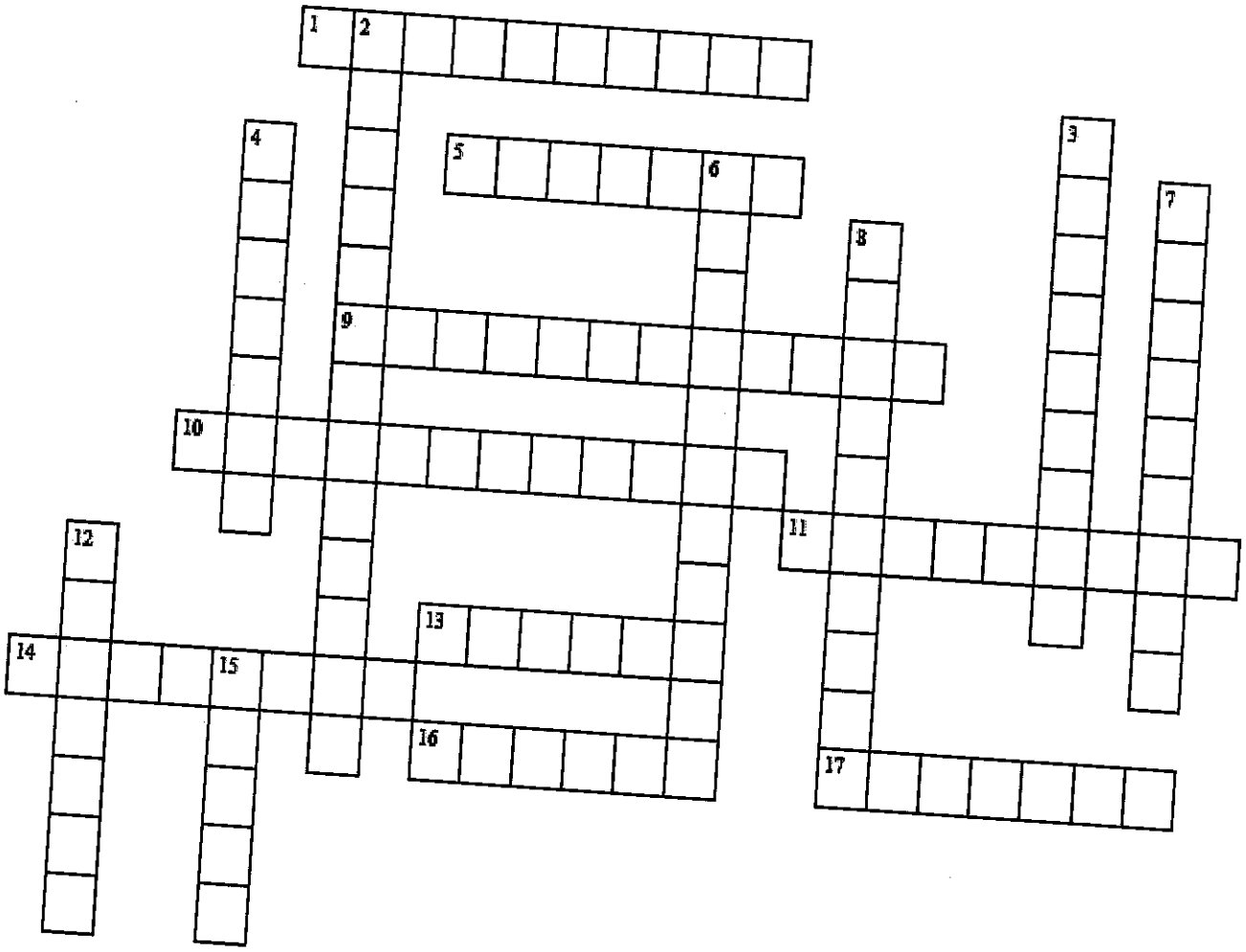
AP Biology (Davidkumar) Students

Darwin – Crossword Puzzle



Activity A: Darwin's Life

ACROSS

1 When farmers purposely breed cows to create new breeds that produce more milk, this is an example of _____

DOWN

2

3 The captain of the Beagle (two words) Darwin's father's job

selection.

5 The type of bird that Darwin studied the most

9 The fossil of Archeopterix is an example of a _____ form between reptiles and birds.

10 Evolution is descent with _____.

11 Darwin made some of his most important observations on the _____ islands.

13 The boat Darwin worked on

14 Humans and apes have a common _____.

4 The earth is 4.5 _____ years old.

6 The _____ can influence adaptation.

7 The Galapagos islands were formed by _____.

8 In natural selection, _____ is the process of an organism becoming better suited to its environment.

12 One of Darwin's favorite hobbies

15 The HMS Beagle was sent to map the coast of _____ America.

16 Darwin's middle name

17 _____ selection is a law of nature that leads to adaptation in all species.

The Evolution of Populations

What truly fuels evolution? Why is genetic variation so important? Are there any situations in which evolution will not occur? What are the different types of Natural Selection? Do individual organisms evolve? Explain.

Compare and contrast discreet with quantitative characteristics.

Geographic Variation -

Mutation -

How does sexual reproduction affect evolution?

Population -

Gene Pool -

What is the **Hardy-Weinberg Equalibrium**? How can this be used to study evolution? Write and translate the formula.

How does natural selection alter gene frequencies?

Genetic Drift -

Founder Effect -

Bottleneck Effect -

List and summarize the four key points of Genetic Drift.

Gene Flow -

What does gene flow do to allele frequencies between populations?

Relative Fitness -

Describe the 3 types of natural selection? Draw what the gene frequency graphs for each type of selection.

Directional Selection **Disruptive Selection** **Stabilizing Selection**

Sexual Selection -

Sexual Dimorphism -

Compare and contrast **Intrasexual Selection** with **Intersexual Selection**. Use examples in your explanations.

Explain how the situations listed below help to ***maintain genetic variation***.
Diploidy -

Heterozygote Advanatage -

Frequency Dependent Selection -

Neutral Variation -

Why can't natural selection create "perfect" organisms

Descent With Modification: A Darwinian View of Life

Why descent with modification? What exactly is Natural Selection, and Survival of the Fittest?
What evidence is there to support evolution?

Evolution -

What did Linnaeus do?

Fossils -

Explain briefly the beliefs and studies of Hutton.

Explain briefly the beliefs and studies of Lyell.

Explain briefly the beliefs and studies of Lamarck. Was Lamarck accurate?

Adaptations -

Natural Selection -

What is meant by ***Descent with Modification***?

Artificial Slection -

How does artificial selection provide evidence for evolution?

What are the recap bullets of natural selection?

Explain the Guppy experiment that illustrates evolutionary change

How does the fossil record support evolution? Cite specific examples.

Homology -

Homologous Structures -

How does homology support evolution? Cite specific examples.

Vestigial Structures -

What is **Convergent Evolution**? Cite a specific example.

What is **Biogeography?** How does it support evolution?

Endemic -

Describe what an evolutionary tree is. What does it display? How so?

Vocabulary

Ethology

Behavior

Stimulus

External Stimulus

Internal Stimulus

Imprinting

Imprinting

Habituation

Classical Conditioning

Operant Conditioning

Reasoning

Types of animal behavior (Any 10)

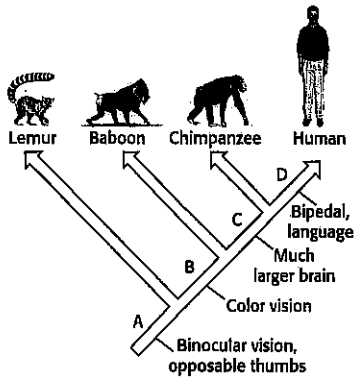
Make a booklet. Include pictures!! (Print/ Draw). Make it colorful and attractive!!

