

Difference Between Histones and Nucleosomes

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Key Difference - Histones vs Nucleosomes

It is estimated that the human body contained approximately 50 trillion cells. In each cell, there is a [genome](#) composed of 46 [chromosomes](#). These 46 chromosomes contain approximately 6 billion base pairs of DNA packaged. The length between two base pairs is estimated as 0.3 nm, and the total length of DNA in 46 chromosomes account 2 meters approximately. When calculated the total length of the [DNA](#) in a human body, it is 100 trillion meters of DNA. This total length of the chromosomal DNA is nicely packaged inside the nucleus by special proteins called histones. These DNA and histone complexes are known as chromatin fiber. Histone proteins provide the energy for folding or coiling DNA and packing them tightly inside the [nucleus](#). DNA packaging is a vital process in [eukaryotes](#), and it facilitates the accommodation of total length of DNA within the cell nucleus. The basic unit of DNA packaging with histone proteins is known as a [nucleosome](#). **The key difference between histones and nucleosomes is that histones are the proteins that package and order the DNA into nucleosomes while nucleosomes are the basic units of DNA packaging.**

What are Histones?

Histone proteins are identified as the chief protein component of the chromatin fiber. They are [alkaline](#) proteins. These proteins provide energy and essential structures to wind DNA and reduce its length during the DNA packaging into the nucleus. They mainly act as spools in which DNA winds and stabilizes. Therefore, histone proteins are extremely important in organizing chromosomes and packaging genetic material inside the nucleus. If histone proteins do not exist, chromosomes would not exist and unwound DNA will stretch into a long length making them hard to locate within the nucleus.

Histone proteins work together with nonhistone proteins to stabilize the DNA. Therefore, the presence of nonhistone proteins is extremely important for the function of histones. Histone proteins become core protein molecules to form nucleosomes that are basic units of chromatin. There are 8 histone proteins in one nucleosome. DNA coils several times around the histone core octamer and stabilize it.

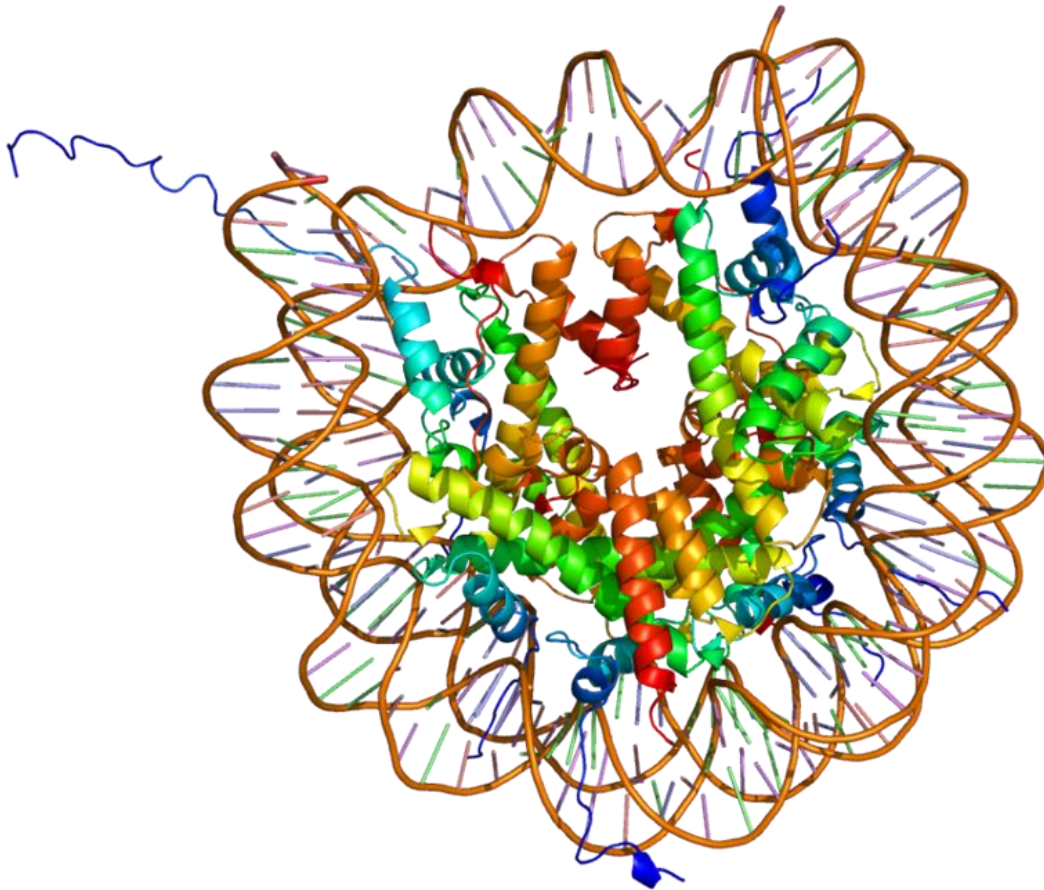


Figure 01: Histones

And also histone proteins are involved in gene regulation. They help to control [gene expression](#). Histone proteins are highly conserved in species, unlike nonhistone proteins.

What are Nucleosomes?

