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# Difference Between Euchromatin and Heterochromatin

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# Difference Between Euchromatin and Heterochromatin

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## Main Difference – Euchromatin vs Heterochromatin

Euchromatin and heterochromatin are the two structural forms of DNA in the genome, which are found in the nucleus. Euchromatin is the loosely packed form of DNA, found in the inner body of the nucleus. Heterochromatin is the tightly packed form of DNA, found in the periphery of the nucleus. Around 90% of the human genome consists of euchromatin. The **main difference** between euchromatin and heterochromatin is that **euchromatin consists of**

**transcriptionally active regions of DNA whereas heterochromatin consists of transcriptionally inactive DNA regions in the genome.**

This article looks at,

### 1. What is Euchromatin

– Characteristics, Structure, Function

### 2. What is Heterochromatin

– Characteristics, Structure, Function

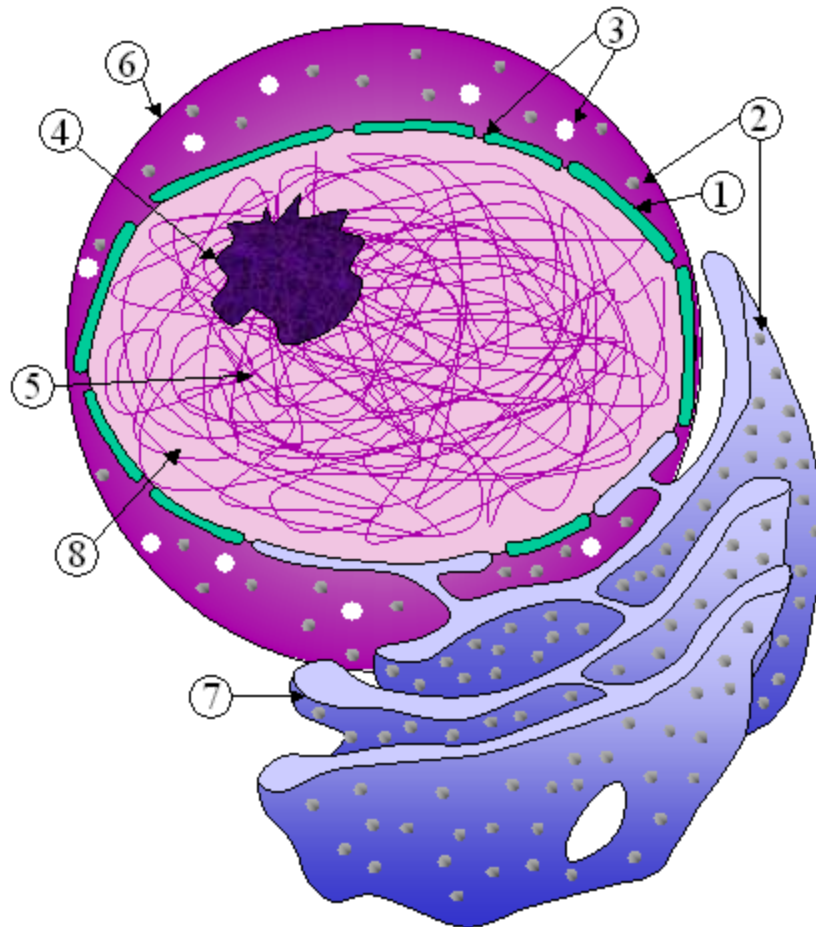
### 3. What is the difference between Euchromatin and Heterochromatin

## EUCHROMATIN VERSUS HETEROCHROMATIN

Euchromatin is a loosely packed form of DNA in the chromosome	Heterochromatin is a tightly packed form of DNA in the chromosome
Lightly stained	Stained dark
Low DNA density	High DNA density
Does not exhibit heteropycnosis	Exhibit heteropycnosis
Found in prokaryotes and eukaryotes	Found only in eukaryotes
Present in the inner body of the nucleus	Present in the periphery of the nucleus
Genetically active	Genetically inactive
DNA is affected by genetical processes, variating the alleles	Phenotype of an organism remains unchanged
Contains transcriptionally active regions	Exhibits little or no transcriptional activity
Early replicative	Late replicative
Euchromatin regions are not sticky	Heterochromatin regions are sticky
Allows the genes to be transcribed and genetic variations to occur	Maintains the structural integrity of the genome and allows the regulation of gene expression

## What is Euchromatin

The loosely packed form of chromatin is referred to as euchromatin. After the cell division, DNA becomes loosely packed and exists in the form of chromatin. Chromatin is formed by the condensation of DNA with histone proteins, exhibiting beads on a string like structure. Euchromatin consists of transcriptionally active sites of the genome. Parts of the genome, which contain active genes in the genome are loosely packed in order to let the transcription of these genes to occur. The frequency of chromosomal crossing over is high in euchromatin, letting the euchromatic DNA to be genetically active. Euchromatin regions in the genome can be observed under the microscope as loops, containing 40 to 100 kb regions of DNA in it. The diameter of the chromatin fiber is 30 nm in euchromatin. Matrix-associated regions (MARs), which contain AT-rich DNA are attached to euchromatin loops into the nuclear matrix. Euchromatin is shown in number 5 of figure 1.