Student #_____ Name:_____

Period:_____ Date:_____

Worksheet: Understanding Branching Diagrams (Cladograms)

Directions: Use the branching diagrams to answer the questions that go with them.



1. Which organisms have a large brain?

_____

2. Which organism shares the most traits with humans?

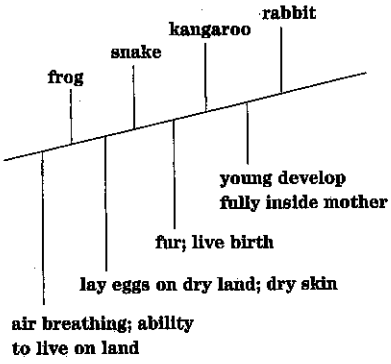
_____

3. What trait does a baboon have that a lemur does not?

_____

4. What 2 traits separate humans from all other primates in the diagram?

a) _____ b) _____



5. What trait makes a rabbit different from a kangaroo?

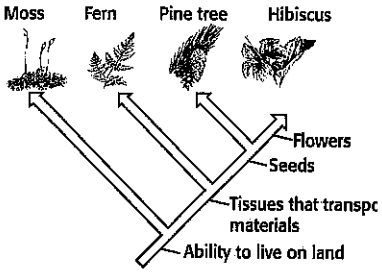
_____

6. Which organisms give birth to live young?

_____

7. All of the organisms shown share which 2 traits?

a) _____ b) _____



8. Mosses and ferns do not produce _____ and flowers.

9. Which is the only organism that makes flowers?

_____

10. Which plant is most closely related to the hibiscus?

_____

11. All of the plants shown are able to do what according to the diagram?

_____

12. Which organisms have tissues that transport materials?

_____

Name:_____ **Date:** _____ **Hour:**_____

CLADOGRAM ANALYSIS

What is a cladogram? It is a diagram that depicts evolutionary relationships among groups. It is based on **PHYLOGENY,** which is the study of evolutionary relationships. Sometimes a cladogram is called a phylogenetic tree (though technically, there are minor differences between the two).

In the past, biologists would group organisms based solely on their physical appearance. Today, with the advances in genetics and biochemistry, biologists can look more closely at individuals to discover their pattern of evolution, and group them accordingly - this strategy is called **EVOLUTIONARY CLASSIFICATION**

CLADISTICS is form of analysis that looks at features of organisms that are considered "innovations", or newer features that serve some kind of purpose. (Think about what the word "innovation" means in regular language.) These characteristics appear in later organisms but not earlier ones and are called **DERIVED CHARACTERS.**

Fill out the following character matrix. Mark an "X" if an organism has the trait.

	Cells	Legs	Antenna	Wings	2 sets of wings
Worm					
Spider					
Carpenter Ant					
House fly					
Dragonfly					

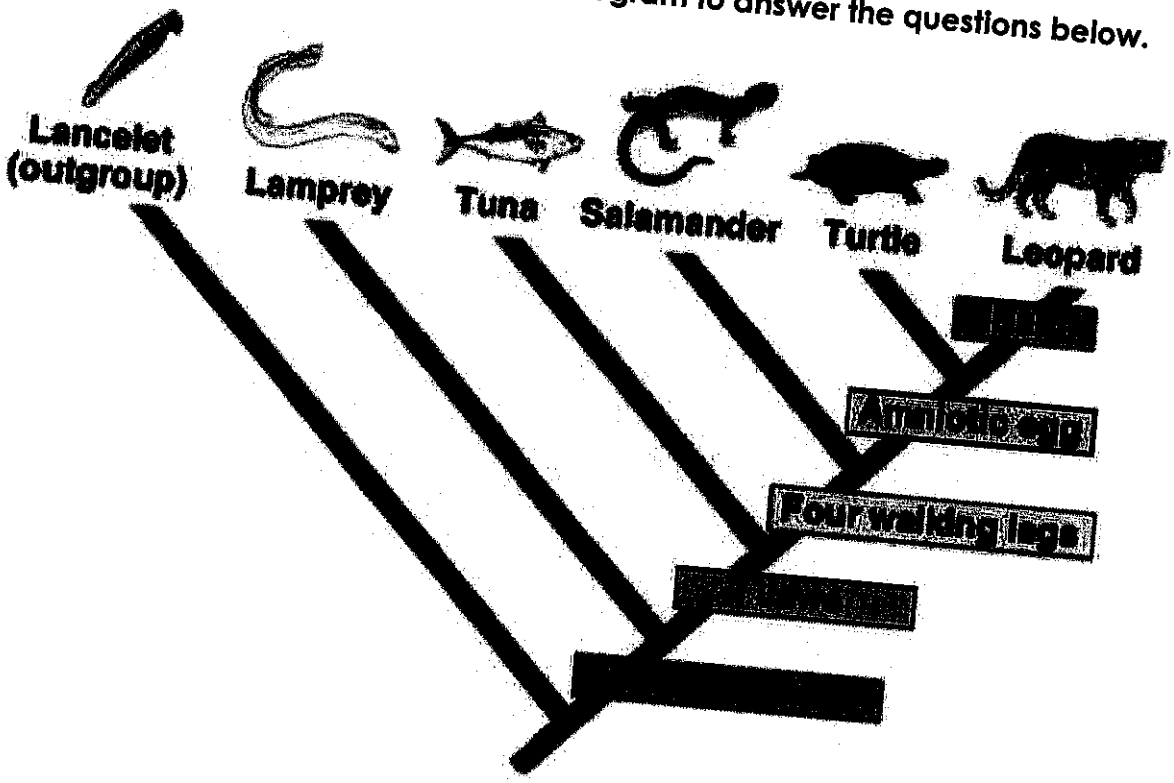
In the box below, create a cladogram based off your matrix.

1. According to your cladogram, which two species are more closely related: worms and spiders or worms and ants? **How do you know?**

2. According to your cladogram, what species are dragonflies most closely related to? **How do you know?**

3. In a different colored writing utensil, add a June Bug to your cladogram based on its characteristics.

Use the following cladogram to answer the questions below.



