

Cells are the smallest unit of all living things

One of the foundations of modern biology is that all living things are made of cells

We have about 75 trillion human cells in our bodies

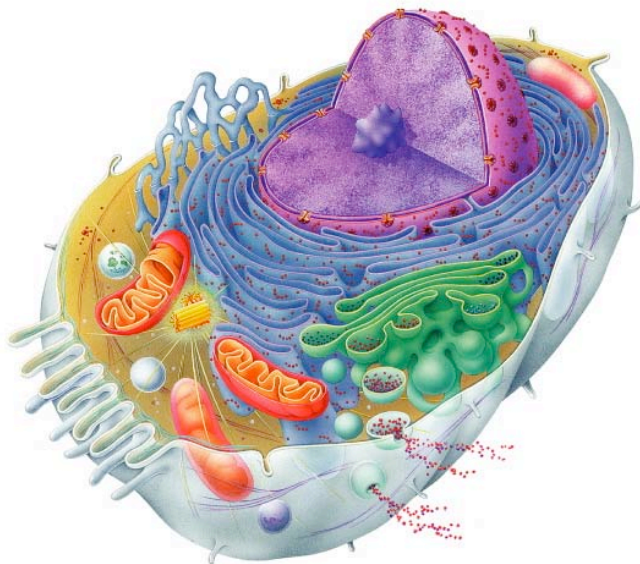
...*human* cells?

We have at least **750 trillion *bacterial*** cells living in our gut and on the surface of our skin (1,000s of different species)—about 4-5 pounds of your body weight is bacteria

Despite the huge **diversity** of cells we'll see this semester, there is amazing **unity** in the components we find inside of cells

There is a huge diversity of sizes and functions of cells

Cells are the smallest unit of all living things



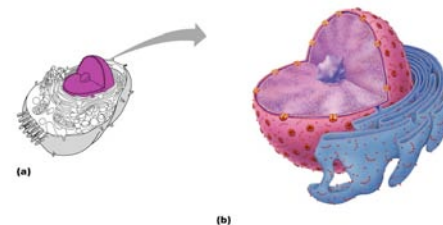
The nucleus is the control center of the cell

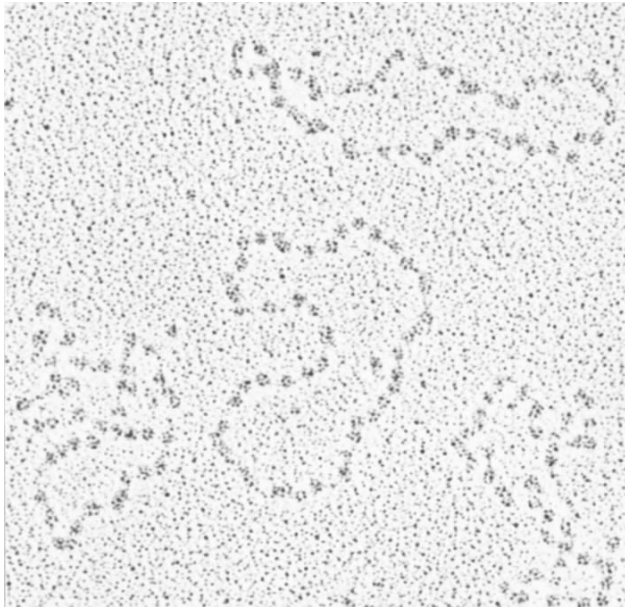
Contains DNA, the blueprint for all of our proteins, and is necessary for cell reproduction (i.e. growth and repair)

Encased by a double layered **nuclear envelope**, which contains **nuclear pores** allowing some things to pass through freely

