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Year	Species	Genetic Distance
1981	Human	1.0
1981	Chimpanzee	0.8
1981	Orangutan	0.7
1981	Gorilla	0.6
1981	Protonotary	0.5
1981	Gibbon	0.4
1981	Lemur	0.3
1981	Mouse	0.2
1981	Rabbit	0.1
1981	Human	0.0

40 Biology Notes and Practice

Phylogenetic Trees

The saying "Don't judge a book by its cover" could be applied to the topic of evolution. For example, humans share 99% of their DNA with chimpanzees. Biologists point to this as evidence that humans and chimpanzees are closely related. However, this is not always the case. For example, a mouse and a rabbit share a common ancestor, which refers to an (usually extinct) organism that is an ancestor of two different organisms (species or genera). The advent of DNA technology has given scientists the tools with which to determine how closely related certain species are. DNA analysis allows scientists to construct **phylogenetic trees**, whose branches link together the relationships of different organisms. In a phylogenetic tree, each node with descendant represents the inferred most recent common ancestor of the descendants and the branch lengths in some trees may be interpreted as time estimates.

Figure 1 displays a phylogenetic tree that shows the relationships of raccoons, pandas, and bears. Figure 2 displays the amino acid sequence of the cytochrome c protein, a protein involved in cellular respiration, for several different species. Cytochrome c is a protein found in many organisms due to its vital role in cellular respiration. Over time, different types of mutations have occurred in the cytochrome c gene that do not affect the function of the cytochrome c protein. These mutations are called neutral mutations. By looking at these mutations, scientists can predict when the organisms diverged from a common ancestor and from each other.

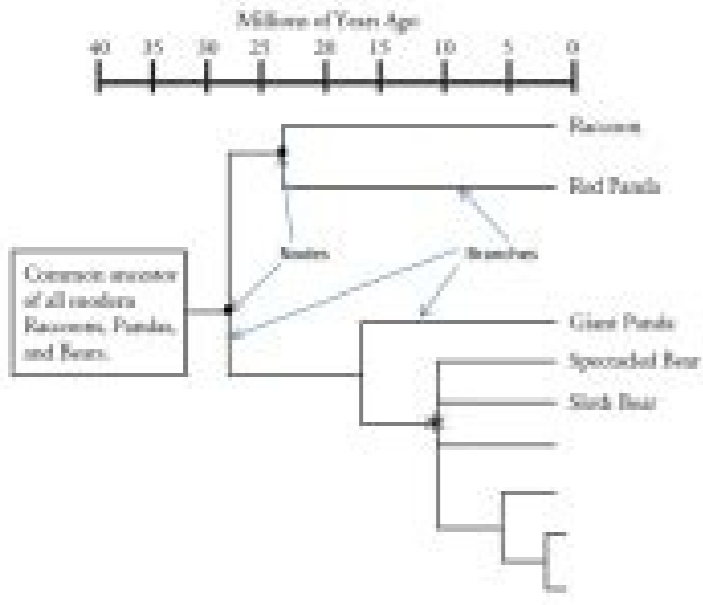


Figure 1

13-1: The Genetic Material

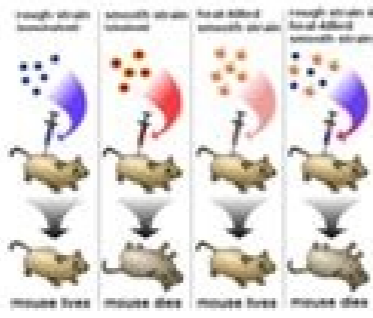
How was DNA discovered to be the chemical unit of heredity? Scientists already knew that chromosomes played a role in heredity, but the chemical composition of the chromosome included DNA and proteins. At the time, they did not know which molecule actually contained the hereditary information.

Frederick Griffith's Experiment - Transformation

Using two varieties of streptococcus, he originally searched for a vaccine. One variety of bacteria had a capsule (like a cell wall) the other did not have a capsule.

1. Injection with live encapsulated bacteria -- mice contracted pneumonia and died
2. Injection with live naked bacteria -- mice lived, immune system destroyed the bacteria
3. Injection with heat killed encapsulated bacteria -- mice remained healthy
4. Injection with dead encapsulated bacteria and live naked bacteria -- mice contracted pneumonia and died

*note that neither of these forms caused disease before, but when placed together something occurred to make the living naked bacteria virulent.



What conclusions can be drawn from the experiment?

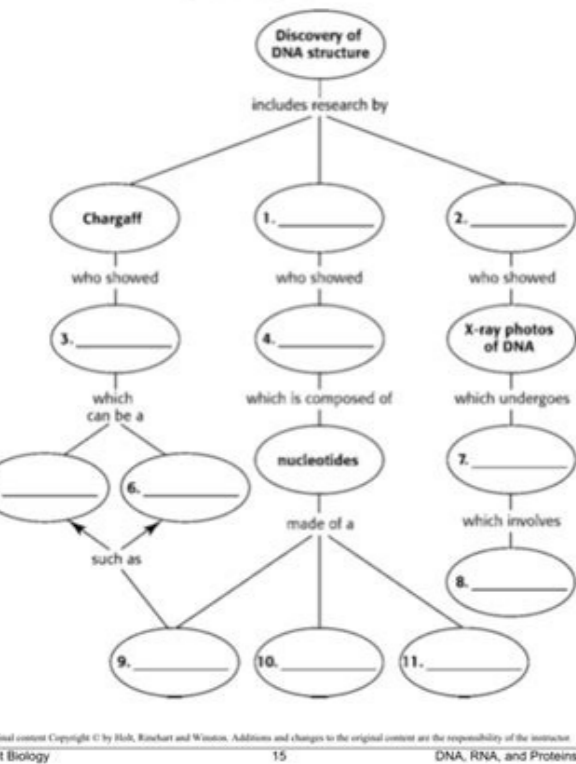
Living bacteria acquired genetic information from dead bacteria - particularly the instructions for making capsules, thus transforming the naked bacteria into encapsulated bacteria. The transforming agent was discovered to be DNA. DNA was isolated and added to live naked bacteria, and they were transformed into the



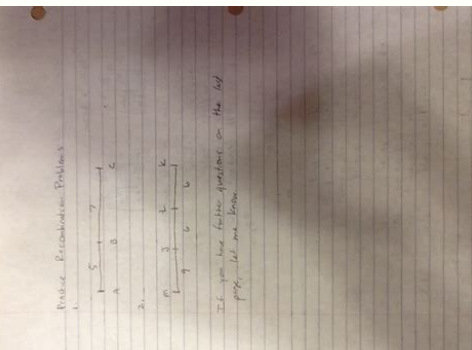
Concept Mapping Chapter 13

Using the terms and phrases provided below, complete the concept map showing the discovery of DNA structure.

- amount of base pairs
- DNA polymerase
- DNA replication
- double helix
- five-carbon sugar
- Franklin and Wilkins
- nitrogenous base
- phosphate group
- pyrimidine
- Watson and Crick



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