

Body Cells and Tissues



COMPILED BY HOWIE BAUM

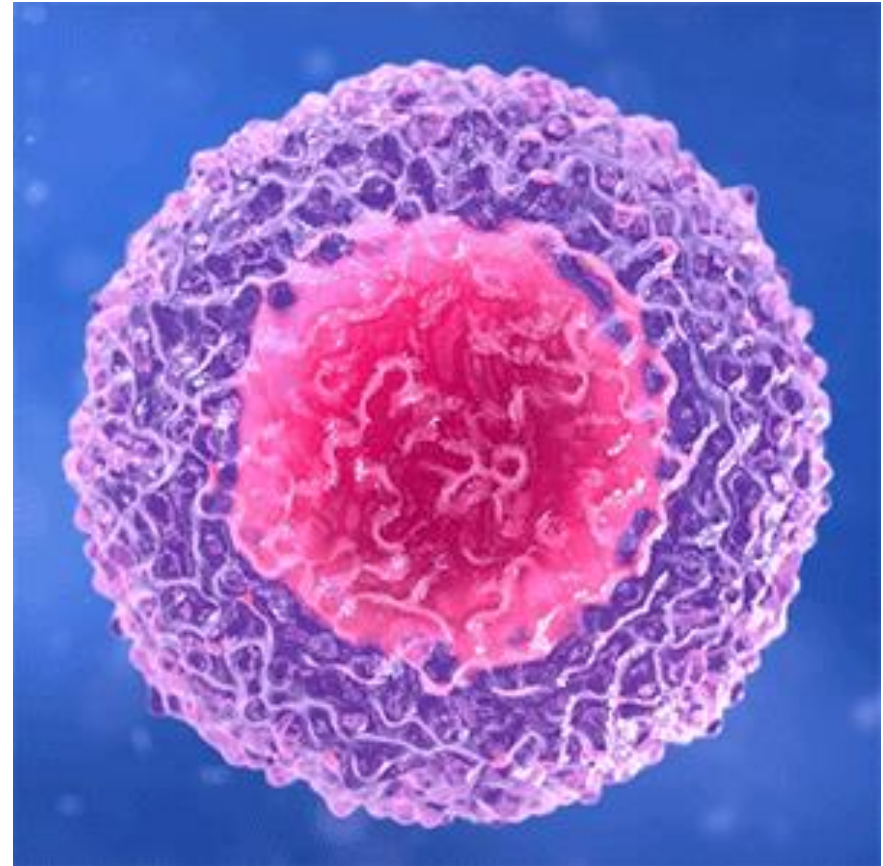
INTRODUCTION TO THE CELL

CELLS are often called the microscopic building blocks of the body.

They are active and dynamic, they continually grow and specialize, function, die, and **replenish themselves, by the millions every second.**

The whole body contains about 37.2 trillion (37,200,000,000,000 cells,

There are 226 different kinds !!



Cells provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions.

They also contain the body's hereditary material in the form of DNA and make copies of themselves.

Human cell



Red blood cell



White blood cell



Cells in the inner lining of the intestine



Bone cell

Ovum

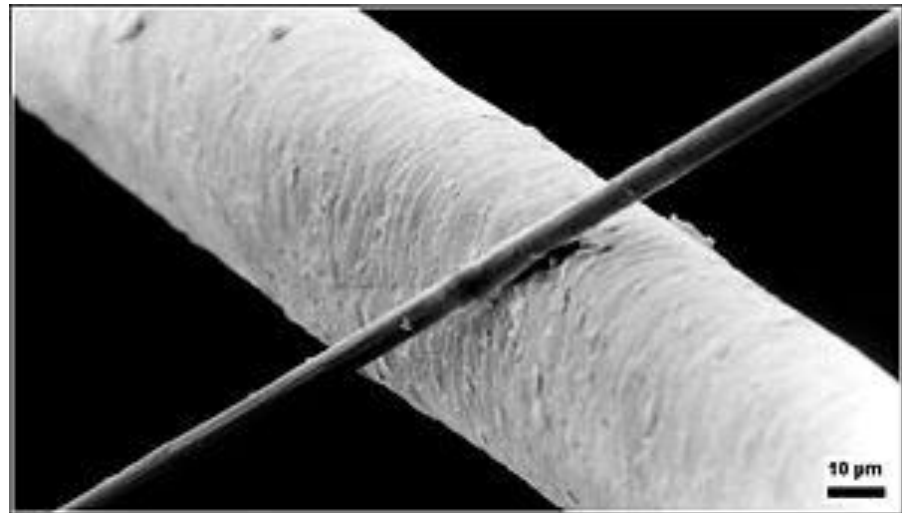
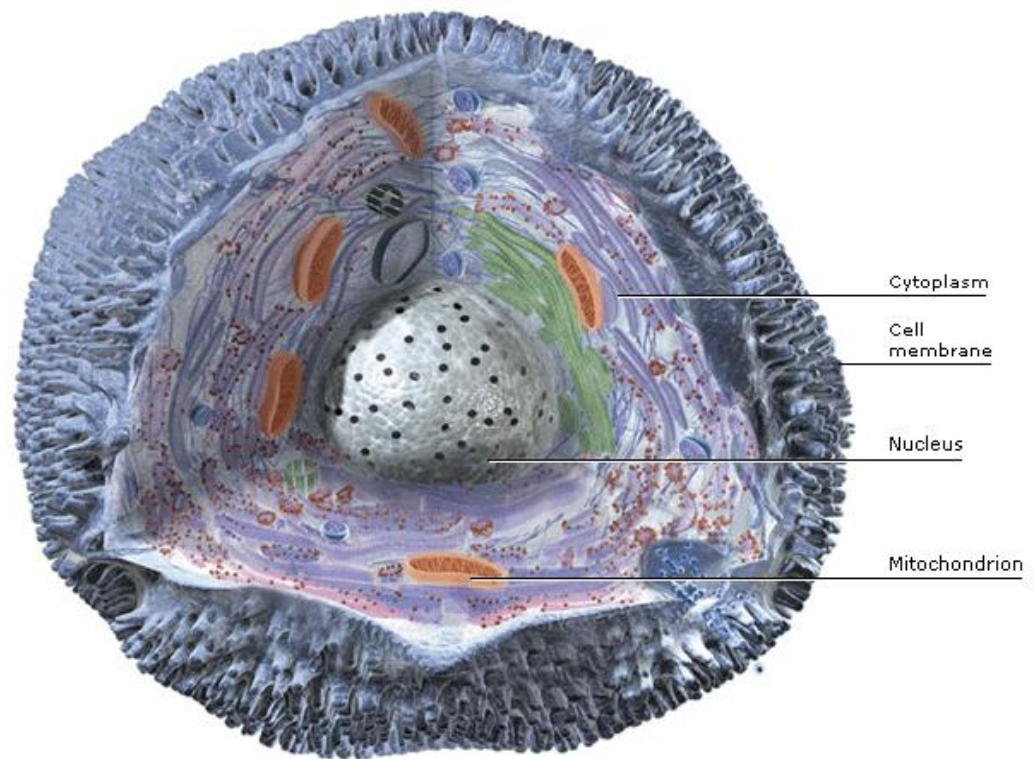


Sperm cell

The cell is the basic functional unit of the human body.

Cells are considered as the basic unit of Life !!

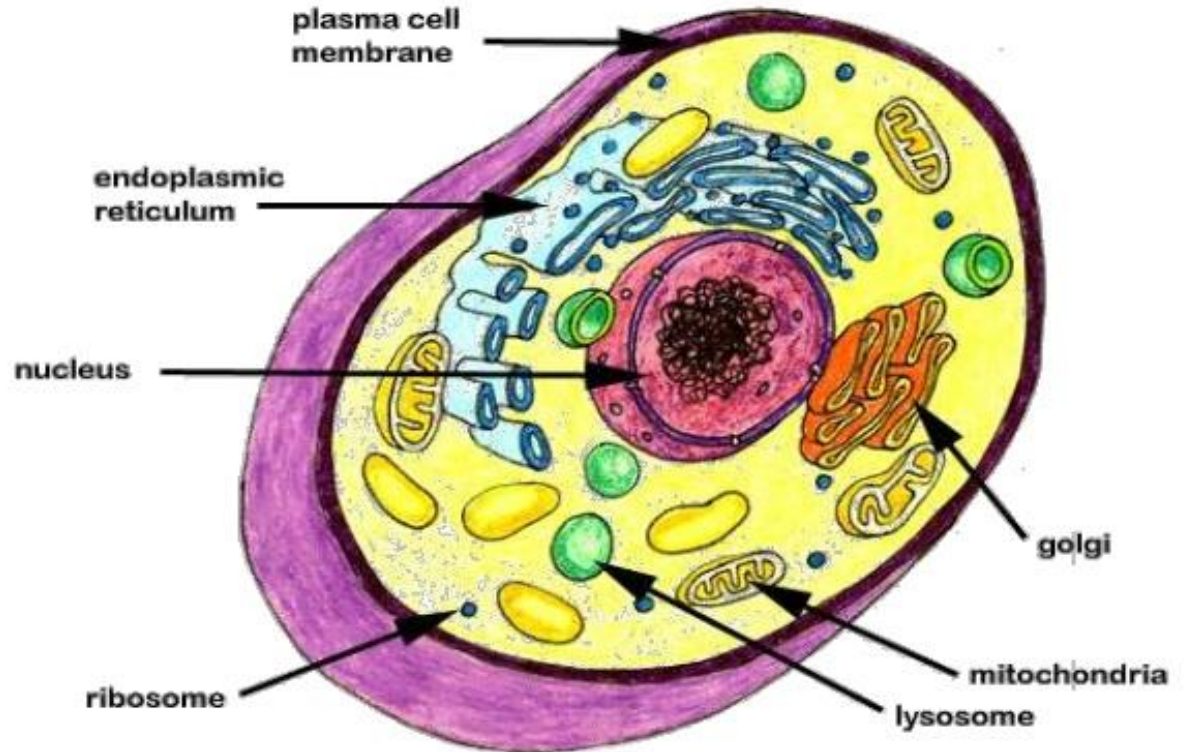
Cells are extremely small, typically only about 0.01 millimeter (.0004 or 4 ten-thousandths of an inch) across – even our largest cells are no bigger than the width of a human hair.



A 6 micron diameter carbon filament above a 50 micron diameter human hair

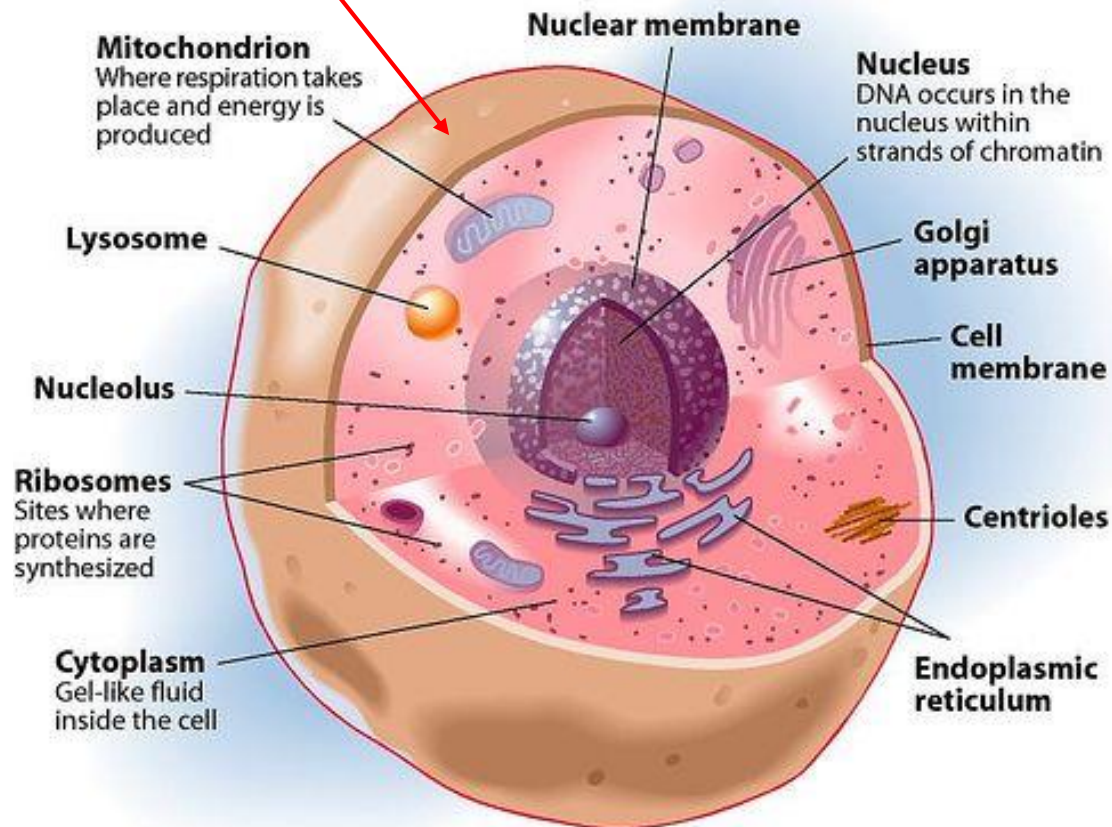
The Parts of the Cell

- Each living cell carries out the tasks of taking food, transforming food into energy, getting rid of wastes, and reproducing.
- Most of our body cells have three main parts:
 - Cell outer Membrane
 - Cytoskeleton structure inside to keep its shape
 - The nucleus



The cell membrane is a double layer of lipids and proteins that surrounds a cell and separates the cytoplasm (the liquid contents of the cell) from its surrounding environment.

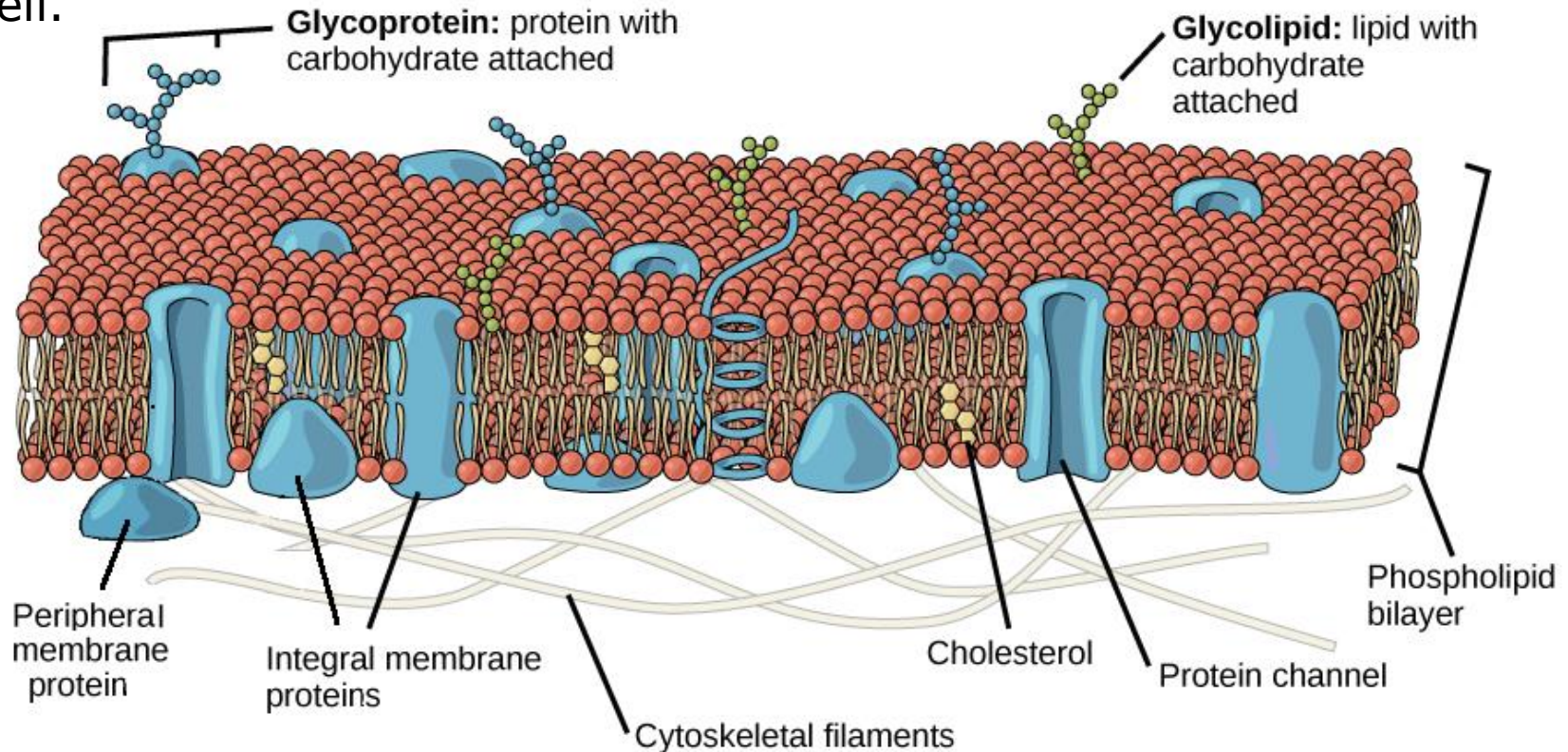
It is selectively permeable, which means that **it only lets certain molecules enter and exit and it controls the amount** of some substances that go into or out of the cell.



The cell membrane also contains many different proteins which make up about half of its surface.

Many of these proteins are embedded in the membrane but stick out on both sides. **There are thousands of proteins and ion channels on each of the 37.2 Trillion cells in the body !!**

Some of these proteins are receptors which bind to signal molecules, while others are ion channels which are the only means of allowing ions into or out of the cell.



