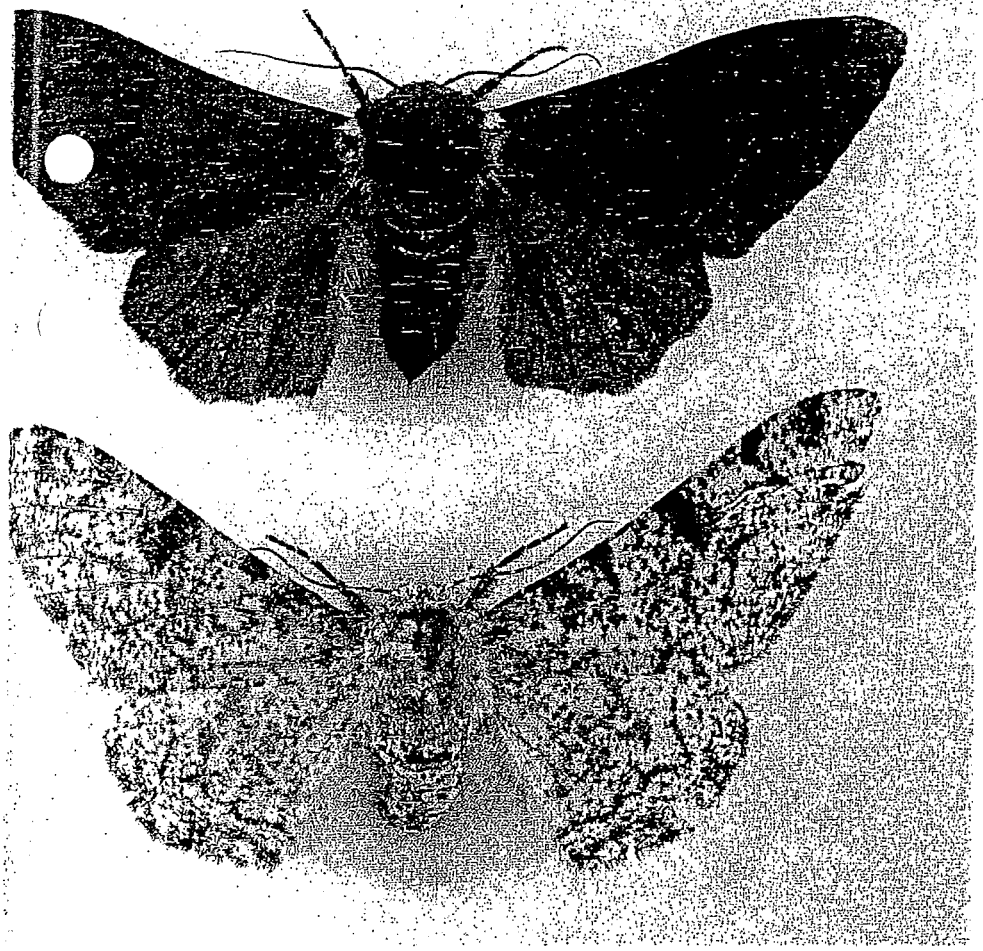
In 1896, the English naturalist James Tutt suggested an explanation: the black variety was harder to spot by birds when resting on trees blackened by the pollution from heavy industry. In other words, the black variety was benefiting from Darwinian 'natural selection' linked to the chance mutation that gave them their darker coloration.

Controlled experiments have since confirmed Tutt's suspicion – making the peppered moth a celebrated example of modern evolution. The introduction of pollution controls in the 1950s has led to cleaner trees, – and a resurgence in the original light-coloured moth.

Fish fingered

Matt Friedman of the University of Chicago made the discovery in 2008 after looking through a textbook of fossil fish. Like the venerable works of Ray and Linnaeus, the book included classifications of each example. One type of fossil fish, the 50-million-year-old *Amphistium*, caught Friedman's attention. The fossils had been classified as a different type of fish, since their skull shape wasn't clear – and nor was the location of their eyes. Friedman suspected the fossils might still be flatfish, raising the possibility their eyes might turn out to be in the intermediate position predicted by Darwin's theory.

To find out, Friedman tracked down examples of the fossils in two European



museums and examined them with X-rays from a medical scanner. The results confirmed that the fossils are indeed ancient relatives of modern flatfish – and have eyes positioned on the skull at locations between those of earlier fish and those of modern flatfish.

The discovery of missing links is cause for celebration among scientists. Yet such discoveries cut little ice with creationists, who simply point to the myriad other gaps in the fossil record that have yet to be bridged. And even when a missing link is found, creationists can simply demand fossil evidence bridging the two gaps thus created before and after the new link.

It's far from clear whether any amount of evidence will convince creationists to abandon their belief that all life was created by an omnipotent God. After all, such a deity is, by definition, capable of doing ›ything – including creating fossils that ›k like missing links.

As such, creationism is the antithesis of science. It makes no predictions, and is utterly unaffected by new evidence, ›very fresh discovery being by definition consistent with creation by an omnipotent being. In contrast, evolution predicts the existence of missing links, and their emergence adds ever more weight to the theory. Some would say it makes an even grander claim than creationism too: that the processes of evolution are still working miracles with living things to this day.

ROBERT MATTHEWS is a science journalist and Visiting Reader in Science at Aston University, UK. www.robertmatthews.org

FIND OUT MORE

▶ ***Evolution: a very short introduction***
by Brian and Deborah Charlesworth
(Oxford University Press, 2003)

▶ **www.eol.org**
The Encyclopaedia of Life, an online project

NEXT ISSUE

Catastrophism: the hazard posed to our planet by meteors and asteroids, and what we can do about it

QUESTION TIME

MATT FRIEDMAN is a graduate student of the Field Museum and University of Chicago. He has made headlines with his discoveries about fossil flatfish, which add to the weight of evidence for the theory of evolution.

How did you come to work on the science of evolution?
My interest in evolution stems from an early fascination with fossils. The museum near my childhood home in Cleveland, OH, displayed some remarkable specimens of primitive fishes collected from local rocks deposited about 360 million years ago in an ancient seaway. As I grew up, I discovered the questions they raised in my mind could be addressed with the tools of science.

What's been the response of fellow scientists to your discovery?
The response to this research has been overwhelmingly positive, and has come from various fields, from developmental biologists to palaeontologists. In particular, my colleagues are enthusiastic about having another case study for teaching evolution to their students.

What about the reaction of creationists ?
Creationists' responses have come in a few predictable flavours: either the results are discounted out-of-hand as insignificant, or are said to be significant if true and then rejected as gross misinterpretations. These are the same tired arguments wheeled out in the face of every new discovery, and they highlight an important distinction: while scientific frameworks are revised in the face of new data, the static creationist agenda is immune to their implications.

How should scientists respond to creationism in schools?
It's crucial to actively promote the teaching of science at all educational levels, and vital when confronted with attempts to sneak creationism into classrooms. A working knowledge of the scientific method immediately exposes ideas like 'intelligent design theory' for what they are: scientific in name alone.

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NEXT ISSUE: Darwin 200 celebration special

Natural Selection Lab

Procedures:

1. You will pick an animal to represent your team. Each team will be the lab table (4).
2. Each team will have to "hunt" to capture as many prey as you can in 30 seconds. Each person will go once and have 30 seconds. Once you capture as many "prey" as you can, you must go back to the start line and count the different colored prey.
3. Record the number of prey of each color in the chart below.
4. You will then have a second round representing a second season. You must go "hunting' in the same order as before.

5. Graph the class totals on the graph on the following page

Round 1	green	yellow	Red	blue
Hunter 1				
Hunter 2				
Hunter 3				
Hunter 4				
total				

Round 2	green	yellow	Red	blue
Hunter 1				
Hunter 2				
Hunter 3				
Hunter 4				
total				

Round 1	green	yellow	Red	blue
Class totals Hunter 1				
Class totals Hunter 2				
Class totals Hunter 3				
Class totals Hunter 4				
total				

Round 2	green	yellow	Red	blue
Class totals Hunter 1				
Class totals Hunter 2				
Class totals Hunter 3				
Class totals Hunter 4				
total				

QUESTIONS

1. What colored toothpicks were easiest to find?

2. What would this color represent in a real animal in the environment?

3. How would you find the number of remaining "organisms"

4. Subtract the number of toothpicks caught of hunter 1 from 400. This is the number of each color that survived the hunt. Determine the number of each color remaining in hunter 2 round from the number that survived through round 1. Write all the numbers of color left for each color.

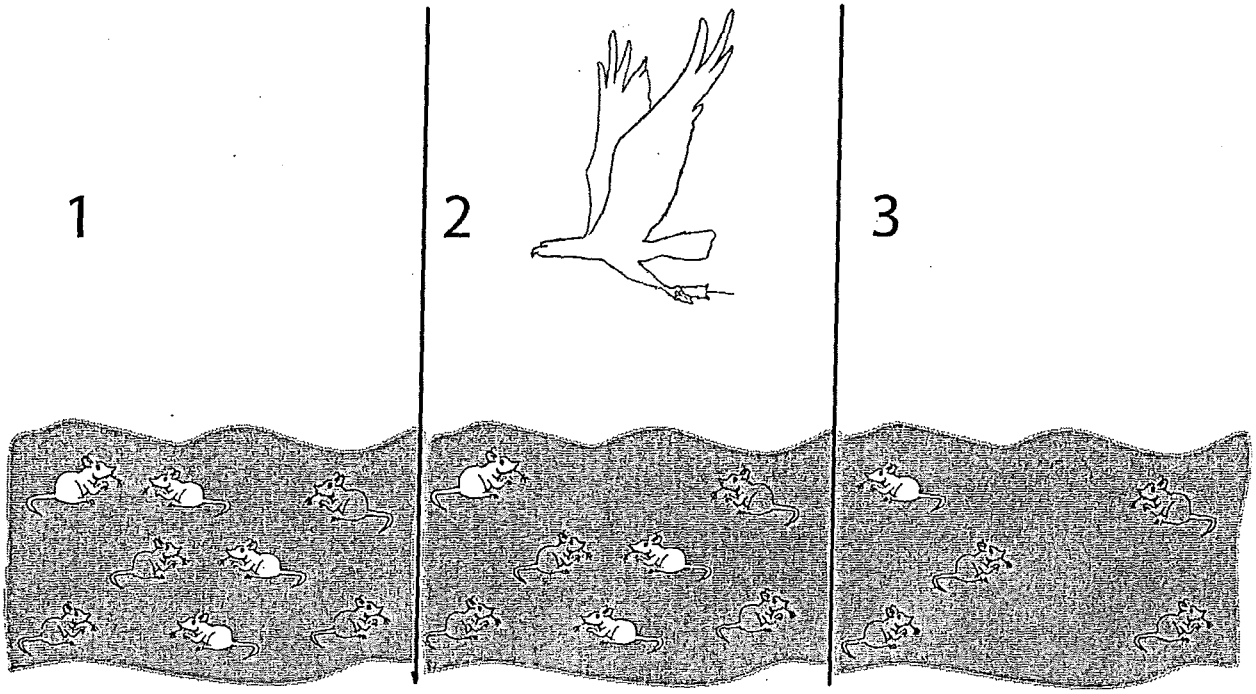
5. What would happen if you did this lab in a straw field?

6. What trends do you see in your graph?

Evolution by Natural Selection

Adapted from the University of California, Los Angeles Life Sciences 1 Demonstration Manual
Copyright 2008 by Jennifer Doherty and Dr. Ingrid Waldron, Department of Biology, University of Pennsylvania[1]

Describe what is happening in figures 1-3. Is the population of mice different in figure 3 than in figure 1? Explain why.



Living things that are well adapted to their environment survive and reproduce. Those that are not well adapted don't survive and reproduce. An **adaptation** is any characteristic that increases **fitness**, which is defined as the ability to survive and reproduce. What characteristic of the mice is an adaptation that increased their fitness?

The table below gives descriptions of four female mice that live in a beach area which is mostly tan sand with scattered plants. According to the definition given for fitness, which mouse would biologists consider the fittest? Explain why this mouse would be the fittest.

Color of fur	Black	Tan	Tan and Black	Cream
Age at death	2 months	8 months	4 months	2 months
# pups produced by each female	0	11	3	0
Running speed	8 cm/sec.	6 cm/sec.	7 cm/sec.	5 cm/sec.

If a mouse's fur color is generally similar to its mother's color, what color fur would be most common among the pups?

[1] Teachers are encouraged to copy this student handout for classroom use. A Word file (which can be used to prepare a modified version if desired), Teacher Preparation Notes, comments, and the complete list of our hands-on activities are available at http://serendip.brynmawr.edu/sci_edu/waldron/.

A more complete definition of fitness is the ability to survive and produce offspring who can also survive and reproduce. Below are descriptions of four male lions. According to this definition of fitness, which lion would biologists consider the "fittest"? Explain why.

Name	George	Dwayne	Spot	Tyrone
Age at death	13 years	16 years	12 years	10 years
# cubs fathered	19	25	20	20
# cubs surviving to adulthood	15	14	14	19
Size	10 feet	8.5 feet	9 feet	9 feet

(Adapted from Michigan State University, Occasional Paper No. 91, Evolution by Natural Selection: A Teaching Module by Beth Bishop and Charles Anderson, 1986)

Suppose that Tyrone had genes that he passed on to his cubs that helped his cubs to resist infections, so they were more likely to survive to adulthood. These genes would be more common in the next generation, since more of the cubs with these genes would survive to reproduce.

A characteristic which is influenced by genes and passed from parents to offspring is called **heritable.** Over many generations heritable adaptive characteristics become more common in a population. This process is called **evolution by natural selection**. Evolution by natural selection takes place over many, many generations.

Evolution by natural selection leads to adaptation within a population. The term evolution by natural selection does not refer to individuals changing, only to changes in the frequency of adaptive characteristics in the population as a whole. For example, for the mice that lived in the beach area with tan sand, none of the mice had a change in the color of their fur; however, due to natural selection, tan fur was more common for the pups than for the mother mice.

In summary, a heritable characteristic that helps an animal or plant to have more offspring which survive to reproduce will tend to become more common in a population as a result of evolution by natural selection.

Questions

1. Explain why a characteristic which helps an animal to live longer will generally tend to become more common in the population as a result of evolution by natural selection.

2. Not all characteristics which contribute to longer life become more common in the population. Some characteristics contribute to long life, but not more offspring. For example, a female cat which is sterile and cannot have any offspring may live longer because she will not experience the biological stresses of repeated pregnancies. Explain why a characteristic like this which contributes to a long life, but with few or no offspring, would not become more common as a result of evolution by natural selection.

Simulation of Natural Selection

We will now play a **simulation** game to demonstrate how natural selection works.

A simulation is a good way to simplify the problem in such a way that we can observe how evolution by natural selection may work in a real population. This simulation involves pom poms that can reproduce. These pom poms live out their lives on a Black Forest or Red Grassland habitat in the middle of the classroom. The only concern our pom pom creatures have is the presence of ravenous hunters (that's you!). All we need is a system that has three necessary conditions for evolution by natural selection.

1. **Variation in characteristics**: For natural selection to occur, different individuals in a population must have different characteristics. In our simulation, pom poms vary in color; they are black, red, and white. The hunters vary as well; hunters have three distinct types of feeding structures: forks, knives, and spoons.
2. **Differences in fitness**: For natural selection to occur, the different characteristics of different individuals must contribute to differences in fitness (i.e. differences in ability to survive and reproduce). It seems possible that variation in pom pom color will influence the probability that a pom pom is snatched up by a hungry hunter. It also seems possible that different feeding types may vary in their success in capturing pom poms. These differences contribute to survival and therefore success in reproducing.
3. **Heritability of characteristics**: For natural selection to occur, the characteristics that affect fitness must be heritable (i.e. passed by genes from one generation to the next). In our simulation, a pom pom that is born into the pom pom population is the same color as its parent and a hunter that is born into the hunter population has the same feeding structure as its parent.

Here is exactly what we will do:

1. Your class will be split into two groups which will carry out the simulation using two different habitats: Black Forest (represented by a rough black material such as faux fur) and Red Grassland (represented by a red fleece material).

2. Pom poms come in three colors: black, red, and white. Your teacher will "plant" an equal number of each color on the Black Forest and on the Red Grassland at the beginning of the simulation. Which color pom pom do you think will be more likely to survive in each habitat?

   Black Forest:

   Red Grassland:

   Why do you think that?

3. Now it is time to arm the hunters. There are three different feeding types: forks, knives, and spoons. Your teacher will distribute the feeding structures so that there are equal numbers of each. You will also be given a cup. This cup will serve as your "stomach". To capture a pom pom, you must use only your fork, knife or spoon to lift the pom pom from the habitat and put it into your cup. Which feeding structure do you think will do better in each habitat?

   Black Forest:

   Red Grassland:

   Why do you think that?

4. Your teacher will record the initial numbers of each type of pom pom and each type of hunter in each habitat on the board.

5. At your teacher's signal, start feeding. Don't be shy about competing with your fellow hunters. However, once a pom pom is on a fork, knife or spoon it is off limits. When your teacher calls time, **STOP** feeding.

6. Now count how many pom poms you have eaten and line up with your classmates who were feeding on the same habitat, from fewest pom poms eaten to most pom poms eaten. Only the top half of the hunters will survive and reproduce. Your teacher will tell you who lives and who dies. Those who die will be reborn as the children of the survivors and will now have the same type of feeding structure as their parents had.

7. Your teacher will count how many pom poms of each color were eaten, calculate how many pom poms survived, and help the surviving pom poms reproduce. Only the pom poms that were not eaten will reproduce.

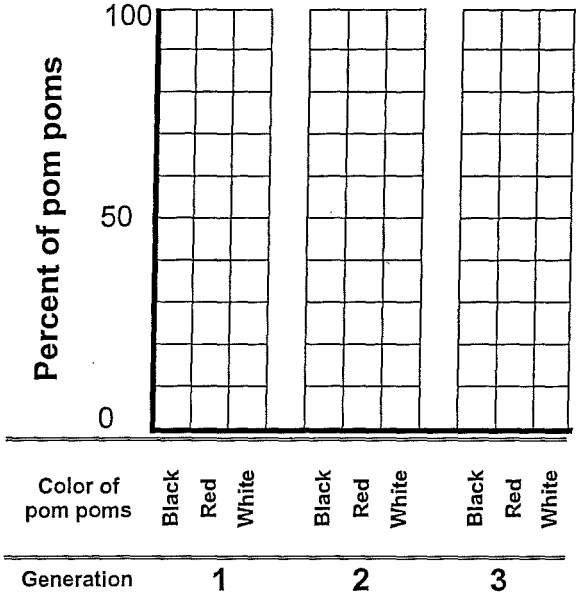
8. You will run through the simulation one more time. Your teacher will post on the board the numbers of pom poms of each color and hunters of each type at the beginning of the simulation (generation 1) and at the end of each cycle (generations 2 and 3). Copy down the numbers on the board in the table on the next page. Then, for each generation of pom poms in each habitat, calculate the percent that are black, red, or white. Similarly, for each generation of hunters in each habitat, calculate the percent that have spoons, forks, or knives as their feeding implement.

	Red Grassland				Black Forest			
	Pom poms				Pom poms			
	Black	Red	White	Total	Black	Red	White	Total
Generation 1 Number								
Percent				100%				100%
Generation 2 Number								
Percent				100%				100%
Generation 3 Number								
Percent				100%				100%

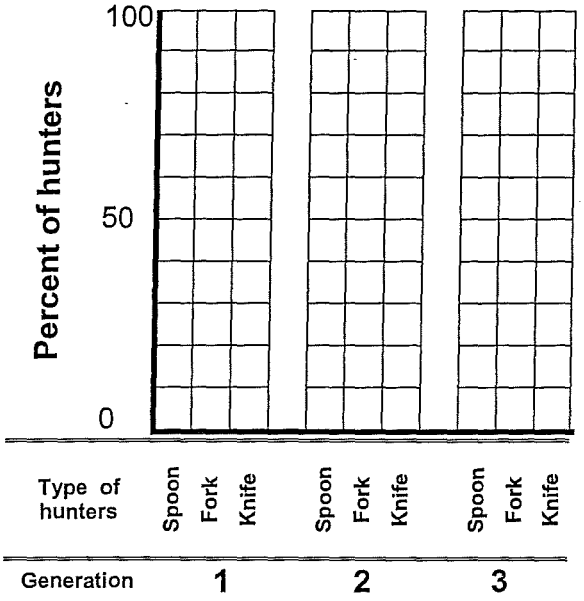
	Red Grassland				Black Forest			
	Hunters				Hunters			
	Spoon	Fork	Knife	Total	Spoon	Fork	Knife	Total
Generation 1 Number								
Percent				100%				100%
Generation 2 Number								
Percent				100%				100%
Generation 3 Number								
Percent				100%				100%

9. Use the data to complete the following 4 bar graphs. This will allow you to observe the changes in the percent of pom poms of each color and hunters of each type over the three generations in each habitat.

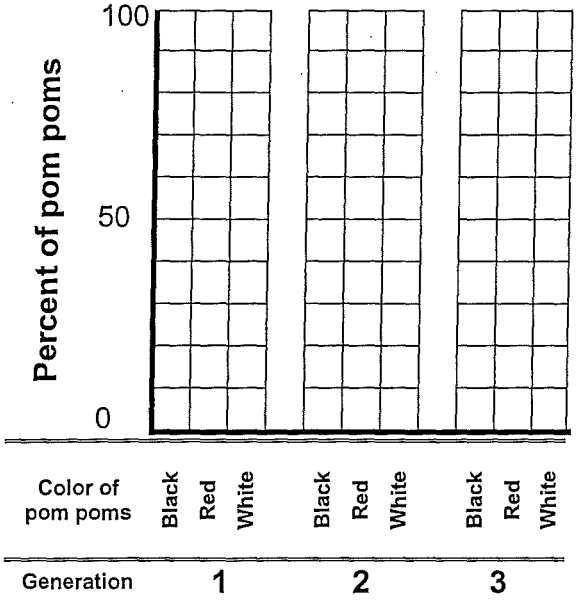
Pom poms in the Black Forest



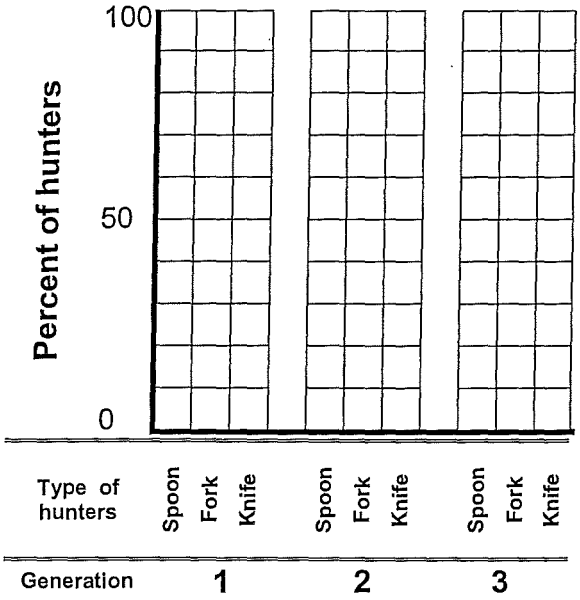
Hunters in the Black Forest



Pom poms in the Red Grassland



Hunters in the Red Grassland



10. Did evolution by natural selection occur in each pom pom population? In other words, did one pom pom color become more common over time while the other colors became less common? What traits contributed to the survival of pom poms that survived to reproduce?

Black Forest:

Red Grassland:

Remember that the pom pom populations were the same on the Black Forest and Red Grassland at the beginning. Explain why the trends differ in these two different habitats and the two populations of pom poms end up so differently.

11. For each population of hunters, did one feeding type become more common while other feeding types became less common? What traits contributed to the survival of hunters that survived to reproduce?

Black Forest:

Red Grassland:

Explain the differences in the trends in the feeding type of the hunters in the two habitats.

12. Did any individual pom poms change color or adapt? If not, then why did the colors of the pom poms in the final population differ from the colors of the pom poms in the original populations?

13. If we ran the simulation for 50 more generations, what would you predict about the colors of the pom poms and the hunter types in each habitat?

Black Forest:

Red Grassland:

14. What do you think would happen to the pom pom population if the black forest experienced a decade long drought and became red grassland? First, make your prediction of what would happen if the population of pom poms in the black forest at the beginning included red, white and black pom poms.

Next, suppose that natural selection over many generations had resulted in only black pom poms surviving in the black forest, and then a prolonged drought resulted in this habitat turning into a red grassland. Would natural selection for pom pom color occur?

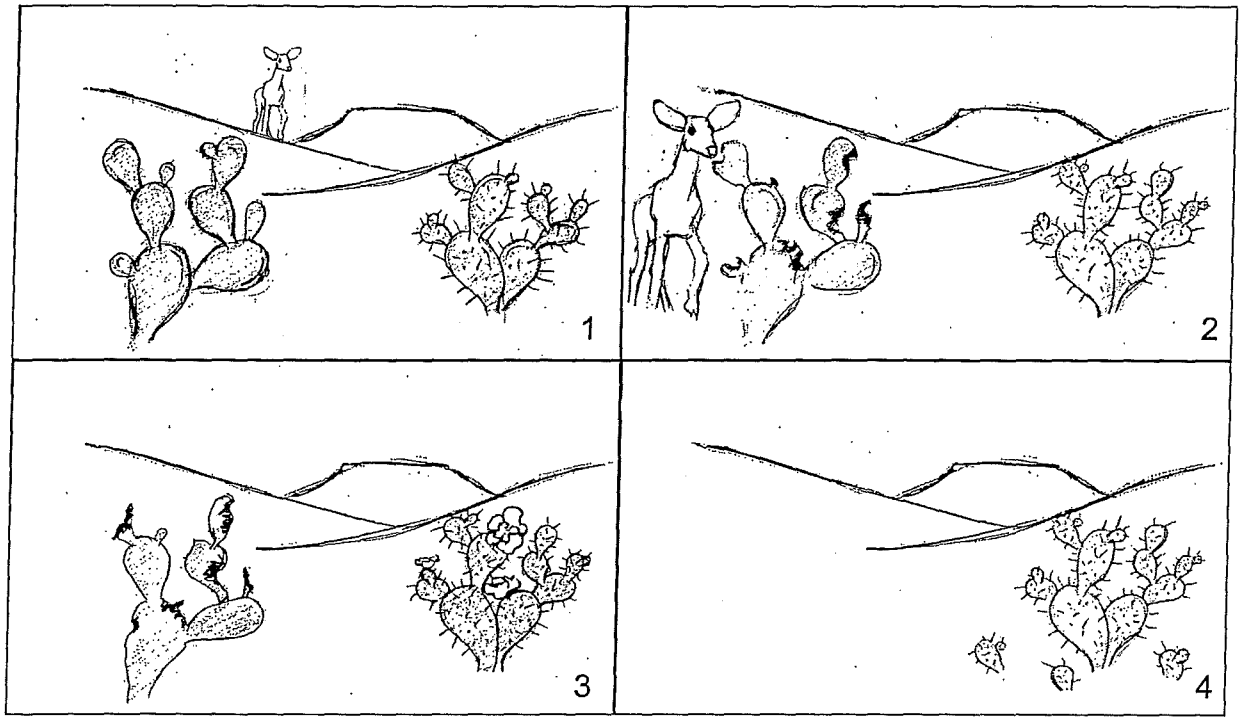
Based on this example, explain why evolution by natural selection can not occur if there is no variation in a characteristic.

15. Explain why evolution by natural selection can not occur if the variation in a characteristic does not contribute to differences in fitness. Suppose, for example, that all the hunters in the simulation were blind-folded and could only find pom poms by touch. Would you expect evolution by natural selection in the color of the pom poms?

16. Explain why evolution by natural selection can not occur if the variation in a characteristic is not heritable. Suppose, for example, a tree limb fell on a young lion and broke his leg, and the leg never healed normally. Obviously, this would affect the lion's ability to survive and reproduce. However, if this lion did manage to have cubs, the offspring would each have four normal legs. Explain why natural selection does not operate on characteristics like this which affect fitness but are not heritable.

17. "Survival of the fittest" is a common expression. What do you think most people mean by this expression? How would you explain this expression to help someone understand how natural selection actually functions?

18. Below is a series of pictures representing changes in a population of cacti. Pictures 1 and 2 show what happened when a deer came to eat, picture 3 shows the cacti a few weeks later (notice the flowers on the right-hand cactus), and picture 4 shows the situation a few months later.



Recall that the three conditions listed below are necessary for natural selection to take place.

1. **Variation in characteristics within the population:** In picture 1, what is the main difference between the cactus on the left and the cactus on the right?

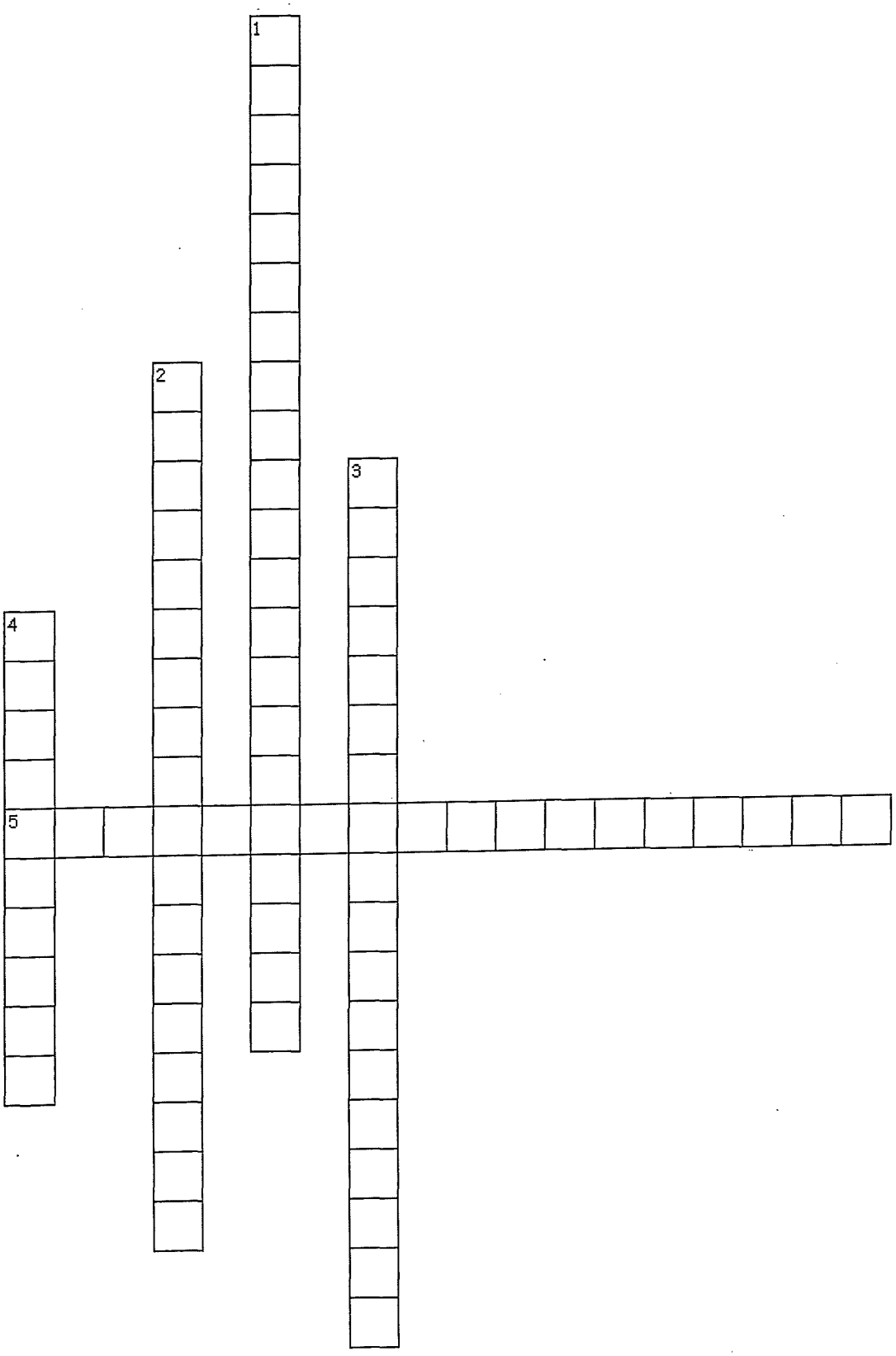
2. **Differences in survival and reproduction, fitness**: Why would a deer be more likely to eat the cactus on the left than the cactus on the right?

   What effect does the deer's behavior have on the survival and reproduction of these two types of cactus?

3. **Heritability of characteristics from parent to offspring:** The difference between the cacti is a heritable characteristic (see picture 4).

Do you think that evolution by natural selection is occurring in this cactus population? Explain why or why not.

Ch 17 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard for each term with the word on one side and the definition on the back



Across

5. the study of the frequency and interaction of alleles and genes in populations

Down

1. a state in which a population can no longer interbreed with other populations to produce future generations
2. a state in which the allele frequencies of a population remain in the same ratios from one generation to the next
3. a line graph showing the general trends in a set of data of which most values are near the mean
4. a taxonomic classification below the level of species; refers to populations that differ from, but can interbreed with, other populations of the same species

CH 17
Vocabulary Review

Refer to the word bank to unscramble each term. Then fill in each blank provided.

genetic equilibrium | population genetics | subspecies
normal distribution | reproductive isolation

1. tengice brilimuequi _____
2. scubspesei _____
3. droptivecure tinosoila _____
4. nopalopitu tengices _____
5. lornam buittoindirs _____

Using the word bank below, fill in each blank provided.

genetic equilibrium | population genetics | subspecies
normal distribution | reproductive isolation

6. A population that is different from, but can interbreed with other populations of the same species is called a _____.
7. If you were to plot the height of everyone in your class on a graph, the values would probably form a hill-shaped curve called a _____ _____.
8. The study of changes in the numbers and types of alleles in populations is called _____ _____.
9. A population in which no genetic change is occurring is in a state of _____ _____.
10. A state in which two populations can no longer interbreed to produce future offspring is called _____ _____.

In the space provided, write the letter of the term or phrase that best completes each sentence or best answers each question.

_____ 11. A normal distribution produces a graph with a
a. hill-shaped curve.
b. a straight line.
c. a curve on one end.

_____ 12. A population that is in genetic equilibrium is no longer
a. growing.
b. breeding.
c. changing.

_____ 13. Population genetics is the study of changes in the
a. biodiversity of an ecological community.
b. numbers and types of alleles in populations.
c. adaptive radiation of a species.

_____ 14. A subspecies is one that is different from another similar species, but the two species can still
a. interbreed.
b. compete.
c. look alike.

_____ 15. When two populations are no longer able to breed with one another or produce fertile offspring, they are in
a. genetic equilibrium.
b. reproductive isolation.
c. a normal distribution.

In the space provided, write the letter of the description that best matches each term.

_____ 16. genetic equilibrium

_____ 17. normal distribution

_____ 18. population genetics

_____ 19. reproductive isolation

_____ 20. subspecies

a. a species that has diverged from another species, but can still interbreed with it
b. graph produces a hill-shaped curve
c. study of changes in population alleles
d. two populations can no longer interbreed
e. the state of a population in which no genetic change occurs

Chapter 17 Population Genetics and Speciation

I. POPULATION GENETICS-Microevolution can be studied by observing changes in the numbers and types of alleles in populations. The study of _____ in this sense is population genetics.

II. PHENOTYPIC VARIATION-Biologists study polygenic phenotypes by measuring each individual in the population and then analyzing the distribution of the measurements.

A. The variety of _____ that exists for a given characteristic depends on how many genes affect it. Polygenic characters are influenced by several genes. Examples include human eye color and height.

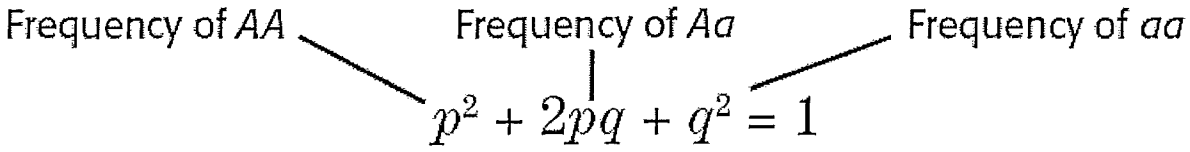
B. A _____ is an overview of the relative frequency and range of a set of values.

1. Often, some values in a range are more common than others.
2. A normal distribution, or _____, is one that tends to cluster around an average value in the center of the range.

III. MEASURING VARIATION AND CHANGE-Genetic variation and change are measured in terms of the _____ of alleles in the gene pool of a population.

A. A frequency is the proportion or ratio of a group that is of one type. To study genetic change, the _____ of each allele in a population can be tracked over time.

B. The particular combination of alleles in a population at any one point in time makes up a _____.



IV. SOURCES OF GENETIC VARIATION-The major source of new alleles in natural populations is mutation in _____

A. Evolution cannot proceed if there is no variation.

B. Mutation generates new alleles at a slow rate.

C. Only mutations in germ cells (egg and sperm) are _____ to offspring.

V. EQUILIBRIUM AND CHANGE-The _____ principle predicts that the frequencies of alleles and genotypes in a population will not change unless at least one of five forces acts upon the population. The forces that can act against genetic equilibrium are _____, _____.

- A population in which no genetic change occurred would be in a state of _____.
- Genetic change in a population can be measured as a change in genotype frequency or allele frequency.
- A change in one doesn't necessarily mean a change in the other.

A. Gene Flow-_____ occurs when genes are added to or removed from a population. Gene flow can be caused by migration, the movement of individuals from one population to another.

B. _____-In sexually reproducing populations, any limits or preferences of mate choice will cause nonrandom mating.

C. _____-Chance events can cause rare alleles to be lost from one generation to the next, especially when populations are small. Such random effects on allele frequencies are called genetic drift.

D. Mutation-_____ can add a new allele to a population.

E. Natural Selection

1. _____ acts to eliminate individuals with certain traits from a population.

2. As individuals are eliminated, the alleles for those traits may become less frequent in the population.

3. Thus, both allele and genotype frequencies may change.

Hardy-Weinberg principle

Frequencies of alleles and genotypes in a population will not change unless at least one of five forces acts on the population.

Forces that Can Change Allele Frequencies	
Force	**Description**
Gene flow	Individuals that join a population might bring in new alleles. Individuals that leave a population might remove alleles from the population.
Nonrandom mating	In nonrandom mating, individuals may have a limited choice of mates, or they may prefer mates with certain traits. Thus, certain alleles may get passed to more offspring than other alleles.
Genetic drift	Chance events, such as fire or flood, can cause rare alleles to be lost from a population.
Mutation	Mutations can create new alleles.
Natural selection	Natural selection can remove individuals with certain traits from a population. The alleles for those traits may become less common in the population.

VI. SEXUAL REPRODUCTION AND EVOLUTION-Sexual reproduction creates the possibility that mating patterns or behaviors can influence the gene pool of a population.

A. For example, in animals, females sometimes select mates based on the male's size, color, ability to gather food, or other characteristics. This kind of behavior is called sexual selection and is an example of _____

B. Another example of nonrandom mating is inbreeding, in which individuals either self-fertilize or mate with others like themselves. Inbreeding is more likely to occur if a population is small. In a small population, all members are likely to be closely related.

VII. POPULATION SIZE AND EVOLUTION-Allele frequencies are more likely to remain stable in _____ populations than in small populations.

A. Population size strongly affects the probability of genetic change in a population.

B. Genetic drift is a strong force in small populations and occurs when a particular allele disappears.

VIII. NATURAL SELECTION AND EVOLUTION- Natural selection acts only to change the relative _____ of alleles that exist in a population. It acts on genotypes by removing unsuccessful phenotypes from a population. Natural selection is a result of the following facts:

A. All populations have genetic variation.

B. Individuals tend to produce more _____ than the environment can support.

C. Populations depend upon the reproduction of individuals.

IX. Genetic Results of Selection

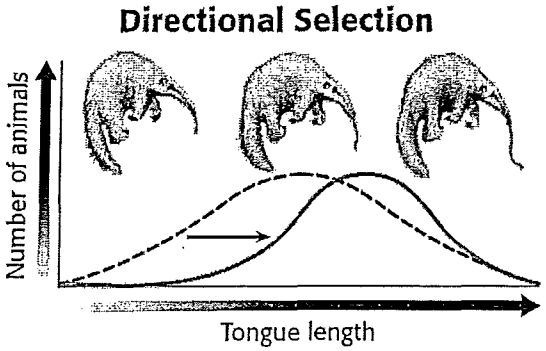
A. The result of natural selection is that each allele's frequency may increase or decrease depending on the allele's effects on _____ and reproduction.
B. Although natural selection is not the only force that can cause evolution, it is a powerful force.

