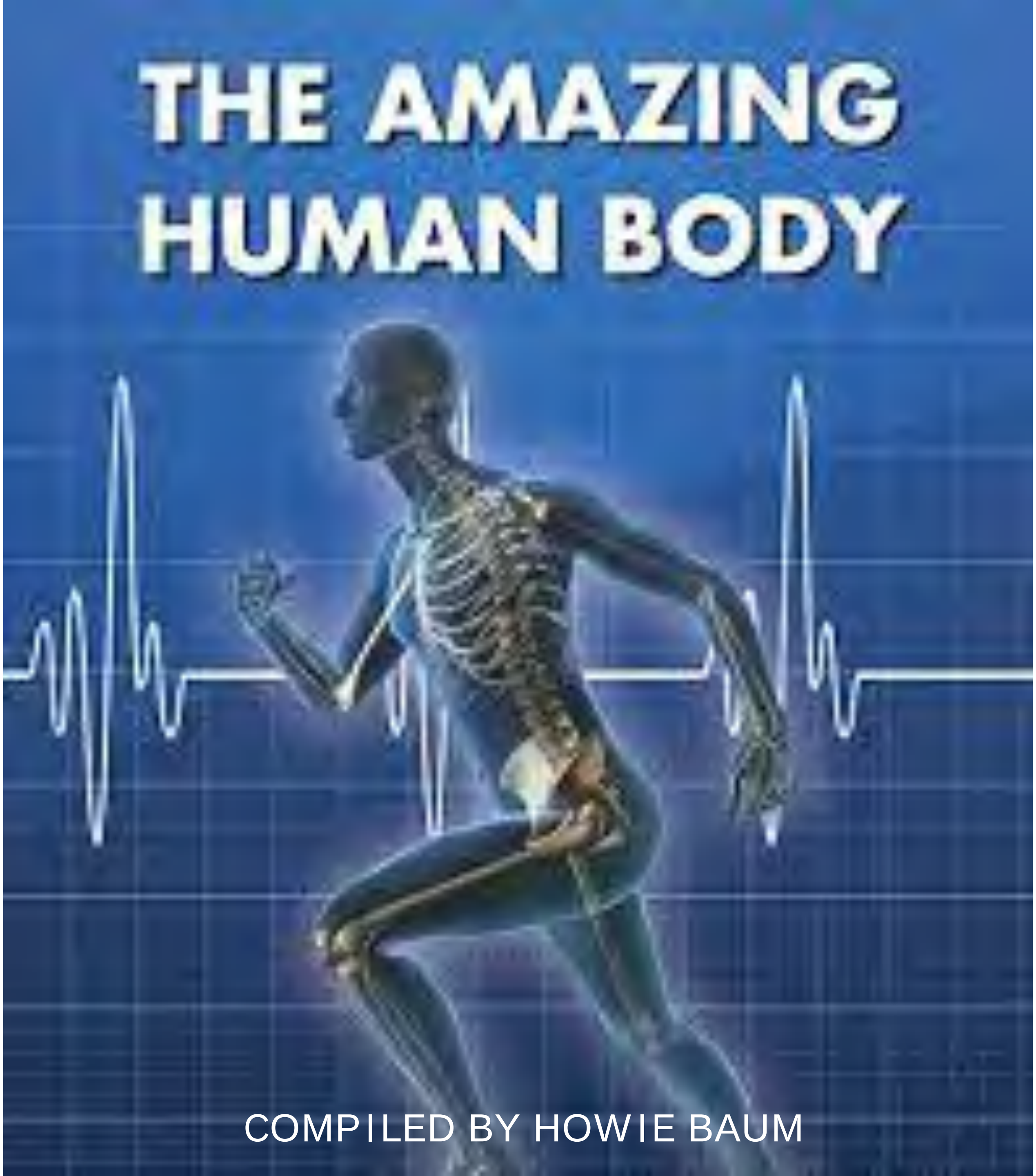

THE AMAZING
HUMAN BODY
COMPILED BY HOWIE BAUM

OUTLINE AND SCHEDULE - **"YOUR AMAZING HUMAN BODY"**

MODERATOR: Howie Baum

WEEK 1

A. Introduction to the class

B. Anatomy and Physiology

C. Levels of organization of the Human Body

D. Characteristics and Maintenance of Life

E. Homeostasis and Feedback

F. Body Cavities, Membranes, and the 11 Body / Organ Systems

G. Diagnostic Imaging techniques and the different types of microscopes and devices for studying the body

WEEK 2

- Introductory Chemistry about the atoms and molecules in the body

- The importance of Minerals, Vitamins, and Trace mineral elements for the body

WEEK 3

- Cells and Tissues

- Circulatory System

WEEK 4

- Endocrine System

- Digestive System

WEEK 5

- Immune System

- Muscular System

WEEK 6

- Nervous System
- Integumentary System

WEEK 7

- Urinary System
- Respiratory System

WEEK 8

- Skeletal System/ Joints
- Reproductive Systems – Female and Male

AN INTRODUCTION TO THE HUMAN BODY

- The number of humans in the world now is 7.53 billion (7, 530,000,000) !!
- More than 250 babies are born every minute, while 150,000 people die daily, with the population increasing by almost three humans per second.
- Each of us lives, thinks, worries, and daydreams with, and within, that most complex and marvelous of possessions – a human body !!
- The body is a series of 11 integrated systems. Each system carries out one major role or task.
- The systems are, in turn, composed of main parts known as organs, the organs consist of tissues, and tissues are made up of cells.

Anatomy and Physiology

A) <u>Anatomy</u> deals with the structure of the body and its parts; in other words, the names of the parts.

Pictures of the inside of the body are often shown in isolation, using techniques such as cutaways, cross-sections, and “exploded” views, which provide clarity and understanding.

But in reality, the inside of the body is a crowded place. Tissues and organs push and press against one another. There is no free space, and no stillness either. Body parts shift continually in relation to each other, as we move about, breathe, sleep, and eat.

B) <u>Physiology</u> studies the functions of these parts or asks the question, “how do they work?”

The two disciplines are closely interrelated because the functional role of a part depends on how it is made.

Levels of Organization of the Body

The human body is the sum of its parts and these parts can be studied at a variety of levels of organization.

1. Chemicals:

   a. Atoms are the simplest level.

   b. Two or more atoms comprise a molecule.

   c. Macromolecules are large, biologically important molecules inside cells.

2. Organelles are groups of macro-molecules used to carry out a specific function in the cell.

Levels of organization of the Body

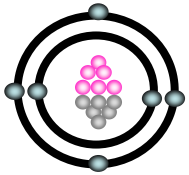
3. Cells are the basic units of structure and function for living things.

4. Tissues are groups of cells functioning together.

5. Groups of tissues form organs that have specialized functions.

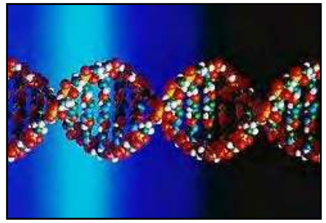
6. Groups of organs function together as an organ system.

7. The 11 Body (Organ) systems functioning together, to make up an organism.

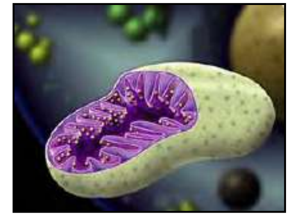


Carbon atom

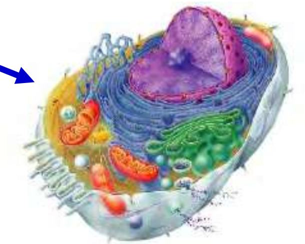
Chemical



DNA molecule

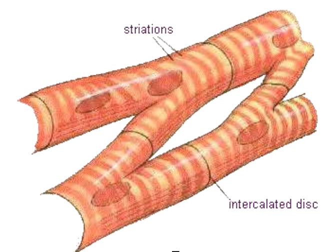


organelle

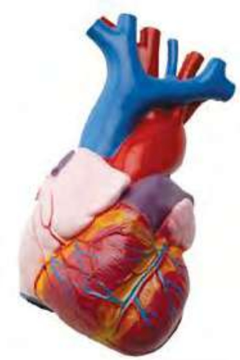


cell

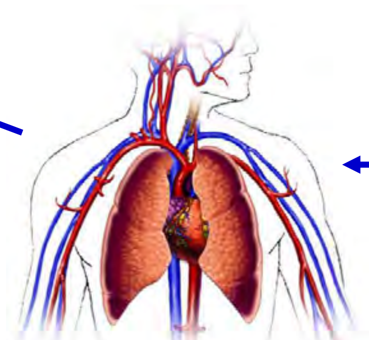
LEVELS OF ORGANIZATION OF THE BODY



tissue



organ



organ system

organism

CHARACTERISTICS OF LIFE

Fundamental characteristics of life are traits shared by all organisms.

1. Movement – change in position of the body or a body part; motion of an internal organ
2. Responsiveness – reaction to internal or external change
3. Growth – increase in size without change in shape
4. Reproduction – new organisms or new cells
5. Respiration – use of oxygen; removal of Carbon Dioxide
6. Digestion – breakdown of food into simpler forms

7. Absorption – movement of substances through membranes and into fluids

8. Circulation – movement within body fluids

9. Assimilation – changing nutrients into chemically different forms

10. Excretion – removal of metabolic wastes

Taken together, these 10 characteristics constitute our metabolism – the physical and chemical events that obtain, release, and use energy.

What Are the Main Characteristics of organisms?

1. Made of CELLS

2. Require ENERGY (food)

3. REPRODUCE (species)

4. Maintain HOMEOSTASIS (keeping the body systems in balance)

5. ORGANIZED

6. RESPOND to environment

7. GROW and DEVELOP

8. EXCHANGE materials with their surroundings (water, wastes, gases)

MAINTENANCE OF LIFE

Life depends on the availability of the following:

A) WATER

1) The most abundant chemical in the body

2) Required for many metabolic processes

3) Transportation of cells and body materials

4) Regulates body temperature

5) Makes up intracellular and extracellular fluid compartments

What Does Water do for You?

1. Maintenance of life - (Continued)

B) FOOD

1) Provides the body with needed nutrients

2) Needed for energy, raw building materials for growth and repair, and to regulate chemical reactions

b. Oxygen – releases energy from food

c. Heat – product of metabolic reactions and muscle movement that controls and maintains the body temperature

1. Maintenance of life - (continued)

C) PRESSURE

1) Force applied to something

2) Atmospheric pressure is needed for breathing

3) Hydrostatic (water) pressure is needed to move blood through blood vessels – our blood pressure

2. Both the quality and quantity of these factors are important

HOMEOSTASIS

All organisms must maintain a constant internal environment to function properly

- Temperature
- pH (acidic or basic)
- Salinity (salt level)
- Fluid levels

HOMEOSTASIS

1. Maintenance of a stable internal environment of the body is called homeostasis.

2. Homeostasis is regulated through control systems which have receptors (sensors), a set point, and effectors in common.

   a. Receptors are of many types whose job is to monitor for changes

   b. The set point is the normal value or range of values

   c. Effectors are muscles or glands that respond to the changes to return to stability

3. Examples include:

   a. Homeostatic mechanisms regulate body temperature in a manner similar to the functioning of a home heating/cooling thermostat.

   b. Another homeostatic mechanism employs pressure-sensitive receptors to regulate blood pressure

4. Each individual uses homeostatic mechanisms to keep body levels within a normal range; normal ranges can vary from one individual to the next.

5. Many of the body's homeostatic controls are <u>negative feedback</u> mechanisms.

   a. Responses move in the opposite direction from the change

   b. Reduces the amount of change from the set point

   c. Includes most control mechanisms in the body

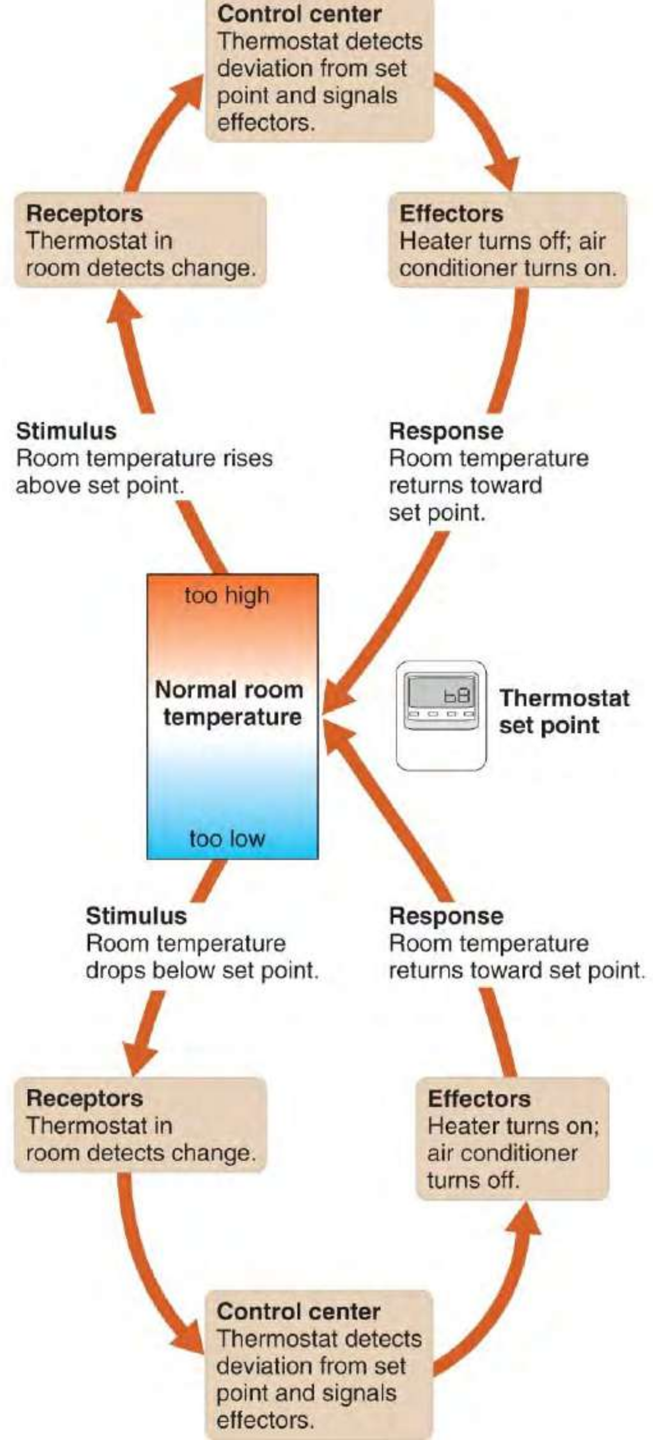
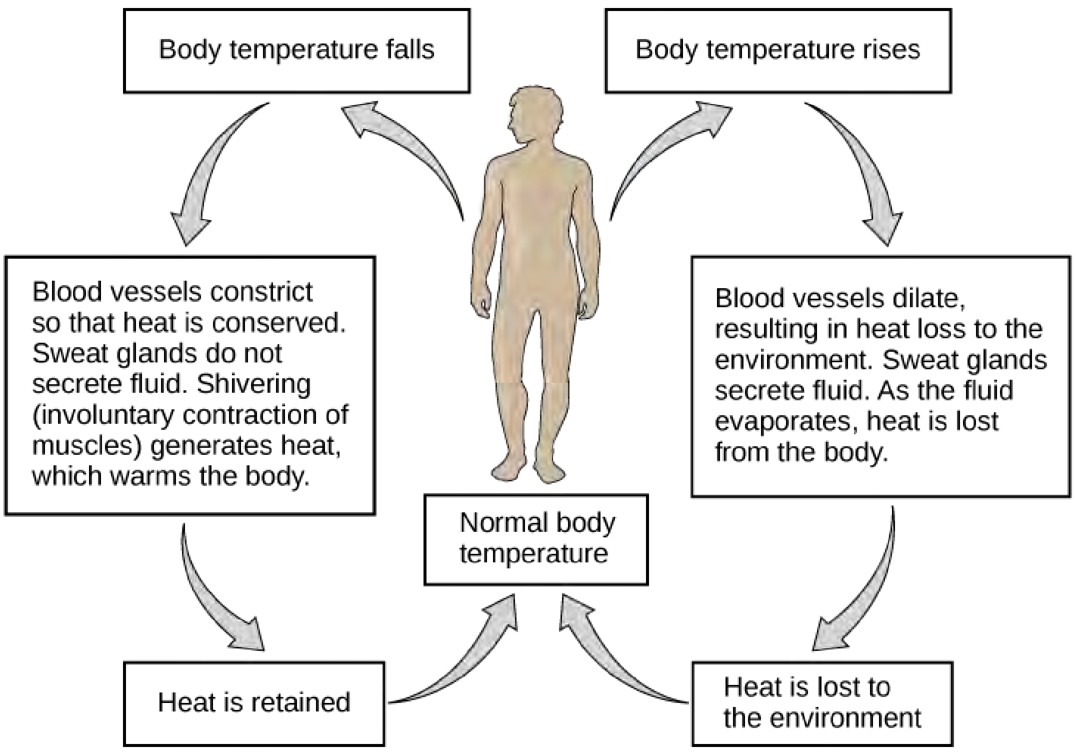
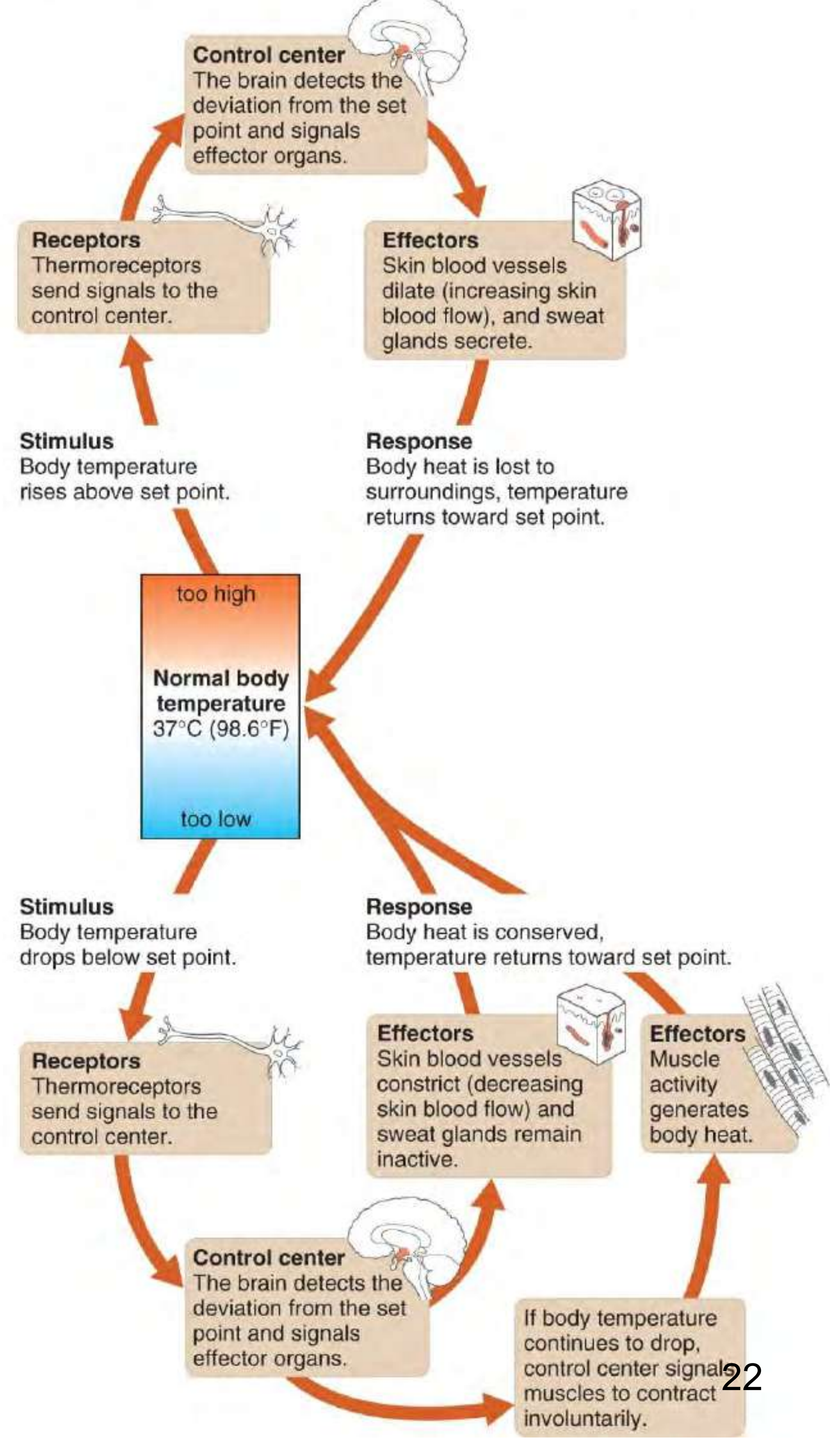

Control center
Thermostat detects deviation from set point and signals effectors.
Receptors
Thermostat in room detects change.
Effectors
Heater turns off; air conditioner turns on.
Stimulus
Room temperature rises above set point.
Response
Room temperature returns toward set point.
too high
Normal room temperature
too low
Thermostat set point
Stimulus
Room temperature drops below set point.
Response
Room temperature returns toward set point.
Receptors
Thermostat in room detects change.
Effectors
Heater turns on; air conditioner turns off.
Control center
Thermostat detects deviation from set point and signals effectors.

Fig 1.6


Body temperature falls
Body temperature rises
Blood vessels constrict so that heat is conserved. Sweat glands do not secrete fluid. Shivering (involuntary contraction of muscles) generates heat, which warms the body.
Blood vessels dilate, resulting in heat loss to the environment. Sweat glands secrete fluid. As the fluid evaporates, heat is lost from the body.
Normal body temperature
Heat is retained
Heat is lost to the environment


Control center
The brain detects the deviation from the set point and signals effector organs.
Receptors
Thermoreceptors send signals to the control center.
Effectors
Skin blood vessels dilate (increasing skin blood flow), and sweat glands secrete.
Stimulus
Body temperature rises above set point.
Response
Body heat is lost to surroundings, temperature returns toward set point.
too high
Normal body temperature
37°C (98.6°F)
too low
Stimulus
Body temperature drops below set point.
Response
Body heat is conserved, temperature returns toward set point.
Receptors
Thermoreceptors send signals to the control center.
Effectors
Skin blood vessels constrict (decreasing skin blood flow) and sweat glands remain inactive.
Effectors
Muscle activity generates body heat.
Control center
The brain detects the deviation from the set point and signals effector organs.
If body temperature continues to drop, control center signals muscles to contract involuntarily.

6. Positive feedback mechanisms

a. Response moves further from the set point

b. Change from set point gets larger

c. Many positive feedback mechanisms produce unstable conditions in the body which eventually go back to normal.

d. Examples associated with normal health

1) Blood clotting

2) Birth

Table 1–1 The Roles of Organ Systems in Homeostatic Regulation

Internal Stimulus	Primary Organ Systems Involved	Functions of the Organ Systems
Body temperature	Integumentary system	Heat loss
	Muscular system	Heat production
	Cardiovascular system	Heat distribution
	Nervous system	Coordination of blood flow, heat production, and heat loss
Body fluid composition		
Nutrient concentration	Digestive system	Nutrient absorption, storage, and release
	Cardiovascular system	Nutrient distribution
	Urinary system	Control of nutrient loss in the urine
	Skeletal system	Mineral storage and release
Oxygen, carbon dioxide levels	Respiratory system	Absorption of oxygen, elimination of carbon dioxide
	Cardiovascular system	Internal transport of oxygen and carbon dioxide
Levels of toxins and pathogens	Lymphatic system	Removal, destruction, or inactivation of toxins and pathogens
Body fluid volume	Urinary system	Elimination or conservation of water from the blood
	Digestive system	Absorption of water; loss of water in feces
	Integumentary system	Loss of water through perspiration
	Cardiovascular system and lymphatic system	Distribution of water throughout body tissues
Waste concentration	Urinary system	Excretion of wastes from the blood
	Digestive system	Elimination of wastes from the liver in feces
	Cardiovascular system	Transport of wastes products to sites of excretion
Blood pressure	Cardiovascular system	Pressure generated by the heart moves blood through blood vessels
	Nervous system and endocrine system	Adjustments in heart rate and blood vessel diameter can raise or lower blood pressure

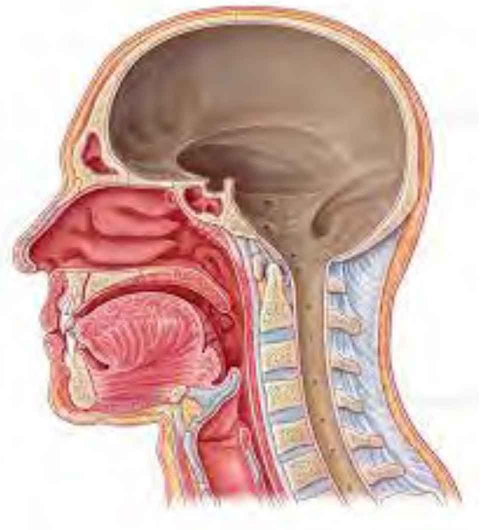
ORGANIZATION OF THE BODY – BODY CAVITIES

1. Body Cavities - A body cavity is a space created in an organism which houses organs.

2. It is lined with a layer of cells and is filled with fluid, to protect the organs from damage as the organism moves around.