**Figure 1: "Euchromatin in the Nucleus"**

1 – Nuclear envelope, 2 – Ribosomes, 3 – Nuclear pores, 4 – Nucleolus, 5 – Euchromatin, 6 – Outer membrane, 7 – RER, 8 – Heterochromatin

## Function of Euchromatin

Euchromatin is both transcriptionally and genetically active. The active genes in the euchromatin regions are transcribed to synthesize mRNA, encoding the functional proteins. The regulation of genes is also allowed by the

exposure of regulatory elements in euchromatic regions. The transformation of euchromatin into heterochromatin and vice versa can be considered as a gene regulating mechanism. Housekeeping genes, which are always active exist in the form of euchromatin.

## What is Heterochromatin



The tightly packed form of DNA in the nucleus is referred to as heterochromatin. However, heterochromatin is less compact than metaphase DNA. The staining of non-dividing cells in the nucleus under the light microscope exhibits two distinct regions depending on the intensity of the staining. Lightly stained areas are considered as euchromatin, whereas the darkly stained areas are considered as heterochromatin. Heterochromatin organization is more compact in such a way that their DNA is inaccessible to the proteins which are involved in the gene expression. Genetic events like chromosomal crossing over are avoided by the compact nature of heterochromatin. Hence, heterochromatin is considered as transcriptionally and genetically inactive. Two heterochromatin types can be identified in the nucleus: constitutive heterochromatin and facultative heterochromatin.

## Constitutive Heterochromatin

Constitutive heterochromatin contains no genes in the genome, hence it can be retained in its compact structure also during the interphase of the cell. It is a permanent feature of the cell's nucleus. DNA in the telomeric and centromeric regions belong to the constitutive heterochromatin. Some regions in the chromosomes belong to the constitutive heterochromatin; for example, most of the regions of Y chromosome is constitutionally heterochromatic.

## Facultative Heterochromatin

Facultative heterochromatin contains the inactive genes in the genome; hence, it is not a permanent feature of the cell's nucleus but it can be seen in the nucleus some of the time. These inactive genes may be inactive either in some cells or during some periods. When those genes are inactive, they form facultative heterochromatin. Chromatin structures, beads on a string, 30 nm fiber, active chromosomes in the interphase are shown in *figure 2*.

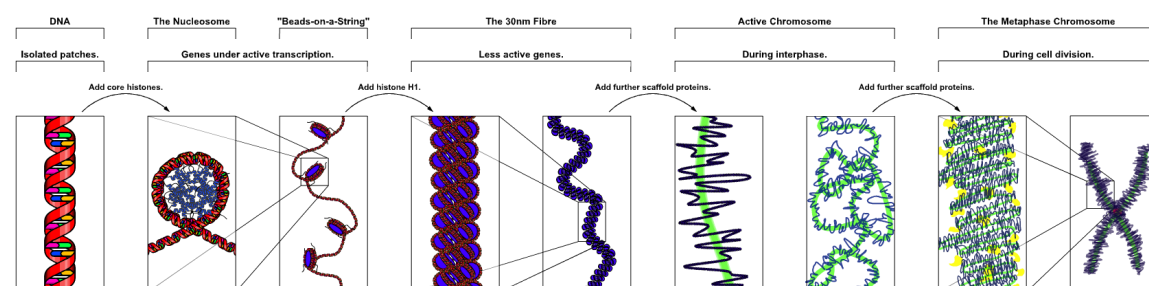


Figure 2: Chromatin Structures

## Function of Heterochromatin

Heterochromatin is mainly involved in maintaining the integrity of the genome. The higher packaging of heterochromatin allows the gene expression to be regulated by keeping the DNA regions inaccessible to proteins in gene expression. The formation of heterochromatin prevents the DNA end damage by endonucleases due to its compact nature.

## Difference Between Euchromatin and Heterochromatin

### Definition

**Euchromatin:** Euchromatin is the uncoiled form of chromatin.

**Heterochromatin:** Heterochromatin is a part of chromosome. It is tightly packed.

### Intensity of Packaging

**Euchromatin:** Euchromatin consists of chromatin fibers, and the DNA is wrapped around histone protein cores. Hence, it is loosely packaged.