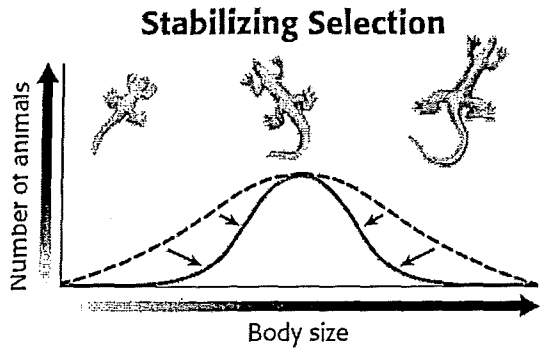
X. Why Selection is Limited

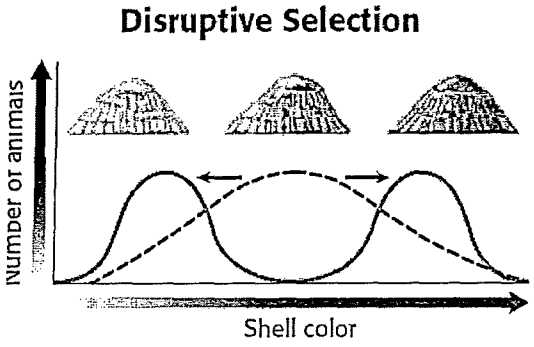
A. The key lesson that scientists have learned about evolution by natural selection is that the environment does the selecting.
B. Only characteristics that are _____ can be targets of natural selection. If a mutation results in rare recessive alleles, for example, selection cannot operate against it.
C. For this reason, genetic disorders (such as cystic fibrosis in humans) can persist in populations.

XI. PATTERNS OF NATURAL SELECTION- Three major patterns are possible in the way that natural selection affects the distribution of polygenic characters over time. These patterns are directional selection, stabilizing selection, and disruptive selection.

1. _____In directional selection, the "peak" of a normal distribution moves in one direction along its range.
2. In this case, selection acts to eliminate on extreme from a range of phenotypes, making them less common.
3. _____In stabilizing selection, the bell-curve shape becomes narrower. In this case, selection eliminates individuals that have alleles for any extreme type.
4. Stabilizing selection is very common in nature.
5. _____In disruptive selection, the bell curve is "disrupted" and pushed apart into two peaks.
6. In this case, selection acts to eliminate individuals with average phenotype values.







XII. DEFINING SPECIES- A species is generally defined as a group of natural populations that can interbreed and usually produce _____ offspring. This definition is based on the biological species concept.

XIII. FORMING NEW SPECIES-Speciation has occurred when the net effects of evolutionary forces result in a population that has unique features and is reproductively isolated. _____ is the process of forming new species by evolution from preexisting species.

A. In each place, natural selection acts upon each population and tends to result in offspring that are better adapted to each specific environment.
B. If the environments differ, the adaptations may differ. This is called _____ and can lead to the formation of new species.

XIV. Reproductive Isolation- Reproductive isolation is a state in which two populations can no longer interbreed to produce future offspring. From this point on, the groups may be subject to different forces, so they will tend to diverge over time. Any of the following mechanisms may contribute to the reproductive isolation of populations:

A. Geography
B. Ecological Niche

C. Mating Behavior and Timing
D. Polyploidy
E. Hybridization

Mechanisms of Reproductive Isolation	
Mechanism	**Description**
Geography	A physical barrier may form that separates populations. The barrier prevents the populations from interbreeding. Over time, if the populations diverge enough, they will not be able to interbreed, even if the barrier is removed.
Ecological niche	Divergence can happen when populations use different niches.
Mating behavior and timing	Many species that reproduce sexually use specific behaviors to attract mates. These behaviors may include sounds or actions. The individuals of some species mate at particular times. If two populations develop different mating behaviors or mate at different times, they may no longer interbreed.
Polyploidy	A polyploid individual may not be able to mate with others in the population because it cannot pair gametes. However, it may be able to reproduce with other polyploid individuals or self-fertilize. The offspring would form a new population.
Hybridization	In hybridization, two closely related species mate and produce offspring. In many cases, the offspring are not fertile or are not adapted to survive in their environment. However, some hybrids may be able to survive and produce fertile offspring. These hybrids may form a new species.

XV. EXTINCTION: THE END OF SPECIES-The species that exist at any time are the net result of both speciation and extinction. Extinction occurs when a species fails to produce any more descendants. Extinction, like speciation, can only be detected after it is complete.

A. More than _____ of all of the species that have ever lived becoming extinct.
B. Many cases of extinction are the result of environmental change.
C. If a species cannot adapt fast enough to changes, the species may be driven to extinction.

HOMEWORK DATE DUE

CH 17 SEC 1

1. How do scientists study microevolution?

2. How does the number of genes that affect a phenotype relate to the variation in traits?

3. How do scientists measure phenotypic variation?

4. How do scientists measure genetic variation?

5. A population consists of 100 individuals. In this population, 61 people have unattached earlobes. Of these individuals, 33 are homozygous dominant and 28 are heterozygous. The remaining individuals have attached earlobes. What is the frequency of each genotype? What is the frequency of each allele?

6. What is the major source of variation in a population?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

HOMEWORK DATE DUE_____

CH 17 SEC 2

1. What five forces can cause allele frequencies in a population to change?

_____

_____

2. How would a beneficial mutation affect original allele frequencies for a particular character?

_____

_____

3. Why is genetic drift more likely to occur in a small population than in a large population?

_____

_____

4. List two limitations of natural selection.

_____

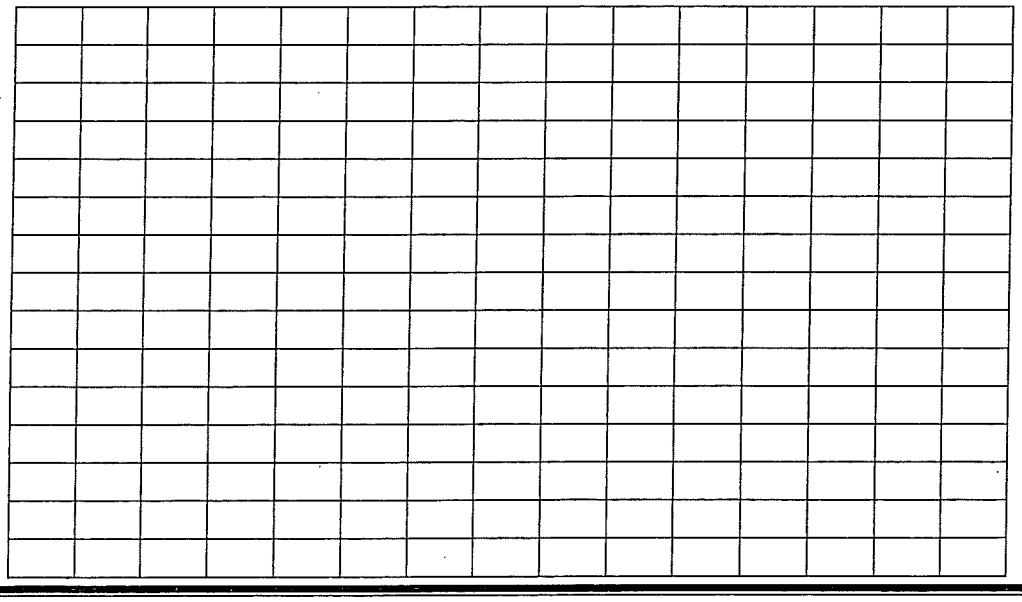
_____

_____

_____

5. On a particular island, birds have a variety of beak sizes. Those with the largest beaks can eat hard seeds, and those with the smallest beaks eat smaller, softer seeds. An environmental change on this island eliminates the plants that produce small, soft seeds. Over time, what will happen to the beak sizes of the birds? Draw a graph to show the pattern of natural selection that is likely to happen on the island. Be

6. sure to label the axes of your graph.



BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION_____

_____

ANSWER_____

_____

_____

_____

HOMEWORK DATE DUE

CH 17 SEC 3

1. Why do scientists use more than one definition for *species*?

2. What are the five mechanisms that can cause reproductive isolation of a population?

3. Scientists studied the mating activity of four closely related species of frogs and recorded the peak mating times of each species. Which two species show the greatest amount of divergence in mating activity? Explain your answer.

4. What two forms of evidence show that a new species has formed?

5. If you represented evolution with a diagram of a tree, what part of the tree would represent speciation? How would you represent extinction? Draw Below

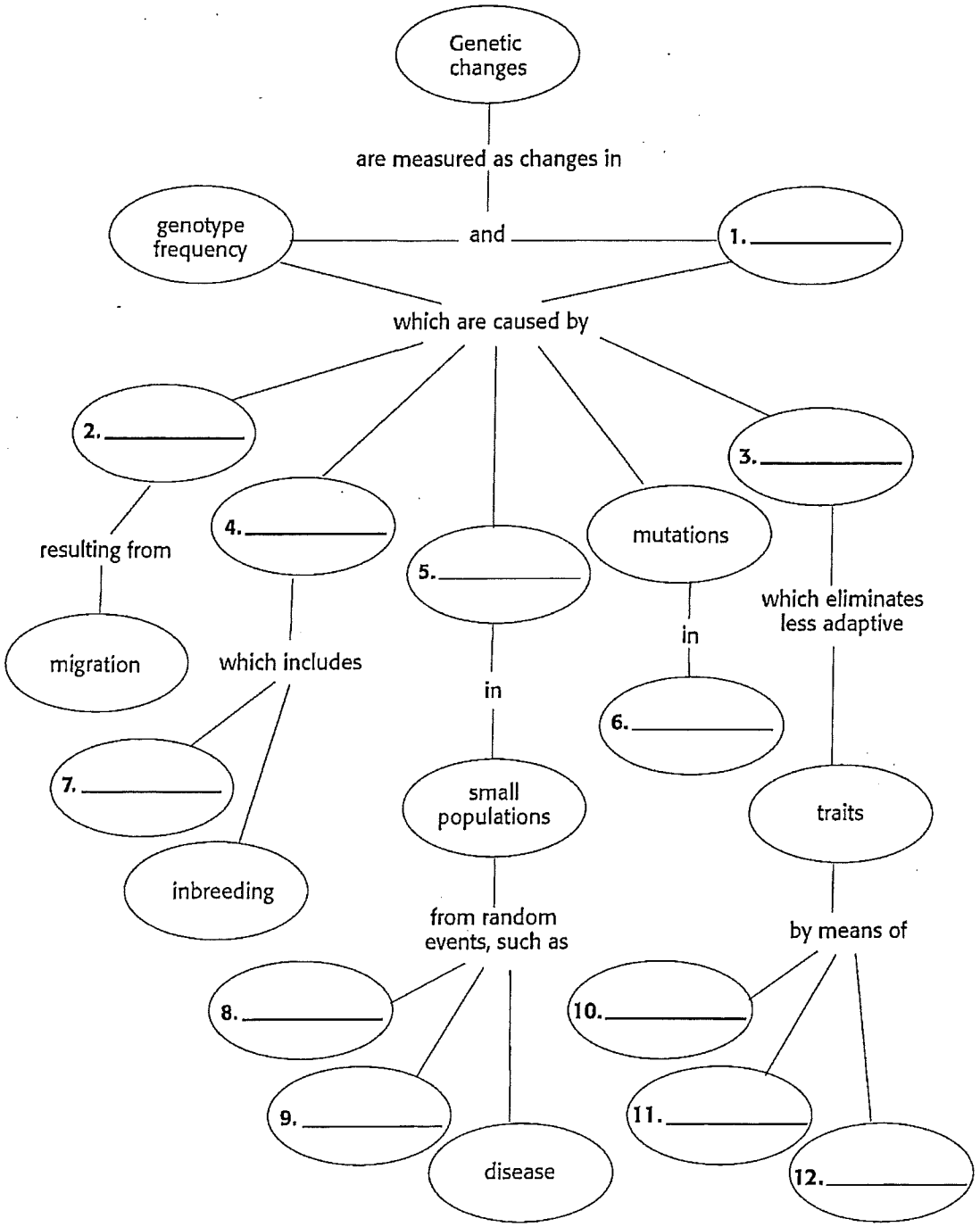
BELLRINGER QUESTION CIRCLE M T W TH FRI DATE

ANSWER

Ch 17
Concept Mapping

Using the terms provided below, complete the concept map showing how genetic changes occur in populations.

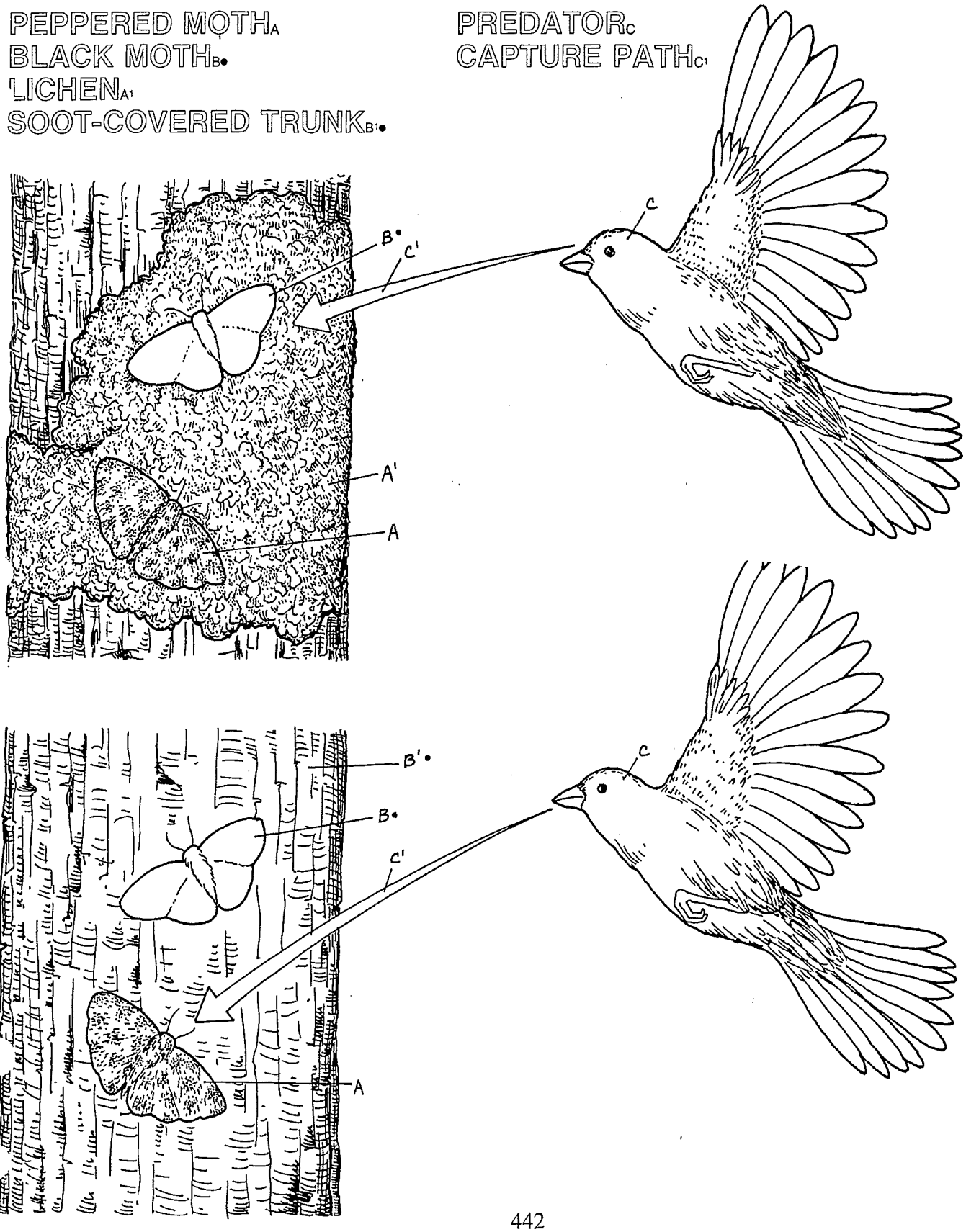
allele frequency	fire	natural selection
directional selection	gene flow	nonrandom mating
disruptive selection	genetic drift	sexual selection
drought	germ cells	stabilizing selection



NATURAL SELECTION WE CAN SEE.

PEPPERED MOTH$_A$
BLACK MOTH$_B$.
LICHEN$_{A1}$
SOOT-COVERED TRUNK$_{B1}$.

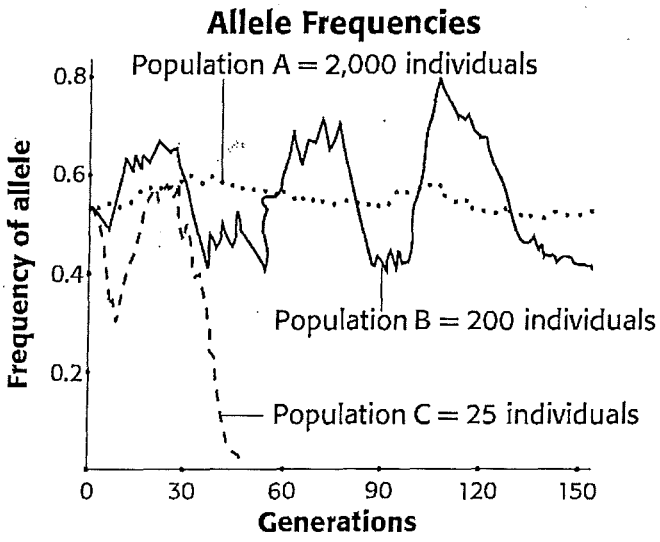
PREDATOR$_C$
CAPTURE PATH$_{C1}$



Hardy Weinberg/ Allele Frequencies

Interpreting Graphics

Use the figure below to answer questions 1– 4.



Read each question, and write your answer in the space provided.

1. Which of these populations is closest to Hardy-Weinberg equilibrium? Explain.

2. What happened to the frequency of the allele in the smallest population shown in the graph above? Explain.

3. What conditions must be present in order for a population to maintain Hardy-Weinberg equilibrium?

4. What factors might cause genotype frequencies to deviate Hardy-Weinberg equilibrium?

Ch 17 Review

1. Genetic variation and change are measured in terms of the frequency of alleles in the _____ of a population.
2. To study genetic variation, what must be counted or estimated in a population?
3. What is macroevolution?
4. What is microevolution?
5. Population genetics involves the study of _____
6. The sum of allele frequencies for any one characteristic in a population is
7. What condition absolutely must be present in a population before evolution can act upon it?
8. Why are mutations in body cells not a source of genetic variation?
9. What is the Hardy-Weinberg principle?
10. What causes Hardy-Weinberg principle to not be in proportion?
11. What is gene flow?
12. What is homozygous?
13. What is heterozygous?
14. What happens to a population that inbreeds?
15. What is inbreeding?
16. Which is a probable origin of many recessive genetic disorders?
17. In natural selection, what does the selecting?
18. What is directional selection?
19. What is stabilizing selection?
20. What is disruptive selection?
21. What is directional selection?
22. A population of clams lives in a rocky intertidal zone where black lava has flowed into an area of white sand and bleached coral. The clams' shells range in color from white to black with a shade of gray in between. The white clams and the black clams each outnumber the gray clams ten to one. What type of selection is in effect here?
23. According to the biological species concept, any populations that do not share future offspring are _____
24. When a species begins to occupy more than one niche, and divergence and speciation occur as a result, the species is said to have undergone _____
25. Why is accidental polyploidy in an individual considered a form of reproductive isolation?
26. How can geography lead to reproductive isolation?

27. When a species fails to produce any more descendants, it is said to be _____.

28. Under which circumstance could a well-adapted species become poorly adapted?

29. Extinction, like speciation, can be detected only after it is _____.

LAB CH 17
The SEX Lab- using Hardy Weinberg

□□60 index cards with "A" alleles
□□60 index cards with "a" alleles

Population One (Random)

1. Each student will select 2 cards from the gene pool.
2. Determine the genotype of each student (first generation) and record the data on the Chart. You will write down the frequencies of each allele
3. "Mate" with another student. Decide which one will be offspring 1 and offspring 2 – whichever person has the lower number on their envelope will be offspring 1.
4. When mating, face each other with both allele index cards inside the envelopes. Together, count to three and then pull out one allele from the envelope (don't look at the allele you are taking). The two alleles (one from each student) represent the first offspring.
5. The other set of alleles-one from each student is the second offspring.
6. Exchange the cards with your mate..
7. When I call time,the first generation dies out and one student assumes the genotype of offspring 1,
while the other student in each pair assumes the genotype of the second offspring. (Index cards represent genes.).
9. Count the number of each of the possible genotypes (AA, Aa, and aa) that occurred in the second generation and determine the frequency of each of the alleles (A and a).
10. Repeat steps 4-9 until you have the data recorded for at least five generations.
11. Copy the information from the board onto the chart.

Population Two (Selection)

Follow the same procedure as in population one, but conditions are altered so that any offspring that are homozygous recessive "aa" will not survive and must be replaced (Go to the gene pool and pick 2 more cards). Only "AA" and "Aa" individuals will occur in generation two and higher. Repeat steps four through nine until data is recorded for at least five generations.

Answer the questions and **graph** the number of alleles in each heneration for population 1 and 2.

1. What conditions make the Hardy-Weinberg not valid (wrong)?

_____
_____
_____

2. Does this activity give accurate data for the Hardy Weinberg principle? Why or why not?

_____
_____
_____

Hardy-Weinberg Lab

Round1	AA	Aa	aa
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Totals			

Round2	AA	Aa	aa
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
Totals			

Ch 17 LAB
Genetic Drift

OBJECTIVES

- **Investigate** the effect of population size on genetic drift.
- **Analyze** the mathematics of the Hardy-Weinberg principle.

MATERIALS

- buttons, blue (10 to 100)
- buttons, red (10 to 100)
- buttons, white (10 to 100)
- jar or beaker, large, plastic

Preparation

1. **Scientific Methods** **State the Problem** How does population size affect allele frequencies? Read the procedure to see how you will test this.
2. **Scientific Methods** **Form a Hypothesis** For a hypothesis that predicts the results of this procedure for three different population sizes.

_____

_____

Procedure

1. Prepare to model the populations. First, assign each color button to one of the alleles (I^A, I^B, or i) of the ABO blood types. Notice how each possible pairing of alleles matches one of the four types (A, B, AB, or O). Then, choose three different population sizes. Also choose one ratio of alleles at which to start all three populations (for example, I^A: I^B: i = 2: 2: 1). Create tables for your data.
2. Represent the first population's alleles by placing the appropriate number of blue, red, and white buttons in a jar.
3. Randomly select two buttons from the jar to represent one person, and record this person's genotype and phenotype. Tally the total number of each allele within this generation.
4. Repeat step 3 until you have modeled the appropriate number of people in the population. Tally the total number of each allele within this generation.
5. Empty the jar and refill it with the number and color of buttons that matches the tallies recorded in step 4.
6. Repeat steps 3 through 5 until you have modeled four generations.

7. Repeat steps 2 through 6 to model two more populations.

Analyze and Conclude

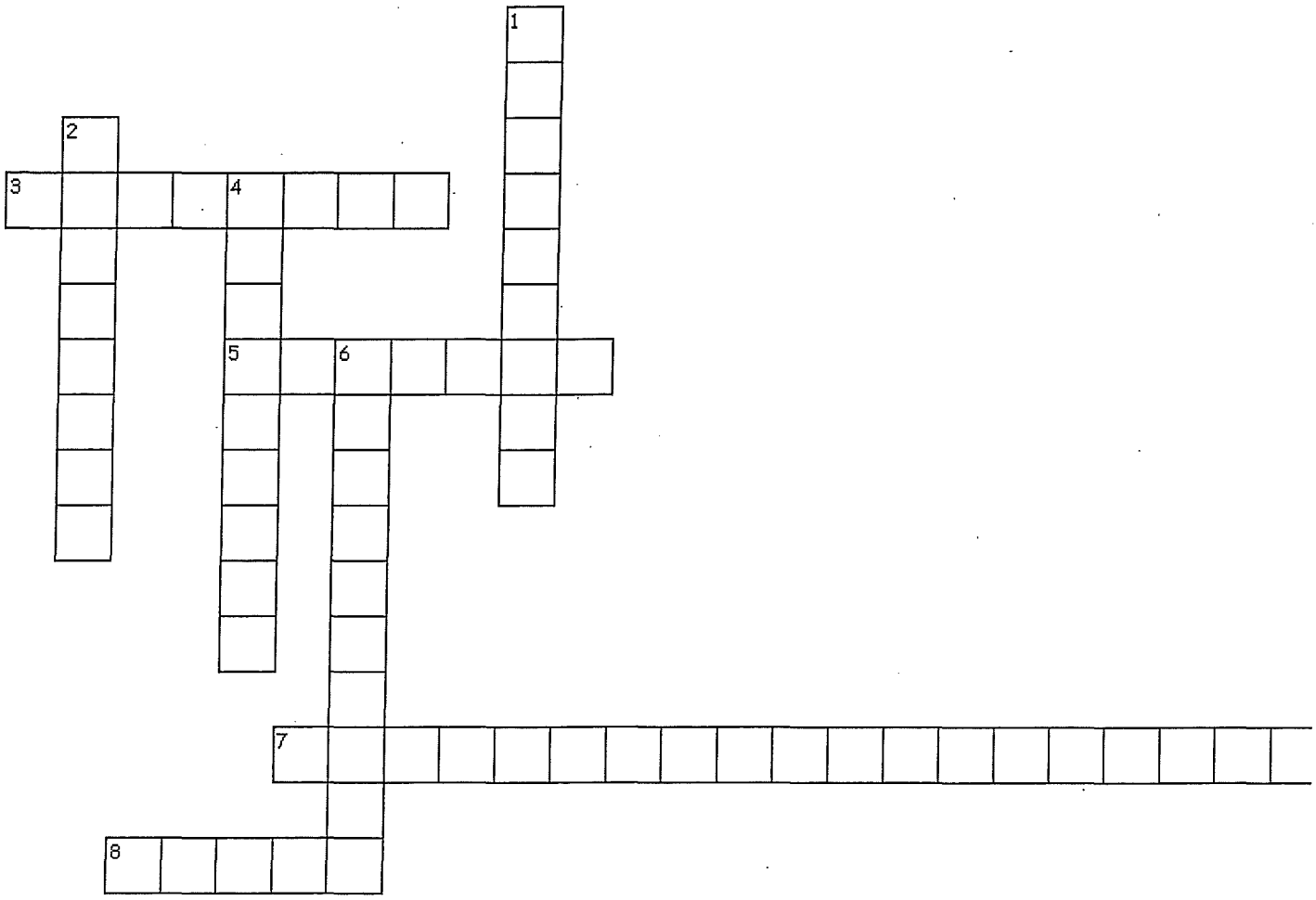
1. **Analyzing Data** Describe any changes in genotype and phenotype ratios within each population over time.

2. **Explaining Results** Did this population maintain genetic equilibrium? Explain how you can tell.

3. **Scientific Methods** **Analyzing Results** Which population showed the greatest amount of genetic drift? Explain.

4. **Applying Concepts** How might your results differ if you started with a larger number of buttons? a smaller number? a different ratio of colors? Explain your answers.

Ch 18 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard for each term with the word on one side and the definition on the back



Across

3. extremely small, single-celled organisms that usually have a cell wall and that usually reproduce by cell division; members of the domain Bacteria
5. prokaryotes that are distinguished from other prokaryotes by differences in their genetics and in the makeup of their cell wall; members of the domain Archaea
7. a system for giving each organism a two-word scientific name that consists of the genus name followed by the species name
8. the level of classification that comes after family and that contains similar species

Down

1. the evolutionary history of a species or taxonomic group
2. the science of describing, naming, and classifying organisms
4. an organism made up of cells that have a nucleus enclosed by a membrane, multiple chromosomes, and a mitotic cycle; members of the domain Eukarya
6. a phylogenetic classification system that uses shared derived characters and ancestry as the sole criterion for grouping taxa

Ch 18
Vocabulary Review

In the space provided, write the letter of the term that best completes each statement.

_____ 1. A method of analysis based on shared derived characters is
a. evolutionary systematics.
b. heredity.
c. cladistics.

_____ 2. The evolutionary history of a species is its
a. phylogeny.
b. kingdom.
c. heredity.

_____ 3. Similar species are combined into a(n)
a. order.
b. genus.
c. family.

_____ 4. The science of naming and organizing organisms is
a. evolution.
b. taxonomy.
c. kingdom.

_____ 5. The two-word system for naming organisms that was originated by Linnaeus is
a. cladistics.
b. evolutionary systematics.
c. binomial nomenclature.

Match the words on the left with the statements on the right.

___ 6. archaea
_____ 7. bacteria
_____ 8. cladistics
_____ 9. eukaryote
_____ 10. taxonomy

a. cells have nucleus and other internal compartments
b. the more modern way of using ancestry to group organisms
c. group of prokaryotes with strong exterior cell walls and a unique genetic system
d. the science practiced by Linnaeus
e. group of prokaryotes that includes extremophiles

Chapter 18 Classification

I. THE NEED FOR SYSTEMS- Biologists use taxonomic systems to organize their knowledge of organisms. These systems attempt to provide consistent ways to name and categorize organisms.

A. The practice of naming and classifying organisms is called _____. Taxonomic systems do not use common names, which may be confusing because they are different in different places.

B. Taxonomic systems use categories to organize organisms.

C. The general term for any one of these categories is a _____ (plural, _____).

II. SCIENTIFIC NOMENCLATURE-All scientific names for species are made up of two Latin or Latin-like terms. A simpler and more consistent system was developed by Swedish biologist Carl _____ in the 1750s.

III. Naming Rules

A. Linnaeus' unique, two-part name for a species is now called a scientific name.

B. No two species can have the same scientific name.

C. When you write the scientific name, the genus name should be _____ and the species identifier should be _____. Both terms should be _____. Ex- *Homo sapiens*

IV. THE LINNAEAN SYSTEM-The eight basic levels of modern classification are _____PHYLOGENETICS- _____ is the ancestral relationships between species.

A. Not all similar characteristics are inherited from a common ancestor. Consider the wings of an insect and the wings of a bird.

B. Through the process of convergent evolution, similarities may evolve in groups that are not closely related.

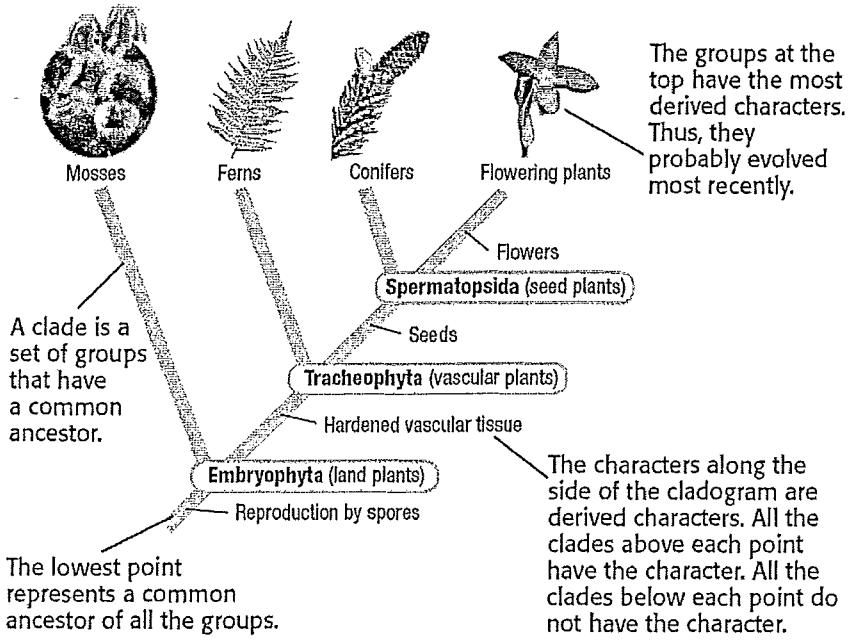
1. Similar features may evolve because the groups have adopted similar _____ or lifestyles.
2. Similarities that arise through _____ evolution are called analogous characters.

V. CLADISTICS- Cladistic analysis is used to select the most likely phylogeny among a given set of organisms.

A. _____ focuses on finding characters that are shared between different groups because of shared ancestry.

B. Cladistics infers relatedness by identifying shared derived and ancestral characters among groups, while avoiding analogous characters.

1. A _____ character is defined as ancestral if it is thought to have evolved in a common ancestor of both groups.
2. A _____ character is one that evolved in one group but not the other.
3. All groups that arise from one point on a cladogram belong to a _____
4. A clade is a set of groups that are related by descent from a single ancestral lineage.
5. Each clade is usually compared with an outgroup, or group that lacks some of the shared characteristics.



VI. INFERRING EVOLUTIONARY RELATEDNESS-

A. Morphological Evidence- _____ refers to the physical structure or anatomy of organisms. An important part of morphology in multicellular species is the pattern of development from embryo to adult.

B. Molecular Evidence- Scientists can now use genetic information to infer phylogenies. Genetic sequence data are now used widely for cladistic analysis.

C. Evidence of Order and Time

1. Cladistics can determine only the relative order of divergence, or branching, in a phylogenetic tree.
2. The fossil record can often be used to infer the actual time when a group may have begun to "branch off."
3. DNA mutations occur at relatively constant rates, so they can be used as an approximate "genetic clock."
4. Scientists can measure the genetic differences between taxa and estimate time of divergence.

VII. THE THREE-DOMAIN SYSTEM-TMajor taxa are defined by major characteristics, including:

A. Cell Type: prokaryotic or eukaryotic
B. Cell Walls: absent or present
C. Body Type: unicellular or multicellular– Nutrition: autotroph (makes own food) or heterotroph (gets nutrients from other organisms)
D. Genetics: Related groups of organisms will also have similar genetic material and systems of genetic expression. Organisms may have a unique system of DNA, RNA, and proteins.

VIII. _____

A. Bacteria are prokaryotes that have a strong exterior wall and a unique genetic system.
B. All bacteria are similar in structure, with no organelles
C. Bacteria are the most abundant organisms on Earth and are found in every environment.

IX. _____

A. Archaea have a chemically unique cell wall and membranes and a unique genetic system.
B. Scientists think that archaea evolved in a separate lineage from bacteria early in Earth's history.

X. _____

A. Eukaryotes are organisms composed of eukaryotic cells.
B. All eukaryotes have cells with a nucleus and other internal compartments.
C. Also, true multicellularity and sexual reproduction only occur in eukaryotes. – True multicellularity means that the activities of individual cells are coordinated and cells themselves are in contact.

XI. KINGDOMS OF EUKARYA

A. Kingdom Plantae

1. Almost all plants are autotrophs that produce their own food by absorbing energy and raw materials from the environment. The process that makes food, photosynthesis, occurs in chloroplasts.
2. The plant cell wall is made of a rigid material called cellulose.
3. Sexual reproduction is an important part of the life cycle of most eukaryotes.

B. Kingdom Animalia

1. Animals are multicellular heterotrophs.
2. Animal cells lack a rigid cell wall.

C. Kingdom Fungi

1. Fungi are heterotrophs that are mostly multicellular.

2. Their cell wall is made of a rigid material called chitin.
3. Fungi are considered to be more closely related to animals than to any other kingdom.

D. Kingdom Protista

1. Kingdom Protista is a "leftover" taxon, so it is a diverse group.
2. Any single-celled eukaryote that is not a plant, animal, or fungi can be called a protist.
3. Protists did not descend from a single common ancestor.
4. For many years, biologists recognized four major groups of protists:
    a) *flagellates,*
    b) *amoebas,*
    c) *algae*
    d) *parasitic protists.*

HOMEWORK DATE DUE_____

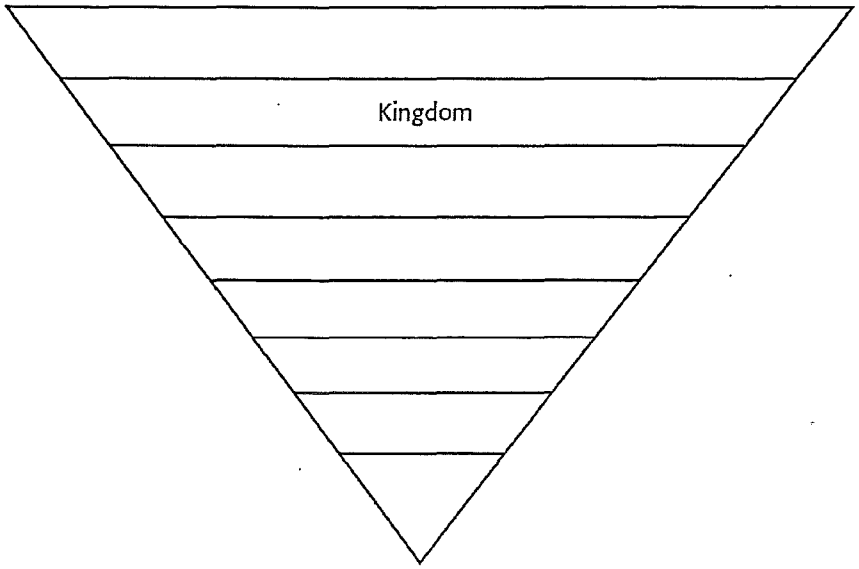
CH 18 SEC 1

1. What are two reasons common names for species can be confusing?

   _____

   _____

2. Complete the hierarchy below to show the eight levels of classification in the Linnaean system. Start at the top with the most general level.



3. Circle the cheetah's correctly written scientific name.

   Acinonyx jubatus *Acinonyx jubatus*

   Acinonyx Jubatus *acinonyx jubatus*

4. If two organisms are classified in the same order, what other levels of classification do they share?

   _____

   _____

5. Are there more phyla or genera on Earth? Explain your answer.

   _____

   _____

   _____

   _____

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION_____

_____

ANSWER_____

_____

_____

_____

HOMEWORK DATE DUE

CH 18 SEC 2

1. What are two reasons grouping organisms by similar structures and features can be a problem?

2. List three sources of evidence that scientists use to construct cladograms.

3. Many scientists who study dinosaurs have stated that dinosaurs are not extinct. Explain this view.

4. Use the information in the table to draw a cladogram that represents a possible phylogeny for a house cat. In your cladogram, be sure to include the derived characters.

Animal	Four legs	Internal fertilization	Hair
Salmon	no	no	no
Frog	yes	no	no
Lizard	yes	yes	no
House cat	yes	yes	yes

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

HOMEWORK DATE DUE_____

CH 18 SEC 3

1. What are the six kingdoms scientists use today to classify all organisms?

2. Which two domains are made up of prokaryotes?

3. Which domain contains multicellular organisms?

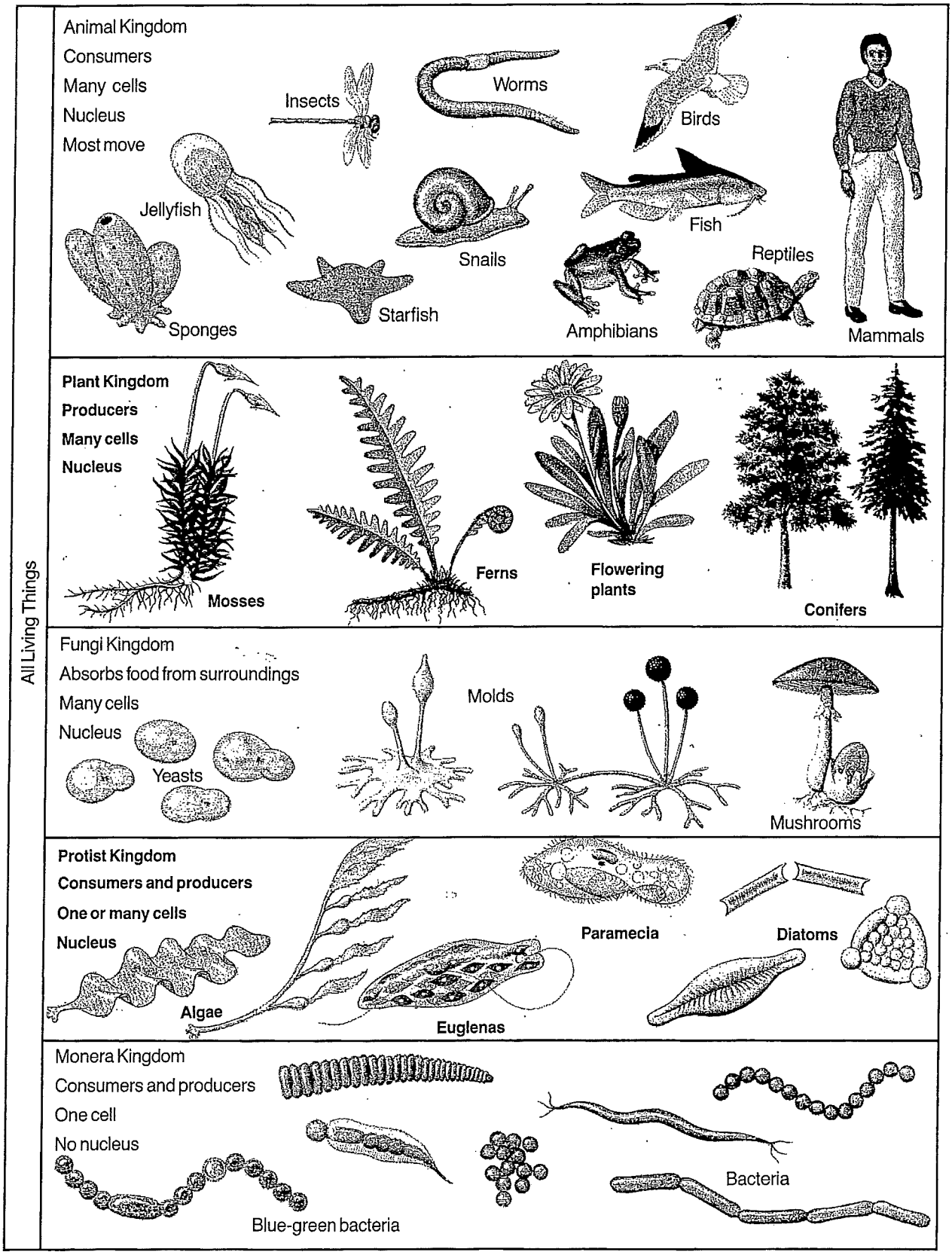
4. What is an *extremophile*? Which domain contains extremophiles?