3. Body cavities form during development, as solid masses of tissue fold inward on themselves, creating pockets in which the organs develop.

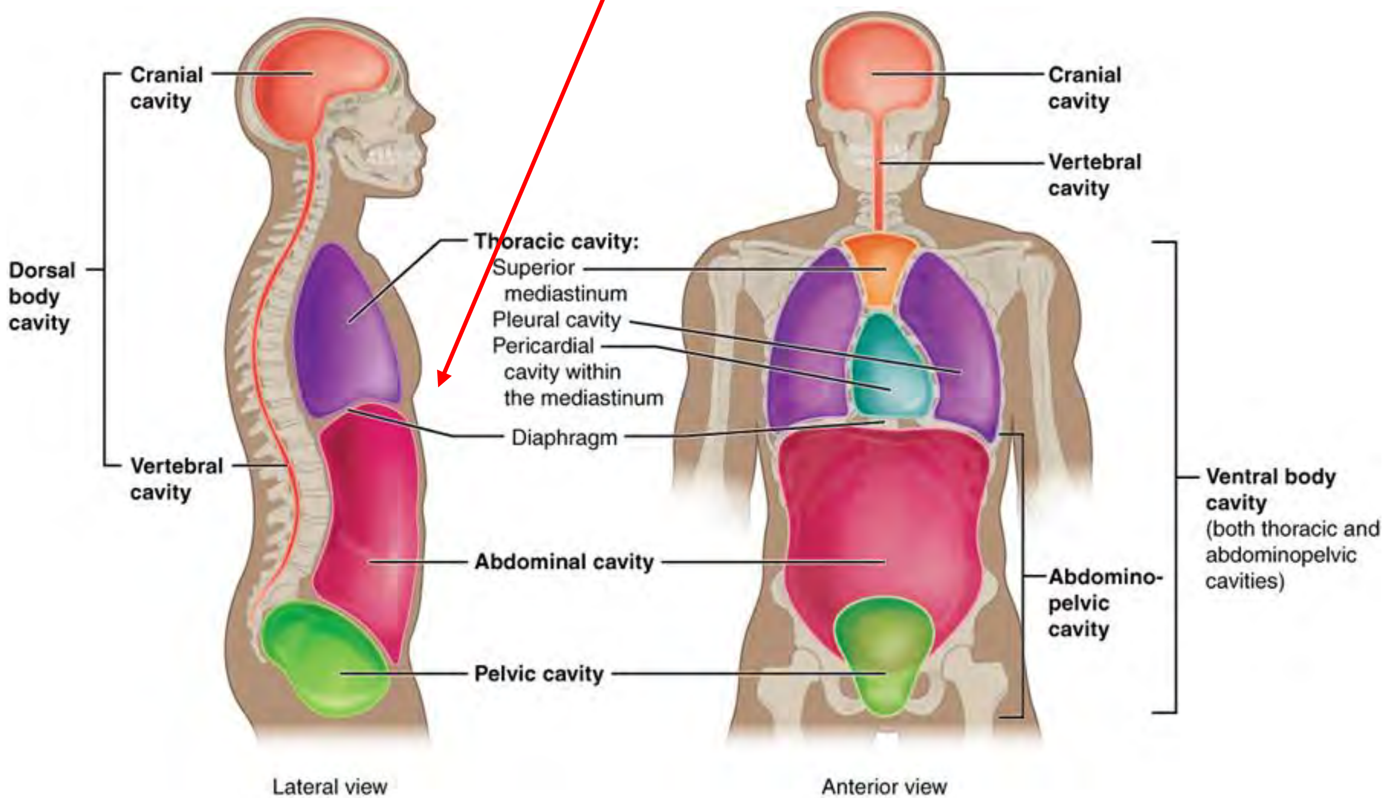
4. An example of a body cavity in humans would be the cranial cavity, which houses the brain.



THE HUMAN BODY HAS TWO MAIN BODY CAVITIES

The first, the *ventral cavity*, is a large cavity which sits ventrally to the spine and includes all the organs from your pelvis to your throat.

The first subdivision is the *diaphragm* muscle, which divides the *abdomino-pelvic cavity* from the *thoracic cavity*. This can be seen in the image below.

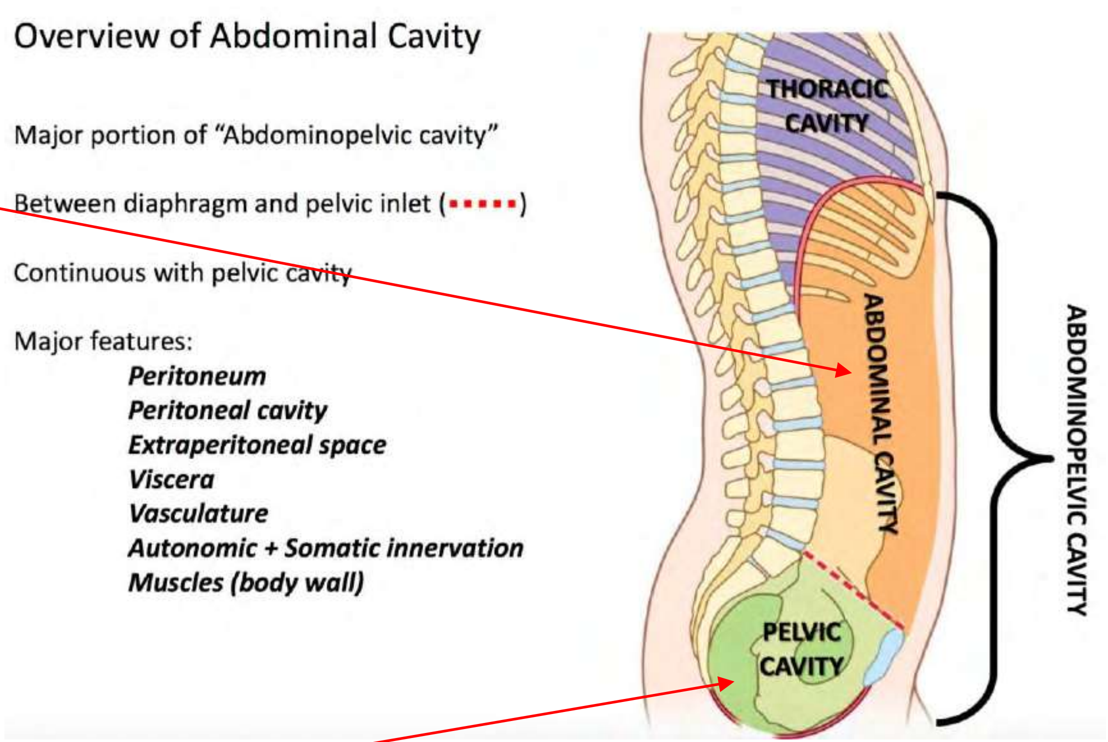


The abdomino-pelvic cavity is then further subdivided into the pelvic cavity and the abdominal cavity.

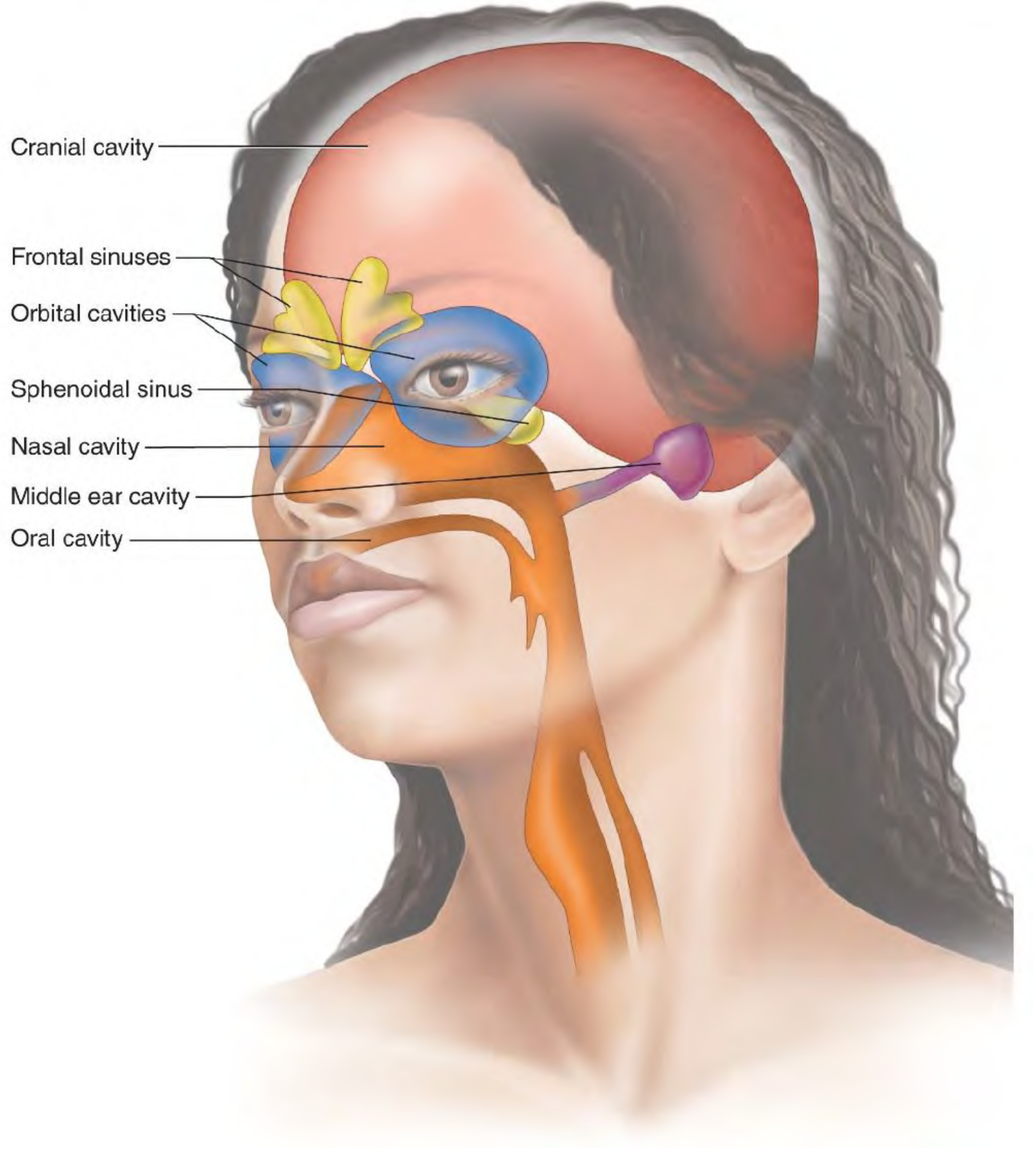
The abdominal cavity is where the majority of the body's organs lie. These are sometimes referred to as the "viscera", and they include organs like the liver, stomach, spleen, pancreas, kidneys and others involved in digestion, metabolism, and filtering of the blood.

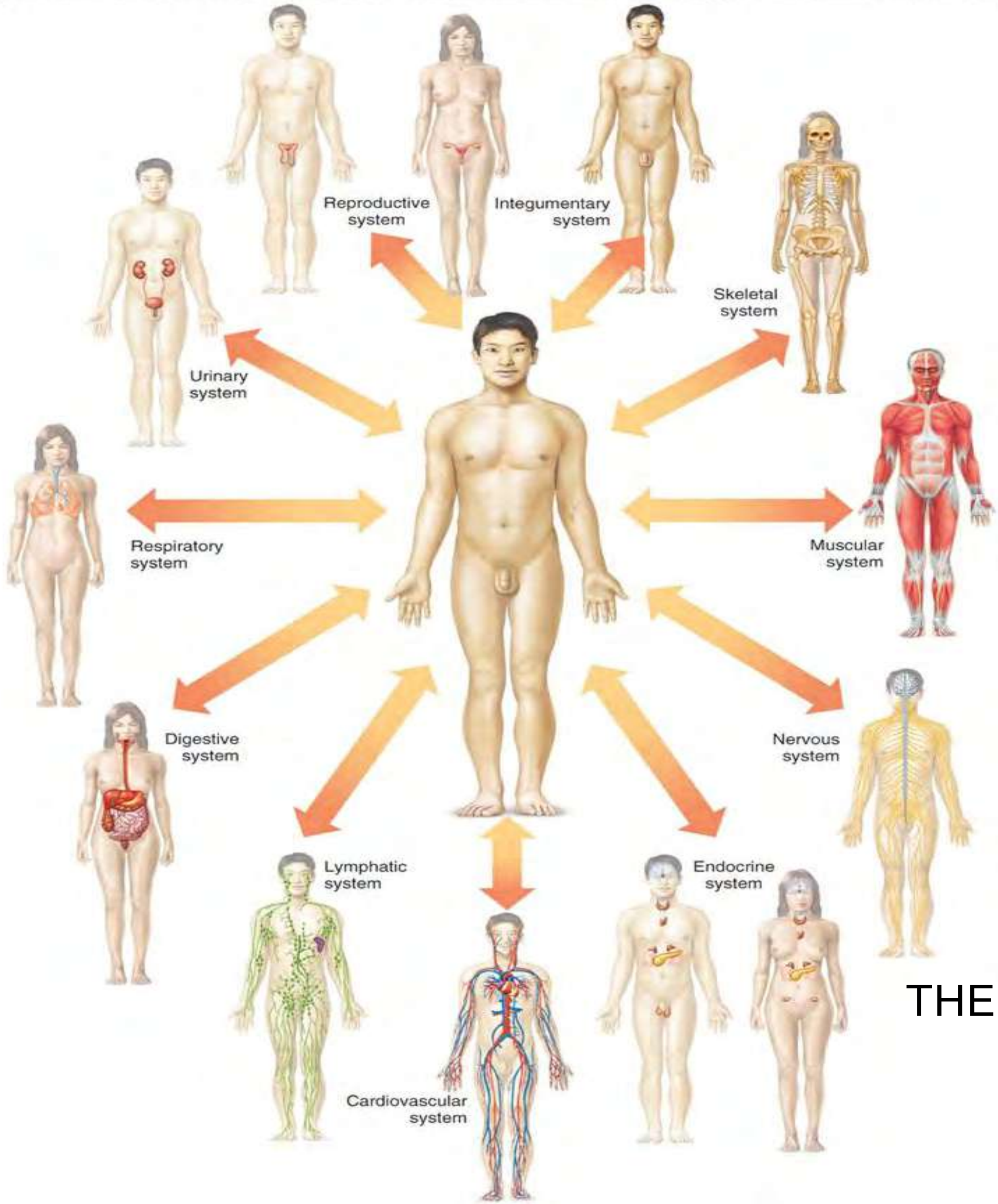
The pelvic cavity holds the reproductive organs, bladder, and allows the intestines passage to the anus

A special membrane holds all of these organs in place and is called the peritoneum.



Smaller cavities within the head include the oral cavity, nasal cavity, orbital cavities (eye sockets) , and middle ear cavities





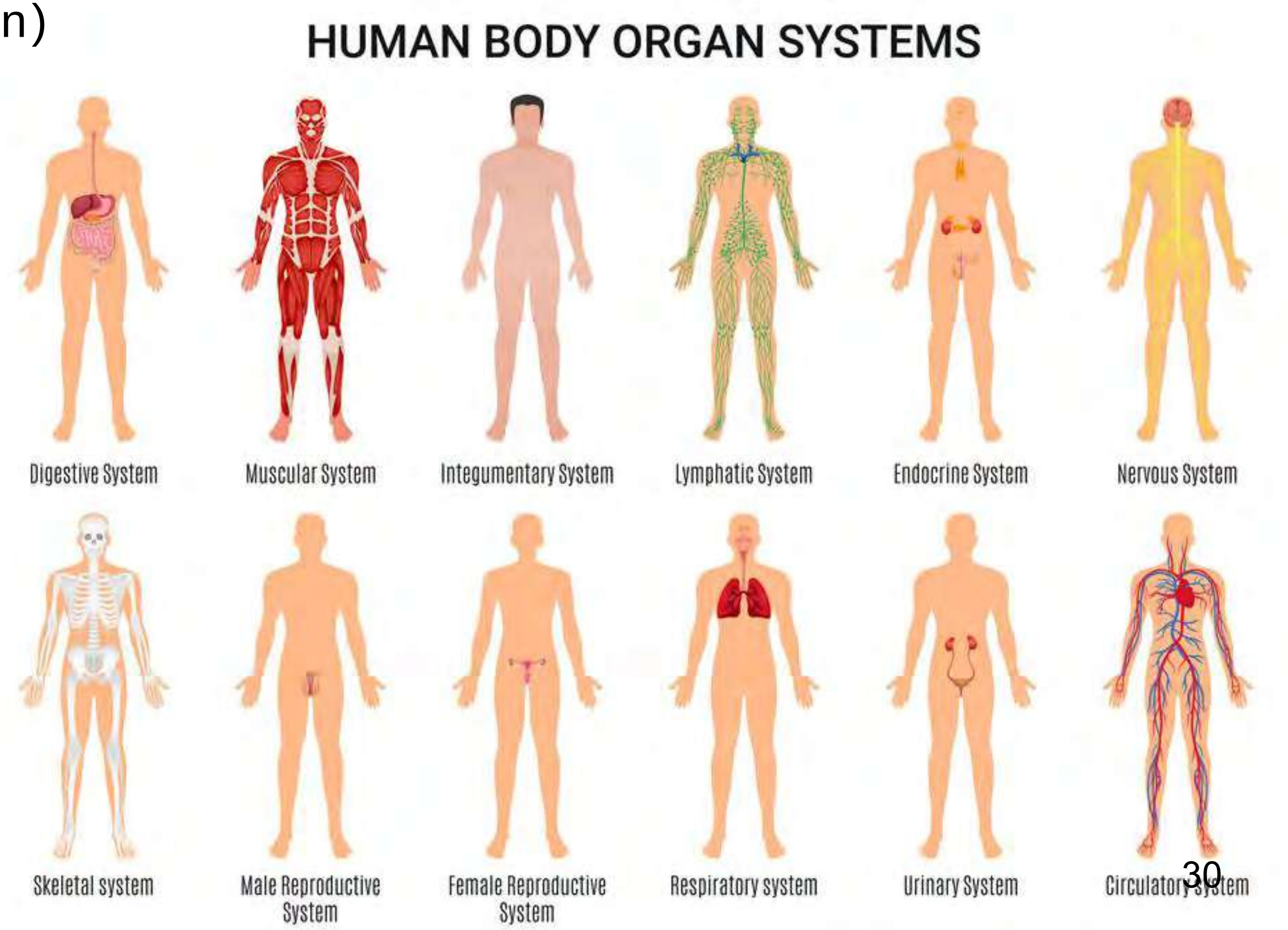
THE 11 BODY (ORGAN) SYSTEMS

When groups of tissues work together, they are called organs. Some examples of organs are the heart, lungs, skin, and stomach.

When organs work together, they are called systems and each one depends, directly or indirectly, on all of the others..

The 11 organ systems of the body are:

- ❖ Integumentary (skin)
- ❖ Muscular
- ❖ Skeletal
- ❖ Nervous
- ❖ Circulatory
- ❖ Lymphatic,
- ❖ Respiratory
- ❖ Endocrine
- ❖ Urinary/Excretory
- ❖ Reproductive
- ❖ Digestive.



All of your body systems have to work together to keep you healthy. If any system in your body isn't working properly, other systems are affected

- ❖ Your bones and muscles work together to support and move your body.

- ❖ Your respiratory system takes in oxygen from the air and gets rid of carbon dioxide.

- ❖ Your digestive system absorbs water and nutrients from the food you eat.

- ❖ Your circulatory system carries oxygen, water, and nutrients to cells throughout your body.

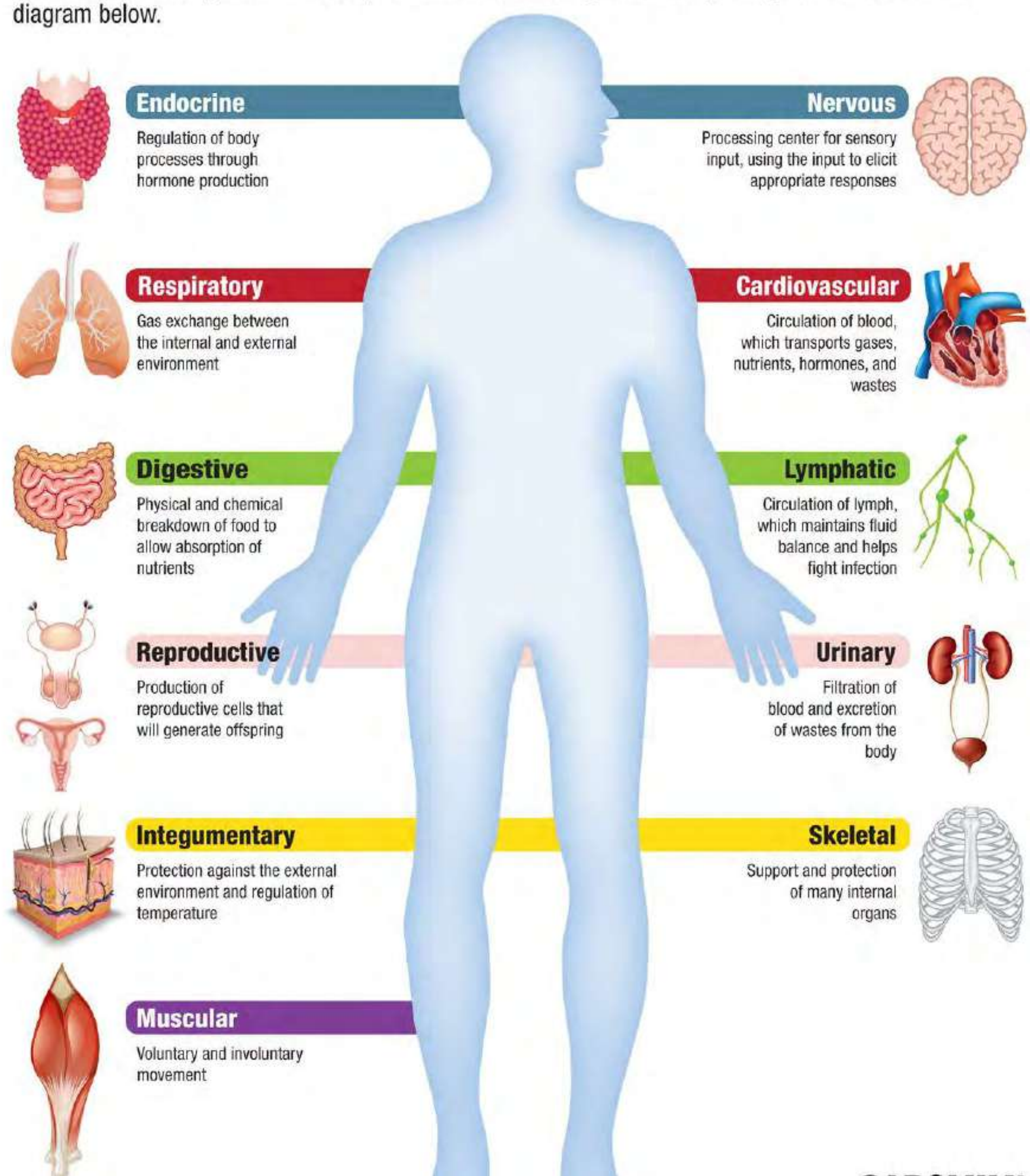
- ❖ Wastes from the cells are eliminated by your respiratory system, excretory system, and skin.

