

The NUCLEUS

Where does the DNA live?

The answer depends on if the cell is prokaryotic or eukaryotic.

The main difference between the two types of cells is the presence of a nucleus. **And in eukaryotic cells, DNA lives in the nucleus.**

1. Where is DNA located in eukaryotic cells?

The Nucleus

The **nucleus** is a membrane-enclosed organelle found in most eukaryotic cells. The nucleus is the largest organelle in most animal cells (the central vacuole is large and centered in plant cells) and contains most of the cell's genetic information (mitochondria also contain DNA, called mitochondrial DNA, but it makes up just a small percentage of the cell's overall DNA content). The genetic information, which contains the information for the structure and function of the organism, is found encoded in DNA in the form of genes. A **gene** is a short segment of DNA that contains information to encode a protein. DNA in the nucleus is organized in long linear strands that are attached to different proteins. These proteins help the DNA coil up for better storage in the nucleus. Think how a string gets tightly coiled up if you twist one end while holding the other end. These long strands of coiled-up DNA and proteins are called **chromosomes**. Each chromosome contains many genes. The function of the nucleus is to maintain the integrity and security of these genes and to control the activities of the cell by regulating gene expression. **Gene expression** is the process by which the information in a gene is "decoded" using RNA and ribosomes to produce a functional protein.

2. What is a gene?

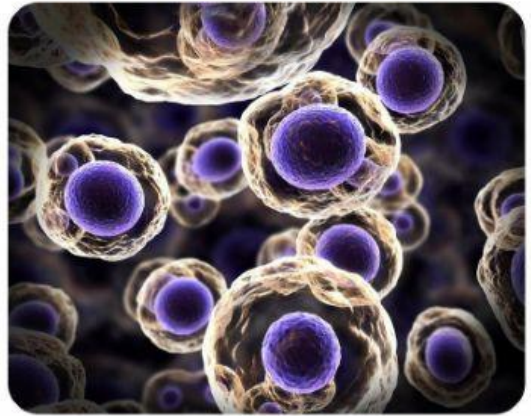
3. What are chromosomes?

4. What is gene expression?

The degree of DNA coiling determines whether the chromosome strands are short and thick or long and thin. Between cell divisions when the cell is NOT actively dividing (Interphase of the Cell Cycle), the DNA in chromosomes is more loosely coiled and forms long, thin strands called **chromatin**. When the cell divides (Prophase of Mitosis), the chromatin coil up more tightly and form chromosomes. Only chromosomes stain clearly enough to be seen under a microscope. The word chromosome comes from the Greek word *chroma* (color), and *soma* (body), due to its ability to be stained strongly by dyes.

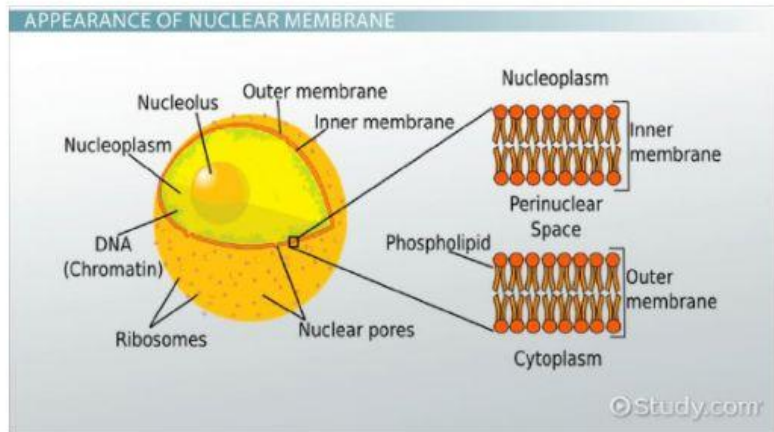
5. What is chromatin and when is it found in the nucleus?

6. How is chromatin changed into chromosomes and when does this happen?



The Nuclear Envelope

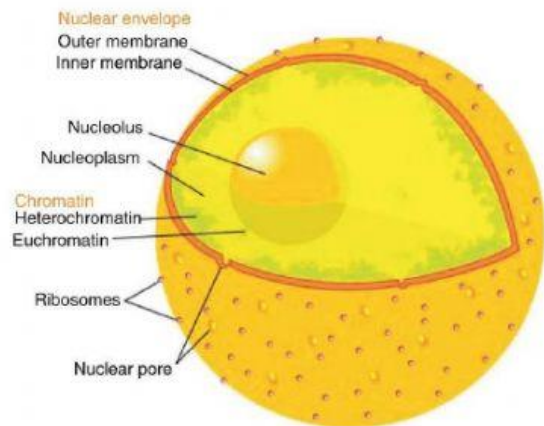
The **nuclear envelope** is a double membrane of the nucleus that encloses the genetic material. It separates the contents of the nucleus from the cytoplasm. The nuclear envelope is made of two lipid bilayers, an inner membrane and an outer membrane. The outer membrane is continuous with the rough endoplasmic reticulum. Many tiny holes called **nuclear pores** are found in the nuclear envelope. These nuclear pores help to regulate the exchange of materials (such as RNA and proteins) between the nucleus and the cytoplasm.



7. How many layers make up the nuclear membrane?
8. What is the nuclear membrane connected to?
9. What are nuclear pores?

The Nucleolus

The nucleus of many cells also contains a non-membrane bound organelle called a **nucleolus**. The nucleolus is mainly involved in the assembly of ribosomes. **Ribosomes** are organelles made of protein and ribosomal RNA (rRNA), and they build cellular proteins in the cytoplasm. The function of the rRNA is to provide a way of decoding the genetic messages within another type of RNA (called mRNA), into amino acids. After being made in the nucleolus, ribosomes exit the nucleus through pores, where they direct protein synthesis.



10. What does the nucleolus make?
11. What do ribosomes do for the cell?
12. How do ribosomes leave the nucleus?