5. Why do systems of classification change?

6. Into which kingdom would you classify a unicellular organism that has a nucleus but no cell wall? Explain your answer.

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION_____

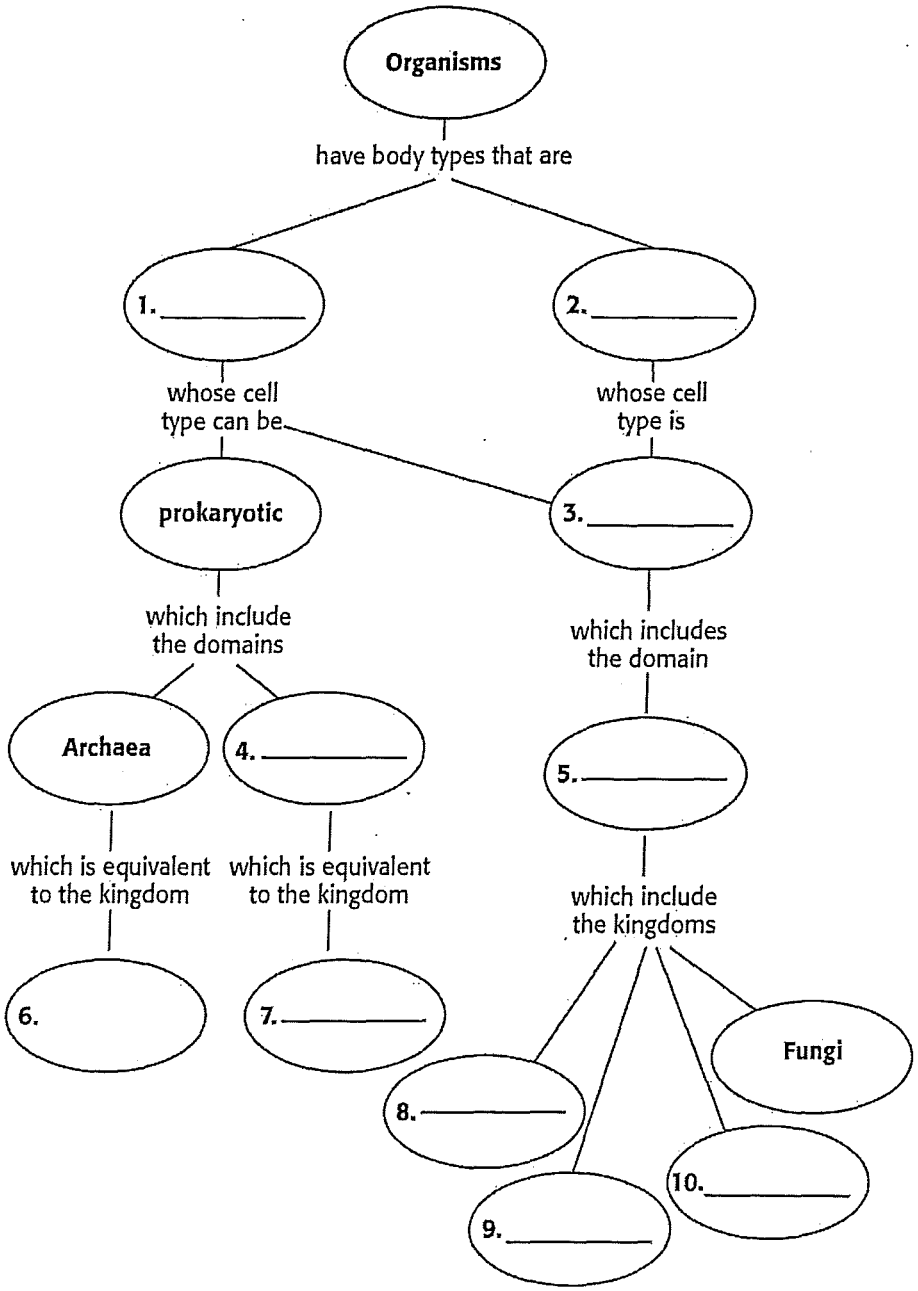
ANSWER_____


All Living Things
Animal Kingdom
Consumers
Many cells
Nucleus
Most move
Insects
Worms
Birds
Jellyfish
Snails
Fish
Reptiles
Sponges
Starfish
Amphibians
Mammals
Plant Kingdom
Producers
Many cells
Nucleus
Mosses
Ferns
Flowering plants
Conifers
Fungi Kingdom
Absorbs food from surroundings
Many cells
Nucleus
Yeasts
Molds
Mushrooms
Protist Kingdom
Consumers and producers
One or many cells
Nucleus
Algae
Euglenas
Paramecia
Diatoms
Monera Kingdom
Consumers and producers
One cell
No nucleus
Blue-green bacteria
Bacteria

Ch 18
Concept Mapping

Using the terms provided below, complete the concept map that shows the classification of organisms.

Animalia	Bacteria	eukaryotic	Protista
Archaebacteria	Eubacteria	multicellular	unicellular
Eukarya	Plantae		



System lab

Often, more than one way exists to organize or group things. In this lab, you will work with others to decide on a system.

Procedure

1. Work with a partner. Examine the assortment of objects provided by your teacher.
2. Sort your objects into groups of "related" objects. Try to get every object into a group with at least one other object.
3. Choose a name for each group.
4. Choose one object from your collection, and trade it for an object from another pair of students.
5. Try to fit the new object into one of your groups.

Analysis

1. **List** and define each of your group names from step 3.

2. **Describe** how you classified the new object in step 4.

3. **Predict** whether another person would be able to "correctly" classify one of your objects by using your list of groups. Explain your reasoning.

4. **Draw** a classification tree with each of the objects including the names of your cateogories on back.

Dichotomous Keys

OBJECTIVES

- **Identify** objects by using a dichotomous key.
- **Design** a dichotomous key for a group of objects.

MATERIALS

- objects, common (6 to 10)
- labels, adhesive
- pencil

Procedure

USE A DICHOTOMOUS KEY

1. Work with a small group. Use the dichotomous key below to identify the leaves shown on p. 438 of your textbook. Identify one leaf at a time. Always start with the first 2 statements (1a and 1b). Follow the direction beside the statement that describes the leaf.
2. Proceed through the key until you get to the name of a tree. Record your answer for each leaf shown on the following sheet.

Key to Forest Trees		
1a	Leaf edge is smooth or barely curved.	go to 2
1b	Leaf edge has teeth, waves, or lobes.	go to 3
2a	Leaf has a sharp bristle at its tip.	shingle oak
2b	Leaf has no bristle at its tip.	go to 4
3a	Leaf edge has small, shallow teeth.	Lombardy poplar
3b	Leaf edge has deep waves or lobes.	go to 5
4a	Leaf is heart shaped.	eastern redbud
4b	Leaf is not heart shaped	live oak
5a	Leaf edge has more than 20 large lobes.	English oak
5b	Leaf edge has more than 20 waves.	chestnut oak

A	
B	
C	
D	
E	
F	

DESIGN A DICHOTOMOUS KEY

3. Chose 6 to 10 objects from around the classroom or from a collection supplied by your teacher.
4. Study the structure and organization of the dichotomous key, which includes pairs of contrasting descriptions that form a "tree" of possibilities. Use this key as a model for the next step.
5. Work with the members of your group to design a new dichotomous key for the objects that your group selected. Be sure that each part of the key leads to either a definite identification of an object or another set of possibilities. Be sure that every object is included.
6. Test your key using each one of the objects in your collection.

EXCHANGE AND TEST KEYS

7. After each group has completed the steps above, exchange your key and your collection of objects with another group. Use the key you receive to identify each of the new objects. If the new key does not work, return it to the group so corrections can be made.

CLEANUP

8. Clean up your work area and return or dispose of materials as directed by your teacher. Wash your hands thoroughly before you leave the lab and after you finish all of your work.

Analyze and Conclude

1. **Draw** your own dichotomous key on the last page for the objects you were provided
2. **Scientific Methods Critiquing Procedures** What other characteristics might be used to identify leaves by using a dichotomous key?

_____

_____

3. **Analyzing Results** What challenges did your group face while making your dichotomous key?

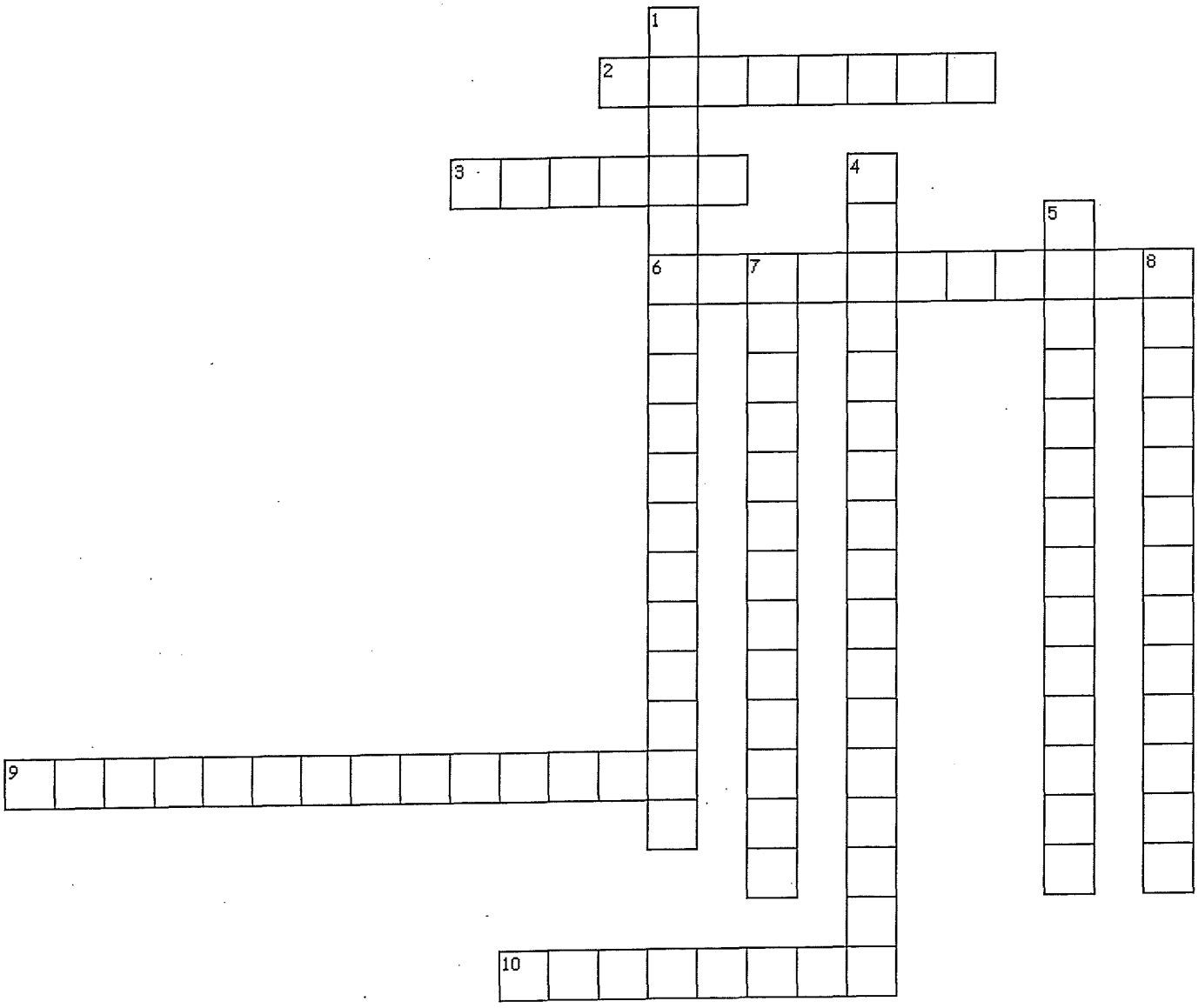
4. **Evaluating Results** Were you able to use another group's key to identify the group's collection of objects? Describe your experience.

5. **Scientific Methods** **Analyzing Methods** Does a dichotomous key begin with general descriptions and then proceed to more specific descriptions, or vice versa? Explain your answer by using examples.

6. **Scientific Methods** **Evaluating Methods** Is a dichotomous key the same as the Linnaean classification system? Explain your answer.

	DESCRIPTION	GO TO
1A		
1B		
2A		
2B		
3A		
3B		
4A		
4B		
5A		
5B		
6A		
6B		
7A		
7B		
8A		
8B		
9A		
9B		
10A		
10B		
11A		
11B		
12A		
12B		
13A		
13B		

Ch 19 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard for each term with the word on one side and the definition on the back



Across

2. the time required for half of a sample of a radioactive substance to decay
3. record the history of life in the geologic past as indicated by the traces or remains of living things
6. a hollow microscopic spherical structure that is usually composed of proteins or a synthetic polymer
9. an episode during which large numbers of species become extinct
10. a type of RNA that can act as an enzyme

Down

1. a method of determining the absolute age of an object by comparing the relative percentages of a radioactive (parent) isotope and a stable (daughter) isotope
4. the standard method used to divide Earth's long natural history into manageable parts
5. a method of determining whether an event or object, such as a fossil, is older or younger than other events or objects
7. bacteria that carry out photosynthesis; blue-green algae
8. a mutually beneficial relationship in which one organism lives within another

Ch 19
Vocabulary Review

Circle the term that best completes each sentence.

1. The theory that explains how chloroplasts and mitochondria got to be part of cells is called (cyanobacteria, microsphere, endosymbiosis).
2. The period of time determined for the decay of radioactive elements used in radiometric dating is the (half-life, era, Precambrian).
3. (Microspheres, Ribozymes, Cyanobacteria) are tiny hollow structures made of short chains of amino acids and might have been the first step towards cellular organization.
4. Describing a fossil as being older than the layer of rock above it is called (fossil, relative, absolute) dating.

Match the words on the left with the statements on the right.

_____ 5. fossil record

_____ 6. geologic time scale

_____ 7. mass extinction

_____ 8. radiometric dating

a. the death of all members of many species

b. shows the different parts of Earth's 4.5 billion years of history

c. made up of all the fossil evidence that has been found so far

d. a way of finding the absolute age of a fossil

Using the word bank below, fill in each blank provided.

cyanobacteria	isotopes
eras	ribozyme

9. Oxygen entered the atmosphere because of the _____.
10. A kind of RNA that can act like an enzyme is a(n) _____.
11. Radiometric dating uses unstable _____.
12. The geologic time scale is divided into large blocks of time called _____.

Chapter 19 History of Life on Earth

I. LIFE'S BUILDING BLOCKS-Among the hypotheses that address the origin of life, one states that early biological molecules formed close to _____. Organic molecules may also have arrived on early Earth on meteorites.

A. Hydrothermal Vents-The heat from hydrothermal vents could have provided energy for chemical reactions. Within the sea, biological molecules would have been protected from harmful solar radiation.
B. Space-Some _____ contain amino acids. Such molecules could have arrived on early Earth, when frequent meteorite impacts were common.

II. THE FIRST CELLS- Many scientists think that the formation of _____ may have been the first step toward cellular organization.

A. Forming a Cell – When studying the behavior of organic molecules in water, scientists have observed that lipids tend to combine in water. Certain lipids, when combined with other molecules, can form a tiny droplet that has a surface that resembles a _____.

B. Further research has shown that short chains of amino acids can form tiny spherical structures called _____. Microspheres could not be considered cells unless they had the characteristic of heredity.

Event	Description
Evolution of prokaryotes	The oldest known fossils are of prokaryotes. They are more than 3.5 billion years old. Scientists think that some of the first prokaryotes were marine cyanobacteria (singular, **cyanobacterium**), which could carry out photosynthesis.
Formation of oxygen	Oxygen gas was rare in Earth's early atmosphere. By about 2.4 billion years ago, cyanobacteria had begun to add oxygen to the atmosphere by carrying out photosynthesis.
Formation of the ozone layer	As the amount of oxygen in Earth's atmosphere increased, the ozone layer began to form. The ozone layer protected early organisms from ultraviolet rays in sunlight. As a result, organisms were eventually able to survive on land.

III. Origin of Heredity - Scientists have studied the origins of heredity by studying the formation of proteins. In the laboratory, scientists have _____ been able to make proteins or DNA form spontaneously in water. They have been able to form short chains of RNA, the nucleic acid that helps to carry out the instructions of DNA.

A. RNA molecules may have been the first self-replicating molecule.
B. –RNA can form spontaneously in water, without DNA.

C. –RNA was the first self-replicating molecule that stored information and catalyzed the formation of the first proteins.

IV. THE FOSSIL RECORD-Both the _____ distribution of organisms and when they lived on Earth can be inferred from the fossil record.

A. These fossils form when organisms or traces of organisms are rapidly buried in fine _____ that are deposited by water, wind, or volcanic eruptions.
B. Many species have lived in environments where fossils _____.

V. ANALYZING FOSSIL EVIDENCE-In order to analyze fossil evidence, paleontologists use both relative and absolute dating methods to date fossils.

A. According to the law of superposition, _____ strata are covered by _____ strata.
B. Types of Fossils

1. _____ fossils are the most common types of fossils.
2. In some cases, an organism breaks down, leaving a hollow space called a _____
3. This mold may fill with minerals, preserving the shape of the organism.
4. In rare cases, fossils are preserved in hardened plant sap, or _____. In these fossils, soft parts of tissue are preserved in detail.

VI. Relative Age- A process called relative dating is used to estimate the ages of fossils found within strata. Relative dating _____ reveal a _____. But it can reveal the _____ that strata and the fossils within them were laid down over time. Paleontologists organize fossils into a sequence based on the relative age of the strata in which the fossil was found.

A. An _____ fossil is a fossil of an organism that was common and had widespread geographic distribution during a certain time in Earth's history.
B. _____ fossils are used to estimate the age of other strata that contain the same type of fossil.
C. Scientists have compared patterns of strata and index fossils within them to make the geologic time scale.

VII. Absolute Age- A method called _____ _____ estimates the age in years of an object by measuring certain _____ isotopes that the object contains.

A. An _____ is a form of an element whose atomic mass differs from that of other atoms of the same element.
B. Radioactive isotopes, or _____, are unstable isotopes that break down and give off energy in the form of charged particles, or radiation. This breakdown is called _____ _____
C. The time required for half of a sample of parent radioisotope to decay into a daughter isotope is the isotope's half-life. Each radioisotope has a specific _____.
D. The rate at which a radioisotope _____ is not affected by external factors.
E. By comparing the amounts of certain radioisotopes and their daughter isotopes, scientists can calculate how many half-lives have passed since a material formed. – One radioisotope that is widely used to date organic materials is carbon-14. The half-life of carbon-14 is relatively short—_____.
F. _____ is used to measure the age of carbon-containing materials that are younger than 75,000 years old.
G. To find the age of older materials, scientists must measure other radioisotopes.

VIII. DESCRIBING GEOLOGIC TIME-The geologic time scale is based on evidence in the fossil record and has been shaped by mass extinctions. Divisions of Geologic Time

A. Earth has existed for more than _____.
B. From the beginning of Earth to about 542 million years ago is often referred to as Precambrian time.
C. From the end of Precambrian time to the present, Earth's history is divided into three eras: the Paleozoic Era, the Mesozoic Era, and the Cenozoic Era.
D. These three eras are further divided into periods.
E. Humans appeared during the Quaternary Period.

IX. Mass Extinction When large numbers of species become extinct, the event is called a _____. The fossil record shows _____ mass extinctions in Earth's history. Evidence indicates that worldwide geologic and weather changes are common factors that contribute to mass extinctions.

A. Mass extinctions may have contributed to overall _____ on Earth.
B. After a mass extinction, opportunities open for new life-forms to emerge.
C. Mass extinctions have been used to mark the divisions of geologic time.
D. Large mass extinctions mark the boundaries between _____
E. Smaller mass extinctions mark the divisions between _____

HOMEWORK DATE DUE_____

CH 19 SEC 1

1. Why do scientists think that RNA may have been the molecule that first carried genetic information?

2. How do scientists think the first organic compounds formed?

3. How did Miller and Urey add energy to the mixture of chemicals in their device?

4. What were two kinds of complex organic molecules that formed during the Miller-Urey experiment?

5. The compounds that Miller and Urey used in their experiment were probably not found on early Earth. Why are the results of their experiment still useful today?

6. What are two possible places that the organic molecules on Earth could have come from?

7. According to scientists, what two types of structures may have been the first steps toward the formation of cells?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION_____

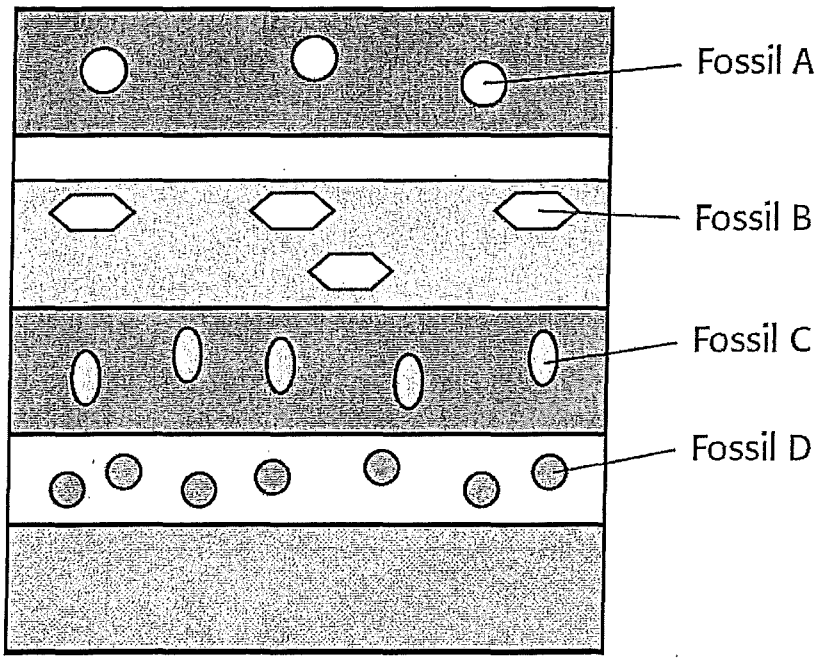
ANSWER_____

HOMEWORK DATE DUE

CH 19 SEC 2

1. How does the fossil record provide evidence that evolution has occurred?

2. The diagram below shows several rock layers that contain fossils. Which fossil is probably the oldest? Which fossil is probably the youngest?



3. How is the fossil record related to the geologic time scale?

BELLRINGER QUESTION CIRCLE M T W TH FRI DATE

ANSWER

HOMEWORK DATE DUE

CH 19 SEC 3

1. What type of organism was probably one of the first prokaryotes to evolve?

2. Where did most of the oxygen in Earth's atmosphere probably come from?

3. How did the increasing amounts of oxygen in Earth's atmosphere allow organisms to live on land?

4. Why do scientists think that mitochondria and chloroplasts evolved through endosymbiosis? Give two reasons.

5. Name three kinds of organisms that evolved during the Paleozoic Era.

6. Name three kinds of organisms that evolved during the Mesozoic Era.

7. Name two kinds of organisms that are dominant in the Cenozoic Era.

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

Chapter 19 review

1. What are microspheres?
2. The age of Earth is estimated to be about _____
3. What is relative dating?
4. What is absolute dating?
5. The geologic time scale is based on _____.
6. What do mass extinctions determine ?
7. Cyanobacteria changed the young Earth's atmosphere by producing

   _____
8. Pre-eukaryotic cells lacked _____
9. What is endosymbiosis?
10. A layer of ozone in the atmosphere was critical to the formation of life on land because

    _____
11. The first organisms to populate the surface of the land were _____
12. All of the major phyla of animals on Earth today are _____
13. While there was no soil present, plants were able to invade the surface of the ancient Earth

    because they _____
14. The first animals to invade the land were the _____
15. Arthropods were successful first where, then where?
16. Two-thirds of all terrestrial life disappeared in the last mass extinction approximately

    _____years ago

History of Earth Timeline Lab

Procedures:

1. Read Chapter 19- History of Life. Using the timeline, have 22 cards or toilet paper sized pieces of paper with the designated events found in the coloring sheets. You may draw or color pictures to describe what was happening and have how many millions of years ago it occurred.
2. You will use a roll of toilet paper to create a timeline. Assuming that the roll of toilet paper has 500 sheets, determine the millions of years each square represents. The earth is approximately 5 billion (5000000000) years old. Divide 5 billion by the number of squares you have in your roll.
3. Tape the beginning of the roll to the farthest point in the hall.
4. You will put the events in order by taping the correct card to the toilet paper at the appropriate point in the timeline.
5. In order to complete the lab in time, each lab group will have a designated person for each- one to measure, one to put the cards on the roll, one person to do any mathematical calculations to find the distance between each event and one person to read the timeline for the correct order.
6. When you are finished, I will check your work for accuracy.
7. Answer the questions following.

Questions

1. In your own words, summarize how long photosynthesis has been on earth. What impacts has photosynthesis had besides helping plants.

   _____
   _____
   _____

2. Do you believe humans are finished evolving? What do you base this answer on?

   _____
   _____
   _____

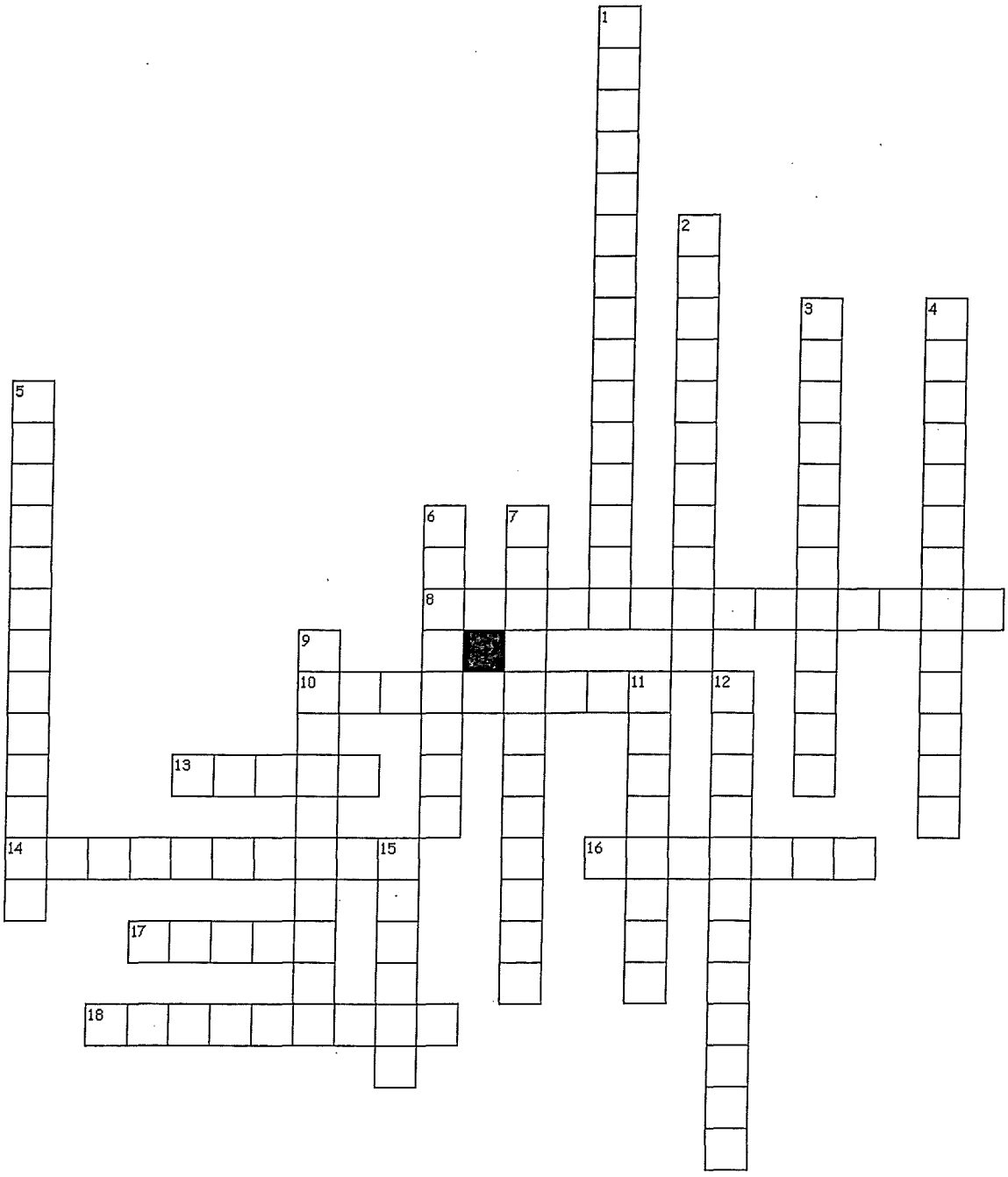
3. Looking at the rate of mass extinctions prior to now, is there a regular period that these occur?

   _____
   _____
   _____

4. Knowing that 99% of all species are now extinct how does this timeline help put this in perspective- what do you notice about the rate of evolution and extinction.

   _____
   _____
   _____

Ch 20 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard for each term with the word on one side and the definition on the back



Across

8. the transfer of genetic material in the form of DNA fragments
10. a thick-walled structure that forms inside bacteria and resists harsh conditions
13. viral replication that results in the destruction of a host cell and the release of many new virus particles
14. a substance that can inhibit the growth of or kill some microorganisms
16. a circular DNA molecule in bacteria
17. a substance that is produced by one organism that is poisonous to other organisms
18. viral replication in which a viral genome is replicated as a provirus without destroying the host cell

Down

1. a four-stage procedure for identifying a pathogen
2. a type of sexual reproduction in which two cells join to exchange DNA
3. a prokaryote that has a small amount of peptidoglycan in its cell wall, has an outer membrane, and is stained pink during Gram staining
4. a virus that infects bacteria
5. a protein-carbohydrate compound that makes the cell walls of bacteria rigid
6. an organism or virus that causes disease; an infectious agent
7. a prokaryote that has a large amount of peptidoglycan in its cell wall and is stained violet during Gram staining
9. the ability of an organism to tolerate a chemical or disease-causing agent
11. a membranelike layer that covers the capsids of some viruses
12. the transfer of DNA from one bacterium to another through a virus
15. a protein sheath that surrounds the nucleic acid core in a virus

plasmid a circular DNA molecule in bacteria

Ch 20
Vocabulary Review

In the space provided, write the letter of the term or phrase that best completes each sentence or answers each question.

_____ 1. Which of the following is a protein-carbohydrate compound found in bacterial cell walls?
a. peptidoglycan b. plasmid c. Gram-negative

_____ 2. A small extra loop of DNA is a
a. pilus. b. chromosome. c. plasmid.

_____ 3. A bacterial structure that can survive environmental stress is a(n)
a. endospore. b. plasmid c. toxin.

_____ 4. Bacteria that stain pink with a Gram stain are
a. Gram-positive. b. Gram-negative. c. archaea.

_____ 5. A process in which two organisms exchange genetic material is called
a. conjugation. b. binary fission. c. transformation.

_____ 6. A process in which bacteria take up DNA from their environment is called
a. conjugation. b. transduction. c. transformation.

_____ 7. Bacteria that stain purple with Gram stain are
a. Gram-positive. b. Gram-negative c. archaea.

_____ 8. A process in which DNA is transferred from a virus to a bacterium is called
a. binary fission. b. conjugation. c. transduction.

Using the word bank below, fill in each blank provided.

bacteriophages	envelope	lytic cycle
capsid	lysogenic cycle	

Pieces of nucleic acid contained in a protein coat are called viruses. The protein coat, or (9) _____, may enclose RNA or DNA, but not both. Many viruses have a membrane, or (10) _____, that gives the virus a spherical shape and helps the virus enter a cell. Viruses that infect bacteria are called (11) _____. Viruses cause damage when they replicate inside cells many times. When the viruses break out, the cell is destroyed. The cycle of infection, replication, and cell destruction is called the (12) _____ _____. Sometimes, a virus becomes part of the host DNA and remains in the host cell for a long period of time. This process is called the (13) _____ _____.

Using the word bank below, fill in each blank provided.

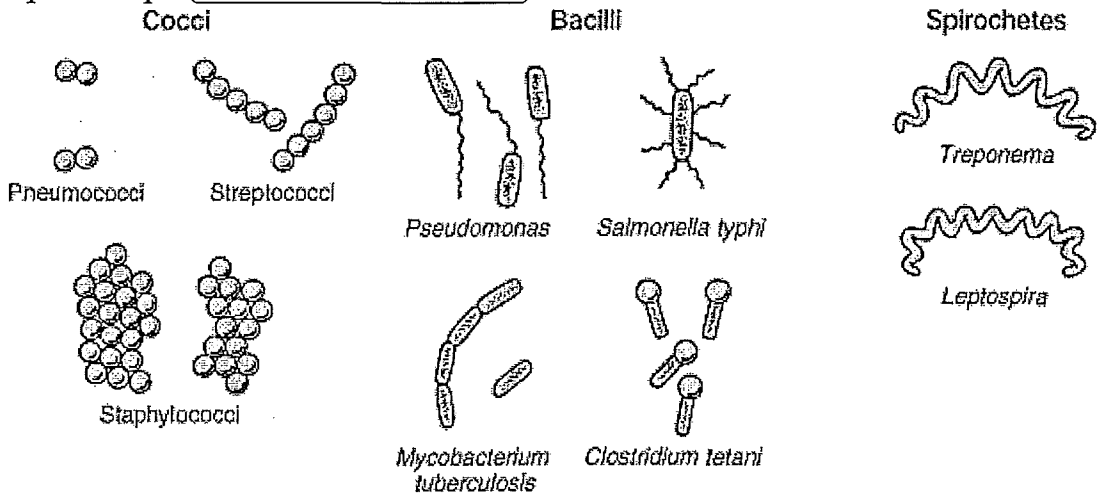
antibiotics	pathogens	toxins
Koch's postulates	resistance	

Diseases are caused by agents called (14) _____. The four-step procedure that is used to identify these agents is known as (15) _____. Bacteria cause disease in two ways. They destroy body tissues, or they release poisonous (16) _____. Bacteria that cause disease can be killed or prevented from growing by the use of chemicals called (17) _____. The overuse of these chemicals can cause (18) _____, which allows the bacteria to tolerate them.

Chapter 20 Bacteria and Viruses

I. Prokaryotes are divided into two major groups: the domain Archaea and the domain Bacteria. Prokaryotes are single-celled organisms that do not have membrane bound organelles. They are generally found in three shapes:

A. a rod shape (_____)
B. a sphere shape (_____)
C. spiral shape (_____).

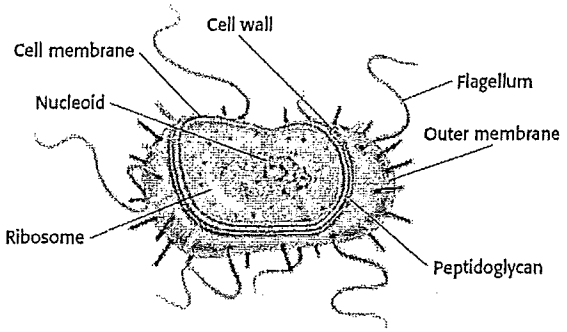


II. Domain Archaea- _____ are found in many places, including extreme environments such as salt lakes and hot springs. Archaea are structurally very different from Bacteria. Some Archaean molecules are more similar to those found in eukaryotes. Others are unique among living organisms.

III. Domain Bacteria – Most known prokaryotes are members of the domain Bacteria. Bacteria can be found virtually everywhere. One square inch of skin has an average of 100,000 bacteria!

IV. BACTERIAL STRUCTURE-. Bacteria have genetic material in the form of DNA (circular). Bacteria often have small extra loops of DNA called _____.

A. Bacteria have ribosomes and many types of enzymes.
B. Bacterial cell membranes are lipid bilayers. Outside the cell membrane, bacteria have rigid cell walls that can be one or two layers thick.
C. The bacterial cell wall is made of a protein-carbohydrate compound called _____ and may also include a membrane covering the peptidoglycan layer.



E. coli is a common bacterium that lives in the intestines of humans.

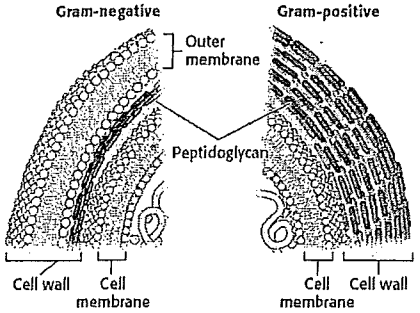
V. GRAM STAINING- The presence of this membrane allows biologists to group bacteria into two categories using a technique called the Gram stain.

A. Gram-Positive Bacteria-usually less dangerous

1. The first dye is dark purple. Gram-positive bacteria trap the dark purple dye because their peptidoglycan layer is very thick.
2. The second, pink dye is also absorbed, but it cannot be seen because the purple dye is much darker. As a result, Gram-positive bacteria appear _____ after staining.

B. Gram-Negative Bacteria- _____ bacteria

1. The thin peptidoglycan layer of Gram-negative bacteria does not trap the purple dye.
2. When the pink dye is added, it is absorbed by the cell. Because the pink dye is the only dye present in Gram-negative bacteria, they appear _____ after staining.
3. The outer membrane of Gram-negative bacteria makes them more resistant to host defenses and to medicines.



Gram-negative bacteria have an outer membrane but Gram-positive bacteria do not.

VI. OBTAINING ENERGY AND NUTRIENTS-Grouping prokaryotes based on their energy source separates them into photoautotrophs, chemoautotrophs, and heterotrophs.

A. Photoautotrophs- Organisms that get their energy from sunlight through _____ are called photoautotrophs.

1. These bacteria include purple _____ bacteria, green sulfur bacteria, and _____.
2. Green and purple sulfur bacteria can grow only in _____-free environments.
3. _____ are abundant today and are a major component of the _____ that floats in the oceans. They produce a great deal of our oxygen and probably formed Earth's oxygen atmosphere.

B. Chemoautotrophs

1. Prokaryotes called chemoautotrophs are the only organisms that can get their energy from inorganic sources.
2. They use molecules that contain _____ or _____ and simple organic molecules to obtain energy.
3. In the presence of hydrogen-rich chemicals, chemoautotrophic bacteria can form all of their own amino acids and proteins.

C. Heterotrophs

1. Most prokaryotes are _____ and get both their energy and their nutrients from other organisms.
2. Most absorb nutrients from dead organisms, but some are _____ or _____.
3. Many heterotrophic bacteria live in the presence of oxygen, but some can live without it.

VII. REPRODUCTION AND ADAPTATION-Prokaryotes reproduce by binary fission; exchange genetic material through conjugation, transformation, and transduction; and survive harsh conditions by forming endospores.

A. BINARY FISSION-Prokaryotes usually reproduce _____ by binary fission. In this process, a single cell divides into two identical new cells. Mutations do occur during prokaryotic reproduction, and new forms emerge frequently.
B. There are three ways that prokaryotes can form new genetic combinations.

1. _____ occurs when two bacteria exchange genetic material._____ often convey antibiotic resistance.
2. _____ occurs when bacteria take up DNA fragments from their environment.
3. _____ occurs when genetic material, such as a plasmid, is transferred by a _____.

C. ENDOSPORES-Some bacteria survive harsh conditions by forming thick-walled structures called endospores.

1. _____ form inside the bacteria. They surround the DNA and a small bit of cytoplasm.
2. Endospores can survive _____, _____, and _____. They show no signs of life and can be revived after hundreds of years.