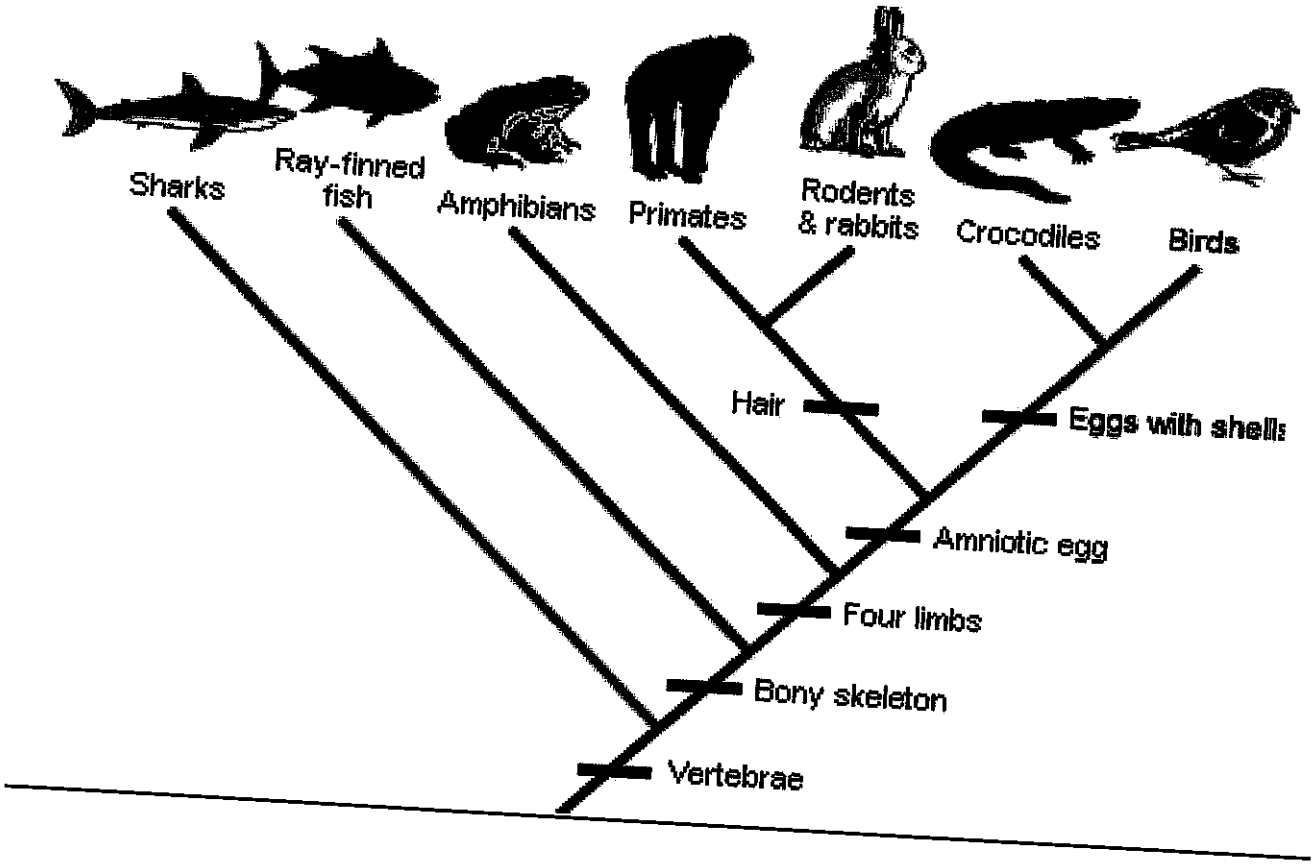
4. What trait separates lampreys from tuna on this cladogram?

5. What separates a salamander from a turtle?

6. Which organism is most related to the leopard?

7. Which organism's DNA will differ the most from the leopard? **Why?**

Use the following cladogram to answer the questions below.



8. What separates rabbits/primate from the crocodiles on this cladogram?

9. Which organism is most related to the rodents and rabbits on this cladogram?

10. What 5 traits do the bird and its closest relative share?

a.

b.

c.

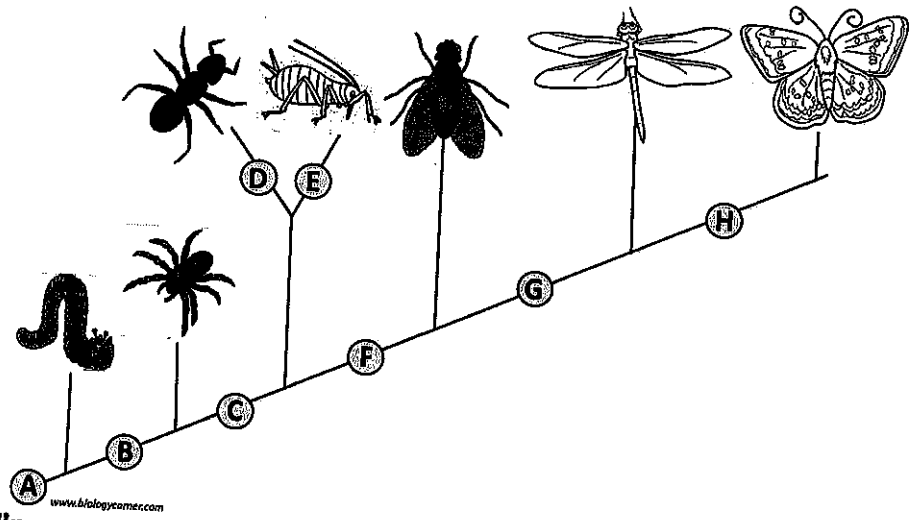
d.

e.

11. Which organism will have DNA most similar to the bird? **Why?**

12. Which organism's DNA will differ the most from the bird? **Why?**

Examine the cladogram below. Each letter represents a derived characteristic. Match the letter to its characteristic.



13._____ **Wings**

14._____ **6 legs**

15._____ **Segmented Body**

16._____ **Double set of wings**

17._____ **Cerci (back appendages)**

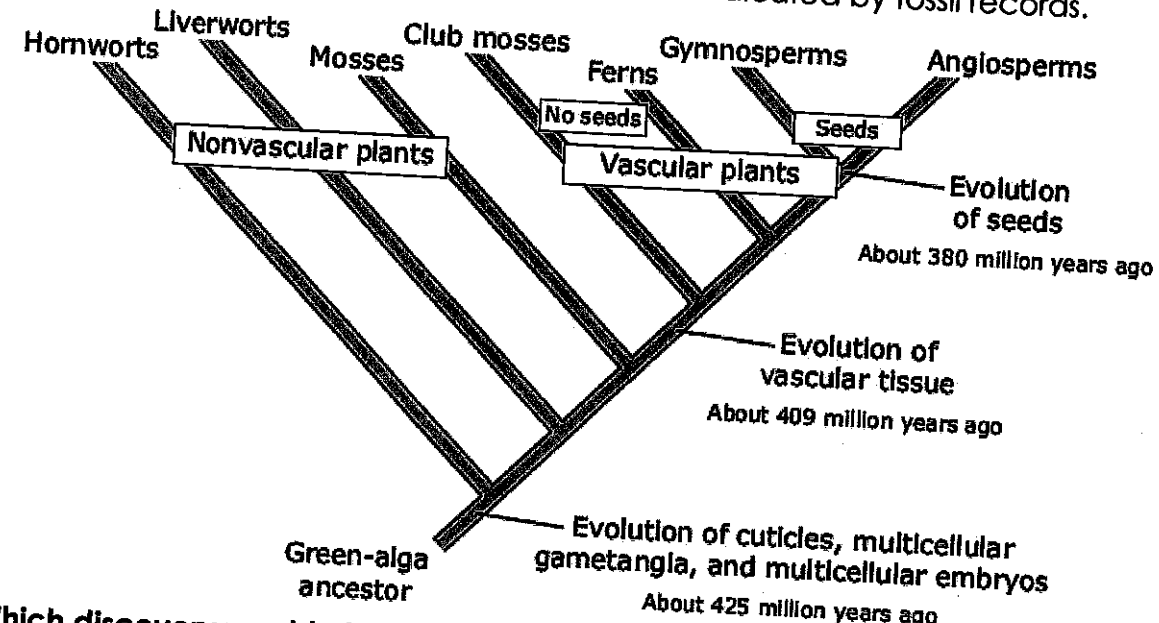
18._____ **Crushing mouthparts**

19._____ **Legs**

20._____ **Curly Antennae**

Circle the correct answer for the cladogram question below.

The cladogram shows the evolution of land plants as indicated by fossil records.



21. **Which discovery would challenge the validity of this cladogram?**

A. A large aquatic vascular plant about 200 million years old
B. A species of algae that has existed for less than one million years
C. A moss species that has existed for less than 380 million years
D. A fossil of a fern more than 425 million years old

Biologically, one could use anatomical features, behavior, or molecular similarities and differences in constructing a cladogram. Molecularly, one could look at the number of mutations in a common strand of DNA. Another way would be to compare strings of amino acids and note differences in the order of the amino acids.

Cytochrome c is a protein located in the mitochondria of cells involved with cellular respiration. Below is a table showing the amino acid sequences for cytochrome c in several organisms.

