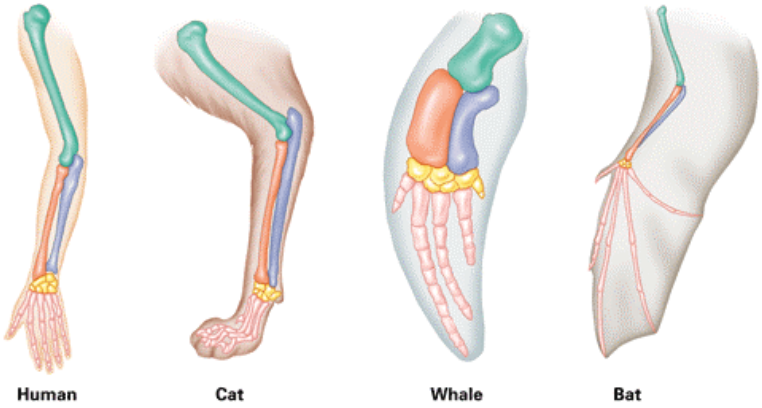
Activity 2. Evidence of Evolution Homologous Structures – Use your notes, book and the Internet to answer the following questions on homologous structures.

Evidence for Evolution Homologous Structures

Homologous Structures

1. What are homologous structures?
   Structures shared by organisms because they descended from a common ancestor. The structures are built from the same bones, but can be modified in form and function.

2. Place the same letter or number on the corresponding bones in each of the front limbs pictured below.



3. Based on the limbs above, what can you conclude about the ancestor shared by the organisms above?

   The common ancestor to these organisms had the same bones

4. Compare and contrast two limbs from questions 2. Your answer should include an analysis of size, shape, and function.

   The human and whale front limbs have the same bones in the same positions. The human limb is used for grasping and its bones are longer and thin. The whale limb is used for steering and its bones are shorter and wider.

5. How are the pictured limb structures used to support the theory of evolution?

   The ancestor to these organisms had the same bones, but the limbs have been modified in form and function (descent with modification).

6. Find a definition for a **vestigial structure**. Identify 1 structure that scientists classify as vestigial that wasn't presented in the notes.

   Structures without a clear or current use in an organisms, but had a use in the ancestor.
   EX: Sexual organs of dandelions

Activity 3. Evidence of Evolution Molecular Data – Use your notes, book and the Internet to answer the following questions about molecular evidence.

Amino Acid Sequence and Evolutionary Relationships

The biochemical similarity of organisms is another technique used to determine evolutionary relationships between organisms. Though molds, aardvarks, and humans appear to have little in common physically, a study of their proteins reveals certain similarities. Biologists have perfected techniques for determining the sequence of amino acids in proteins. By comparing the amino acid sequences in homologous proteins of similar organisms and of diverse organisms, evolutionary relationships that might otherwise go undetected can be determined. Biologists believe that the greater the similarity between the amino acid sequences of two organisms, the closer their relationship. Conversely, the greater the differences, the more distant the relationship. Further, biologists have found that such biochemical evidence compares favorably with other lines of evidence for evolutionary re1ationships

In this investigation, you will compare amino acid sequences in proteins of several vertebrates. You will also study amino acid differences and infer evolutionary relationships among some diverse organisms.

Comparing Amino Acid Sequences

1. Examine Figure 1, which compares corresponding portions of hemoglobin molecules in humans and five other vertebrate animals. Hemoglobin, a protein composed of several long chains of amino acids, is the oxygen-carrying molecule in red blood cells. The sequence shown is only a portion of a chain made up of 146 amino acids. The numbers in Figure 1 indicate the position of a particular amino acid in the chain.

2. In Data Table 1, notice that the abbreviated names of the amino acids in human hemoglobin are printed.

3. Compare the human sequence to the sequence of each of the other species. Circle any difference when compared to the human amino acids.

4. Turn your paper 90-degrees to the left and shade in the number of boxes that corresponds to the total number of differences between humans that the other organisms.