VIII. VIRUS- Viruses are not considered living because they are missing key characteristics of living organisms.

A. Viruses do have genetic material, but they cannot _____ on their own.
B. Viruses reproduce by infecting cells. Viruses use the cell's ribosomes, ATP, enzymes, and other molecules to make more viruses.
C. Viruses do not grow. Instead, they are assembled into their full size within a cell.
D. Viruses do not carry out any _____ activities, do not have any cytoplasm or organelles, and do not maintain _____

Virus	Disease	Symptoms
Influenza virus	flu	fever, headache, tiredness, muscle aches, cough
Varicella zoster virus	chickenpox, shingles	fever, tiredness, itchy or painful blisters
Measles virus	measles	fever, cough, runny nose, pink-eye, a rash that covers the body
Mumps virus	mumps	fever, headache, muscle aches, tiredness, loss of appetite, swelling of salivary glands
HIV virus	HIV infection/AIDS	early symptoms: fever, tiredness, swollen lymph nodes; later symptoms: weight loss, infections, death
Human papillloma virus	HPV infection, cervical cancer	usually no symptoms; occasionally genital warts; can cause cervical cancer
Hepatitis B virus	hepatitis, liver cancer	jaundice, tiredness, abdominal pain, nausea, joint pain, liver disease, liver cancer, death
West Nile virus	West Nile virus infection	fever, headache, bodyache; in rare cases coma, numbness, and paralysis

IX. VIRAL STRUCTURE-All viruses have nucleic acid and a capsid. There are 2 types

A. DNA Viruses

1. The genetic material of a DNA virus can become _____ into the host cell's DNA or may remain separate.
2. The virus makes copies of its DNA by using the host cell's enzymes and nucleotides.
3. Viral DNA also directs production of mRNA and proteins that are assembled into new viruses.

B. RNA Viruses

1. Reproduction of RNA viruses can occur by one of two methods.
2. In one method, the viral RNA may be used directly to make mRNA, which is used to make more viral RNA.
3. In the second method, the viral RNA is transcribed into DNA, _____ into the host cell's DNA, and then transcribed into viral mRNA.
4. Viruses that use this method of reproduction are called _____

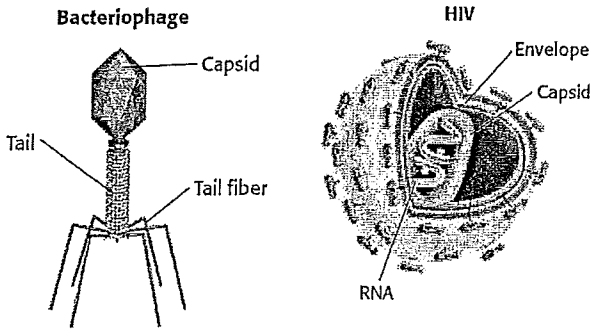
X. PARTS OF A VIRUS

A. _____- The protein coat, or capsid, of a virus encloses its genetic material. Viruses recognize their hosts by specific proteins on a host cell's surface. The

proteins on the host cell must match proteins on the capsid of the virus, as a key matches a lock.

B. _____- Many viruses, such as HIV, have a membrane, or envelope, surrounding the capsid. The envelope gives the virus an overall spherical shape, but the capsid can have a very different shape. The envelope is made of proteins, lipids, and glycoproteins, which are proteins with attached carbohydrate molecules.

C. _____- Viruses that infect bacteria are called bacteriophages or just phages. Phages have a complicated structure. A T2 bacteriophage, for example, has a capsid attached to a tail with tail fibers. A long DNA molecule is coiled within the polyhedron. The tail and tail fibers function like a tiny syringe, which injects the viral DNA into its bacterial host.



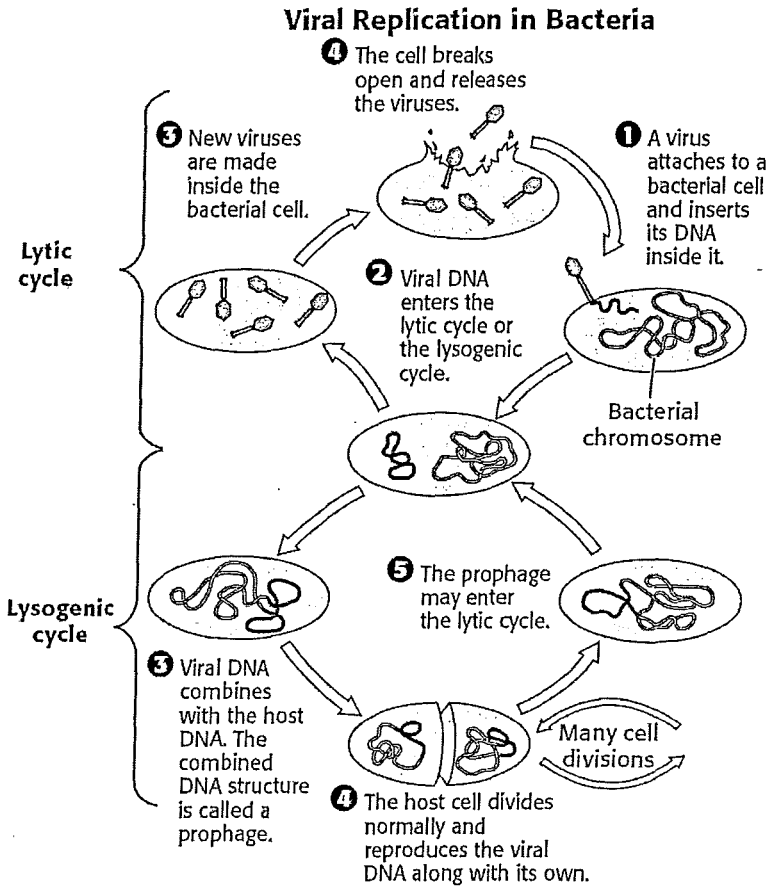
XI. REPRODUCTION- Viruses can reproduce by a lytic life cycle and a lysogenic life cycle. A viral infection begins when the genetic material of a virus enters a host cell. Once inside the cell, a virus can reproduce by two different processes.

A. Lytic Cycle- The cycle of viral infection, reproduction, and cell destruction is called the _____.

1. Viral genetic material that enters a cell remains separate from the host cell's DNA.
2. The virus uses the host cell's organelles, enzymes, and raw materials to replicate the virus's DNA and to make viral proteins. The proteins are assembled with the replicated viral DNA to form complete viruses.
3. The host cell _____ _____, releases newly made viruses, and dies. The new virus particles can infect other host cells.
4. Viruses that reproduce only by the lytic cycle are often called virulent.

B. Lysogenic Cycle- When viral DNA becomes part of its host cell's DNA, the virus is called a _____.

1. When the host cell replicates its own DNA, the cell also replicates the _____. New cells are produced that contain the provirus. Many cells may be produced that contain the viral DNA.
2. New virus particles are not assembled, and the host cell is not _____.
3. This process is called the _____ cycle. After days, months, or even years, the provirus may leave the host's DNA and enter a lytic cycle.
4. If the virus never enters the lytic cycle, it may become a permanent part of its host's genome.
5. A virus whose reproduction includes the lysogenic cycle is called a temperate virus.



XII. VIROIDS AND PRIONS-Viroids and prions are molecules that are able to reproduce and cause disease.

A. _____- A viroid is a single strand of RNA that has no capsid. The RNA of viroids is much smaller than that of viruses. Viroids can replicate inside a host's cell to make new viroids. Viroids cause abnormal development and stunted growth in plants.

B. _____- Prions are nonfunctioning, misshapen versions of proteins. They attach to normal proteins that are found in the brain. The misfolding spreads like a chain reaction and destroys brain tissue. Prions can be transmitted by eating food contaminated with infected brain tissue.

XIII. ROLES OF BACTERIA AND VIRUSES- Bacteria play important roles in the environment and in industry. Both bacteria and viruses are important in research.

A. Bacteria play a vital role in all of Earth's ecosystems by producing oxygen, making nitrogen available, and decomposing organisms. Many form important symbiotic relationships.

B. Bacteria are important in a variety of industries such as food production, chemical production, mining, and environmental cleanup.

XIV. KOCH'S POSTULATES AND DISEASE TRANSMISSION- The four main steps in Koch's postulates are finding and isolating the pathogen, growing the pathogen, infecting a healthy animal, and then isolating the same pathogen. German physician Robert Koch developed a technique for diagnosing the cause of an infection. Koch's four-step procedure, known as Koch's postulates, is still used today to identify a disease-causing agent, or pathogen.

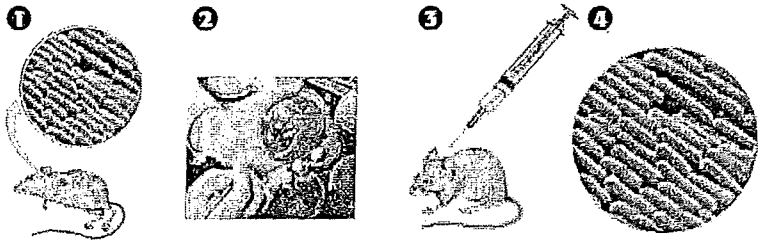
A. Step 1: The pathogen must be found in an animal with the _____ and not in a healthy animal.
B. Step 2: The pathogen must be _____ from the sick animal and grown in a laboratory culture.
C. Step 3: When the isolated pathogen is injected into a healthy animal, the animal must _____ the disease.
D. Step 4: The pathogen should be taken from the second animal, grown in the lab, and shown to be the _____ as the original pathogen.

1. Diseases that can spread from person to person are considered _____.
2. Some contagious diseases must be transmitted directly from one host to another by contact.
3. Other diseases can survive outside a host for a period of time. These diseases can be transmitted through the air, in contaminated food or water, or on contaminated objects.

Koch's Postulates

❶ Finding the Pathogen
The pathogen must be found in an animal that has the disease. It must not be present in healthy animals.

❷ Growing the Pathogen
The pathogen must be taken from an animal that has the disease and grown in a laboratory culture.



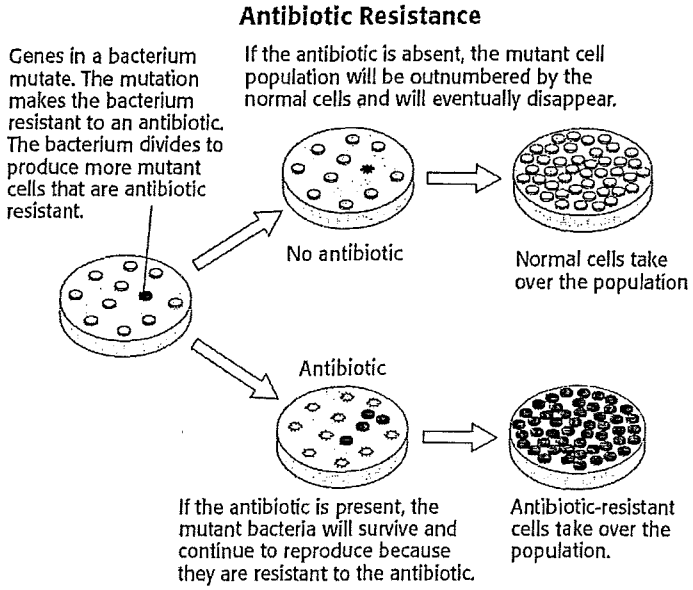
❸ Infecting a Healthy Animal
The pathogen from the laboratory culture is injected into a second animal that is healthy. The second animal must develop the same disease as the first animal.

❹ Finding the Same Pathogen
The pathogen must be taken from the second animal and grown in a laboratory culture. This pathogen culture must be the same as the pathogen culture from the first animal.

XV. BACTERIAL DISEASES-Bacteria can cause disease by producing toxins and by destroying body tissues. The most common way that bacteria cause disease is by producing poisonous chemicals, called toxins. _____ may be released or stored inside the bacteria until the bacteria die. A second way that bacteria cause disease is by producing _____ that break down the host's tissues into nutrients that the bacteria can use.

XVI. ANTIBIOTIC RESISTANCE-Antibiotic resistance spreads when sensitive populations of bacteria are killed by antibiotics. As a result, resistant bacteria thrive.

A. Antibiotic resistance is the ability of bacteria to _____ antibiotics. Mutations for antibiotic resistance arise naturally and often in bacteria.
B. Plasmids containing antibiotic-resistance genes can pass between bacteria during conjugation.
C. When the antibiotic is present, vulnerable bacteria are killed. Resistant bacteria survive and reproduce. In this way, antibiotic-resistant bacteria become the _____ type in the population.



XVII. VIRAL DISEASES-Because viruses enter host cells to reproduce, it is difficult to develop a drug that kills the virus without harming the living host.

A. Viruses can be transmitted by any action that brings virus particles into contact with a host cell.
B. Many symptoms of a viral infection, such as aches and _____, result from the body's _____ to infection.
C. Many viral diseases can be prevented through _____. A vaccine is a weakened form of a pathogen that prepares the immune system to recognize and destroy the pathogen.

XVIII. EMERGING DISEASES-_____ diseases are infectious diseases that are newly recognized, that have spread to new areas or a new host, or that have reemerged when a disease that was once considered under control begins to spread.

A. Diseases can spread to new areas or a new host when people come into contact with a pathogen in a different way than in the past.
B. Environmental changes can cause diseases to emerge.
C. Human _____ plays an important role in emerging disease.

Benefit To	Description
Ecosystems and other organisms	• Bacteria produce oxygen, make nitrogen available to plants, and decompose dead organisms. • Many bacteria form relationships that benefit other organisms. For example, bacteria inside the large intestines of humans produce vitamin K.
Industry	• Bacteria are used to make foods such as pickles, soy sauce, and sourdough bread. • Bacteria are used to produce certain chemicals. • Mining companies use bacteria to extract valuable minerals, such as copper. • Bacteria are used to clean up oil spills and to clean the water in sewage treatment plants.
Scientific research	• Bacteria and viruses are used in genetic research. They provide information about DNA replication, transcription, and translation. • Viruses are used to deliver genetic material directly to target cells.

HOMEWORK DATE DUE_____

CH 20 SEC 1

1. What are the two major domains of prokaryotes?

2. Describe two ways in which the structure of Gram-positive bacteria is different from that of Gram-negative bacteria.

3. What are chemoautotrophs?

4. If eight bacterial cells each undergo binary fission, how many bacterial cells will result?

5. How do endospores help bacteria survive harsh conditions?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION_____

ANSWER_____

HOMEWORK DATE DUE

CH 20 SEC 2

1. Summarize Use the words "yes" and "no" to indicate whether each property listed below describes living things, viruses, or both.

PROPERTY	LIVING THINGS	VIRUSES
Made of cells		
Have genetic material		
Can grow		
Can reproduce on their own		
Can only replicate DNA inside host cells		

2. What two structures do all viruses have?

3. What structures help a bacteriophage inject its DNA into a bacterium?

4. Describe three ways in which the lysogenic cycle and lytic cycle are different.

5. When a host cell divides in the lysogenic cycle, what genetic material does each new cell receive?

6. What is a prion and how does it cause disease?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

HOMEWORK DATE DUE

CH 20 SEC 3

1. What are three ways in which bacteria benefit ecosystems?

2. What is the second step in Koch's Postulates?

3. What are two ways that bacteria cause disease?

4. Why are some diseases that were once easy to treat with antibiotics now more difficult to treat?

5. Why are viral diseases difficult to cure?

6. What has caused diseases such as whooping cough, measles, and diptheria to reemerge?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

Name _____ Date _____ Class _____

Concept Mapping Viral Infections

Complete the events chain about how the lytic cycle and lysogenic cycle in viral infections are related. These terms may be used more than once: cytoplasm, dormant, exocytosis, genetic material, host cell, host cell chromosome, lysogenic cycle, lytic cycle, protein coat, viral genes.

A virus attaches to the
(1) _____.

↓

The (2) _____
of the virus enters the host's
(3) _____.

↙ ↘

In the (4) _____,
viral DNA enters the nucleus of the host cell.

↓

The viral DNA integrates into a(n)
(5) _____.

↓

Viral genes can remain
(6) _____ for
some time.

↓

Activation of the viral genes results in the
(7) _____.

In the lytic cycle, the host cell makes copies of viral DNA or RNA.

↓

The (8) _____
instruct the host cell to make viral protein capsids and viral enzymes.

↓

The (9) _____
forms around the nucleic acids of new viruses.

↓

New viruses leave the cell by
(10) _____ or by
causing the cell to lyse.

Bacterial Observation

There are millions of kinds of bacteria, yet bacteria only appear in a few basic shapes.

Procedure

1. Using a compound light microscope, observe prepared slides of bacteria.
2. Draw each type of bacteria that you see.

Analysis

1. **Describe** the shapes of the bacteria that you saw.

_____

_____

_____

2. **State** whether you saw a nucleus or organelles in any of the bacteria that you observed.

_____

_____

_____

3. **Predict** whether bacterial cells are larger or smaller than animal cells.

_____

_____

_____

Practice Staining Techniques

The parts (organelles) of a typical cell are mostly transparent. In a technique called staining, color is added to cell parts to help identify and distinguish them.

Procedure

1. Use forceps to remove a thin layer of onion skin, and place it in the center of a glass slide. Add a drop of water, and place a coverslip over the specimen.
2. Examine the onion skin with a light microscope. Draw what you see.

3. Place a drop of iodine stain along one edge of the coverslip. Touch a piece of paper towel to the opposite edge to draw the water. When the skin is stained, examine it with the microscope.

Analysis

1. **Describe** how the stain affected the onion skin.

2. **Critical Thinking** **Analyzing Information** What is the advantage of using the paper to draw the stain across the field of view?

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characteristics of bacteria

http://my.hrw.com/sh2/sh07_10/student/flash/visual_concepts/60414.htm

gram stainig

http://my.hrw.com/sh2/sh07_10/student/flash/visual_concepts/60419.htm

bacterial capsule

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prokaryotic cell

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pili

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chemoautotroph

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conjugation

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virus]

http://my.hrw.com/sh2/sh07_10/student/flash/visual_concepts/60443.htm

parts of as virus

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lytic cycle

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lysogenic cycle

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lytic lysogenic cycle

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comparison lytic lyso

bacteria and food

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Most Contaminated Place in the School Contest- Bacterial Staining

OBJECTIVES

- **Prepare** and **stain** smears of bacteria.
- **Practice** using sterile technique to avoid contaminating bacterial cultures.

MATERIALS

- paper towels
- microscope slides (3)
- culture tubes of bacteria (3)
- sterile cotton swabs
- beaker, 150 mL
- methylene blue stain in dropper bottle
- 70% isopropyl alcohol
- pencil, wax
- Bunsen burner with striker
- test-tube rack
- forceps or wooden alligator-type clothespin
- water, 75 mL
- microscope, compound

Procedure

1. Put on safety goggles, gloves, and a lab apron.

2. **CAUTION: Alcohol is flammable. Do not use alcohol in the room when others are using a Bunsen Burner.** Use alcohol and paper towels to clean your lab table and gloves. Allow the table to air-dry.
3. **CAUTION: Microscope slides are fragile and have sharp edges.** Use a wax pencil to label three microscope slides "A," "B," and "C."

4. **CAUTION: I will not allow you near the flames- please stay back and have slides ready.**

PRE-LAB:

1. You will prepare your bacterial culture prior to Monday's lab. In order to see where you may personally be exposed to bacteria, I will allow you to go to your shops to culture objects.
2. You will only have one petri dish per lab group. You may break this down into quarters by using a wax pencil on the underside of the petri dish (where agar is). You must also write both science numbers. Do not use any other type of marker these dishes must go into the incubator. Failure to follow this may result in melting of the dish and a ZERO for the lab.
3. Use a sterile moistened cotton swab and move the cotton over your object of interest several times. Then rub the cotton gently on the agar in the designated area. Do not puncture or rip the agar as this will cause you to get zero growth
4. You do not need gloves for this part- these are objects that you touch every day.
5. Tape the top to the plate on 2 spots only and place with top closest to the table in the pepsi rack. Remember to have both of your science numbers on the plate.
6. You will be observing the growth of the colonies and the bacteria over the course of the week. **You will complete the observation sheets for each day.** If you do not finish the observations during the class time that day, you must come after school or during lunch. NO EXCEPTIONS

PART A: MAKING A SMEAR

5. Normally, the following is the procedure for making bacterial smears. You must be familiar with this procedures for the state test. Remove the cap from culture tube. **Keep the cap in your hand.** To avoid polluting your bacterial culture, do not place the cap on the table or other surface.
6. Pass the opening of the tube through the flame of a Bunsen burner to sterilize (clean thoroughly) the end of the culture tube.
7. Use a sterile swab to collect a small sample of bacteria. Do this by lightly touching the tip of the swab to the bacterial culture.
8. Pass the opening of the tube through the flame again. Replace the cap.
9. Make a smear of bacterial culture A by rubbing the swab on the slide. Spread a thin layer of culture over the middle of the slide. Cover about half of the slide and allow it to dry.
10. Throw out the swab in a proper container.
11. Repeat steps 5 through 10 for cultures B and C.

PART B: STAINING BACTERIA

12. Again, you will not be going near an open flame ,but you must be familiar with the proper procedure. You can read this or watch me. Using microscope slide

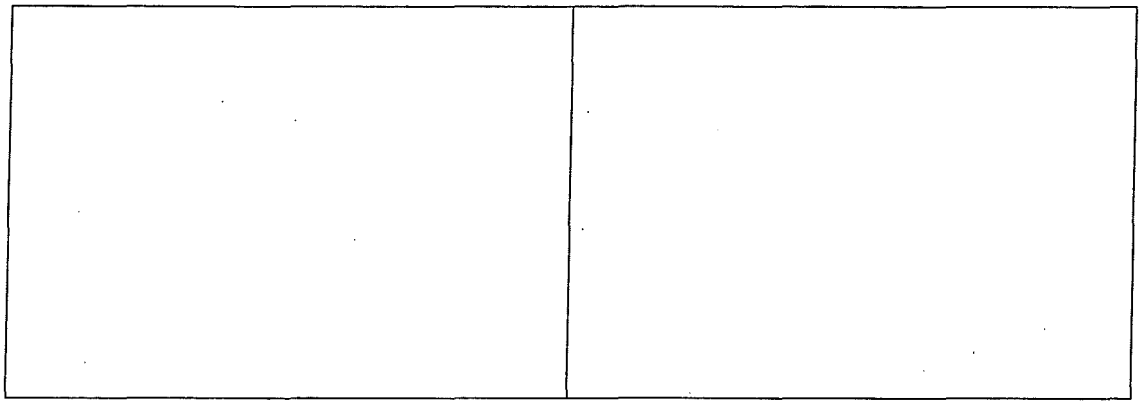
forceps, pick up each slide one at a time, and pass it over the flame several times. (Hint: Do not hold the slide constantly over the open flame.) Let each slide cool.

13. Using microscope slide forceps, place one of your slides across the top of a 150 mL beaker half-filled with water.
14. **CAUTION: Methylene blue will stain your skin and clothing.** Place 2 to 3 drops of methylene blue stain on the dried bacteria. Do not allow the stain to spill into the beaker.
15. Let the stain stay on the slide for 2 minutes.
16. Dip the slide into the water in the beaker several times to rinse it. Gently pat the slide dry with a paper towel. Do not rub the slide.
17. Repeat steps 14 through 17 for your other two slides.
18. Allow each slide to completely dry before looking at your slides under the microscope.

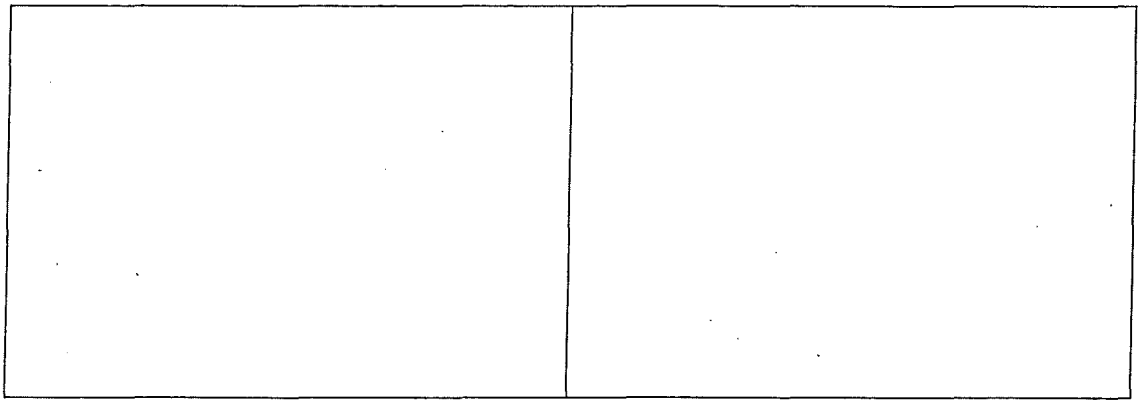
PART C: OBSERVING BACTERIA

19. Look at each slide under the microscope on low and high power. Make a sketch of a few cells that you see on each slide.

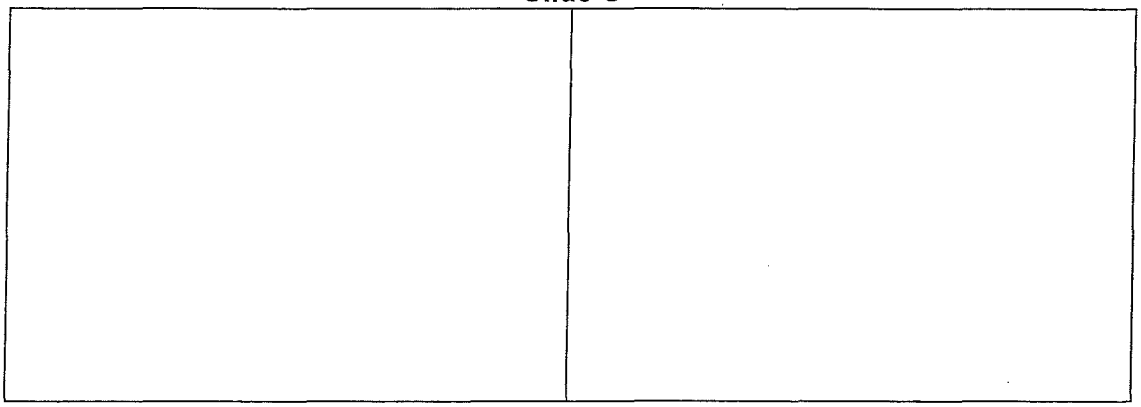
Slide A



Slide B



Slide C



20. Clean up your lab materials! You must clean and rinse your slides and put your microscopes on the back table.

Questions

1. Describe the shape of the cells of each type of bacteria that you looked at. How were the cells grouped?

2. How did you classify the bacteria in cultures A, B, and C: as coccus, bacillus, or spirillum?

3. Which were the easiest to identify? Which characteristics of the bacteria were must difficult to see. Be specific. Explain your answer.

Infectious Disease and Population Growth

How Does an Infectious Disease Spread?

An infectious disease is any disease caused by germs that can be spread from one person to another. Germs include viruses, bacteria and protozoa. What are some infectious diseases?

What are some diseases that are not infectious?

This activity will simulate the spread of an infectious disease. A simulation is a simplified demonstration of a real biological process. Our simulation will show how an infectious disease can spread from one infected person to other people, who in turn infect others.

Instructions

1. Your teacher will give everyone a cup filled with a clear solution. This solution represents your body. Only one person in the class will have a cup that has been "infected".

   Obviously, you should **not drink** from the cup. (In laboratory activities you should never drink or eat anything unless your teacher tells you that it is safe to do so.)

2. In this part of the activity, you will interact with two other students.

   To interact with another student, pour all of your solution into your partner's cup. Then have your partner pour all of the mixed solution back into your empty cup. Finally, pour half of the mixed solution back into your partner's empty cup.

   Wait for the signal from your teacher, and then move to another part of the classroom and interact with a second student. After you have finished your second interaction, return to your seat.

   Estimate how many people you think will be infected. _____

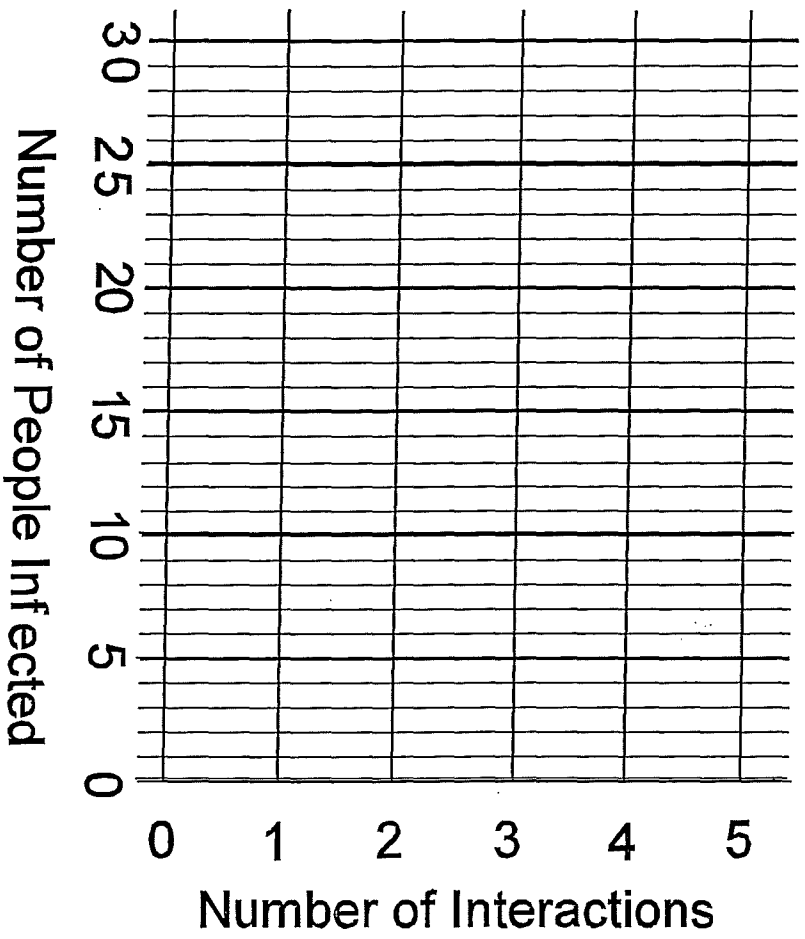
3. Your teacher will come around and put an "infection indicator" in your cup. If you have exchanged solutions with the original infected person or someone else after they became infected, you are now infected and your solution will turn pink. If you have not exchanged solutions with anyone who was infected, your solution will not turn color.

   Next, your teacher will ask everyone who is infected to raise their hand.
   How many people were infected? _____

4. You will do another set of interactions, again beginning with only one student with an infected cup. This time there will be three rounds of interactions. For each interaction, be sure to move to a different part of the room with different students.

   Estimate how many people you think will be infected after each student has interacted with three other students. _____
   After the teacher has come around with the indicator, write down how many people were actually infected. _____

5. Now you will graph how an infection spreads with increasing numbers of interactions.



First, plot a point to indicate that one person was infected before any interactions.

How many people would be infected after just one interaction? _____
Add this point to your graph.

Next, plot the number of people who were infected after two interactions (from 3 on page 1) and the number of people who were infected after three interactions (from 4 on pages 1-2).

Discussion

6. Did the number of people infected increase by the same amount for interaction 1, interaction 2, and interaction 3?
   Which interaction resulted in the smallest increase in the number of infected people?
   Which interaction resulted in the largest increase in the number of infected people?

   In each interaction, each infected person can infect one new person. Therefore an interaction that begins with more infected people will generally result in more new infections.

7. How many people do you think would be infected if you had four interactions? _____

8. How many people do you think would be infected if you had ten interactions? _____
   After the tenth interaction, would the rate of increase in the number of infected people become faster or slower? Explain why.

9. What are some ways that infectious diseases are transmitted from one person to another?

10. What are some ways you can prevent the spread of an infectious disease?

11. Our simulation showed the way a disease could spread if the spread of disease depends on person-to-person contact. Examples of this kind of disease include pink eye, chickenpox and herpes (lip sores). Other diseases, such as colds and tuberculosis, can be spread by germs in the air. How might the spread of these diseases differ from the spread of diseases that depend on person-to-person contact?

12. The spread of the disease in our simulation was very rapid. Multiple people were infected within a few minutes. In real life, infections do not spread as rapidly as in this simulation. Why is the spread of infections slower in real life?

13. In addition to exposure to germs or pathogens, what other factors influence your risk of getting an infectious disease? What defenses does your body have that can prevent you from getting sick, even when you have been exposed to a pathogen?

14. Once you have caught a cold or flu, you do not stay sick forever. How does your body eventually get rid of the viruses that cause a cold or flu?

15. A person who becomes infected with the HIV virus is not able to get rid of the HIV virus. With highly effective modern medical treatment, a person may survive a long time with an HIV infection, but an untreated HIV-infected individual is very likely to develop AIDS and die. Why is a person with an HIV infection unable to get rid of this infection the way a person can get rid of an infection with a cold or flu virus?

Population Growth

There are some interesting similarities between the spread of infectious diseases and population growth, e.g., the increase in the number of bacteria, plants or animals in a population. For example, in a growing population of bacteria, each bacterium can give rise to two new bacteria after about 30 minutes. This results in a doubling of the number of bacteria every 30 minutes, which is similar to the doubling in the number of infected people after the first and second rounds of interactions in the spread of infectious disease activity.

Suppose a single bacterium is placed on an agar plate and the number of bacteria in the population doubles every 30 minutes. How long do you think it would take before there would be 1000 bacteria?

To calculate how long it would actually take for the single bacterium to multiply to form a colony of 1000 bacteria, fill in the number of bacteria at each time in the table.

1	bacterium at the beginning
	bacteria after 30 minutes
	bacteria after 1 hour
	bacteria after 1 hour and 30 minutes
	bacteria after 2 hours
	bacteria after 2 hours and 30 minutes
	bacteria after 3 hours
	bacteria after 3 hours and 30 minutes
	bacteria after 4 hours
	bacteria after 4 hours and 30 minutes
	bacteria after 5 hours

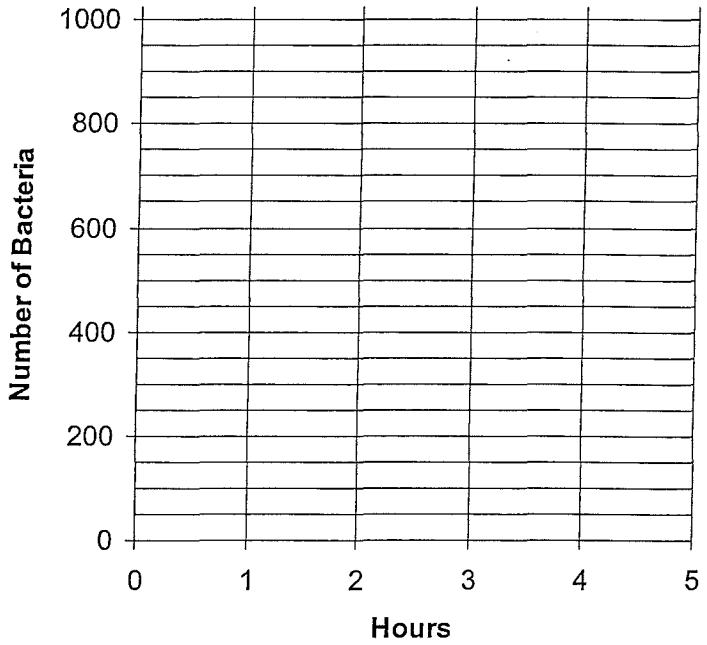
How long would it take for the population of bacteria to increase from 1 bacterium to 500 bacteria?

How long would it take for the population of bacteria to increase from 500 bacteria to 1000 bacteria?

Notice that, when a population doubles every 30 minutes, the number of bacteria in the population increases faster and faster as the population gets larger.

This kind of population growth is called **exponential growth.**

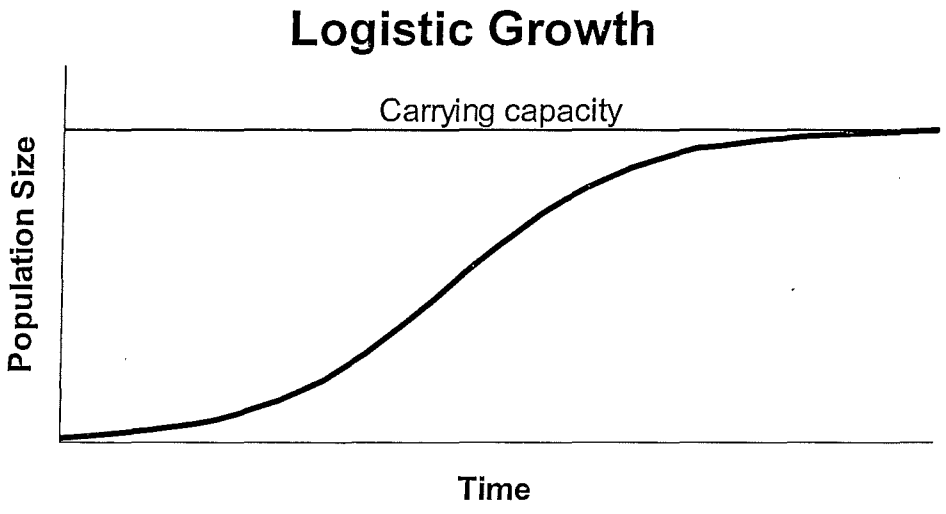
To see what exponential growth looks like in a graph, use the data from the above table to plot the number of bacteria at each time in the graph.



If exponential growth continued for 10 hours, the original single bacterium would increase to a population of over one million bacteria. This illustrates how exponential growth can result in very rapid increase of population size.

In the real world, no population of bacteria or any other biological organism can keep increasing exponentially forever. Why not?

All organisms require resources such as water and nutrients to grow and reproduce. The environment where a population is growing has only a limited amount of resources. As the population gets larger, there will not be enough resources to support continued rapid growth of the population. The rate of growth of the population will slow down, and finally the population will reach a maximum size which is called the **carrying capacity** of the environment. This type of **logistic growth** curve is illustrated in the following figure. The first part of a logistic growth curve looks like an exponential growth curve, but a logistic growth curve levels off as the population size approaches the _____ of the environment.



You will be creating a 3 dimensional model of a microbe that will be assigned to you. There will be viruses, bacteria, protists and some other disease causing eukaryotes. The model you make MUST be to scale.

1 nanometer = 1 inch

And be accurately represented (if it is octahedral, the model should not be round!)
The model must stay together on its own, be to scale and have a neatly **hand-printed 5 x 7** card with the information below printed on it and ATTACHED to the microbe- use a plastic bag, Chinese food container, etc. The rubric MUST be attached to the back of the card!!!
You may use any materials that you would like- clay, paper mache, Styrofoam, paper and glue, beads (for viuses) newspaper pulp, etc. I have the recipe for salt clay that you can make at home. I do not suggest play-doh because it falls apart too easily and you will lose points for this.

Name of Microbe
Kingdom, genus and species
Disease the microbe causes
Size of the microbe
Vector of transmission
**In bacteria only :Gram positive or gram negative
**In virus only, morphology (shape)
Environments that microbe is found
Symptoms of disease
Treatment/cure of disease (if any)
Prevention of transmission

NAME_____SCI#_____

POINTS	3	2	1	0
CONTENT	ALL INFO IS GIVEN IN COMPLETE SENTENCES AND IS ACCURATE	INFORMATION /DESCRIPTIONS NOT COMPLETE	SOME INFORMATION IS INACCURATE	MOST INFORMATION IS MISSING OR INCORRECT
NEATNESS	INFORMATION IS LEDGIBLY HAND PRINTED ON 5X7 INDEX CARD	WRITING IS SLOPPY OR INCORRECT LAYOUT IS USED	WRITING IS DIFFICULT TO READ OR IN CURSIVE, IMPROPER FORMAT OF INFO IS USED	WRITING IS NOT LEDGIBLE OR NOT PRESENT
REPRESENTATION OF ORGANISM	SIZE, SHAPE AND APPEARANCE ARE CORRECT	ONE OF THE THREE CATEOGORIES(SIZE, SHAPE,APPEARANCE) IS MISREPRESENTED	TWO OF THE THREE CATEOGORIES(SIZE, SHAPE,APPEARANCE) IS INACCURATE	ALL CATEOGORIES(SIZE, SHAPE,APPEARANCE) AREINACCURATE
PRESENTATION OF ORGANISM	MODEL IS COMPLETE WITH GOOD WORKMANSHIP	MODEL WAS NOT PLANNED WELL BUT ACCURATELY REPRESENTS ORGANISM	MODEL IS SLOPPY OR DOES NOT STAY TOGETHER	MODEL SHOWS POOR WORKMANSHIP AND/OR IS FALLING APART

TOTAL_____

Remember.....

To ace this project be sure to have completed each of the following:

Model is to scale *(1 nanometer = 1 inch)*

Model is accurately represented

Model is made so it stays together on its own

Hand printed 5 x 7 card is attached to the microbe model

Hand printed 5 x 7 card has the rubric attached to the back of it

Hand printed card has all the necessary info on it *(look at example carefully)***

Student Guide
Are You Cavity Prone?

In this exercise, you will determine your susceptibility to dental cavities.