Organism	**Biochemical Data**
Amoeba	Amino Acid Sequence: ISO-SER-ASP-GLN-PHE-ILE-LEU-GLN-SER-ARG-LEU-LEU-HIS DNA Sequence: ATTAGCGACCAGTTTATCCTACAATCCCGTCTACTTCAT
Kangaroo	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-HIS-LEU-LEU-SER DNA Sequence: CTAATCCCCCCGTTTATCCTACTTTCCCATCTACTAAGT
Earthworm	Amino Acid Sequence: LEU-ISO-ASP-PRO-PHE-ILE-LEU-HIS-SER-ARG-LEU-LEU-ARG DNA Sequence: CTTATCGACCCGTTTATCCTACATTCCCGTCTACCTTCGT
Cat	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-HIS-LEU-LEU-SER DNA Sequence: TTAATCCCCCCGTTTATCCTACTTTCCCATCTACTAAGT
Shark	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-ARG-LEU-LEU-ARG DNA Sequence: CTTATCCCCCCGTTTATCCTACTTTCCCGTCTACTTCGT
Dolphin	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-HIS-VAL-VAL-SER DNA Sequence: CTAATCCCCCCGTTTATCCTACTTTCCCATGTAGTAAGT
Lizard	Amino Acid Sequence: LEU-ISO-PRO-PRO-PHE-ILE-LEU-LEU-SER-ARG-LEU-LEU-ARG DNA Sequence: CTAATCCCCCCGTTTATCCTACTTTCCCGTCTACTTCGT
Sponge	Amino Acid Sequence: ISO-ISO-ASP-GLN-PHE-ILE-LEU-HIS-SER-ARG-LEU-LEU-ARG DNA Sequence: ATTATCGACCAGTTTATCCTACATTCCCGTCTACTTCGT

22. The more amino acids that an organism has in common, both type and order, indicates the closer the relationship. The same is true for nucleotides. Compare the biochemical data above. Which organism is most closely related to the lizard? Why?

23. Which organism is most closely related to the Dolphin? Why?

24. How do you think different amino acid sequences would effect organisms? Explain your answer.

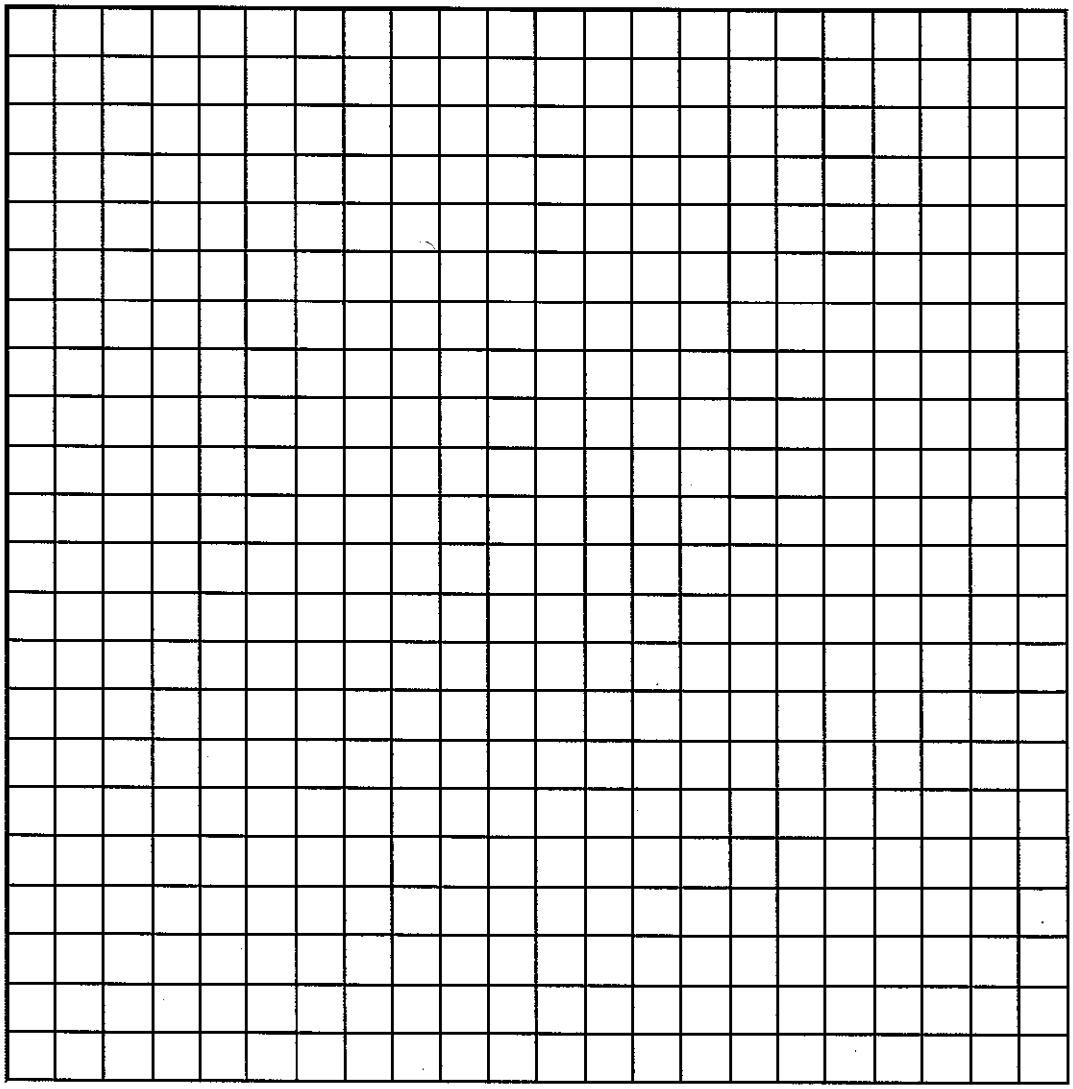
Name: _____ Period: _____ Date: _____

Natural Selections in Populations

Ex. 1 - A scientist has been examining a specific population of spiny cacti, which is originally in genetic equilibrium. A road is built quite close to the study site, which keeps away the parasitic insects, but with the road comes the tourists. In many desert areas of the United States, passing cactus lovers like to pick up a souvenir cactus to take home with them after a day-trip out into the desert. This is a serious problem in some areas because the tourists always take the better-looking cacti, and these happen to be the ones with the middle-spine-numbers.

Years of collecting have left their toll on the roadside cacti. Using this background knowledge and the data collected below; create a graph of both the original population of cacti and the current population on a piece of graph paper.

Original Population		Current Population (Yrs later)	
Number of Cactus	Number of Spines	Number of cactus	Number of Spines
4	71	10	72
12	82	22	80
25	95	5	93
13	106	12	108
8	113	14	110
4	122	9	120
2	130	4	129



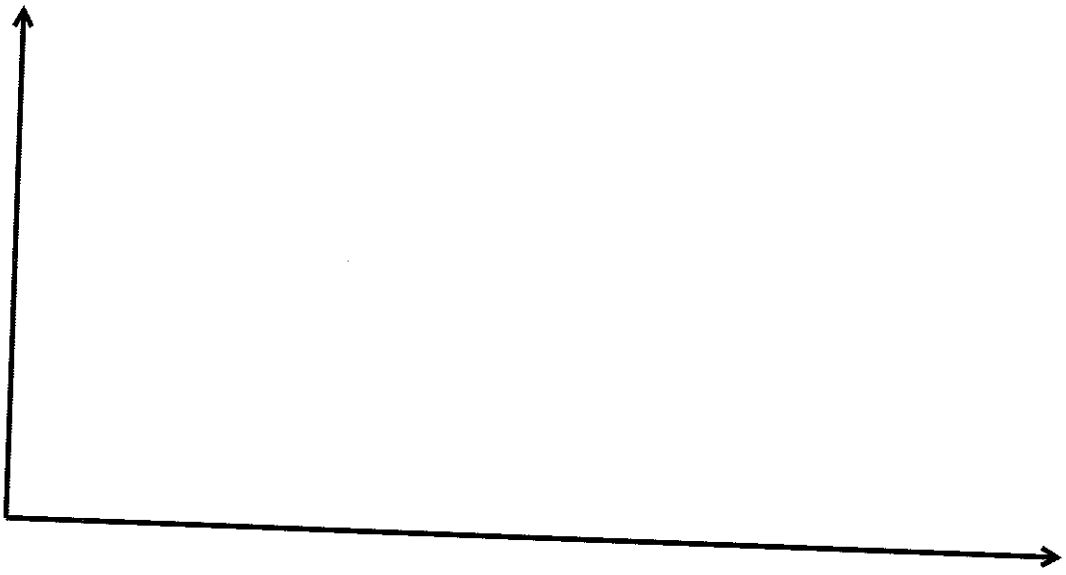
1. What seems to have changed between the historical data, and the current data?