5. After you are done graphing, answer the questions.

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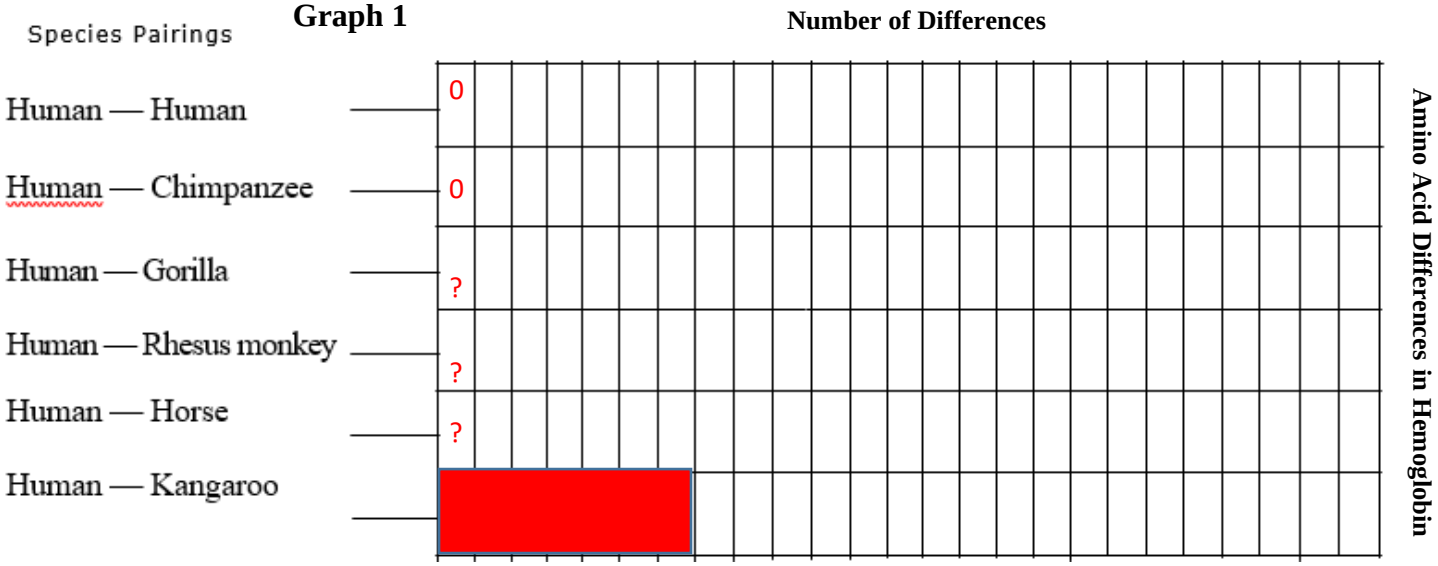
Figure-1 Amino Acid Sequences and Evolutionary Relationships

	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101
Human	THR	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Chimpanzee	THR	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Gorilla	THR	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Rhesus monkey	GLN	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Horse	ALA	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Kangaroo	LYS	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU

	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116
Human	ASN	PHE	ARG	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Chimpanzee	ASN	PHE	ARG	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Gorilla	ASN	PHE	LYS	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Rhesus monkey	ASN	PHE	LYS	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Horse	ASN	PHE	ARG	LEU	LEU	GLY	ASN	VAL	LEU	ALA	LEU	VAL	VAL	ALA	ARG
Kangaroo	ASN	PHE	LYS	LEU	LEU	GLY	ASN	ILE	ILE	VAL	ILE	CYS	LEU	ALA	GLU

