

4/3/20

Hey everyone! I hope you and your families are all staying healthy during these times. Most of you have done a great job getting work turned in, but there are still some of you that have turned in only partial or no assignments. Make sure to get these to me ASAP.

Next week is Spring Break (April 4-12), and you will have no assignments from your teachers during this time. After that, we will begin to start learning new information that we have not covered yet this year. I will post notes, videos, etc on Classroom and will have virtual office hours where we can have video chats together to answer questions. Packets of work can be picked up in the office or printed off for students with no or limited internet access. You may also use the school parking lot as a means to get temporary WIFI access.

My office hours starting the week of April 13th will be Tuesdays from 12-1 and Thursdays from 9-10.

Assignments for the Next 3 Weeks

Week 4 - 1. Read through the Overview of Evolution and the Theory of Evolution by Natural Selection slideshow notes and as you go through them, fill out the guided vocabulary sheets. 2. Watch the "What is Natural Selection" Youtube video. 3. Complete the Steps of Nat Sel Practice worksheet. 4. Take the Week 4 Assessment

Week 5 - 1. Read through the Evolution of Populations slideshow notes and as you go through them, fill out the guided vocabulary sheets. 2. Watch the Rock Pocket Mouse Video and complete summary worksheet on it. 3. Take the Week 5 Assessment

Week 6 - 1. Read through the Classification and Cladograms slideshow notes and as you go through them, fill out the guided vocabulary sheets. 2. Complete the Cladogram Analysis Practice worksheet. 3. Take the Week 6 Assessment

Please feel free to email me with any questions or concerns that you may have or to just simply say hello! I will continue using Remind as another mode of communication and I also added a discussion board feature on Google Classroom. Be smart during these times, use good judgement, and follow the orders and guidelines of the health officials / scientific community!

Stay safe and take care!

Mr. Besancon

Overview of Evolution by Natural Selection

1. Variation

Due to sexual reproduction (meiosis) and genetic mutations, species exhibit variation (differences in traits) among individuals.

2. Struggle for Survival

In nature, more individuals are born than can survive to adulthood and reproduce. Because of this, there is a competition for the limited amount of resources (food, shelter, mates)

3. Natural Selection

The individuals that are best fitted to survive in their environment have a better chance of surviving to adulthood than individuals without the beneficial traits

4. Evolution

Because individuals with these beneficial traits tend to survive longer, they will have more offspring that also inherit the beneficial traits. Over many generations, these beneficial traits will become more common in the population

5. Speciation

When a population has undergone enough changes in new traits that they can no longer reproduce with the original species, they are now distinct and can be considered a new species

Natural Selection: Requirements

Three conditions must be met for natural selection to occur in a population:

1. **Variation** – differences in traits in a population or species
2. **Heritability** – traits are passed down from parents to offspring
3. **Struggle for Survival** – not all individuals can survive and make it to adulthood

Lamarckism

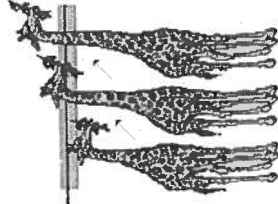
Jean-Baptiste Lamarck – French naturalist, proposed a theory known as “Use it or lose it”

- Individuals lose characteristics they do not require and develop those which are useful.
- Lamarck believed in the inheritance of acquired traits - Individuals inherit the acquired traits of their ancestors.

The Theory of Evolution by Natural Selection

Lamarckism

- Examples include: the stretching by giraffes to reach leaves leads to offspring with longer necks;
- A man lifting weights and getting bigger muscles will pass on the trait of big muscles to his children



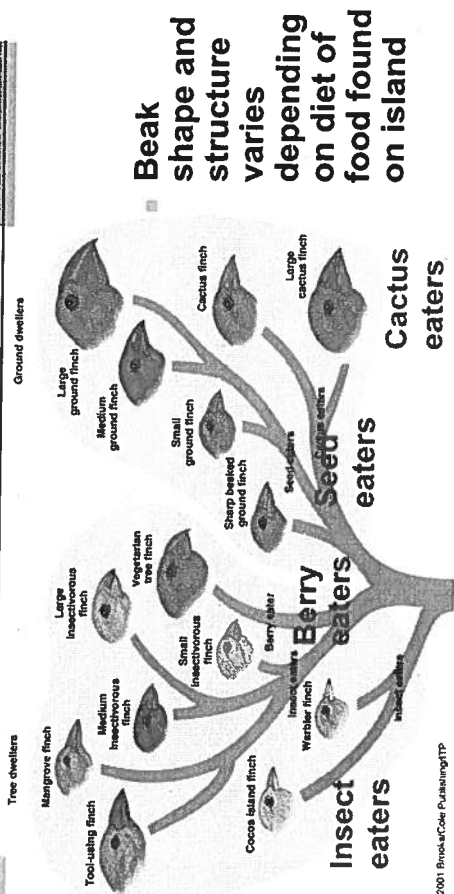
This theory was later disproved!

Darwin's Voyage

- **Charles Darwin**
- Set sail around world in 1831
- Observed that the animals on the islands were similar to those on the mainland yet had distinct traits that allowed them to thrive on the unique conditions of the island



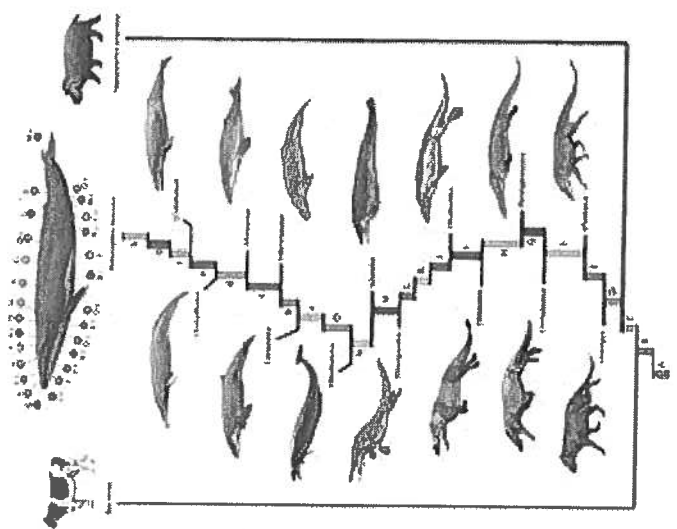
Galápagos Finches



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Evolution

Change in a species over time; the process by which modern organisms have descended from ancient organisms



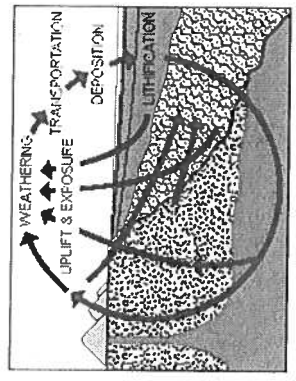
Darwin's Voyage

- On the *Origin of Species* (Darwin's book)
 - Darwin wrote about how species can change gradually over many, many generations and become better adapted to new environmental conditions. He called this process **EVOLUTION**



Uniformitarianism

- "The present is the key to the past"
- Theory that states that the earth is always changing and that the geologic processes that shaped Earth in the past are still occurring today

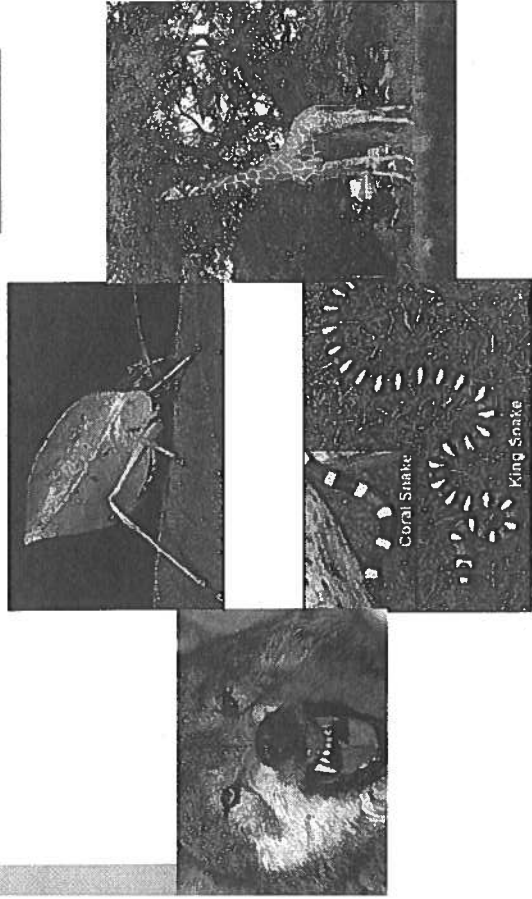


Natural Selection

Organisms that are better **adapted** to an environment are more likely to survive and reproduce than organisms that are less adapted.

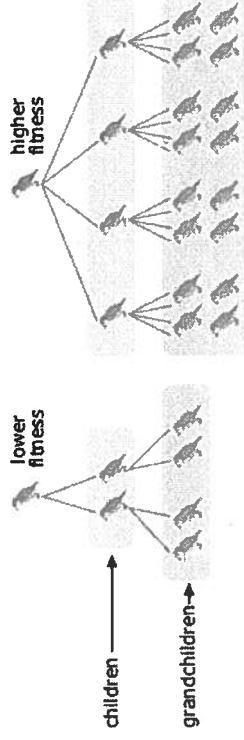


Adaptation - An inherited trait that increases an organism's chance of survival in its environment (increases its fitness)



Fitness

- Fitness is defined as the measure of an ability to survive and reproduce in an environment
- Specifically, the more offspring an organism has compared to others in its species, the more "fit" the organism is



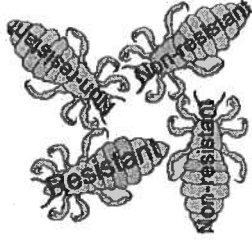
Sexual Selection

- Type of natural selection arising through preferences in certain traits by individuals of the opposite sex which increase mating opportunities



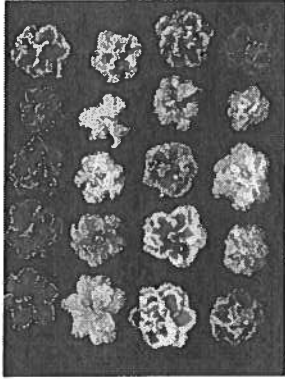
Mutations

- Mutations are a random change in DNA and are important to evolution because they help increase variation
- Most mutations are neutral and often they can be negative.
- In some cases however, they can add to provide new traits that are an advantage and are beneficial to the organism.