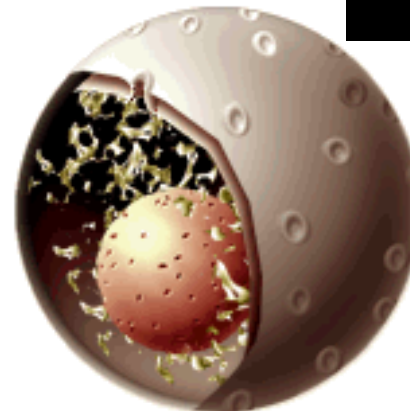
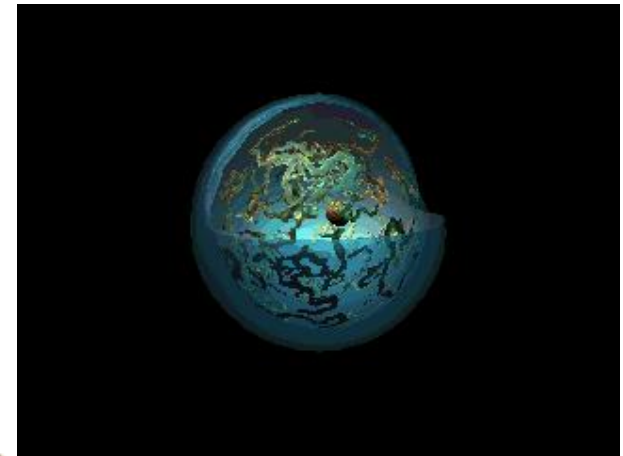
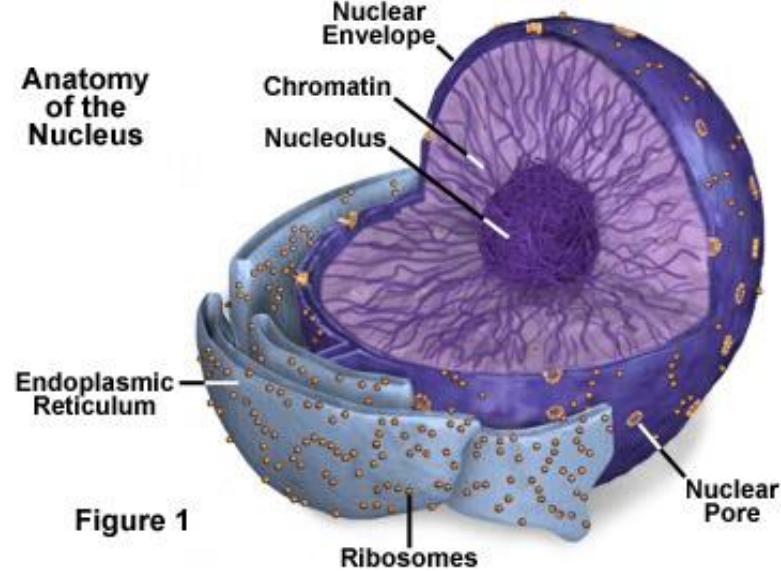
Nucleus

- Structure:

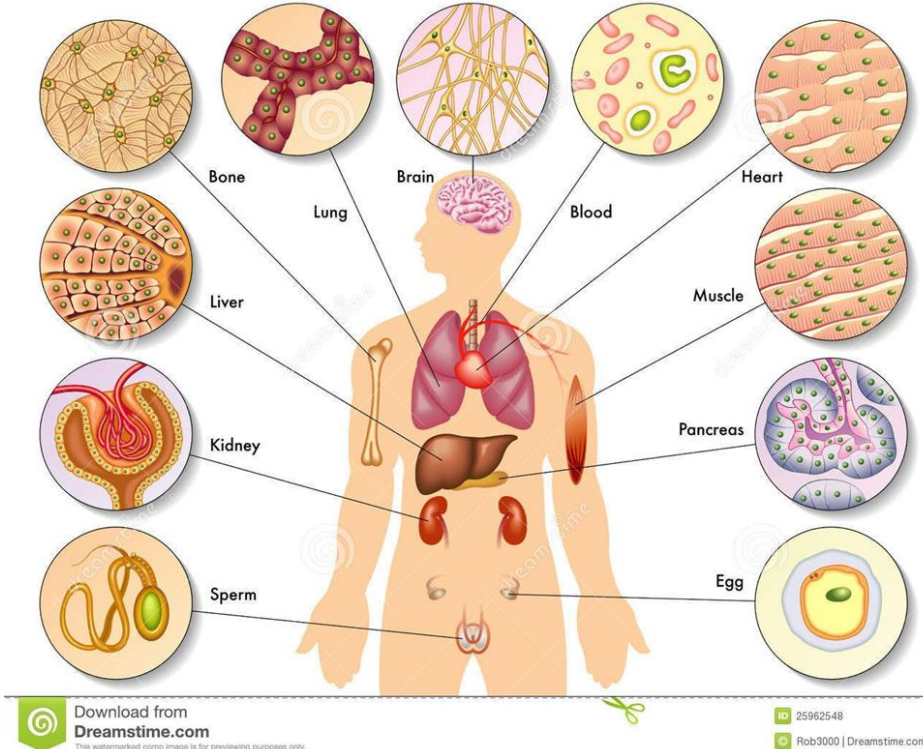
- The nucleus is a sphere that contains another sphere called a nucleolus

- It's function: - the storage center of the cell's DNA

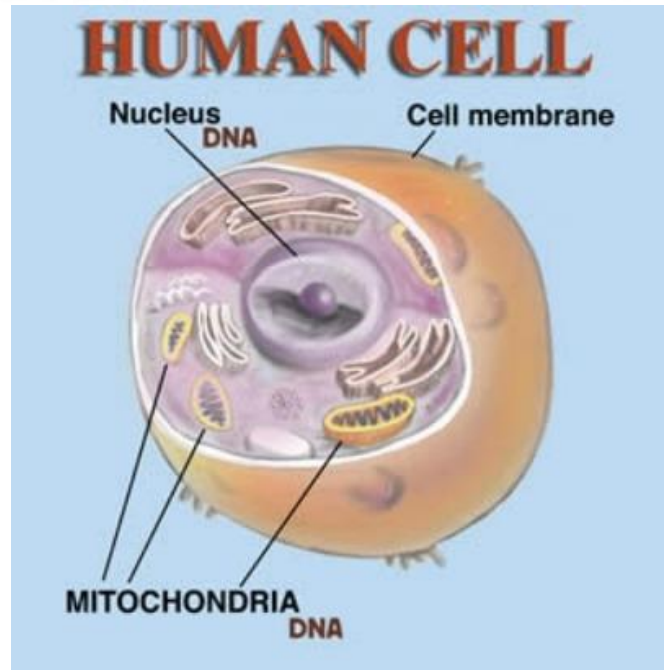
- Manages cell functions



As mentioned, there are 226 types of Body cells - some can form sheets like those in your skin or lining your mouth, while others can store or generate energy, such as fat and muscle cells.

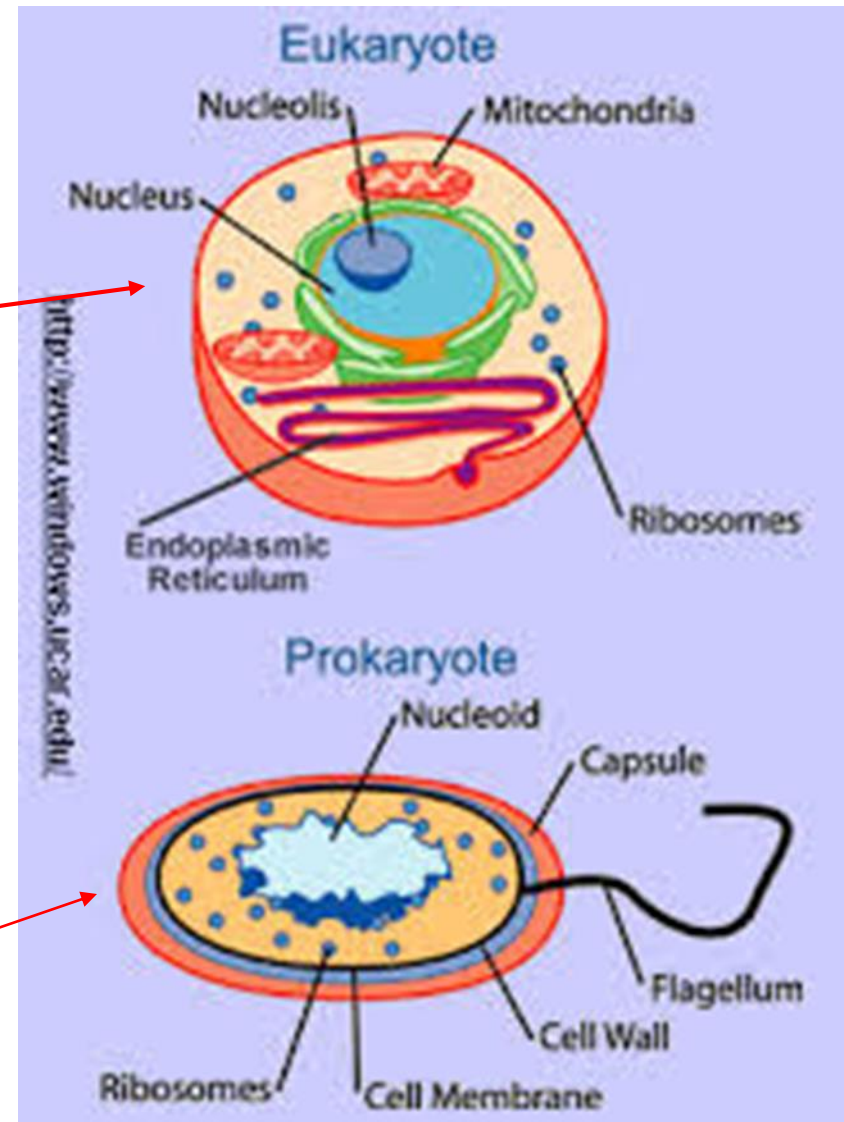


All cells have an outer membrane, a control center called a nucleus that contains our DNA, and tiny powerhouses called mitochondria.



CELL DIVERSITY- INTERNAL ORGANIZATION

- The Nucleus of each cell contains **DNA** (deoxyribonucleic acid) which directs the activity of the cell.
- **Eukaryotes** are cells in animals and plants that contain a nucleus and membrane-bound organelles (small internal parts), which includes all of our body cells.
- As a group, the Eukaryotes and the sex cells in our bodies are called **Somatic cells**.
- **Prokaryotes** are cells that lack nuclei and membrane-bound inside parts, such as those in bacteria.

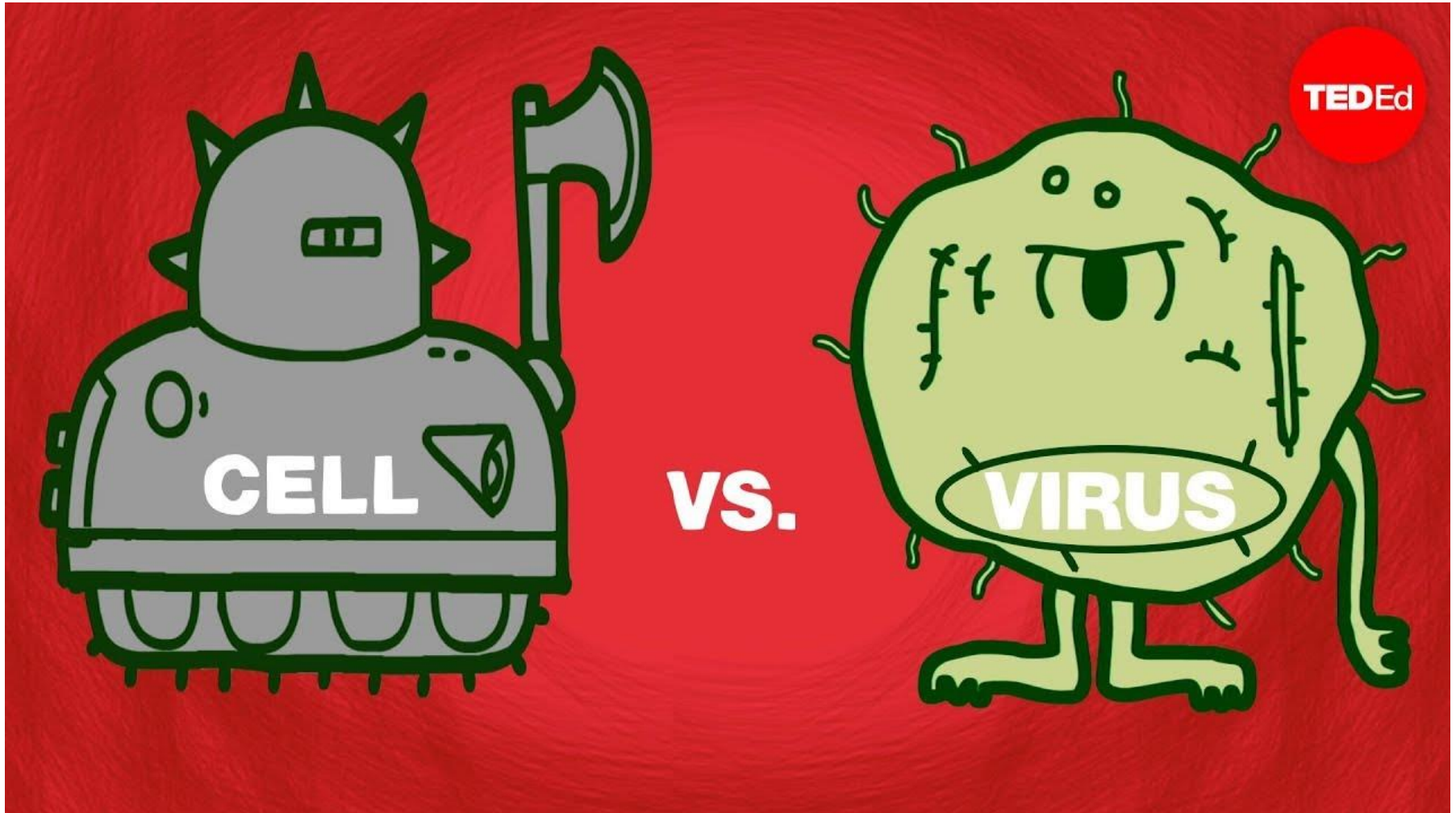


STRUCTURE AND FUNCTION OF ORGANELLES

- An **organelle** is a tiny cellular structure that performs specific functions within a cell.
- **Organelles** are embedded within the cytoplasm (liquid) of our cells and are held in there by an outside membrane.

- Cell Membrane
- Nucleus
- Cell Wall
- Cytoplasm
- Cytoskeleton
- Ribosomes
- Endoplasmic Reticulum
- Golgi Apparatus
- Mitochondria
- Lysosomes
- Peroxisomes
- Cilia and Flagella
- Basal Bodies
- Centrioles
- Vacuoles
- Plastids

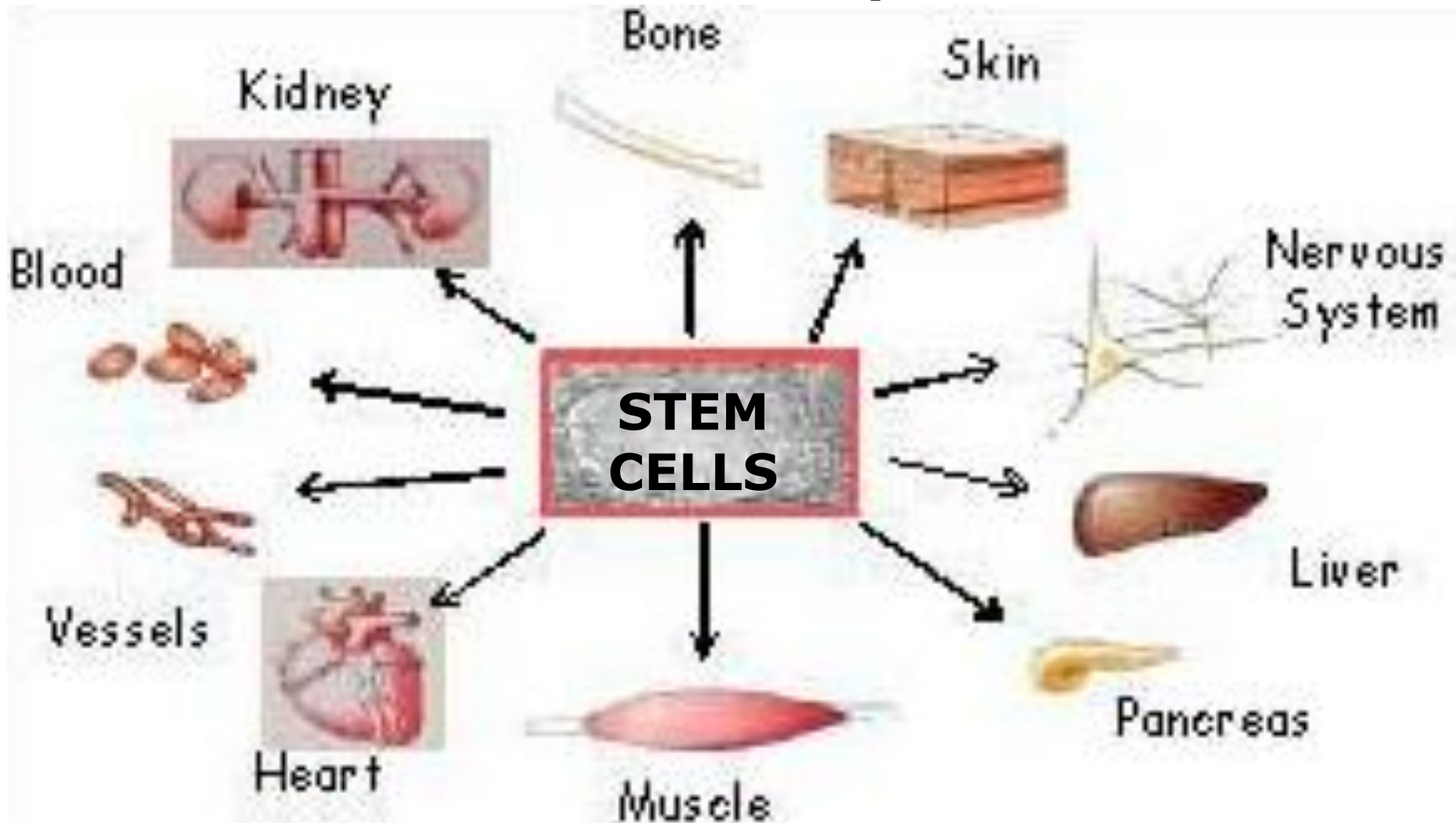
CELL VS. VIRUS: A BATTLE FOR HEALTH



<https://www.youtube.com/watch?v=oqGuJhOeMek>

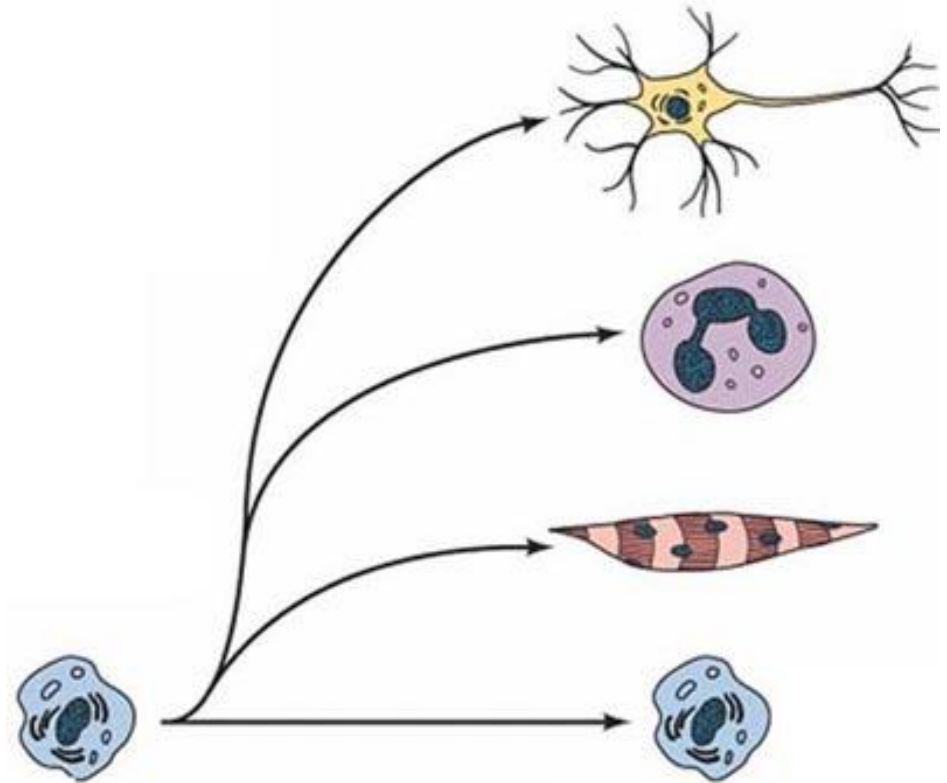
MULTICELLULAR ORGANISMS

Cells in multicellular organisms often **specialize** (take on different shapes & functions)