- ❖ Your nervous system controls all these activities with electrical impulses..

System	Major structures	Functions
Circulatory	Heart, blood vessels, blood (cardiovascular) lymph nodes and vessels, lymph (lymphatic)	Transports nutrients, wastes, hormones, and gases
Digestive	Mouth, throat, esophagus, stomach, liver, pancreas, small and large intestines 	Extracts and absorbs nutrients from food; removes wastes; maintains water and chemical balances
Endocrine	Hypothalamus, pituitary, pancreas and many other endocrine glands	Regulates body temperature, metabolism, development, and reproduction; maintains homeostasis; regulates other organ systems
Excretory	Kidneys, urinary bladder, ureters, urethra, skin, lungs	Removes wastes from blood; regulates concentration of body fluids
Immune	White blood cells, lymph nodes and vessels, skin	Defends against pathogens and disease
Integumentary	Skin, nails, hair	Protects against injury, infection, and fluid loss; helps regulate body temperature
Muscular	Skeletal, smooth, and cardiac muscle tissues	Moves limbs and trunk; moves substances through body; provides structure and support
Nervous	Brain, spinal cord, nerves, sense organs 	Regulates behavior; maintains homeostasis; regulates other organ systems; controls sensory and motor functions
Reproductive	Testes, penis (in males); ovaries, uterus, breasts (in females)	Produces gametes and offspring
Respiratory	Lungs, nose, mouth, trachea	Moves air into and out of lungs; controls gas exchange between blood and lungs
Skeletal	Bones and joints 	Protects and supports the body and organs; interacts with skeletal muscles, produces red blood cells, white blood cells, and platelets

Human Body Systems

There are 11 main systems that keep our bodies functioning. Learn the primary roles of each in the diagram below.



1) INTEGUMENTARY SYSTEM (SKIN)

Forms the external body covering and protects deeper tissues from injury.

Synthesizes vitamin D, and contains cutaneous (pain, pressure, etc.) receptors and sweat and oil glands.

2. Support and Movement

(2 Parts)

A) The <u>skeletal system</u> is made up of bones and ligaments.

It supports, protects, provides frameworks, stores inorganic salts, and houses blood-forming tissues.

B) The muscular system consists of the muscles that provide body movement, posture, and body heat.

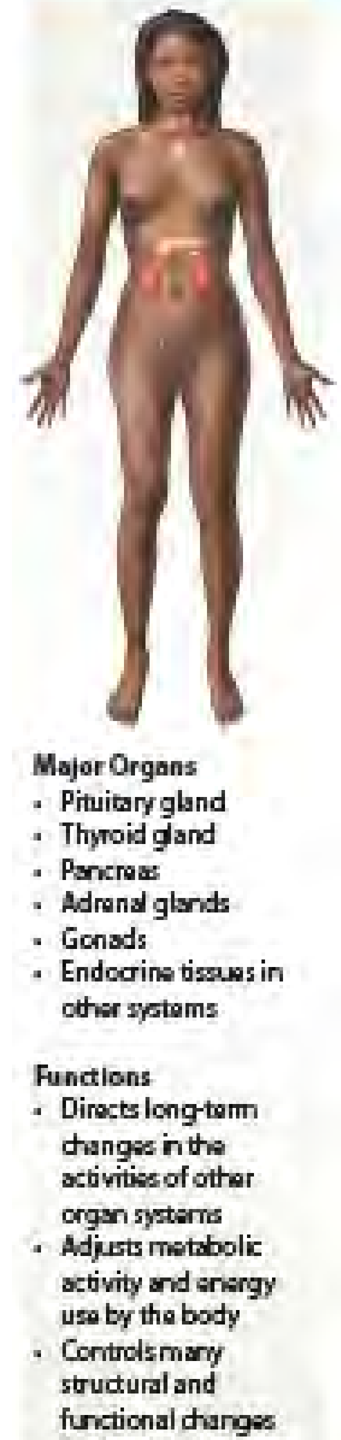
3. Integration and Coordination (2 parts)

A) The <u>nervous system</u> consists of the brain, spinal cord, nerves, and sense organs.

It integrates incoming information from receptors and sends impulses to muscles and glands.

B) The endocrine system, includes the hypothalamus, pituitary, thyroid, parathyroid, pineal, and thymus glands, pancreas, ovaries, and testes, along with other organs that secrete hormones.

It helps to integrate metabolic functions.



4. Transport (2 parts)

A) The cardiovascular system, is made up of the heart and blood vessels.

It distributes oxygen, nutrients, and hormones throughout the body while removing wastes from the cells.

B) The lymphatic system, consists of lymphatic vessels, lymph nodes, thymus, and spleen.

It drains excess tissue fluid and includes cells of immunity.

5. Absorption and Excretion
(3 parts)

A) The digestive system is made up of the mouth, esophagus, stomach, intestines, and accessory organs.

It receives, breaks down, and absorbs nutrients.

B) The Respiratory system exchanges Oxygen and Carbon Dioxide between the blood and air and is made up of the lungs and passageways.

C) The Urinary system, consists of the kidneys, ureters, bladder, and urethra.

It removes wastes from the blood and helps to maintain water and electrolyte balance.

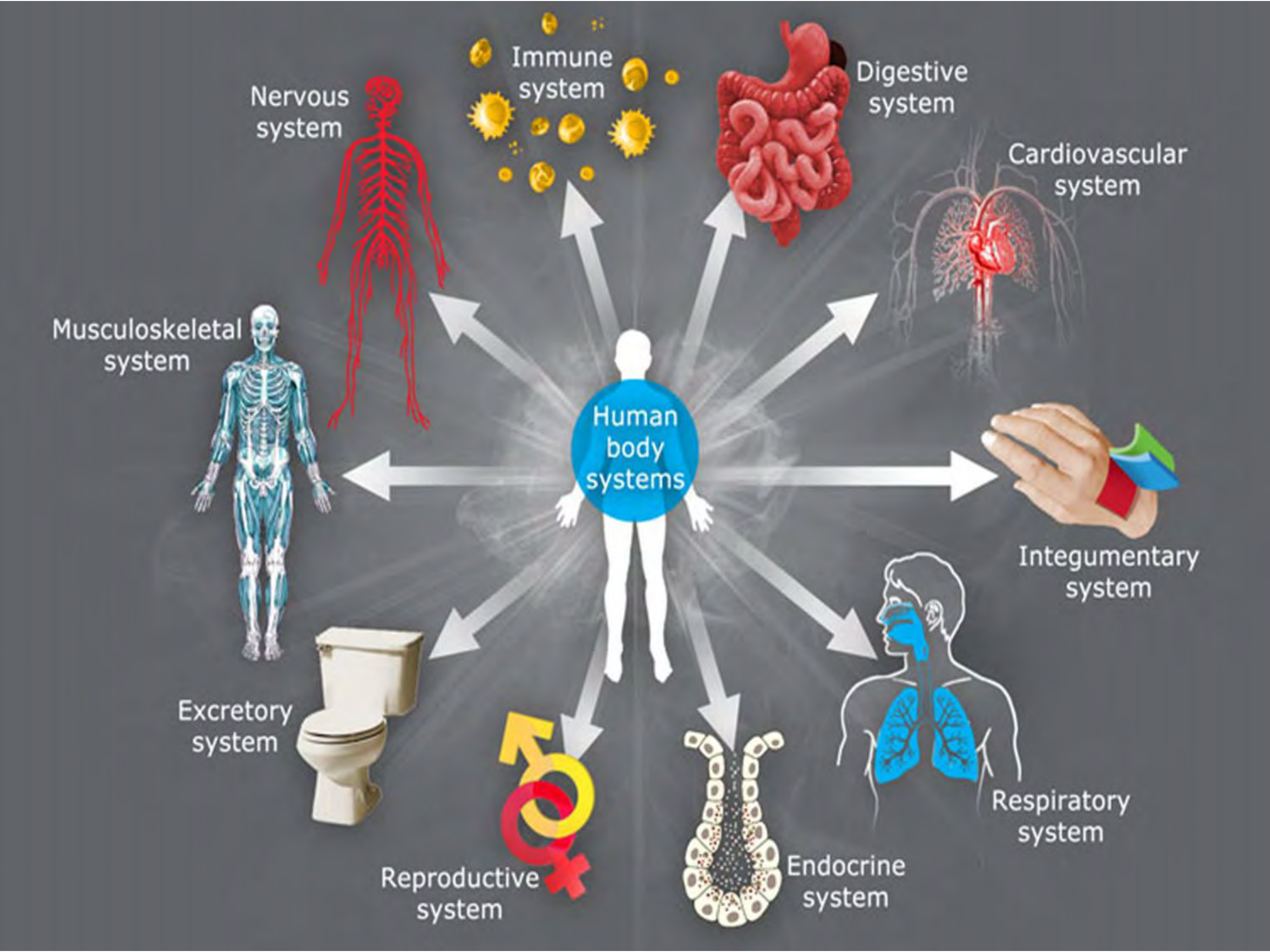
6) The Reproductive system produces new organisms.

A) The male reproductive system consists of the testes, penis, accessory organs, and vessels that produce and conduct sperm to the female reproductive tract.

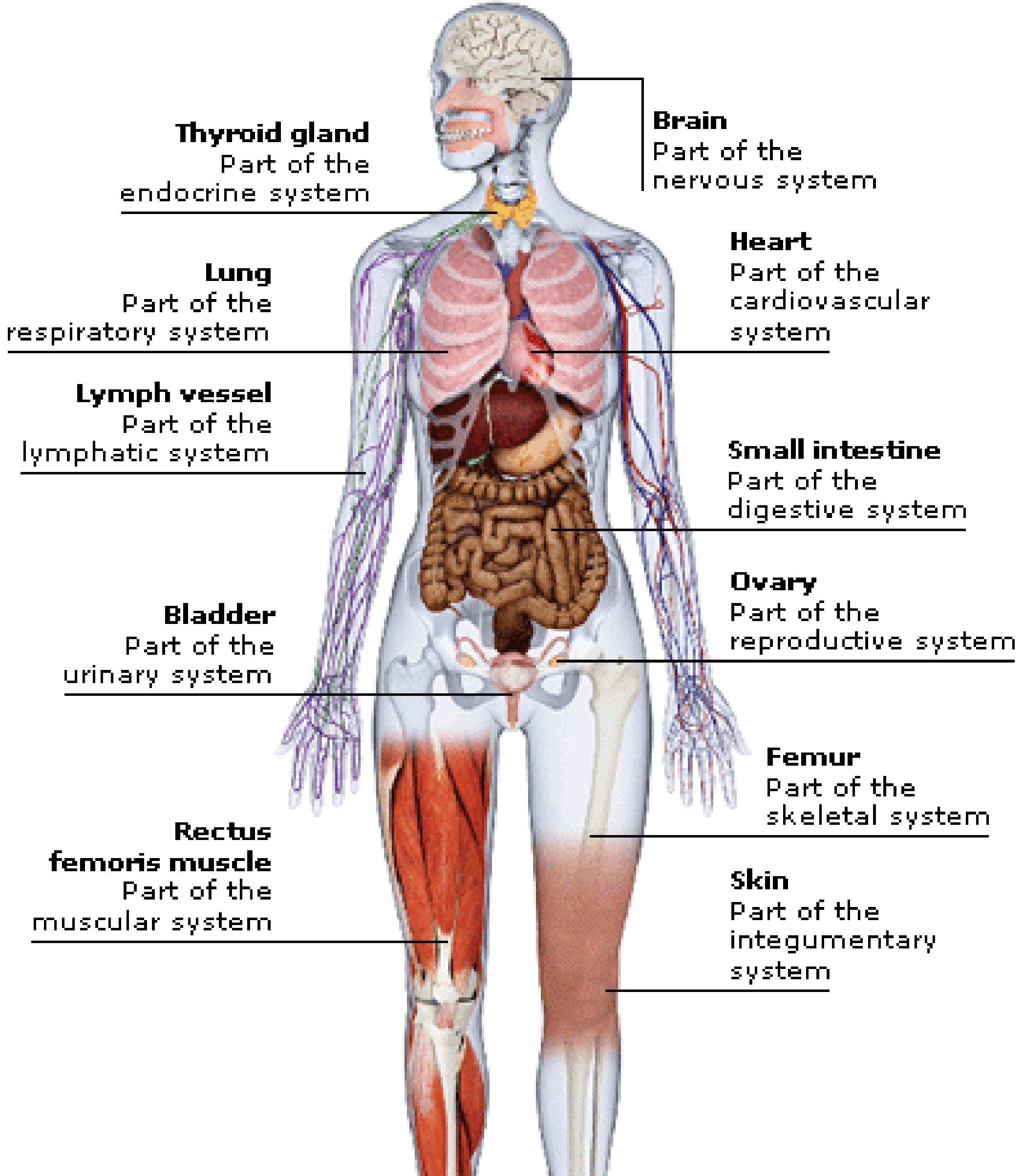
B) The female reproductive system consists of ovaries, uterine tubes, uterus, vagina, and external genitalia.

She produces egg cells and also houses the developing baby.

5 minute video https://www.youtube.com/watch?v=Ae4MadKPJC0

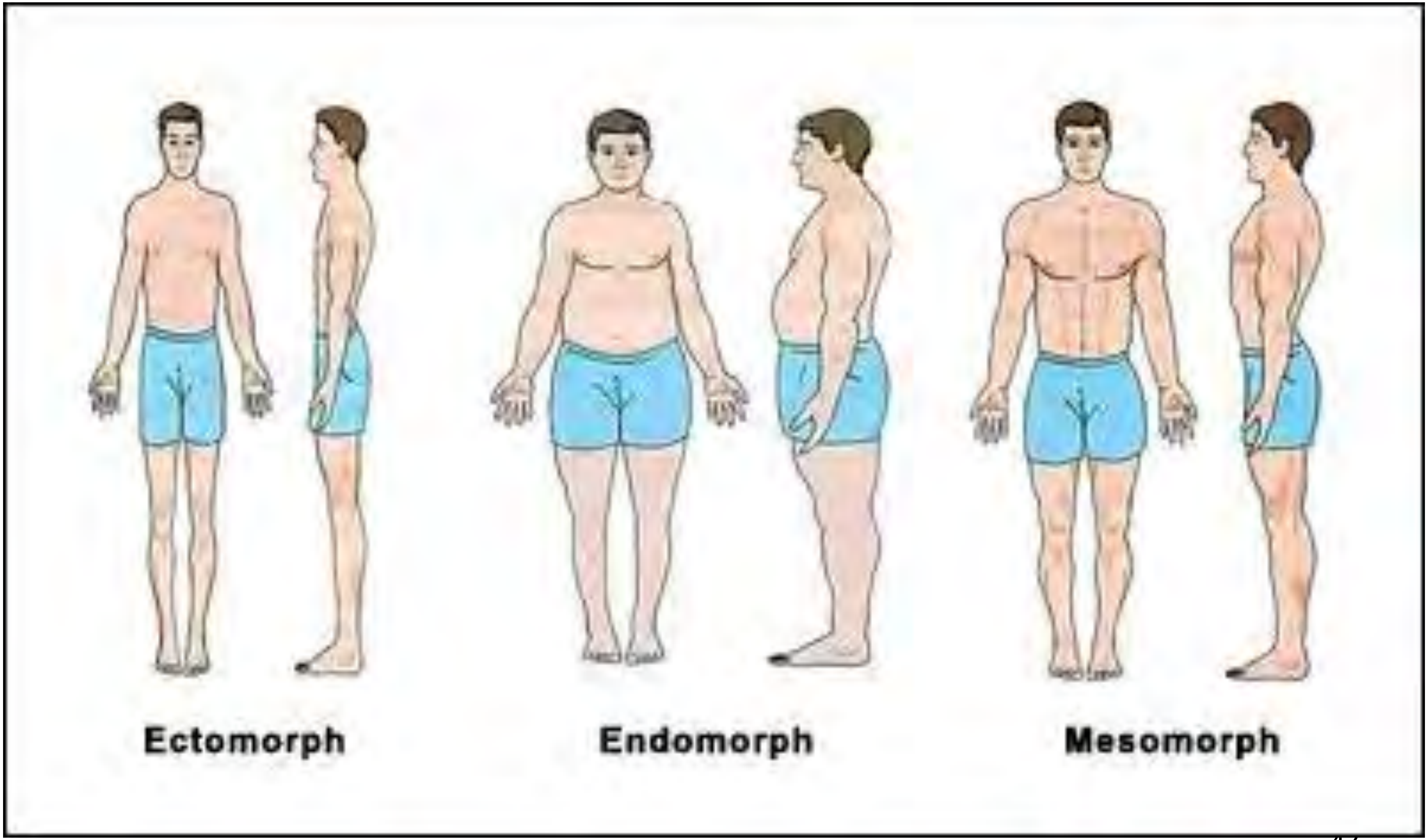


Immune system
Nervous system
Digestive system
Cardiovascular system
Musculoskeletal system
Human body systems
Integumentary system
Excretory system
Respiratory system
Reproductive system
Endocrine system

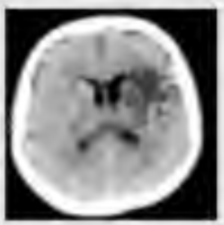
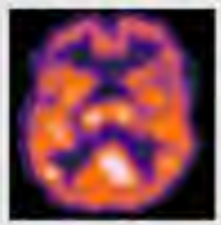
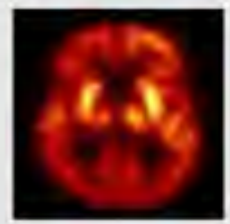


Thyroid gland
Part of the
endocrine system
Brain
Part of the
nervous system
Lung
Part of the
respiratory system
Heart
Part of the
cardiovascular
system
Lymph vessel
Part of the
lymphatic system
Small intestine
Part of the
digestive system
Ovary
Part of the
reproductive system
Bladder
Part of the
urinary system
Femur
Part of the
skeletal system
Rectus
femoris muscle
Part of the
muscular system
Skin
Part of the
integumentary
system

WHAT IS YOUR BODY TYPE ?



Diagnostic Imaging Techniques and Microscopy methods

	CT	MRI	PET	SPECT	Ultrasound
Example					
Main characteristic	Scan body organs using X-rays and produce a series of cross-sectional based images via the computer	Produce "slices" that represents the human body through applying magnetic signals	Nuclear imaging technique example where the tracers are used in diseases diagnosis	A non-invasive based technique where cross-sectional images of radiotracer within the human body are structured	Sound waves based technique that possesses a high temporal frequency and which is capable of producing quantitative and qualitative diagnostic information through a set of comprised methodologies

What is Diagnostic Imaging?

Diagnostic imaging refers to technologies that doctors use to look inside your body for clues about a medical condition.

Different machines and techniques can create pictures of the structures and activities inside your body.

They are great because they are not invasive.

TYPES OF DIAGNOSTIC IMAGING

1. The technology your doctor uses will depend on your symptoms and the part of your body being examined.

2. Types of diagnostic imaging include:

   - X-rays
   - CT scans (Computed Tomography) previously called CAT scans – (Computed Axial Tomography)
   - Nuclear medicine scans
   - MRI scans (Magnetic Resonance Imaging)
   - Ultrasound
   - PET/CT (Positron Emission Tomography/ Computed Axial Tomography)

The X-ray Shoe Fitting machine

Shoe fitting x-ray machines were common in department stores in the late 1940's and early 1950's. It produced an image of how your shoe fit which you could look at and see your toe bones move as you wiggled them.

By the 1970s, the radiation hazard of the shoe fitting x-ray was realized, eliminating its use as a shoe fitting device.

X-ray

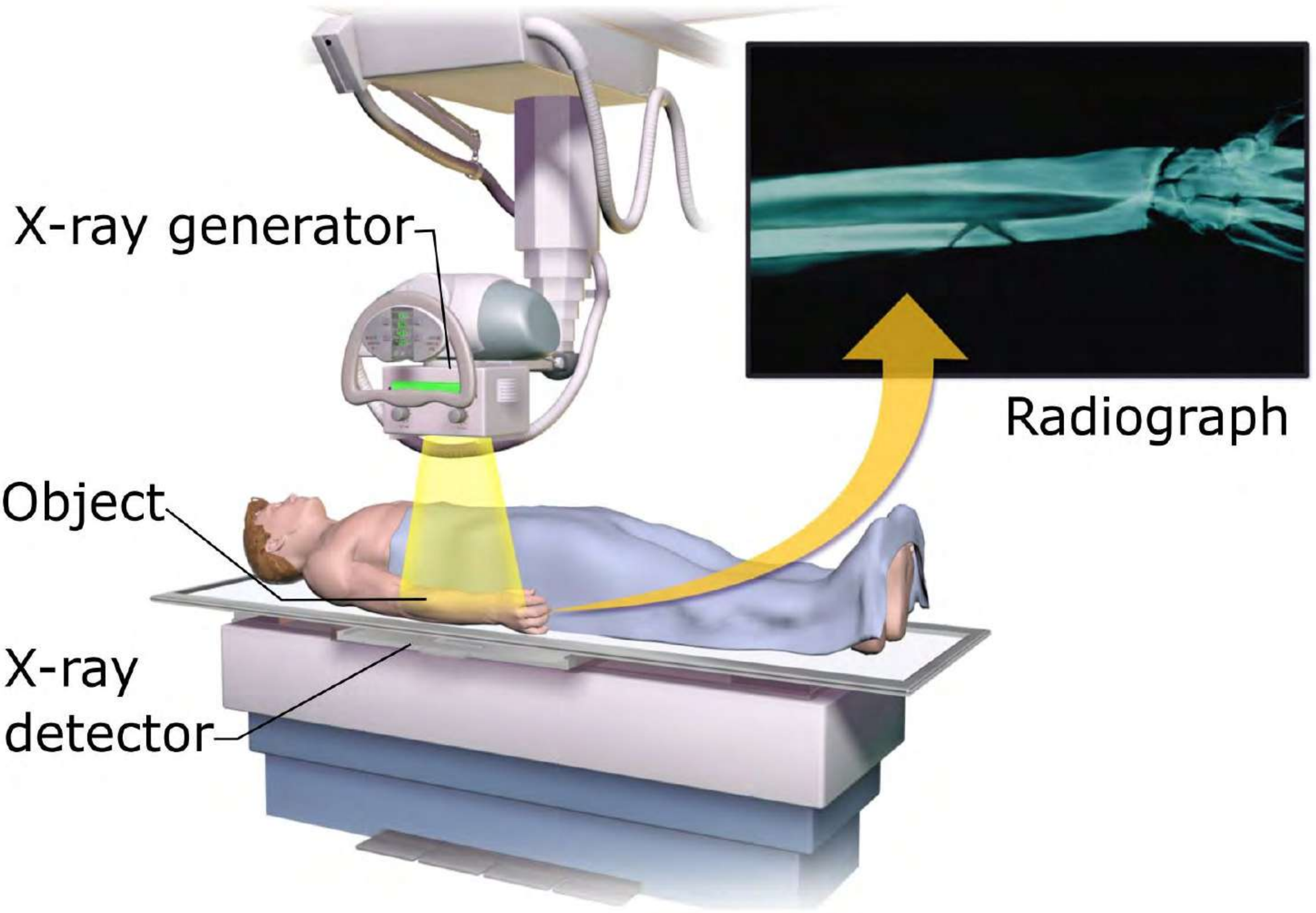
1. Used to look for broken bones, problems in your lungs and abdomen, cavities in your teeth and many other problems.

2. X-ray technology uses electromagnetic radiation to make images. The image is recorded on a film, called a radiograph.

3. Calcium in bones absorbs X-rays the most, so bones look white on the radiograph. Fat and other soft tissues absorb less and look gray. Air absorbs the least, so lungs look black.