Nucleoli are sites of ribosome assembly, and are necessary for protein synthesis

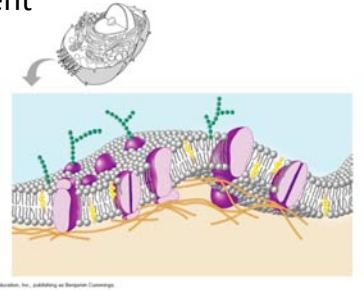
DNA combines with chromatin to form a pearl necklace-like structure called chromatin (forms chromosomes during mitosis)





The plasma membrane separates the cell from its environment

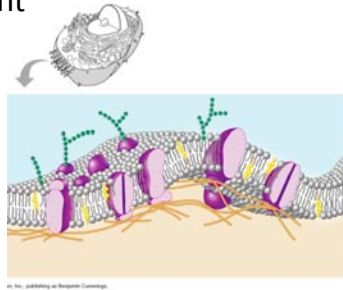
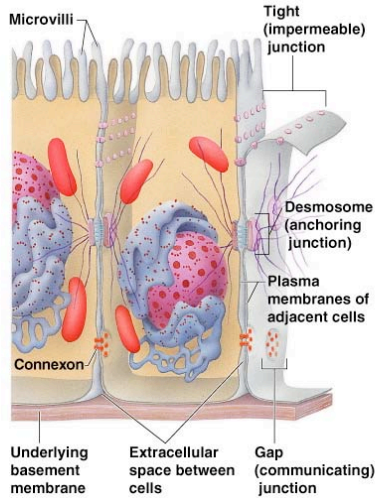
Composed of a *phospholipid bilayer*:



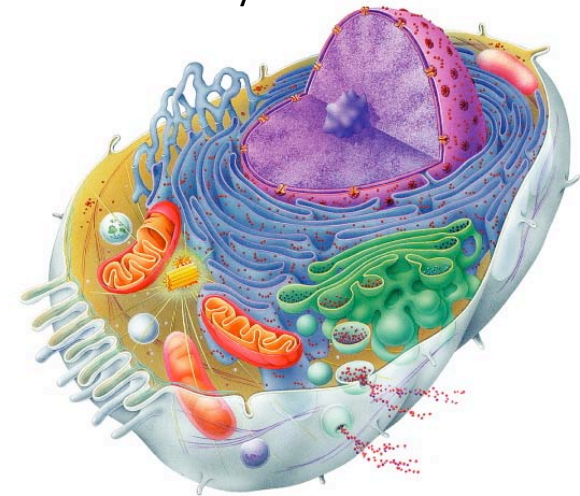
hydrophilic heads orient themselves outward, and hydrophobic tails inward; this creates a barrier that is *selectively permeable*

The plasma membrane also has many embedded proteins, sugars and cholesterol, each serving a specific purpose. These “float” around in the “sea” of phospholipids, much like a buoy in the ocean.

