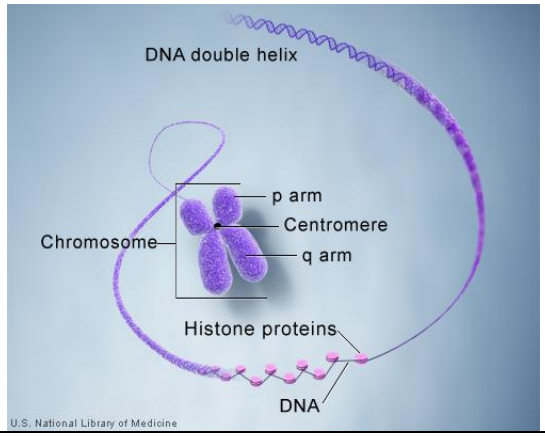
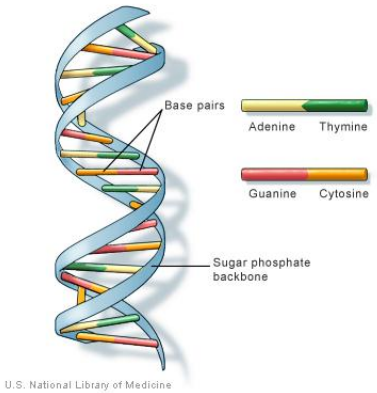
4.3 How Do Chromosomes Carry Information?
Study Guide by Hisrich

4.3.a. What are chromosomes made of? 4.3.c. What is the relationship between chromosomes, DNA, & **genes**?

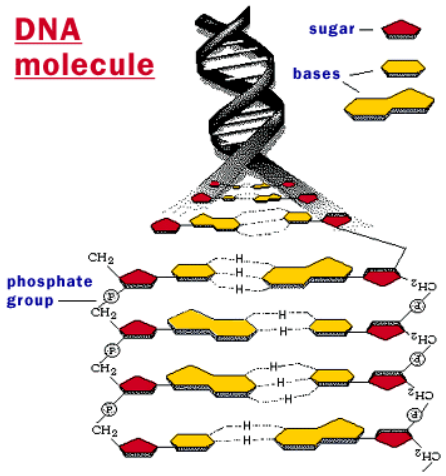
Chromosomes are tightly would packages of DNA that each contain multiple **genes** (from about 20 to more than 100 each). In order to package itself as tightly as possible, the DNA winds itself around histone proteins. However, DNA is a different kind of molecule than a protein. Proteins are made of 20 different kinds of amino acids, whereas DNA is made of the 4 **nucleotides adenine**, **guanine**, **cytosine**, and **thyamine**.



4.3.b. What is DNA?



DNA stands for deoxyribonucleic acid and is the 4th kind of macromolecule (in addition to proteins, carbohydrates & lipids. It is found in the nucleus of the cells of living organisms, from strawberries to grass to flies to humans. It has the structure of a double **helix**, with two complimentary strands held together by **hydrogen bonds**. **Adenine** always pairs with **thymine** & **cytosine** always pairs with **guanine**. The name comes from the fact that the sugar attached to each **nucleotide** is deoxyribose & the building blocks of DNA are nucleic acids. DNA was first isolated in 1869, but wasn't found to be the molecule of heredity until 1952. Since DNA is too small to see with a microscope, **models** can be used to help show the structure.

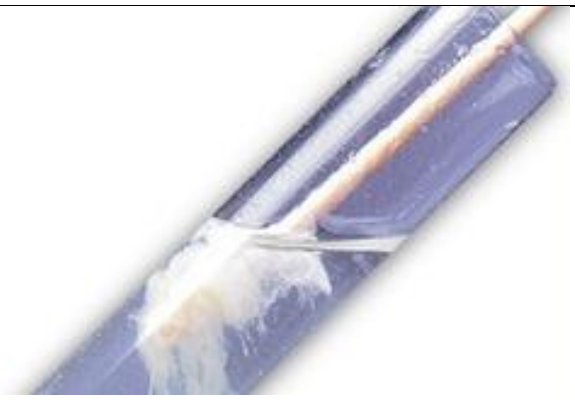


4.3.d. Does every cell in an organism have the same DNA?

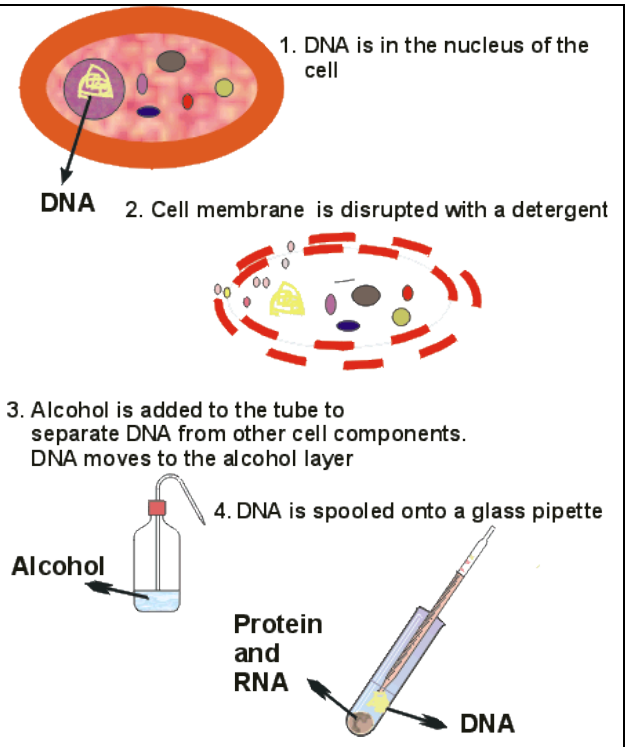
Old Answer	New Answer
Yes. Every cell with a nucleus, from those in the skin to those in muscles to those in an eyeball, contain all of the chromosomes of the individual and all the DNA. The reason the tissues are different is because different genes are "turned on" in different cells.	Maybe not. Here's a quote from a 2009 study, "AAA is one of the rare vascular diseases where tissue samples are removed as part of patient therapy. When they compared them, the researchers discovered major differences between BAK genes in blood cells and tissue cells coming from the same individuals, with the suspected disease "trigger" residing only in the tissue." **http://www.sciencedaily.com/releases/2009/07/090715131449.htm**

4.3.e. How do scientists isolate DNA in order to study it?

1. Break open the cells (**lysis**) to get the DNA out of the nucleus—this step requires the use of a **buffer** to maintain pH (DNA is pH sensitive)
2. Removing membrane lipids using detergent
3. Removing proteins by adding the enzyme protease (optional)
4. Precipitating out the DNA, using ice cold alcohol



The DNA forms a **supernatant**—floating on the surface. It can be removed using an instrument like a toothpick.



4.3.f. How much DNA is in a single human cell?

A human genome is 46 chromosomes, with a total of 3 billion base pairs. Each base pair is 0.00000000034 meters long. 3×10^{9} base pairs * 3.4×10^{-10} meters/bp = 1 m of DNA. Other estimates are up to 3 meters.