2. What has contributed to this change?

3. What affect may this have on allele frequencies in the future?

4. What do you feel will happen in the future (next 50 yrs) regarding this population of cacti? Explain your reasoning.

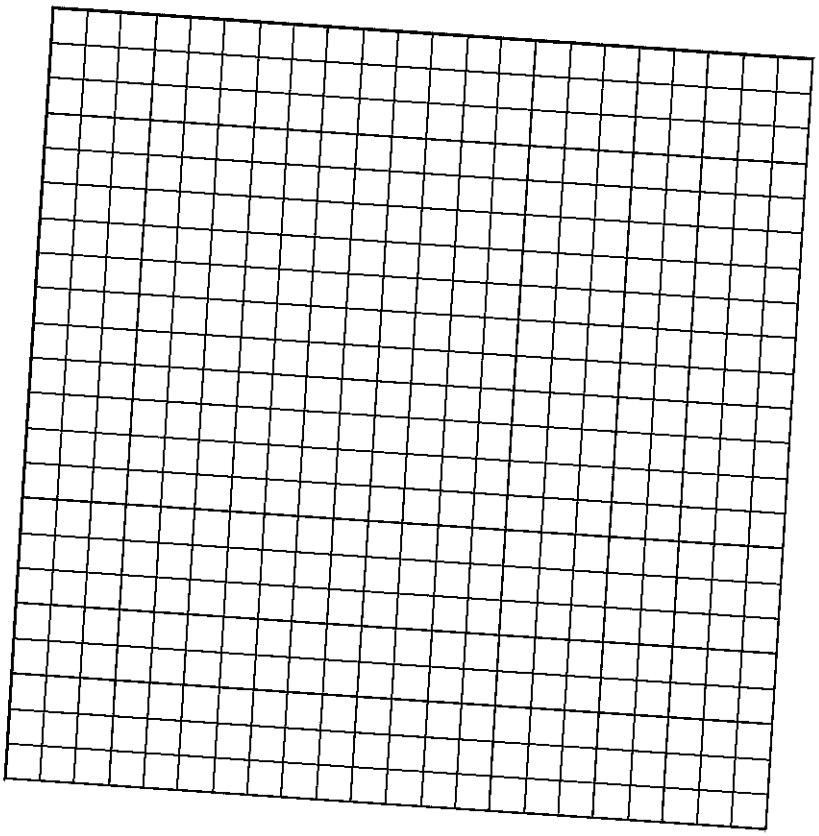
5. Draw what you feel the graph will look like after 50 more years goes by. This graph should support your answer for number 4.



Ex 2 - A Scientist in the 1800's studied a population of moths over the past 50 years. In 1821, a coal-burning factory was built only half a mile from the forest where the study had been conducted. This put a lot of soot into the atmosphere, and ultimately altered the environment.

The scientist studied the population of moths, and the variations in their color. The scientist rated the color of the moths on a scale of 1-20. 1 was a moth that was completely white, and 20 was a moth that was completely black. The numbers in-between these two numbers ranged from very light gray, to very dark gray. He counted the moth populations of each grade of moth in each year. The data below shows the population from the beginning of the 50-year period, to the end.

	# of Moths by Year	
Color	**1820**	**1870**
1	120	43
2	144	63
3	156	75
4	166	90
5	189	100
6	201	115
7	210	137
8	198	160
9	180	187
10	176	201
11	160	210
12	150	234
13	122	220
14	107	208
15	92	190
16	84	174
17	74	163
18	60	140
19	55	123
20	49	111



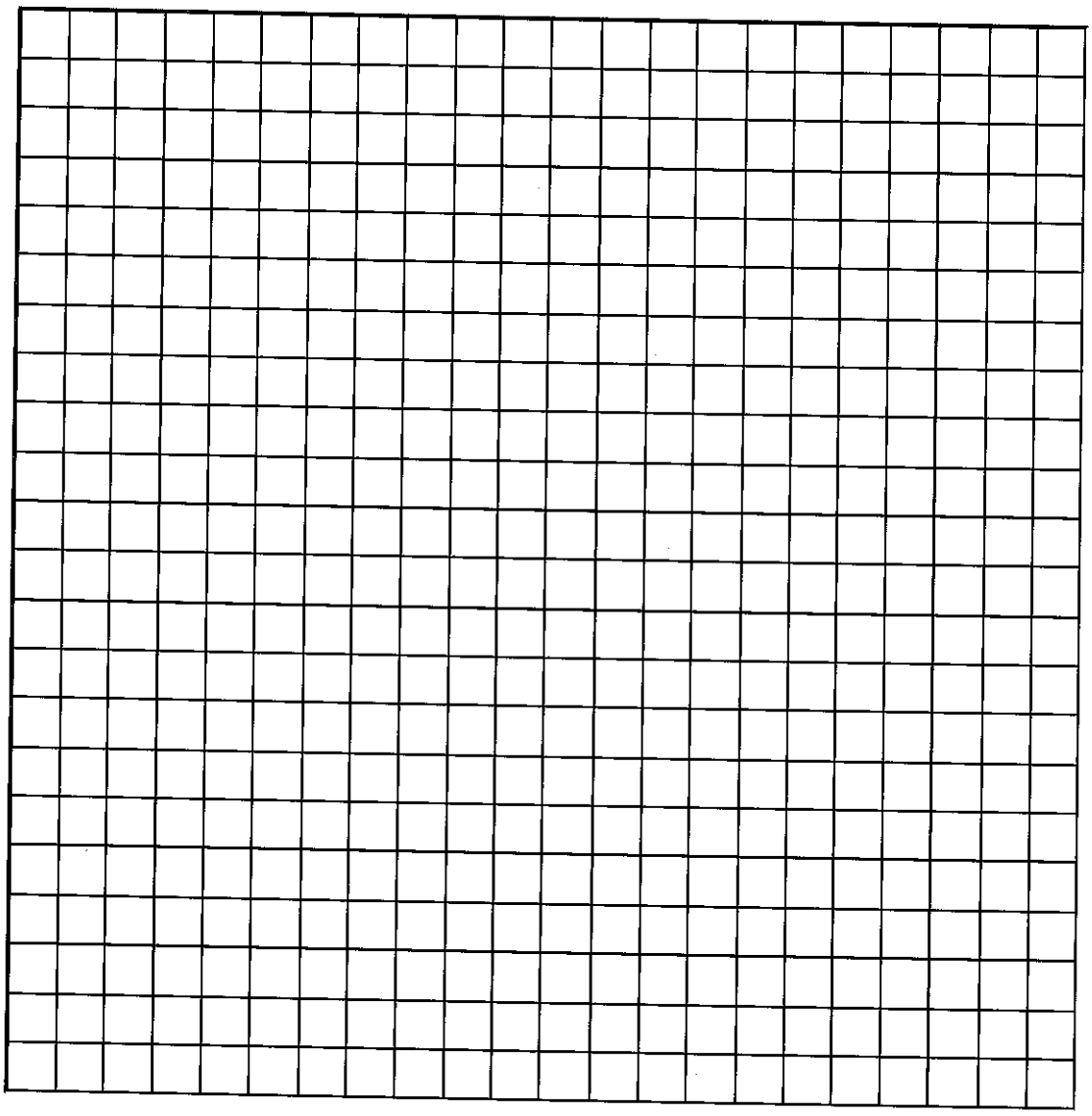
1. What seemed to happen to the population of moths between 1820 and 1870?