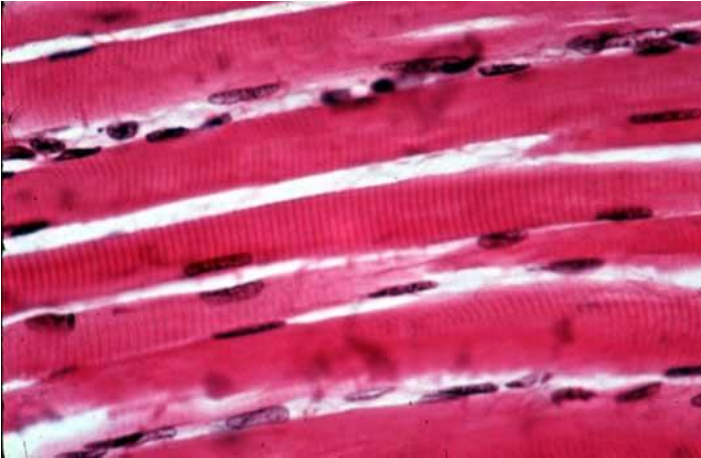
CELL SPECIALIZATION

- Cells in a multi-cellular organism become specialized by turning different genes on and off inside a **Stem cell**
- This is known as **DIFFERENTIATION**

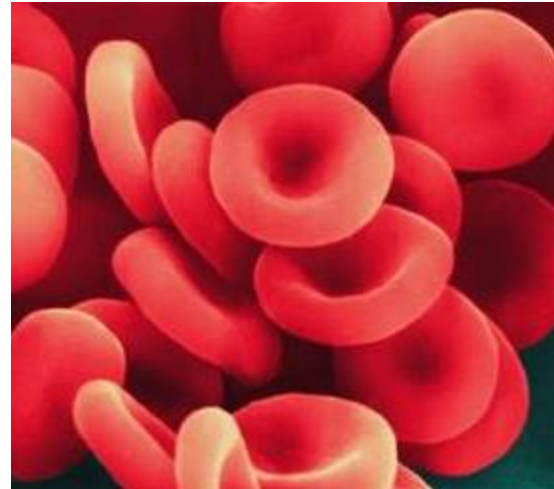


SPECIALIZED ANIMAL CELLS

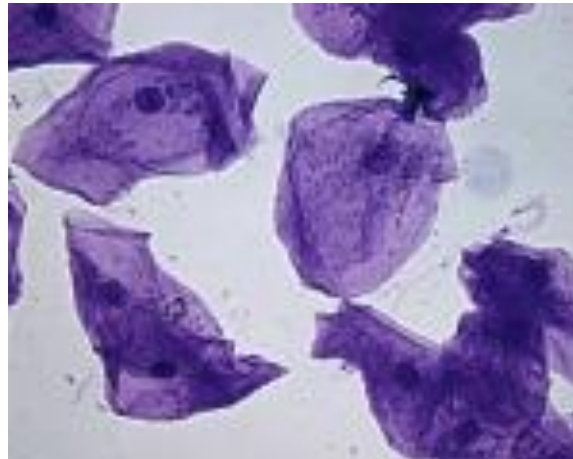
Muscle cells



Red blood cells



Cheek cells





Red blood cells

Unlike other cells, red blood cells lack a nucleus and organelles. Instead, they have an oxygen-carrying protein (hemoglobin), which gives blood its red color.



Epithelial cells

The skin cells and the cells lining the lungs and reproductive tracts are among the barrier cells, called epithelial cells, which line the cavities and surfaces of the body.



Adipose (fat) cells

These cells are highly adapted for storing fat – the bulk of their interior is taken up by a large droplet of semi-liquid fat. When we gain weight, they fill up with more fat.



Nerve cells

These electrically excitable cells transmit electrical signals down an extended stem called an axon. Found throughout the body, they enable us to feel sensations.



Photoreceptor cells

Located in the eye, these are of two types—cone and rod (left). Both have a light-sensitive pigment and generate electrical signals when struck by light, helping us see.

Smooth muscle cells

One of three types of muscle cell, smooth muscle cells are spindle-shaped cells found in the arteries and the digestive tract that produce contractions.



Ovum (egg) cells

The largest cells in the female human body, eggs are female reproductive cells. Like sperm, they have just 23 chromosomes.



Sperm cells

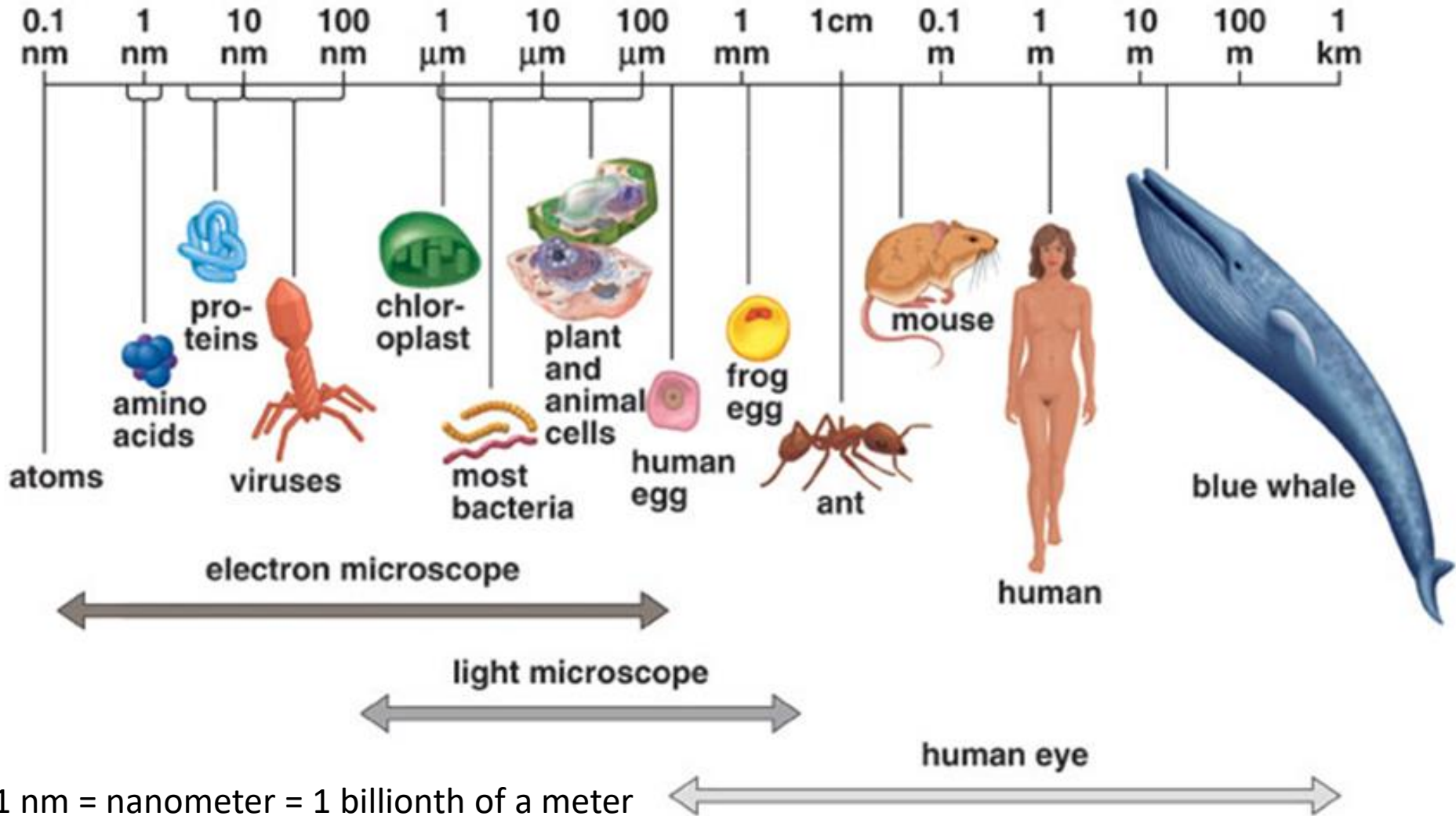
Sperm are male reproductive cells, with tails that enable them to swim up the female reproductive tract and fertilize an egg.



The Cell Theory

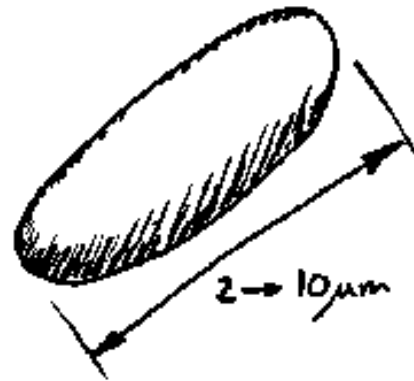
1. All living things are composed of one or more cells.
2. Cells are an organisms' basic units of structure and function.
3. Cells come only from existing cells.
4. Each cell maintains homeostasis at the cellular level.
5. Homeostasis at the level of the tissue, organ, organ system, and organism, reflects the combined and coordinated actions of billions of cells !

CELL SIZE



1 nm = nanometer = 1 billionth of a meter
μm = 1 micron = 1 millionth of a meter

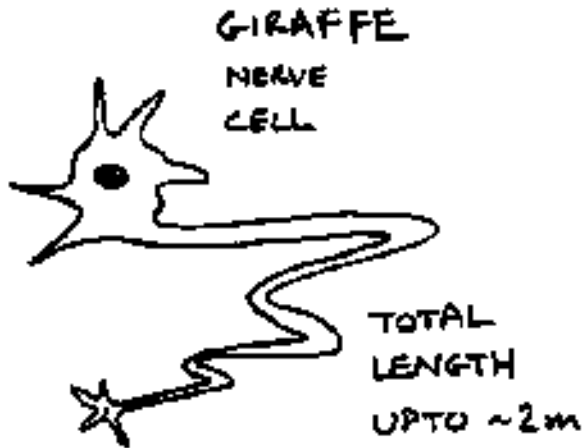
BACTERIUM



Smallest Cells:

Cell Diversity- Size

Longest Cells:



Biggest Cells:

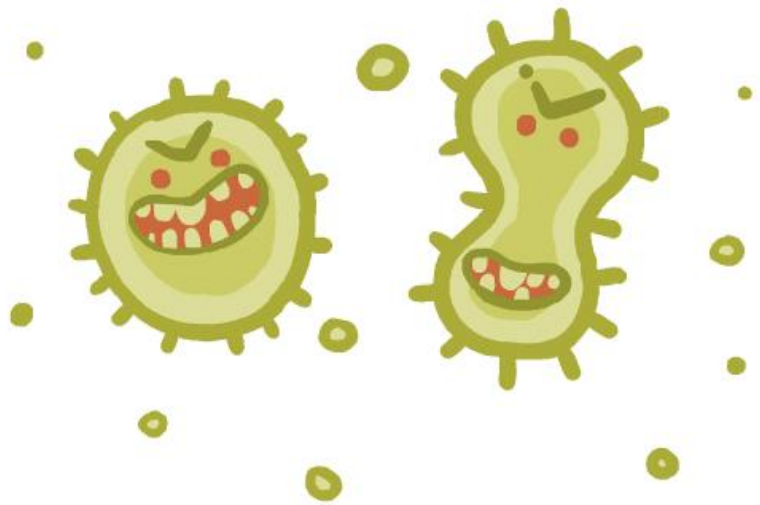
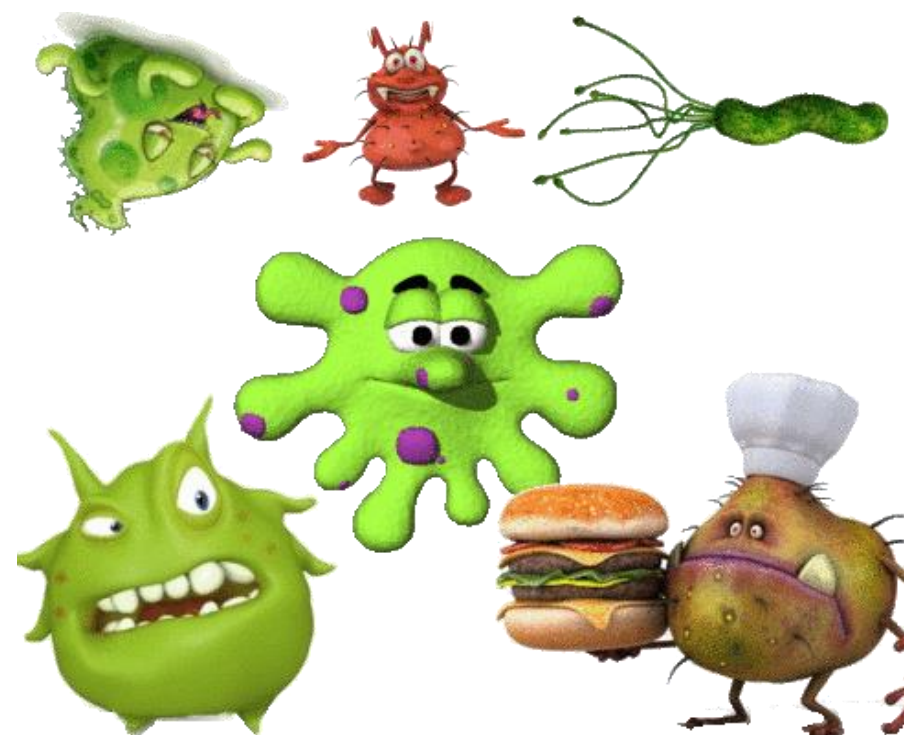
6 inches long, 5 inches wide, 3 pounds



Ostrich Egg

1 nm = nanometer = 1 billionth of a meter
μm = 1 micron = 1 millionth of a meter

AND NOW, JUST IN TIME FOR HALLOWEEN, WE PRESENT THE AMAZING AMOUNT OF CREEPIES AND CRAWLERS THAT ARE ON THE OUTSIDE AND INSIDE OF YOUR BODY !!



MORE THAN HALF YOUR BODY IS NOT HUMAN !

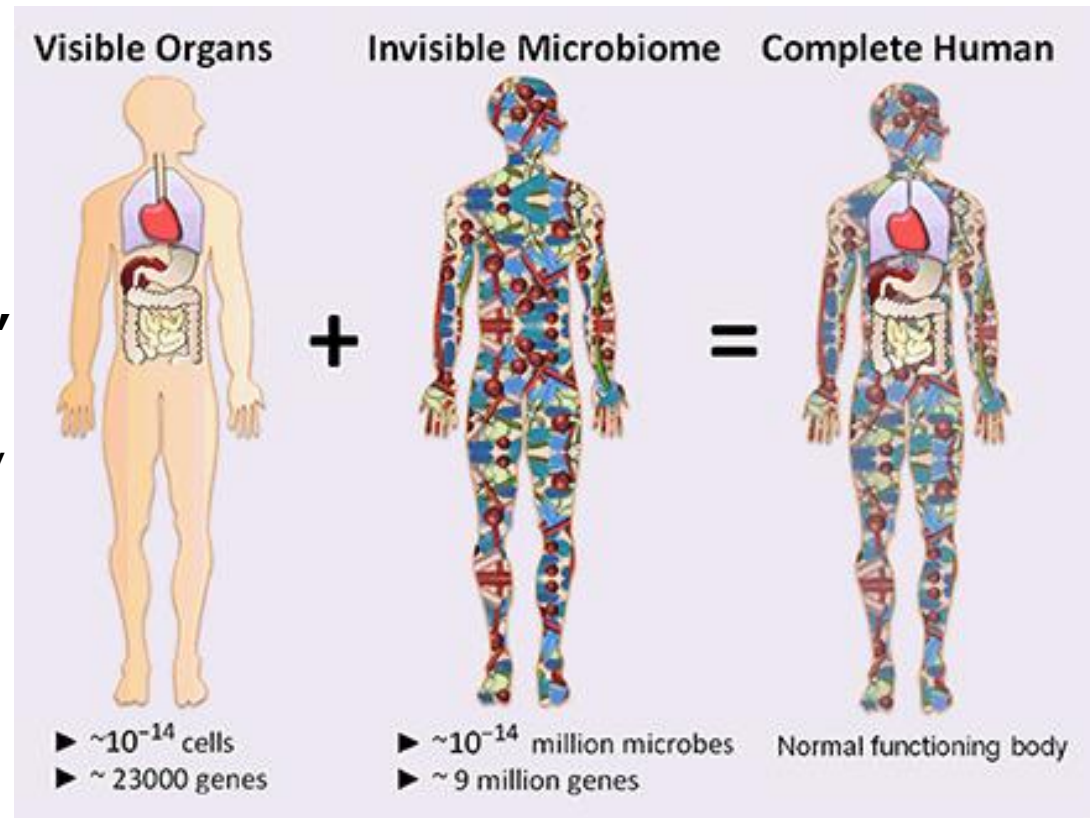
Human cells make up only 43% of the body's total cell count. The rest – 57%, are microscopic colonists called our Microbiome.