Graph 1



Analysis and Conclusions

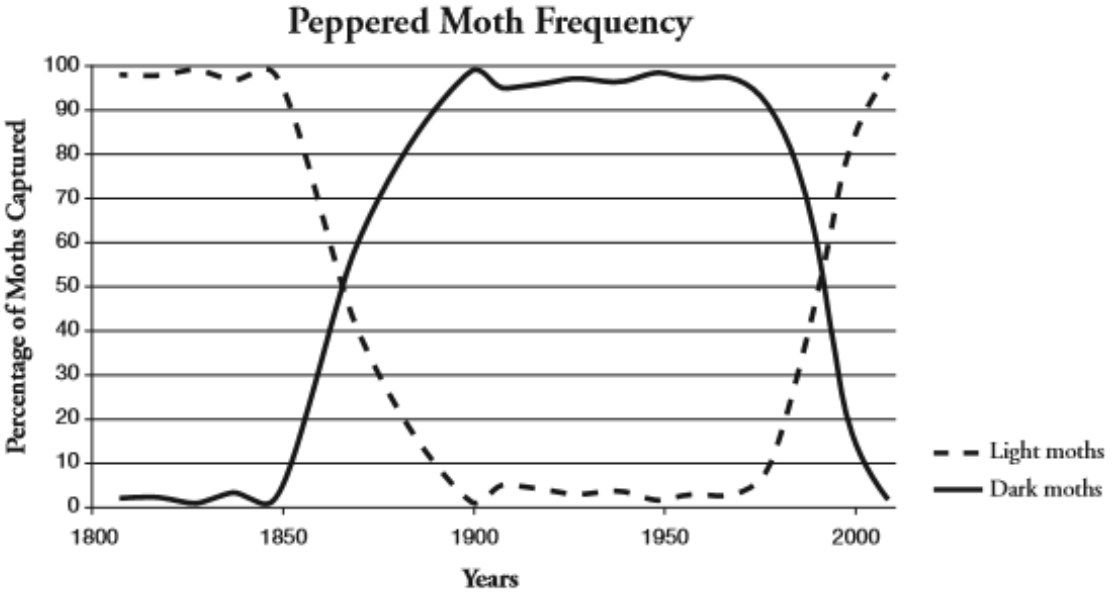
1. On the basis of hemoglobin similarity, what organism appears to be most closely related to humans? Explain. Chimpanzee, Explain
2. Among the organisms, which one appears to be least closely related to humans? Explain. Kangaroo, Explain
3. There is a difference of only one amino acid in one chain of the hemoglobin of humans and gorillas. What might have caused this difference? Mutation (What type?)
4. If the amino acid sequences in the proteins of two organisms are similar, why will their DNA also be similar? DNA instructions are used to build proteins. _____ → mRNA → _____
5. Many biologists believe that the number of differences between proteins of different species indicates how long ago the species diverged from common ancestors. Why do these biologists believe that humans, chimpanzees, and gorillas diverged from a common ancestor only a few million years ago? Fewer differences would mean a more recent common ancestor because there has been less time to accumulate mutations/variation.

Activity 5. Use the graph and information provided to answer the questions.

Evolution and Selection

What mechanisms lead to changes in the diversity of species on Earth?

Color Variations in Moths in Great Britain



1. Refer to the graph of Peppered Moth Frequency.
   a. Which moth color was more prevalent before 1850? Light
   b. Which color was more prevalent between 1900 and 1950?
2. Describe the change in the percentage of light-colored moths and dark-colored moths between 1850 and 1900.
   Light changed from 100% to 0%, Dark changed from _____
3. Describe the change in the percentage of light-colored moths and dark-colored moths between 1950 and 2000. Light changed from near _____, the Dark changed from near 100% to 10%.
4. During the Industrial Revolution through the mid-20th century, factories and power plants, which burned coal, produced large quantities of soot and smog. Near industrialized areas, black powder covered surfaces, including the moth habitat.
   a. Which color moth would have a better chance of surviving predation (better camouflage to hide from predators) on this dark surface? Dark
   b. How does this help explain the change in the colors of the moth population?
   Dark moths survived better, reproduced more and passed more of their dark genes to the next generation. This is why the dark moths became more common than white.
5. Air Acts were passed by governments of industrialized nations beginning in the mid-1950s. Use this information to explain why the color of the moth population shifted again. Less pollution would lighten the environment, allowing Light moths to survive better, reproduce more and pass more of their light genes to the next generation.

Activity 6. Click on two (minimum) of the video links. Describe how the behaviors you observe can lead to speciation.

Bird of Paradise - https://www.youtube.com/watch?v=W7QZnwKqopo
Riflebird - https://www.youtube.com/watch?v=7XhPHWY4RuM
MW Bird - https://www.youtube.com/watch?v=eI_quJRRGxk
Peacock spider - https://www.youtube.com/watch?v=9GgAbyYDFeg
(You can jump through parts to see the behavior)

In all four examples, males are "showy" and females are "choosy". Males perform displays that females use to select a mate. If females don't choose males based on their behavior/display, then their gametes remain separate and they become reproductively isolated. Reproductive isolation over a period of time can lead to new species.

Activity 7. Use the information in the data table below to construct a phylogenetic tree, then cladogram.

Answer:

Plant Species 2

- Species 1: - enzyme, 4 aa different, no common DNA bands
- Species 2: + enzyme, 1 aa different, all DNA bands common
- Species 3: + enzyme, 3 aa different, 1common DNA band

Based on the data collected, label the phylogenetic tree.

- Place Unknown, Species 1, Species 2 and Species 3 on the tree to represent the possible evolutionary relationships
- Identify the species that diverged from a common ancestor most recently. Place the purple circle over the common ancestor.
- Place the red bar for Enzyme M onto the tree to make a cladogram.