4. X-ray examination is painless, and the amount of radiation exposure you receive during an X-ray examination is small.

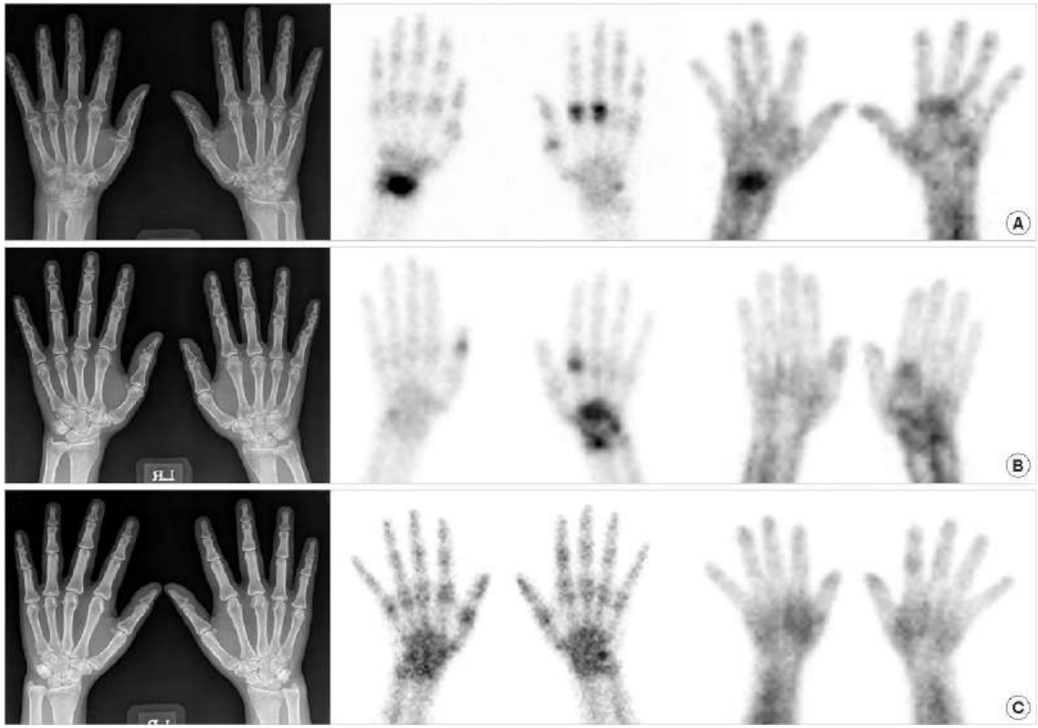
Projectional radiography



X-rays are moving from film to digital files with both computed radiography and digital radiography.

This saves costs and the time to develop the x-ray films.

Scintigraphy, also known as a Gamma scan, is a diagnostic test in nuclear medicine, where radioisotopes attached to drugs that travel to a specific organ or tissue (radiopharmaceuticals) are taken internally and the emitted gamma radiation is captured by external detectors to form two-dimensional images in a similar process to the capture of x-ray images.



Hand radiography and bone scintigraphy findings in rheumatoid arthritis

Computed Tomography (CT) Scans

1. Computed tomography (CT) (or Computed Axial Tomography (CAT) scans are a diagnostic procedure that uses special X-ray equipment to create cross-sectional pictures of your body.

2. CT images are produced using X-ray technology and powerful computers.

3. The uses of CT include looking for:

   Broken Bones
   Cancer
   Blood Clots
   Signs of Heart Disease
   Internal Bleeding

During a CT scan, you lie still on a table.

The table slowly passes through the center of a large X-ray machine.

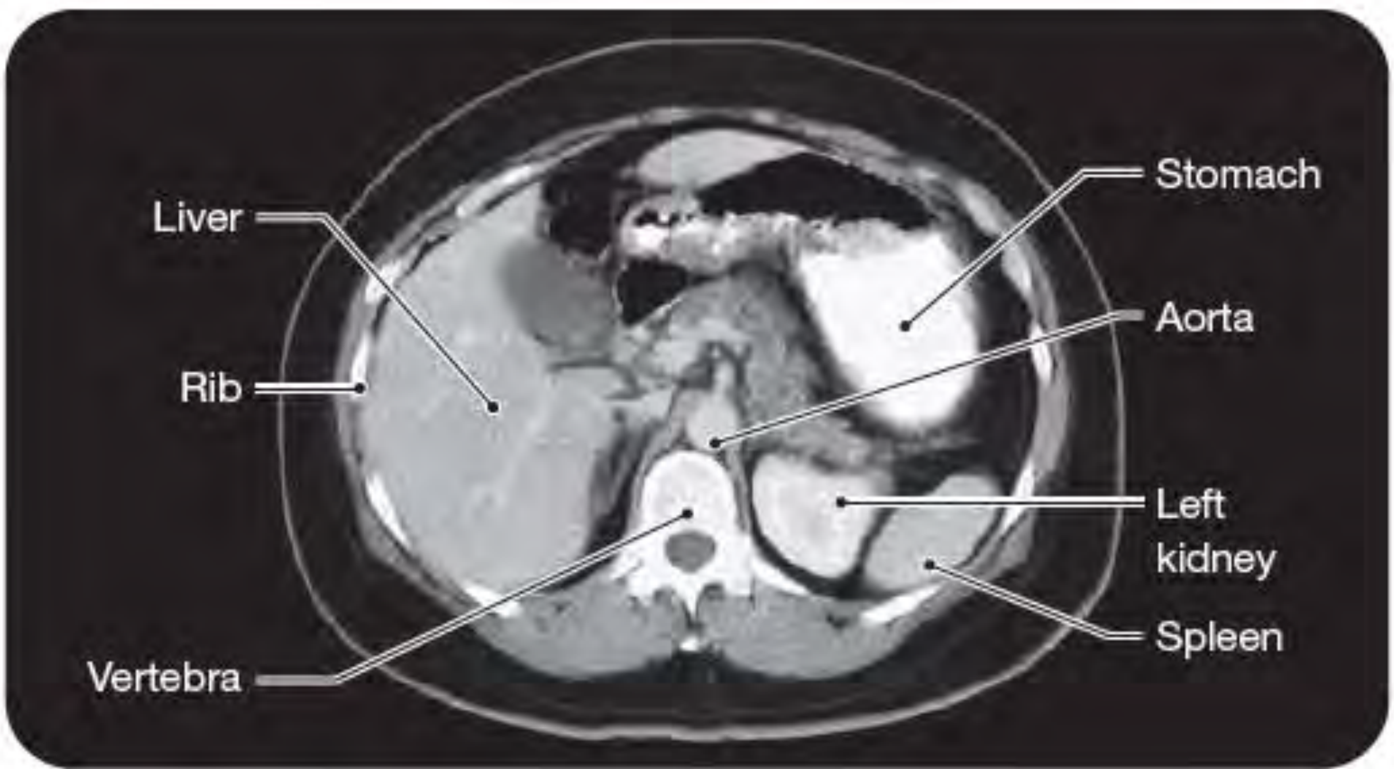
The test is painless.

During some tests you receive a contrast dye, which makes parts of your body show up better in the image.

CT scan of the abdomen

CT (computed tomography) scans use computers to reconstruct sectional views.

The x-ray source completes one revolution around the body every few seconds. It then moves a short distance and repeats the process.

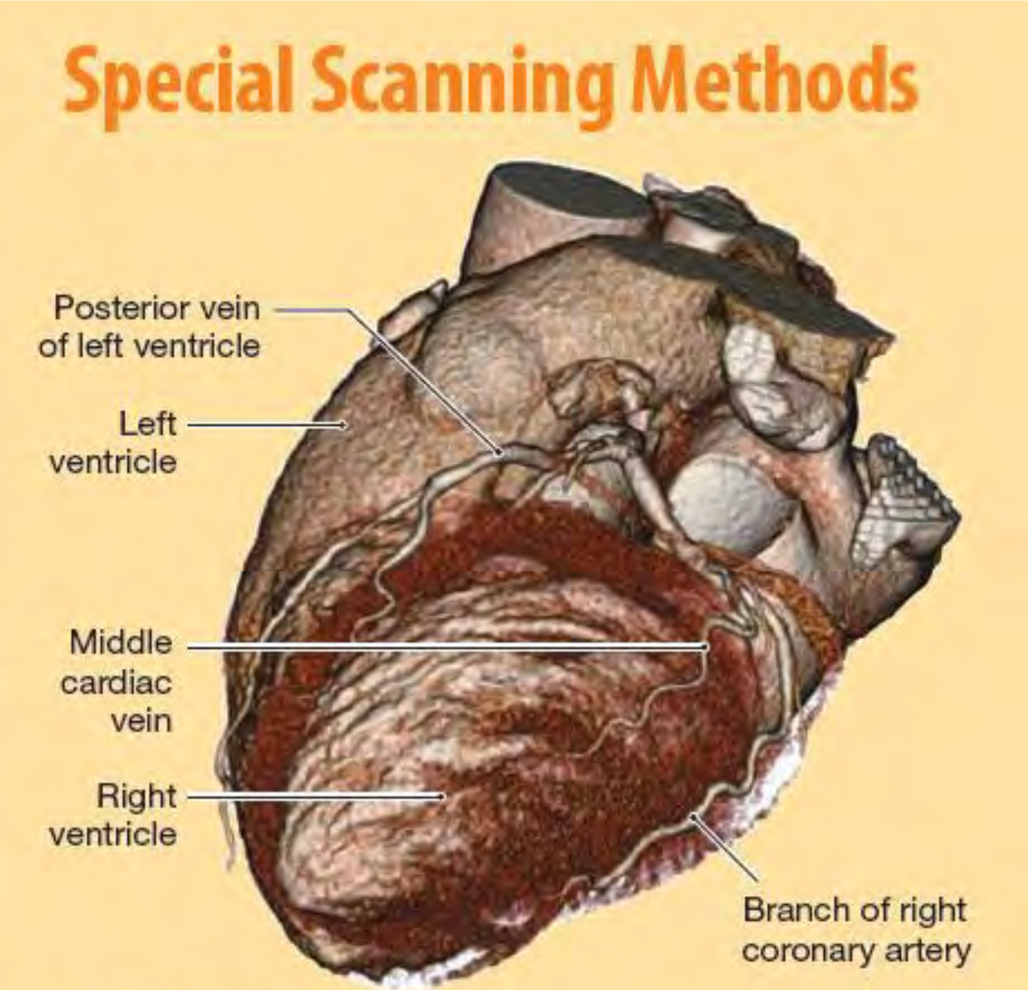


SPIRAL CT SCAN

A spiral CT scan is a form of three-dimensional imaging technology

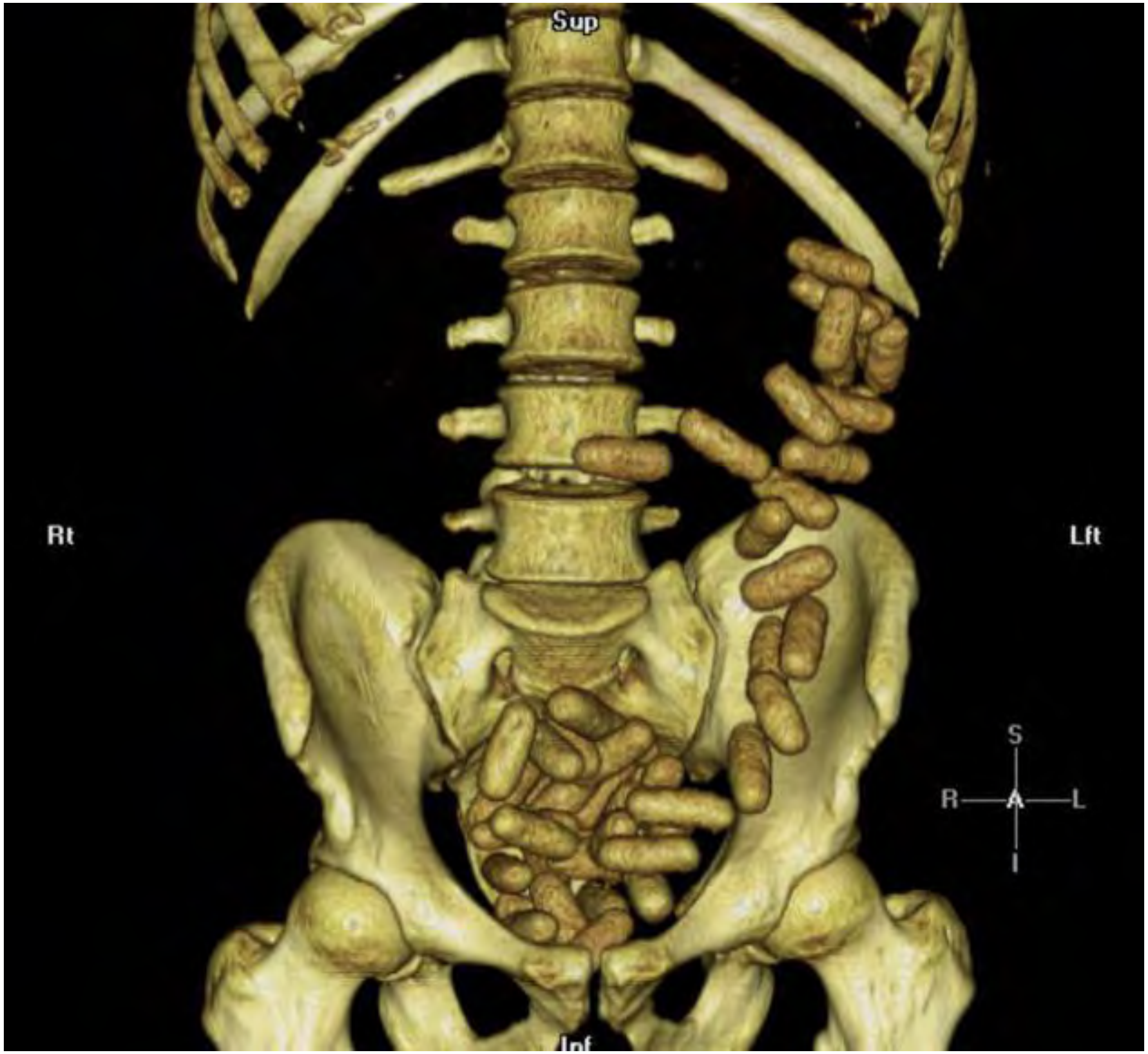
During a spiral CT scan, the patient is on a platform that advances at a steady pace through the scanner while the imaging source, usually x-rays, rotates continuously around the patient.

With this method, a higher quality image is generated, and the patient is exposed to less radiation.



Spiral scan of the heart
[Courtesy of TeraRecon, Inc.]

CT SCAN



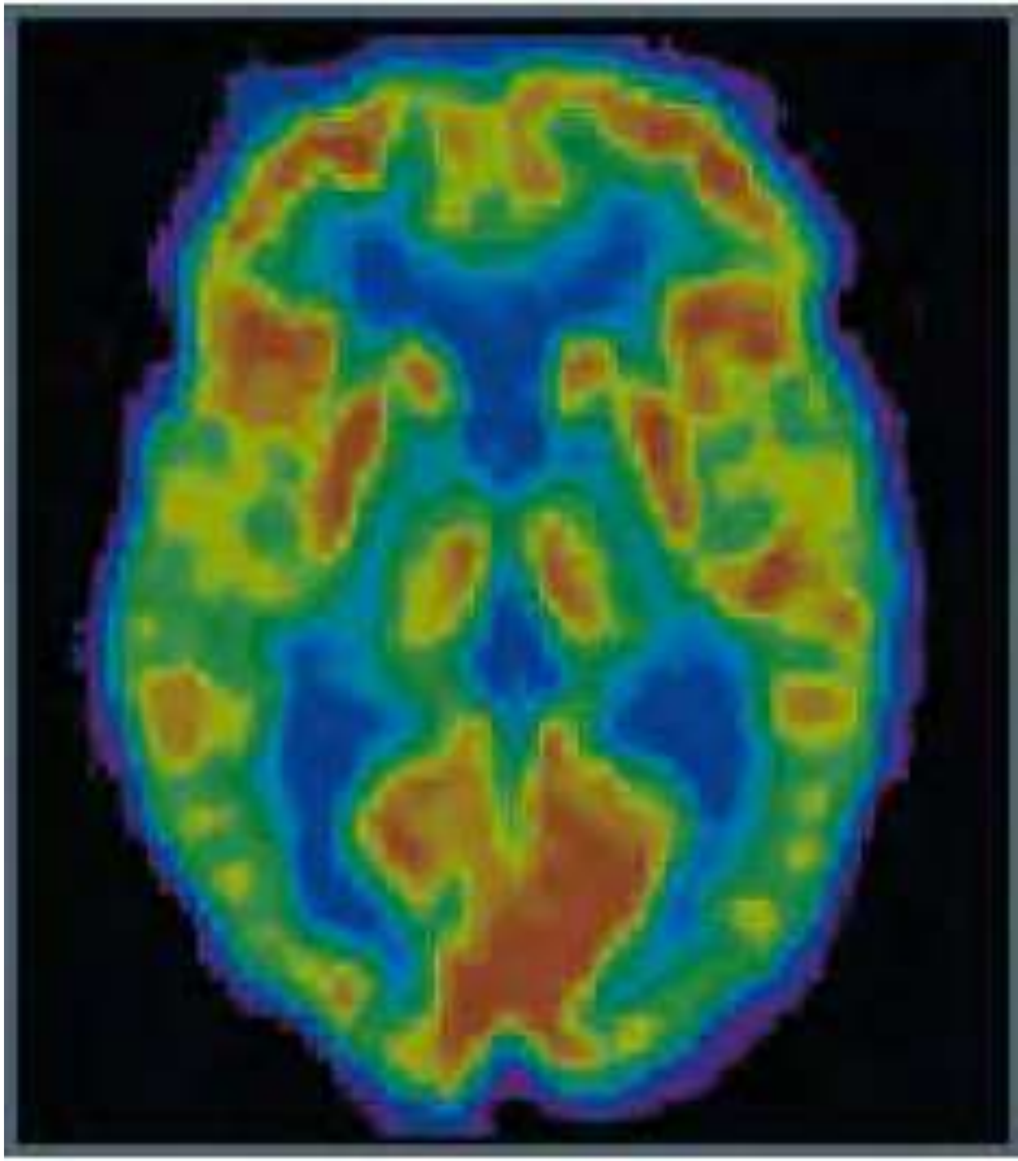
3D reconstruction of CT Scan.
Objects are packets of cocaine.

PET (POSITRON EMISSION TOMOGRAPHY)

PET scan of the brain

Positron emission tomography (PET) is an imaging technique that assesses metabolic and physiological activity of a structure.

A PET scan is an important tool in evaluating healthy or diseased brain function



NUCLEAR SCANS USING A PET (POSITRON EMISSION TOMOGRAPHY) SCANNING PROCESS

1. Nuclear scanning uses radioactive substances to see structures and functions inside your body.

2. Nuclear scans involve a special camera that detects energy coming from the radioactive substance, called a tracer.

3. Before the test, you receive the tracer, often by an injection. Although tracers are radioactive, the dosage is small.

During most nuclear scanning tests, you lie still on a scanning table while the camera makes images.

Most scans take 20 to 45 minutes.

Nuclear scans can help doctors diagnose many conditions, including cancers, injuries and infections.

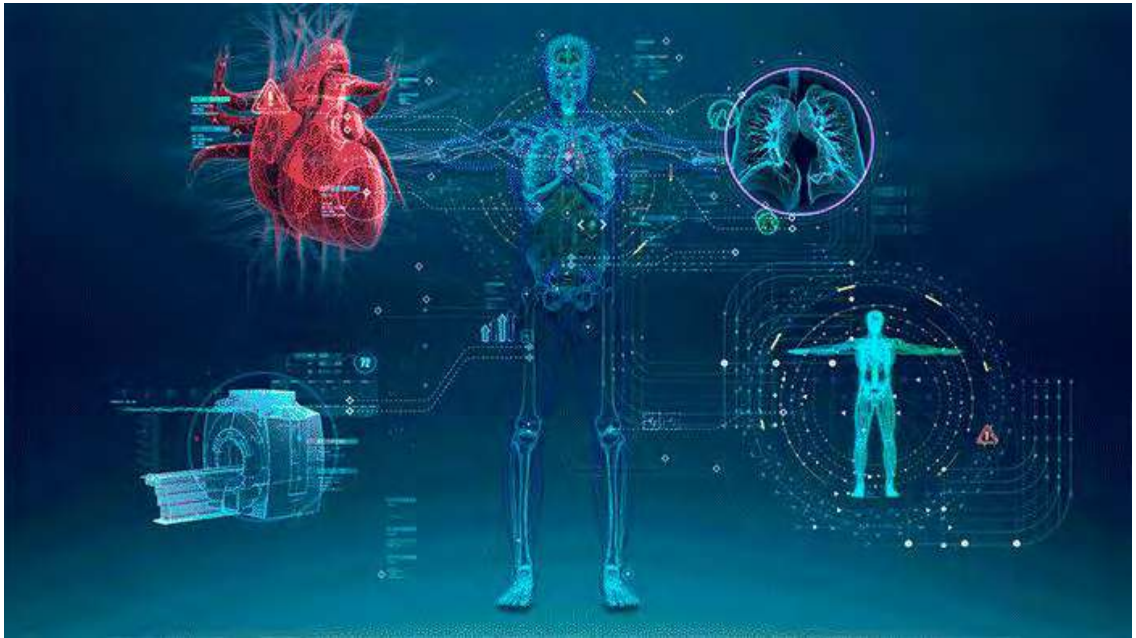
They can also show how organs like your heart and lungs are working.

Magnetic Resonance Imaging (MRI)

1. MRI's do not use X-rays

2. Magnetic resonance imaging (MRI) uses a large magnet and radio waves to look at organs and structures inside your body.

3. Health care professionals use MRI scans to diagnose a variety of conditions, from torn ligaments, tumors, the brain, and spinal cord.



MRI MACHINE

GE MRI SYSTEM

MAGNET

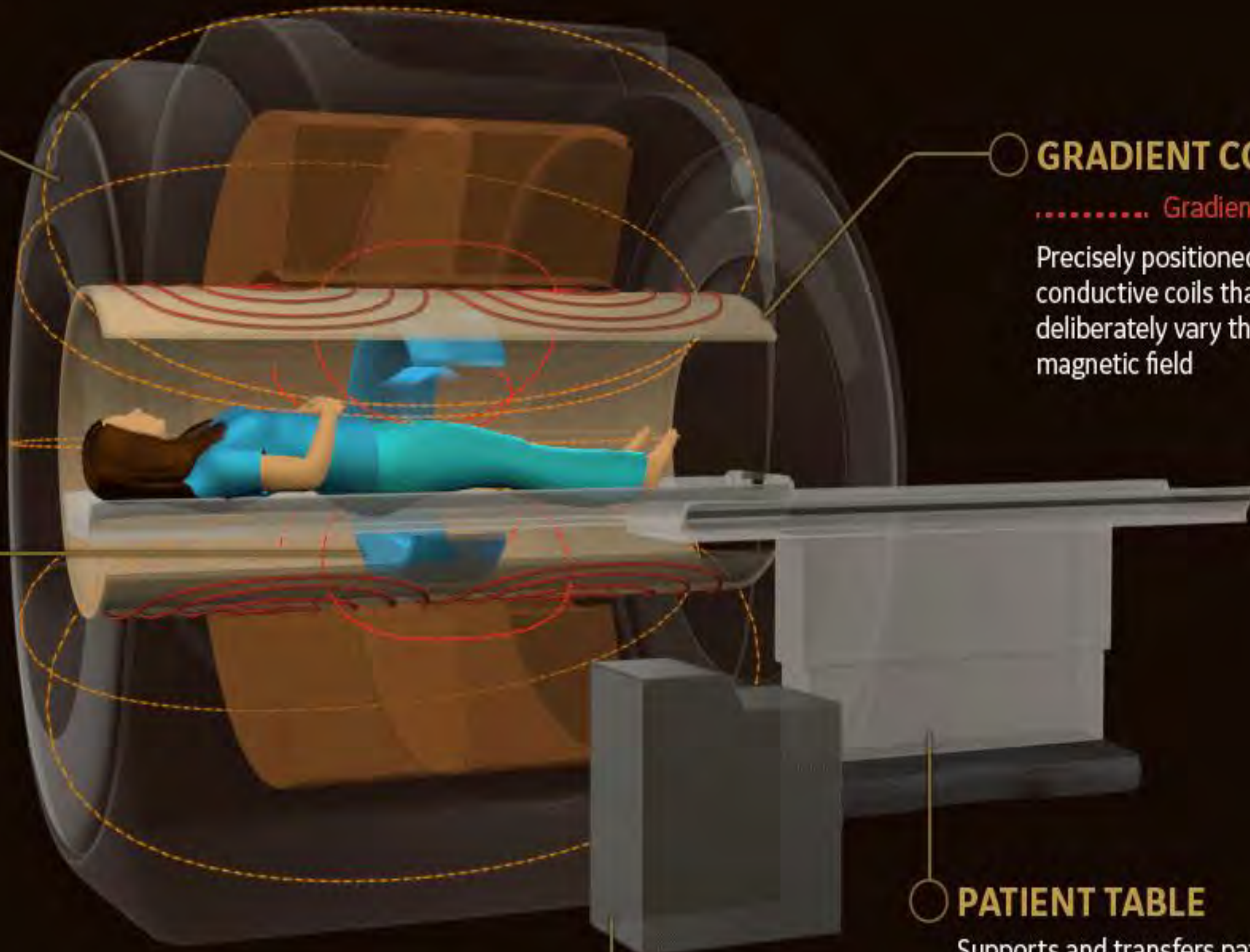
Magnetic field

Aligns the nuclei of atoms inside the patient and a variable magnetic field that causes nuclear magnetic resonance.