DIRECTIONS

1. Obtain a paraffin block, sterile petri dish, sterile pipet, and Snyder test agar tube.
2. Place the Snyder test agar tube into the water bath just long enough to liquify the agar. Remove the tube and allow it to cool to 50° C, which feels comfortably hot to the touch.
3. To remove bacteria from the teeth, soften a piece of paraffin under the tongue. *Chew for three minutes,* moving the paraffin from side to side. Do not swallow the saliva: as it accumulates, deposit it into the sterile petri dish. Keep the lid of the sterile petri dish closed at all times except when depositing saliva. At the end of three minutes, deposit all the accumulated saliva into the petri dish. Discard the paraffin.
4. Remove a pipet from the packaging, being careful not to touch the tip. Do not lay the pipet down.
5. Remove the cap from the Snyder test agar tube and flame the top of the tube over the Bunsen burner for a few seconds. With the sterile pipet, measure 0.25 ml saliva (Fig. 1), being careful not to introduce bubbles. Transfer the saliva to the Snyder test agar tube. Do not allow the pipet tip to touch the agar or the sides of the tube. Flame the mouth of the tube again. Replace the cap of the test tube. Discard the pipet, the petri dish, and saliva.
6. While the agar is still liquid, rotate the test tube between your palms to mix the saliva and the agar (Fig. 2).
7. Label your tube with your initials and the date. After the agar has solidified, place your tube in an incubator set at 37° C.
8. Record the date and time that you inoculated your tube (added bacteria from saliva) on the Student Data Sheet (Table 1).
9. Check the tube at 24, 48, 72, and 96 hours after inoculation. Observe the color of the agar to see if the bromocresol green indicator has turned yellow. Compare your tube with the negative (uninoculated) control tube. Record your results in Table 1.
10. After 96 hours, refer to Table 2 and determine your individual susceptibility to cavities.

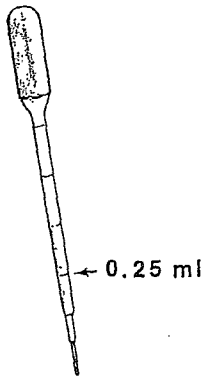


Figure 1 Proper amount of saliva to be inoculated into Snyder test agar tube.

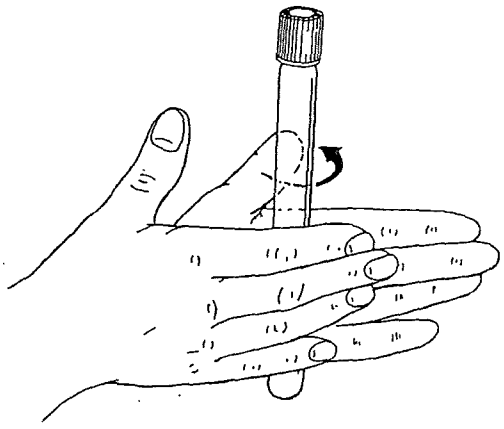


Figure 2 Proper method of mixing agar and saliva.

TABLE 1
Student Data Sheet

Date	Day	Hours from inoculation	Time	Color of agar	Results
	1	0		Green	None
	2	24			
	3	48			
	4	72			
	5	96			

Agar is green (no color change): –
Agar is yellow: +

TABLE 2
Cavity Susceptibility

	Incubation time (hours)			
Interpretation	24	48	72	96
Marked	+	+	+	+
Moderate	–	+	+	+
Slight	–	–	+	+
Negative	–	–	–	+
Negative	–	–	–	–

Agar is green (no color change): –
Agar is yellow: +

QUESTIONS

1. How did the results of your test compare to the number of dental cavities you have had?

2. How did the results of other students compare with your results?

3. What factors affect a person's susceptibility to dental cavities?

4. Which one of the factors does this experiment explore?

5. What was the purpose of the control tube in this exercise?

6. Name the ways to prevent tooth decay.

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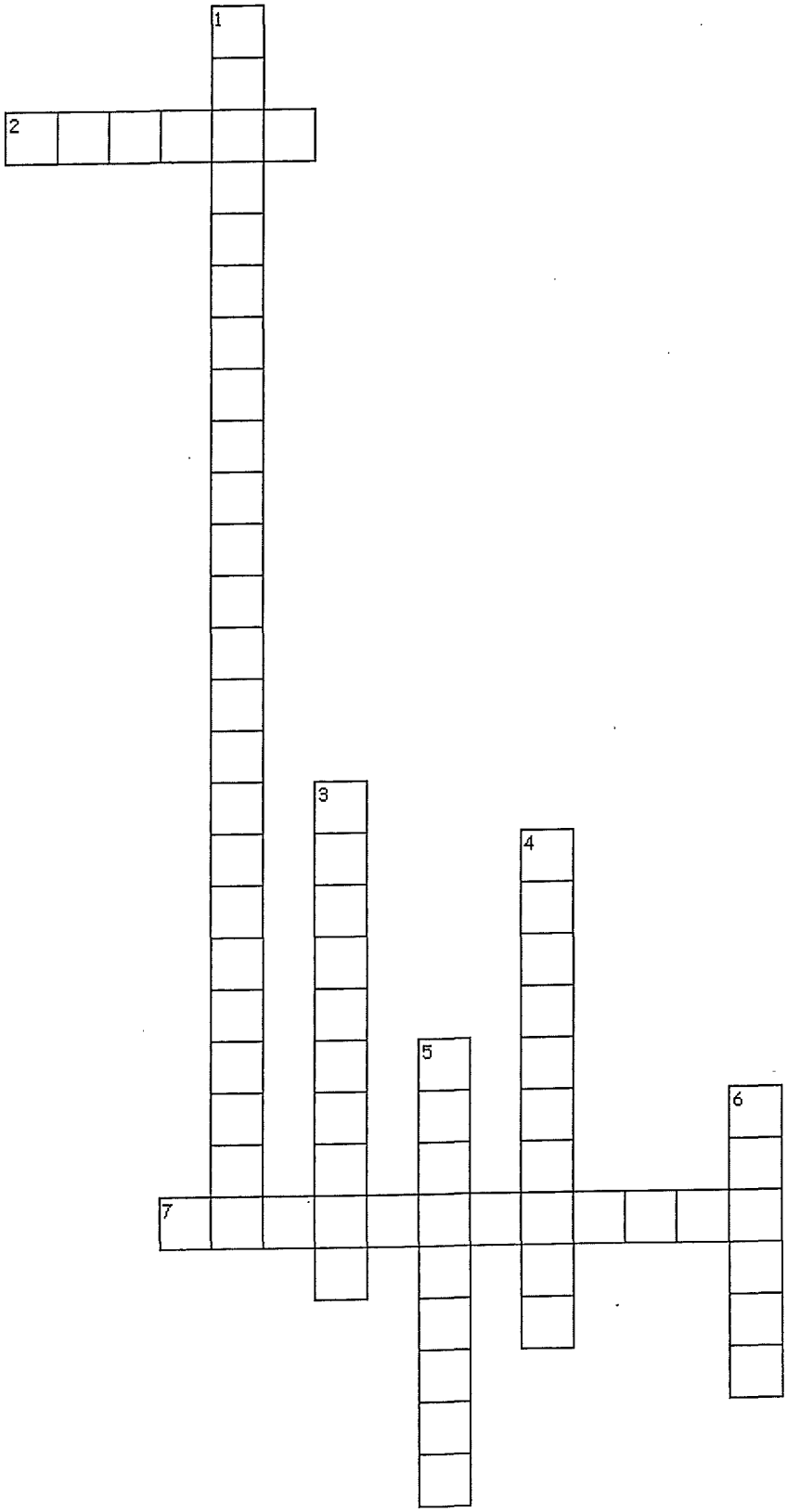
Ch 21 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard

for each term with the word on one side and the definition on the



Across

2. the cell that results from the fusion of gametes
7. a cytoplasmic extension that functions in food ingestion and movement

Down

1. within the life cycle of an organism, the occurrence of two or more distinct forms that differ from each other in method of reproduction
3. the multinucleate cytoplasm of a slime mold that is surrounded by a membrane and that moves as a mass
4. a rapid increase in the population of algae in an aquatic ecosystem
5. a thick-walled protective structure that contains a zygote
6. a haploid reproductive cell that unites with another gamete to form a zygote

Ch 21
Vocabulary Review

Using the word bank below, fill in each blank provided.

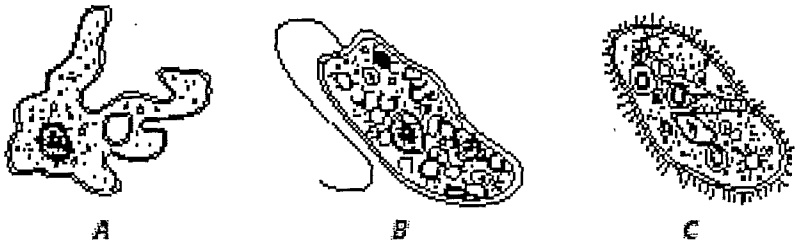
alternation of generations	holdfast	zygospore
gametes	red tide	zygote

1. A _____ is caused by a bloom of dinoflagellates.
2. Brown algae use a _____, a rootlike structure, to prevent being washed away by waves.
3. Many protists reproduce sexually when two _____ combine to form a _____.
4 The process of reproduction in which two distinct forms that differ in method of reproduction are produced is called _____.
5. A _____ can survive freezing, drying, and UV radiation.

Circle the term that best completes each sentence.

6. A (pseudopod, plasmodium, flagellum) is a mass of cytoplasm with many nuclei.
7. The side-by-side reproduction of two paramecia where nuclear material is exchanged is (mitosis, conjugation, binary fission).
8. (Sporozoans, Flagellates, Amoeboids) are protists that have no means of locomotion.
9. Paramecia use (a contractile vacuole, an oral groove, cilia) to remove excess water from the cell.
10. Amoebas engulf food particles with their (pseudopodia, vacuoles, oral grooves).
11. A (water mold, flagellate, sporozoan) caused the great potato blight in Ireland in the 1800s.

Questions 12–14 refer to the figures below, which show three single-celled organisms. Circle the term that best completes each sentence.



12. Organism A moves using flexible extensions called (pseudopodia, flagella, cilia).

13. Organism B moves by means of a (flagellum, tail, cilium).

14. Organism C moves by means of (cilia, pseudopodia, flagellum).

In the space provided, write the letter of the description that best matches the term.

_____ 15. blade	a. first stage of malaria parasite that infects the liver
_____ 16. algal bloom	b. diploid phase of multicellular algae
_____ 17. merozoite	c. overgrowth of protists in an aquatic environment
_____ 18. sporozoite	d. second stage of malarial parasite that infects red blood cells
_____ 19. test	e. leaflike structure in kelp
_____ 20. sporophyte	f. outer shell of an amoeboid protist

Chapter 21 Protists

I. CHARACTERISTICS OF PROTISTS -Protists are eukaryotic organisms that cannot be classified as fungi, plants, or animals.

A. Several important characteristics evolved in protists. Those characteristics include membrane-bound organelles, complex _____ and flagella, sexual reproduction with _____, and multicellularity.

B. Multicellularity allows cells to specialize, which in turn allows for the development of tissues, organs, and organ systems.

II. REPRODUCTION -Protists can reproduce asexually by _____, budding, and fragmentation. Protists can also reproduce sexually by fusion of gametes.

III. CLASSIFYING PROTISTS -The classification of organisms currently grouped in the kingdom Protista is likely to change as scientists learn more about how these organisms are related to each other and to members of other kingdoms. Molecular studies suggest that protists could be classified into up to 20 kingdoms.

IV. ANIMAL-LIKE PROTISTS - Animal-like protists ingest other organisms to obtain energy. Animal-like protists are often called *protozoa,* which means "first animals." All animal-like protists are unicellular, most can move, and most reproduce asexually by binary fission.

A. Amoeboid Protists - Amoeboid protists include a wide variety of organisms that move by using extensions of their cells called _____. Pseudopodia are also used to surround and engulf food particles.

B. Ciliates - Most or all of the body of a ciliate is covered by a tough yet flexible outer covering and short, hairlike structures called _____. Ciliates move and hunt for food by beating their cilia. Most ciliates are free-living and can be found in fresh water and salt water.

C. Flagellates - _____ are protists that have whip-like structures called *flagella.* Some flagellates also have cilia or form pseudopodia.

D. Sporozoans - Animal-like protists that form sporelike cells when they reproduce are called _____. Sporozoans lack flagella, cilia, and pseudopodia and thus do not move. All sporozoans are _____ and cause disease. Sporozoans reproduce both asexually and sexually.

Some Groups of Animal-like Protists		
Group and example	**Major structures**	**Other characteristics**
Amoeboids (*Amoeba proteus*) 	• pseudopodia to move and capture prey	• found in fresh water, salt water, and soils • most free-living; some parasitic
Ciliates (*Paramecium*)	• short, hair-like structures called *cilia* for movement and hunting for food • tough, flexible outer covering for protection	• typically free-living • found in fresh water and salt water
Flagellates (*Leishmania*)	• flagella (one or many) for movement • cilia for movement in some • pseudopodia for movement and catching prey in some	• many free-living; some parasitic • free-living species typically found in fresh water
Sporozoans (*Plasmodium*)	• spore-like cells for reproduction	• parasitic • cause disease • do not move

V. PLANTLIKE PROTISTS -Plantlike protists obtain energy through photosynthesis. Plantlike protists include the organisms commonly called *phytoplankton* and algae.

A. Diatoms - _____ are photosynthetic, unicellular protists with unique double shells. Their shells are made of silica or calcium carbonate and have distinct patterns. Diatom shells are like small _____ with lids. Diatoms tend to get smaller with each generation. When they reach a certain minimum size, they reproductive sexually and produces full-sized offspring.

B. Euglenoids - _____ are freshwater protists that have one or two flagella. Many euglenoids are photosynthetic. Some are both photosynthetic and heterotrophic. Others lack chloroplasts and ingest their food. Some have an _____, a light-sensitive organ that helps them move toward light.

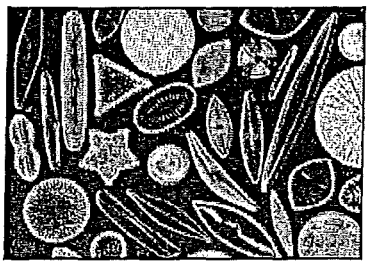
C. Dinoflagellates - _____ are unicellular protists that typically have two flagella. Most dinoflagellates are photosynthetic. Most dinoflagellates have protective coats that may contain silica. The _____ coats give dinoflagellates unusual shapes. As its flagella beat, a dinoflagellate spins through the water like a top.

D. Red Algae - Most _____ are multicellular. They are usually found in warm ocean waters. The pigments in red algae absorb blue light that penetrates deep into water. As a result, red algae are able to grow at greater depths than other algae are. Some red algae have calcium carbonate in their cell walls. These coralline algae play an important role in the formation of coral reefs.

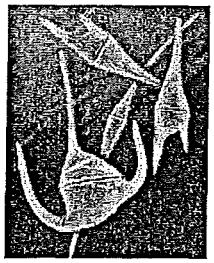
E. Brown Algae - _____ are multicellular protists that are found in cool ocean environments. The largest brown algae are kelp that can reach 60 m (197 ft) in length. Blades often have air-filled sacs that help the algae float close to the surface of the ocean. Brown algae are the only algae that form more than one tissue type.

F. Green Algae - _____ are a very diverse group of protists. They form a major part of marine plankton. Some inhabit damp soil and resemble plants. Some are symbiotic within the cells of other organisms. Green algae are similar to plants in several ways. They use the same photosynthetic pigments that plants do, they use starch to store energy, and their cell walls contain cellulose. Green algae are thought to have given rise to the first true plants.

Diatoms



Dinoflagellates



Some Groups of Plant-like Protists		
Group and example	**Major structures**	**Other characteristics**
Diatoms (*Cyclotella*)	• glassy double shells made of silica or calcium carbonate	• unicellular • found in salt water and fresh water
Euglenoids (*Euglena*)	• flagella for movement • in some, an eyespot that detects light	• unicellular • found in fresh water • some heterotrophic
Dinoflagellates (*Ceratium*)	• typically two flagella for movement • cellulose coats for protection	• unicellular • many found in salt water • some heterotrophic
Red algae (*Corillina*)	• pigments that can absorb blue light in deep water	• mostly multicellular • typically found in warm ocean environments • in some, calcium carbonate in cell walls
Brown algae (*Macrocystis*)	• a root-like *holdfast* • a stem-like *stipe* • leaf-like *blades*	• multicellular • found in cool ocean environments • the only algae that have differentiated tissues
Green algae (*Ulva*)	• cell walls contain cellulose	• some unicellular; some multicellular • use same photosynthetic pigments that plants do

VI. FUNGUSLIKE PROTISTS -Funguslike protists absorb nutrients from their environment and reproduce by releasing spores. Funguslike protists were once classified as fungi. However, molecular analyses reveal that they are not closely related to fungi.

A. Slime Molds - Slime molds form spores and absorb nutrients from soil, decaying wood, or animal dung. Cellular slime molds usually exist as single-celled amoebas. A plasmodial slime mold is a plasmodium, a mass of cytoplasm that has many nuclei.

B. Water Molds and Downy Mildews - Water molds and downy mildews typically form multicellular filaments that resemble fungi. Many of these protists decompose dead organisms. Others are common parasites of aquarium fish.

1. In 1846, one type of water mold destroyed almost the entire potato crop in Ireland, which led to the _____.

2. In 1879, a downy mildew of _____ almost wiped out the French wine industry.

VII. PROTISTS AND DISEASE -Protists cause a number of human diseases, including giardiasis, amebiasis, toxoplasmosis, trichomoniasis, cryptosporidiosis, Chagas disease, and malaria.

A. Giardiasis - _____ is a disease caused by an intestinal parasite of the genus *Giardia.* The parasite enters the body as a cyst. The cyst releases two flagellated protists As the protists move through the intestine, they cause severe diarrhea and intestinal cramps that may last for two to six weeks. The disease is rarely fatal.

B. Amebic Dysentery - The parasite *Entamoeba histolytica* causes two forms of diarrheal illness. One form, _____, is mild and can last a couple of weeks. _____ is a severe form of amebiasis. Symptoms of amebic dysentery include pain, bloody diarrhea, and fever. In rare cases, amoebas travel to the liver, lungs, or brain and can be fatal.

1. *E. histolytica* forms cysts that are transmitted in contaminated _____, most commonly in countries that have poor sanitation.

2. *E. histolytica* can also be transmitted on _____, vegetables, and other foods that have been washed with contaminated water and eaten raw.

C. Toxoplasmosis - _____, caused by the protist *Toxoplasma gondii,* is spread by cats and by eating undercooked meat that contains cysts. Infected _____ release spores in their feces for up to two weeks after infection.

1. If a pregnant woman is infected, her fetus can suffer eye or brain damage.

2. To avoid toxoplasmosis, cook meat fully and wash hands thoroughly after gardening or changing a cat's litter box. Pregnant women should avoid changing cat litter.

D. Trichomoniasis - _____ is one of the most common sexually transmitted infections in the United States. Men often have no symptoms, but can still spread the infection. Women who are infected typically experience discolored discharge, genital itching, and the urge to urinate. If a pregnant woman is infected the baby can die

E. Cryptosporidiosis - Cryptosporidiosis, commonly called _____, is caused by protists of the genus *Cryptosporidium.* It can be spread by contaminated _____ or objects and in uncooked food. The most common symptoms of crypto are severe cramps and diarrhea that may last up to two weeks.

F. Chagas Disease - _____ disease, or American trypanosomiasis, is caused by the protist *Trypanosoma cruzi.* This disease occurs in South and Central America. It is spread by _____. The chronic stage can result in heart disease, abnormal heartbeat, heart failure, heart attack, and enlargement of the esophagus and the large intestine.

G. Malaria - _____ is caused by several types of sporozoans of the genus *Plasmodium.* Malaria is spread by the bite of the *Anopheles* _____. When an infected mosquito bites a human, it injects saliva containing the parasite. Malaria kills up to 3 million people every year.

1. Plasmodium is developing resistance to many drugs, so treatment is becoming more difficult.

2. Efforts to control malaria include distribution of insecticide treated mosquito nets and fumigation to kill mosquitoes.

VIII. PROTISTS AND THE ENVIRONMENT -Protists produce oxygen, take up carbon dioxide, are important producers in aquatic food webs, can produce deadly blooms, serve as nutrient recyclers, and have symbiotic relationships with many animals and plants.

Algal Blooms

1. An algal bloom is a rapid increase in the population of algae in an aquatic ecosystem.

2. A red tide is caused by a bloom of dinoflagellates that produce powerful toxins. Humans can become ill if they eat fish or shellfish during a _____.

3. One genus of dinoflagellates, *Pfiesteria,* produces a powerful toxin that can become airborne. This toxin can cause memory and concentration problems as well as skin rashes.

4. When an algal bloom dies, the bacteria that consume and decompose the algae deplete the oxygen levels in the water.

5. As a result, large numbers of fish and other marine animals may die.

IX. PROTISTS AND INDUSTRY Protists are important in many foods, in industrial and consumer products, and in scientific research.

A. Carrageenan, agar, and alginate substances produced by algae. These substances are used as thickening agents in foods such as ice cream, salad dressings, and gelatin desserts.

B. The empty shells of _____ are used as abrasives in cleaning agents, such as toothpaste. Diatoms are also used in diatomaceous earth as a natural product to control insect pests.

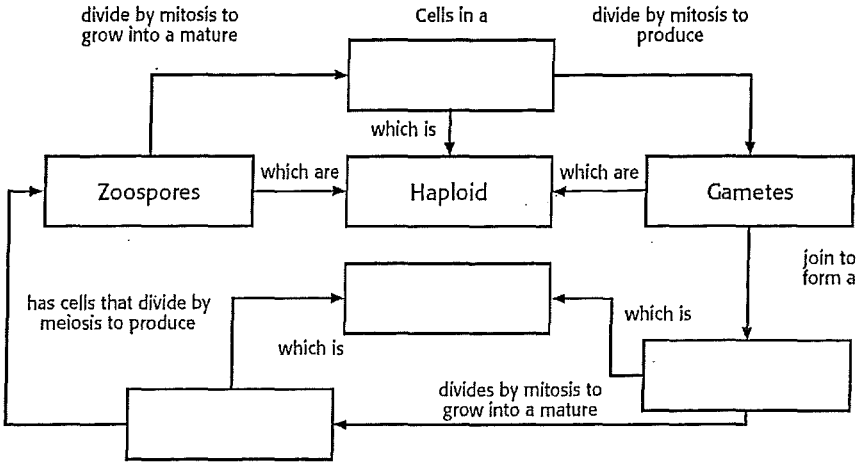
Protist or protist product	Uses
Carrageenan, agar, and alginate	thickener in foods such as ice cream, salad dressings, and gelatin desserts
Agar	gelatin capsules for medication
Carrageenan	paints, fire-fighting foam, and cosmetics
Empty shells of diatoms	abrasives in cleaning agents and toothpastes, reflective roadway paint, natural insect control
Slime molds	studied as models of cell movement and cell signaling

HOMEWORK DATE DUE

CH 21 SEC 1

1. A classmate tells you that he saw a unicellular organism through a microscope and concluded that it was a protist. Is his conclusion valid? What other information do you need?

2. Complete the concept map below to describe alternation of generations.Use the following terms: gamete, zygote, zoospores, haploid, diploid, sporophyte, and gametophyte.



3. How do the offspring of asexual reproduction differ from the offspring of sexual reproduction?

4. Why will the classification of protists likely change in the near future?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

HOMEWORK DATE DUE

CH 21 SEC 2

1. What are three feeding methods that scientists use to classify protists?

2. Why is it useful to classify protists by feeding method?

3. What might be a major drawback of grouping protists based on how they get food?

4. What characteristic do animal-like protists share with animals?

5. Which group of animal-like protists has only parasitic members?

6. What is the general difference between flagellates and dinoflagellates?

7. What are two ways that fungi and fungus-like protists are similar?

8. How does a plasmodium differ from a typical single cell?

BELLRINGER QUESTION CIRCLE M T W TH FRI DATE

ANSWER

HOMEWORK DATE DUE

CH 21 SEC 3

1. Identify seven diseases that protists can cause in humans.

2. What are three ways that disease-causing protists can infect humans?

3. What are two major roles that protists play in aquatic food chains?

4. Describe two ways red tides can harm fish and other marine animals.

5. Why do algal blooms cause a decrease in oxygen levels in seawater?

6. Describe the relationship between some photosynthetic protists and corals.

7. Identify five common products that are made using protists.

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

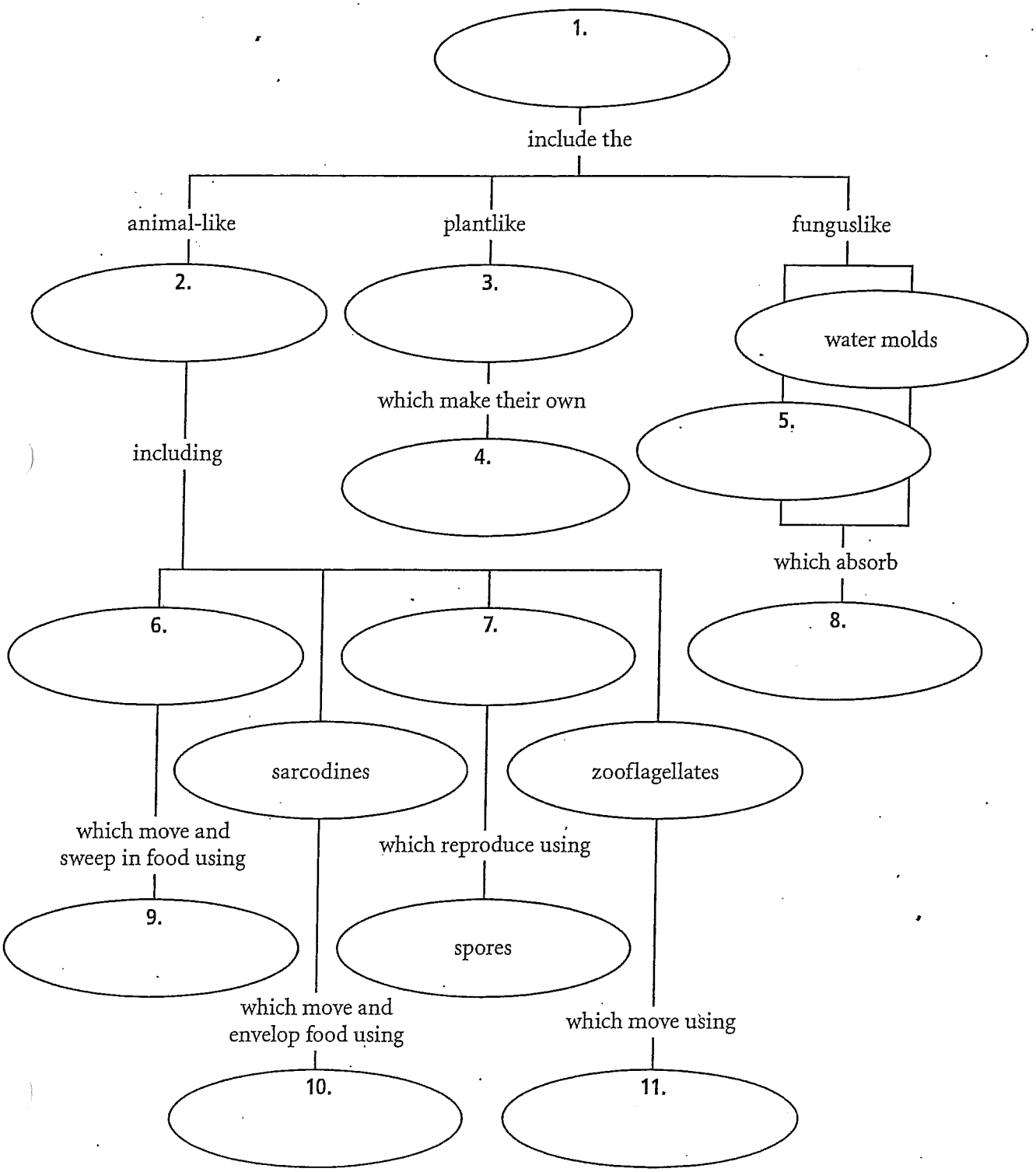
ANSWER

Name _____ Date _____ Class _____

Concept Mapping

The Classification of Protists

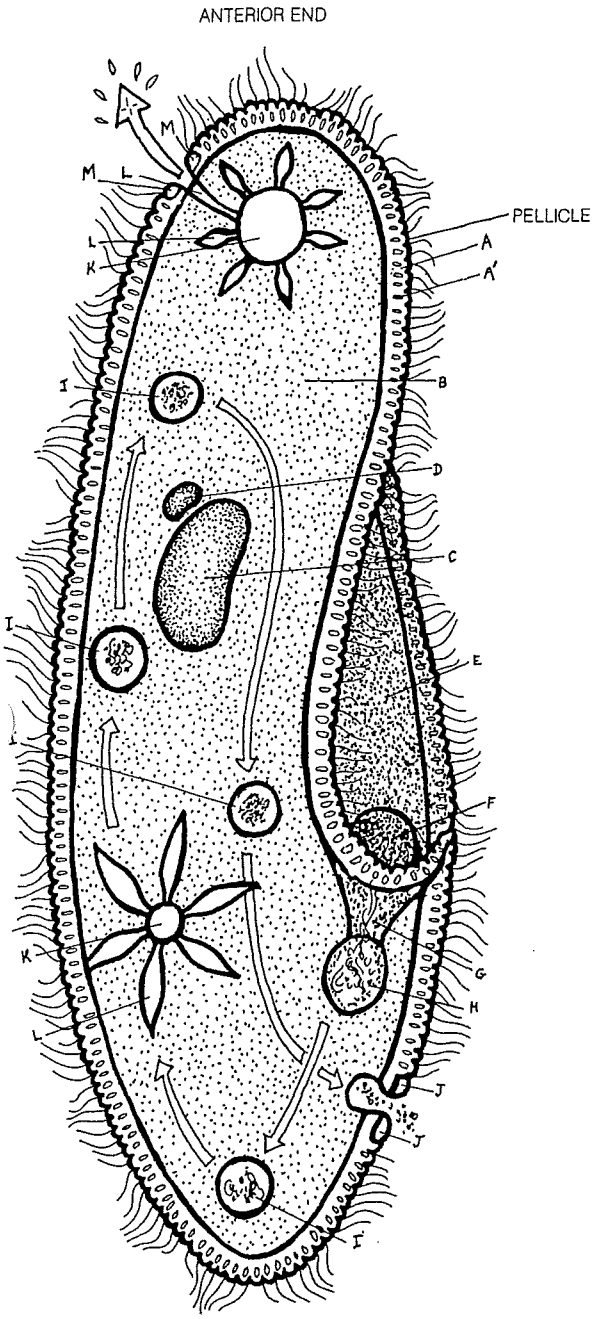
Complete the network tree about the classification of protists. These terms may be used more than once: algae, cilia, ciliates, flagella, food, nutrients, protists, protozoans, pseudopods, slime molds, sporozoans.



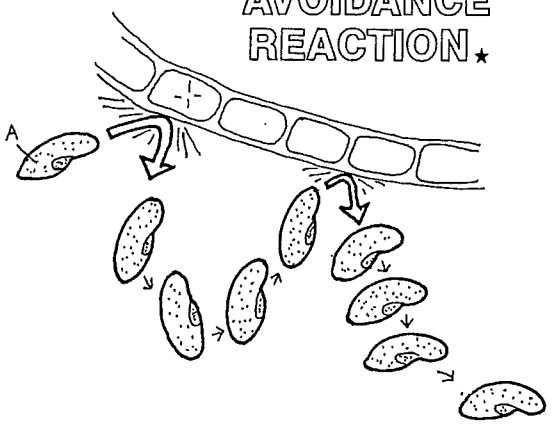
Ch 21 Review

1. What type of organisms are in the Kingdom Protista?
2. What things do organisms in Protista have?
3. Eukaryotes that lack the features of animals, plants, or fungi are classified in the kingdom _____
4. What asre pseudopodia?
5. What are flagella?
6. If something is unicellular and has a cell wall, what type of reproduction does it use?
7. Amoebas capture food by _____
8. How do diatoms reproduce?
9. What are algae? Where are they found?
10. What are euglenoids? How do they eat?
11. What is conjugation?
12. What is giardiasis?
13. What is Chagas disease?
14. What is amoebic dysentery?
15. What is malaria?
16. What is toxoplasmosis?
17. Protists that play an important role in aquatic food webs are called _____
18. The evolution of the plant kingdom can be inferred by studying _____
19. A mass of cytoplasm that has many nuclei is a(n) _____
20. A protist that almost destroyed the entire potato crop in Ireland in 1846 is a _____
21. When an algal bloom dies, the bacteria that decompose the algae do what to the water?

PARAMECIUM.



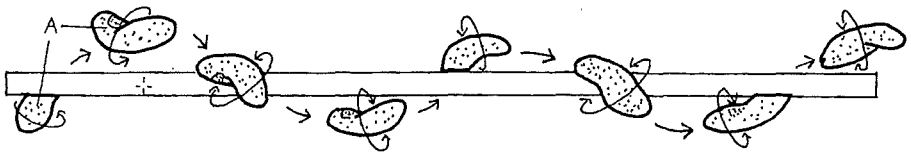
AVOIDANCE REACTION ★



ECTOPLASM A
TRICHOCYST A'
ENDOPLASM B
MACRONUCLEUS C
MICRONUCLEUS D

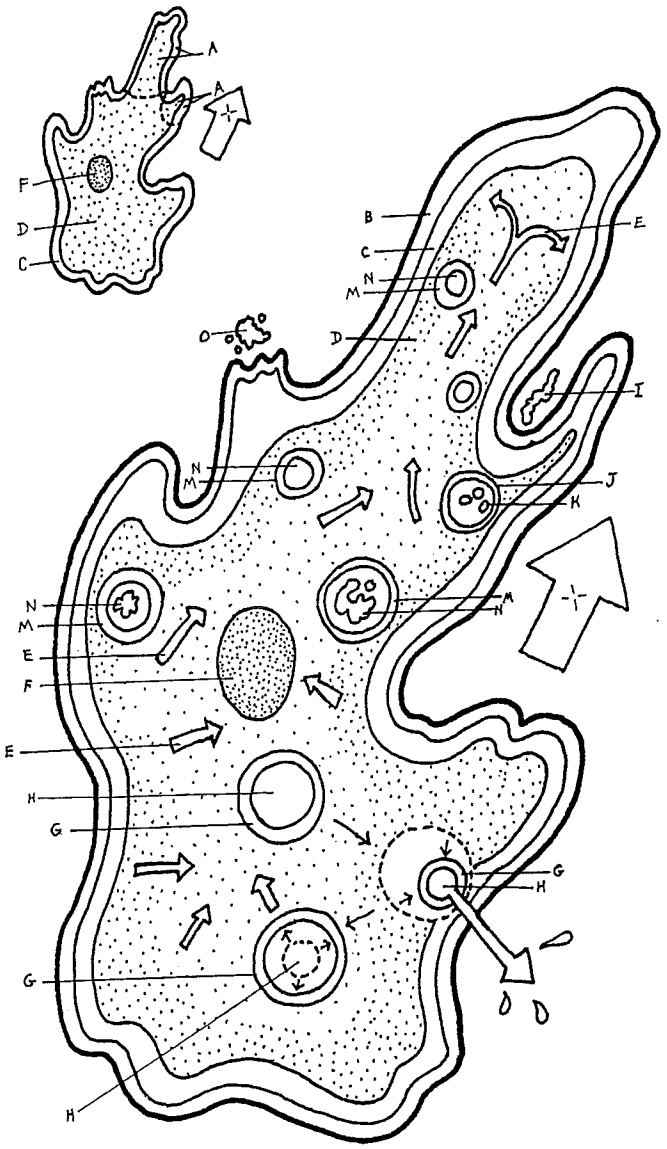
ORAL GROOVE E
MOUTH PORE F
GULLET G
DEVELOPING FOOD VACUOLE H
CIRCULATING FOOD VACUOLE I
ANAL PORE J

CONTRACTILE VACUOLE K
FEEDER CANAL L
EXCRETORY PORE M



LOCOMOTION ★

AMOEBA.



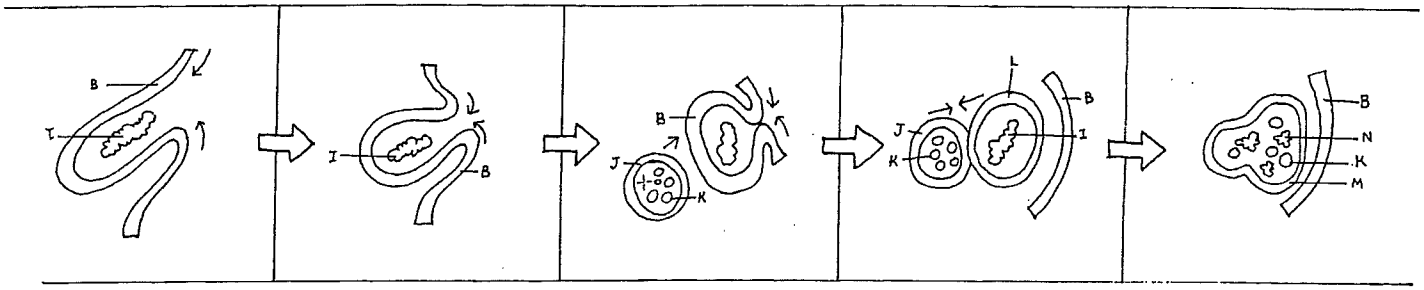
PSEUDOPODIA$_A$

PLASMA MEMBRANE$_B$
ECTOPLASM$_C$
ENDOPLASM$_D$
PLASMASOL MOTION$_E$
NUCLEUS$_F$

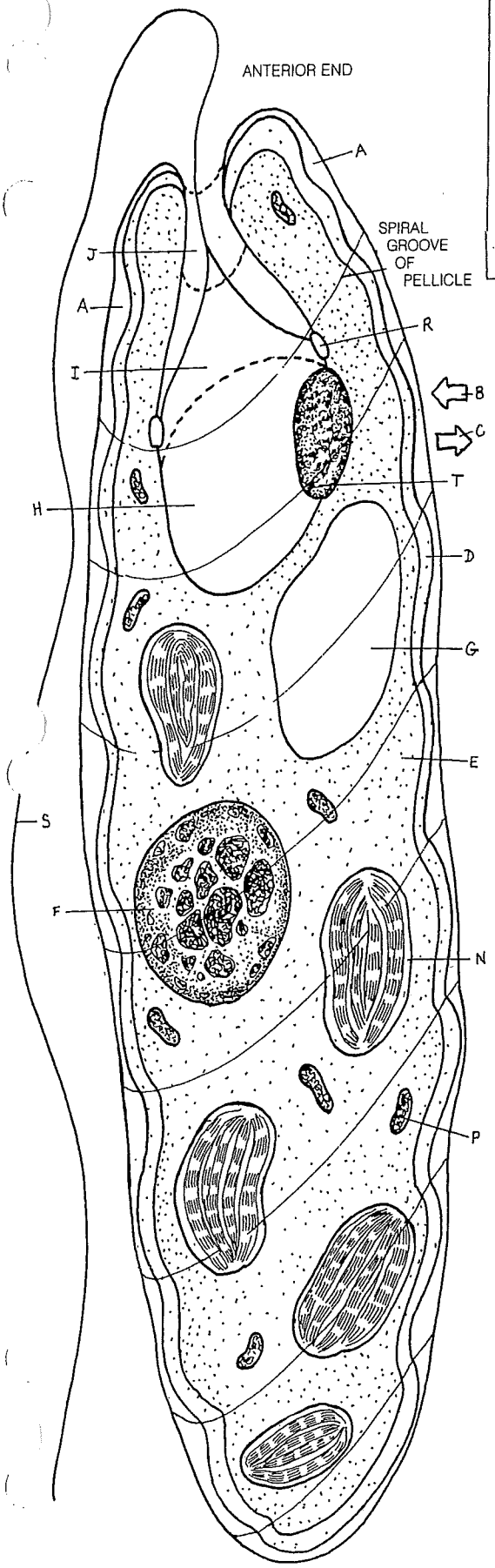
CONTRACTILE VACUOLE$_G$
WATER$_H$

FOOD$_I$
LYSOSOME$_J$
ENZYME$_K$
FOOD VACUOLE$_L$
DIGESTION VACUOLE$_M$
DIGESTED FOOD$_N$
EXPELLED WASTE$_O$

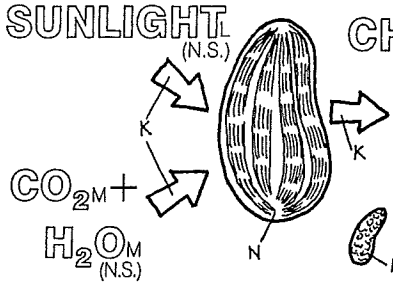
PHAGOCYTOSIS★



EUGLENA.