The plasma membrane separates the cell from its environment

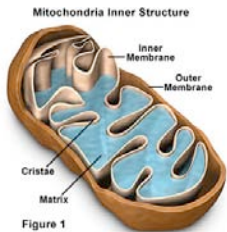


Cytoplasmic organelles are suspended in the cytosol



Mitochondria are the 'powerhouse' of the cell

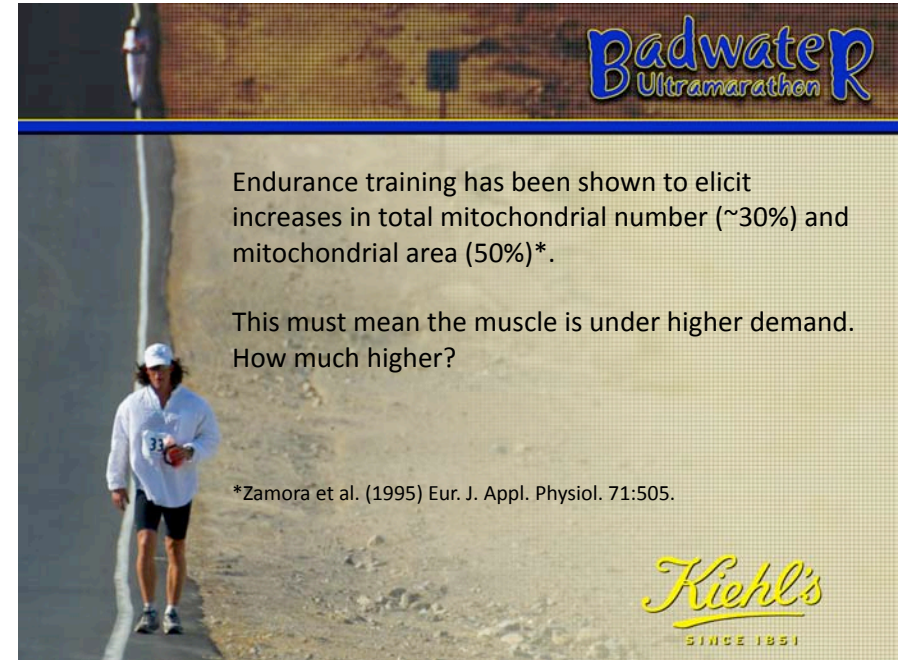
Formed of 2 membranes: an outer and inner membrane
Enzymes dissolved in the *matrix* and *intermembrane space* capture energy from food to produce adenosine triphosphate (ATP), which provides the energy for all cellular work
Number of mitochondria in a cell correlates to how metabolically 'active' that cell is



Ribosomes are the site of protein synthesis

Ribosomes = proteins + **ribosomal RNA**

Can be free-floating, or attached to a membrane (i.e. **rough endoplasmic reticulum**)




Badwater
Ultramarathon

Endurance training has been shown to elicit increases in total mitochondrial number (~30%) and mitochondrial area (50%)*.

This must mean the muscle is under higher demand. How much higher?

*Zamora et al. (1995) Eur. J. Appl. Physiol. 71:505.



Kiehl's
SINCE 1851

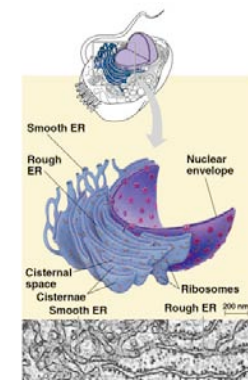
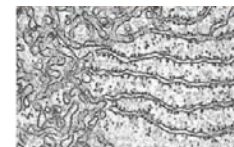
A banner for the Badwater Ultramarathon. It features a runner in a white shirt and blue shorts running on a dirt path. The text discusses the physiological effects of endurance training on mitochondria. The Kiehl's logo is in the bottom right corner.

Endoplasmic reticulum acts as a minicirculatory system for the cell

There are two types of 'ER': **rough** and **smooth**

Rough ER is covered with ribosomes makes essentially all the components of the cell membrane

Especially abundant in tissues that make a lot of protein products (e.g. pancreas)



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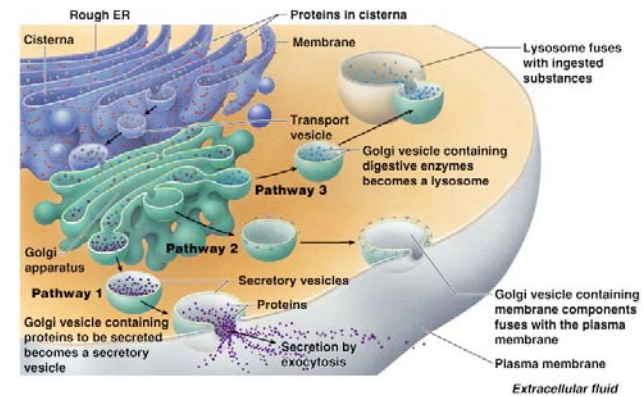
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Smooth ER plays no role in protein synthesis; instead it functions in lipid metabolism and detoxification of drugs and pesticides
Our livers detoxify our bodies, so liver cells are full of smooth ER
Also, cells that make steroids (like testes and ovaries) have lots of smooth ER

The golgi apparatus acts as the cell's "packaging center"

After proteins are produced, they are modified and packaged in the golgi apparatus



Lysosomes and peroxisomes have specialized jobs in the cell

Lysosomes are basically 'bags' of digestive enzymes in our cells. They break down **foreign substances** within the cell, as well as **worn out or nonusable substances**.