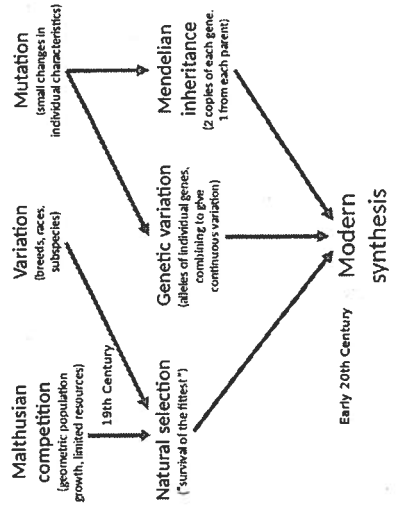
Variation: the differences among members of a species

-Natural selection won't work in a population of clones! Remember that a key to variation is sexual reproduction.



Modern Synthesis

- Today, the **Modern Synthesis** describes the combination of Darwinian Evolution with the newer insights of Mendelian Genetics and DNA.



Evidence of Evolution

- Artificial Selection
- Fossil Record
- Similarities in Body Structure
- Similarities in Early Development
- Vestigial Structures
- Similarities in DNA

Man: Artificial Selection

Selective breeding as practiced by humans on domesticated plants and animals....

For example: Dogs



Fossil Record

- How fossils form
 - An organism dies and becomes buried in sediment
 - Minerals gradually replace the bones and more sediments cover the fossil



Pterodactyl



Trilobite

Fossil Record

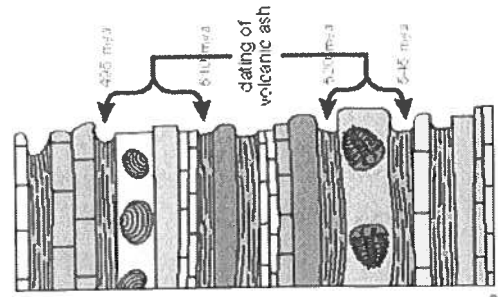
Fossils from organisms that died longer ago are buried deeper in the sediment/rock than fossils from organisms that died more recently.



Radiometric Dating

- Scientists can often use Radioactive Dating to estimate the age of a rock or fossil
 - Rocks that fossils are found near contain radioactive elements.
 - The half-life of a radioactive element is the time it takes for half the atoms in an element to change into a stable element (carbon 14 into carbon 12)

Half-life	Mass of Original C-14 Remaining (grams)	Number of Years
0	1	0
1	$\frac{1}{2}$	5,700
2	$\frac{1}{4}$	11,400
3	$\frac{1}{8}$	17,100
4		
5		
6		



Transitional Fossils

Transitional fossils, such as the Tiktaalik and the Archaeopteryx, can be used to show an intermediate form of a species that existed in-between an ancient, ancestor species and a modern day species.

Tiktaalik

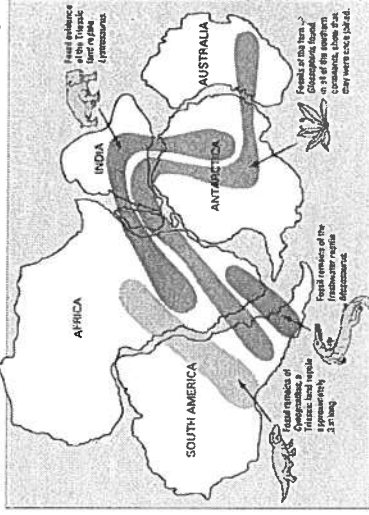


Archaeopteryx

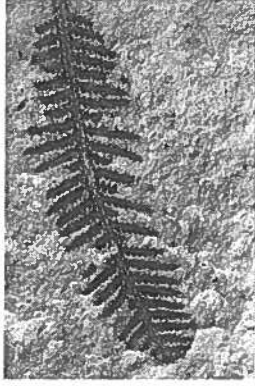


Continental Drift

Fossil records show that when the continents were connected, animals could walk freely where they wanted. When the continents separated, the animals became separated.

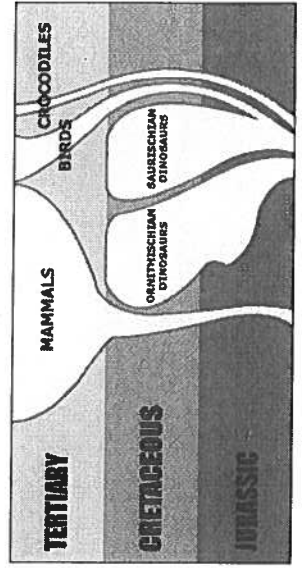


Fern-like plant fossils in Antarctica



Adaptive radiation

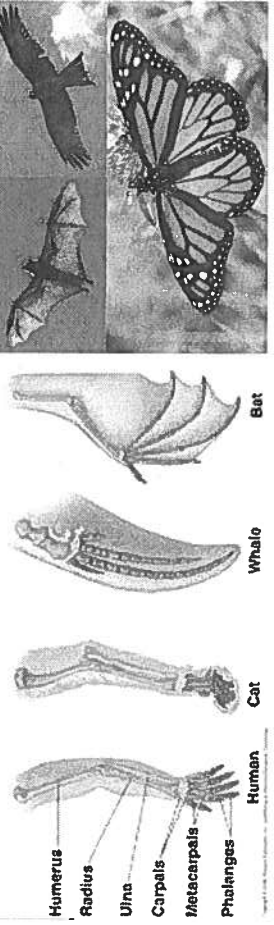
- the rapid diversification of a group of organisms into forms filling different ecological niches.
- Mammals filled ecological niches vacated by dinosaurs
- Typically occurs after mass extinctions



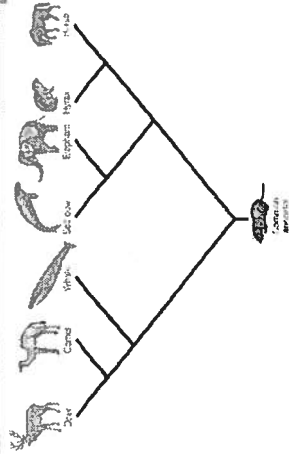
Similarities in Body Structure

- Homologous Structures** – Structures that appear similar because they evolved from a common ancestor
- Analogous Structures** – Structures that appear similar because of environmental factors, NOT due to common ancestry

Homologous Structures Analogous Structures



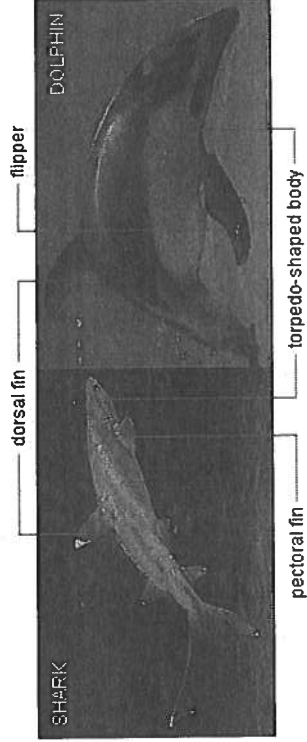
Divergent Evolution



- Process by which organisms are similar because they evolved from a common ancestor (Ex = Lion and Tiger)
- Divergent evolution produces Homologous Structures

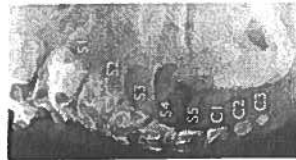
Convergent Evolution

- Process by which unrelated organisms independently evolve similarities when adapting to similar environments (Ex = Shark and Dolphin)
- Convergent evolution produces Analogous Structures



Vestigial Structures

- **Vestigial Structure-** A structure found in a species that is no longer in use but may have been useful at some point in the species' past



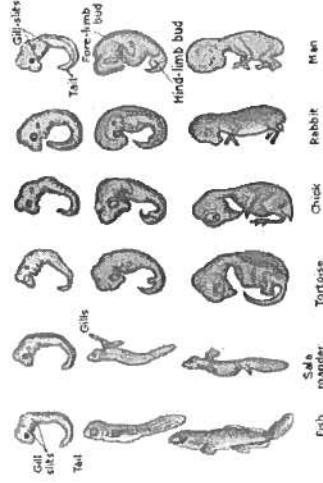
Tail present in human and all vertebrate embryos. In humans, the tail is reduced; most adults only have three to five tiny tail bones and, occasionally, a trace of a tail-extending muscle.



Whales possess a femur and pelvis, but these bones are no longer useful to the mammals.

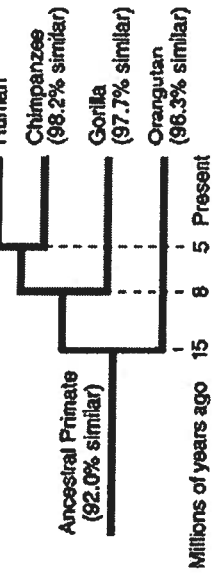
Similarities in Early Development

- **Embryology** – the study of embryos of different organisms at different stages of development
- The more similar the embryos of two organisms are, typically the more closely related the organisms are



Similarities in DNA

- The more similar the sequences of DNA are, the more closely related the organisms are.
- For instance, human and chimpanzee DNA are more similar than human DNA is to dog DNA.



Name _____ Per _____

Evolution by Natural Selection Vocabulary

3 Requirements of Natural Selection

- 1.
- 2.
- 3.