PHOTOSYNTHESIS$_K$



PELLICLE$_A$
NUTRIENT ABSORPTION$_B$
WASTE EXCRETION$_C$

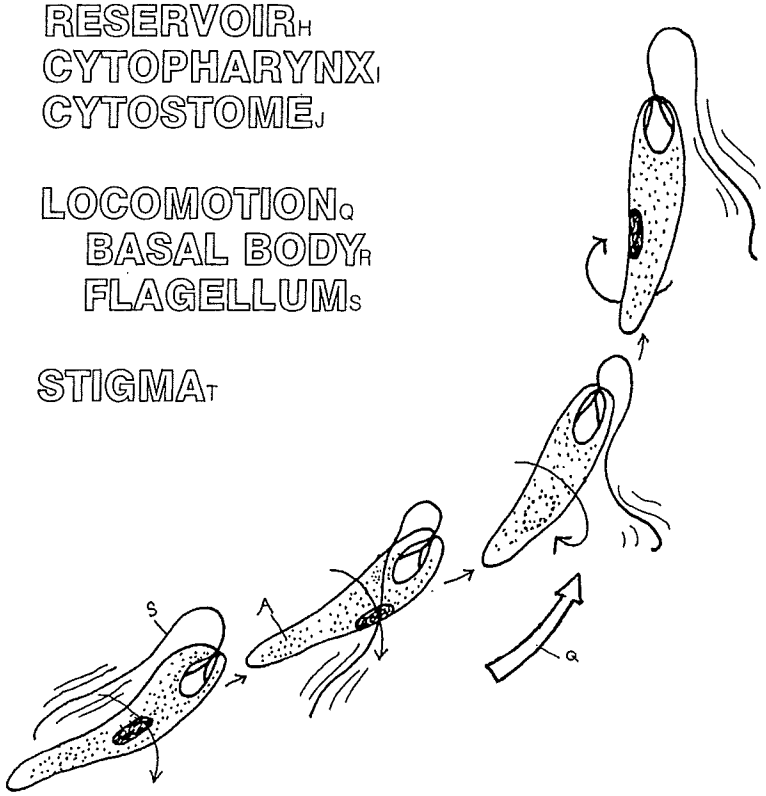
CYTOPLASM$_\star$
ECTOPLASM$_D$
ENDOPLASM$_E$

NUCLEUS$_F$

CONTRACTILE VACUOLE$_G$
RESERVOIR$_H$
CYTOPHARYNX$_I$
CYTOSTOME$_J$

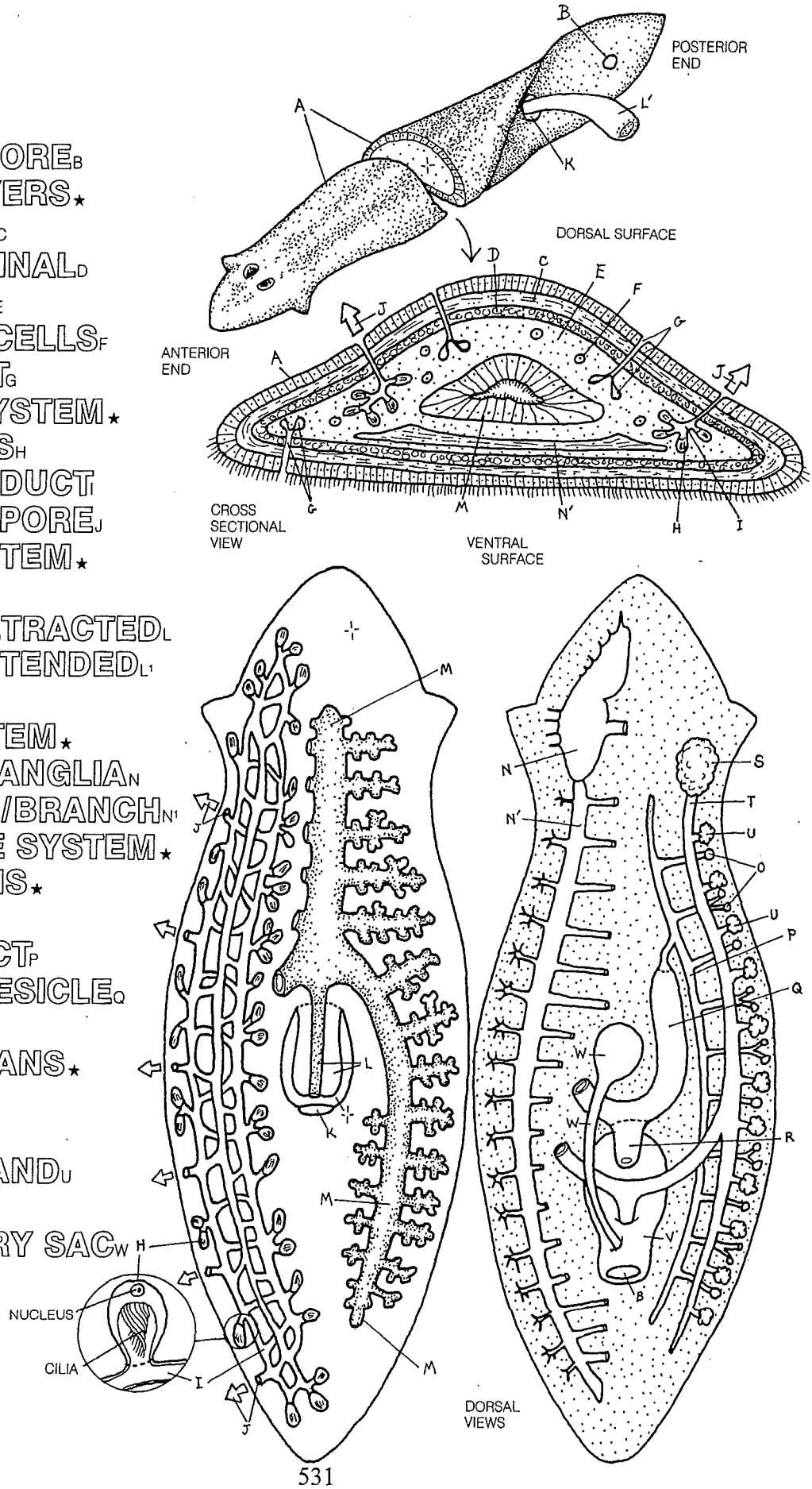
LOCOMOTION$_Q$
BASAL BODY$_R$
FLAGELLUM$_S$

STIGMA$_T$

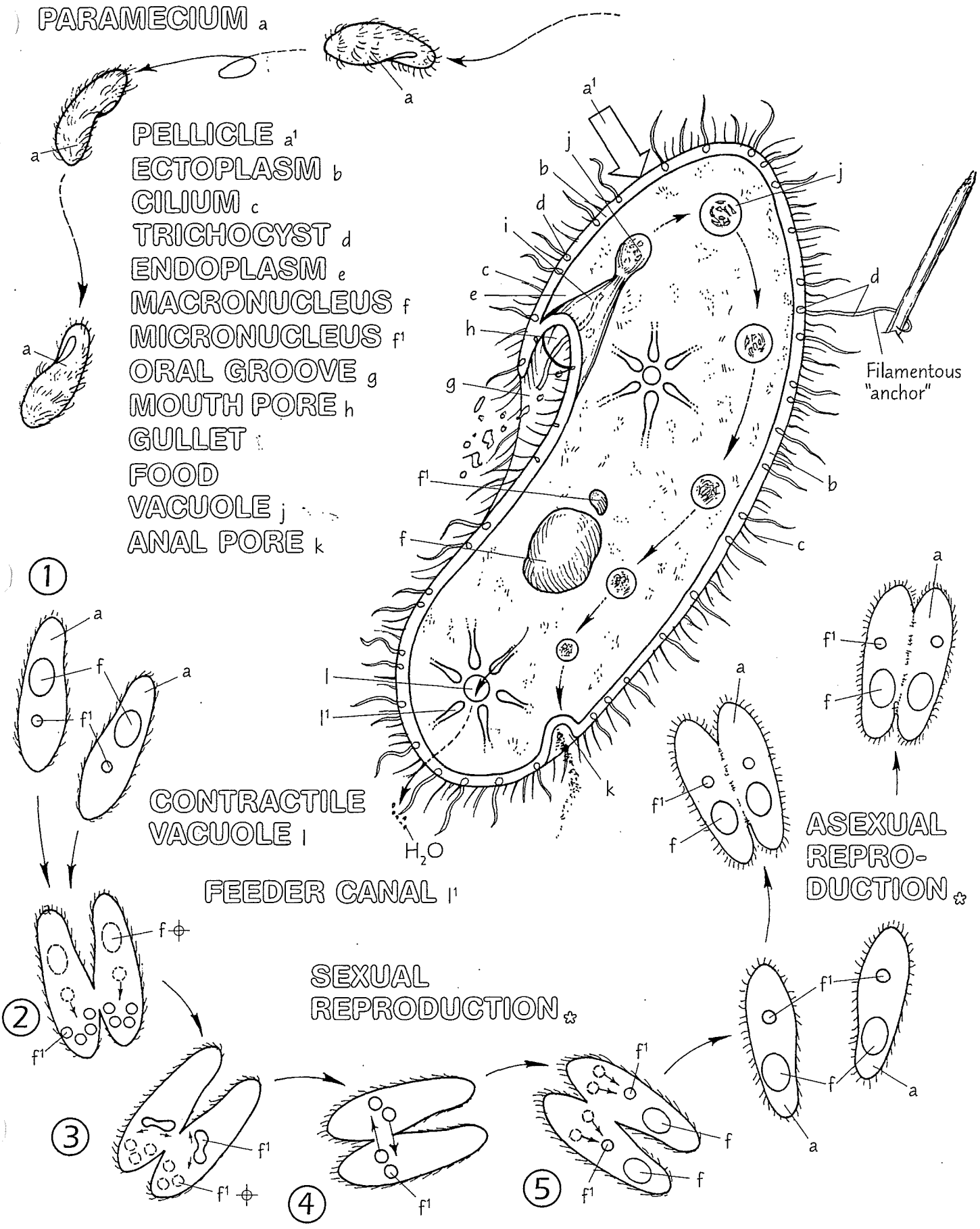


PLANARIA.

- BODY WALL★
  - EPIDERMIS$_A$
    - GENITAL PORE$_B$
  - MUSCLE LAYERS★
    - CIRCULAR$_C$
    - LONGITUDINAL$_D$
- MESENCHYME$_E$
  - FORMATIVE CELLS$_F$
  - GLAND/DUCT$_G$
- EXCRETORY SYSTEM★
  - FLAME CELLS$_H$
  - EXCRETORY DUCT$_I$
  - EXCRETORY PORE$_J$
- DIGESTIVE SYSTEM★
  - MOUTH$_K$
  - PHARYNX RETRACTED$_L$
  - PHARYNX EXTENDED$_{L'}$
  - INTESTINE$_M$
- NERVOUS SYSTEM★
  - CEREBRAL GANGLIA$_N$
  - NERVE CORD/BRANCH$_{N'}$
- REPRODUCTIVE SYSTEM★
  - MALE ORGANS★
    - TESTIS$_O$
    - SPERM DUCT$_P$
    - SEMINAL VESICLE$_Q$
    - PENIS$_R$
  - FEMALE ORGANS★
    - OVARY$_S$
    - OVIDUCT$_T$
      - YOLK GLAND$_U$
    - VAGINA$_V$
    - COPULATORY SAC$_W$

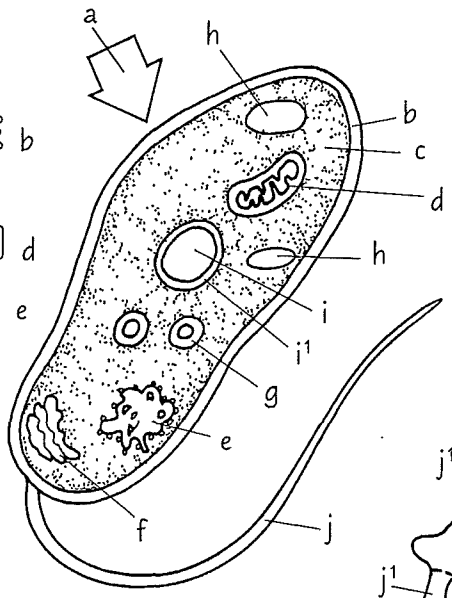


PARAMECIUM


PARAMECIUM a
PELLICLE a¹
ECTOPLASM b
CILIUM c
TRICHOCYST d
ENDOPLASM e
MACRONUCLEUS f
MICRONUCLEUS f¹
ORAL GROOVE g
MOUTH PORE h
GULLET i
FOOD VACUOLE j
ANAL PORE k
CONTRACTILE VACUOLE l
FEEDER CANAL l¹
Filamentous "anchor"
H₂O
ASEXUAL REPRO-DUCTION
SEXUAL REPRODUCTION
1
2
3
4
5

INTRODUCTION TO PROTOZOA

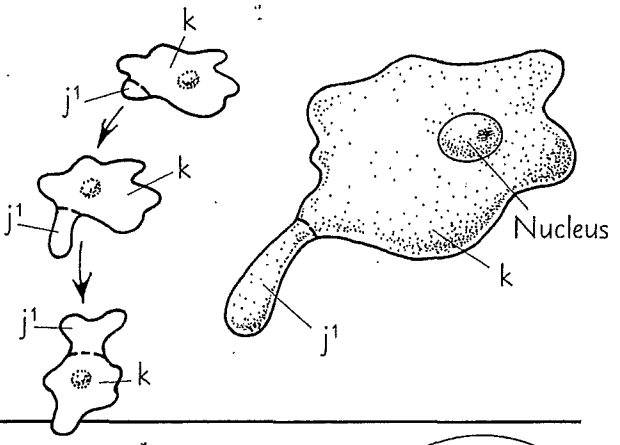
TYPICAL STRUCTURE a
CELL MEMBRANE b
CYTOPLASM c
MITOCHONDRION d
RIBOSOMES / ER e
GOLGI BODY f
FOOD VACUOLE g
CHLOROPLAST h
NUCLEUS i
NUCLEAR MEMBRANE i^1
FLAGELLUM j



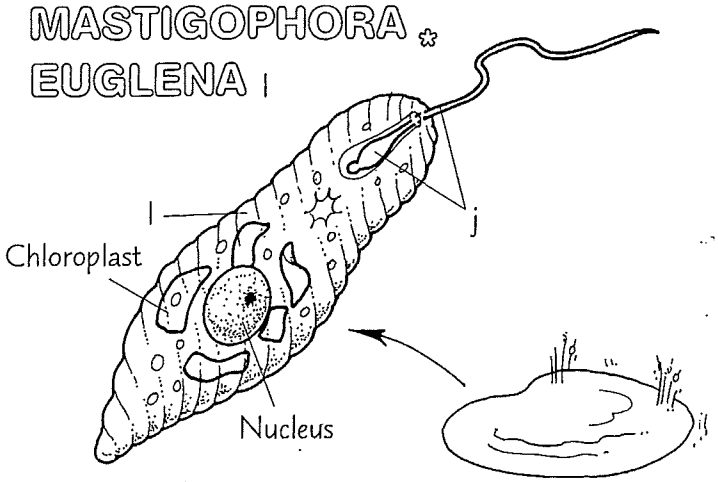
Longitudinal section

SARCODINA ✿
AMOEBA k

PSEUDOPODIUM j^1

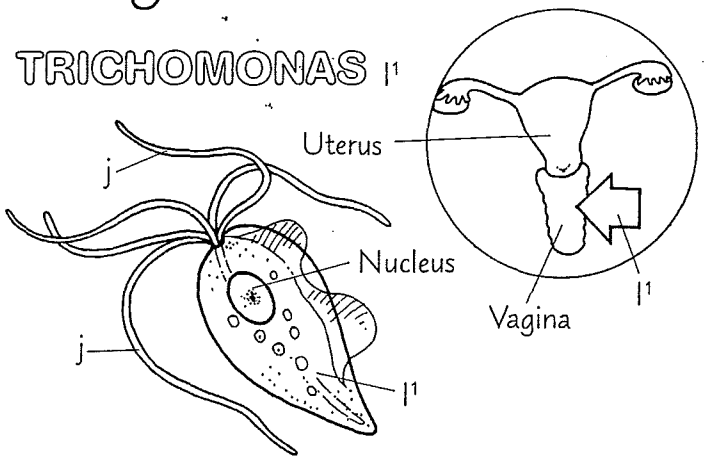


MASTIGOPHORA ✿
EUGLENA l

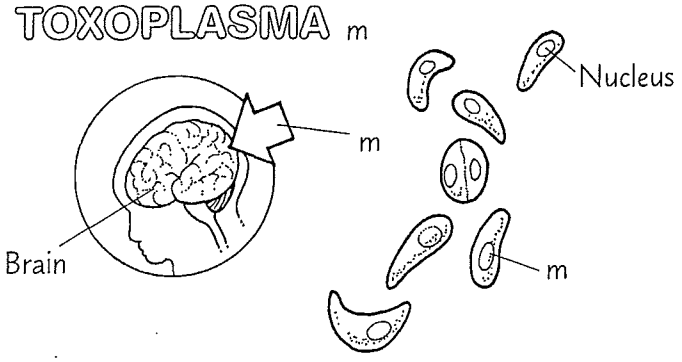


Longitudinal section

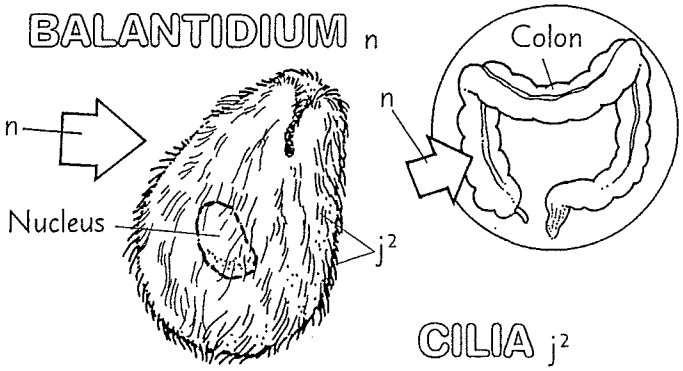
TRICHOMONAS l^1



SPOROZOA ✿
TOXOPLASMA m



CILIOPHORA ✿
BALANTIDIUM n



CILIA j^2

HYDRA.

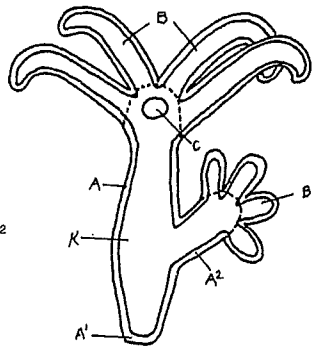
BODY WALL$_A$
BASAL DISC$_{A'}$
BUD$_{A^2}$
GONADS ★
OVARY$_{A^3}$
EGGS$_{F'}$
TESTIS$_{A^4}$
SPERM$_{F^2}$
TENTACLE$_B$
MOUTH$_C$

EPIDERMIS ★
EPITHELIOMUSCULAR CELL$_D$
CNIDOCYTE$_E$
INTERSTITIAL CELL$_F$
NERVE CELL$_G$

MESOGLEA$_H$
NERVE FIBER$_{G'}$

GASTRODERMIS ★
EPITHELIODIGESTIVE CELL$_I$
GLAND CELL$_J$
INTERSTITIAL CELL$_{F^3}$
NERVE CELL$_{G^2}$

GASTROVASCULAR CAVITY$_K$



Inquiry Lab

Pond-Water World

Protists are everywhere. Even a single drop of water can hold an entire community of protists.

Procedure

1. Place a drop of pond water in the center of a clean slide.
2. Place a coverslip on the slide.
3. Use a compound light microscope to observe the wet mount under both low power and high power.
4. Place a drop of slowing agent at the very edge of the coverslip.
5. Observe the wet mount under low power and high power again.
6. Draw the organisms that you see.

Analysis

1. **State** how many types of organisms you could see before you added the slowing agent.

_____

_____

_____

2. **Describe** the various types of organisms that you observed after you added the slowing agent.

_____

_____

_____

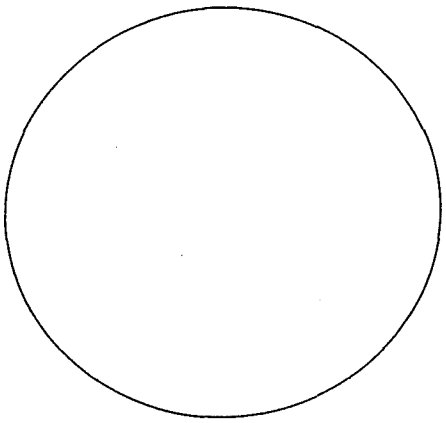
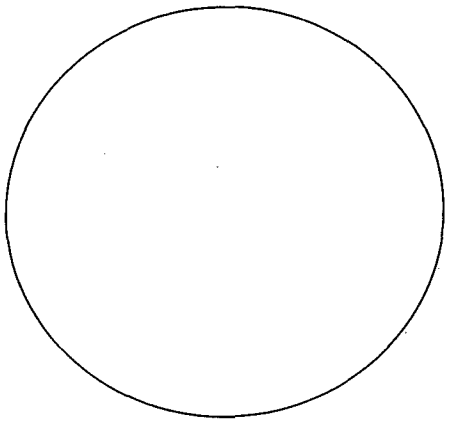
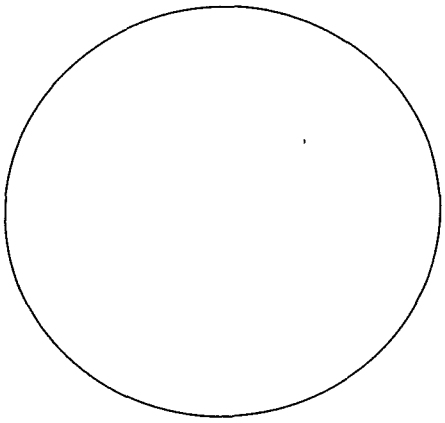
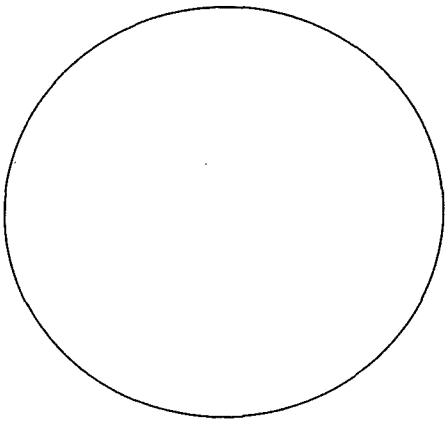
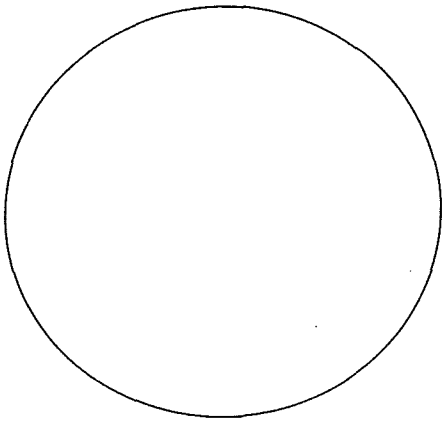
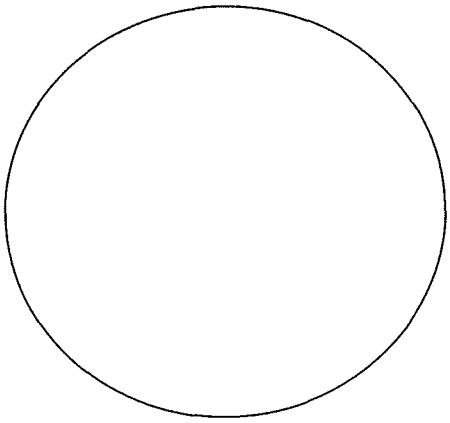
3. **Propose** whether the organisms that you observed were prokaryotes or eukaryotes.

_____

_____

_____

4. **Draw 6** examples of protists you found under HIGH power below

Protists—A Comparison

Protists are microscopic, usually one-celled, organisms found in almost every environment on Earth. Although the ancestors of all life on Earth were simpler one-celled organisms, modern protists have evolved with more complexity. Many protists are extremely complex and perform the same basic life functions as do multicellular organisms. This fact illustrates the basic unity of all life.

In this lab, you will examine and compare representatives of three groups of protists: Sarcodina (*Amoeba*), Ciliophora (*Paramecium*), Euglenophyta (*Euglena*).

OBJECTIVES

- **Compare** and **contrast** members of the kingdom Protista.
- **Identify** the specialized structures in three groups of protists.
- **Interpret** the strategy for classification of protists.

MATERIALS

- safety goggles, lab apron, protective gloves
- compound microscope
- cotton ball
- coverslips (3)
- cultures of *Amoeba, Paramecium,* and *Euglena*
- Detain™ (protist-slowing agent)
- distilled water
- lab apron
- medicine dropper or dropping pipet
- microscope slides (3)
- paper towel
- vinegar
- yeast solution stained with protist metabolic stain

Procedure

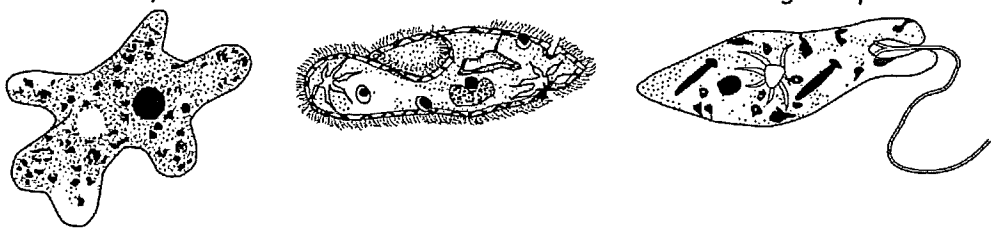
1. Put on a lab apron. Your group will make three wet-mount slides. Each member of your group will choose one protist to prepare. **CAUTION: When working with microorganisms, avoid touching your face or mouth with your hands.** For each slide, you will follow steps 2–11. However, because a slide is a harsh environment for the organisms, do not make a wet mount of an organism until you are ready to use it.
2. Place a few strands pulled from a cotton ball in the center of a clean slide.
3. Use a medicine dropper or dropping pipet with a bulb to draw in protists from the culture container you will be working with. (Hint: *Amoeba* may be found on the bottom of its container. *Euglena* and *Paramecium* may be found by skimming the surface of their containers.)

4. Put a few drops of the culture onto the cotton strands and place a coverslip carefully

over the drops. If you are preparing a wet mount of *Paramecium* or *Euglena*, add Detain™ or methyl cellulose solution to slow the movement of the organisms.

5. View the diagrams of the three protist types in **Figure 1** to get an idea of what you will look for on your slides. Use the low-power setting of your microscope to locate organisms and to observe their movement. The cotton strands should limit movement and make observation easier.

Amoeba proteus *Paramecium caudetum* *Euglena sp.*



6. Use high power to clearly observe a single organism. One-celled organisms are three-dimensional, so check for structural details by changing the fine adjustment and altering the light conditions. Experiment with different settings of the diaphragm to enhance various aspects of the organism. If the organism moves out of view, move the slide to keep up with it. If you are unsuccessful, return to low power to scan a larger field and begin again.
7. As you observe your organism, share your observations with your group members and allow them to view your organism. Fill in **Table 1.** Refer to diagrams in your textbook to identify the parts of each organism. Note the magnification factor of your microscope on your drawing.
   - Are individuals of a single species the same or different sizes? How do you explain the different sizes?

_____

_____

_____

8. Look closely at the cytoplasm. Protists have one or more contractile vacuoles, which collect excess water from cytoplasm and expel it from the cell. Contractile vacuoles may be observed "pulsing," swelling with collected water and then shrinking as the water is expelled. Find a contractile vacuole, and count the number of pulses for one minute. Record your findings in **Table 1.** If the protist's movement makes this step difficult, add Detain™ to the slide.

TABLE 1 PHYSICAL AND BEHAVIORAL CHARACTERISTICS OF THREE TYPES OF PROTISTS

Characteristic	Amoeba	Paramecium	Euglena
General shape			
Overall color			
Color of parts			
Style of movement			
Structure for movement			
Pulses/minute of contractile vacuole			
Vacuole pulses/ minute with water added			
Reaction to yeast			
Reaction to vinegar			

9. Place a drop of distilled water at one edge of the coverslip of the slide. Place a piece of paper towel next to the opposite edge of the coverslip. Now observe the pulsing of a contractile vacuole for one minute. Describe any change in **Table 1.**
10. Check for the formation of food vacuoles. To do this, add a drop of the solution of yeast stained with protist metabolic stain dye to one edge of the coverslip. Place a piece of paper towel along the opposite edge of the coverslip. The yeast will be drawn under the coverslip by the flow of water. Observe one organism, and note its reaction to the yeast. Record your observation in **Table 1.**
11. Place a drop of vinegar at one edge of the coverslip. Observe each species. Some protists form needlelike trichocysts when exposed to acid, a hostile environment, or an enemy. Describe the reaction of the protists to vinegar in **Table 1.**

12. Dispose of your materials according to the directions from your teacher.
13. Clean up your work area and wash your hands before leaving the lab.

Analysis

1. **Explaining Events** What is the function of trichocysts?

2. **Identifying Relationships** *Amoeba* and *Paramecium* are among the protists called protozoa, which means "first animals." In what way is this name accurate? In what way is it misleading?

3. **Analyzing Data** In which species of protists were the contractile vacuoles easiest to see? Which seemed to be most active (having the greatest rate of pulsing) before distilled water was added? Which were most active after distilled water was added?

4. **Recognizing Patterns** List the kinds of locomotion shown by these protists from least to most specialized. Explain your ordering.

5. **Analyzing Data** Did any of the protists give evidence of cell division or reproduction? If so, describe the evidence you observed.

6. **Describing Events** Which organism ingested the most yeast? Is there any specific situation in which some protists would not be expected to take in food at all? If so, describe this situation.

7. **Analyzing Data** How does each organism appear to protect itself against danger or enemies?

Conclusions

8. **Drawing Conclusions** Why is the contractile vacuole important for survival in a freshwater environment, such as a pond?

9. **Interpreting Information** Describe the characteristics you found in common among the species you observed. Can those be used to define what is a protist?

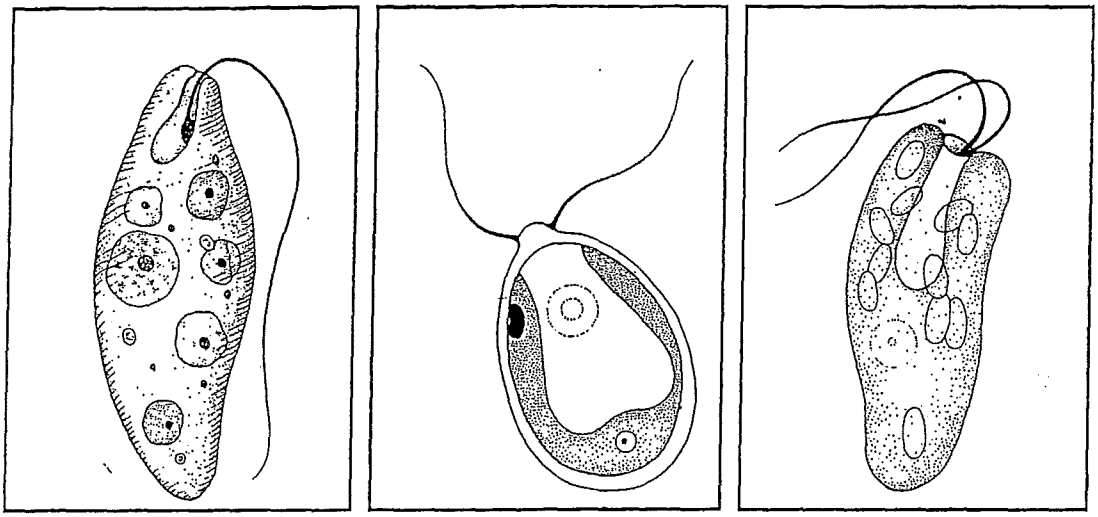
10. **Applying Conclusions** The early Protista are generally considered to have been the ancestors to higher kingdoms (Plants, Animals, Fungi). Which characteristics in which protist did you discover that suggest relationships to plants or animals?

11. **Defending Conclusions** Do the Protista represent a group of organisms that share common adaptations and a common ancestry as suggested by inclusion in a single kingdom? Explain your answer.

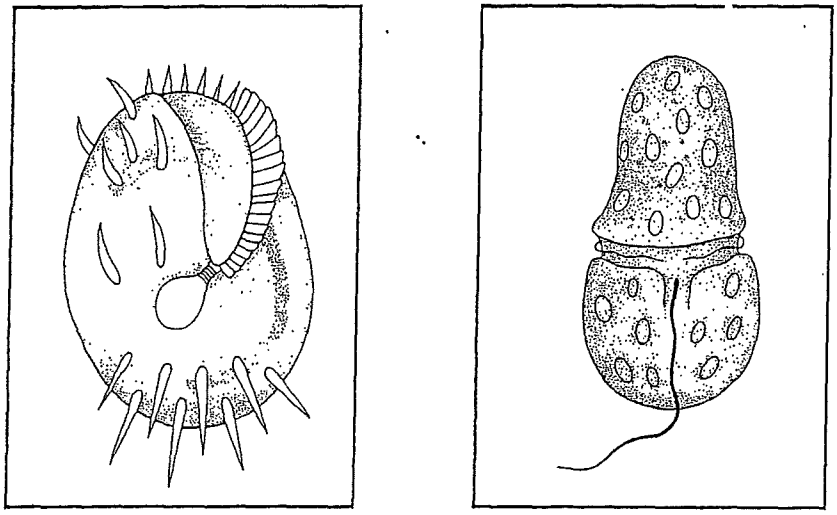
Extensions

12. **Designing Experiments** Changes in the water environment may alter the behavior of some protists. Design an experiment in which you can observe protists' responses to a concentrated (hypertonic) salt or sugar solution. You may also test their responses to a range of pH, from acid to base, and to a range of temperatures. Conduct your experiment after your teacher has checked your procedure for safety.

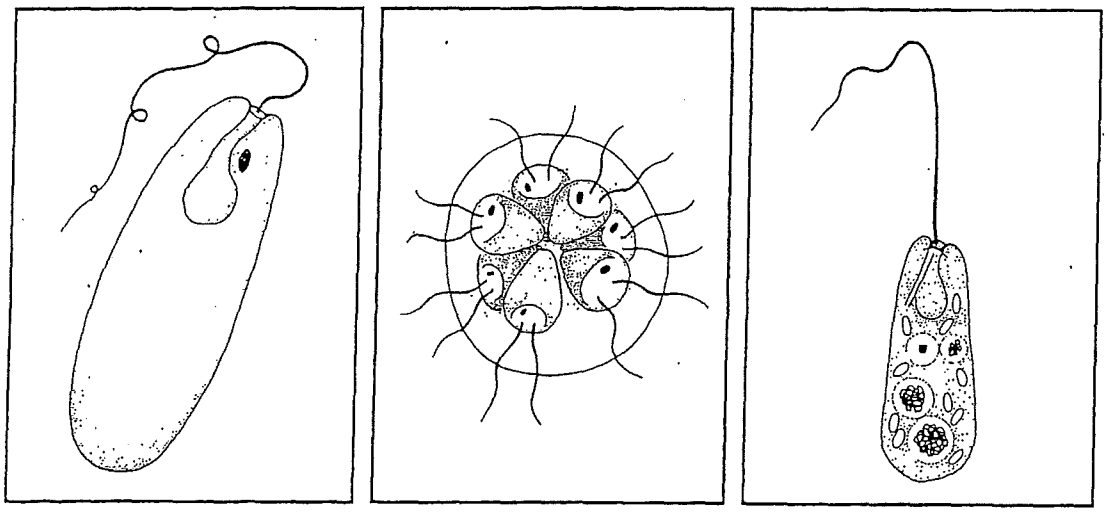
13. **Designing Experiments** Discover more about the eating habits of protists. Feed yeast stained with protist metabolic stain and mixed with activated charcoal powder to protists. View them under a microscope. Then describe your observations.



Euglena Chlamydomonas Chilomonas



Euplotes Dinoflagellate



Haematococcus Pandorina Peranema

Ward's Dichotomous Key to Microlife Dry Mix™

87 W 9057

Using a Dichotomous Key

Identification of microlife forms can be made by either comparing the observed cell to the illustrations or by using the key. A dichotomous or two-statement key is presented below. Begin a statement 1. Proceed according to the key until it terminates in the name of a microlife form.

1

Wet mount observed at high power (430x) under a compound microscope — 2

Stained smear observed at high power (430x) under a compound microscope — 14

2

Body microscopic; one cell or a group of cells, never forming more than one layer. Cells with or without photosynthetic pigments confined in granules (chloroplasts); specialized structures of locomotion (cilia or flagella). Appear as single cells or as stalked forms. **Protists** — 3

Body usually macroscopic, the organism usually visible to naked eye. Organism of many cells, forming several layers and usually organs. Body transparent and thread-like. Body constantly wiggles. In soil sediments. — **Soil nematode**

3

Cell with cilia (hair-like structures used for locomotion). **Ciliate** — 9

Cell with flagella (long whip-like structures used for locomotion). **Flagellate** — 4

4

Cell colored green — 6

Cell not green; colorless or transparent — 5

5

Cell round or circular in shape — 8

Cell not spherical in shape — 7

6

Cell elongate, with a single flagellum observed — **Euglena**

Cell round, with two observed flagella — **Chlamydomonas**

7

Cell very small; looks like wiggling comma. With two observable flagella. Cells abundant about pieces of decaying debris. — **Photochrysis**

Cell very small; constantly changing shape. Cells often appear to vibrate when in motion. Cell has a single, long flagellum. — **Peranema**

8

Cell very small and round, often with a clear circle inside of it. Two or more flagella may be visible. Often hundreds of similar cells observed together at the surface or just below. — **Tetrablepharis**

Cell very small and heart-shaped. Two or more flagella may be visible. Often hundreds of similar cells observed together at the surface or just below. — **Pyraminonas**

9

Cell very small and round, often hundreds together "buzzing" around one another. Usually at the surface or just below. — **Urotrichia**

Cell very small and not round — 10

10

Cell on a stalk. Top portion of cell round. Usually observed attached to debris. Cell contracts on its stalk at intervals. — **Vorticella**

Cell not on a stalk — 11

11

Cell has a notch on one side — 12

Cell does not have a notch — 13

12

Cell very small; oval in shape with both sides flattened. Cell has notch in top ⅓ of body. — **Colpoda**

Cell large; oval in shape with both sides flattened. Cell has notch in middle of body. — **Tillina**

13

Cell elongate; appears to form the letter "s". — **Metapus**

OR

Cell elongate, with one end pointed; in side view looks like tiny cap. — **Chilodenella**

OR

Cell elongate with a comma-shaped area in top ⅓ of body with bristle-like areas at each end. — **Oxytricha**

14

Cell(s) rod-shaped. Observed in either chains (cells attached end-to-end) or singly. **Bacteria.** — **Bacillus-type bacteria**

Cell(s) spiral or corkscrew-shaped. Usually occur singly. **Bacteria.** — **Spirillum-type bacteria**

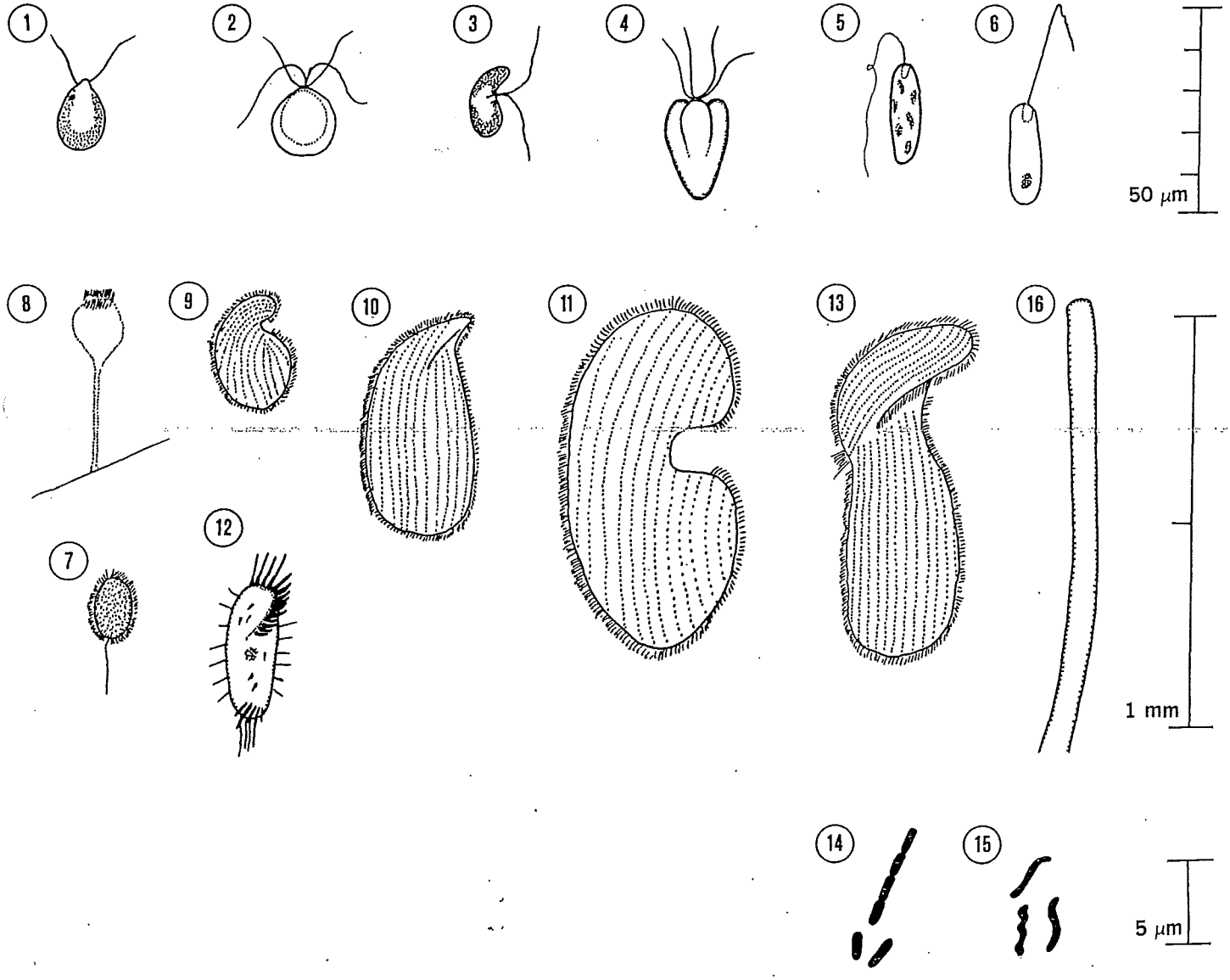
Student Worksheet Investigating Microlife

Techniques

The most important technique for you to master is that of making a **wet mount.** A wet mount is really a sandwich of a drop of water between two glass surfaces — a microscope slide and a coverglass. To make a wet mount, place a drop of water in the center of a microscope slide. To slow the faster-moving microlife forms, add a drop of **Detain** directly on top of the first drop. Mix the two drops using a toothpick. Cover this mixture with a coverglass by laying it down on top of the mixed water drop at an angle.