There are over 400 different species of them !!

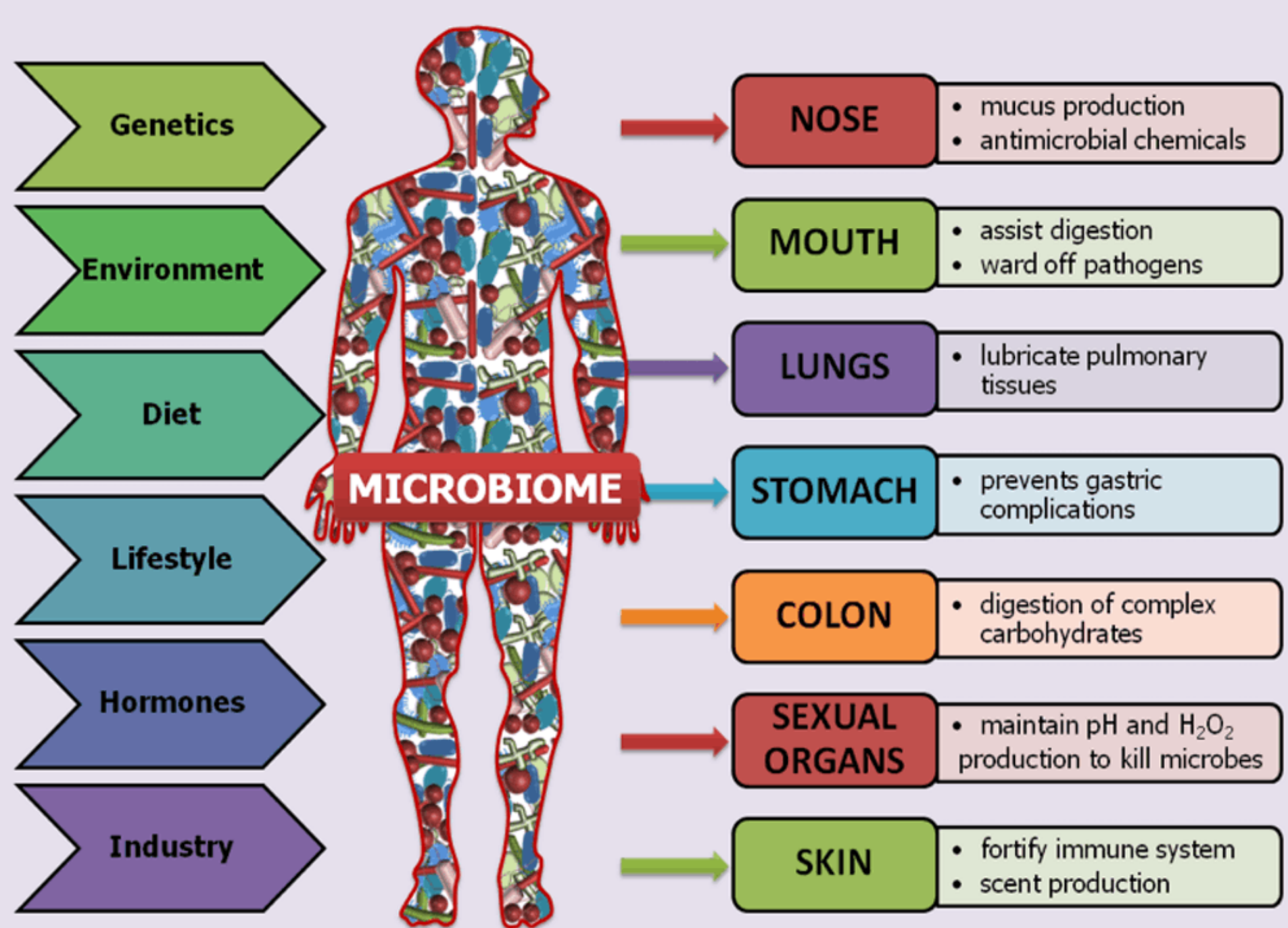
They are essential to your health, so your body isn't just you !

No matter how well you wash, nearly every nook and cranny of your body is covered in microscopic creatures, including **bacteria, viruses, fungi and archaea (organisms originally misclassified as bacteria)**.

The greatest concentration of this microscopic life is in the dark murky depths of our oxygen-deprived bowels.



37.2 Trillion cells + 49.3 Trillion cells = 86.5 Trillion cells !!



A scanning electron micrograph (SEM) of human skin. The image shows a large, cylindrical hair follicle in the center, with a textured, ribbed surface. The surrounding skin surface is covered in fine, wavy ridges and valleys, characteristic of the epidermal layer. In the lower-left corner, there is a cluster of smaller, more rounded structures, possibly sebaceous glands or other skin appendages. The overall color palette is in shades of brown and tan, typical of SEM images.

The average person has 67 different species of bacteria in their belly button.

You have about 32 million bacteria on every square inch of your skin !!

MITOSIS

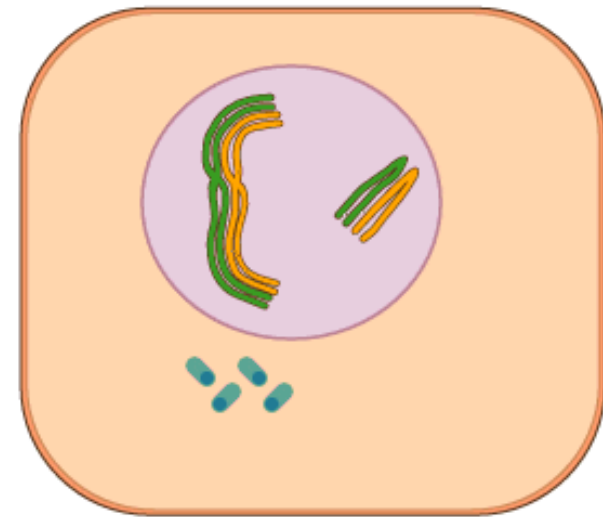
Out of the 37.2 Trillion cells in your body, 96 million of them die every minute but luckily, 96 million new cells are created each minute. To do this, there has to be an efficient process in place to do that.

This is called **Mitosis**, when one cell divides to produce two genetically identical cells, with the same DNA in them. **The longer name for the final part of the process is Cytokinesis.**

It takes 2 hours for each cell to divide into 2 cells !!

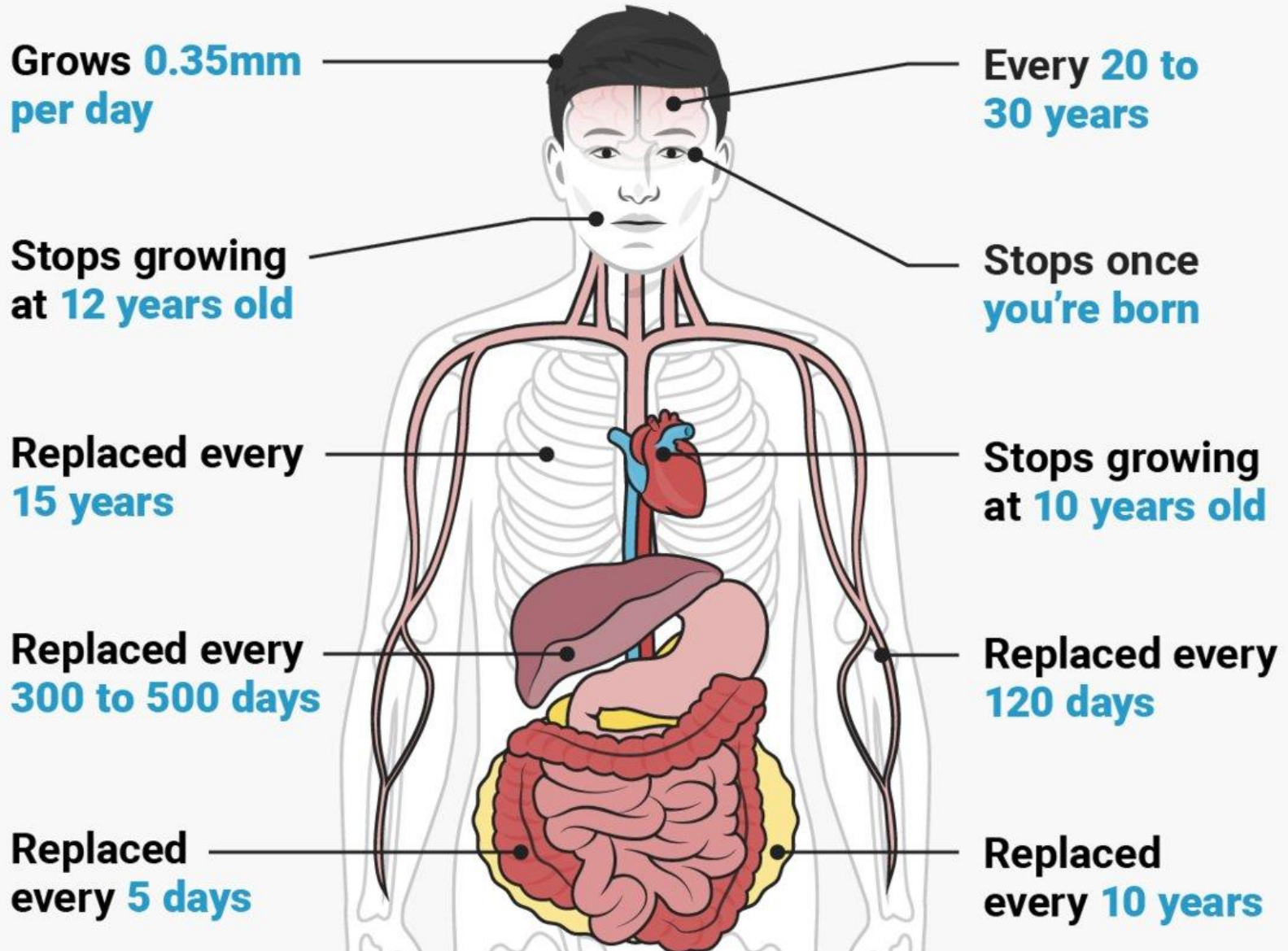
There is another type of cell division called **Meiosis** which is **a process where a single cell divides twice to produce four cells, with each containing half the original amount of genetic information.**

These **cells** are our sex **cells** – sperm in males, eggs in females.

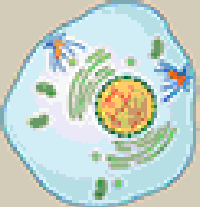
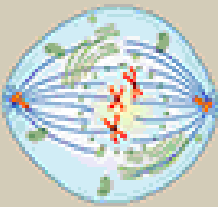
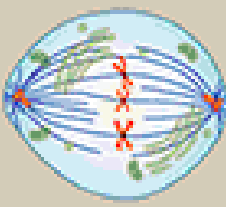
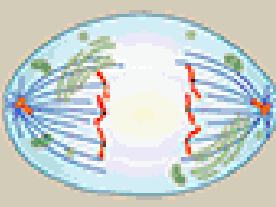
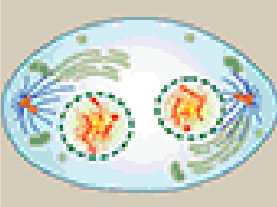
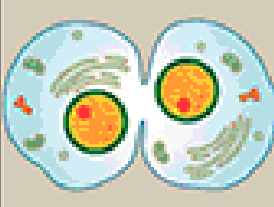
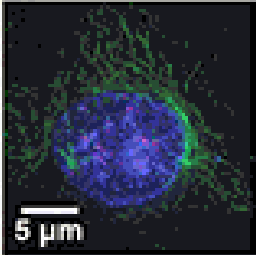
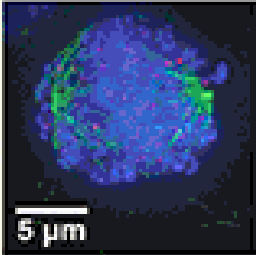
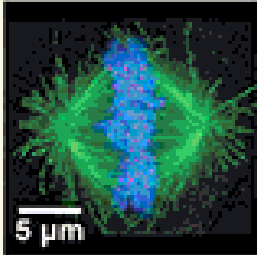
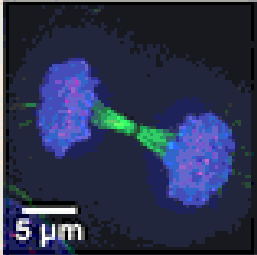
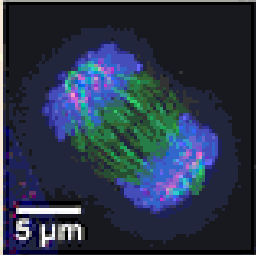



https://www.youtube.com/watch?v=AhgRhXI7w_g

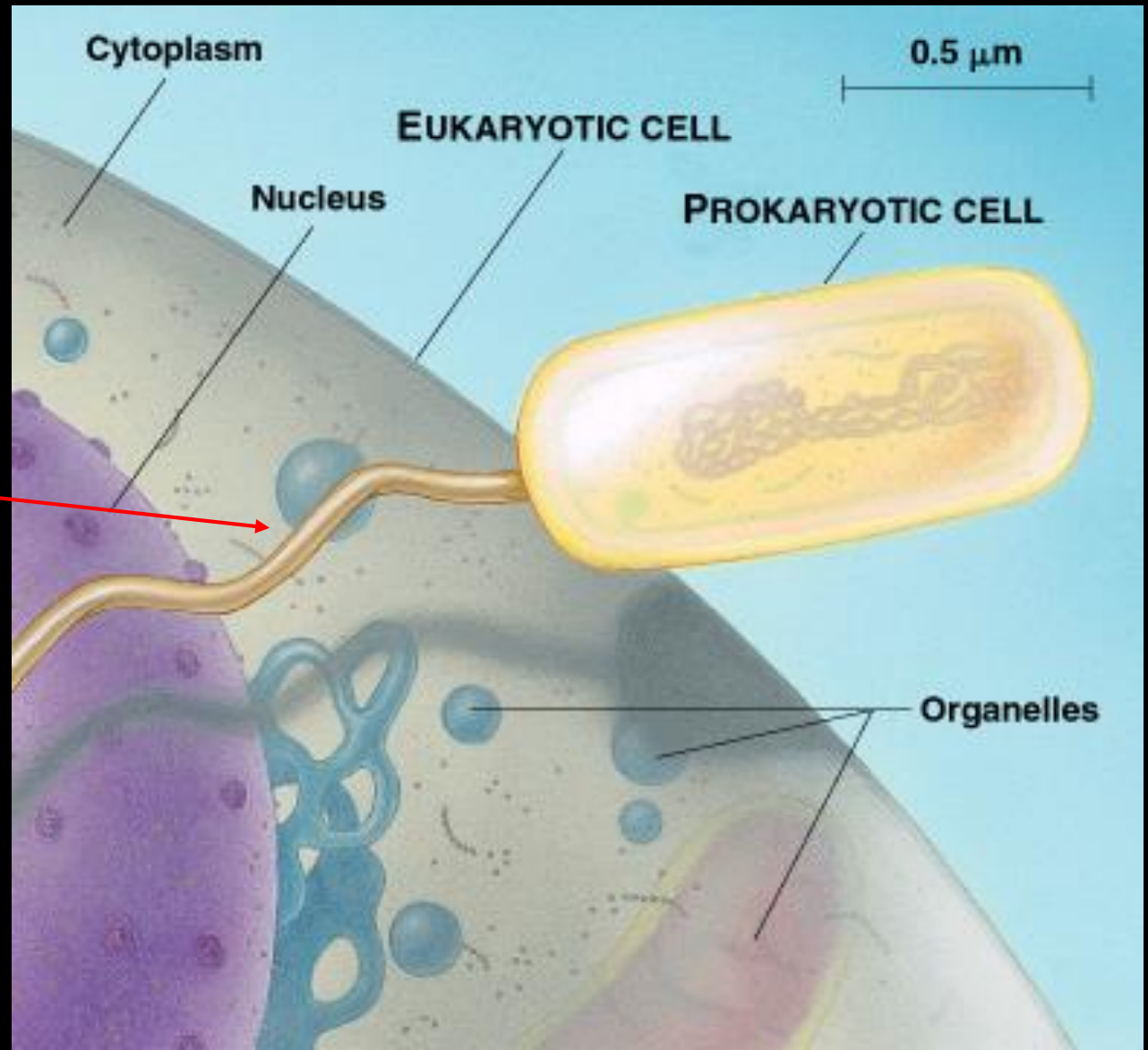
There are different stages of growth of our body parts, based on how the cells divide in those areas



The whole cell division process takes 7 hours with the last part – Cytokinesis, taking 2 hours for the cells to finish their being created and split apart !!