2. What do you feel might be a plausible explanation for this? Explain

3. What do you feel would have happened in the factory was never built? Explain your answer.

Ex. 3 - OBGYN doctors keep extremely detailed records of many aspects of the children that are born. One of the most important factors determining whether a child is healthy or not is their birth weight. Doctors conducted a study looking at birth weight of children, and how many of each particular weight survived to the age of 13. The table below shows their findings

Birth weight (lbs)	# of Children At Birth	Survivors at age 13
0-1.0	13	3
1.0-2.0	15	4
2.0-3.0	20	13
3.0-4.0	29	20
4.0-5.0	48	31
5.0-6.0	54	49
6.0-7.0	57	52
7.0-8.0	60	57
8.0-9.0	58	49
9.0-10.0	56	38
10.0-11.0	49	30
11.0-12.0	32	17
12.0-13.0	20	12
13.0-14.0	13	7
14.0-15.0	11	3



1. Did the average birth weight appear to change based on the graph? Explain.

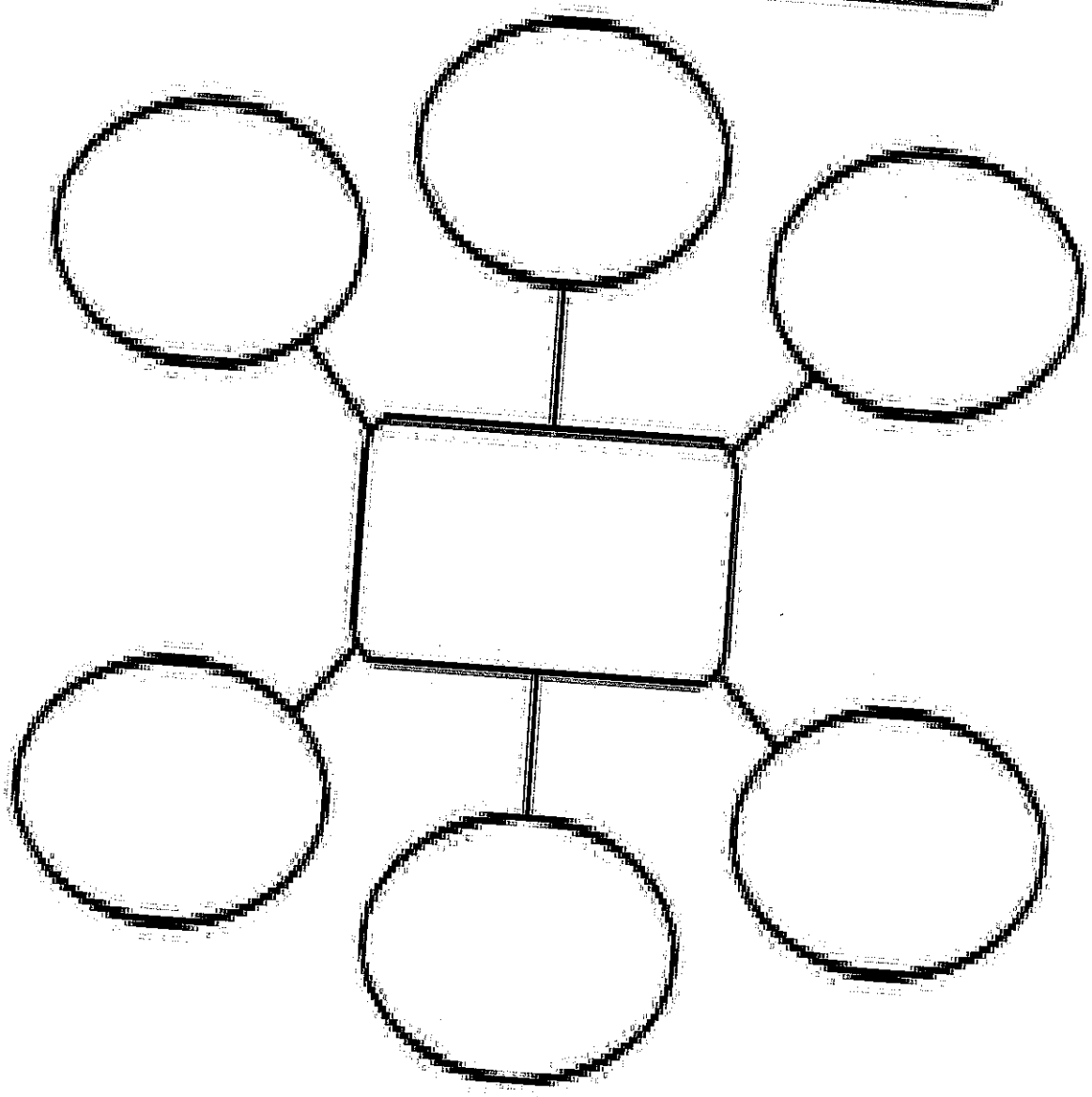
2. Do you feel this has any bearing on gene frequency in the human population? Explain.

3. What did this graph illustrate to you? What information can be taken from this graph?

Bacteria – Characteristics of bacteria

Name: _____ Date: _____

Bubble Map



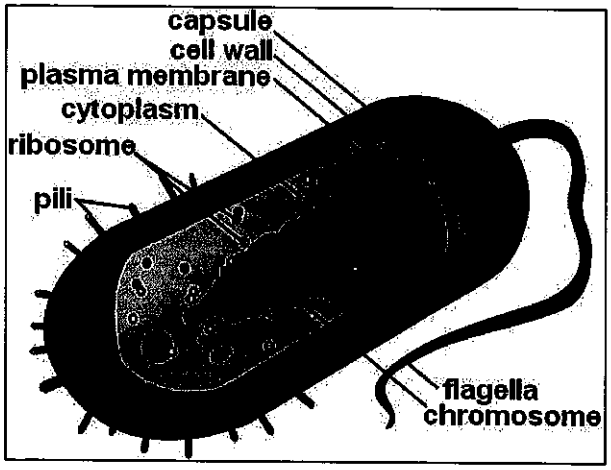
Draw and label the structure of bacteria

Name: _____ Date: _____ Period: _____

Characteristics of Bacteria Worksheet

Bacteria are classified into two very different kingdoms-Archaebacteria and Eubacteria. All bacteria have the same basic structure. Look at the two pictures below as you continue your reading.

Like all cells, bacteria have a **plasma membrane** that controls what can enter and leave the cell. The plasma membrane is surrounded by a **cell wall**. The cell wall gives the bacteria shape and support. Certain kinds of bacteria have yet another coat around the cell wall; called a **capsule**. The capsule is a thick and sticky overcoat that some bacteria have. Bacteria that have a capsule usually cause disease. Therefore, scientists think the capsule helps them stick to its host.



Some bacteria have one or more **flagella** sticking out of the plasma membrane. Flagella are used to move the cell around. Bacteria also have a circular piece of DNA called a **plasmid** instead of a proper nucleus. They also have many **ribosomes** which make proteins for the bacteria. The bacteria also have one or more **pili** (singular = pilus) sticking through the cell membrane. Bacteria use the pilus to trade pieces of its DNA with other bacteria during a process called **conjugation**.