Lysosomes are the cell's demolition sites

Peroxisomes are responsible for detoxifying a number of poisonous substances, like alcohol or formaldehyde

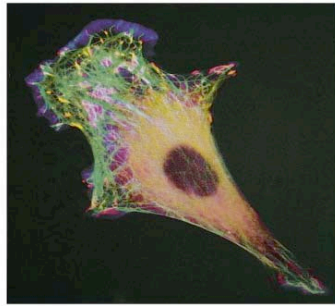
More importantly, they convert **free radicals** into hydrogen peroxide, which is then converted to water (by **catalase**)

Study tip: Think about what organs or tissues you would find the most of these organelles in. Which organs are most active in detoxification?

Cytoskeletal elements are the 'bones and muscles' of the cell

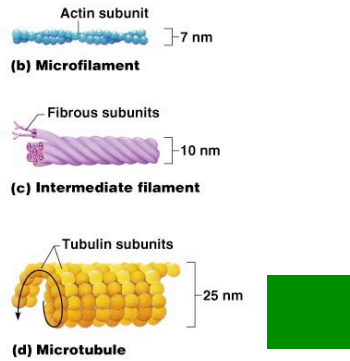
A group of filaments, in various sizes, act to support the cell as well as provide an internal framework for intracellular transport and cellular movements:

- **Intermediate** filaments act as wires to resist pulling on the cell
- **Microfilaments** tend to be involved with cell motility and shape changes
- **Mictotubules** tend to be involved with determining the shape of the cell as well as the distribution of organelles within the cell.



(a)

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Cilia and fla

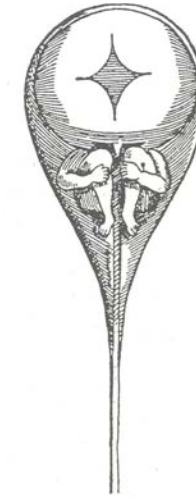
As a general rule, surface. They

→ Remember pse from lab??

Flagella move the flagellated cell

Man the seed, woman the incubator

17



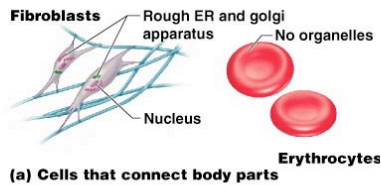
Homunculus
 The little pre-formed person in the sperm. An imaginary representation of what a sperm might look like, if able to be seen clearly, drawn by Nicolaus Hartsoeker in *Essai de diatrique*, 1694.

Microtubules

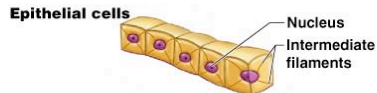
Microtubules cross a cell's surface.

Microtubules are epithelium

Microtubules are ample of a nucleus.



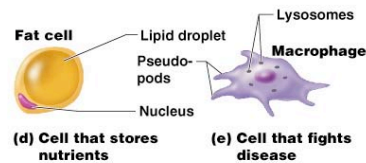
(a) Cells that connect body parts



(b) Cells that cover and line body organs

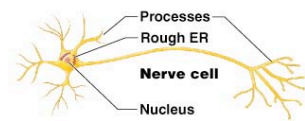


(c) Cells that move organs and body parts

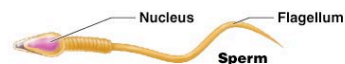


(d) Cell that stores nutrients

(e) Cell that fights disease



(f) Cell that gathers information and controls body functions



(g) Cell of reproduction