Prophase	Prometaphase	Metaphase	Anaphase	Telophase	Cytokinesis
					
<ul style="list-style-type: none"> • Chromosomes condense and become visible • Spindle fibers emerge from the centrosomes • Nuclear envelope breaks down • Centrosomes move toward opposite poles 	<ul style="list-style-type: none"> • Chromosomes continue to condense • Kinetochores appear at the centromeres • Mitotic spindle microtubules attach to kinetochores 	<ul style="list-style-type: none"> • Chromosomes are lined up at the metaphase plate • Each sister chromatid is attached to a spindle fiber originating from opposite poles 	<ul style="list-style-type: none"> • Centromeres split in two • Sister chromatids (now called chromosomes) are pulled toward opposite poles • Certain spindle fibers begin to elongate the cell 	<ul style="list-style-type: none"> • Chromosomes arrive at opposite poles and begin to decondense • Nuclear envelope material surrounds each set of chromosomes • The mitotic spindle breaks down • Spindle fibers continue to push poles apart 	<ul style="list-style-type: none"> • Animal cells: a cleavage furrow separates the daughter cells • Plant cells: a cell plate, the precursor to a new cell wall, separates the daughter cells
 5 μm	 5 μm	 5 μm	 5 μm	 5 μm	 5 μm

Structural Organization of Eukaryotic and Prokaryotic Cells

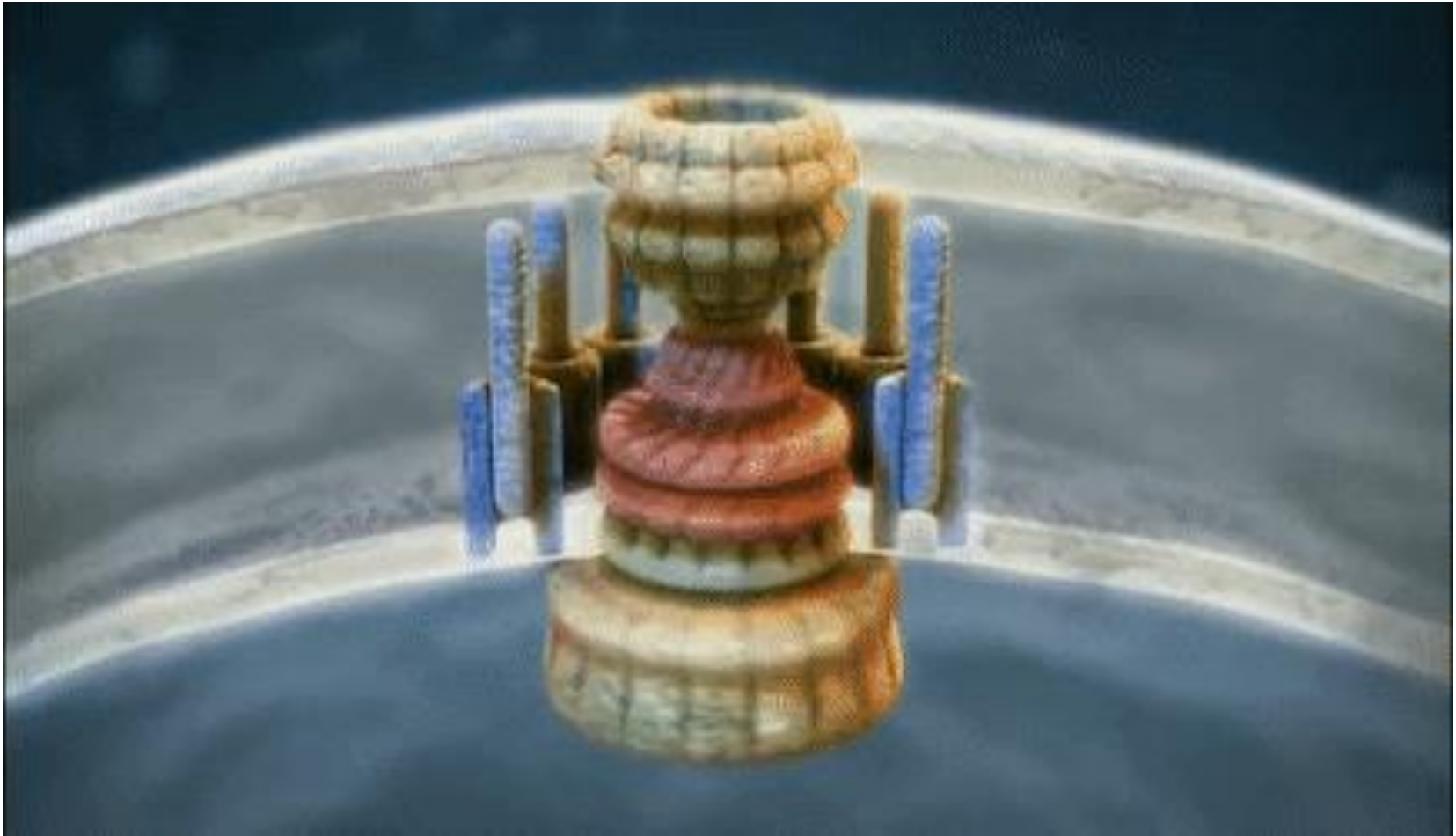


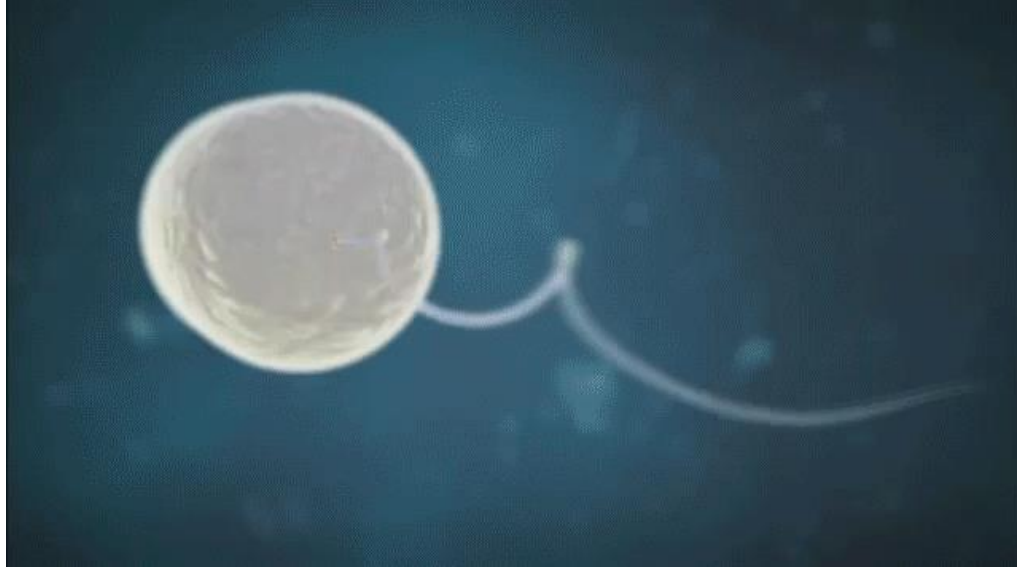
Flagella

Small bacteria and other cells have tails they can rotate to let them move through body fluids.

At one millionth of the size of a grain of sand, it is done with a motor designed by Nature, called a flagellar motor assembly.

It is a self-assembling nano machine.





FLAGELLUM



CILIA



How does a Prokaryotic cell (bacteria) move around to find food and do its thing ?

<https://www.youtube.com/watch?v=GnNCaBXL7LY>



Honoring Henrietta: The Legacy of Henrietta Lacks

Henrietta Lacks (born Loretta Pleasant; August 1, 1920 – October 4, 1951) was an African-American woman whose cancer cells are the source of the HeLa cell line, the first immortalized human cell line and one of the most important cell lines in medical research.

Immortalized means that instead of dying when cultured in a lab, her cells continue to reproduce and are used for cancer research all around the World !!



Lacks was the unwitting source of these cells from a tumor biopsied during treatment for cervical cancer at Johns Hopkins Hospital in Baltimore, Maryland, U.S., in 1951.

These cells were then cultured by Dr. George Otto Gey who created the cell line known as **HeLa (after her name)**, which is still used for medical research all around the world.

He discovered that Mrs. Lacks' cells were unlike any of the others he had ever seen.

Where other cells would die, Mrs. Lacks' cells doubled every 20 to 24 hours.

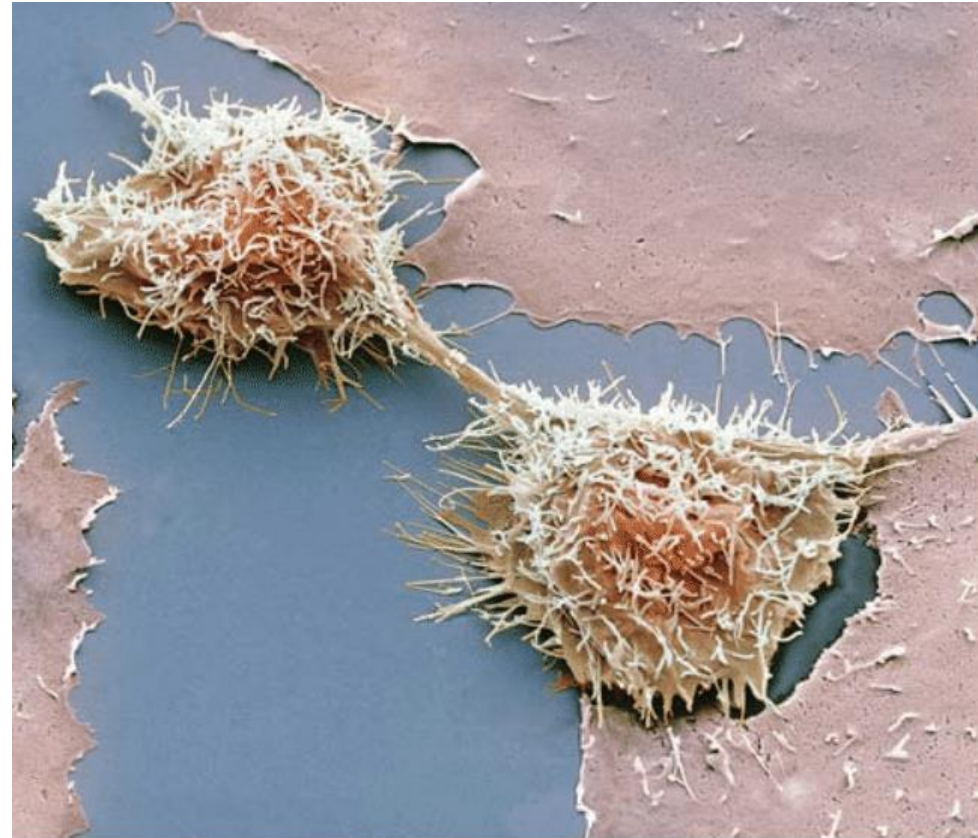


Dividing HeLa cells as seen by a scanning electron micrograph (colored).

The image is taken during cell division (cytokinesis).

The transient connecting midbody formed by microtubules can be seen.

Credit: Steve Gschmeissner / Photo Researchers, Inc



10 μm

TYPES OF TISSUES IN THE BODY

TISSUE TYPES

Cells often group together with their own kind to form tissues that perform a specific function. However, not all cells in a tissue are necessarily identical. The four main types of tissue in the human body are muscle, connective tissue, nervous tissue, and epithelial tissue. Within these groups, different forms of these tissues can have very different appearances and functions. For example, blood, bone, and cartilage are all types of connective tissue, but so are fat layers, tendons, ligaments, and the fibrous tissue that holds organs and epithelial layers in place. Organs such as the heart and lungs are composed of several different kinds of tissue.

Smooth muscle

Able to contract in long, wavelike motions without conscious thought, smooth muscle is found in sheets or sheaths of the blood vessels, stomach, intestines, and bladder. It is vital for maintaining blood pressure and for pushing food through the digestive system.

SMALL INTESTINE



Cartilage

This soft, rubbery connective tissue is composed of cells called chondrocytes embedded in a matrix of gel-like material, which the cells secrete. Cartilage is found in the joints between bones, and in the ear and nose. The high water content of cartilage makes it tough but flexible.

NOSE CARTILAGE



Dense connective tissue

This contains fibroblast cells, which secrete the fibrous protein called type I collagen. The fibers are organized into a regular parallel pattern, making the tissue very strong. Dense connective tissue occurs in the outer layer of skin, and forms structures such as ligaments and tendons.

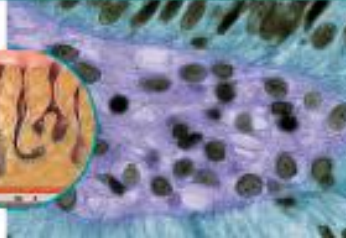
KNEE LIGAMENTS



Epithelial tissue

This tissue forms a covering or lining for internal and external body surfaces. Some epithelial tissues, like the skin, can secrete substances such as digestive enzymes; others can absorb substances like food or water.

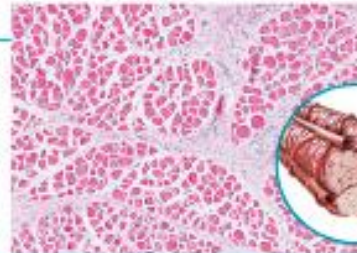
STOMACH WALL



Skeletal muscle

This tissue performs voluntary movements of the limbs. Unlike smooth muscle, skeletal muscle cells are arranged into bundles of fibers, which connect to bones via tendons. They are packed with highly organized filaments that slide over one another to produce contractions.

MUSCLE FIBERS



Spongy bone

Like cells secrete a hard material that makes bones strong and brittle. Spongy bone is found in the center of bones, and is softer and weaker than the compact bone. The spongy spaces in spongy bone are filled with bone marrow or connective tissue.

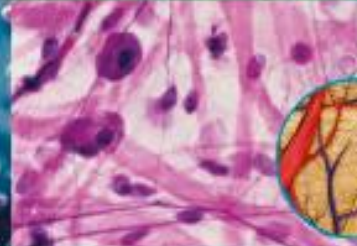
END OF THE FEMUR



Loose connective tissue

This type of tissue also contains cells called fibroblasts, but the fibers they secrete are loosely organized and run in random directions, making the tissue quite pliable. Loose connective tissue holds organs in place and provides cushioning and support.

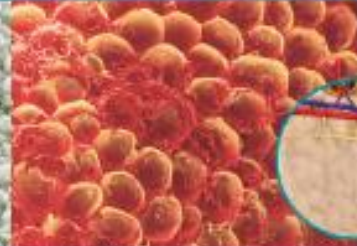
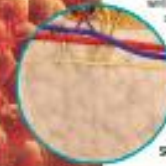
DERMAL TISSUE



Adipose tissue

A type of connective tissue, adipose tissue is composed of fat cells called adipocytes, as well as some fibroblasts, immune cells, and blood vessels. Its main function is to act as an energy store and to cushion, protect, and insulate the body.

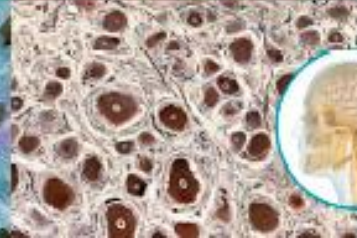
SUBCUTANEOUS FAT



Nerve tissue

This forms the brain, spinal cord, and the rest of the central nervous system, transmitting and regulating many body functions. It is mainly made up of networks of nerve cells (see opposite).

UPPER SPINAL CORD



THE 4 TYPES OF BODY TISSUE

Your body is made of cells and when groups of cells do the same kind of work, they are called tissues.

You have four main types of tissues: Connective, Epithelial, Muscle, and Nervous tissue.

Connective tissue joins bones and cushions organs.

Epithelial tissue covers the outside of the body. It also lines organs and cavities.

Muscle tissue helps you move

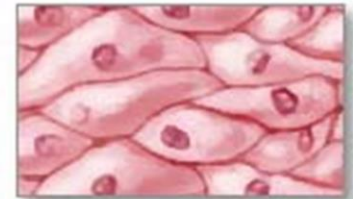
Nervous tissue sends electrical signals.

Blood, bone, and cartilage are all types of connective tissue, but so are fat layers, tendons, ligaments, and the fibrous tissue that holds organs and epithelial layers in place.

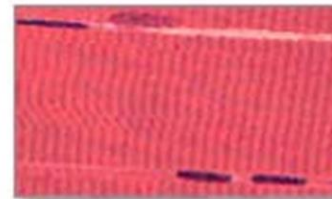
Four types of tissue



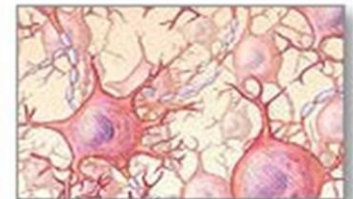
Connective tissue



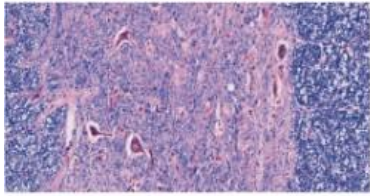
Epithelial tissue



Muscle tissue

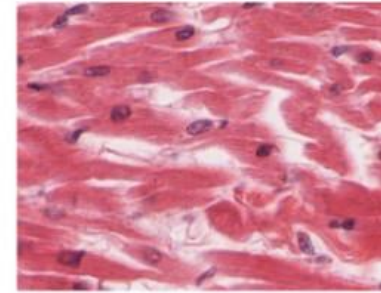


Nervous tissue



Nervous tissue

- Brain
- Spinal cord
- Nerves

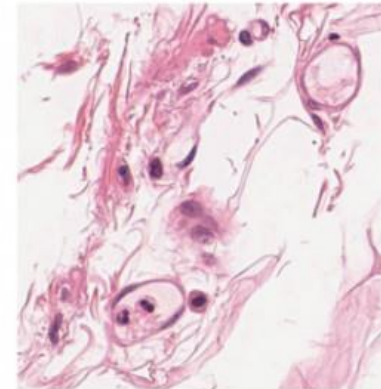
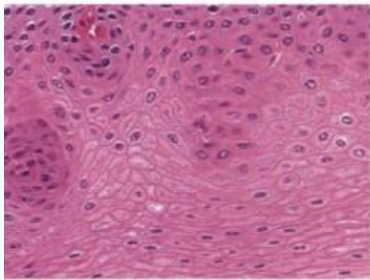