Archaebacteria and Eubacteria probably split from each other several billion years ago, but nobody knows exactly when. There are many differences between the Archaebacteria and the Eubacteria. Some of those differences are:

1. Their cell walls have different structures
2. The lipids in their plasma membranes are different.
3. Their tRNA and rRNA bases are different.
4. They react differently to antibiotics.

Archaebacteria – the extreme bacteria

Archaebacteria include 3 sub-types that are found mainly in extreme habitats where little else can live.

- One group lives in oxygen-free environments and produces methane. These Archaebacteria are called Methanogens. They can live in the digestive tract of many animals, where they produce methane gas.
- A second group can live only in bodies of concentrated salt water such as the Great Salt Lake in Utah and the Dead Sea in the Middle East. These are the extreme halophiles.
- The third group, Thermoacidophiles, is found in the hot acidic waters of sulfur springs and near deep-sea ocean vents.

Eubacteria - all the other bacteria

Eubacteria, the second main group of bacteria, live in many different habitats and have different types of metabolism. Some examples of eubacteria are *Streptococcus* which causes strep throat, *E. coli* which helps us digest our food, and *Streptomyces erythraeus* which produces the antibiotic streptomycin. Some characteristics of eubacteria are:

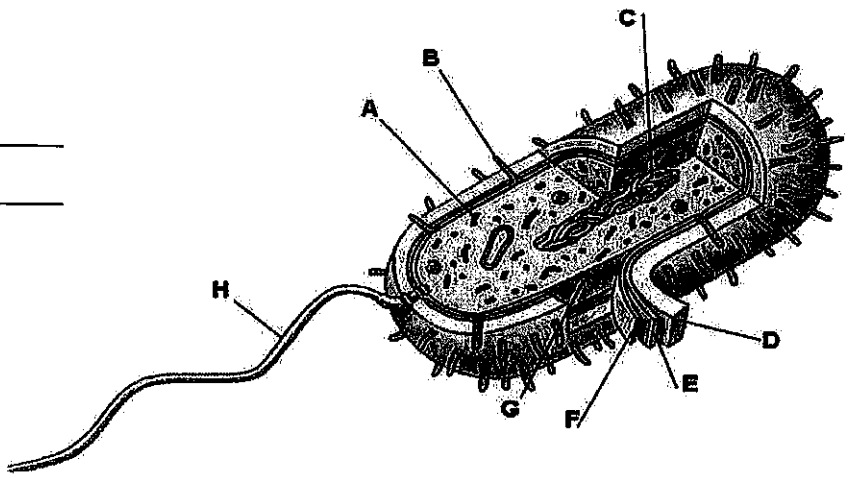
- Bacteria are the smallest and simplest of living things.
- Bacteria are also prokaryotes, which means they have no membrane-bound organelles like a nucleus, mitochondria, or chloroplasts.
- Their ribosomes are smaller than those of eukaryotes.
- Their genetic information is held in a single circular chromosome, rather than in paired chromosomes.

1) What are the **two** kingdoms of bacteria?

   a. _____

   b. _____

2) Label the parts of the bacterium in the picture to the right.



3) Name three differences between Archaebacteria and Eubacteria.

   a. _____

   b. _____

   c. _____

4) Fill in the missing information in the table below about the parts of a bacteria and what they do.

Parts of a Bacteria	What it does
A.	Controls what enters and leaves the bacteria
Cell Wall	B.
C.	Sticky covering outside the cell wall that helps disease causing bacteria stick to its host
Pili	D.
E.	Circular piece of genetic information that keeps the information needed to run the cell
Ribosome	F.
G.	Movement

5) Name the three groups of Archaebacteria.

   a. _____

   b. _____

   c. _____

6) Name three characteristics of all eubacteria.

   a. _____

   b. _____

   c. _____

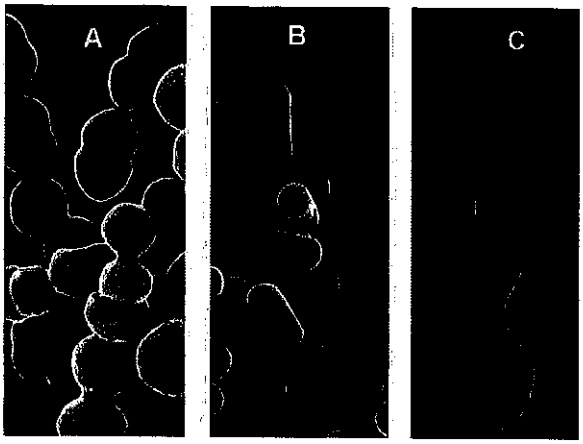
7) Where do each Archaebacteria live?

   a. Thermoacidophiles: _____

   b. Methanogens: _____

   c. Extreme halophiles: _____

Classification of Bacteria By Shape



The three most common shapes are spheres, rods and spirals. Sphere shaped bacteria such as those shown in the A section of the photo to the right are called **coccus** (pl. is cocci) bacteria. They usually have coccus in their name like streptococcus. Another group in the shape classification system is the **bacillus** (bacilli =plural). These bacteria are rod shaped. These bacteria are pictured above in B. The third group is the **spirillum** (spirilla plural). These are the corkscrew shaped bacteria. These bacteria are pictured above in C.

Because scientist wished to give as much information as they can when naming bacteria, scientist use their shape as well as if they are found in pairs, chains, or clusters.

If they are found in pairs, adding the prefix diplo- to their shape forms the name. An example is diplococci (a sphere shaped bacteria that is found in pairs).

If the bacteria are found in chains, the prefix strepto- is added to their shape (ex. streptococci = long chains of sphere shaped bacteria).

Bacteria that are found in grapelike clusters have the prefix staphylo- added to their shape (ex. staphylobacilli = grapelike clusters of rod shaped bacteria).

Classification of Bacteria By How They Get Their Energy

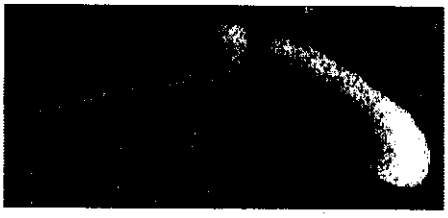
Another way bacteria are classified is by how they get their energy. They are broken up into three groups.

1. The first group is the **heterotrophs**. These bacteria get their energy by decomposing other organisms. These bacteria have a huge roll in recycling materials in an ecosystem.
2. The second group is the **photosynthetic autotrophs**. These bacteria are able to change sunlight into food (that's the photosynthetic part) all by themselves (that's the autotroph part). These bacteria are important because they are the producers in almost all aquatic ecosystems. They capture the sunlight and change it into energy the consumers in the ecosystem can use.
3. The third group is the **chemosynthetic autotrophs**. This group can make their own energy but instead of using sunlight to do it they use chemicals around them. These bacteria are important in changing the nitrogen in the atmosphere that we can't use into a form that we can use to make proteins.

Reproduction

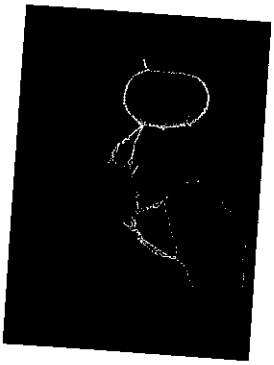
Bacteria cannot reproduce by mitosis or meiosis because they have no nucleus. Instead, they have evolved different methods of reproduction, binary fission and conjugation. Bacteria reproduce asexually by a process known as **binary fission**. The steps in this process are:

1. The bacterium first copies its single chromosome.
2. The copies attach to the cell's plasma membrane.
3. As the cell grows in size, the two copies of the chromosome separate.
4. The cell then divides in two as a partition forms between the two new cells as shown in the picture to the right.