Evolution - _____ in a species over _____; the process by which modern organisms have _____ from ancient organisms

Uniformitarianism - "_____ is the key to the past" -Theory that states that the earth is always _____ and that the _____ processes that shaped Earth in the _____ are still occurring today

Natural Selection - Organisms that are better _____ to an _____ are more likely to _____ than organisms that are less adapted.

Fitness - The _____ of the ability of an organism to _____ in an environment. -More _____ = greater fitness

Adaptation - An _____ trait that increases an organism's _____ in its environment (increases its _____)

Sexual Selection - Type of _____ arising through _____ in certain traits by individuals of the _____ which increase _____ opportunities

Variation - the _____ among members of a _____

Mutation - a _____ change in _____. -In some cases, they can provide _____ that are an advantage and are _____ to the organism.

Modern Synthesis - describes the combination of _____ with the newer insights of _____ and _____.

Evidence of Evolution

Artificial Selection - _____ as practiced by _____ on domesticated plants and animals

Transitional Fossil - can be used to show an _____ form of a species that existed in-between an _____ species and a _____ species.

Adaptive Radiation - the _____ diversification of a group of organisms into forms filling different ecological _____. -Typically after _____

Homologous Structures - Structures that appear _____ because they _____ from a common _____

Analogous Structures - Structures that appear _____ because of _____ factors, _____ due to common ancestry

Divergent Evolution - Process by which _____ are similar because they evolved from a common _____ - Produces _____ structures

Convergent Evolution - Process by which _____ organisms independently evolve _____ when adapting to similar _____ - Produces _____ structures

Vestigial Structures - A structure found in a species that is _____ in use but may have been _____ at some point in the species' _____

Embryology - the study of _____ of different organisms at _____ stages of _____. The more similar the _____, the more closely _____ the organisms are

Steps of Natural Selection Practice

Read the following situations below and identify the 5 points of Darwin's natural selection.

Example) There are 2 types of worms: worms that eat at night (nocturnal) and worms that eat during the day (diurnal). The birds eat during the day and seem to be eating ONLY the diurnal worms. The nocturnal worms are in their burrows during this time. Each spring when the worms reproduce, they have about 500 babies but only 100 of these 500 ever become old enough to reproduce.

a. What worm has natural selection selected AGAINST? *diurnal worms* FOR? *nocturnal worms*

Darwin's 5 steps: Identify the 5 steps in the scenario above.

Population has variations. *nocturnal and diurnal worms*

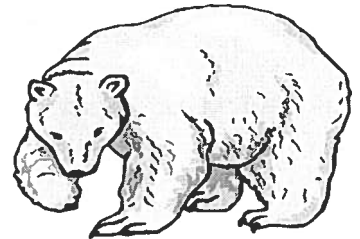
Some variations are favorable. *nocturnal worms not being eaten*

More offspring are produced than survive. *only 100 out of 500 offspring survive to adulthood*

Those that survive have favorable traits. *nocturnal ones survive*

A population will change over time. *population of worms will become more and more nocturnal over time*

1) There are 3 types of polar bears: ones with thick coats, ones with thin coats and ones with medium coats. It is fall, soon to be winter. The temperatures are dropping rapidly and the bears must be kept warm, or they will freeze to death. Many of the bears have had ~2 cubs each but due to the extreme temperatures, many mothers only have one cub left.



a. What bear will natural selection select AGAINST? FOR?

Darwin's 5 steps: Identify the 5 steps in the scenario above.

Population has variations.

Some variations are favorable.

More offspring are produced than survive.

Those that survive have favorable traits.

A population will change over time.

2) In ostriches, there are 2 types: ones that run fast and those that run slowly. The fast birds can reach up to 40 miles an hour. Jackals love to eat ostrich, and they can reach speeds of up to 35-40 miles per hour. A flock of ostrich will lay ~ 10 eggs (each mother only lays 1), but many of the young are eaten by jackals.



a. What ostrich will natural selection select AGAINST? FOR?

Darwin's 5 steps: Identify the 5 steps in the scenario above.

Population has variations.

Some variations are favorable.

More offspring are produced than survive.

Those that survive have favorable traits.

A population will change over time.

3) In giraffes, there is variation in the length of their necks. Some giraffes have extremely long necks while others have slightly shorter necks. A female giraffe can have up to 10 babies in her lifetime. In the savannas where they live, the trees in which they eat leaves from are very high up. Because of this, giraffes with longer necks have more opportunities to obtain food while short necked giraffes may die of starvation.



a. What giraffe will natural selection select AGAINST? FOR?

Darwin's 5 steps: Identify the 5 steps in the scenario above.

Population has variations.

Some variations are favorable.

More offspring are produced than survive.

Those that survive have favorable traits.

A population will change over time.

Week 4 Assessment

1. Email address *

2. Which of the following is a true statement concerning genetic variation?

1 point

Mark only one oval.

- It is created by the direct action of natural selection.
- It always arises in response to changes in the environment.
- It is a result of both sexual reproduction and mutations
- It only exists in organisms of different species, not in the same species

3. -Beetle #1 lives for 2 months and produces 150 offspring -Beetle #2 lives for 4 months and produces 200 offspring -Beetle #3 lives for 5 months and produces 175 offspring
Which beetle would a Biologist consider to have the greatest fitness?

1 point

Mark only one oval.

- Beetle 1
- Beetle 2
- Beetle 3

4. Which is NOT one of the 3 requirements of Natural Selection

1 point

Mark only one oval.

- Heritability
- Variation
- Long amount of time
- Struggle for survival

5. A shark and a dolphin look very similar because they have adapted to live in similar environments, NOT because they are closely related. This would be an example of which type of evolution?

1 point

Mark only one oval.

- Homovergent Evolution
- Heterovergent Evolution
- Convergent Evolution
- Divergent Evolution

6. A structure found in a species that no longer has a use but may have been useful at some point in the organisms past (ex = tail bone in humans or hip bones in whales)

1 point

Mark only one oval.

- homologous structure
- analagous structure
- embryological structure
- vestigial structure

7. Why do some adaptive traits, such as thicker fur, evolve over time within a population of organisms? 1 point

Mark only one oval.

- Organisms with these traits survived longer and had more offspring than other organisms in the population, so their traits were passed on to more offspring.
- Such traits evolved out of necessity to ensure survival of the species.
- These traits evolved randomly, and just happened to persist over time.
- These traits evolve in response to environmental challenges, ensuring that the population will survive changes in its habitat.

8. The idea of uniformitarianism is that earth today is about the same as it always has been and it does not change very much over time 1 point

Mark only one oval.

- True
- False

9. Evolution can occur in both Individuals and Populations 1 point

Mark only one oval.

- True
- False

10. Sometimes species may evolve traits that hurt their chances of survival but give them more mating opportunities 1 point

Mark only one oval.

- True
- False

11. If an individual lifts weights and gets stronger, it will have no effect on the strength of his/her offspring 1 point

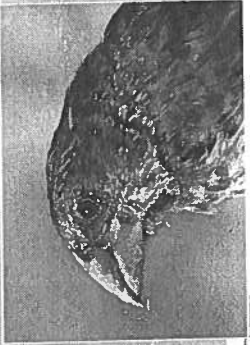
Mark only one oval.

True

False

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Google Forms



THE EVOLUTION OF POPULATIONS

- Darwin did not know how organisms passed traits to offspring
- 1866 - Mendel published his paper on genetics
- Mendelian genetics supports Darwin's theory → Evolution is based on genetic variation & heredity
- **Modern Synthesis** - the current view of evolution that combines Darwin's ideas of evolution with Mendel's knowledge of genes and inheritance



Species - a group of closely related organisms that are genetically similar and are capable of interbreeding and producing fertile offspring in nature

Population: group of individuals of the same species that live in the same area and interbreed

- **Gene pool**: the combination of all of the alleles for all genes in all the members of a population
- Each individual has 2 alleles for every gene (homozygous/heterozygous)

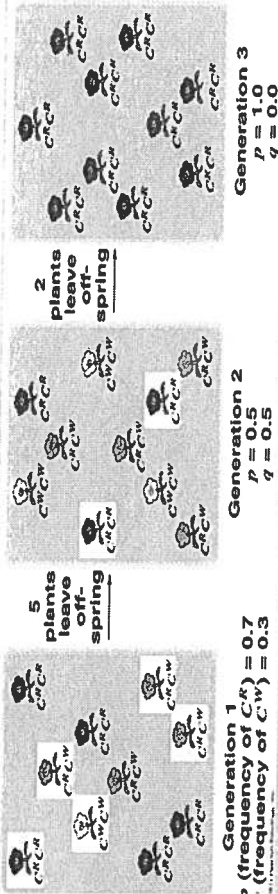
Genetic Drift

- = Random change in allele frequencies over time due to chance alone
- has a much greater effect on Small populations

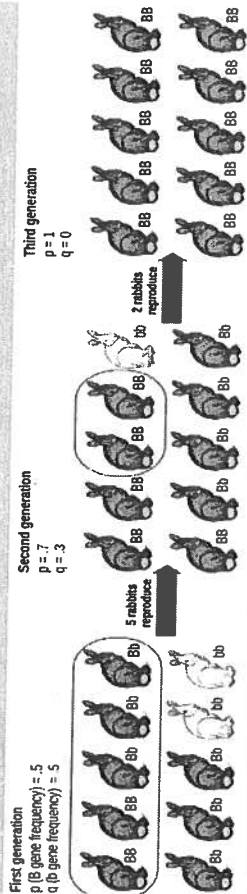
Genetic Drift

2 special cases of genetic drift:

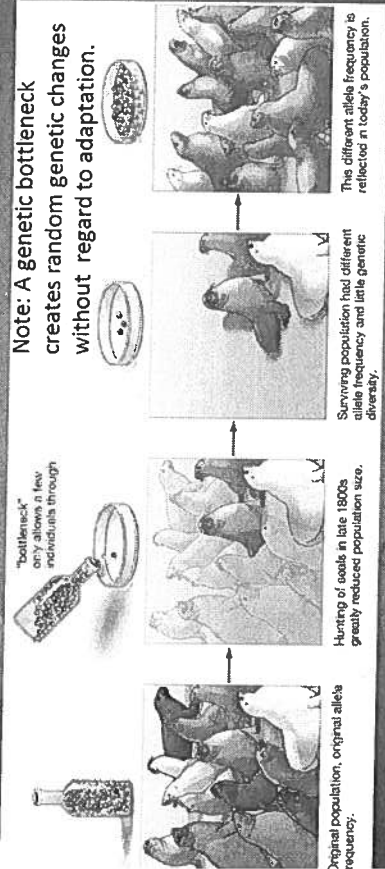
- **Founder Effect** - small group of individuals settle in new area
 - **Bottleneck Effect** - small group of individuals survive a catastrophic event
- both of these new populations can evolve to be much different than original population



Genetic Drift Examples

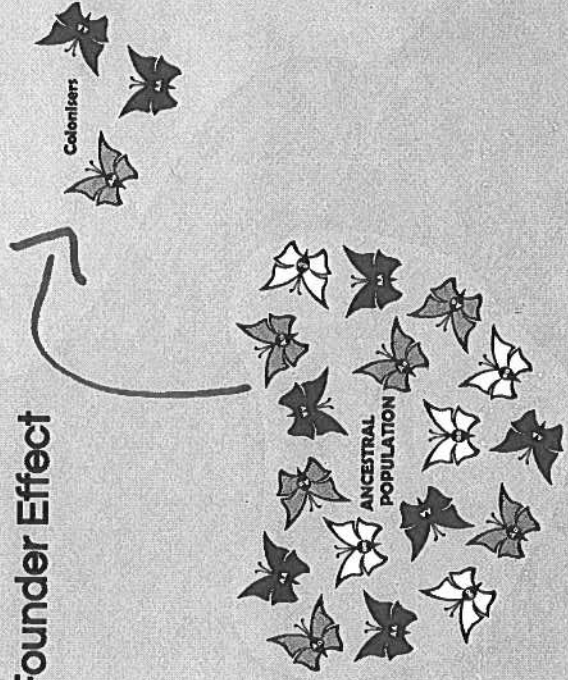


Genetic Bottleneck – A Historical Case



A severe genetic bottleneck occurred in northern elephant seals. Other animals known to be affected by genetic bottlenecks include the cheetah and both ancient and modern human populations.

Founder Effect



MAJOR CAUSES OF EVOLUTION

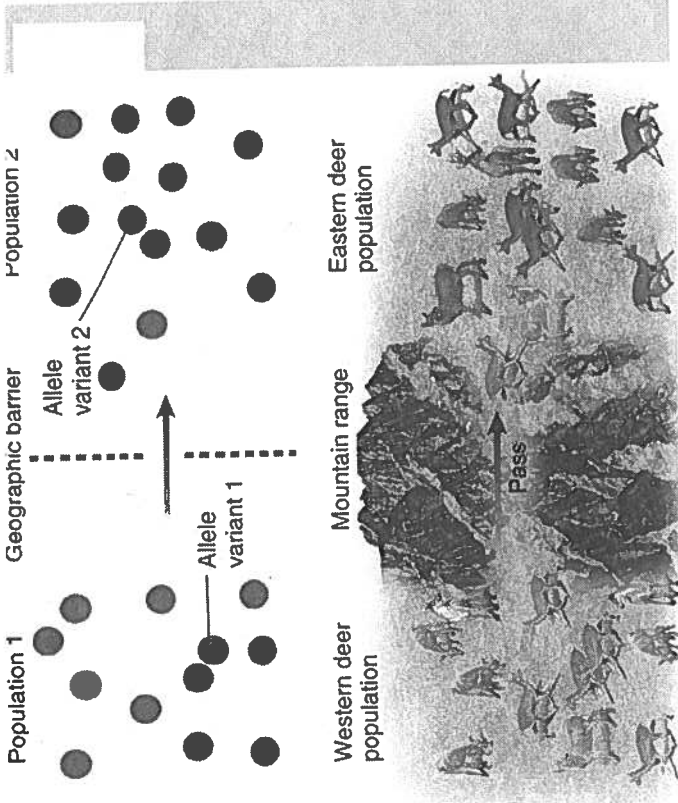
Gene Flow

- Movement of fertile individuals between different populations (immigration and emmigration)
- Helps increase variation in a population by introducing new alleles
- Reduces genetic differences between populations



Parus major

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If gene flow is cut off, populations may evolve so many differences that if they come into contact in future they can no longer interbreed and are considered 2 different species.

Gene flow in a ring pattern around a barrier

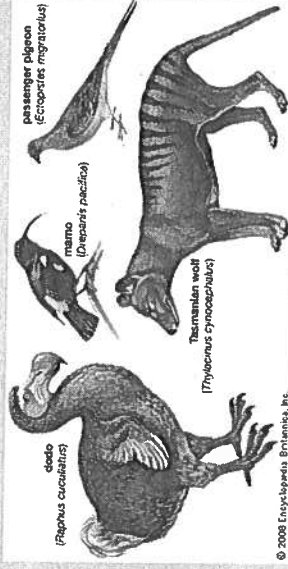
NATURAL SELECTION CANNOT FASHION PERFECT ORGANISMS.

1. Selection can act only on existing variations.
2. Evolution is limited by historical constraints.
3. Adaptations are often compromises.
4. Chance, natural selection, and the environment interact.

* Just because a trait may be beneficial or even necessary for survival, does not guarantee that the trait will evolve.

Extinction

- happens when species cannot evolve fast enough to withstand changes in its environment



REQUIREMENTS FOR HARDY-WEINBERG EQUILIBRIUM

1. No mutations.
2. Random mating.
3. No natural selection.
4. Extremely large population size.
5. No gene flow.

If even one of these conditions is NOT met, then the population is EVOLVING!

HARDY-WEINBERG PRINCIPLE

Hardy-Weinberg Principle: The allele and genotype frequencies of a population will remain constant from generation to generation

...UNLESS they are acted upon by outside forces

H-W Equilibrium = allele and genotype frequencies remain constant

*The opposite of each of the H-W Equilibrium requirements are what cause evolution to occur

Causes of Evolution:

- #1 - Mutations
- #2 - Nonrandom mating (sexual selection)
- #3 - Natural selection
- #4 - Genetic drift
- #5 - Gene flow

Hardy-Weinberg Principle

Allele Frequencies:

- Gene with 2 alleles : p, q
- p = frequency of dominant allele (A)
- q = frequency of recessive allele (a)

Note:

$$1 - p = q$$
$$1 - q = p$$

$$p + q = 1$$

Hardy-Weinberg Equation

Genotypic Frequencies:

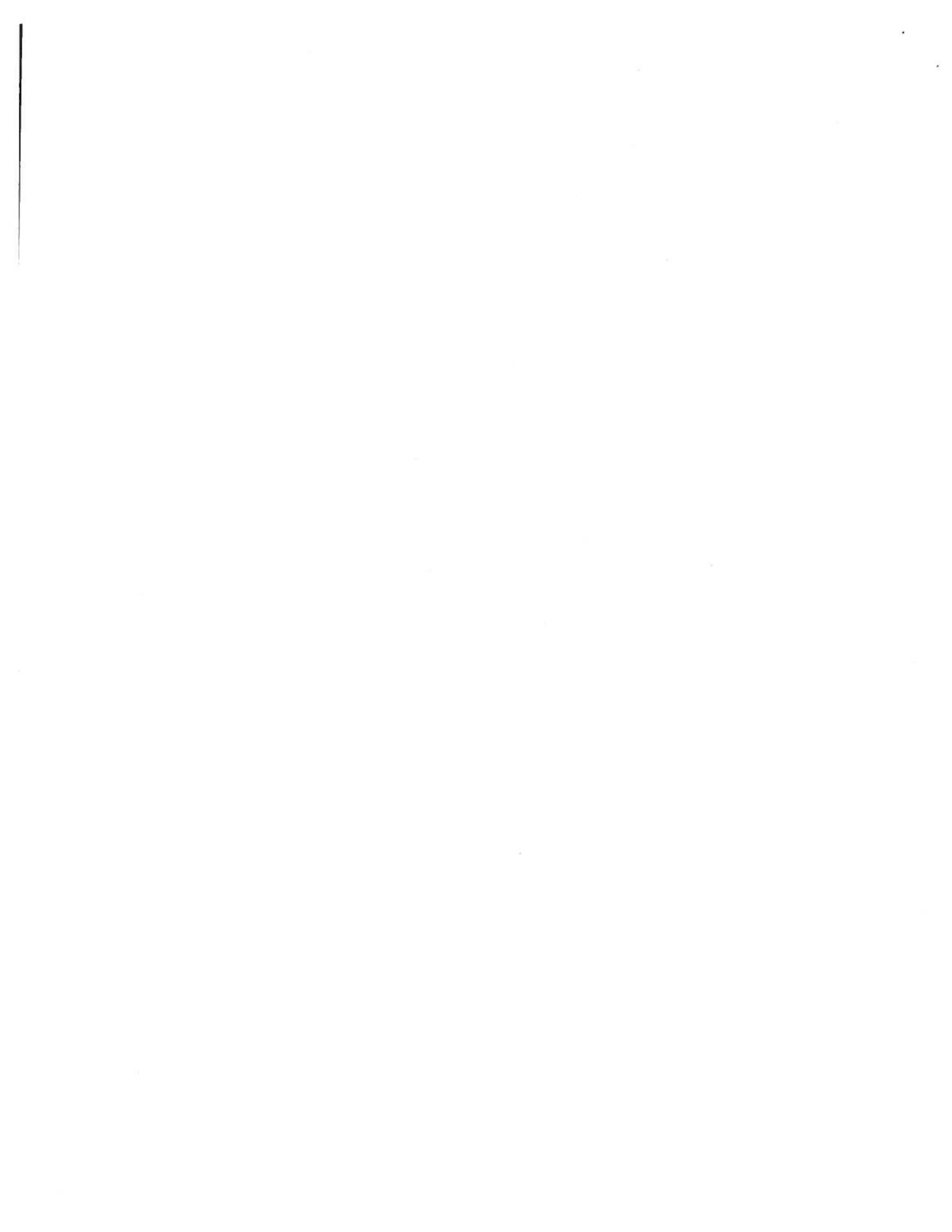
- 3 genotypes (AA, Aa, aa)

$$p^2 + 2pq + q^2 = 1$$

p^2 = AA (homozygous dominant genotype)