RADIO FREQUENCY COIL

RF signal

Transmits and receives radiofrequency (RF) signals in the body.



GRADIENT COILS

Gradient field

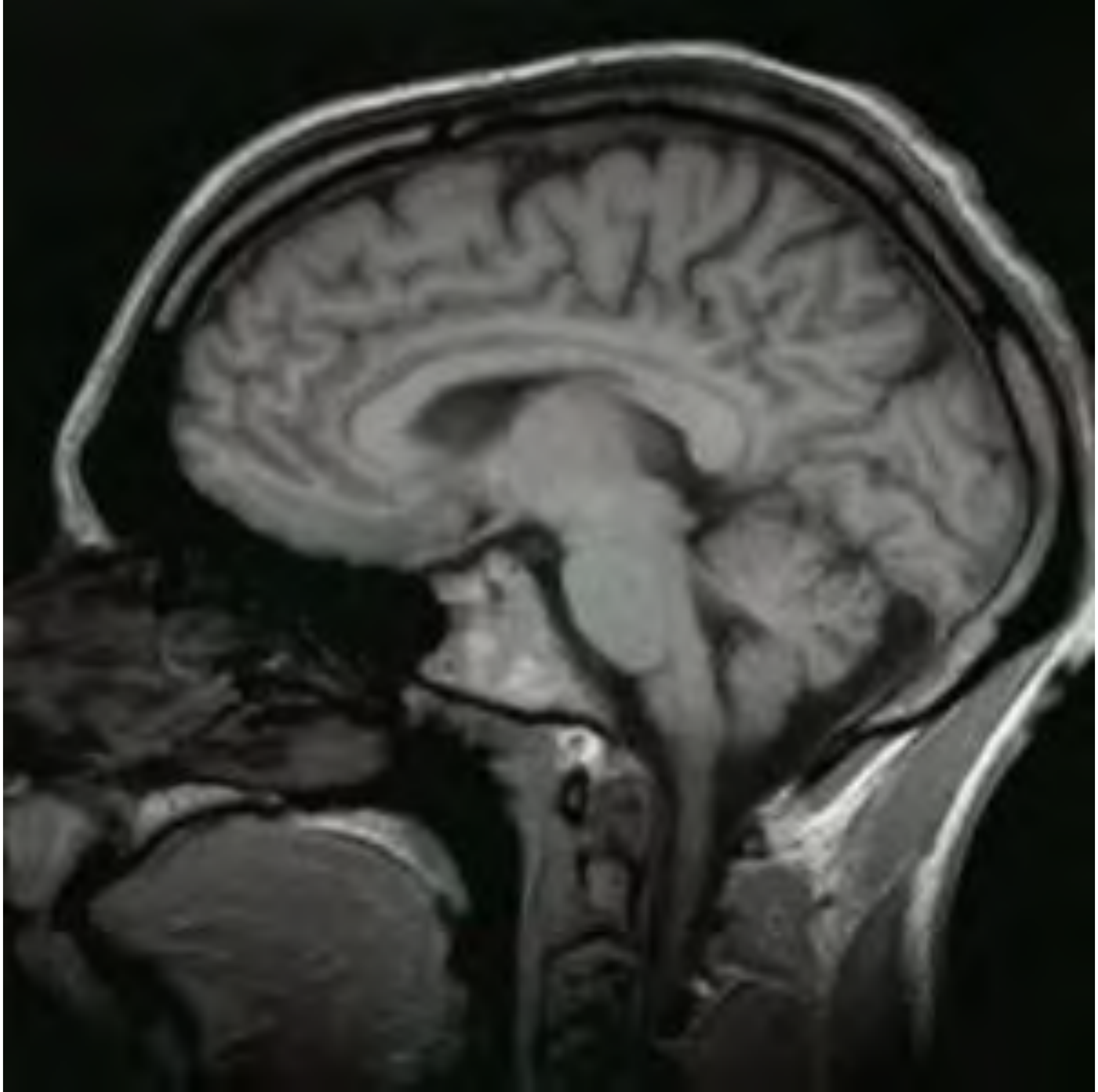
Precisely positioned conductive coils that deliberately vary the magnetic field

PATIENT TABLE

Supports and transfers patient for imaging examination.

SYSTEM PROCESS

High performance electronics and computer.



MRI WITH CONTRAST

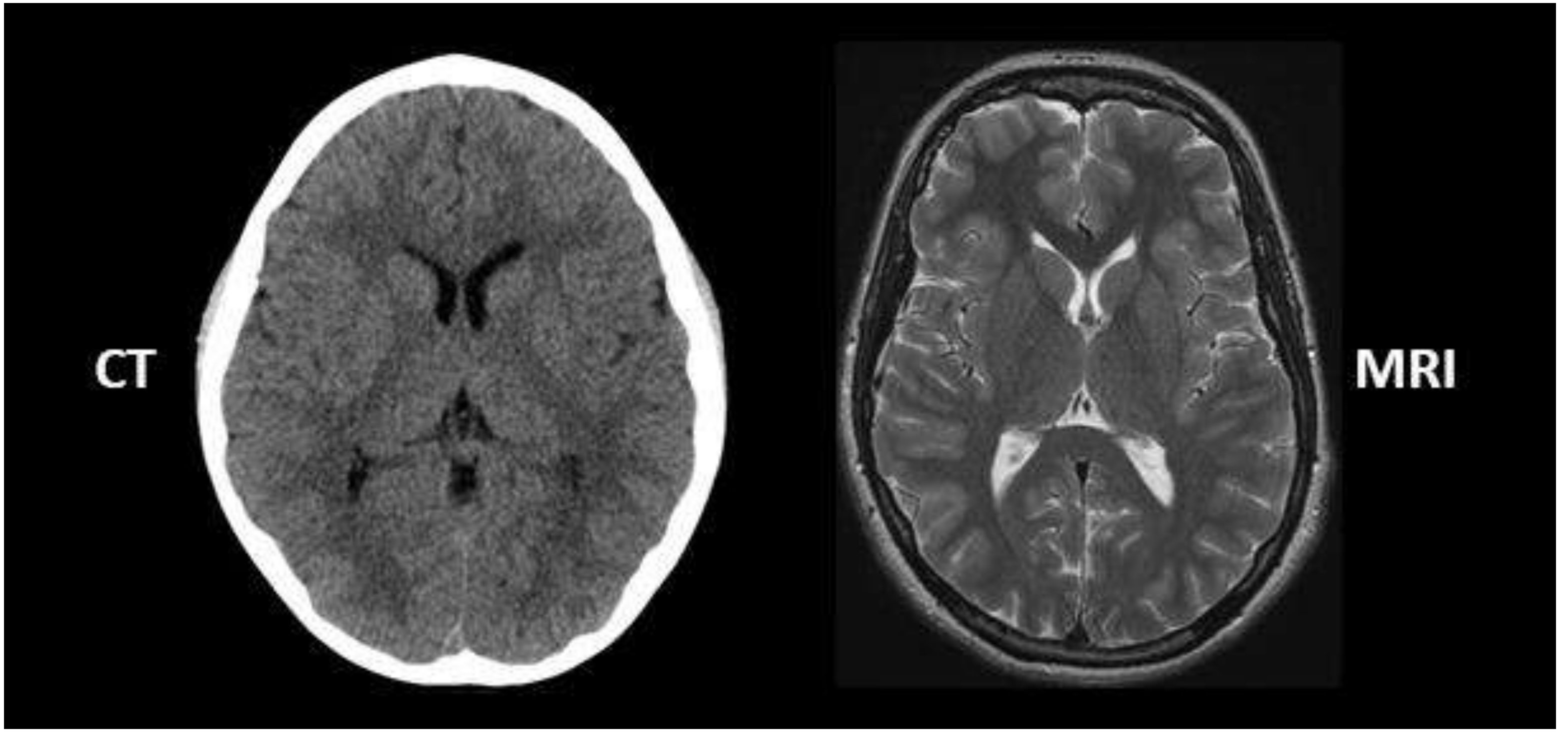
1. During an MRI, the patient may be given an injectable contrast, or dye.

2. This contrast alters the local magnetic field.

3. Normal and abnormal tissue will respond differently to this contrast.

A magnetic resonance imaging scan, more commonly known as an MRI scan, is a detailed cross-sectional image of a part of the body.

It is similar to a CT scan, but has a higher quality, so it is easier to see differences in tissues, as shown in the picture below.



WHAT IS THE DIFFERENCE BETWEEN A MRI AND A CT SCAN ?
https://www.youtube.com/watch?v=aQZ8tTZnQ8A

ULTRASOUND

1. Ultrasound uses high-frequency sound waves to look at organs and structures inside the body.

2. Health care professionals use them to view the heart, blood vessels, kidneys, liver and other organs.

3. During pregnancy, doctors use ultrasound tests to examine the fetus.

4. Unlike x-rays, ultrasound does not involve exposure to radiation.

3D

4D

HD

Ultrasound

During an Ultrasound test, a special technician or doctor moves a device called a transducer over part of your body.

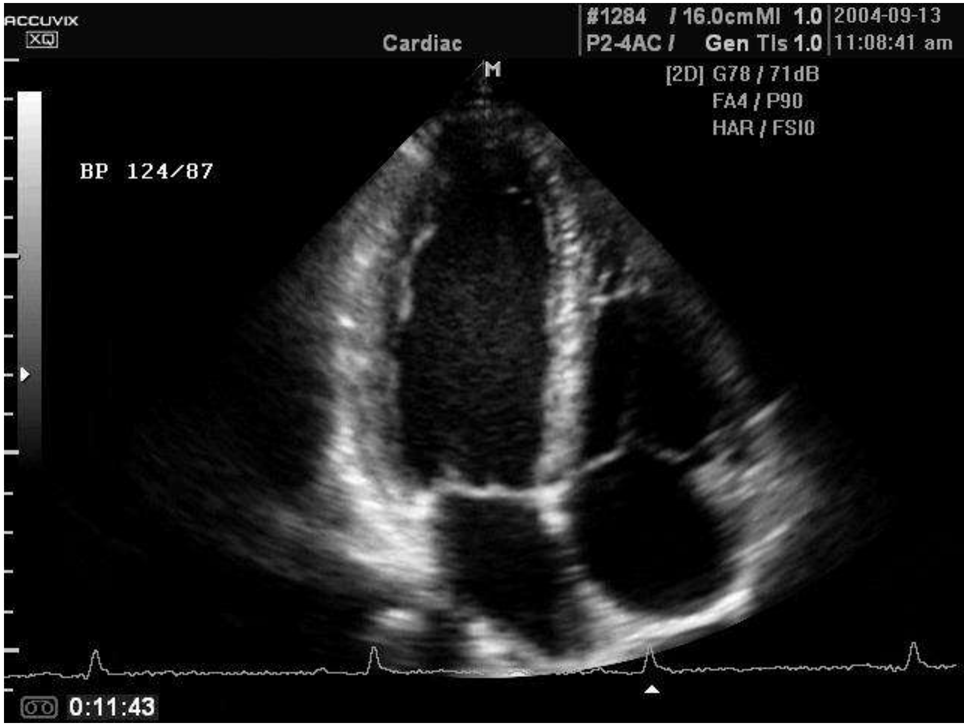
The transducer sends out sound waves, which bounce off the tissues inside your body.

The transducer also captures the waves that bounce back.

Images are created from these sound waves.

All Ultrasound is going toward real-time 3-D images.

ECHOCARDIOGRAPHY - When ultrasound is used to image the heart, it is referred to as an echocardiogram.



Echocardiography is a safe way to see detailed structures of the heart, including chamber size, heart function, the valves of the heart, as well as the pericardium (the sac around the heart).

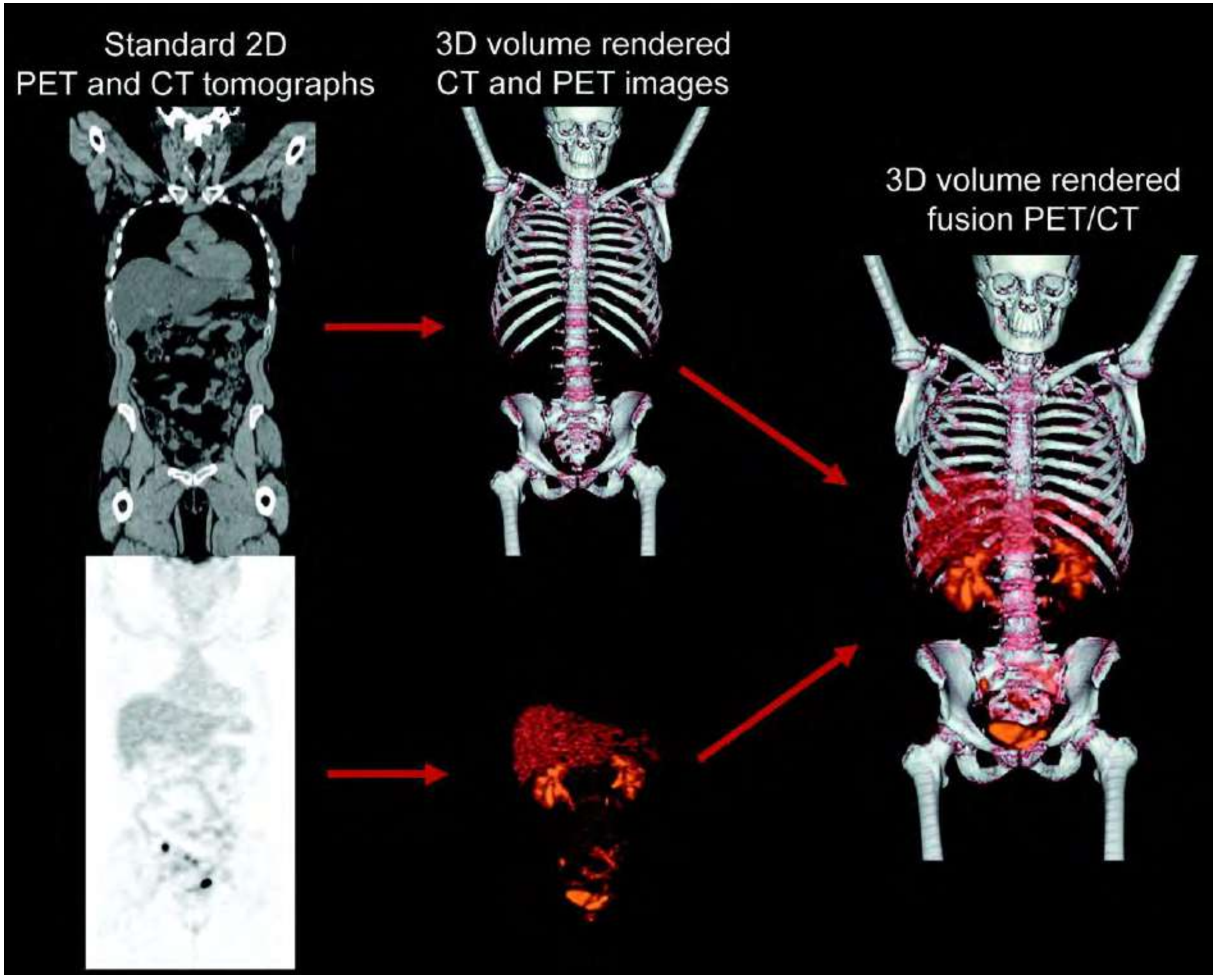
It is a great method for those experiencing shortness of breath or chest pain, to those undergoing cancer treatments.

It is one of the most commonly used imaging methods in the world due to its portability and use in a variety of applications.

PET / CT

1. A PET/CT scan not only helps doctors locate a lesion more accurately (CT), but it also helps determine how active the lesion is on the molecular level (PET).

2. A **lesion** is any damage or abnormal change in the tissue of an organism, usually caused by disease or trauma



PALPATION is the practice of feeling the stiffness of a patient's tissues with the practitioner's hands.

Manual palpation dates back at least to 1500 BC, with the Egyptian Ebers Papyrus and Edwin Smith Papyrus, both giving instructions on diagnosis with palpation.

In a breast self-examination, women look for hard lumps, as cancer is usually stiffer than healthy tissue.

Manual palpation, however, suffers from several important limitations: it is limited to tissues accessible to the physician's hand, it is distorted by any intervening tissue, and it is qualitative but not quantitative.

Elastography, the measurement of tissue stiffness, seeks to address these challenges.

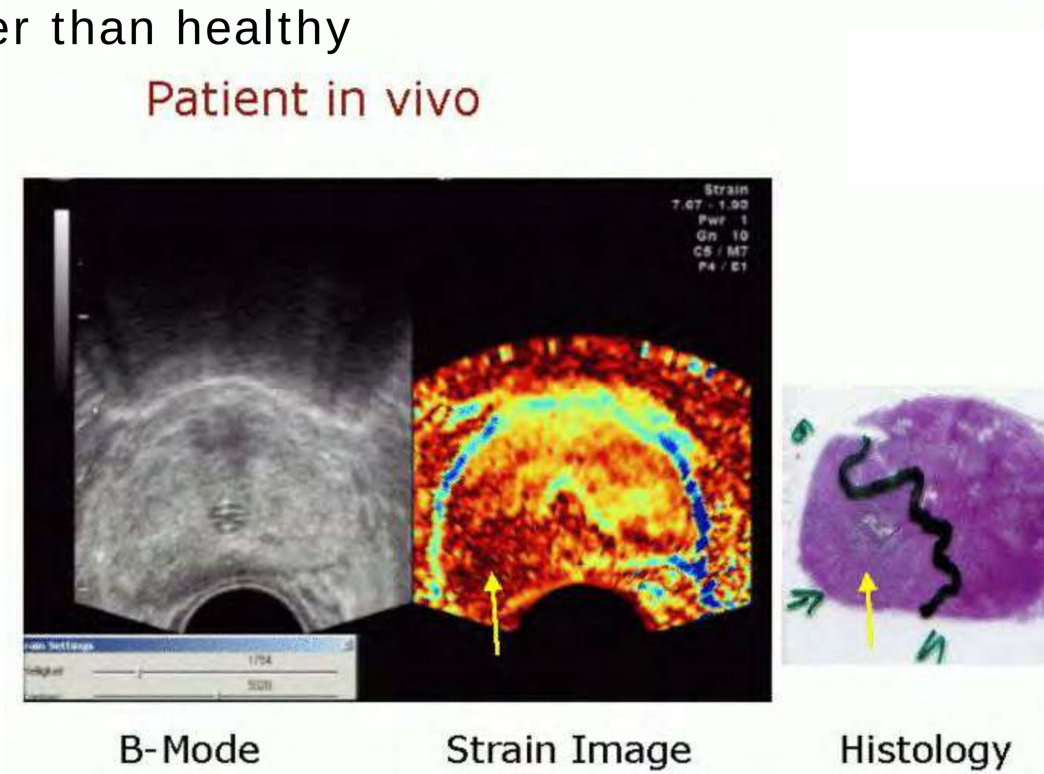
A United States Army doctor palpates a young Vietnames girl's abdomen in the bac Ninh Province of Vietnam

ELASTOGRAPHY

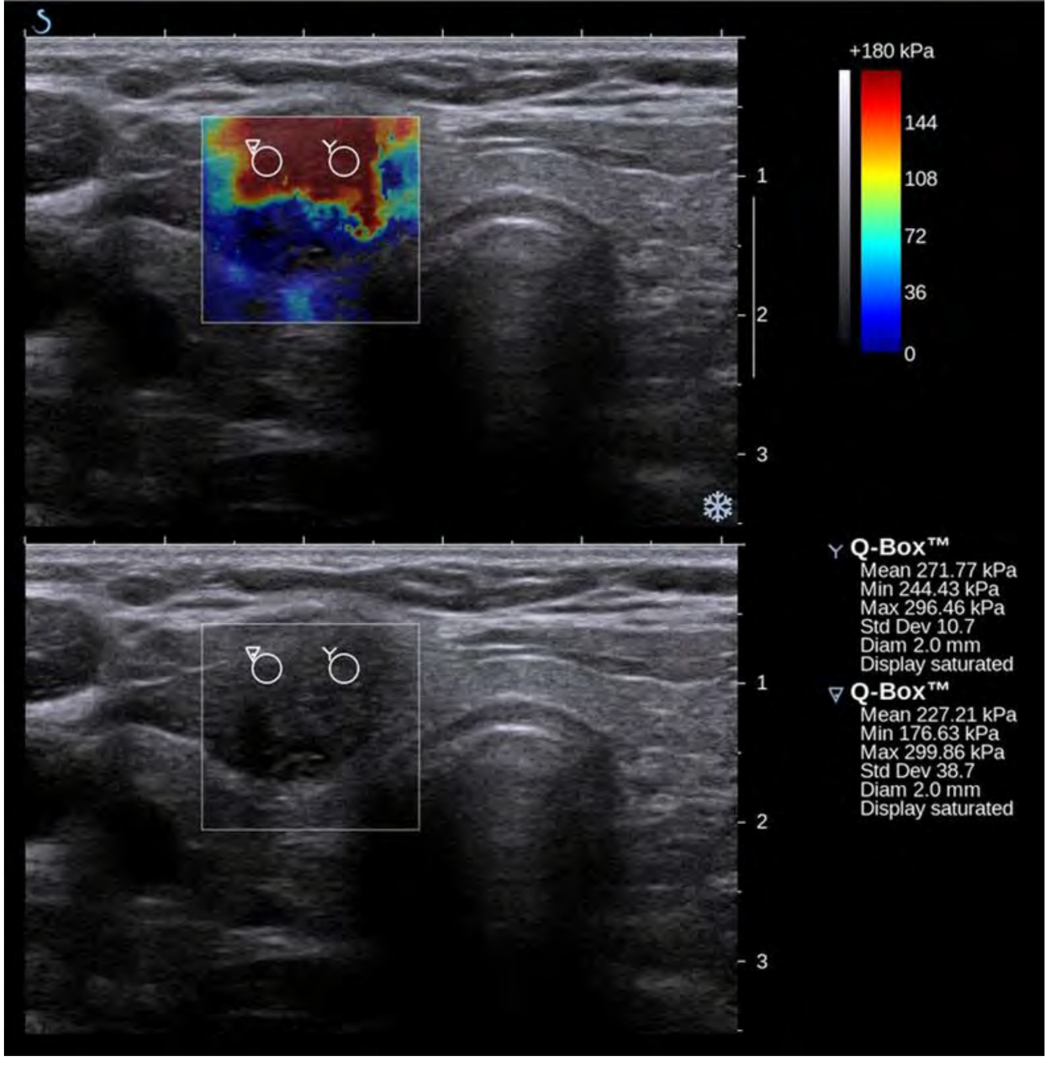
Elastography is a relatively new imaging process that maps the elastic properties of soft tissue. It emerged in the last 20 years.

It is useful in medical diagnoses, as elasticity can discern healthy from unhealthy tissue for specific organs/growths.

For example, cancerous tumors will often be harder than the surrounding tissue, and diseased livers are stiffer than healthy ones.



While not visible on conventional grayscale ultrasound (left), a strain elastography image (center) of the prostate gland detects a cancer (dark red area at lower left). The finding is confirmed by histology.