A nucleosome is the basic structural unit of DNA packaging. It looks like a bead in a string. It consists of a DNA fragment wrapped around histone proteins arranged in a core histone protein. Core histone protein is an octamer composed of eight histone proteins. The 8 histone proteins that are in the octamer are four types namely H2A, H2B, H3, and H4. From each type, two protein molecules are included into the nucleosome. Core DNA tightly wraps around the globular core histone octamer and makes a nucleosome. Nucleosomes are then arranged into a chain like structure and wrapped around additional histone proteins tightly to make the stable chromatin in the chromosomes.

octamer of core histones:
H2A, H2B, H3, H4 (each one ×2)

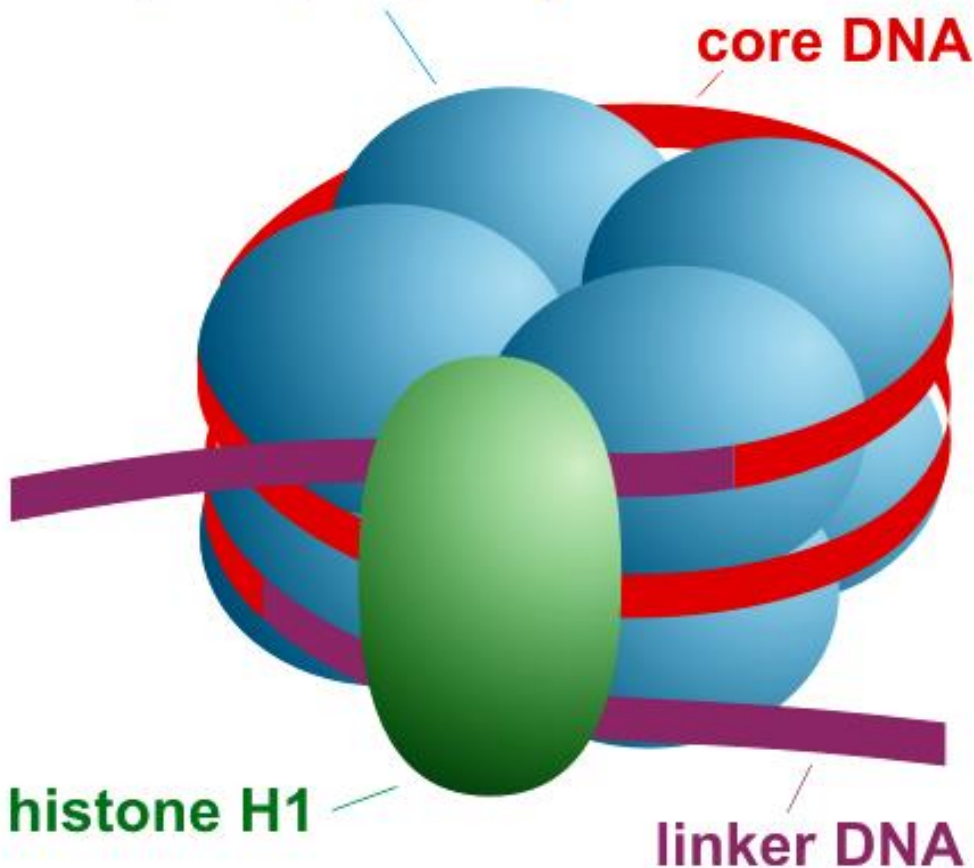


Figure 02: Nucleosome

The length of the core DNA strand that wraps around the histone octamer in the nucleosome is approximately 146 base pairs. Approximate diameter of the nucleosome is 11 nm, and the spiral of nucleosomes in the chromatin (solenoid) has a diameter of 30 nm. Nucleosomes are supported by additional histone proteins to package into tightly coiled structure inside the nucleus.

What are the Similarities Between Histones and Nucleosomes?

- Both histones and nucleosomes are associated with DNA packaging.
- Both histones and nucleosomes are essential for the genome stability.
- Both histones and nucleosomes are components of chromatin.
- Both histones and nucleosomes are present within the nucleus of eukaryotes.

What is the Difference Between Histones and Nucleosomes?

Histones vs Nucleosomes	
Histones are main proteins that provide energy and structural surface to wind DNA around them.	Nucleosomes are the basic units of DNA packaging.
Composition	
Histones are alkaline proteins.	Nucleosomes are composed of histone proteins, DNA segments and other supportive proteins.

Summary - Histones vs Nucleosomes

DNA packaging is an important process in eukaryotic organisms. It allows DNA to accommodate inside the nucleus without stretching and subjecting into breakages and loses. DNA packaging is supported by proteins called histones. These histone proteins act as the main proteins of the basic units of DNA packaging and there are four main types. Basic unit of the DNA packaging is known as nucleosome. Nucleosome is composed of a segment of DNA wrapped around a core histone protein. It looks like a bead in a string. Nucleosomes collectively make the structure of chromatin fiber. This is the difference of histones and nucleosomes.

Reference:

1. "Histone." Wikipedia, Wikimedia Foundation, 17 Feb. 2018. [Available here](#)
2. Nature News, Nature Publishing Group. [Available here](#)

Image Courtesy:

1. 'Protein H2AFJ PDB 1a0i' By Emw - Own work, [\(CC BY-SA 3.0\)](#) via [Commons Wikimedia](#)
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