Muscle tissue

- Cardiac muscle
- Smooth muscle
- Skeletal muscle

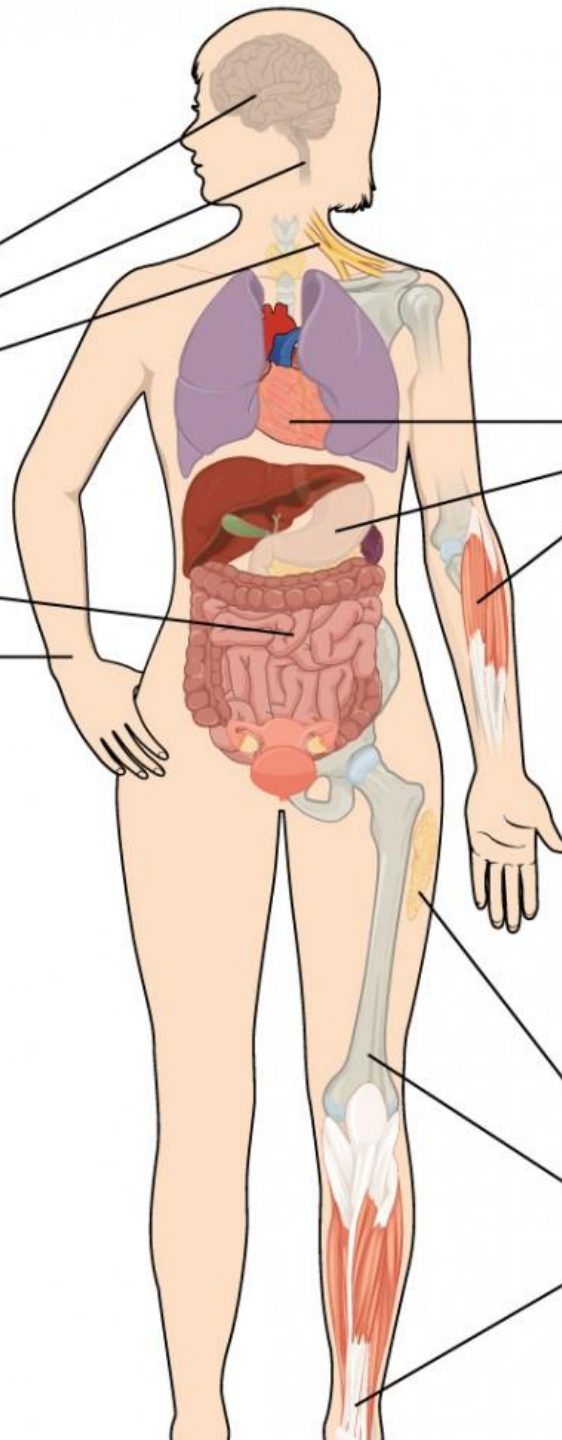
Epithelial tissue

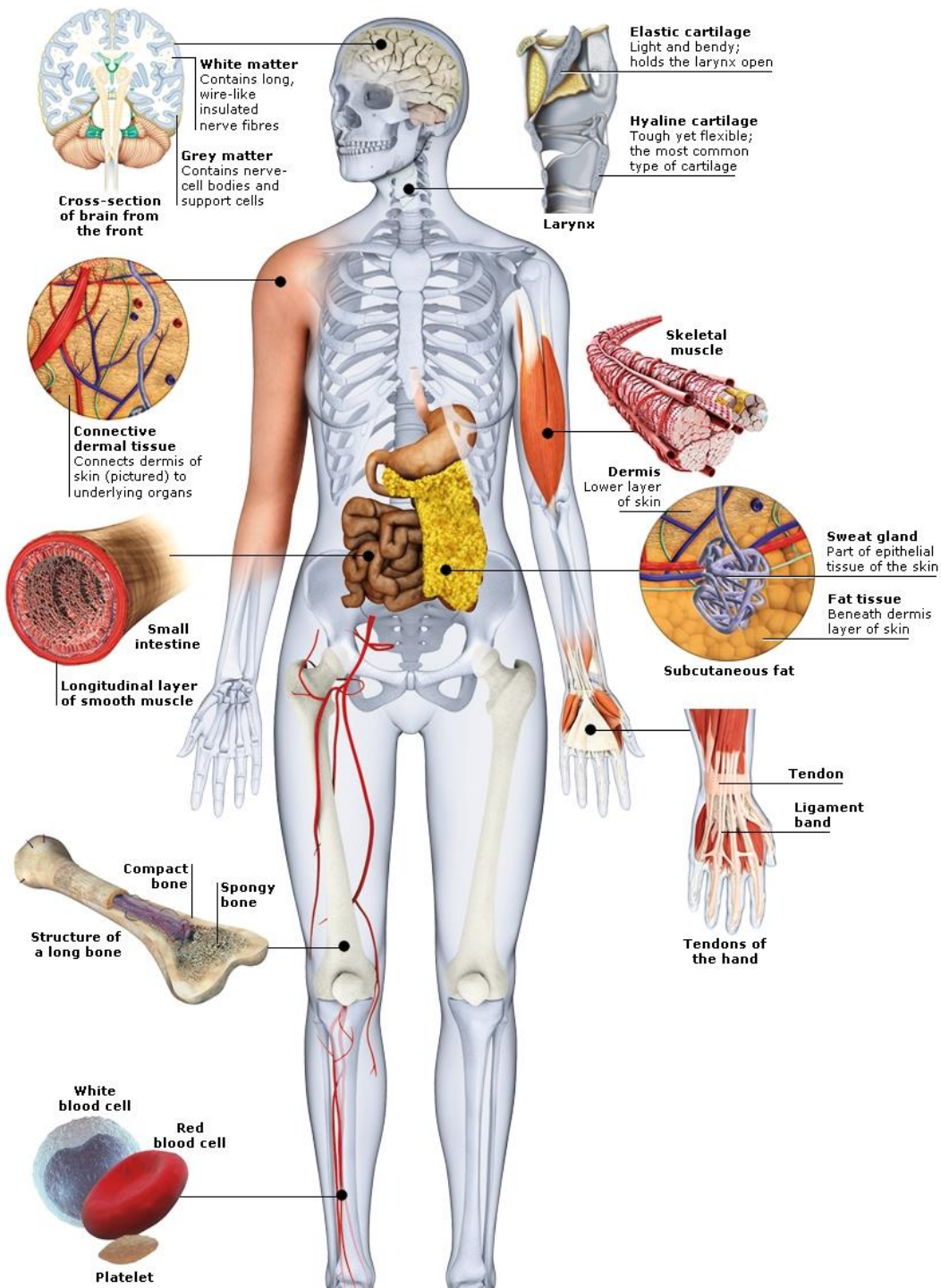
- Lining of GI tract organs and other hollow organs
- Skin surface (epidermis)



Connective tissue

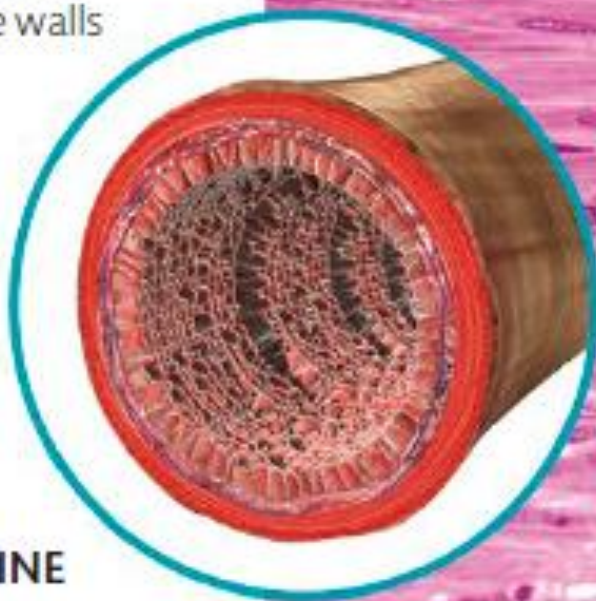
- Fat and other soft padding tissue
- Bone
- Tendon



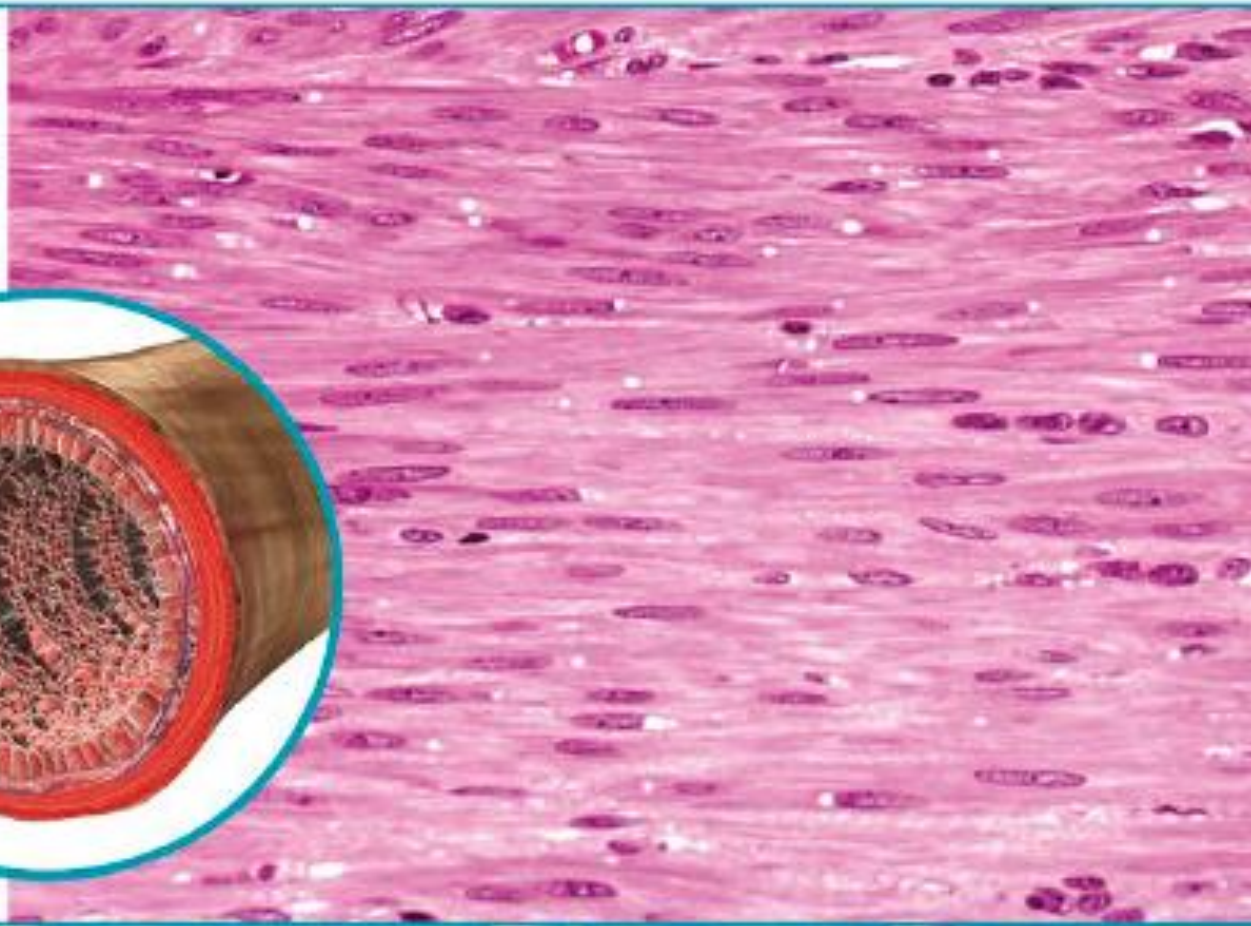


Smooth muscle

Able to contract in long, wavelike motions without conscious thought, smooth muscle is found in sheets on the walls of the blood vessels, stomach, intestines, and bladder. It is vital for maintaining blood pressure and for pushing food through the digestive system.



SMALL INTESTINE



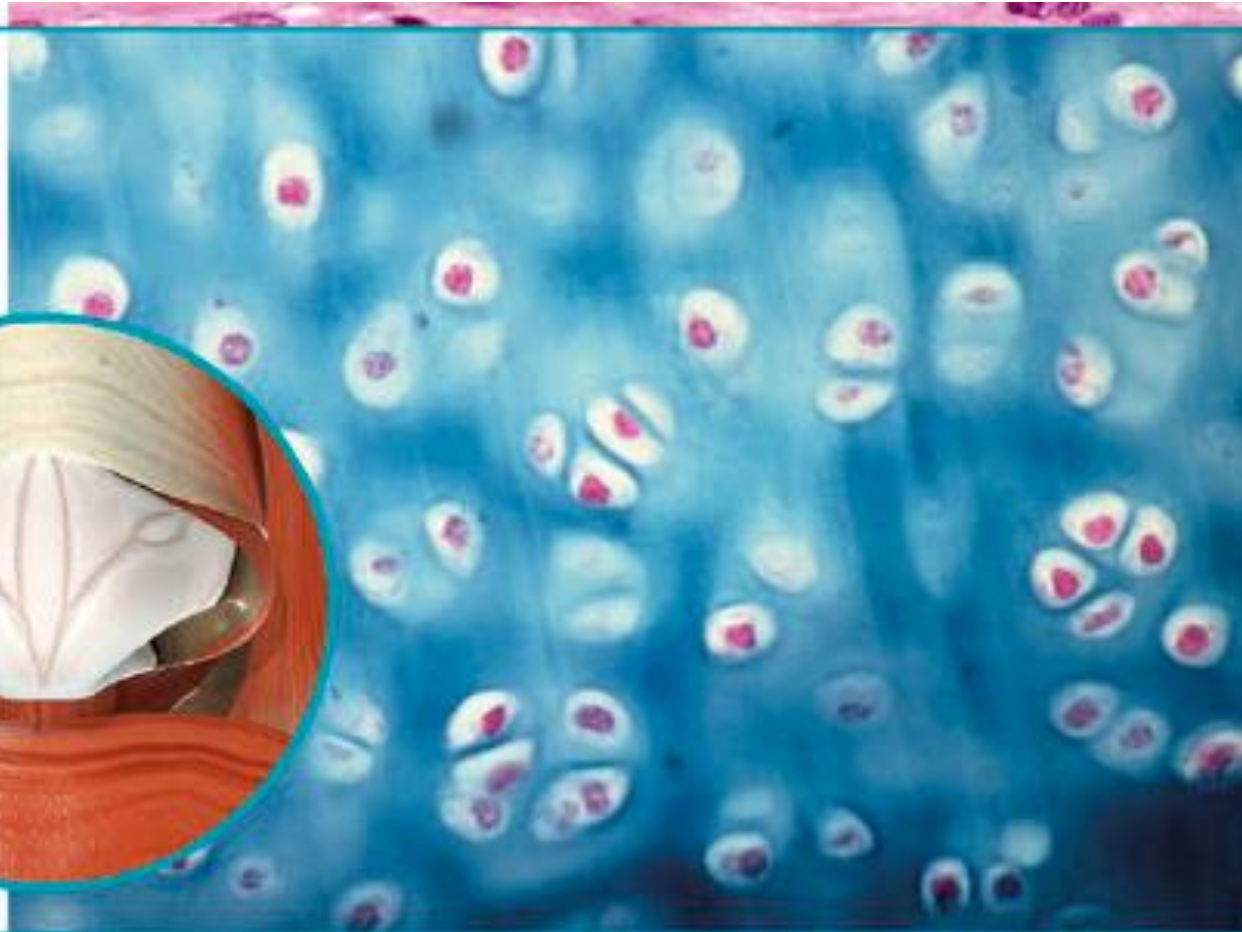
Cartilage

This stiff, rubbery, connective tissue is composed of cells called chondrocytes embedded in a matrix of gel-like material, which the cells secrete.

Cartilage is found in the joints between bones, and in the ear and nose. The high water content of cartilage makes it tough but flexible.



NOSE CARTILAGE



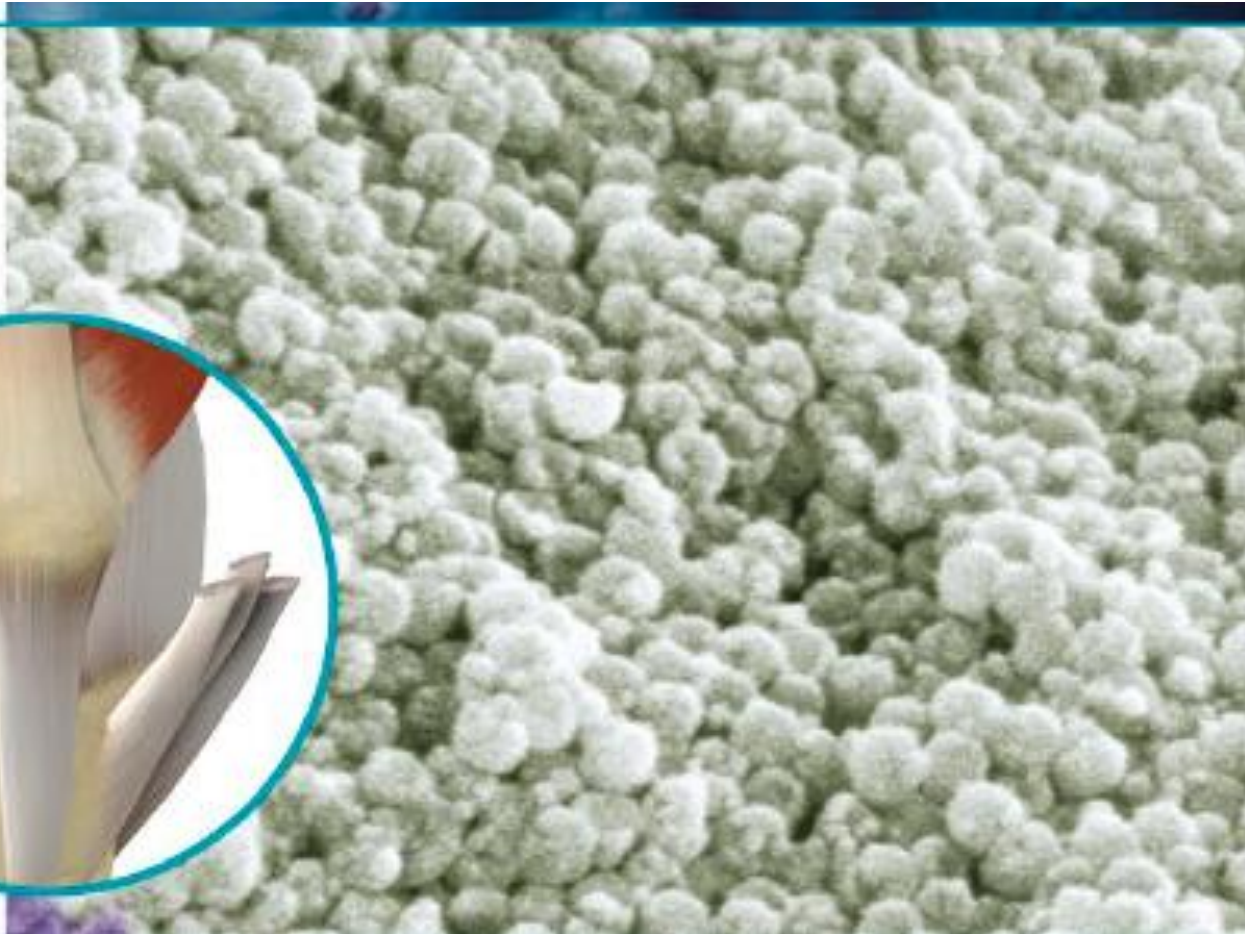
Dense connective tissue

This contains fibroblast cells, which secrete the fibrous protein called type 1 collagen. The fibers are organized into a regular parallel pattern, making the tissue very strong.

