Lecture 11: Overview and Anatomy of a Generalized Cell - Nucleus

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Overview of the Cellular Basis of Life

- In the late 1600s, Robert Hooke saw some cubelike structures in a sample of cork through a microscope.
- The structures resembled the long rows of monk's rooms, or *cells*, at the monastery, so he named the structures cells.

Overview of the Cellular Basis of Life

- Since the late 1800s, cell research has been exceptionally fruitful and provided us with four concepts collectively known as the **cell theory**:
  - A cell is the basic structural and functional unit of living organisms. This means that when you define cell properties, you are also defining the properties of life.

Overview of the Cellular Basis of Life

- The activity of an organism depends on the collective activities of its cells.
- According to the *principle of complementarity*, the biochemical activities of cells are dictated by their shape or form and by the relative number of their specific subcellular structures.

Overview of the Cellular Basis of Life

- Continuity of life has a cellular basis.
- These ideas will be expanded upon in the next few lectures, but let's look at the idea that the cell is the smallest living unit.
- Whatever its form, however it behaves, the cell contains all the parts necessary to survive in a changing world.

Overview of the Cellular Basis of Life

- It follows, then, that loss of homeostasis underlies virtually every disease.
- Perhaps the most striking thing about a cell is its organization.
- Yet if we chemically analyze cells, we find out that they are made up primarily of the same four elements - carbon, oxygen, hydrogen, and nitrogen - plus smaller amounts of several other elements.

Overview of the Cellular Basis of Life

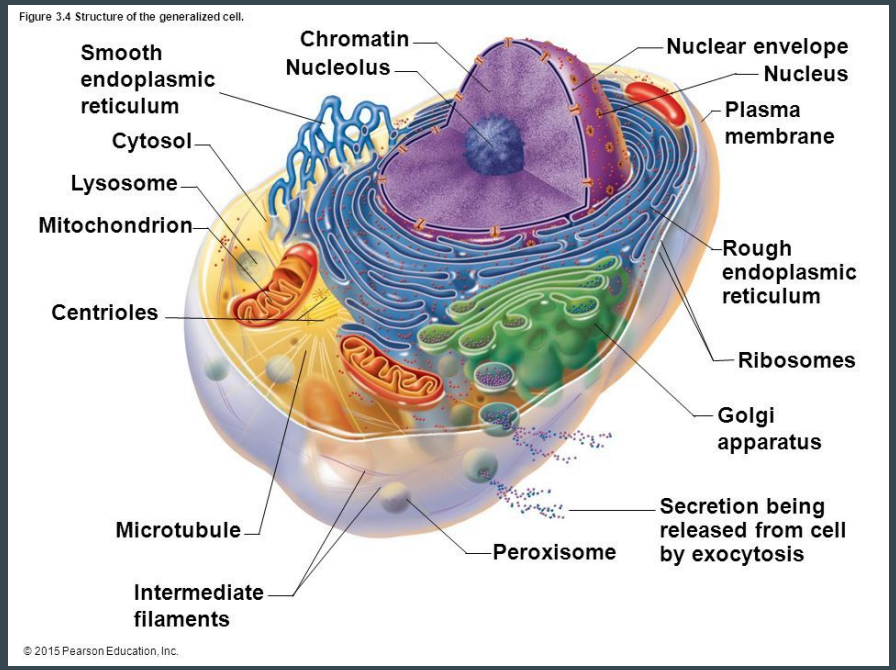
- Strange as it may seem, especially when we feel firm muscles or solid bone, living cells are about 60 percent water, which is one of the reasons water is essential for life.

Anatomy of a Generalized Cell

- Although no one cell type is exactly like all others, cells *do* have the same basic parts, and there are certain functions common to *all* cells.
- We'll talk about the **generalized cell**, which demonstrates these many typical features.
- In general, all cells have three main regions or parts - a *nucleus*, *cytoplasm*, and a *plasma membrane*.

Anatomy of a Generalized Cell

- The nucleus is usually located near the center of the cell.
- It is surrounded by the semifluid cytoplasm, which in turn is enclosed by the plasma membrane, which forms the outer cell boundary.



The Nucleus

- Anything that works, works best when it is controlled.
- For cells, “headquarters,” or the control center, is the gene-containing **nucleus**.
- The genetic material, or *deoxyribonucleic acid (DNA)*, is much like a blueprint that contains all the instructions needed for building the whole body; so, as you might expect, human DNA differs from frog DNA.