Each new cell receives one copy of the chromosome. Therefore, the daughter cells have the same information as each other. Under ideal conditions, bacteria can reproduce every 20 minutes. Such a rate of reproduction yields enormous numbers of bacteria in a short time.

When you have an infection, billions of bacteria grow in your body. If you are given an **antibiotic** for the infection, you should take the antibiotic for the full prescribed period—even though you feel better after just one or two days. Shortly after you begin to take the antibiotic, most of the bacteria are killed. However, if you stop taking the antibiotic and even a single bacterium is left, it will start reproducing. A day later, you will



have millions of bacteria in your body and you will be sick again. Completing the antibiotic ensures that all of the bacteria will be killed so you will not get sick again.

In addition to reproducing by binary fission, some bacteria have a simple form of sexual reproduction called **conjugation**. You will remember that conjugation is not sexual reproduction in the strict sense of the word since there are no specialized sex cells involved. In conjugation, one bacterium transfers all or part of its chromosome to another cell through a bridge like structure called a pilus (pl. pili) that connects the two cells. This transfer of genetic material can be seen in the picture to the left.

8) How do heterotrophic bacteria get their energy? _____

_____

9) How do chemotrophic bacteria get their energy? _____

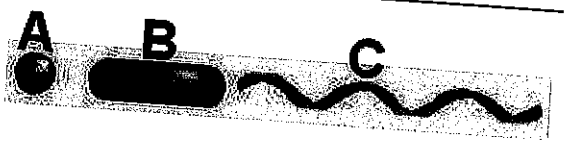
_____

10) Aside from making oxygen, why are photosynthetic autotrophs important to an ecosystem?

_____

_____

11) Name the three basic shapes of the bacteria in the picture to the right.



a. _____ b. _____ c. _____

12) These bacteria in the picture to the left are called *Staphylococcus aureus*. Give two reasons why is it called *Staphylococcus*.

a. _____

b. _____

13) Place the four steps of binary fission in order from start to finish. _____

A – The cell splits into two cells
B – The cell enlarges & chromosomes separate
C – Copy of chromosome is produced
D – Chromosomes connect to the cell membrane

14) Which special structure is used to transfer DNA from one bacterium to another? _____

15) Which process is described in the previous question? _____

16) Which medicines are prescribed to treat bacterial infections and why it's important to finish them?

_____

_____

Student #_____

Name:_____
Period:_____ Date:_____

Worksheet: Shapes of Bacteria

Directions: Use the classification key to identify and name the bacteria pictured below and then answer the questions on the back. Be sure to follow the rules for writing scientific names (the line provided DOES NOT count as an underline for the name—you must underline them). The genus name describes the shape of the bacteria. The type of disease or food that is associated with the bacteria is shown in the parentheses.

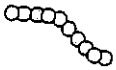
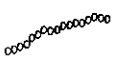
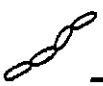
Classification Key for Bacteria Using Shape

If the shape of the bacteria is round, go to Section I.
If the shape of the bacteria is rod-shape, go to Section II.
If the shape of the bacteria is spiral, go to Section III.

Section I
If in pairs, go to 1.
If in chains, go to 2.
If in clumps, go to 3.
1a. without a heavy cover (capsule) – *Diplococcus meningitidis* (spinal meningitis)
1b. with a heavy cover (capsule)—*Diplococcus pneumoniae* (pneumonia)
2a. large in size—*Streptococcus pyogenes* (tonsillitis)
2b. small in size—*Streptococcus lactis* (buttermilk)
3. *Staphylococcus aureus* (boils)

Section II
If in chains, go to 4.
If in pairs, go to 5
If single, go to 6.
4. *Bacillus anthracis* (anthrax)
5. *Bacillus lactis* (sauerkraut)
6a. with hairs (flagella)—*Bacillus typhosa* (typhoid fever)
6b. with a bulge in the middle—*Bacillus botulinum* (botulism food poisoning)
6c. with a bulge at the end—*Bacillus tetani* (tetanus)

Section III
Treponema palladium (syphilis)

1.  _____
2.  _____
3.  _____
4.  _____
5.  _____
6.  _____
7.  _____
8.  _____
9.  _____
10.  _____
11.  _____

(OVER)

1a. What part of the name is the same for all bacteria found in Section I? _____

1b. This word part refers to the shape of the bacterium. What is the shape of the bacteria in Section I? _____

2. The prefix "diplo-", when placed in front of the bacterium's name, must mean _____

3. The prefix "strepto-", when placed in front of the bacterium's name, must mean _____

4. The prefix "staphylo-", when placed in front of the bacterium's name, must mean _____

5a. What part of the name is the same for all bacteria found in Section II? _____

5b. This word part refers to the shape of the bacterium. What is the shape of the bacteria in Section II? _____

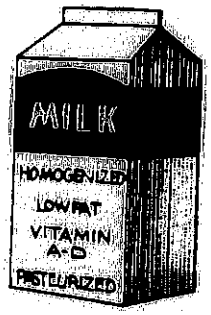
6. According to their scientific names, what is the shape of the bacteria for each of the following diseases?
   a. tonsillitis = _____
   b. anthrax = _____
   c. tetanus = _____
   d. pneumonia = _____

Student #_____

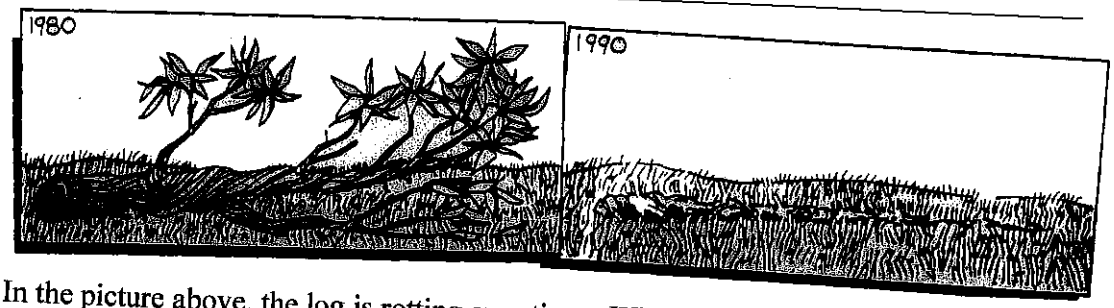
Name:_____
Period:_____ Date:_____

Worksheet: Helpful and Harmful Bacteria

Directions: Answer the following questions or fill in the blank in the space provided.



1. What word on the milk carton tells you that the dairy killed the bacteria when it processed the milk? _____
2. Explain this process. _____



3. In the picture above, the log is rotting over time. What term is used to describe the bacteria that are feeding on this dead log? _____
4. List 2 ways that this type of organism helps the environment. _____
5. What do we call disease-causing organisms? _____
6. An oil tanker is leaking, causing hundreds of gallons of oil to spill into the ocean. Special bacteria are sprinkled on the oil to digest it. This is an example of _____.
7. What do we call a chemical made by one organism that is used to kill another? _____.
8. List 3 foods that are made or flavored using bacteria. _____
9. Bacteria can cause food to spoil. This can be slowed or stopped by taking away one of the needs of life. Next to each method to preserve food, write the need that is taken away from the bacteria.
   a. smoking – _____
   b. refrigeration – _____
   c. canning – _____
   d. salting – _____

Identify whether each of the following is helpful or harmful.

10. bacteria used to make food: _____
11. pathogens: _____
12. saprophytes: _____
13. antibiotics: _____
14. toxins: _____
15. nitrogen-fixing bacteria _____
16. parasites: _____
17. botulism bacteria: _____