$2pq$ = Aa (heterozygous genotype)

q^2 = aa (homozygous recessive genotype)



Evolution of Populations Vocabulary

Modern Synthesis - the current view of evolution that combines _____ ideas of _____ with _____ knowledge of _____

Species - a group of _____ organisms that are _____ similar and are capable of _____ and producing fertile _____ in nature

Population - a group of individuals of the same _____ that live in the same _____ and _____

Gene pool - the combination of all of the _____ for all of the _____ in all of the members of a _____

Genetic Drift - _____ change in allele _____ over time due to _____ alone. - has a much greater effect in _____ populations

Founder Effect - _____ group of individuals _____ in a new _____

Bottleneck Effect - _____ group of individuals survive a _____ event

Gene Flow - movement of _____ individuals between _____ populations

- Helps increase _____ in a population by introducing new

- If gene flow is cut off, populations may _____ so many _____ that if they come in contact in the _____ they can no longer _____ and are considered 2 different _____

* Just because a _____ may be beneficial or even _____, does not guarantee that the trait will _____

Extinction - happens when species cannot _____ fast enough to _____ changes in its _____

Hardy Weinberg Principle - the _____ and _____ frequencies of a population will remain _____ from _____ to generation - unless acted upon by _____ forces

5 Requirements of H-W Equilibrium

- 1.
- 2.
- 3.
- 4.
- 5.

-If even _____ of these conditions is _____ met, then the population is

H-W Principle Equation = $p + q = 1$ where p = frequency of _____ allele (A) and q = frequency of _____ allele (a)

Hardy-Weinberg Equation = $p^2 + 2pq + q^2 = 1$ where p^2 = _____ genotype, $2pq$ = _____ genotype, and q^2 = _____ genotype

Name _____ Per _____

**In your own words, write a 5+ sentence summary on the HHMI Survival of the Fittest -
Rock Pocket Mouse Video**

Week 5 Assessment

1. Email address *

2. The current view of evolution that combines Darwin's ideas of evolution with Mendel's knowledge of genes and inheritance 1 point

Mark only one oval.

Natural selection

Genetic Drift

Hardy-Weinberg

Modern Synthesis

3. Fertile individuals moving into and out of a population (immigration and emmigration) is known as 1 point

Mark only one oval.

mutations

adaptive radiation

genetic drift

gene flow

4. The offspring of a horse and donkey is called a mule. Mules are unable to have offspring of their own. Based on our definition of "species" would you consider a horse and a donkey to be the same species? 1 point

Mark only one oval.

Yes

No

5. Genetic Drift has a much greater effect on 1 point

Mark only one oval.

Small populations

Large populations

Population size does not influence genetic drift

6. A population of rabbits in the Arctic has slowly over time changed from being a 50/50 mix of brown fur and white fur to almost 100% white. The white color is thought to help them blend into their environment and avoid predators. This would be an example of 1 point

Mark only one oval.

Natural Selection

Genetic Drift

Gene flow

Bottleneck effect

7. A population of lizards were an equal mix of blue skinned, green skinned, and brown skinned. After a disease wiped out the majority of the population, the frequency of colors in the lizards are now 75% blue, 25% green, and 0% brown. This would best describe an example of 1 point

Mark only one oval.

- Natural Selection
- Bottleneck Effect
- Founder effect
- Gene flow

8. Which of the following is NOT one of the 5 conditions of Hardy-Weinberg equilibrium? 1 point

Mark only one oval.

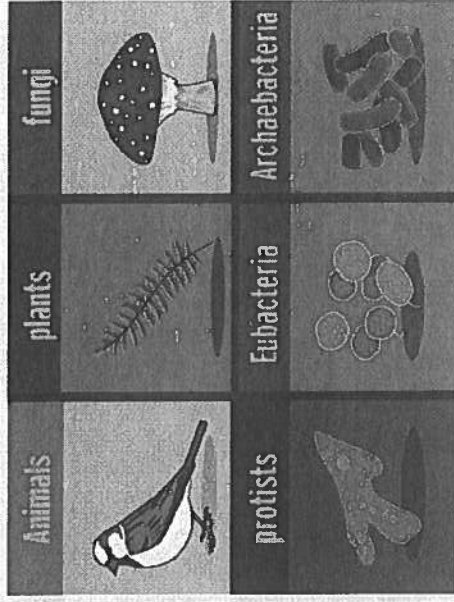
- Random mating
- No mutations
- Small population size
- No gene flow

9. According to the Hardy-Weinberg Equation, the frequency of a heterozygous individual can be found by calculating 1 point

Mark only one oval.

- p^2
- q^2
- $2pq$

Classification of Living Things



TAXONOMY = the branch of biology that names and groups organisms according to their **MORPHOLOGY**

(Study of shape and structure)

Does it have a backbone? Feathers? Gills? Flippers?

AND PHYLOGENY

(Study of evolutionary history)

How has organism changed in fossil record?

What other organisms is it related to?

Tree of Life- Universal Evolutionary Tree

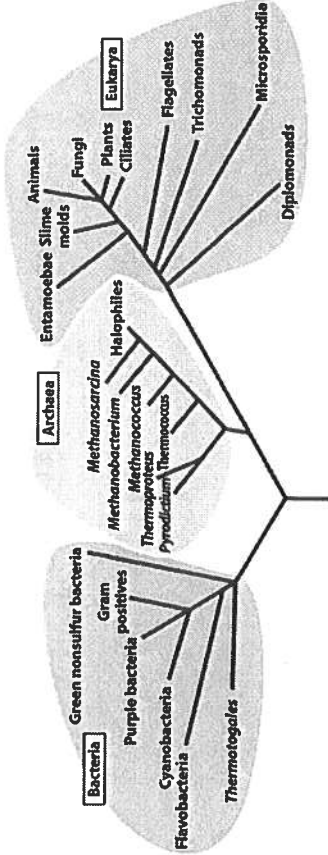
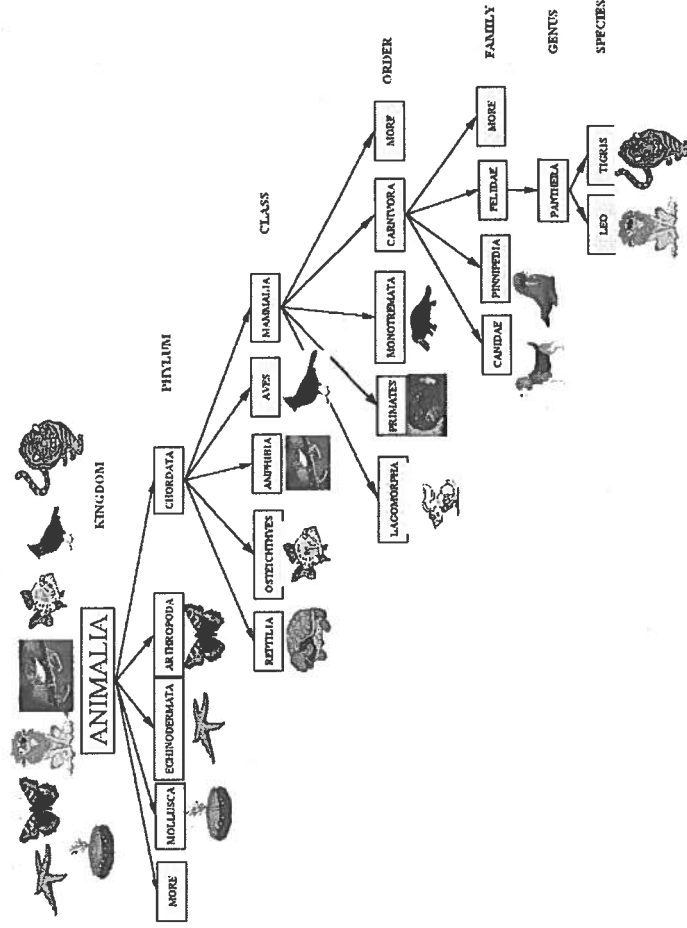


Figure 13-7
Biology of Plants, Seventh Edition
© 2005 W. H. Freeman and Company



EXAMPLE (Lion)

Kingdom Animalia

Phylum Chordata

Class Mammalia

Order Carnivora

Family Felidae

Genus Panthera

Species leo



BINOMIAL NOMENCLATURE

(2 name naming system)

• 1st name = GENUS NAME

– Always capitalized

• 2nd name = SPECIES NAME

– Always lower case

• Both names are UNDERLINED OR written in ITALICS.