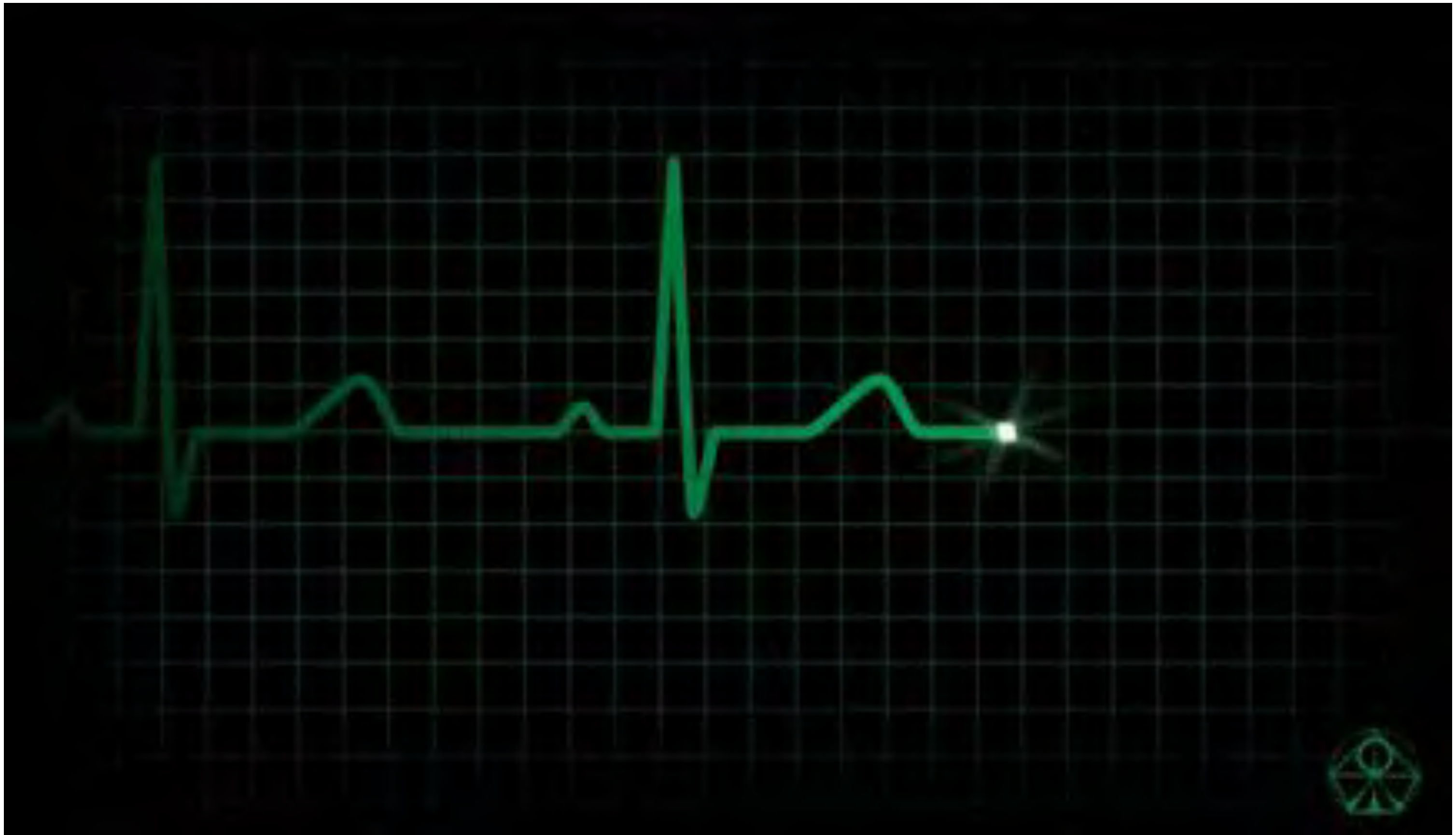


Conventional ultra-sonography (lower image) and elastography (supersonic shear imaging; upper image) of papillary thyroid carcinoma, a malignant cancer. The cancer (red) is much stiffer than the healthy tissue.

ELECTRICAL ACTIVITY - Sensor pads applied to the skin detect electrical signals coming from active muscles and nerves.

The signals are coordinated, amplified, and displayed as a real-time trace, usually a spiky or wavy line.

This technique includes electrocardiography (ECG) of the heart and electro-encephalography (EEG) of the brain’s nerve activity.



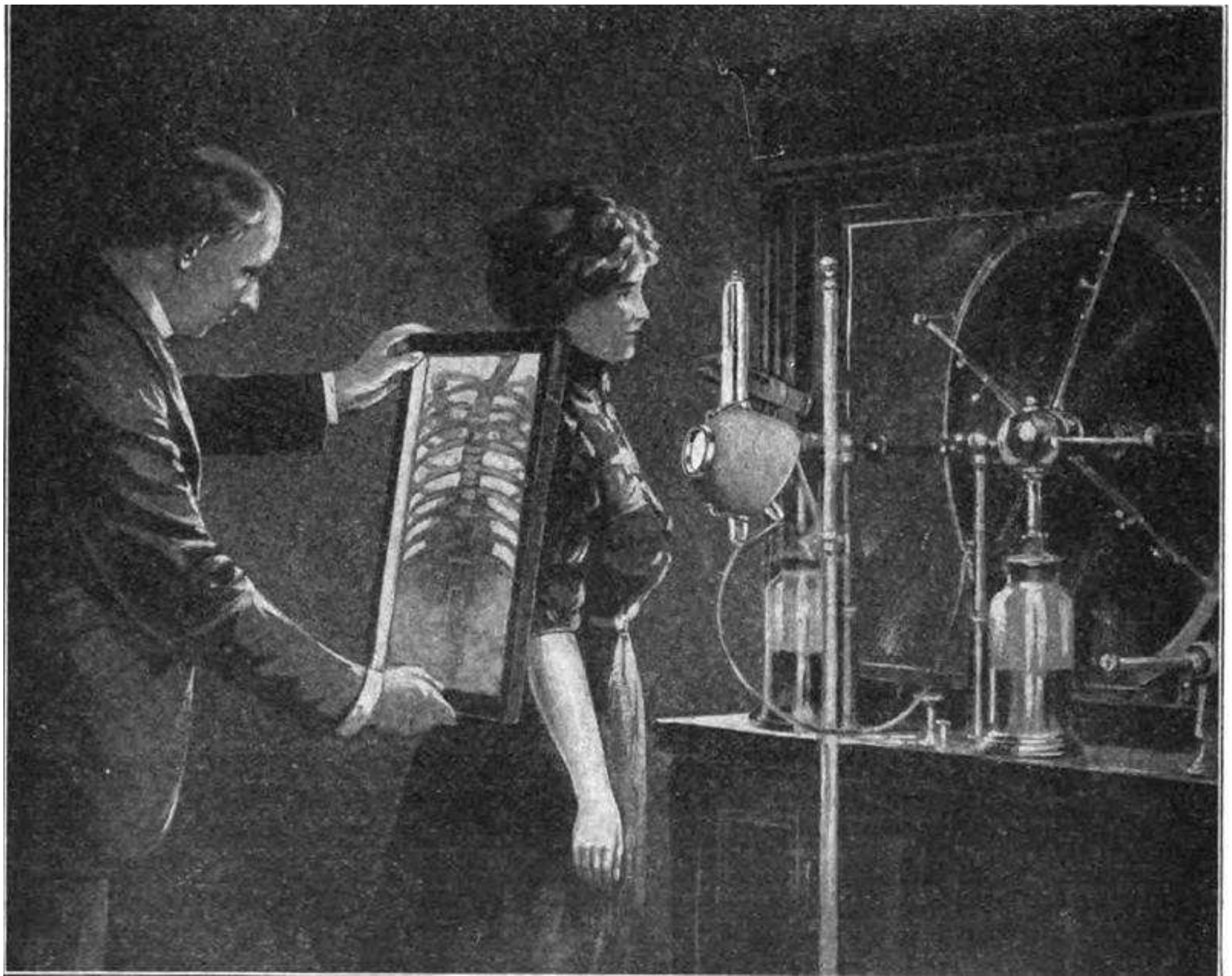
FLUOROSCOPY

While other tests are comparable to still photography, a fluoroscopy is like a motion picture of bodily functions. That's because it shows moving body parts.

The procedure is often done with contrast dyes, which show how they flow through the body. While all of this is being done, an X-ray beam sends signals to a monitor.

Fluoroscopies are used to evaluate both hard and soft tissue, including bones, joints, organs and vessels. Blood flow exams often involve fluoroscopy.

Thoracic fluoroscopy using handheld fluorescent screen in 1909. No radiation protection is used, as the dangers of X-rays were not yet recognized.



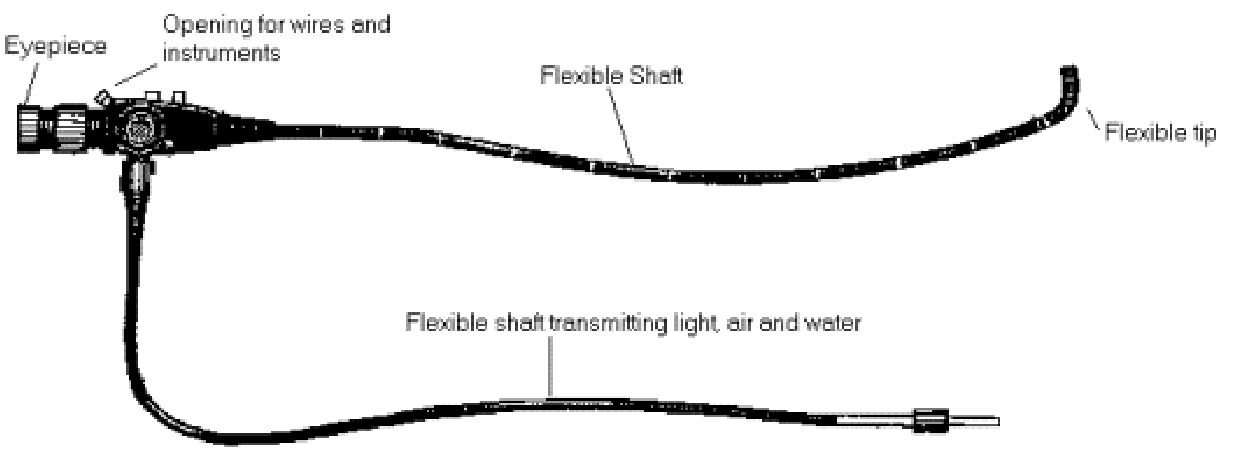
ENDOSCOPY - A variety of telescope-like endoscopes are inserted through natural orifices or incisions to produce images of the body's interior, using their own light source.

Some types are rigid, but many are flexible, utilizing fiberoptic technology, and can be bent and controlled as they are guided along.

They carry their own light source and may be equipped with tubes to introduce or remove fluids or gases, blades for surgery, forceps to take samples (biopsy), and perhaps a laser to cauterize damaged tissue.

Endoscopes have been developed to fit different body parts – a bronchosope for the airways, a gastroscope for the oesophagus and stomach, a laparoscope for the abdomen, and a proctoscope for the lower bowel.

A typical endoscope



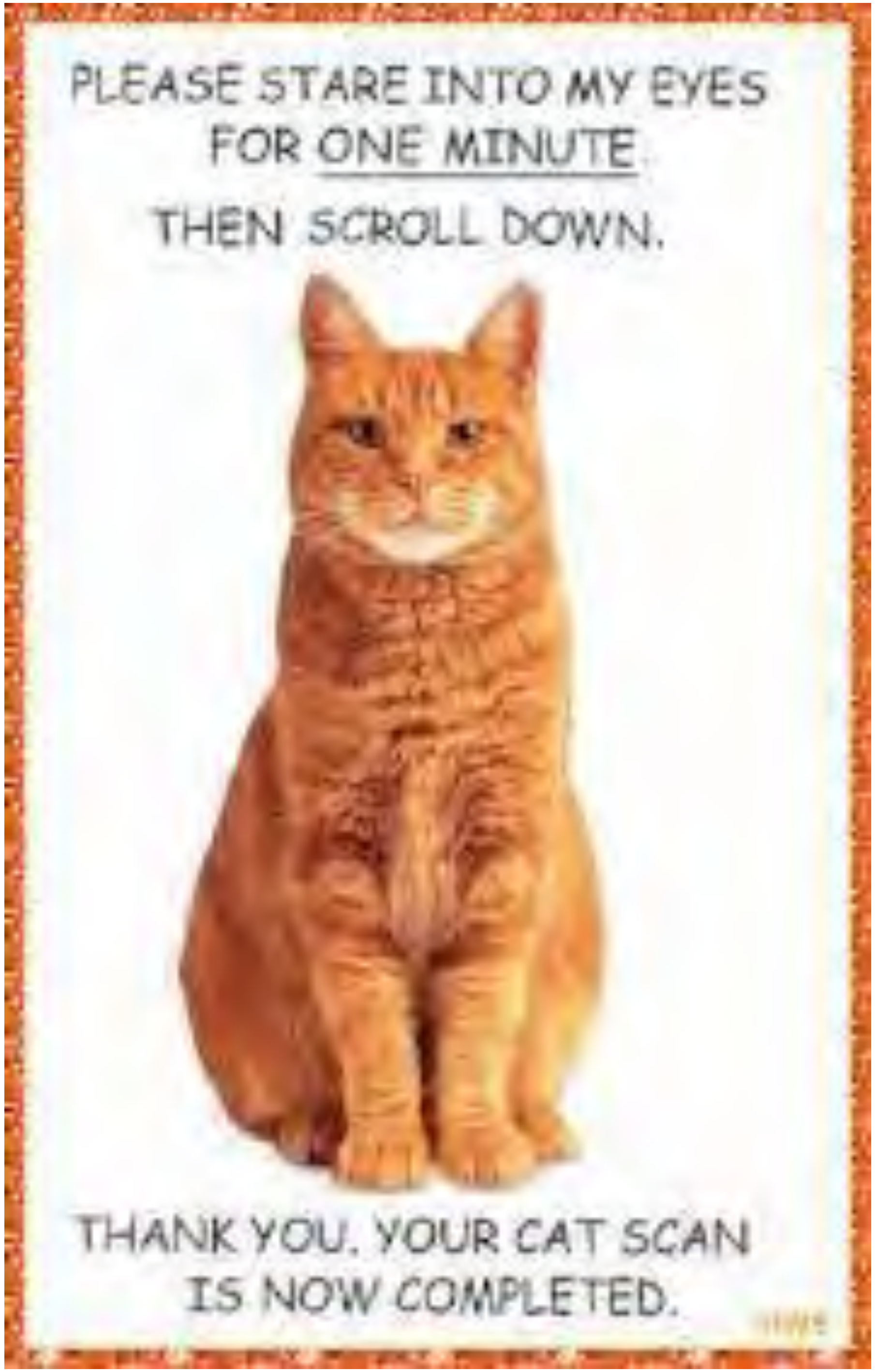
Type of endoscope	**Put in through**	**Body part or area(s) looked at**	**Name(s) of procedure**
Arthroscope	Cuts in the skin	Joints	Arthroscopy
Bronchoscope	Mouth or nose	Trachea (windpipe) and bronchi (tubes going to the lungs)	Bronchoscopy, flexible bronchoscopy
Colonoscope	Anus	Colon and large intestine	Colonoscopy, lower endoscopy
Cystoscope	Urethra	Bladder	Cystoscopy, cystourethroscopy
Enteroscope	Mouth or anus	Small intestine	Enteroscopy
Esophagogastro-duodenoscope	Mouth	Esophagus (swallowing tube), stomach, and duodenum (first part of small intestine)	Esophagogastro-duodenoscopy (EGD), upper endoscopy, panendoscopy, gastroscopy

Capsule Endoscopy

Devices used to perform endoscopy operations

Capsule	PillCam® SB 3 Given Imaging	EndoCapsule® Olympus America	MiroCam® IntroMedic Company	OMOM® Jinshan Science and Technology
Size *	Length: 26.2 mm Diameter: 11.4 mm	Length: 26 mm Diameter: 11mm	Length: 24.5 mm Diameter: 10.8 mm	Length: 27.9 mm Diameter: 13 mm
Weight	3.00g	3.50g	3.25-4.70g	6.00g
Battery life	8 hours or longer	8 hours or longer	11 hours or longer	6-8 hours or longer
Resolution	340x340	512x512	320x320	640x480
Frames per second	2 fps or 2-6 fps	2 fps	3 fps	2 fps
Field of view	156°	145°	170°	140°
Communication	Radio frequency communication	Radio frequency communication	Human body communication	Radio frequency communication
FDA approval	Yes	Yes	Yes	No
Price per capsule	$500	$500	$500	$250

* 25 mm (millimeters) = 1 inch


PLEASE STARE INTO MY EYES
FOR ONE MINUTE.
THEN SCROLL DOWN.
THANK YOU. YOUR CAT SCAN
IS NOW COMPLETED.


CAT SCAN
LAB TEST

BIBLIOGRAPHY

Wikipedia – Diagnostic Imaging

Diagnostic Imaging - Techniques & Treatments slide presentation – by Juliane Monko & Dr. Frank Flanders - CTAE Resource Network

Photo on slide 28 - Photo credit: By Ewelina Szczepanek-Parulska, Kosma Woliński, Adam Stangierski, Edyta Gurgul, Maciej Biczysko, Przemysław Majewski, Magdalena Rewaj-Łosyk, Marek Ruchała - Comparison of Diagnostic Value of Conventional Ultrasonography and Shear Wave Elastography in the Prediction of Thyroid Lesions Malignancy, PLOS ONEDOI: 10.1371/journal.pone.0081532, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=35718612

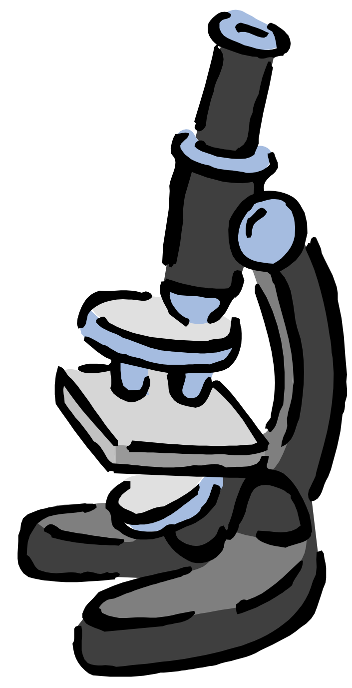
Photo on slide 27 - By Andreaslorenzcommon - Own work, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=32760628

Microscopes

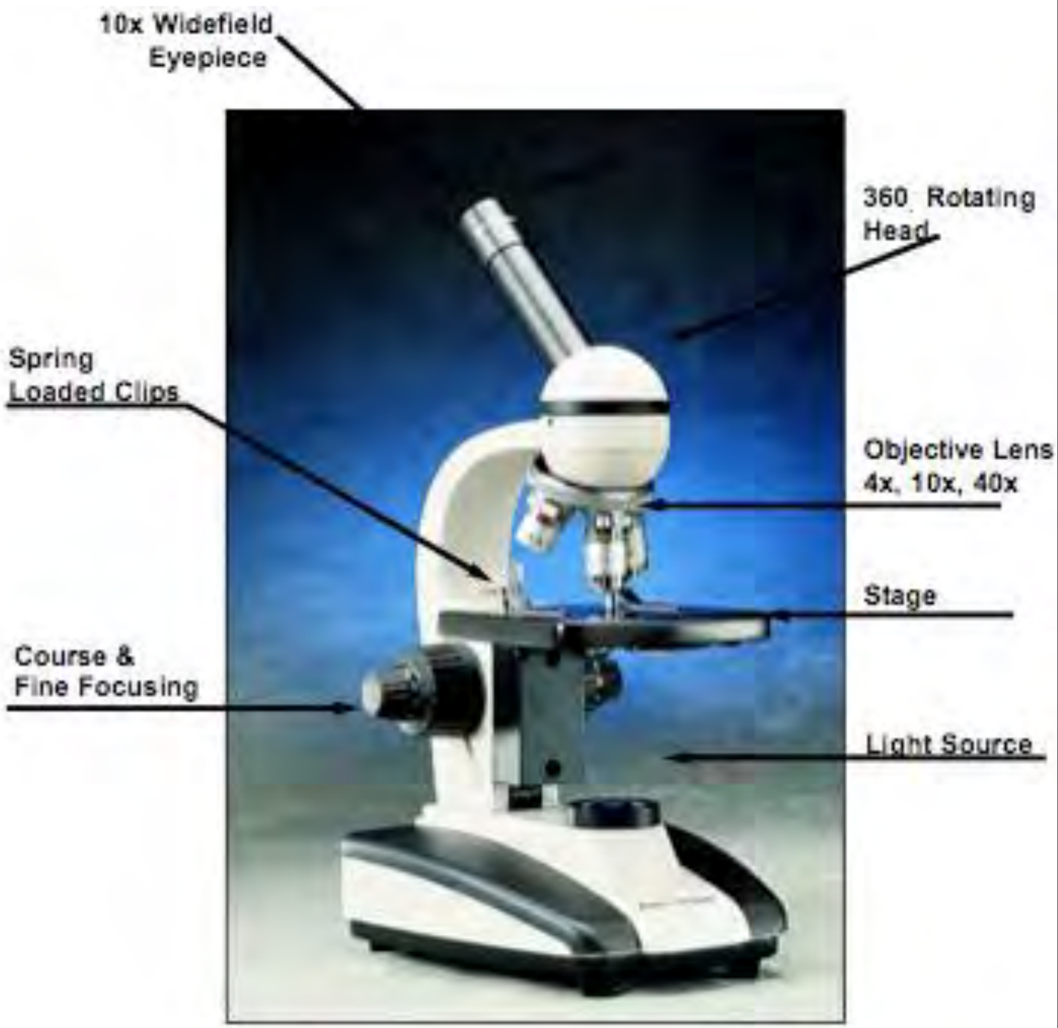
Magnification: refers to the microscope’s power to increase an object’s apparent size

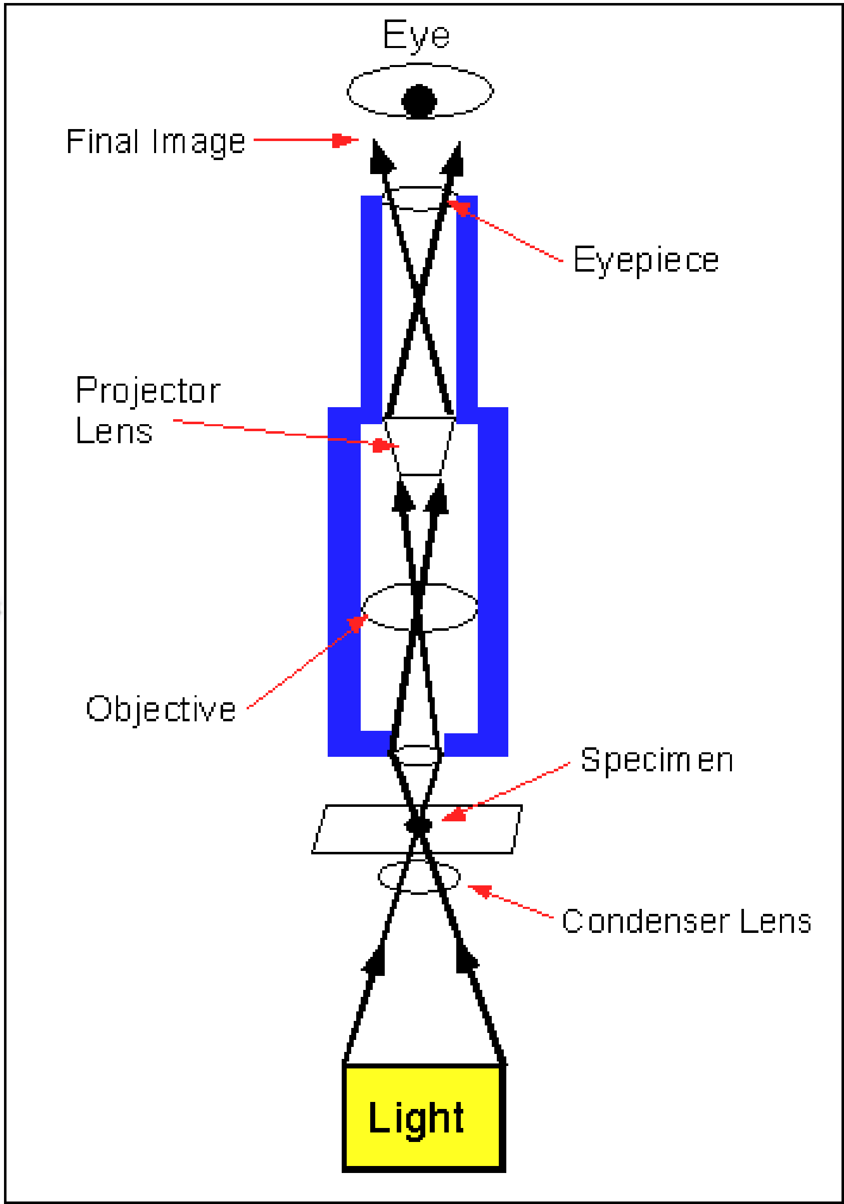
Resolution: refers to the microscope’s power to show detail clearly