Observe your wet mount by first using **low power** (100X) magnification. Scan the slide for slowly moving microlife forms. Once you have found one, switch to **high power** (430X) to better observe and identify them using the dichotomous key.

A **stained smear** is another technique that is used to observe and identify microlife. In this technique you air dry a drop of water on a microscope slide and then stain the dried microlife forms using a simple or water-based stain. The dichotomous key will help you identify these forms by their shape. Your teacher will provide specific instructions on how to prepare a stained smear.



Chlamydomonas
Tetrablepharis ochrysis
Pyraminonas
Euglena
Peranema
7 Urotrichia
8 Vorticella
9 Colpoda
10 Chilodenella
11 Tillina
12 Oxytricha
13 Metapus
14 Bacillus bacteria
15 Spirillium bacteria
16 Nematode

WARD'S
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St. Catharines, Ontario

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Protistan Responses to Light

OBJECTIVES

- **Identify** several types of protists.
- **Compare** the structures, methods of locomotion, and behaviors of several kinds of protists.
- **Relate** a protist's response to light to the protist's method of feeding.

MATERIALS

- protist slowing agent
- mixed culture of protists
- microscope slides
- toothpicks
- paper, white
- scissors
- sunlit windowsill or lamp
- plastic pipets with bulbs
- compound microscope
- coverslips
- construction paper, black
- paper punch
- forceps

Preparation

1. **Scientific Methods** **State the Problem** How do protists respond to various amounts of light?
2. **Scientific Methods** **Form a Hypothesis** Form a testable hypothesis about how protists will respond to various levels of light.

_____

_____

Procedure

MAKE A WET MOUNT OF PROTISTS

1.  Put on safety goggles, gloves, and a lab apron.

2.  **CAUTION: Do not touch your face while handling microorganisms.** Place a drop of protist slowing agent on a microscope slide. Add a drop of liquid from the bottom of a mixed culture of protists. Add a coverslip.
3. View the slide under low power and high power of a microscope.
4. Make a drawing of each type of protist. Note whether the protist moves, and try to determine how it moves.

Movement:	Movement:
Movement:	Movement:

5. Repeat step 1, but do not use slowing agent. Note the alteration in movement.

TEST PROTISTAN RESPONSES TO LIGHT

6. Place a wet mount of protists on a piece of white paper. Then, place the paper and the slide on a sunlit windowsill or under a table lamp.
7. Punch a hole in a piece of black construction paper that has a slight curl, as shown in the photo on p. 513 of your textbook. Position the black paper on top of the slide so that the hole is in the center of the coverslip.
8. To examine the slide, first view the area in the center of the hole under low power. (Note: Do not disturb the black paper, and do not switch to high power. Switching to high power will move the paper.) Then, have a partner carefully remove the black paper with forceps while you observe the slide. Note any movement of the protists in response to the change in light.

DESIGN AN EXPERIMENT

9. Design an experiment that tests your hypothesis and that uses the materials listed for this lab. Predict what will happen during your experiment if your hypothesis is supported.

10. Write a procedure for your experiment, which includes the variables that you will control, the experimental variables, and the responding variables. Construct any tables you will need to record your data. Make a list of all safety precautions you will take. Have your teacher approve your procedure before you begin.

11. Set up and carry out your experiment.

12.  Clean up your lab materials according to your teacher's instruction. Wash your hands before you leave the lab.

Analyze and Conclude

1. **Summarizing Results** Describe the various types of locomotion that you observed in protists, and give examples of each type.

2. **Scientific Methods** **Analyzing Results** Identify which protists were affected by light, describe how they were affected, and note how long the effects lasted once reintroduced to darkness.

3. **Scientific Methods** **Drawing Conclusions** How are a protist's response to light and its method of feeding related? Reproduction?

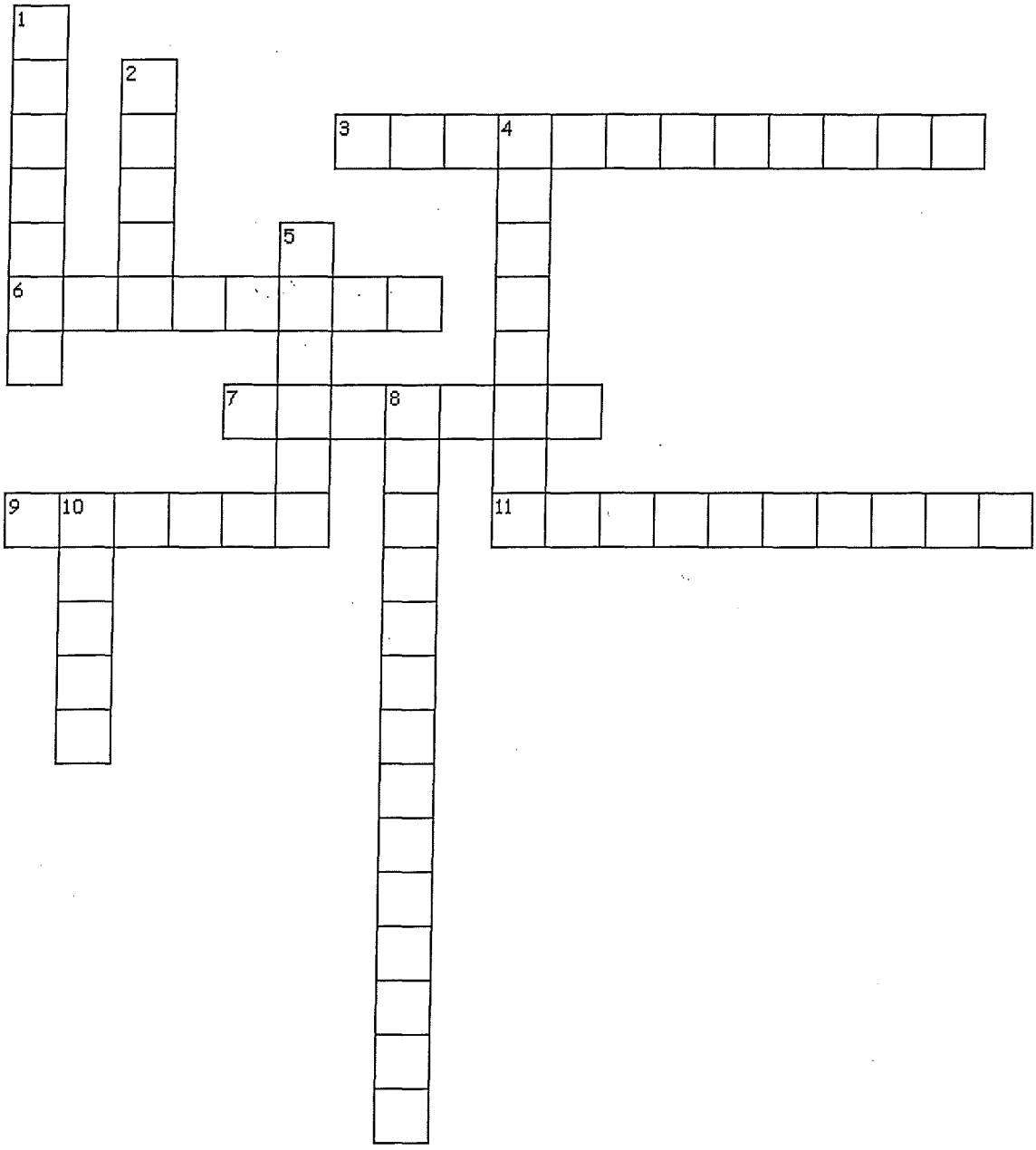
4. **Summarizing Results** Taking into account what you have witnessed in this lab, explain why classifying organisms in the kingdon Protista is so difficult.

Extensions

5. **Research** Investigate livestock diseases that are caused by parasitic protists. Which of these diseases are most common in the United States?

6. **Research** Find out how backpackers can avoid getting diseases that are caused by protists and transmitted in water.

Ch 22 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard for each term with the word on one side and the definition on the back



Across

3. a fungus that infects the skin, hair, or nails
6. the microscopic structure that produces spores in club fungi
7. a rootlike structure that holds fungi in place and absorbs nutrients
9. a carbohydrate found in the cell walls of fungi and other organisms
11. a symbiotic association between fungi and plant roots

Down

1. an organism that absorbs nutrients from dead or decaying organisms
2. the microscopic structure that produces spores in sac fungi
4. the mass of fungal filaments that forms the fungal body
5. a fungus in a symbiotic association with a photosynthetic partner
8. a sexual structure that contains zygotes
10. a filament of a fungus

Ch 22
Vocabulary Review

Match the words on the left with the statements on the right.

_____ 1. chitin
_____ 2. zygosporangium
_____ 3. rhizoid
_____ 4. mycorrhiza
_____ 5. lichen
_____ 6. hyphae

a. aid in the transfer of minerals from the soil to a plant
b. thick-walled sexual structure
c. the tough polysaccharide found in fungal cells and the hard outer covering of insects
d. close living association (symbiosis) between a fungus and a green alga
e. the hyphae that anchor a fungus to its source of food
f. thin filaments that make up the body of a fungus

Match the words on the left with the statements on the right.

_____ 7. mycelium
_____ 8. dermatophyte
_____ 9. ascus
_____ 10. yeast
_____ 11. basidium
_____ 12. saprobe

a. saclike structure in which haploid spores are formed
b. tangled mass formed by hyphae
c. fungi that infect skin and hair
d. the common name given to unicellular fungi
e. club-shaped sexual reproductive structure
f. fungi that absorb nutrients from dead organisms

In the space provided, write the letter of the term or phrase that best completes each sentence or answers each question.

_____ 13. The partial walls between some fungal cells are called
a. membranes.
b. septa.
c. mycelia.

_____ 14. Fungi that do not have an observed sexual stage are grouped together as
a. imperfect fungi.
b. asexual fungi.
c. parasitic fungi.

_____ 15. What is the fungal structure in which asexual spores are produced?
a. sporangium
b. ascus
c. basidium

_____ 16. A dikaryotic hypha has cells with
a. no nuclei.
b. one nucleus.
c. two nuclei.

_____ 17. The phylum of modern fungi that provide clues about the evolution of kingdom Fungi is
a. Zygomycota.
b. Chytridiomycota.
c. Ascomycota.

_____ 18. Ascomycetes produce asexual spores in specialized hyphae called
a. asci.
b. conidiophores.
c. an ascocarp.

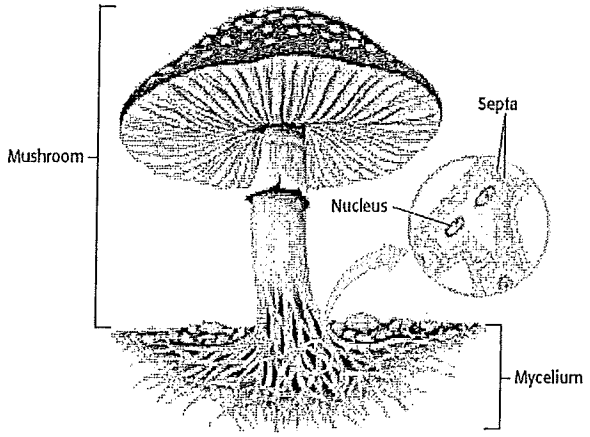
Chapter 22 Fungi

I. WHAT ARE FUNGI?-Fungi have threadlike bodies, their cell walls are made of chitin, and they absorb nutrients from their environment.

A. A fungus body is made of long, slender filaments. The filaments weave more tightly to form reproductive structures, like _____ and _____.

B. Fungi have cell walls that contain _____. Chitin is a tough carbohydrate that is also found in the hard outer covering of insects and other organisms.

C. Fungi obtain energy by breaking down organic and inorganic material in their environment and absorbing the nutrients.



The enlarged image shows hyphae in the mycelium. Septa separate the cells in these hyphae. Gaps in the septa allow nutrients to flow through the hyphae.

II. STRUCTURE AND FUNCTION-A typical fungal body is made of filaments that allow the fungus to have a large surface area and to absorb nutrients efficiently.

A. Body Structure- The threadlike strands of a fungus body are called _____ (singular, hypha). The cells of the hyphae are haploid, are almost identical, and generally perform the same functions. In some fungi, these cells do not have walls that separate the cells. Others fungi have partial cell walls, called septa. Gaps in the septa allow cytoplasm, nutrients, and some organelles to flow through the hyphae. Hyphae form a tangled mass, often many meters long, called a _____. In some fungi, hyphae also form rootlike structures, called rhizoids, that hold the fungus in place and absorb nutrients.

B. Obtaining Nutrients– Fungi release enzymes that break down organic and inorganic matter into nutrients. Fungi absorb the nutrients across their cell walls. Fungi that absorb nutrients from dead organisms are called _____.

_____ recycle nutrients that otherwise would stay trapped in the bodies of dead organisms. Fungi that absorb nutrients from living hosts are called _____. In humans, fungal parasites sometimes cause diseases, such as athlete's foot and ringworm.

III. YEAST AND MOLD- The words yeast and mold refer to stages of the fungus life cycle that are shared by several types of fungi.

A. Some fungi exist primarily in a unicellular state. The common name for this unicellular stage is yeast.
B. Yeasts usually reproduce asexually by budding, a process in which part of the parent pinches off to form a new organism. Under very specific conditions, yeasts can form multicellular hyphae and may reproduce sexually.
C. A mold is a rapidly growing, asexually reproducing stage of some types of fungi. The term mold refers only to the asexual phase. Some fungi that form molds have no observed sexual stage and are grouped with imperfect fungi.

IV. SAC FUNGI-sac fungi are characterized by an ascus, a saclike sexual reproductive structure that produces spores.
V. CLUB FUNGI-Club fungi are characterized by a _____, a clublike sexual reproductive structure that produces spores. When the fungus reproduces sexually, a ring of mushrooms appears. The largest known organism on the planet is a club fungus in Oregon that is _____ across.

Phylum	**Type of fungi**	**Reproductive characteristics**
Chytridiomycota	chytrids	produce spores or gametes that have flagella
Zygomycota	zygote fungi	sexual reproductive structures contain zygotes in a tough capsule
Ascomycota	sac fungi	saclike sexual reproductive structures produce spores
Basidiomycota	club fungi	clublike sexual reproductive structures produce spores

VI. FUNGAL PARTNERSHIPS-Fungi form mutualistic _____ associations to form lichens and mycorrhizae. In a _____ relationship, both members benefit.

A. Lichen

1. A _____ is an association between a fungus and a photosynthetic partner, such as a cyanobacterium, a green alga, or both.
2. Lichens can survive in extreme environments, such as on volcanic rock and arctic tundra.
3. Lichens can be damaged by chemicals in their environment and serve as indicators of air pollution.

B. Mycorrhiza

1. A _____ is an association between fungi and the roots of nearly all plants.
2. The fungal _____ grow inside or around the plant root and out into the soil.
3. The hyphae transfer phosphorus and other minerals from the soil to the roots of the plant.

VII. FUNGI AND INDUSTRY-Fungi are used for food, medicines, research, alternative fuels, and pest control.

VIII. Fungi are probably most familiar as food. White button, shiitake, and portabella mushrooms are common in grocery stores.

A. Yeast is used in _____, brewing, and _____.
B. Fungi also produce the citric acid that is used in soft drinks and candies.
C. Fungi are an important part of the medical industry. They produce the antibiotics _____ and _____.
D. Black bread mold produces cortisone, a drug used to treat skin rashes and to reduce joint swelling.
E. Yeast cells have been genetically engineered to make a vaccine for _____
F. Yeast produces _____, a fuel alternative to gasoline.
G. The use of fungal insect parasites to kill crop-destroying insects helps reduce the use of harmful pesticides.

IX. FUNGI AND THE ECOSYSTEM-Fungi play important ecological roles by decomposing organic matter and by breaking down and absorbing minerals from rocks and soil.

A. The main role of fungi in ecosystems is _____ of dead organisms.
B. As part of _____, fungi slowly break down _____ and prepare environments for other organisms.
C. As part of _____, fungi absorb minerals from the soil and transfer them to plant roots. Almost all _____ have mycorrhizae.

X. FUNGI AND DISEASE-Fungi cause disease by absorbing nutrients from host tissues and by producing toxins.

A. Fungal Infections

1. _____ are fungi that infect the skin and nails. They cause athlete's foot, jock itch, toenail fungus, and ringworm.
2. These fungi absorb nutrients and release metabolic wastes that irritate the skin.
3. _____ is a normal resident of the human body.
4. Antibiotics, hormonal changes, or illness can cause yeast to grow too much. The result is a _____.
5. _____ is a lung infection caused by a fungus that grows in bat and bird feces. When its spores are inhaled, this fungus can cause severe respiratory illness. The fungus sometimes spreads from the lungs to other organs. If untreated, it is fatal.
6. Because fungi grow within the tissues of their host, fungal infections can be difficult to cure. Surface treatments may only relieve the symptoms. Oral medication can cure an infection but can cause damage to the _____ or other organs.

B. Fungal Toxins

1. Many fungi produce dangerous toxins.
2. Toxins in _____ can cause vomiting, diarrhea, liver damage, and even death.
3. A type of fungus that contaminates corn, peanuts, and cottonseed produces aflatoxins and causes liver cancer.
4. Indoor molds can aggravate _____.

Disease	**Description**
Toenail fungus	Dermatophytes that infect the nails cause toenail fungus.
Ringworm and athlete's foot	Dermatophytes that infect the skin can cause ringworm and athlete's foot. These fungi absorb nutrients from the skin and release metabolic wastes that irritate the skin.
Yeast infections	Yeast normally lives inside the body. However, antibiotics, hormones, or illness may enable the yeast to grow too much. This results in a yeast infection. Yeast infections occur on tissues of the reproductive organs and in the mouth.
Histoplasmosis	Histoplasmosis is a lung infection caused by a fungus that grows in bat and bird feces. When its spores are breathed in, this fungus can cause serious respiratory illness.

HOMEWORK DATE DUE

CH 22 SEC 1

1. What are three characteristics that all fungi share?

2. How do fungal parasites obtain nutrients?

3. How does the structure of a mycelium help a fungus take in nutrients from the soil?

4. How does the structure of septa help a fungus move nutrients from one cell to another in hyphae?

5. What type of reproduction takes place in a mushroom?

6. What is different about the division of nuclei to produce haploid spores in asexual reproduction and in sexual reproduction?

7. How does sexual reproduction in fungi begin?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

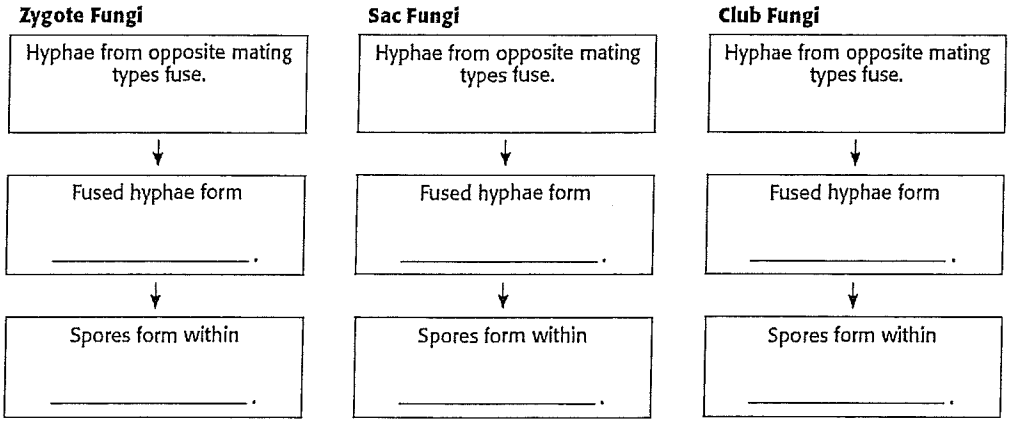
ANSWER

HOMEWORK DATE DUE

CH22 SEC 2

1. What do the similarities between chytrids and protists suggest?

2. Fill in the blank spaces in the diagrams below to show the characteristic sexual reproductive structures of each type of fungi.



3. What feature of a zygosporangium allows it to protect zygotes?

4. What type of structure are mushrooms, and in what types of fungi do they appear?

5. How do both organisms in a mycorrhiza benefit from their symbiotic relationship?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

HOMEWORK DATE DUE

CH 22 SEC 3

1. Name four foods that are made using fungi.

2. How have scientists used yeast in the medical industry?

3. What two antibiotics are made using fungi?

4. What is the main role of fungi in ecosystems?

5. What role do fungi play in mycorrhizae?

6. How do fungi make the minerals in rocks available to other organisms?

7. Name four diseases that fungi can cause in humans.

8. What are aflatoxins, and how can they be harmful to humans?

9. Why can it be dangerous to eat mushrooms in the wild?

BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

CH 22 review

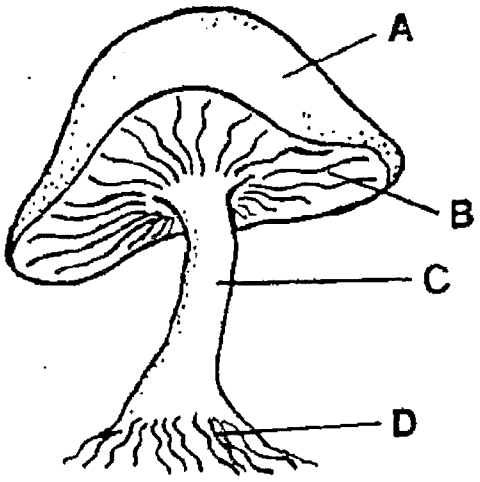
What is chitin?

What are fungi bodies made of?

The individual filaments that make up the body of a fungus are called

What are several types of fungus?

What are the parts of this structure (A-D)



How do fungi obtain food?

How do fungi digest food?

How are fungal spores formed?

The group of fungi that includes the molds that often grow on bread is the _____

What are ascomycetes? How do they reproduce?

Mushrooms, puffballs, and shelf fungi are examples of

In a symbiotic association, such as a lichen, a fungus provides mineral nutrients to a(n)

_____

What are mycorrhizae?

Where do mycrorhizzae grow?

What is a lichen?

What human uses are there for fungi?

What role do fungi have in the ecosystem?

The fungi in lichens prepare the environment for the growth of plants by

What ways do fungi cause disease?

What is a dermatophyte?

Lichen/ Moss Observation

Objective to study a representative group of pioneer plants, the mosses and lichens.

Materials
samples of mosses and lichens microscopes, hand lenses

slide, cover slip

forceps, dissecting needle

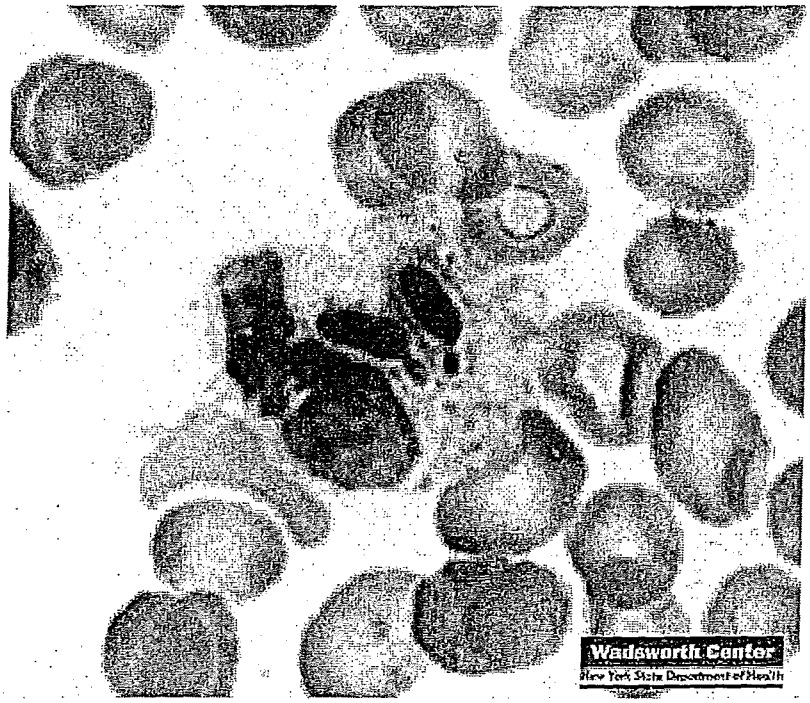
Procedure

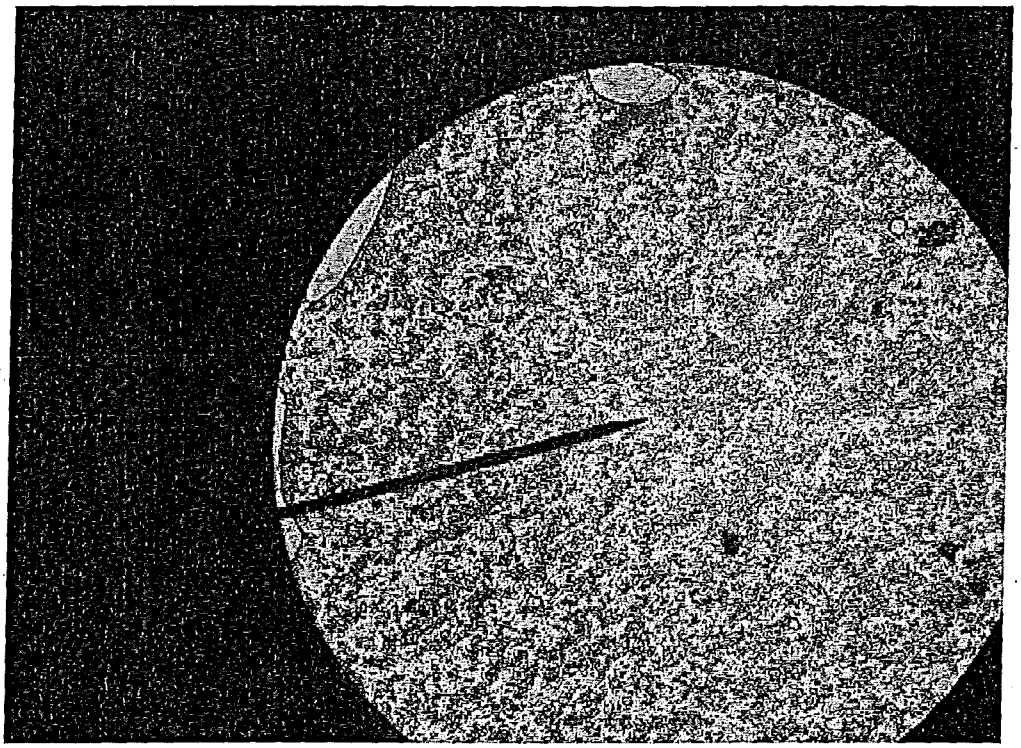
1. Place a piece of the lichen on your slide. Add a drop of water and gently pull the lichen open.
2. Look at the lichen under low power of the microscope. Try to identify the algae part and the fungi part. Sketch what you see below.
3. Place a piece of the moss on your slide. Add a drop of water and examine your sample with the hand lens. Draw what you see below.
4. Now place a coverslip over a very small piece of the moss and look at it under low power with the microscope. Draw what you see below.
5. Use your textbook or other resource books to help you label your drawings.
6. The lichen is an example of a symbiotic relationship. Define *symbiosis*:___
_____
_____
7. What does the algae give to the relationship?_____
_____
_____

What does the fungi give to the relationship?_____
_____
_____

Drawings

Lichens Moss (hand lens) Moss (microscope)

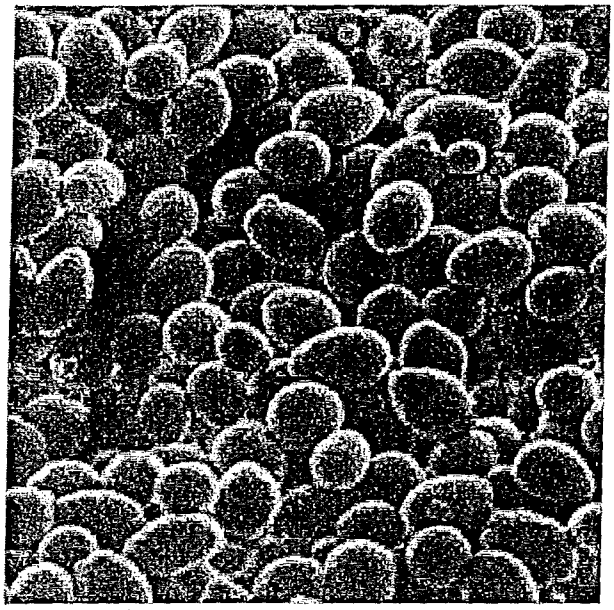




What is yeast and how is it made?

Yeasts consist of one cell, and belong to the taxonomic group called fungi, which also contains moulds.

There are many species of yeasts. The most common yeast known is *Saccharomyces cerevisiae*, which is used in the baking- and brewing industry. Yeasts also play an important role in the production of wine, kefir and some other products. Most yeasts used in the food industry are round and divide themselves through budding. This budding is a characteristic used to recognize them through a microscope. During budding the cells appear in 8-shaped forms.



Yeast cells

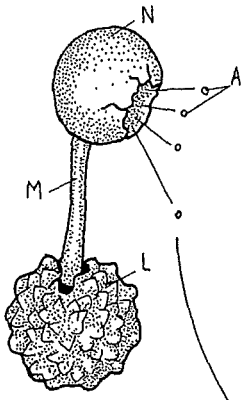
Yeasts need sugar to grow. They produce alcohol and carbon dioxide from sugar. This reaction makes yeast so important for the food industry. Yeasts also produce pleasant aroma components. These aroma compounds play a very important role for the flavour of the end product. In beer the yeast is needed to produce the alcohol and the carbon dioxide for the brim. In the bread industry, both alcohol and carbon dioxide are formed; the alcohol evaporates during baking.

Yeasts can be found everywhere in nature, especially on plants and fruits. After fruits fall off the tree, fruits become rotten through the activity of moulds, which form alcohol and carbon dioxide from the sugars in it. Sometimes drunk animals appear in the news because they have eaten these spoiled fruits.

Yeasts are grown in the industry in big tanks with sugary water in the presence of oxygen. When the desired amount of yeast is reached the liquid is pumped out, and the yeast is then dried. Nothing else is added in the production of yeast.

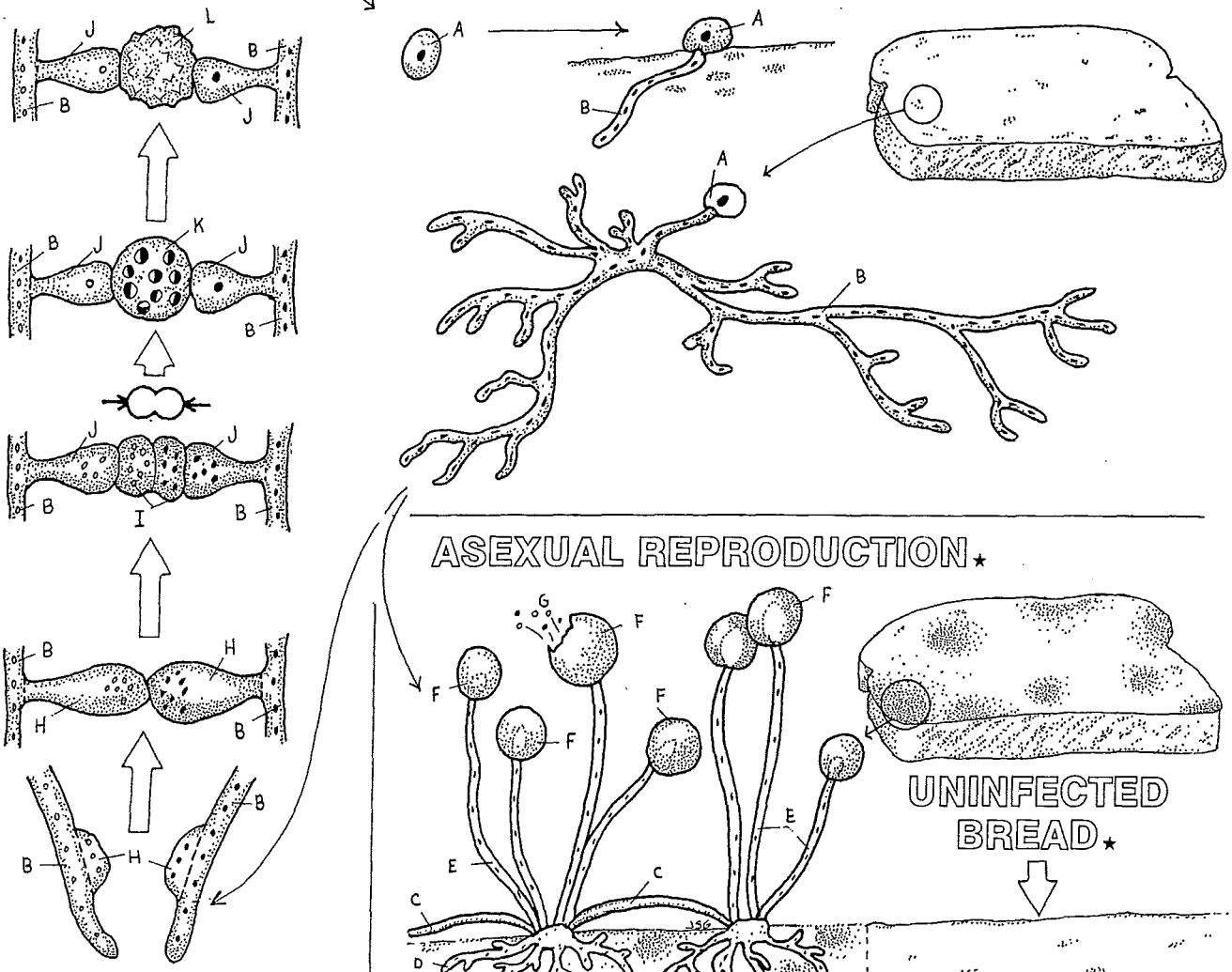
Carbohydrate

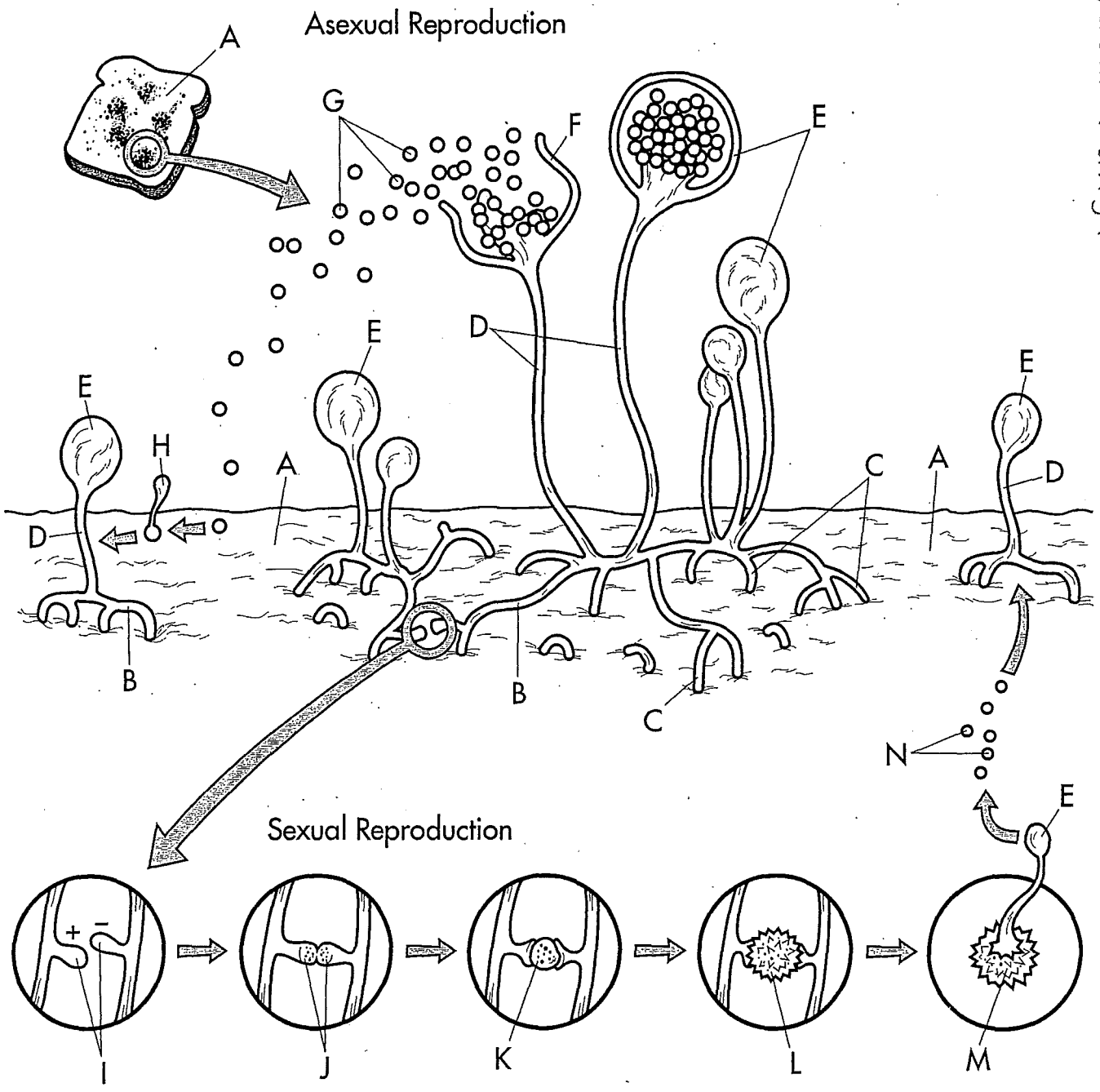
BLACK BREAD MOLD LIFE HISTORY.



MEIOSPORE$_A$
MYCELIUM★
HYPHA$_B$
STOLON$_C$
RHIZOID$_D$
ASEXUAL SPORANGIOPHORE$_E$
MITOSPORANGIUM$_F$
MITOSPORE$_G$
PROGAMETANGIUM$_H$
GAMETANGIUM$_I$
SUSPENSOR$_J$
ZYGOTE$_K$
ZYGOSPORE$_L$
SEXUAL SPORANGIOPHORE$_M$
MEIOSPORANGIUM$_N$

SEXUAL REPRODUCTION★





Kingdom Fungi

- ○ Bread.....A
- ○ Hypha.....B
- ○ Rhizoids C
- ○ Sporangiophores.....D
- ○ Sporangium .....E
- ○ Spore-releasing Sporangium .....F
- ○ Asexual Spores .....G
- ○ Germinating Spore.....H
- ○ Sexually Opposite Hyphae I
- ○ Gametangia .....J
- ○ Fusing Gametangia.....K
- ○ Zygospore.....L
- ○ Germinating Zygospore.....M
- ○ Sexual Spores.....N

Mushroom Dissection

Procedure

1. Identify the stalk, the cap, and the gills on a mushroom.
2. Carefully twist or cut off the cap. Use a magnifying lens to observe the gills. Look for spores.
3. Use the magnifying lens to observe the other parts of the mushroom. Try to find individual hyphae.

Analysis

1. **Sketch** the mushroom, and label its parts.

2. **Identify** the part of the mushroom that produces spores.

_____

_____

3. **Describe** the part of the mushroom that absorbs nutrients.

_____

_____

_____

_____

4. **Explain** how gills might help a fungus reproduce more efficiently.