Binomial nomenclature

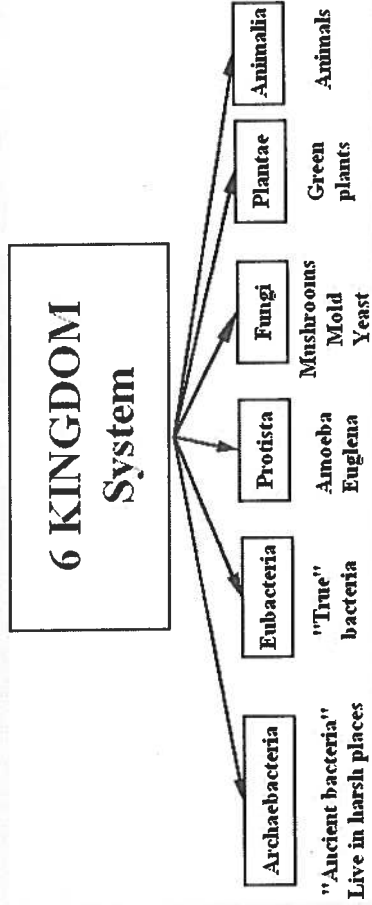


Humans

Homo sapiens

Homo sapiens

Modern Taxonomy



MODERN TAXONOMY



organizes
living things
in the context of
Evolution

MODERN TAXONOMY

Scientists use different kinds of evolutionary evidence to classify organisms:

- Fossil record
- Morphology
- Embryology
- Chromosomes
- Macromolecules (DNA & proteins)

Ex= Protein Comparisons

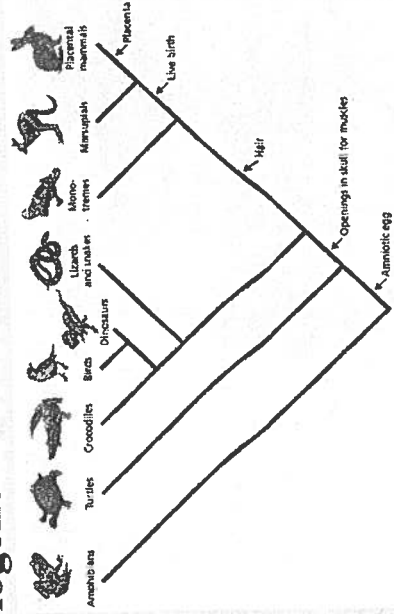
Number of Amino Acids That Differ from a Human Hemoglobin Polypeptide (Total Chain Length = 146 Amino Acids)

Species	Number of Amino Acids That Differ from a Human Hemoglobin Polypeptide (Total Chain Length = 146 Amino Acids)
Human	0
Rhesus monkey	8
Moose	27
Chicken	45
Frog	67
Lamprey	125

CLADISTICS

Evolutionary relationships are shown in a diagram called a CLADOGRAM

Cladograms are also sometimes referred to as Phylogenetic Trees

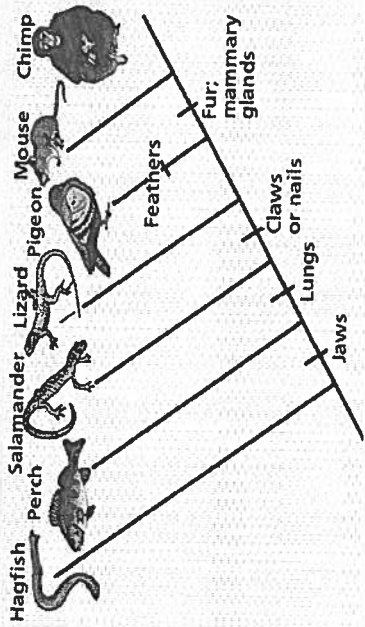


Cladograms are used to...

- Organize organisms based on evolutionary relationships (phylogeny).
- In other words... who is related to who and where did we come from...

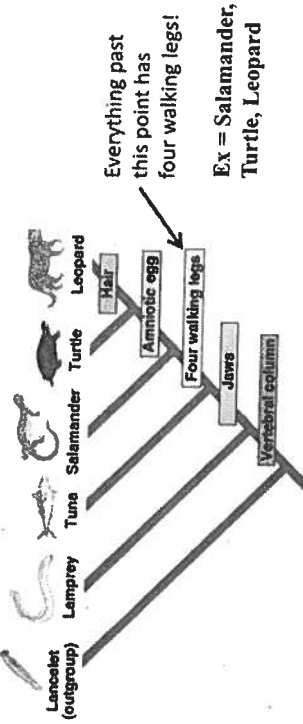
How are cladograms constructed?

- Organisms are grouped together based on their shared derived characteristics (trait modified from the ancestral trait).



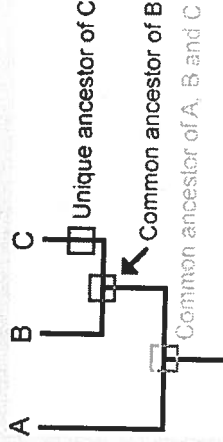
How do you read a cladogram?

- The **closer** two species are on the cladogram, the more closely they are **related**. This means they evolved apart more **recently**.
- Sometimes a cladogram will also list the **characteristics** that make two groups or organisms different.



How Cladograms Show Ancestry

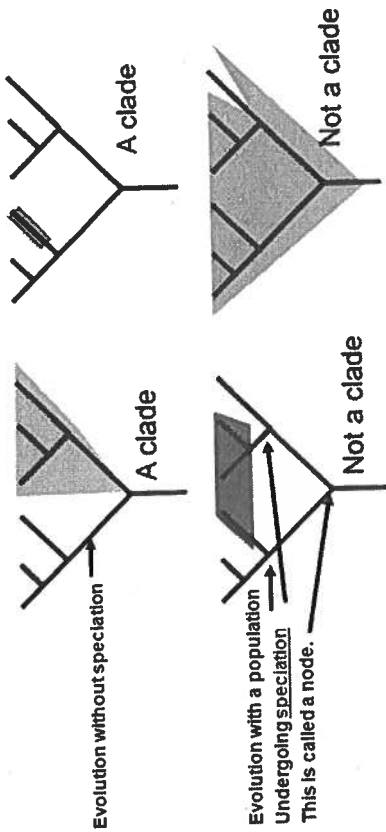
- Common Descent** - Describes how a group of organisms share a most recent common ancestor
- The point (intersection) where two organisms' lines come together is where they shared a common ancestor
- The more recently two species shared a common ancestor, the more closely related they are said to be



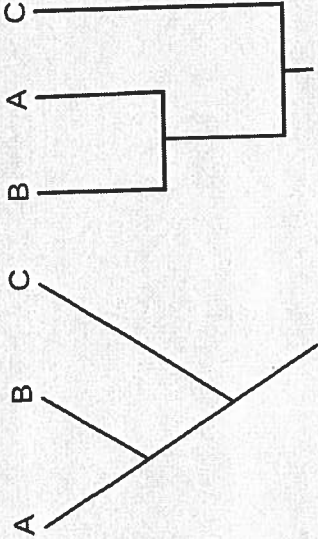
*B and C are the most closely related because they shared a more recent common ancestor. A is equally related to B and C

Deeper Phylogeny

A clade is an evolutionary branch on the tree which represents an ancestor and ALL its descendants.



Types of Cladograms

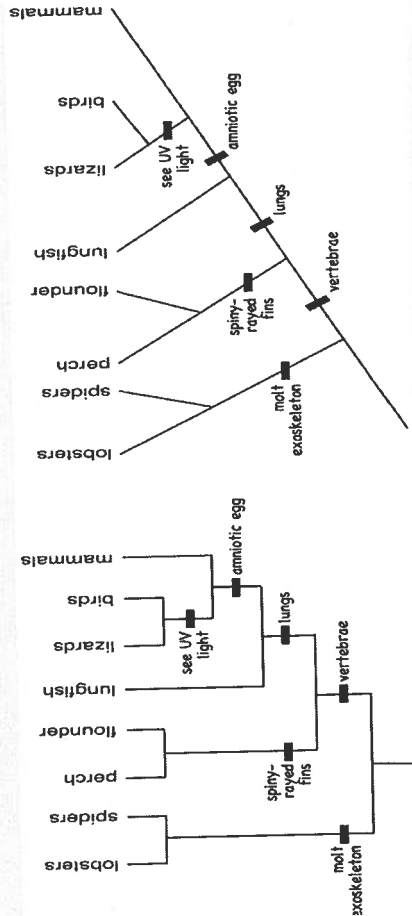


- Although they look different, these two cladograms show the same evolutionary history.
- (B and A are more closely related because they show a more recent common ancestor)

Example 1

- Given a table of derived characters (traits), create a cladogram

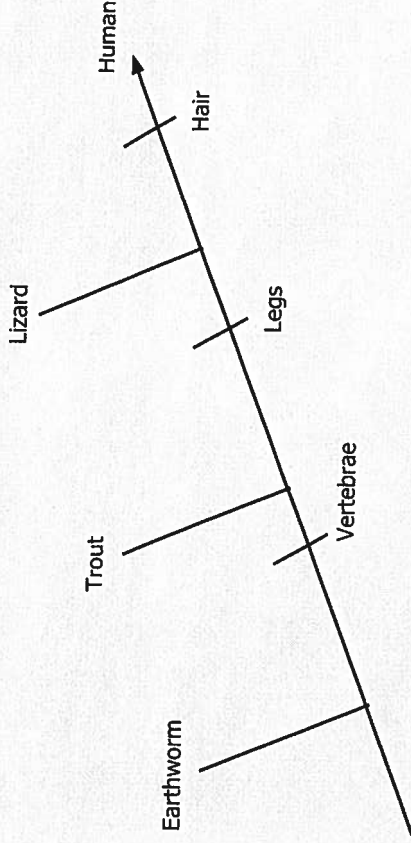
Character	Earthworm	Trout	Lizard	Human
Vertebrae		X	X	X
Legs			X	X
Hair				X



Steps to Constructing a Cladogram

1. Draw a long diagonal line
2. Use vertical lines to add each organism based on the number of shared characteristics. (Least number of traits on left and most number of traits on right)
3. Use small vertical lines or ticks to represent each trait. (Traits shared by the most organisms on the left and traits with least on the right)

Cladogram

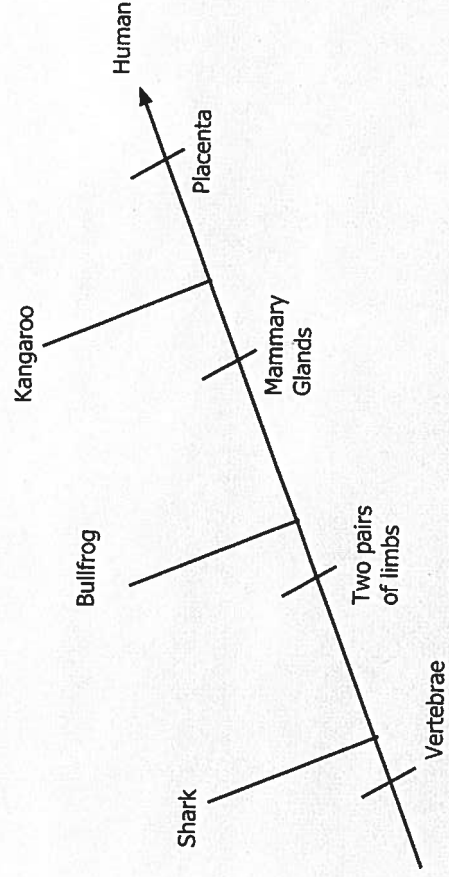


Example 2

Taxa

Characters	Shark	Bullfrog	Kangaroo	Human
Vertebrae	X	X	X	X
Two pairs of limbs		X	X	X
Mammary glands			X	X
Placenta				X

Cladogram



Name _____ Per _____

Classification and Cladograms Vocabulary

Taxonomy - the branch of _____ that names and _____ organisms according to their _____ and _____

Morphology - study of _____ and _____

Phylogeny - study of evolutionary _____

Binomial Nomenclature - _____ name naming _____.