Dense connective tissue occurs in the base layer of skin, and forms structures such as ligaments and tendons.

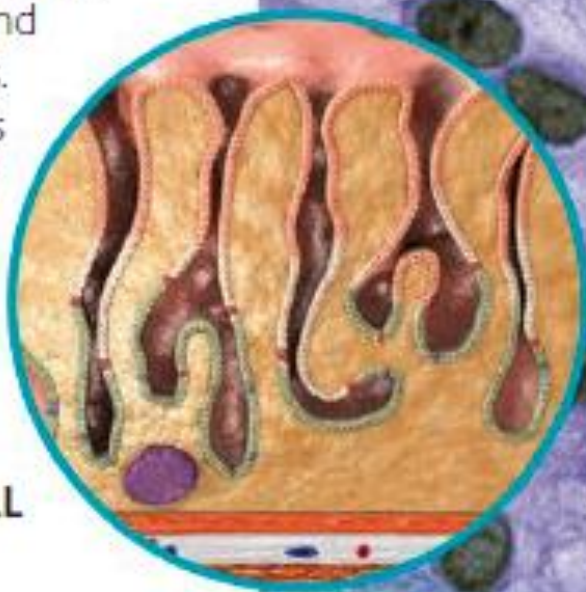


KNEE LIGAMENTS

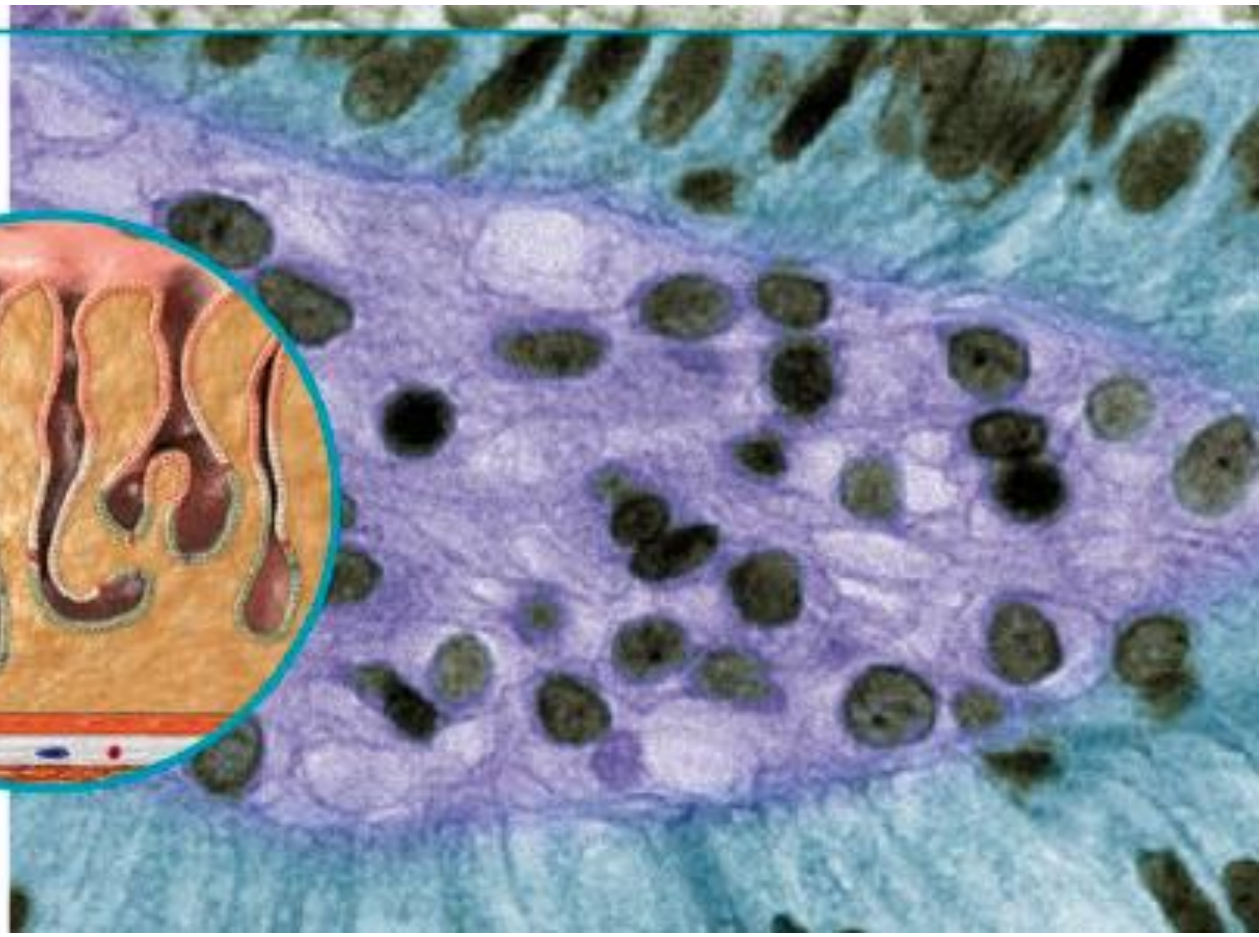


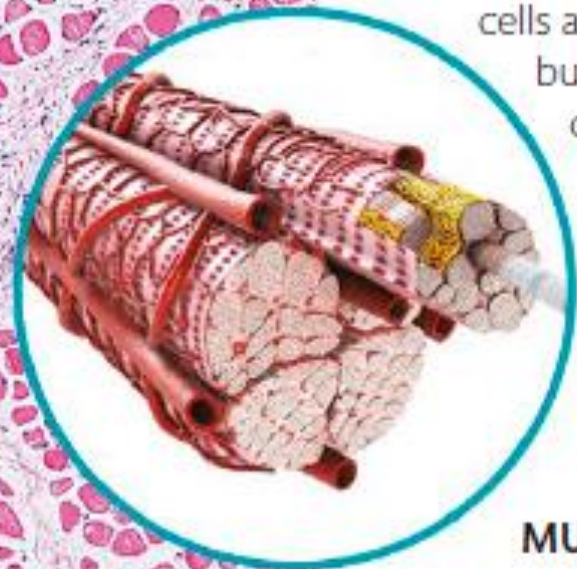
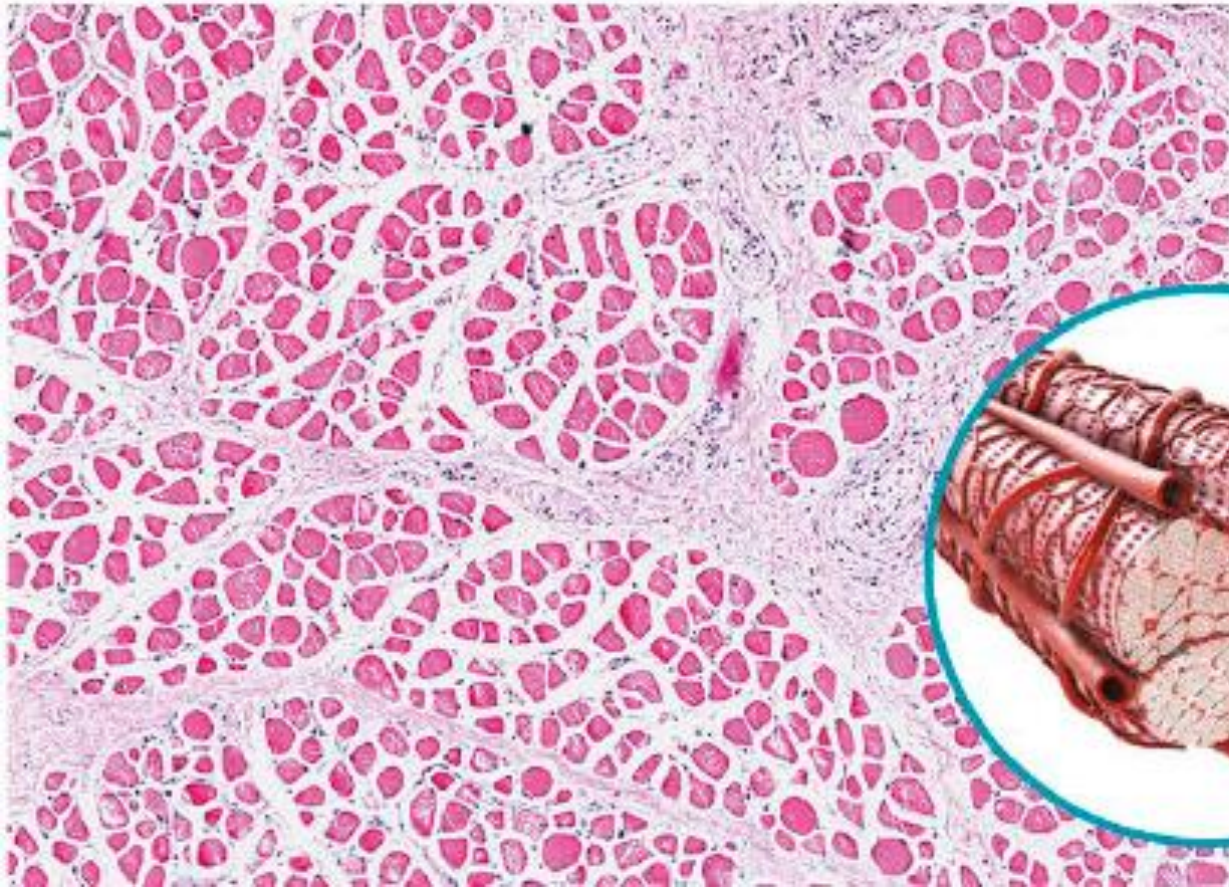
Epithelial tissue

This tissue forms a covering or lining for internal and external body surfaces. Some epithelial tissues can secrete substances such as digestive enzymes; others can absorb substances like food or water.



STOMACH WALL





Skeletal muscle

This tissue performs voluntary movements of the limbs. Unlike smooth muscle, skeletal muscle cells are arranged into bundles of fibers, which connect to bones via tendons. They are packed with highly organized filaments that slide over one another to produce contractions.

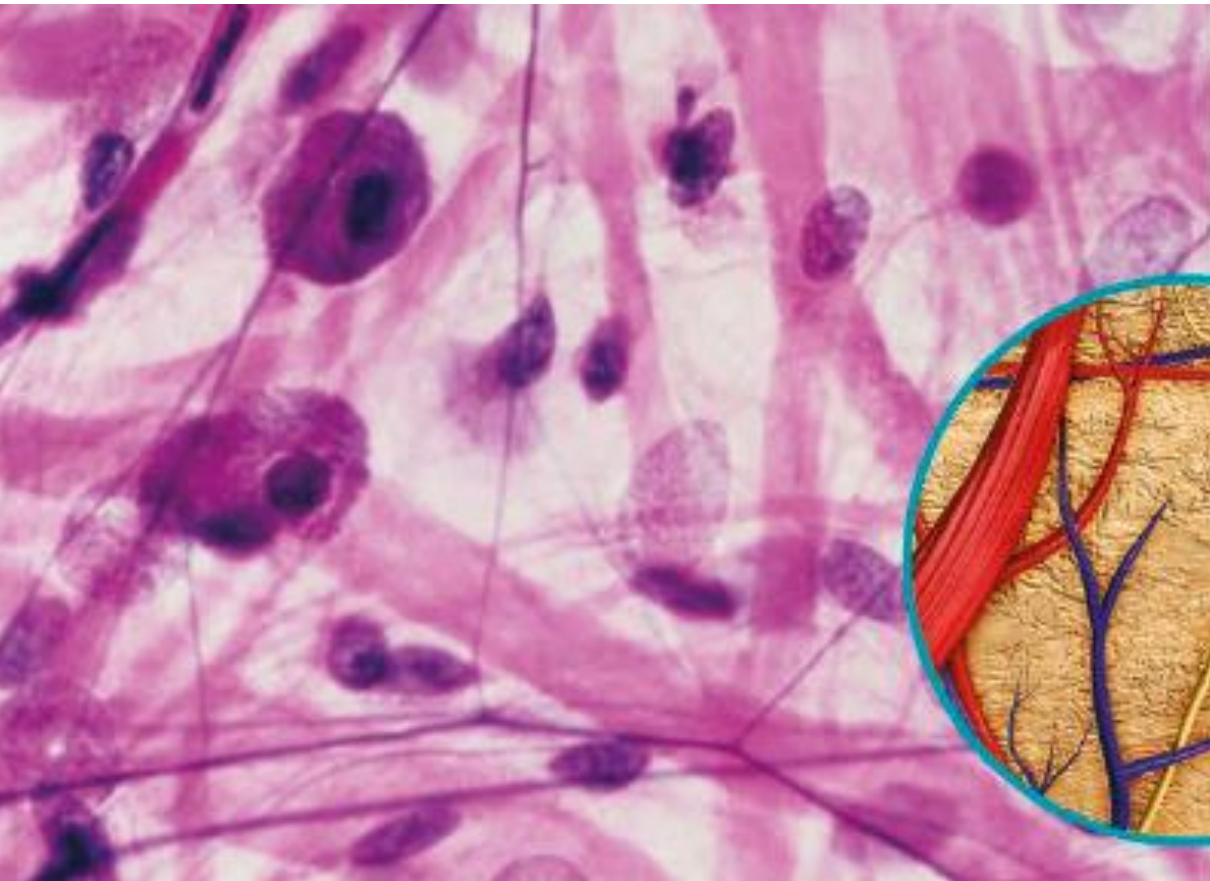
MUSCLE FIBERS



Spongy bone

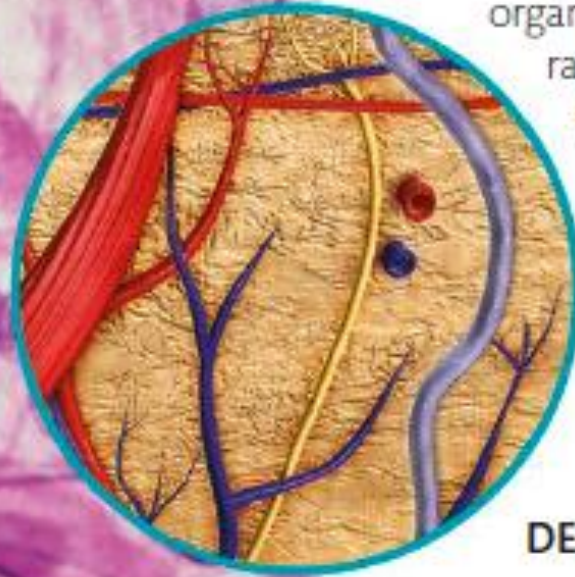
Bone cells secrete a hard material that makes bones strong and brittle. Spongy bone is found in the center of bones, and is softer and weaker than the compact bone. The latticelike spaces in spongy bone are filled with bone marrow or connective tissue.

END OF THE FEMUR

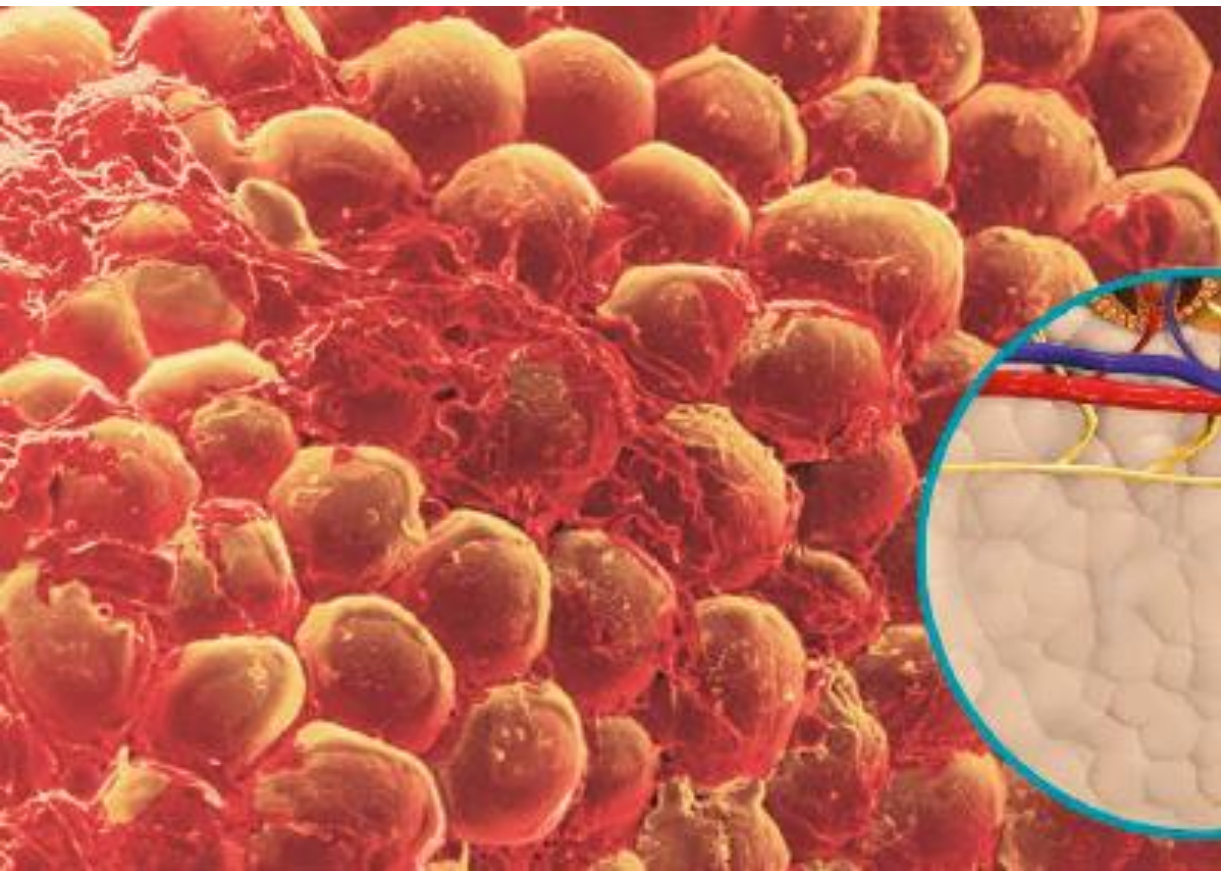


Loose connective tissue

This type of tissue also contains cells called fibroblasts, but the fibers they secrete are loosely organized and run in random directions, making the tissue quite pliable. Loose connective tissue holds organs in place, and provides cushioning and support.