_____

_____

_____

Lichens

36

All organisms classified in the same kingdom have some similarities. Thus, lichens, which contain a fungus, have some characteristics in common with other molds. But lichens are unique in that they are a combination of two different organisms, an alga and a fungus. These two organisms exist together in a symbiotic relationship. Symbiosis is the living together in close association of two different organisms.

In lichens, the alga is either a blue green or green species. Through photosynthesis, the alga provides food for the lichen. The alga is surrounded by the mycelium of the fungus, which provides moisture, protection, and possibly some minerals to the lichen. Because both organisms benefit from their association, a lichen is an example of a mutualistic relationship.

In this investigation, you will

(a) determine the specific lichen type of three lichen samples.
(b) diagram the macroscopic appearance of three lichen samples.
(c) observe and diagram the microscopic appearance of a typical lichen.

Materials

microscope
glass slide
coverslip
dropper
water
three lichen samples labeled A, B, and C
Cladonia (reindeer moss)

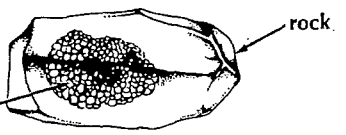
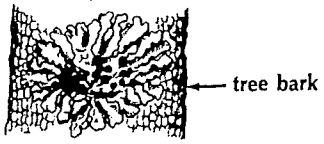
Procedure

Part A. Lichen Types and Appearance

Lichens are grouped into three different categories or types depending on their growth form and general shape. The three types are described in Table 1.

- Examine the lichen samples provided. Each sample is labeled with the letters A, B, or C for identification.
- Using your observations and the information given in Table 1, complete Table 2.

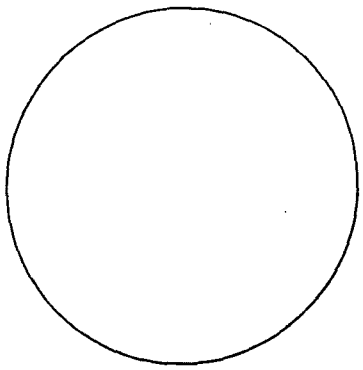
TABLE 1. LICHEN TYPE

LICHEN TYPE	DESCRIPTION	APPEARANCE
crustose	flat or crusty, forms a mat on rocks or bark	(natural size) 
foliose	spreading leaflike lobes, has a papery appearance	(natural size) 
fruticose	stalked vertical growth or branching, may appear hairlike or as branching threads	(2X natural size) 

Part B. Microscopic Appearance of Lichens

- Make a wet mount of a small piece of *Cladonia* (the size of a fingernail). Before adding the coverslip, mash the lichen with the eraser end of a pencil. Add one or two more drops of water if necessary.

- Observe the lichen under low and high powers of your microscope. Look for small round green cells (alga), and long, thin colorless strands (fungus). Diagram and label the parts of the lichen in the space provided.



***Cladonia* under high power**

TABLE 2. LICHEN CHARACTERISTICS				
SAMPLE	COLOR	GENERAL DESCRIPTION	DIAGRAM	TYPE
A				
B				
C				

Analysis

1. Define

   (a) lichen. _____

   (b) symbiosis. _____

   (c) mutualism. _____

2. How are lichens symbiotic? _____

   _____

3. (a) Microscopically, how do the two parts of a lichen differ? _____

   _____

   (b) Why is the color of the alga or cyanobacterium important to a lichen? _____

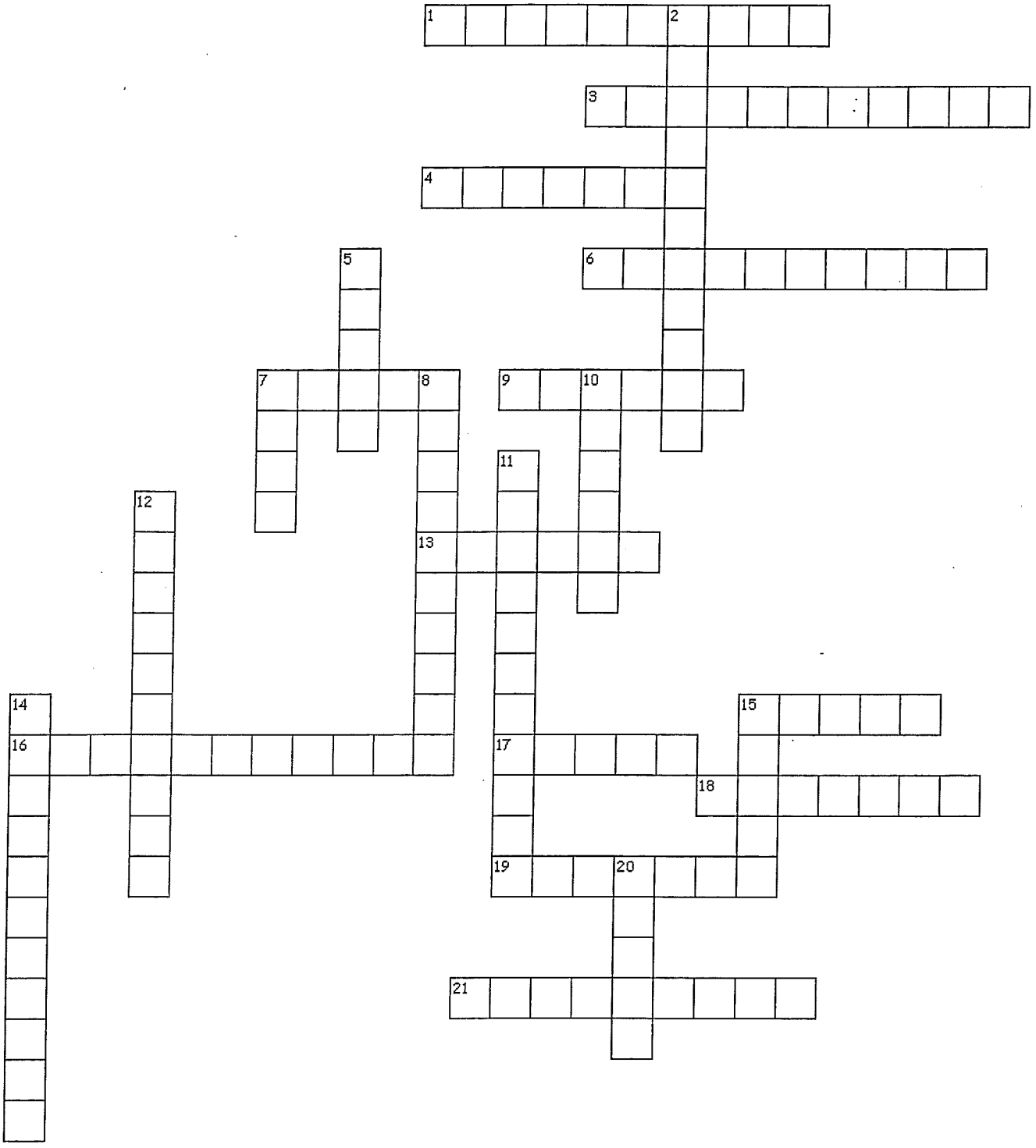
   _____

4. Explain how lichens can survive in barren conditions. _____

   _____

   _____

Ch 23 Crossword/ Vocab Flash Cards- complete the crossword and make a flashcard for each term with the word on one side and the definition on the back



Across

1. a vascular seed plant whose seeds are not enclosed by a fruit
3. the transfer of pollen from the male reproductive structures (anthers) to the tip of a female reproductive structure (pistil) of a flower in angiosperms or to the ovule in gymnosperms
4. a horizontal, underground stem that provides a mechanism for asexual reproduction
6. a flowering plant that produces seeds within a fruit
7. a cluster of sporangia
9. the female reproductive part of a flower that produces seeds and consists of an ovary, style, and stigma
13. the tip of a stamen, which contains the pollen sacs where pollen grains form
15. the leaf of a fern or palm
16. a female reproductive structure that produces a single egg and in which fertilization and development take place
17. an angiosperm that produces seeds that have two cotyledons
18. a waxy or fatty and watertight layer on the external wall of epidermal cells
19. an angiosperm that produces seeds that have only one cotyledon
21. the embryonic leaf of a seed

Down

2. the structure that contains the male gametophyte of seed plants
5. a reproductive cell or multicellular structure that is resistant to environmental conditions
7. a plant embryo that is enclosed in a protective coat
8. a specialized sac, case, capsule, or other structure that produces spores
10. the male reproductive structure of a flower that produces pollen and consists of an anther at the tip of a filament
11. a reproductive structure that produces male sex cells in seedless plants
12. in plants and algae that have alternation of generations, the diploid individual or generation that produces haploid spores
14. in alternation of generations, the phase in which gametes are formed; a haploid individual that produces gametes
15. a mature plant ovary; the plant organ in which the seeds are enclosed
20. a structure of a seed plant that contains a female gametophyte and that develops into a seed after fertilization

cuticle a waxy or fatty and watertight layer on the external wall of epidermal cells

Ch 23
Vocabulary Review

Using the word bank below, fill in each blank provided.

antheridium	pollen grain	sorus
archegonium	pollination	spore

_____ 1. a structure that makes eggs

_____ 2. a structure that makes sperm

_____ 3. a group of sporangia on a fern frond

_____ 4. contains a male gametophyte of a seed plant

_____ 5. a reproductive cell or structure that is resistant to environmental conditions

_____ 6. the transfer of pollen grains from the male to the female reproductive structure

Match the words on the left with the statements on the right.

_____ 7. angiosperm

_____ 8. cotyledon

_____ 9. dicot

_____ 10. gymnosperm

_____ 11. monocot

_____ 12. seed

a. leaflike structure that is part of a plant embryo

b. a seed plant that produces seeds in fruit

c. flowering plant with seeds that have one seed leaf

d. a seed plant that produces cones instead of fruit

e. made up of a plant embryo surround by a protective coat

f. flowering plant with seeds that have two seed leaves

Circle the term that best completes each sentence.

13. The female reproductive part of a flower is the (anther, pistil, or rhizome).

14. The (fruit, rhizome, or spore) is the horizontal underground stem of a fern.

15. The (petal, frond, or stamen) of a flower consists of an anther and a filament.

16. A structure in which spores form is called a (sporangium, frond, or fruit).

Using the word bank below, fill in each blank provided.

cuticle frond fruit

17. The spore-bearing leaf of a fern is called a _____.

18. The _____ is a waxy layer that covers the nonwoody, aboveground parts of most plants.

19. The seeds of angiosperms develop within a _____.

Using the word bank below, fill in each blank provided.

anther ovule sporophyte
gametophyte pollen grain

_____ 20. a structure that carries a plant's sperm

_____ 21. the pollen-producing sac of a seed plant

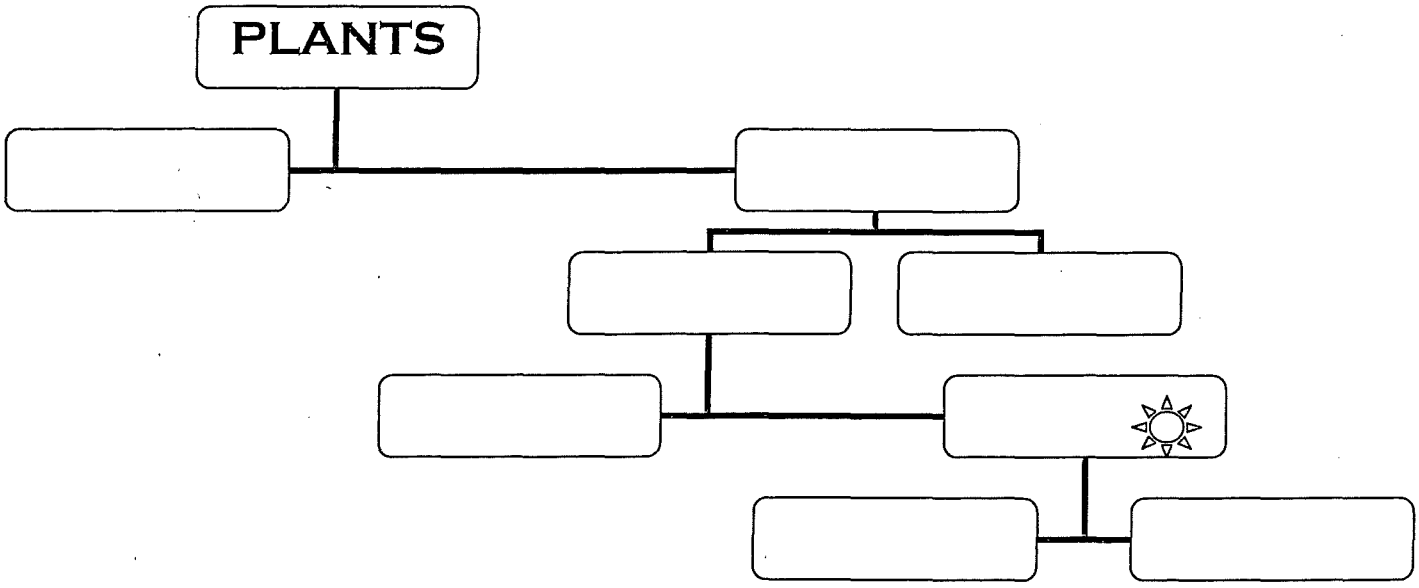
_____ 22. the stage in plant life cycles that produces spores

_____ 23. the stage in plant life cycles that produces gametes

_____ 24. a flower structure that contains an egg and becomes a seed

Chapter 23 Plant Diversity and Life Cycles

2 Types of plants: nonvascular (no water/food carrying tubes) and vascular plants (has xylem and phloem).Vascular plants are further broken down into seedless and seed. Seed plants are then broken down into gymnosperms and angiosperms. Angiosperms can be either monocot or dicot



I. PLANT LIFE CYCLES-Plants have life cycles in which _____ gametophytes alternate with _____ sporophytes. A life cycle in which a gametophyte alternates with a sporophyte is called _____ of _____.

II. <u>NONVASCULAR PLANTS</u>-Nonvascular plants are small plants that reproduce by means of spores.

A. NO CONDUCTING TISSUE-They lack true _____, _____, and _____, which are complex structures

that contain vascular, or conducting, tissues. In nonvascular plants, water and nutrients are transported by _____ and _____, which move materials short distances and very slowly. This method of transport greatly limits the size of a nonvascular plant's body. Thus, all nonvascular plants are relatively small. Mosses, liverworts, and hornworts are examples of nonvascular plants.

B. REPRODUCTION IN NONVASCULAR PLANTS-In the life cycle of nonvascular plants, the gametophyte is the _____ generation. Gametophytes must be covered by a film of _____ in order for fertilization to occur.

III. SEEDLESS VASCULAR PLANTS-Sporophytes of seedless vascular plants have vascular tissue, but _____ lack vascular tissue. Because of their vascular system, vascular plants grow much larger that nonvascular plants and also develop _____ roots, stems, and leaves.

A. Seedless Vascular Types

1. There are two major groups of seedless vascular plants: _____ (lycophytes) and _____ and related species (monilophytes).

2. Unlike true mosses, club mosses have roots, stems, and leaves. Their leafy green stems branch from an underground rhizome. A _____ is a horizontal, underground stem.

3. Most fern sporophytes have a rhizome that is anchored by roots and have leaves called _____. The coiled young leaves of a fern are called _____.

4. _____ are related to ferns. They have hollow vertical stems with joints and whorls of scalelike leaves that grow at the joints.

B. REPRODUCTION IN SEEDLESS VASCULAR PLANTS- Some ferns have sporophytes that are as large as _____ In most species of seedless vascular plants, both eggs and sperm are produced by the _____ _____.

IV. VASCULAR SEED PLANTS-Seed plants are traditionally classified into two groups—_____ and _____.

A. Seeded Vascular Types

1. _____ are seed plants whose seeds do _____ develop within a _____ Most of these seeds develop in a _____.The word gymnosperm comes from the Greek words gymnos, meaning "naked," and sperma, meaning "seed."

2. _____ are seed plants whose seeds develop enclosed within a _____. Fruits develop from part of a flower.The word angiosperm comes from the Greek words angeion, meaning "case," and sperma, meaning "seed."Therefore, angiosperms are _____ plants. Most species of _____ plants are flowering plants.

B. REPRODUCTION IN SEED PLANTS-Unlike seedless plants, seed plants do not require water to reproduce sexually. Reproduction in seed plants is also characterized by a greatly reduced gametophyte and a dominant _____.

1. Following fertilization, the _____ and its contents develop into a _____

2. The male gametophyte of seed plants develops inside a _____.

3. The transfer of pollen grains from the male reproductive structures of a plant to the female reproductive structures is called pollination.

4. After fertilization, the ovule is called a seed and contains an _____.

5. Dispersal may prevent competition for water, nutrients, light, and living space between _____ and _____

6. Many seeds have structures that help _____ _____ or _____ carry them away from their parent plant.

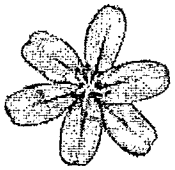
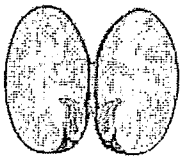
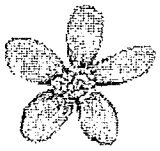
V. GYMNOSPERMS- There are four major groups of gymnosperms: conifers, cycads, ginkgoes, and gnetophytes. Conifers are the most familiar gymnosperms. Conifers have leaves that are needle-like or that are reduced to tiny scales.Some examples of conifers are _____ and _____

VI. ANGIOSPERMS-Botanists traditionally divide the angiosperms into two subgroups—_____ and _____. Angiosperms are the most successful group of plants and range in size from tiny herbs to giant trees.

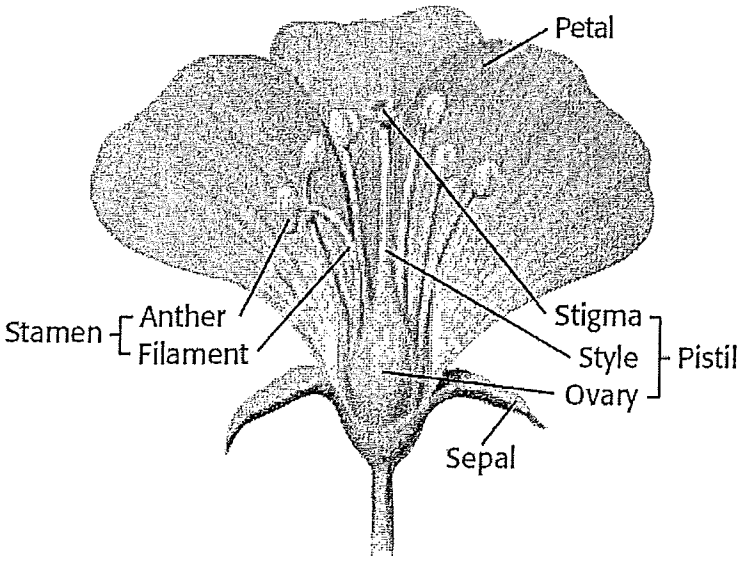
A. _____- Monocots are flowering plants whose seeds have _____ seed leaf, or _____. Most monocots have long, narrow leaves with _____ veins and produce flowers whose parts are in multiples of _____

B. _____- Dicots are flowering plants whose seeds have _____ seed leaves. Most dicots have leaves with _____ veins and produce flowers whose parts are in multiples of _____

Characteristics of monocots and dicots:

Comparing Monocots and Dicots			
Plant type	**Leaves**	**Flower parts**	**Examples**
Monocots 	parallel venation 	usually occur in threes 	lilies, irises, palms, orchids, coconuts, onions, bananas, tulips, and grasses (including wheat, corn, rice, and oats)
Dicots 	net venation 	usually occur in fours or fives 	beans, lettuce, oaks, maples, roses, carnations, elms, cactuses, and most broad-leaved forest trees

C. REPRODUCTION IN ANGIOSPERMS- A flower is a specialized reproductive structure of angiosperms. The male and female gametophytes of angiosperms develop within flowers, which promote pollination and fertilization more efficiently than do cones. The female part of a flower provides a pathway for sperm to reach the eggs without having to swim through water. Flower parts are arranged in _____ concentric whorls.



A typical flower contains sepals, petals, stamens, and one or more pistils.

D. POLLINATION- The flowers of many angiosperms are adapted for pollination by wind or by animals.

1. Flowers may have brightly colored petals, sugary nectar, strong odors, and shapes that attract _____ Flowers are a source of food for pollinators such as insects, birds, and bats.

2. Some flowers, such as those of grasses or oaks, are pollinated by wind. _____-_____ flowers are usually small and lack bright colors, strong odors, and nectar.

E. FRUITS-Although fruits provide some protection for developing seeds, they primarily function in _____ _____

1. A fruit is a structure that develops from an _____ of a flower and contains _____.

2. Many fruits are eaten by _____. The fruits' seeds are dispersed as they pass _____ through the animals.

3. Other fruits, such as the maple seed, have structures that help them _____ on wind or water.

VII. VEGETATIVE REPRODUCTION- Plants reproduce _____ in a variety of ways that involve nonreproductive parts, such as _____, _____, and _____. The reproduction of plants from these parts is called _____ _____.

A. In most plants, _____ reproduction is faster than _____ reproduction. By reproducing vegetatively, a single plant can spread rapidly in a habitat that is ideal for its growth.

B. People often grow plants from vegetative parts that are specialized for vegetative reproduction. For example, in _____ such as potatoes, a single tuber can be cut or broken into pieces such that each piece has at least one bud. Each of these pieces can grow into new shoots.

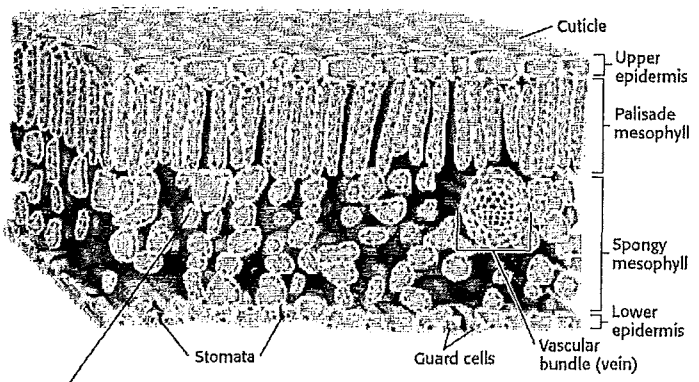
Chapter 24 Seed Plant Structure and Growth

I. PLANT TISSUES- Vascular plants have three tissue systems—

A. _____tissue forms the protective outer layer of a plant.

B. _____ tissue forms strands that conduct water, minerals, and organic compounds throughout a vascular plant.

C. _____ tissue makes up much of the inside of the nonwoody parts of a plant, including roots, stems, and leaves.



II.DERMAL TISSUE SYSTEM- Dermal tissue covers the outside of a plant's body. In the nonwoody parts of a plant, dermal tissue forms a "skin" called epidermis.

A. Extensions of the epidermal cells on root tips, called _____ _____, help increase water absorption.

B. A waxy _____ coats the epidermis of stems and leaves. The cuticle protects the plant and prevents water loss.

C. Pores called _____ (singular, stoma) permit plants to exchange oxygen and carbon dioxide. A pair of specialized cells called _____ _____ borders each stoma. _____ open and close as the guard cells change shape.

D. In addition to its role in protection, dermal tissue functions in gas exchange and in the absorption of mineral nutrients.

III. VASCULAR TISSUE SYSTEM- Vascular plants have two kinds of vascular tissue, called xylem and phloem, that transport water, minerals, and nutrients throughout the plant.

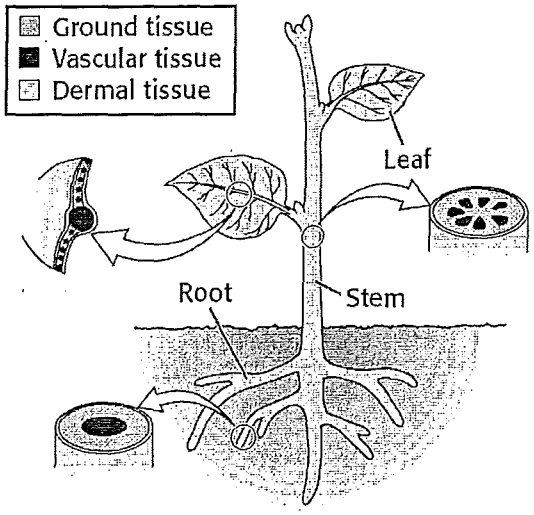
A. _____ is composed of thick-walled cells that provide support and conduct _____ and mineral nutrients from a plant's roots through its stems to its leaves.

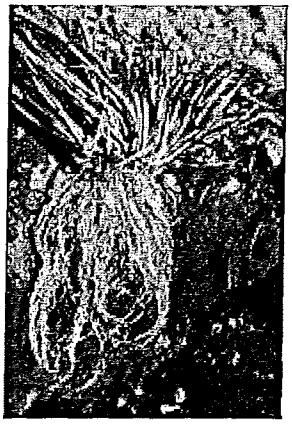
B. _____ is made up of cells that conduct _____ and nutrients throughout a plant's body.

IV. ROOTS- Most plants are anchored to the spot where they grow by roots, which absorb water and mineral nutrients. In many plants, roots also function in the storage of organic nutrients, such as sugar and starch.

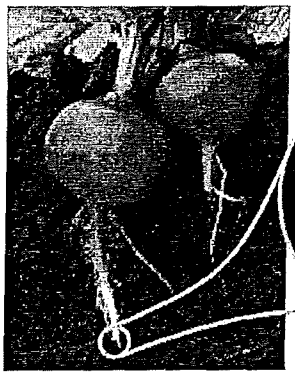
A. Most monocots, such as _____, have a highly branched, fibrous root system.

B. Many dicots, such as _____ and radishes, have a large central root from which smaller roots branch. This type of system is called a taproot system.



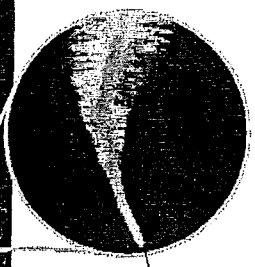


Most monocots, such as grasses, have highly branched root systems. This is a *fibrous root system*. There is not one main root.



Many dicots, such as these radishes, have a large central root called a *taproot*.

Root hairs increase the surface area of a root.

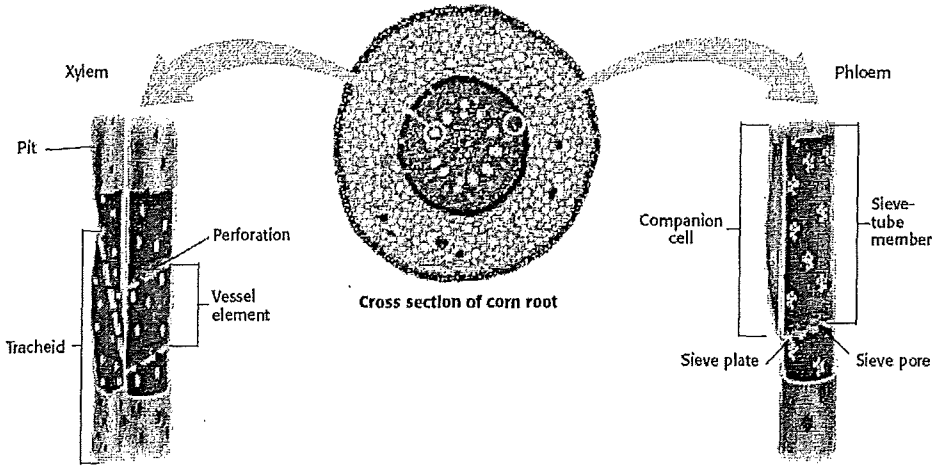


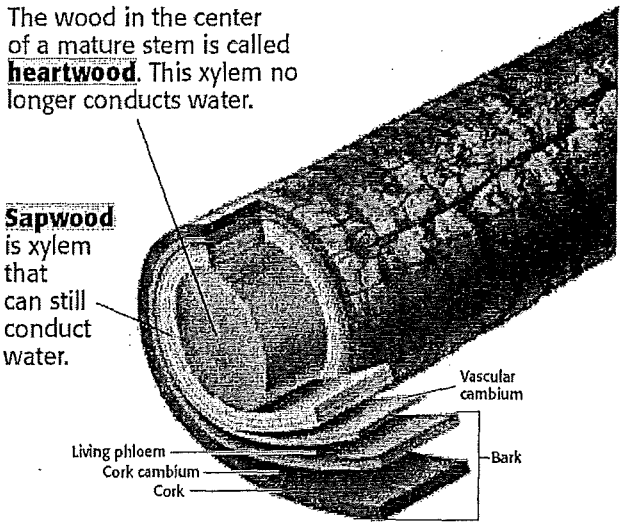
A *root cap* is a mass of cells that protects the growing root tip.

V. STEMS- Stems support the leaves and house the vascular tissue, which transports substances between the roots and the leaves.

A. A plant with stems that are flexible and usually green is called a _____ plant. The stems of herbaceous plants contain bundles of xylem and phloem called vascular bundles. The tissue at the center of the stem of most vascular plants is called the _____.

B. Woody stems, such as those of trees and shrubs, are stiff and nongreen. The wood in the center of a mature stem or tree trunk is called _____. _____, which lies outside the heartwood, contains vessel elements that can conduct water.





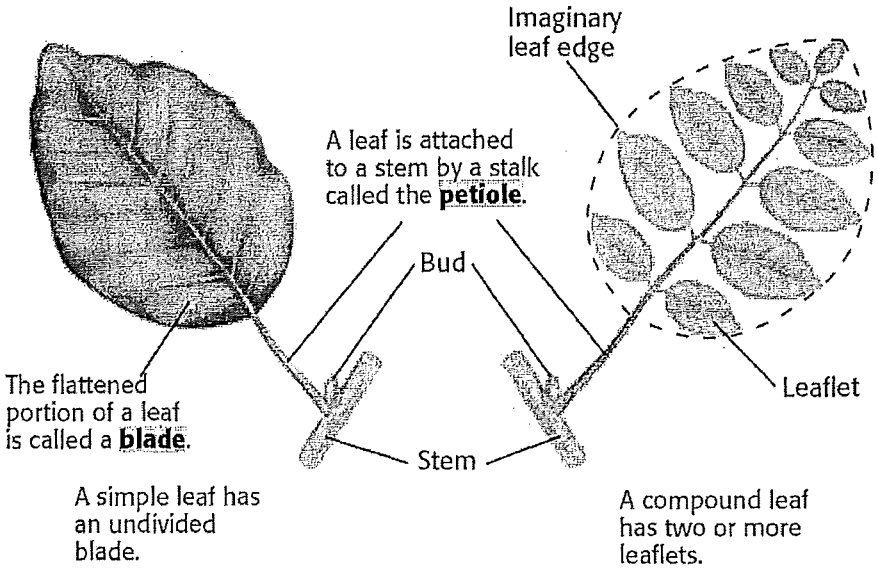
VI. LEAVES- Leaves are the primary photosynthetic organs of plants.

A. Most leaves have a flattened portion, the blade, which is usually attached to a stem by a stalk, called the _____

B. A cuticle coats the upper and lower epidermis.

C. Both xylem and phloem are found in the _____ of a leaf. Veins are extensions of vascular bundles that run from the tips of roots to the edge of leaves.

D. In leaves, the ground tissue is called _____. Mesophyll cells are packed with _____, where _____ occurs.



VII. MERISTEMS- Plants grow by producing new cells in regions of active cell division called meristems.

A. Growth that increases the length or height of a plant is called _____ _____.

B. Growth that increases the width of stems and roots is called _____ _____.

VIII. PRIMARY GROWTH- Primary growth makes a plant's stems and roots get _____ without becoming wider.

A. Apical meristems, which are located at the _____ of stems and roots, produce primary growth through cell division.

B. Each branch of a stem and each branch of a root has its own _____ _____ that produces new primary tissues as the branch grows.

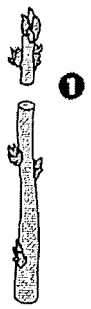
IX. SECONDARY GROWTH- _____ _____ are responsible for increases in the _____ of stems and roots. This increase is called secondary growth.

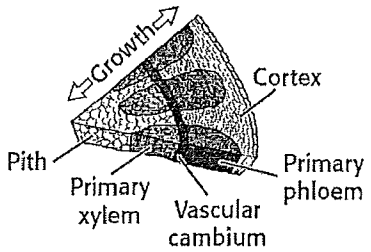
A. Some of the undifferentiated cells that are left behind as stems and roots lengthen and produce lateral meristems.

B. The two lateral meristems responsible for secondary growth are called the _____ _____ and the _____ _____.

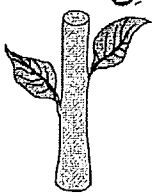
Secondary Growth

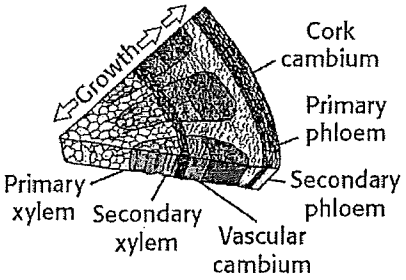
❶ A young stem has a ring of vascular bundles between the cortex and the pith. Each vascular bundle has primary xylem and primary phloem.



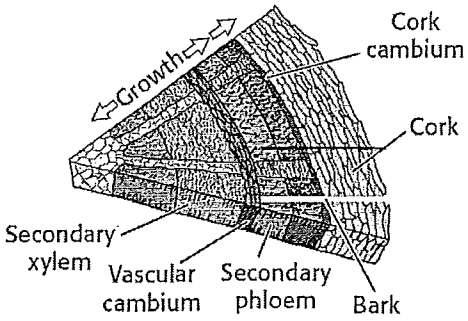


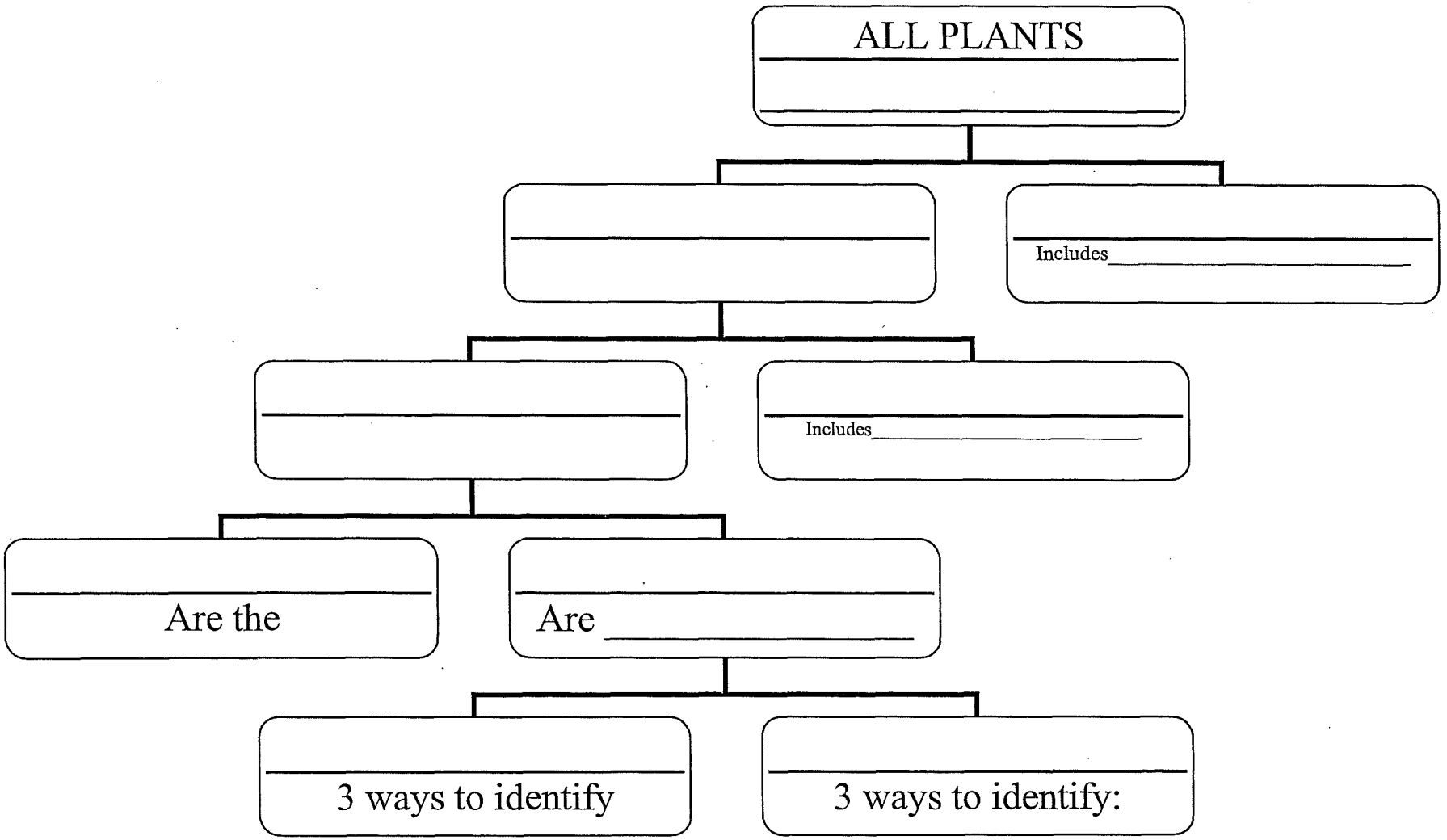
❷ The vascular cambium develops between the primary xylem and the primary phloem.





❸ Thick layers of secondary xylem, or wood, typically form rings. One new ring generally forms each year. Thus, the rings are called *annual rings*.




ALL PLANTS
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CH 23 SEC 2

1. Why are nonvascular plants small?

2. Identify three groups of nonvascular plants.

3. What is the main generation in the life cycle of a nonvascular plant?

4. Describe two ways in which seedless vascular plants are different from nonvascular plants.

5. In addition to gametes, what is needed for fertilization to occur in both nonvascular plants and seedless vascular plants?

6. What is the role of spores in the reproduction of nonvascular plants and seedless vascular plants?

7. What two structures on the gametophytes of nonvascular plants and seedless vascular plants produce eggs and sperm?

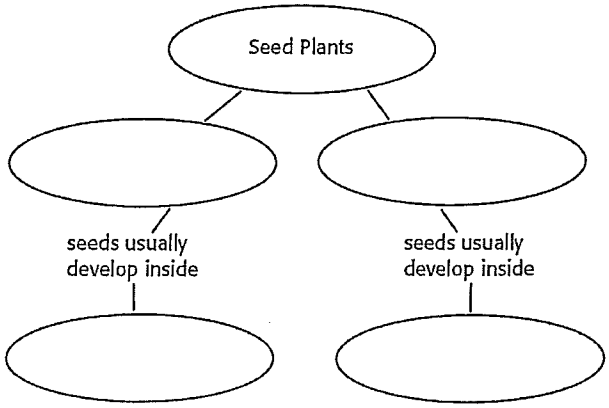
BELLRINGER CIRCLE M T W TH FRI DATE
QUESTION

ANSWER

HOMEWORK DATE DUE_____

CH 23 SEC 3

1. Fill in the Concept Map below to show the two main groups of seed plants and where their seeds develop.



2. In seed plants, how does the size of the gametophyte compare with the size of the sporophyte?

3. How does seed dispersal benefit both parent plants and their offspring?

4. Name the four major groups of gymnosperms.

5. In conifers, how are pollen grains typically carried to seed cones?

BELLRINGER QUESTION CIRCLE M T W TH FRI DATE

ANSWER

PLANT REVIEW

Most of the energy used by life on Earth comes from the _____

Light energy is converted to chemical energy through the process of _____

As light intensity increases, the rate of photosynthesis _____

Low temperatures may cause photosynthesis to occur _____

Which of the following environmental factors does not affect the rate of photosynthesis? _____

The name of the process that takes place when organic compounds are broken down in the absence of oxygen is _____

Fermentation enables glycolysis to continue under _____

If oxygen is absent during the second stage of cellular respiration, _____

Cells produce ATP most efficiently in the presence of _____

The ancestors of today's land plants were probably _____

The waxy protective covering of a land plant is called a _____

The diploid form in a plant's life cycle is called the _____

The haploid form in a plant's life cycle is called the _____

Fiddleheads are produced by _____

Flowering plants are classified as monocots or dicots according to the number of their _____

The primary function of root hairs is _____

The center region of ground tissue in a herbaceous stem is known as the _____

Leaves connect to the stems of plants at the_____

Plants grow in regions of active cell division called _____

During periods of primary growth at apical meristems, stems and roots do what? _____

what is an autotroph? _____

ATP is composed of a nitrogenous base, a sugar, and _____

ATP is called a cell's energy "currency" because _____

An enzyme that catalyzes the synthesis of ATP is _____

Chlorophyll is green because _____

The major atmospheric by-product of photosynthesis is _____

what has photosynthesis done to the atmosphere? _____

When glycolysis occurs, what happens to glucose? _____

What is the net gain of ATP molecules in glycolysis? _____

Cellular respiration takes place in two stages: _____ _____

Which processe produces the most ATP? _____

If a flower has 9 petals, the leaves will have _____

The stomata prevent water vapor and carbon dioxide from entering and leaving the leaf. The size of the stomata are controlled by_____