Light microscope like this one have a magnification range up to 1,000 times

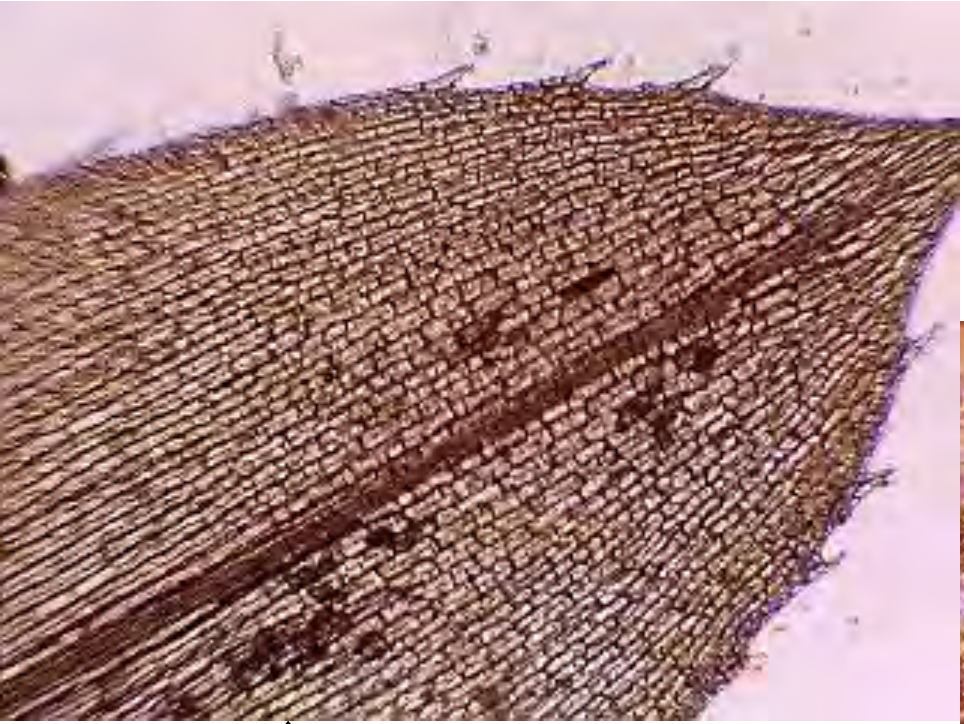


Light Microscope

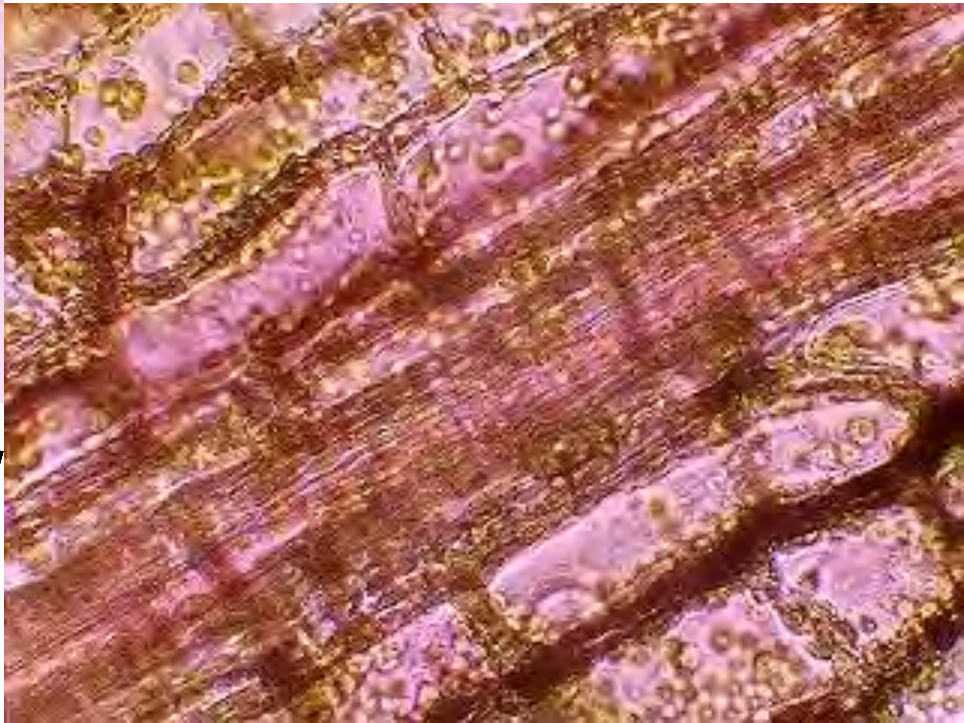




Light Microscope



Elodea - Aquatic Plant



40X

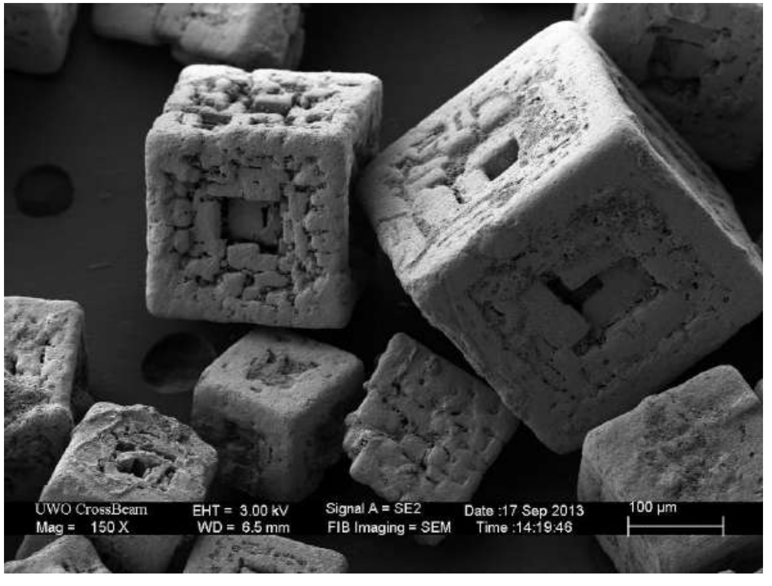
400X

TYPES OF MICROSCOPES

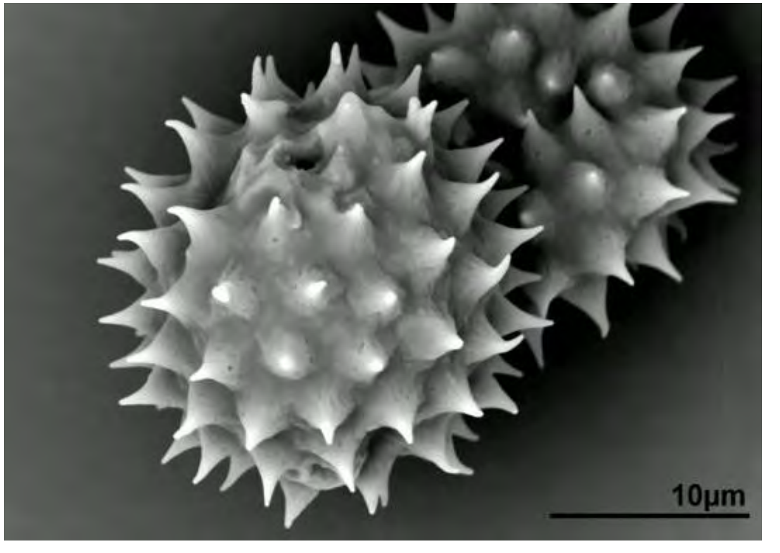
Light microscopy (LM) uses magnifying lenses to focus light rays.

In light microscopy, light passes through a thin section of material and enlarges it up to 2,000 times.

Higher magnifications are achieved with beams of subatomic particles called electrons, with scanning electron microscopy (SEM) – 20 to 100,000 times. The beam runs across a specimen coated with gold film. Electrons bounce off the surface contours, to create a three-dimensional image, as shown below.



SALT GRAINS



DAISY POLLEN GRAINS

Electron microscopes produce an image of a specimen by using a beam of electrons rather than a beam of light, which produces much higher-resolution images.

It has magnitude of 10,000x or more. They can be used to visualize the subcellular structures of the cells.

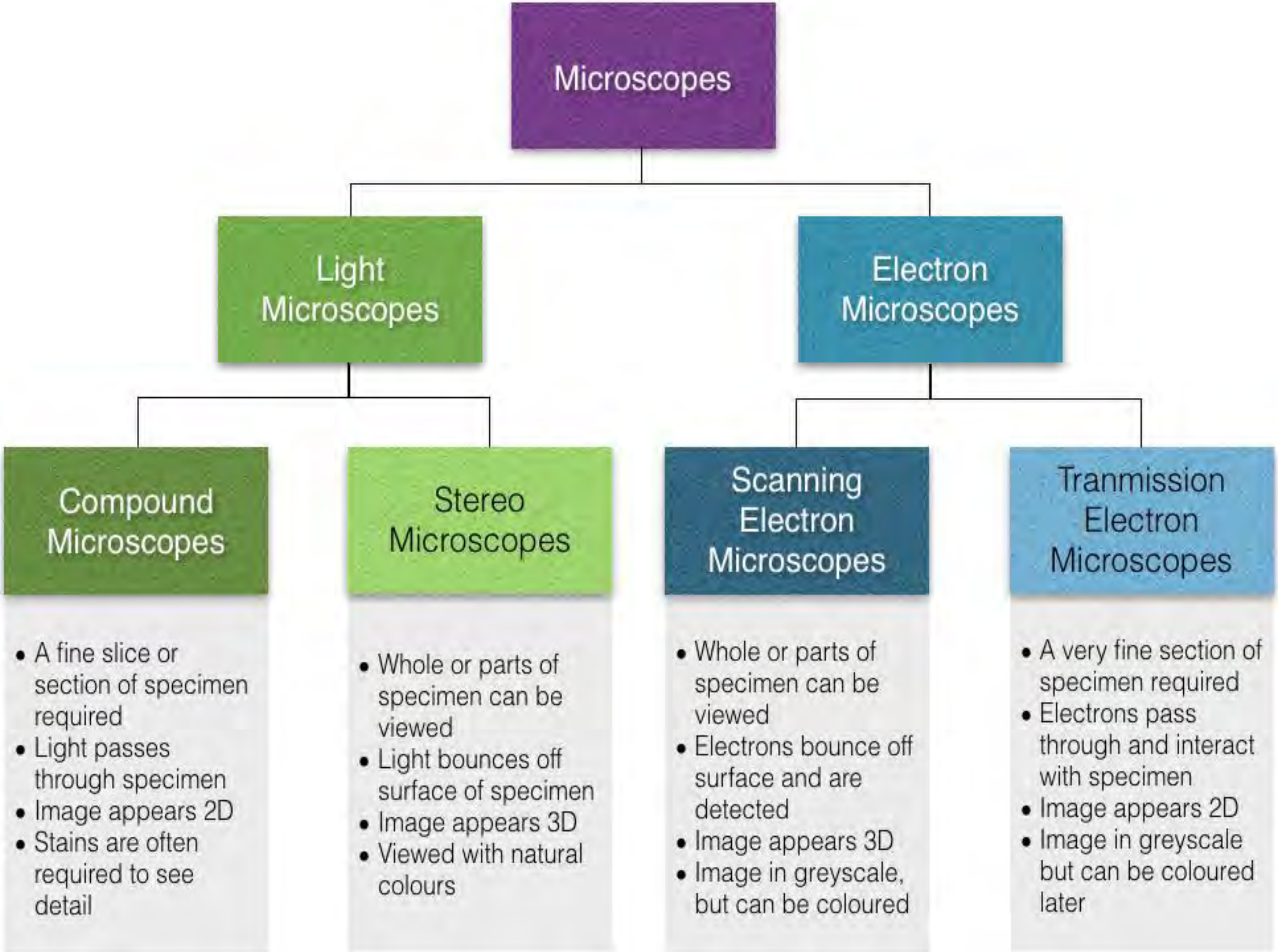
Electron microscopy can be of two types:

Scanning electron microscope (SEM)

Transmission electron microscope (TEM)

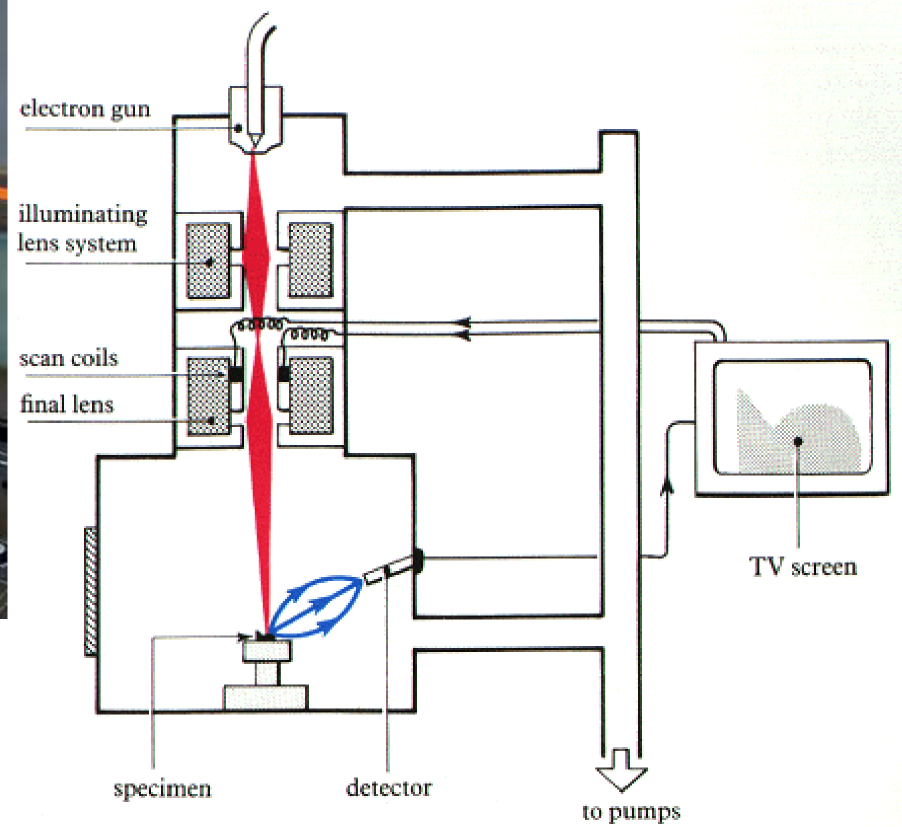
THE FIRST TIME THAT AN ATOM COULD BE SEEN WITH A MICROSCOPE WAS IN 1983 – 36 YEARS AGO !!

ZOOMING INTO A HAIR
https://www.youtube.com/watch?v=r0IK46rL6Ec


Microscopes
Light Microscopes
Electron Microscopes
Compound Microscopes
Stereo Microscopes
Scanning Electron Microscopes
Tranmission Electron Microscopes
• A fine slice or section of specimen required
• Light passes through specimen
• Image appears 2D
• Stains are often required to see detail
• Whole or parts of specimen can be viewed
• Light bounces off surface of specimen
• Image appears 3D
• Viewed with natural colours
• Whole or parts of specimen can be viewed
• Electrons bounce off surface and are detected
• Image appears 3D
• Image in greyscale, but can be coloured
• A very fine section of specimen required
• Electrons pass through and interact with specimen
• Image appears 2D
• Image in greyscale but can be coloured later

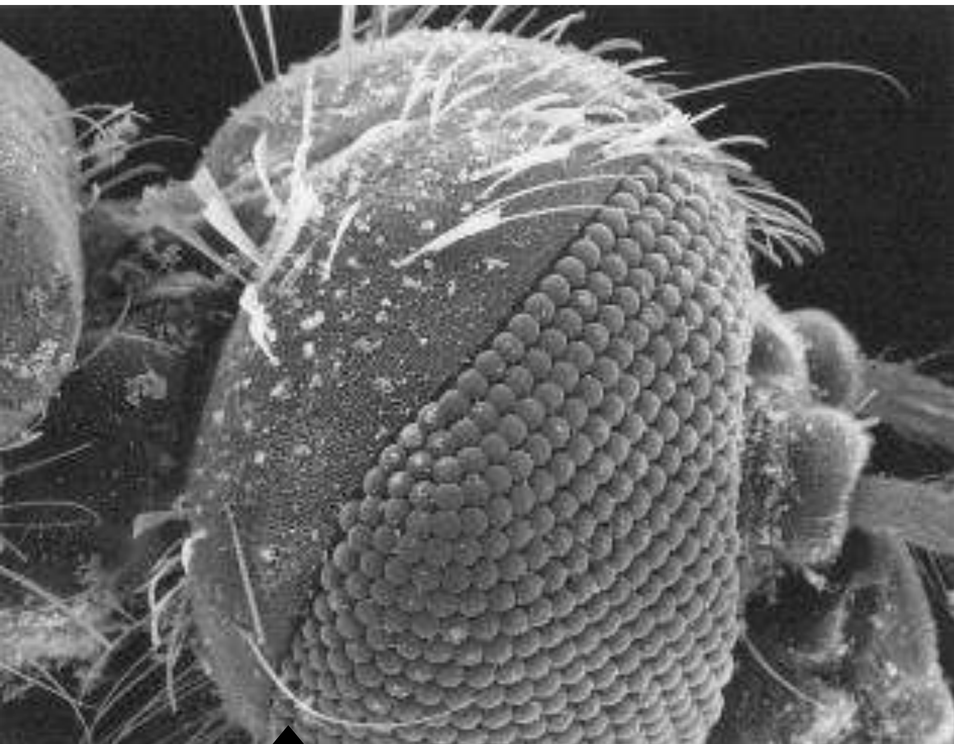
Scanning Electron Microscope (SEM)

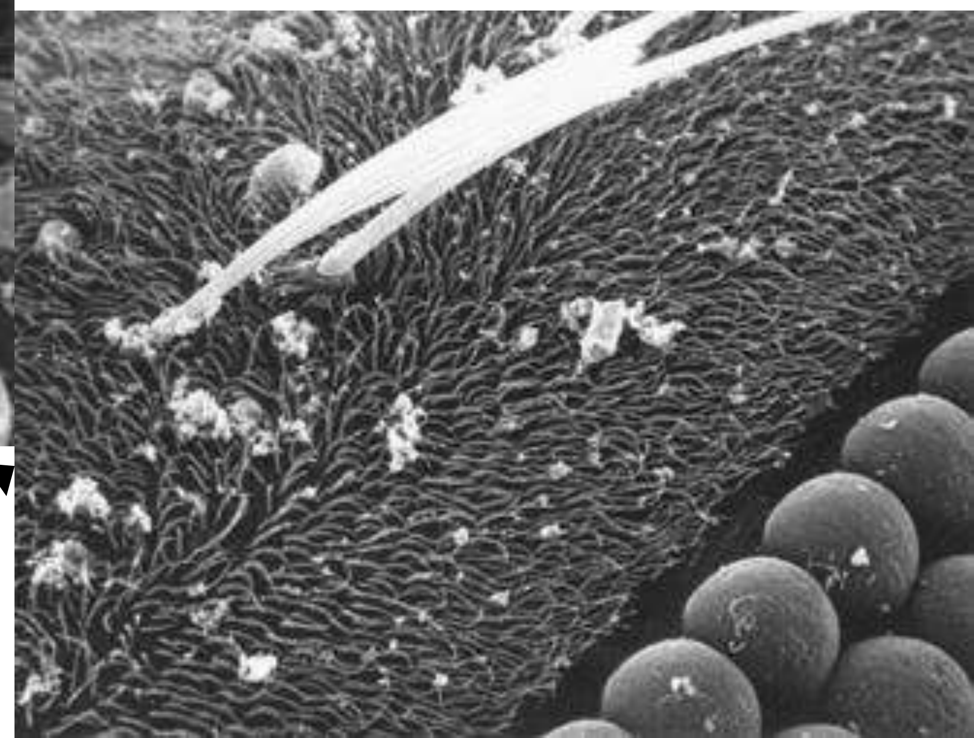
Scanning Electron Microscope (SEM)



Scanning Electron Microscope (SEM)

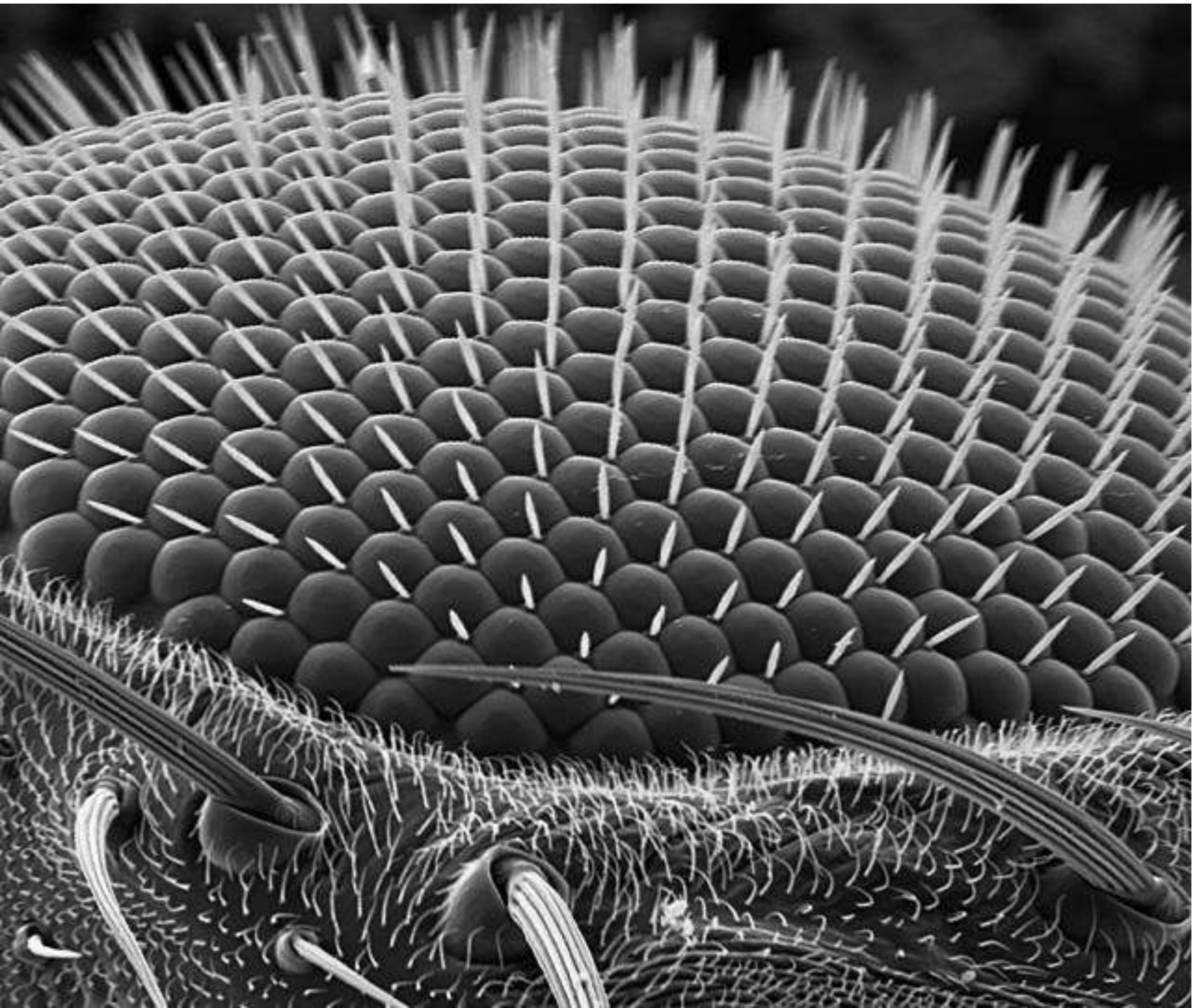
Mosquito Head





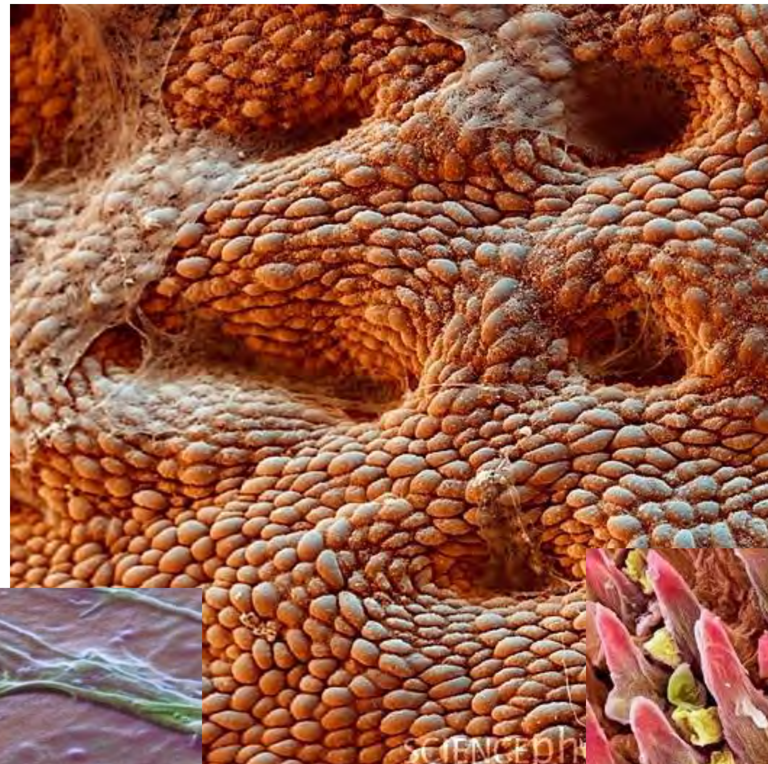
200X 2000X

Scanning Electron Microscope (SEM)