The Nucleus

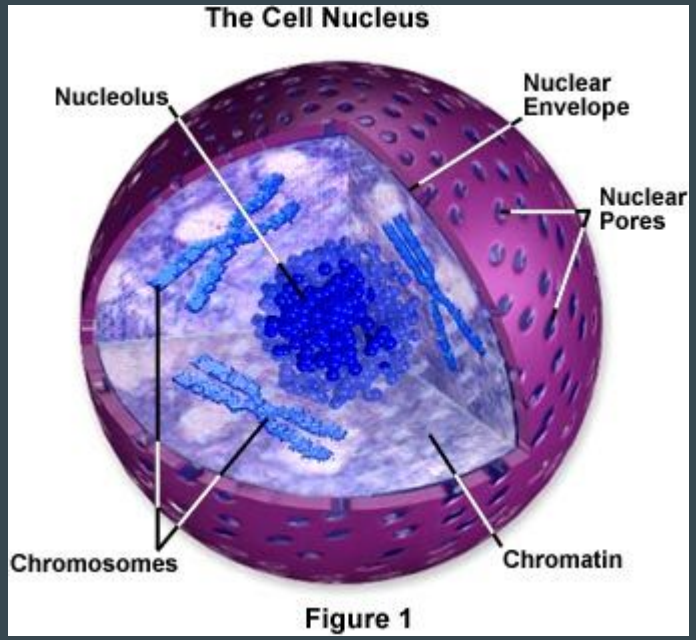
- More specifically, DNA has the instructions for building *proteins*.
- DNA is also absolutely necessary for cell reproduction.
- A cell that has lost or ejected its nucleus (for whatever reason) is programmed only to die.

The Nucleus

- Although it is most often oval or spherical, the shape of the nucleus usually conforms to the shape of the cell.
- For example, if the cell is elongated, the nucleus is usually elongated as well.
- The nucleus has three recognizable regions or structures: the *nuclear envelope*, *nucleoli*, and *chromatin*.

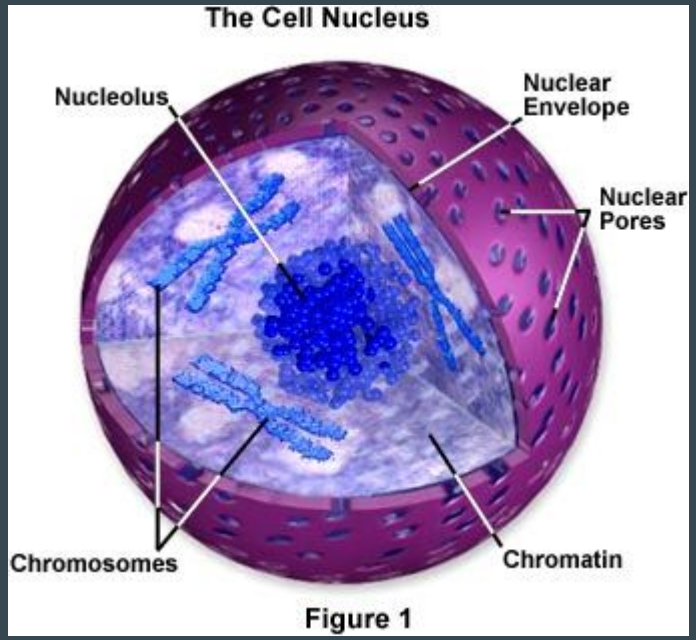
The Nucleus

- The nucleus is bounded by a double membrane barrier called the **nuclear envelope**, or **nuclear membrane**.
- Between the two membranes is a fluid-filled “moat,” or space.



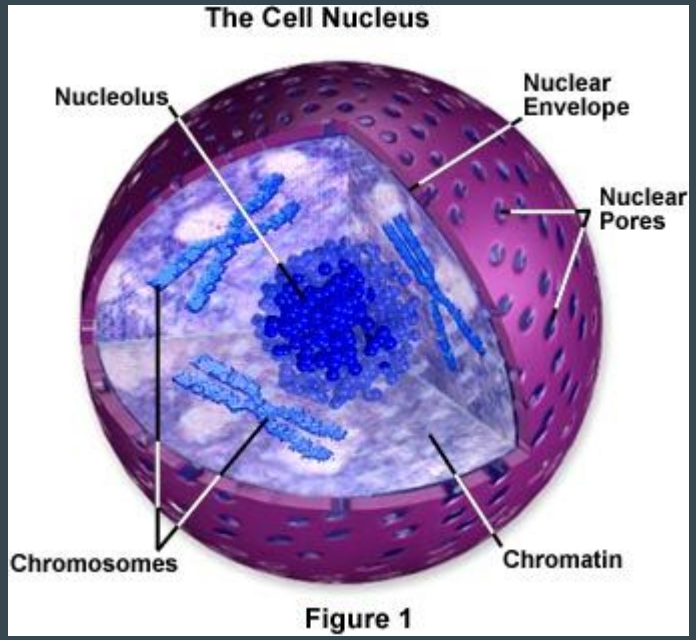
The Nucleus

- At various points, the two layers of the nuclear envelope fuse, and **nuclear pores** penetrate the fused regions.