- 1st name = _____ (always _____)
- 2nd name = _____ (always _____)
- BOTH names must either be _____ or written in _____

6 Current Kingdoms

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

Types of Evidence used for modern taxonomy

-
-
-
-
-

Cladogram - a _____ used to show evolutionary _____

- Cladograms are sometimes referred to as _____

Common Descent - describes how a group of _____ share a most _____ common _____

- The point where two organisms' lines come _____ is where they _____ a common ancestor
- The more _____ two species shared a _____ ancestor, the more _____ related they are said to be

Clade - an evolutionary _____ on the tree which represents an _____ and _____ of its _____

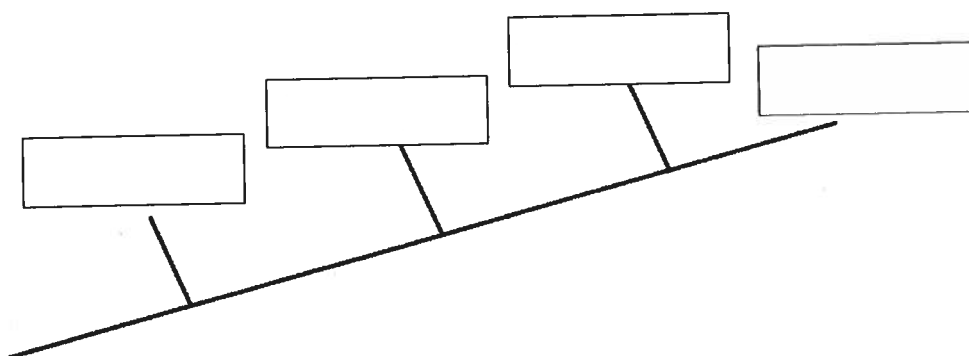
Name: _____ Per _____

Cladogram Analysis Practice

1. Fill in the following table. Mark an "X" if an organism has the trait.

	hair	legs	no tail	eyes
Human				
Snake				
Monkey				
Lizard				

2. Add each of these organisms and traits to the cladogram below.



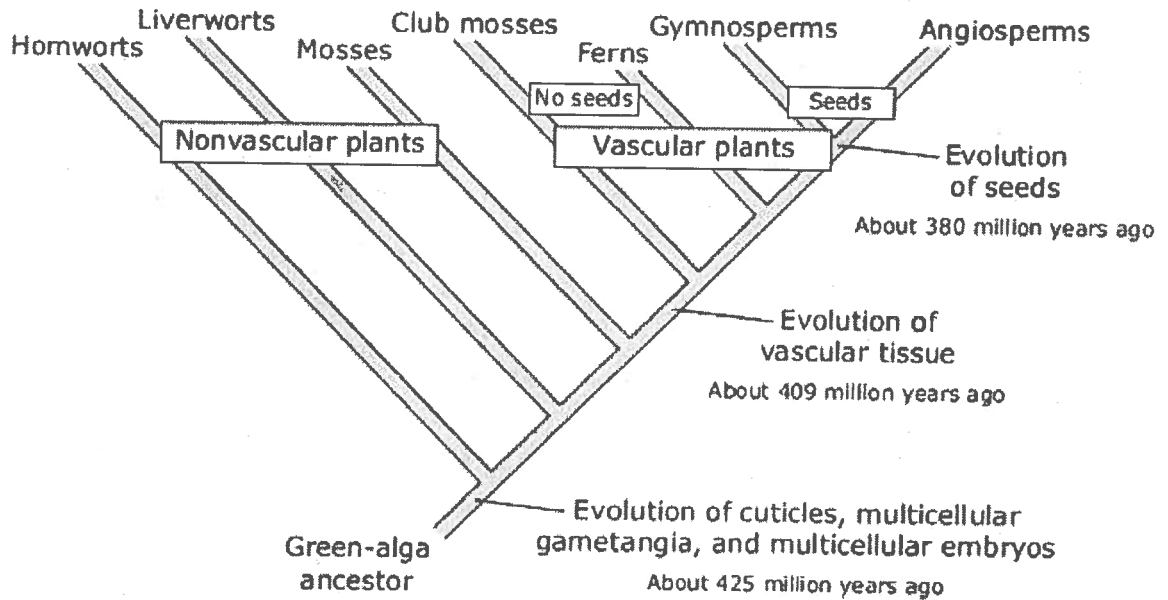
- a. Which animal would be in box 1 on the left? _____
 box 2 _____
 box 3? _____
 box 4 on the right? _____

b. What would be the order of traits placed on the main line from left to right? _____

3. According to your cladogram, which two species are more closely related: humans or snakes or humans or lizards? How do you know?

4. According to your cladogram, what species are humans most closely related to? How do you know?

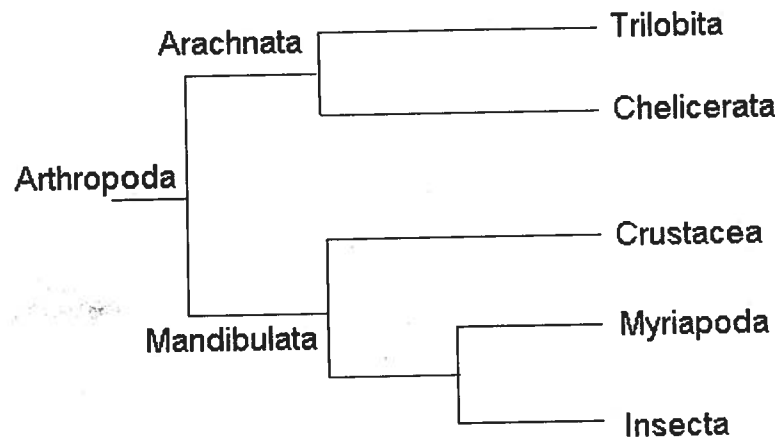
The cladogram shows the evolution of land plants as indicated by fossil records.



5. Which group of plants likely evolved the most recently?

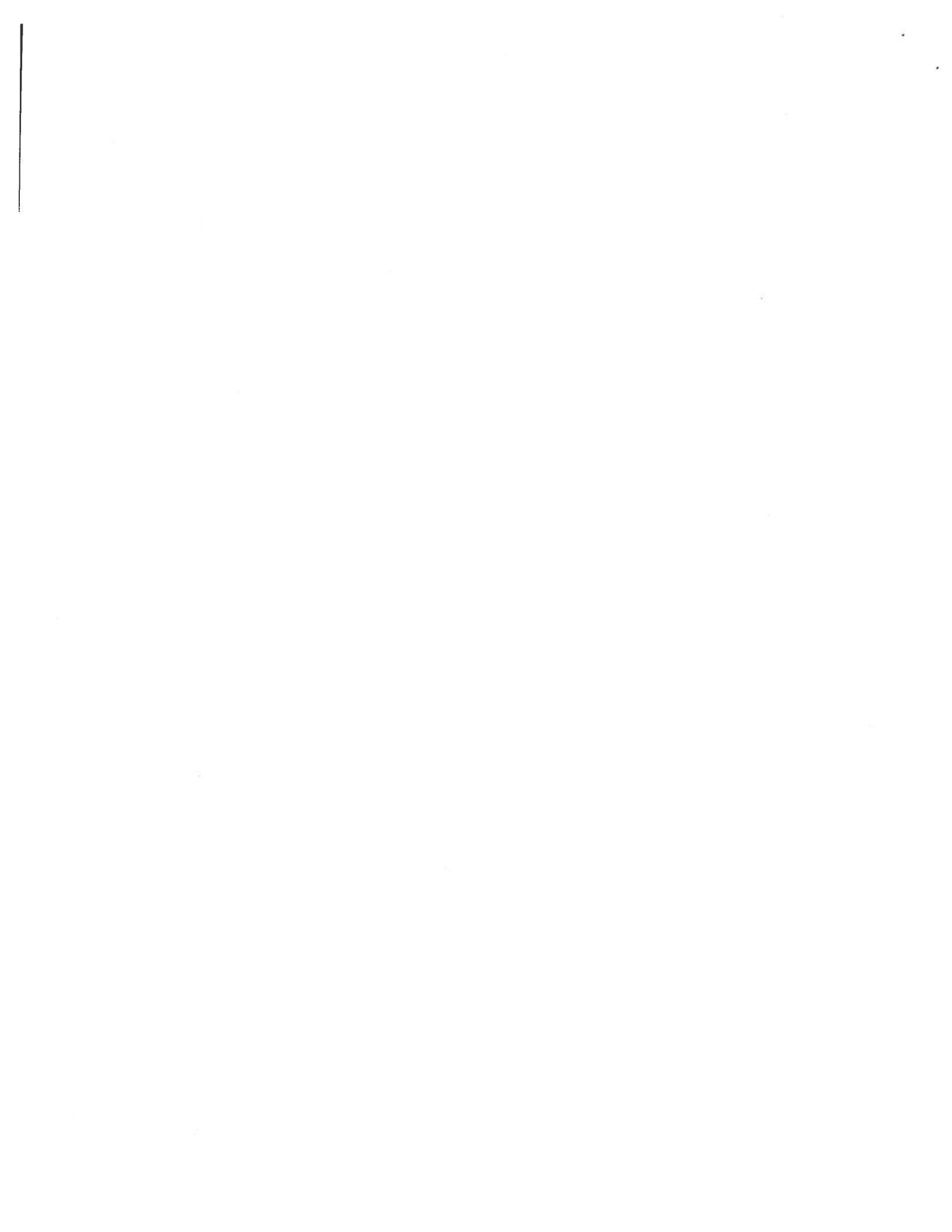
6. Do mosses share a more recent common ancestor with Liverworts or Gymnosperms?