Fly Eye

Scanning Electron Microscope (SEM)



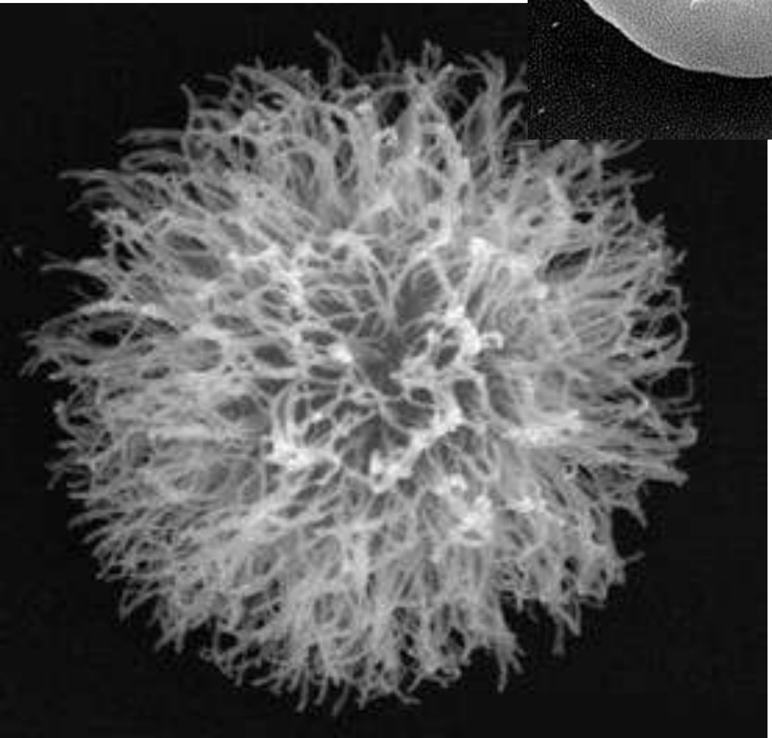
Inside of Stomach

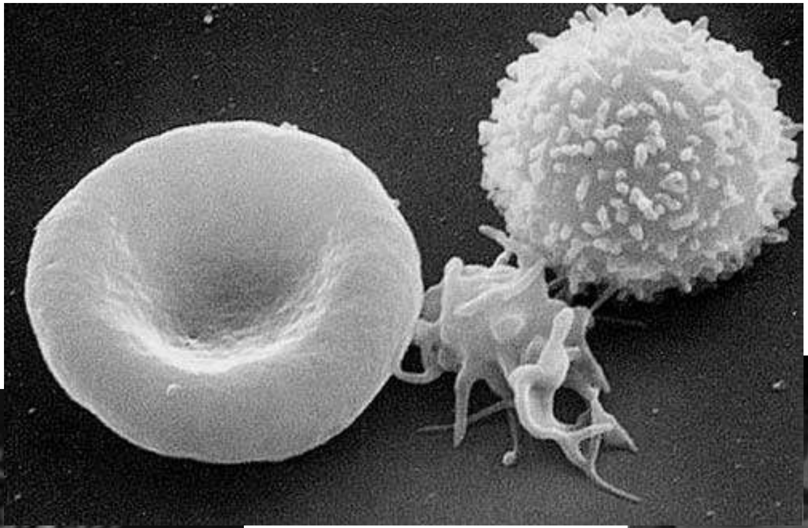
Neuron

Surface of Tongue

Scanning Electron Microscope (SEM)

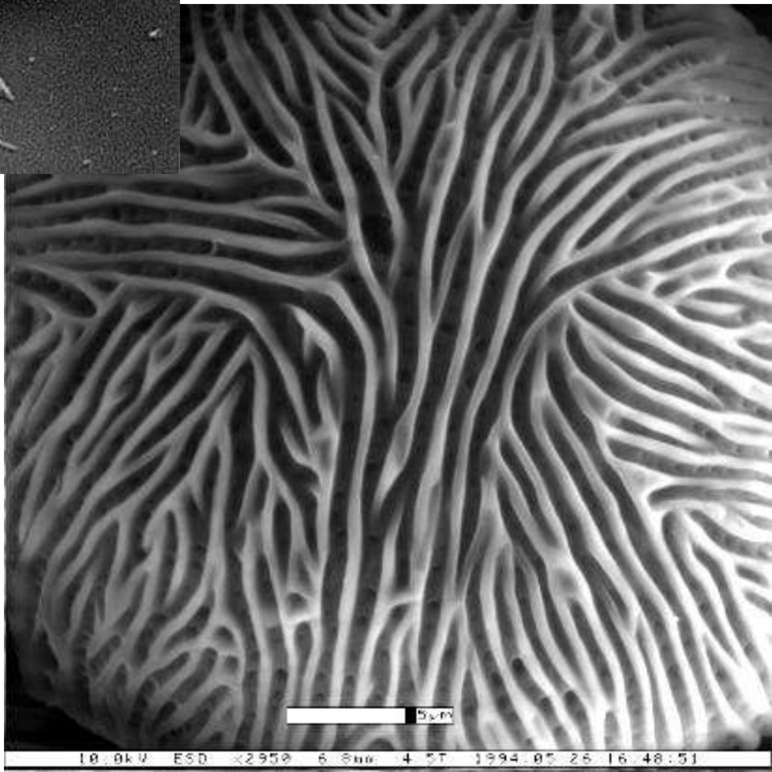
Yeast



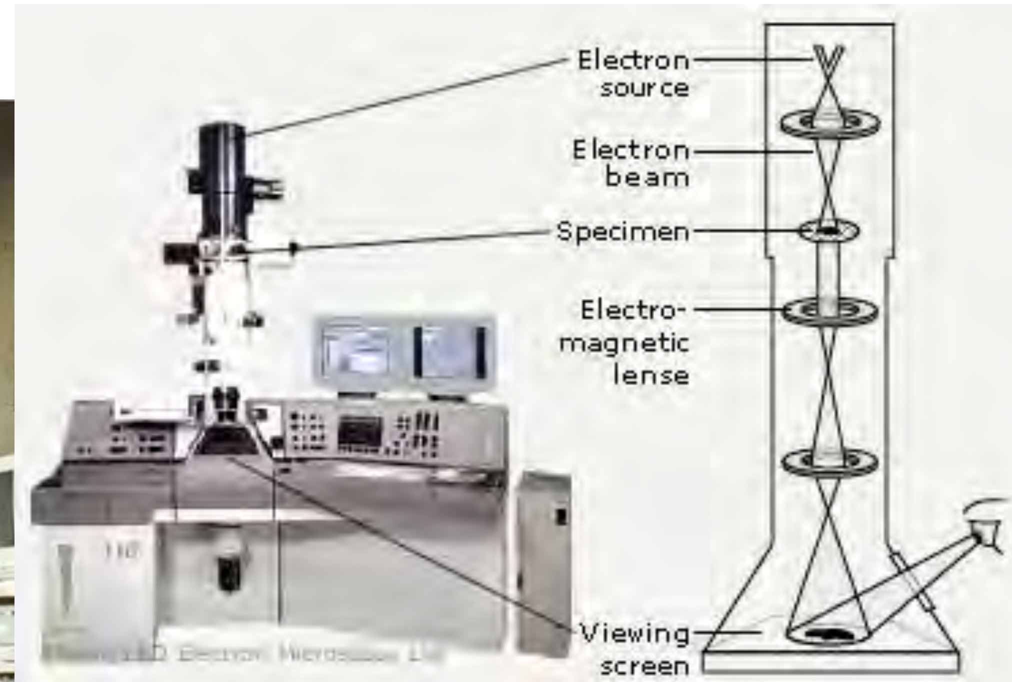


Red Blood Cell, Platelet, and White Blood Cell

Pollen

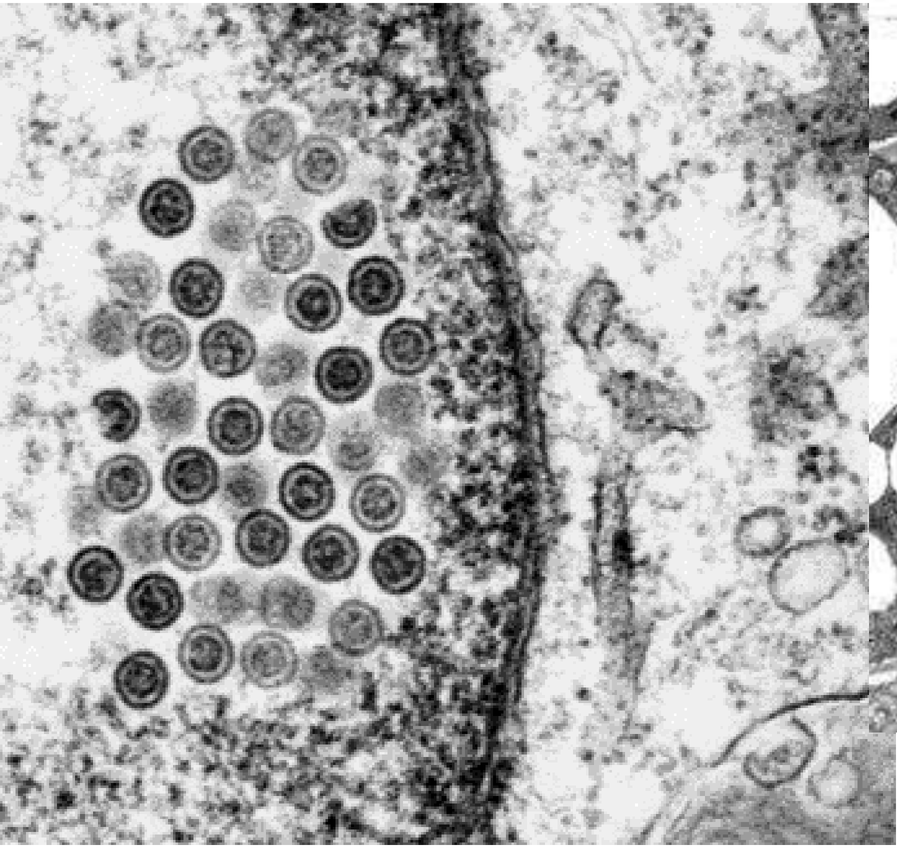


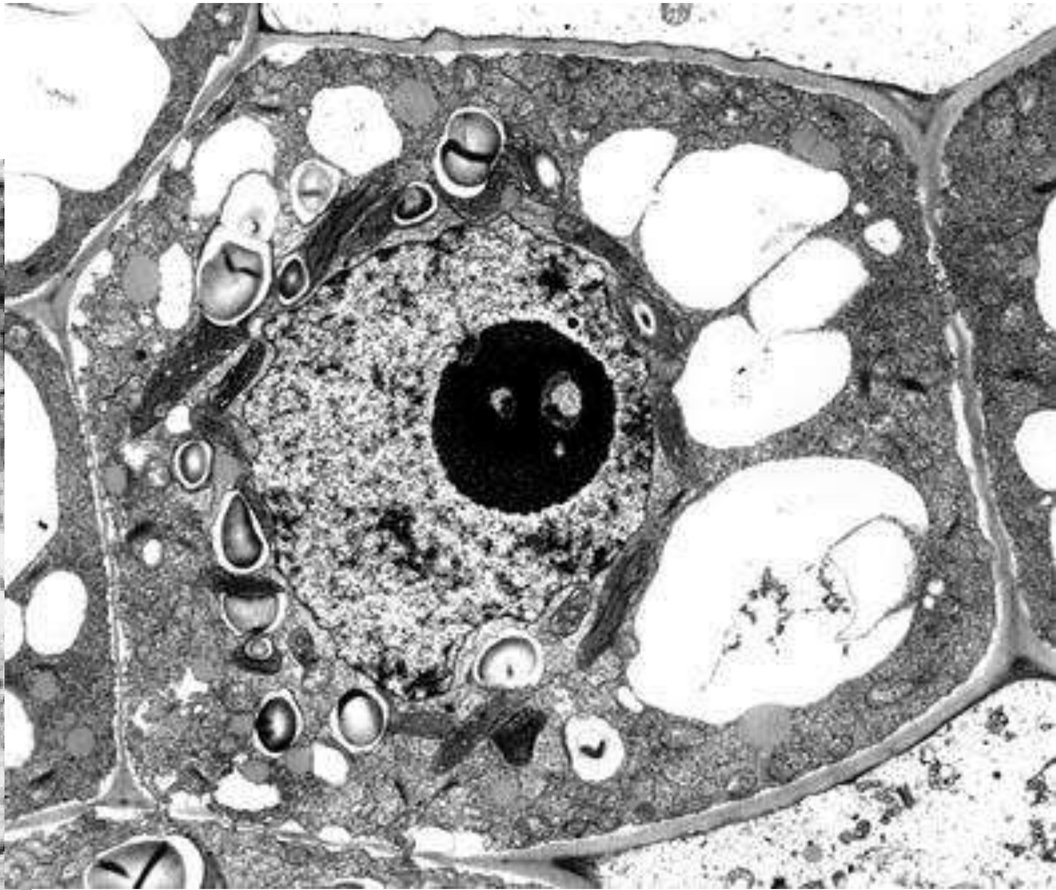
Transmission Electron Microscope (TEM)



Transmission Electron Microscope (TEM)

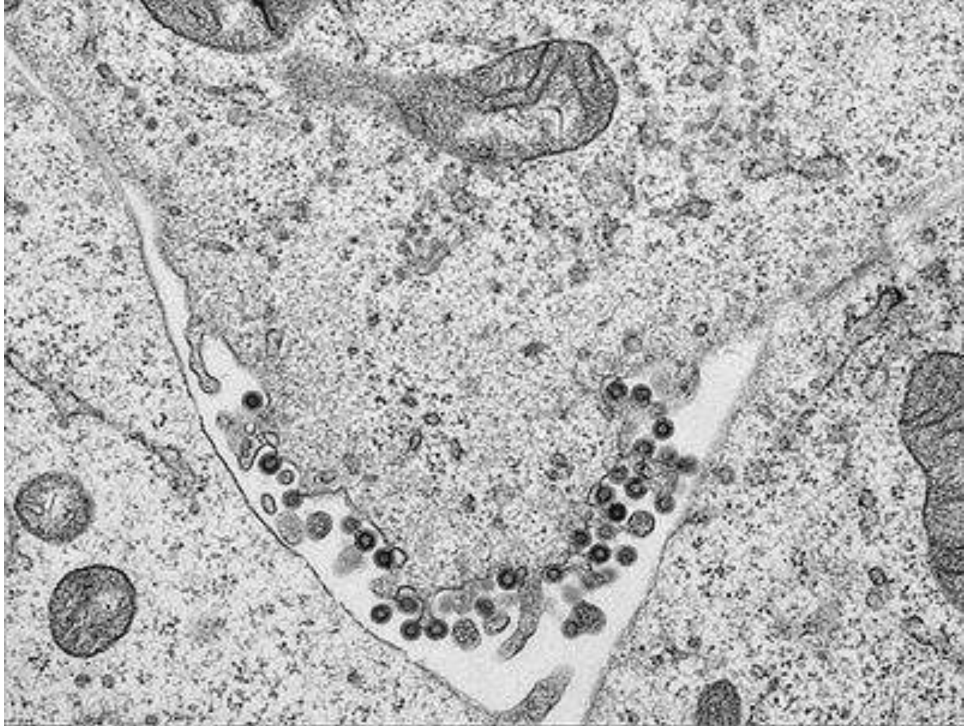
Herpes Virus



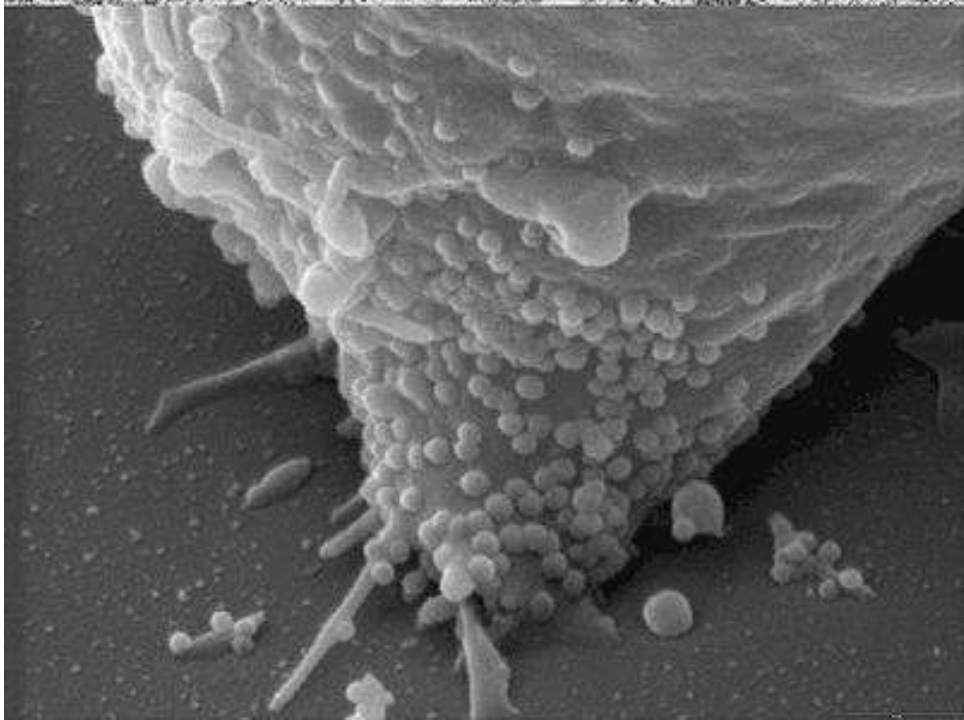


Plant Root Cell

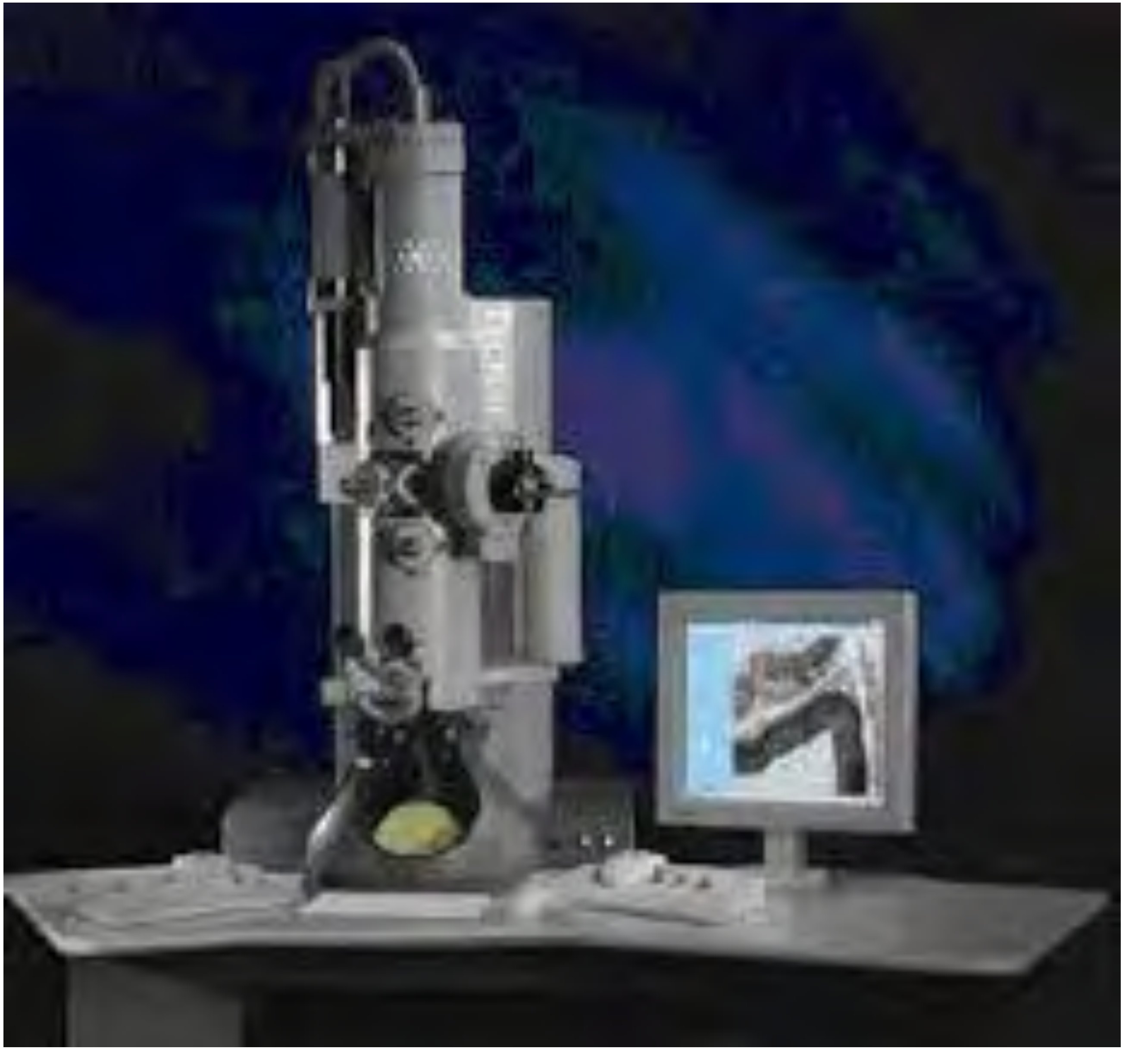
TEM vs. SEM



Viruses leaving a cell



TRANSMISSION CRYO-ELECTRON MICROSCOPY



The Microscope

- A Cryo-EM is a **TEM** with an additional specimen holder which:
  - Enable the viewing of the frozen-hydrated specimen
  - Maintains Liquid Nitrogen or Liquid Helium temperatures

(The EM stands for Electron Microscopy)

Specimen Preparation

- Two methods of specimen preparation are:
  - **Thin Film:** Specimen is placed on EM grid and is rapidly frozen without crystallizing it
  - **Vitreous Sections:** Larger samples are vitrified by high pressure freezing, cut thinly and placed on the EM grid

https://www.youtube.com/watch?v=BJKkC0W-6Qk

THE END

WITH A LONG ZOOM INTO A TOOTH !!

https://www.youtube.com/watch?v=t4RgBZlKlJI