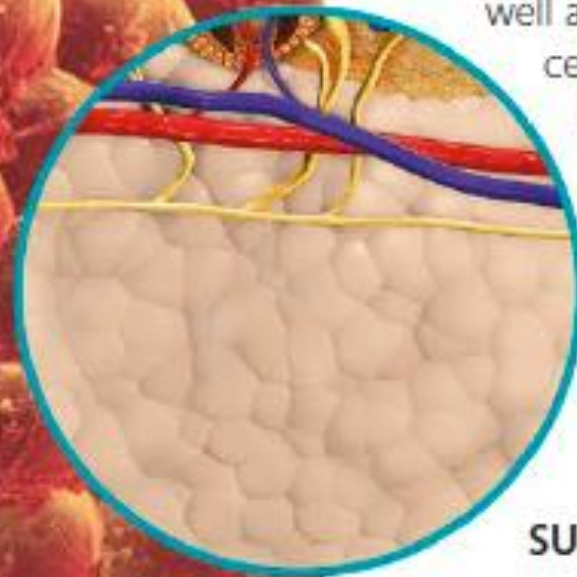


DERMAL TISSUE

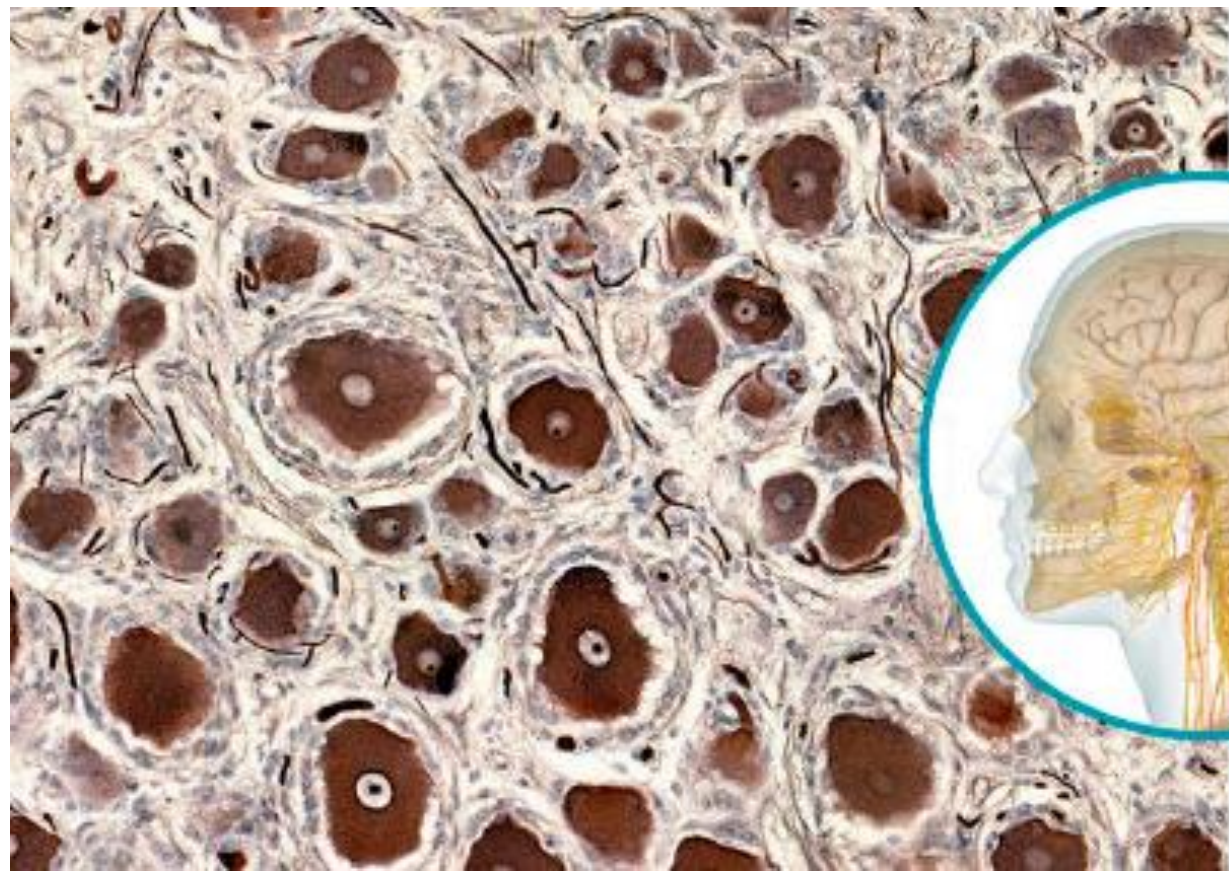


Adipose tissue

A type of connective tissue, adipose tissue is composed of fat cells called adipocytes, as well as some fibroblast cells, immune cells, and blood vessels. Its main function is to act as an energy store, and to cushion, protect, and insulate the body.



SUBCUTANEOUS FAT



Nerve tissue

This forms the brain, spinal cord, and the nerves that control movement, transmit sensation, and regulate many body functions. It is mainly made up of networks of nerve cells (see opposite).

UPPER SPINAL CORD

AND NOW FOR SOME CELL HUMOR !!

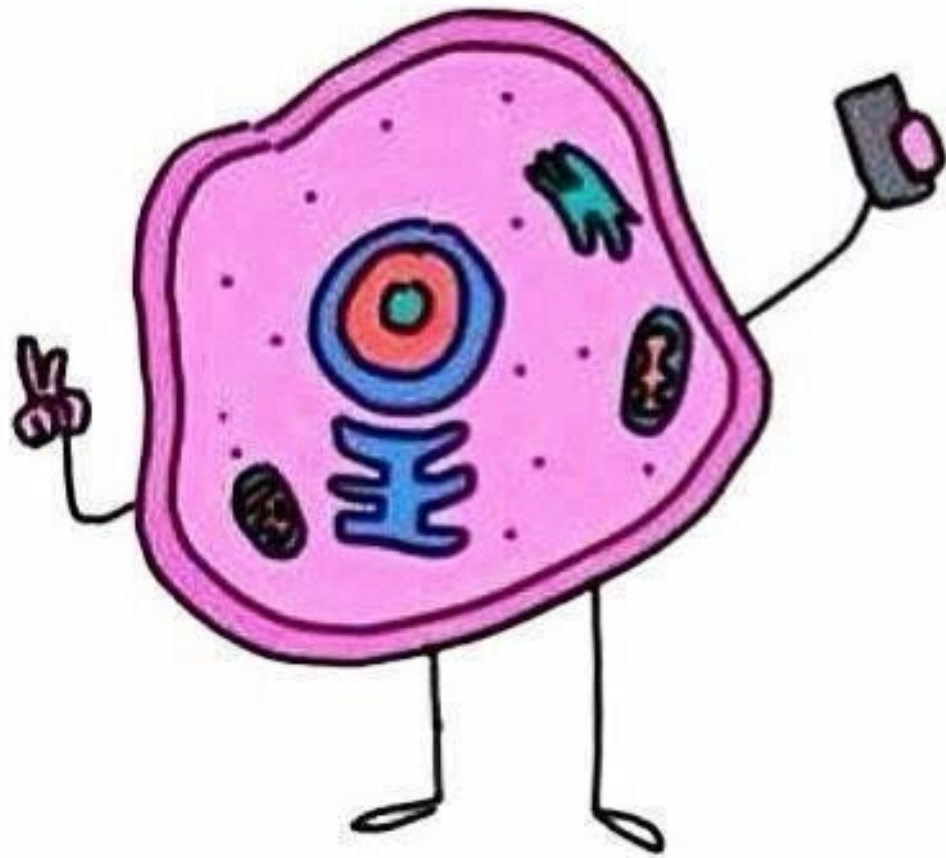
In the average adult, there are 37 trillion human cells and 49 trillion microbes.

At best, you are a little more than 43% you !!

**We're all just
petri dishes
with shoes.**

-ANYLETTER



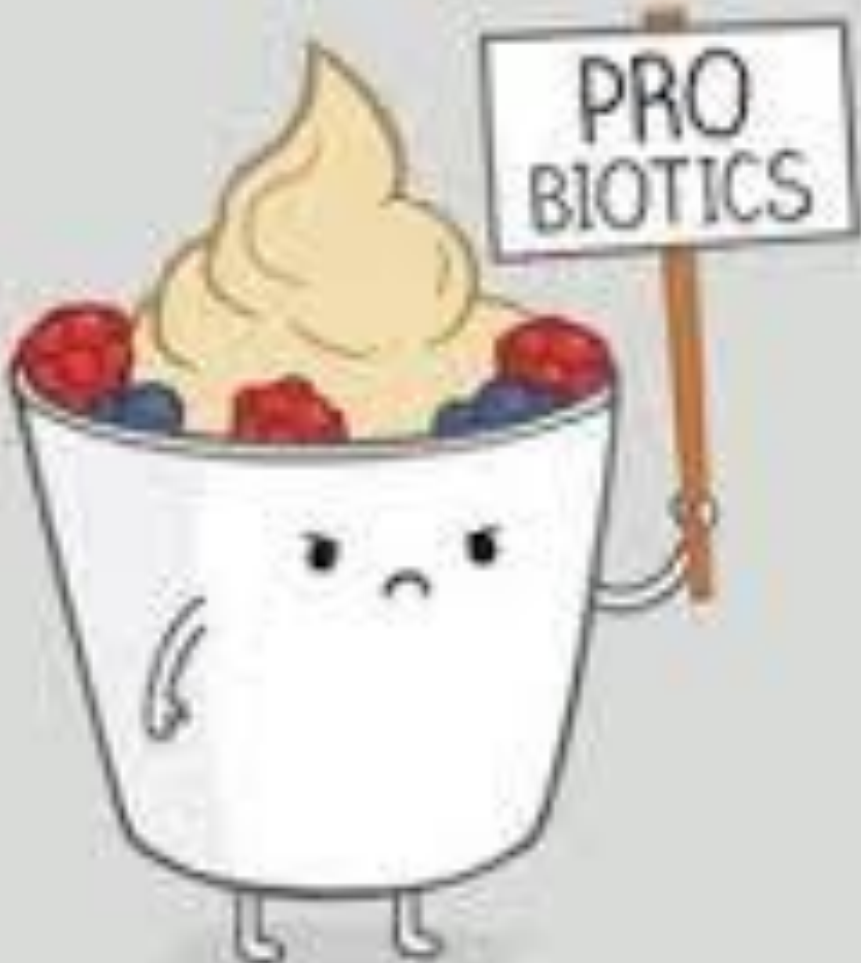


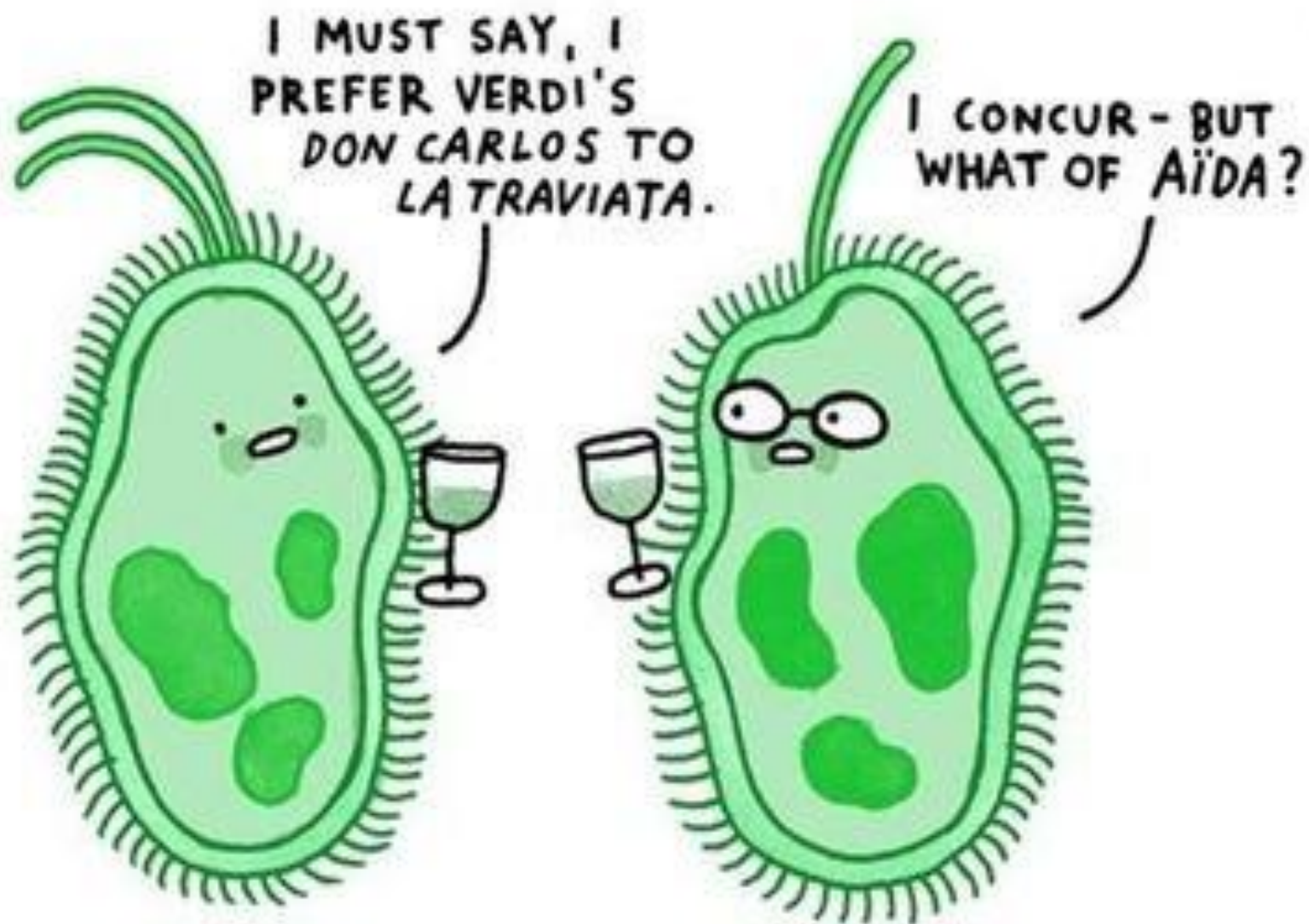
Cell-fie

ARE YOU HAPPY WITH
YOUR CURRENT CELL
PROVIDER?

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2-10 WHAMND





CULTURED BACTERIA

Support bacteria.

It's the only
culture some people have.



HEY, BUG ON MY BACK,
ARE YOU A MITE?

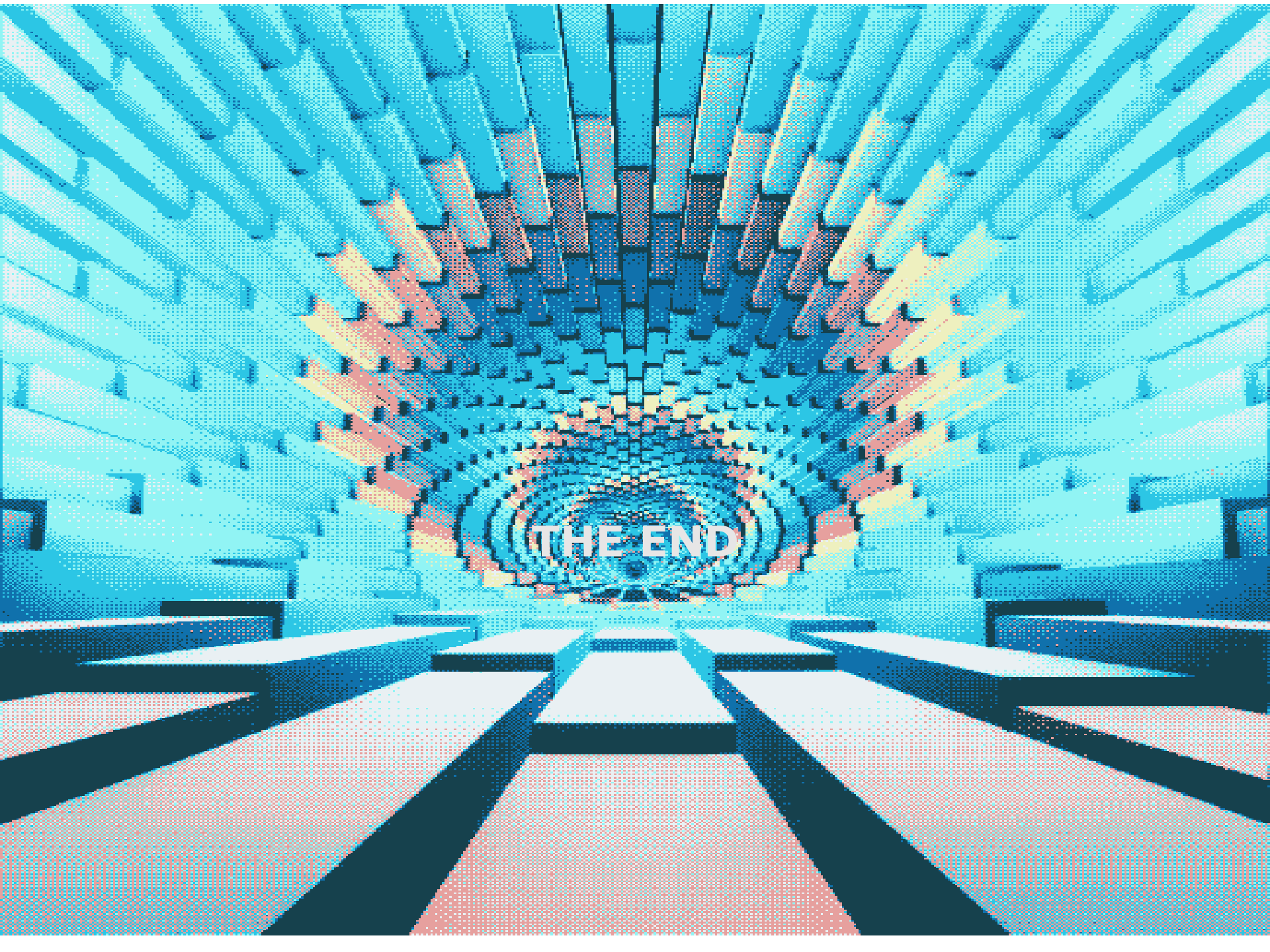
I MITE BE.



STUPIDEST PUN I EVER HEARD.

WHAT DO YOU EXPECT?
I JUST MADE IT UP
ON THE FLY.





THE END