7. Underline one. Which hypothetical new discovery would challenge the validity of this diagram?
 - a. A large aquatic vascular plant about 200 million years old
 - b. A species of algae that has existed for less than 1 million years
 - c. A moss species that has existed for the last 380 million years
 - d. A fossil of a fern dated to be 425 million years old



13. List the species that would be included in a clade with Crustacea.

14. Which species is the most closely related to Myriapoda?



Week 6 Assessment

1. Email address *

2. The study of the internal and external structure and form of an organism.

1 point

Mark only one oval.

- Taxonomy
- Phylogeny
- Morphology
- Binomial Nomenclature

3. The branch of biology that names organisms and groups them according to their characteristics and evolutionary history is called

1 point

Mark only one oval.

- Taxonomy
- Phylogeny
- Morphology
- Binomial Nomenclature

4. Which language is used to write the scientific name of a species?

1 point

Mark only one oval.

- Latin
- English
- Spanish
- French

5. Which of the following is NOT one of the 6 current kingdoms used to classify organisms 1 point

Mark only one oval.

- Plants
- Mammals
- Fungi
- Eubacteria

6. An organism's evolutionary history is known as its

1 point

Mark only one oval.

- Morphology
- Fitness
- Adaptation
- Phylogeny

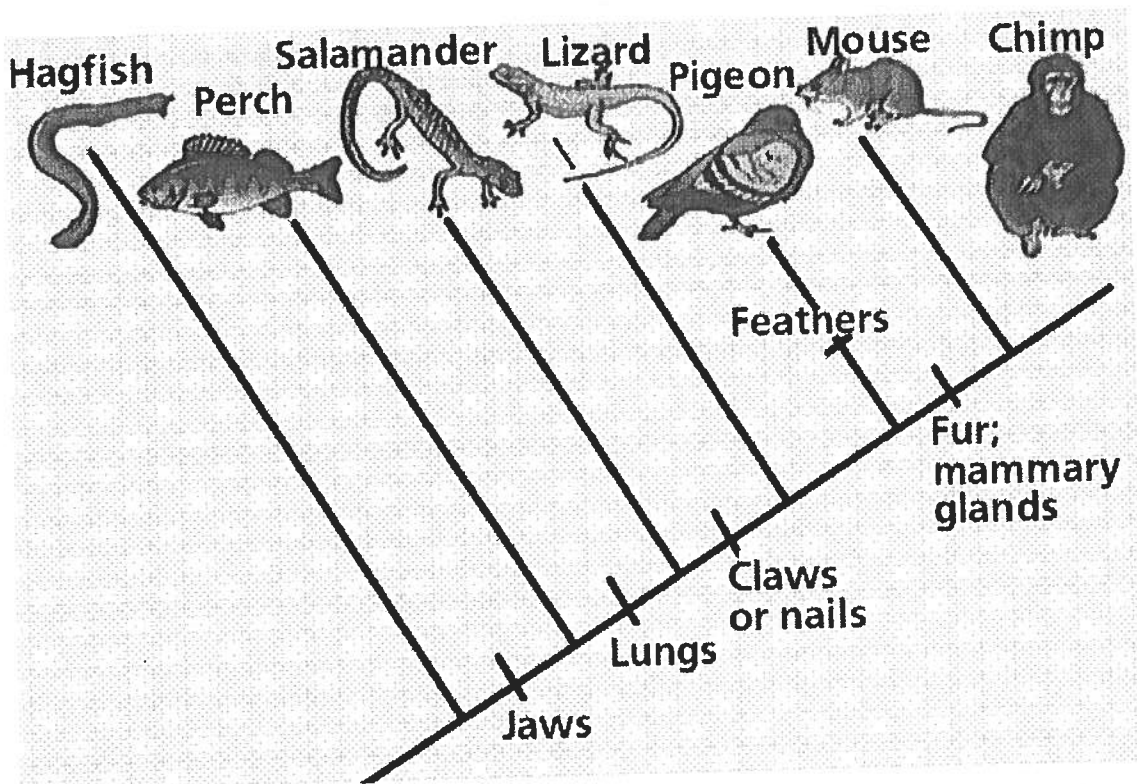
7. Which is the correct way to write humans scientific name?

1 point

Mark only one oval.

- homosapiens
- Homo Sapiens
- Homo sapiens
- homo sapiens

8. According to the cladogram below, which of the following species is the most closely related to the lizard? 1 point

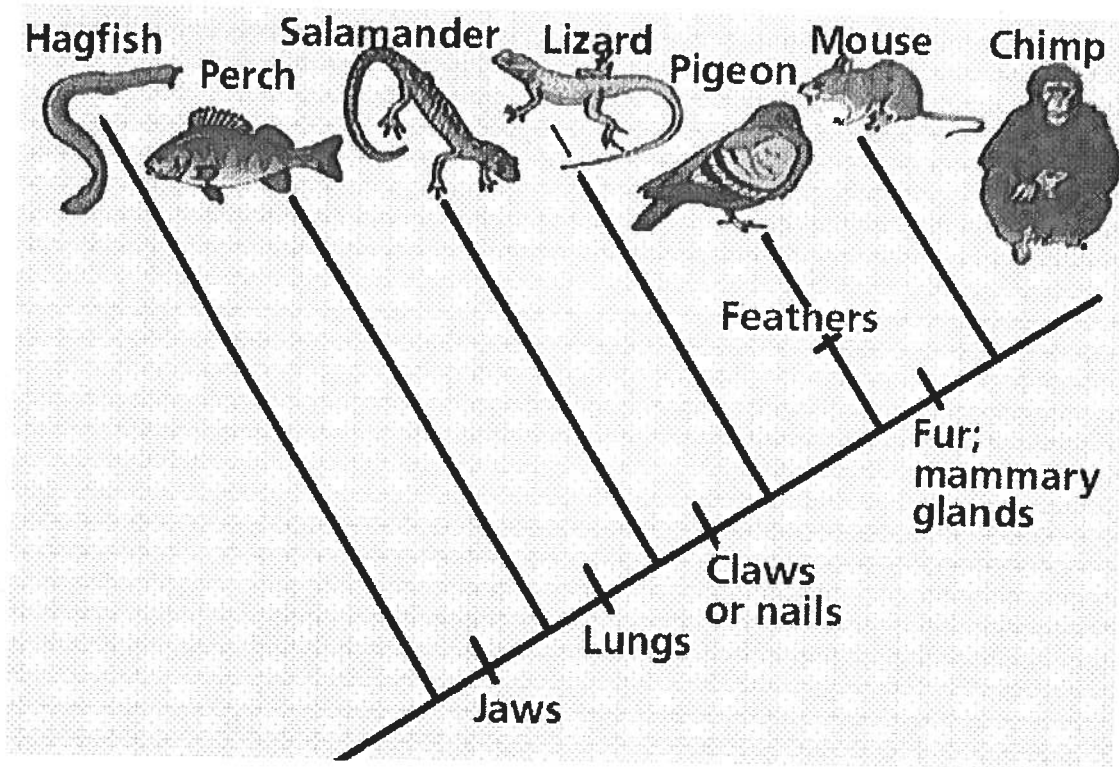


Mark only one oval.

- pigeon
- salamander
- hagfish

9. According to the cladogram below, select ALL (potentially more than one answer) of the species that have mammary glands

1 point

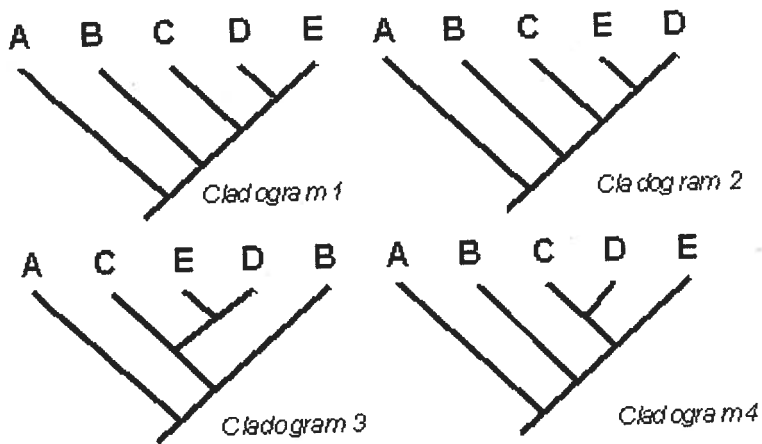


Check all that apply.

- lizard
- pigeon
- mouse
- chimp

10. According to the cladograms below, which cladogram shows a DIFFERENT evolutionary history than the rest?

1 point



Mark only one oval.

- Cladogram 1
- Cladogram 2
- Cladogram 3
- Cladogram 4

11. If any of the 5 conditions for Hardy-Weinberg get broken, what happens?

1 point

Mark only one oval.

- The population can not evolve
- The population will evolve
- The population faces extinction
- The population cannot be classified any longer

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