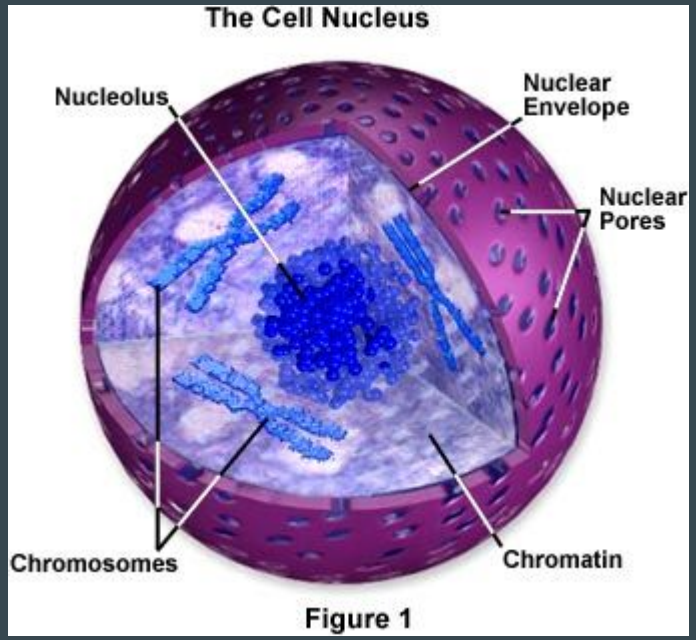
The Nucleus

- Like other cellular membranes, the nuclear envelope allows some but not all substances to pass through it, but substances pass through it more freely than elsewhere because of its relatively large pores.



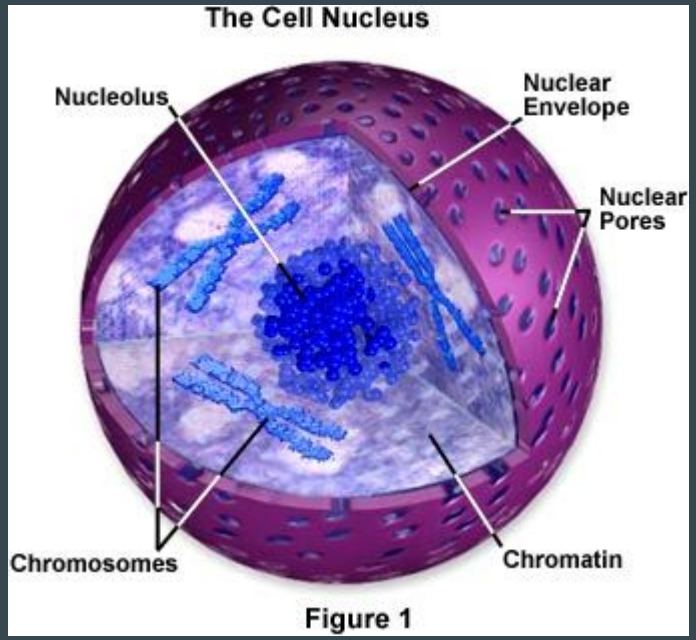
The Nucleus

- The nuclear membrane encloses a jellylike fluid called *nucleoplasm* in which other nuclear elements are suspended.
- The nucleus contains one or more small, dark staining, essentially round bodies called **nucleoli**.



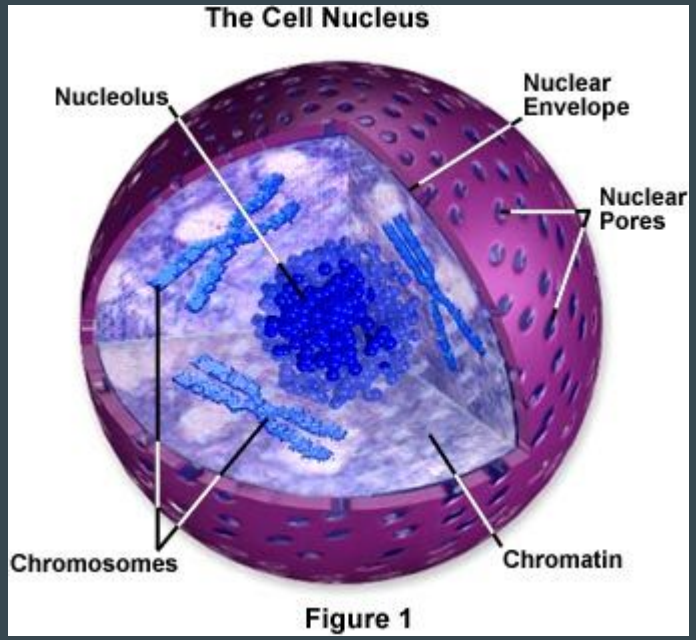
The Nucleus

- Nucleoli are sites where cell structures called *ribosomes* are assembled.
- Most ribosomes eventually migrate into the cytoplasm where they serve as the actual sites of protein synthesis.



The Nucleus

- When a cell is not dividing, its DNA is combined with protein and forms a loose network of bumpy threads called **chromatin** that is scattered throughout the nucleus.



The Nucleus

- When a cell is dividing to form two daughter cells, the chromatin threads coil and condense to form dense, rod-like bodies called **chromosomes** - much the way a stretched string becomes shorter and thicker when allowed to relax.