**Heterochromatin:** Heterochromatin is a tightly packed form of DNA in the chromosome.

### Staining Intensity

**Euchromatin:** Euchromatin is lightly stained. But, it is stained dark during the mitosis.

**Heterochromatin:** Heterochromatin is stained dark during the interphase.

### Amount of DNA

**Euchromatin:** Euchromatin contains a low DNA density compared to heterochromatin.

**Heterochromatin:** Heterochromatin contains a high density of DNA.

### Heteropycnosis

**Euchromatin:** Euchromatin does not exhibit heteropycnosis.

**Heterochromatin:** Heterochromatin exhibits heteropycnosis.

### Presence

**Euchromatin:** Euchromatin is found in both prokaryotes and eukaryotes.

**Heterochromatin:** Heterochromatin is found only in eukaryotes.

## Genetical Activity

**Euchromatin:** Euchromatin is genetically active. It may be exposed to chromosomal cross over.

**Heterochromatin:** Heterochromatin is genetically inactive.

## Effect on the Phenotype

**Euchromatin:** The DNA in euchromatin is affected by genetical processes, varying the alleles on it.

**Heterochromatin:** Since DNA in heterochromatin is genetically inactive, the phenotype of an organism remains unchanged.

## Transcriptional Activity

**Euchromatin:** Euchromatin contains transcriptionally active regions.

**Heterochromatin:** Heterochromatin exhibits little or no transcriptional activity.

## DNA Replication

**Euchromatin:** Euchromatin is an early replicative.

**Heterochromatin:** Heterochromatin is a late replicative.

## Types

**Euchromatin:** A uniform type of euchromatin is found in the nucleus.

**Heterochromatin:** Heterochromatin is composed of two types: constitutive heterochromatin and facultative heterochromatin.

## Location in the Nucleus

**Euchromatin:** Euchromatin is present in the inner body of the nucleus.

**Heterochromatin:** Heterochromatin is present in the periphery of the nucleus.

## Stickiness

**Euchromatin:** Euchromatin regions are not sticky.

**Heterochromatin:** Heterochromatin regions are sticky.

## Function

**Euchromatin:** Euchromatin allows the genes to be transcribed and genetic variations to occur.

**Heterochromatin:** Heterochromatin maintains the structural integrity of the genome and allows the regulation of gene expression.

## Condensation/Decondensation

**Euchromatin:** Condensation and decondensation of DNA is interchanged during the periods of the cell cycle.

**Heterochromatin:** Heterochromatin remains condensed during each period of the cell cycle, except at DNA replication.

## Conclusion

Euchromatin and heterochromatin are two types of DNA structure found within the nucleus. Euchromatin consists of a loosely packed structure of chromatin fibers in the nucleus. Therefore, the DNA in euchromatic regions are accessible to gene expression. Hence, the genes in the euchromatic regions are actively transcribed. On the contrary, DNA regions in the heterochromatin are tightly packed and inaccessible to proteins, which are involved in the gene expression. Hence, the formation of heterochromatin from regions containing genes acts as a mechanism for gene regulation.

The nature of packaging in both euchromatin and heterochromatin can be identified with their staining patterns under the light microscope. Euchromatin with less DNA density is stained lightly and heterochromatin with high DNA density is stained darkly. The condensation and decondensation of euchromatin are interchanged during the cell cycle. But, heterochromatin remains condensed during the phases of the cell cycle except at DNA replication. Therefore, the main difference between euchromatin and heterochromatin lies in both their structure and function.

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- 1.Cooper, Geoffrey M. "Internal Organization of the Nucleus." The Cell: A Molecular Approach. 2nd edition. U.S. National Library of Medicine, 01 Jan. 1970. Web. 22 Mar. 2017.
- 2.Brown, Terence A. "Accessing the Genome." Genomes. 2nd edition. U.S. National Library of Medicine, 01 Jan. 1970. Web. 22 Mar. 2017.

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## About the Author: Lakna

Lakna, a graduate in Molecular Biology & Biochemistry, is a Molecular Biologist and has a broad and keen interest in the discovery of nature related things

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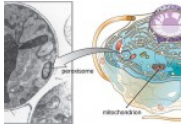
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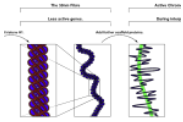
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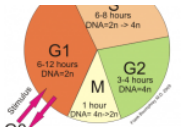
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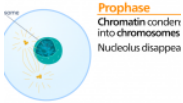
Difference Between  
Lysosome and  
Peroxisome



Difference Between  
Euchromatin and  
Heterochromatin



How Does Interphase  
Prepare a Cell to  
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**Prophase**  
Chromatin condenses  
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Difference Between  
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