Ministry of Higher Education
and Scientific Research

UNIVERSITY OF ANBAR
Applied Science College – Heet
Dept. of Biophysics

Medical Physics

Lecture 1

An Introduction of Medical Physics

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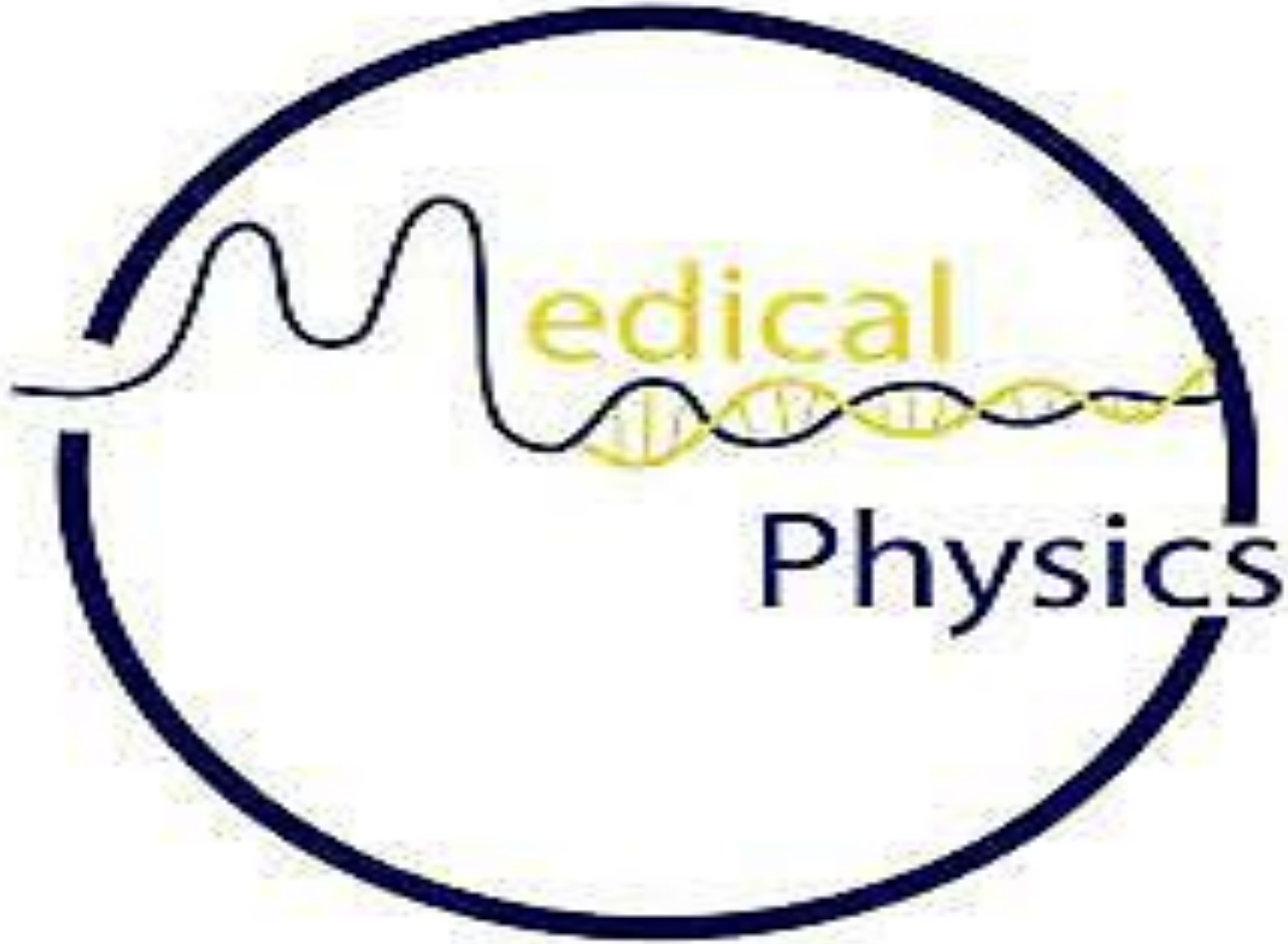
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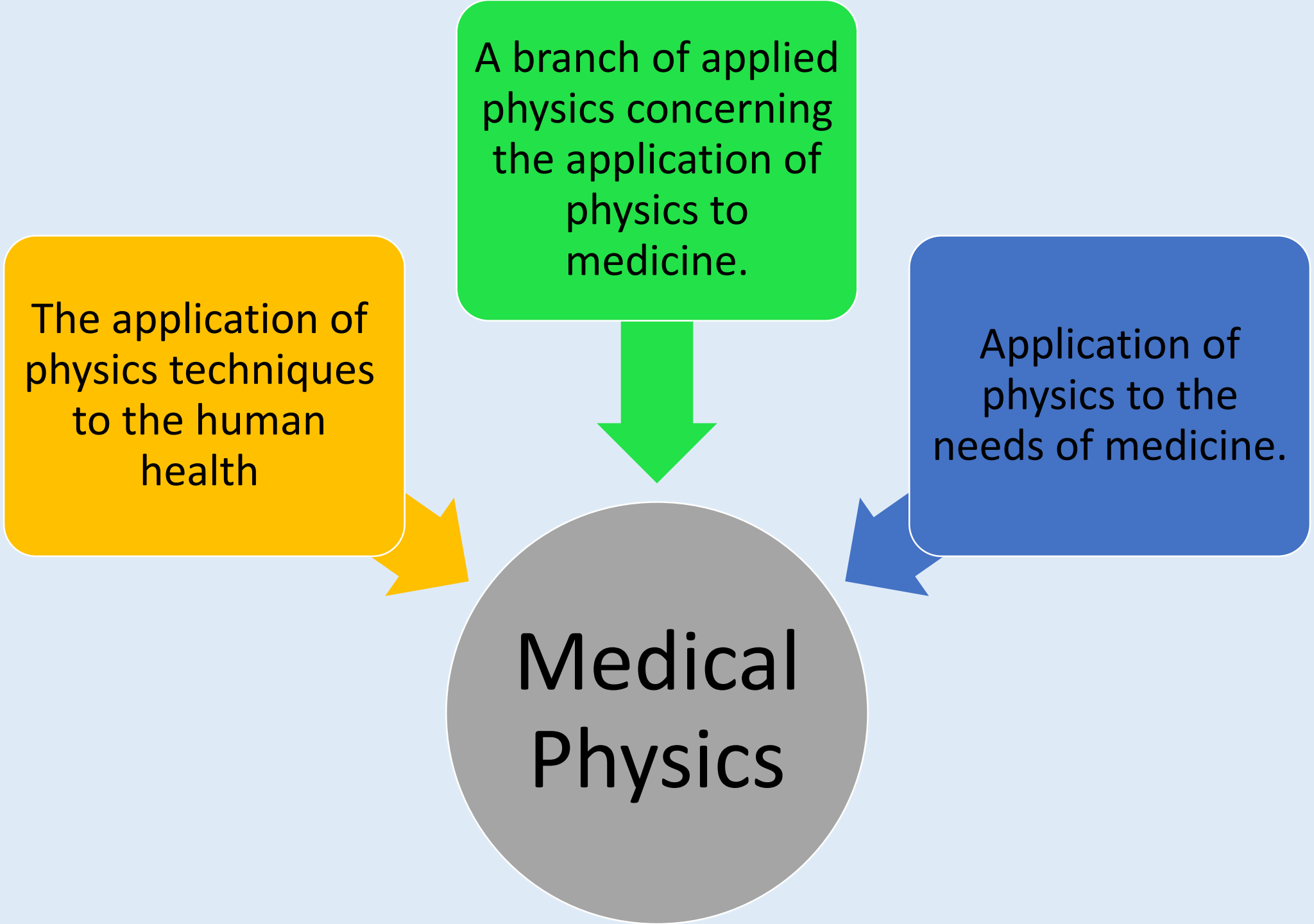
Physics


A branch of applied physics concerning the application of physics to medicine.
The application of physics techniques to the human health
Application of physics to the needs of medicine.
Medical Physics

Medical Physics(cont.)

The fields of physics that medical physics concern with, are:

1. The physical parameters which involve in the function of the body and affect(Understanding physical aspect of the body)pressure, force, Light, Work, Energy, and power .

2. Organs physics and systems of the body such as physics of:

a.Vision

b. Hearing

c. Skeletal

d. Pulmonary

e. Cardiovascular

f. Nervous systems.

Medical Physics(cont.)

3. The biomaterials used in medicine and dentistry, such as artificial bones, contact lenses and Lasik used in ophthalmology.

4. Applications of physics in the practice of medicine such as:

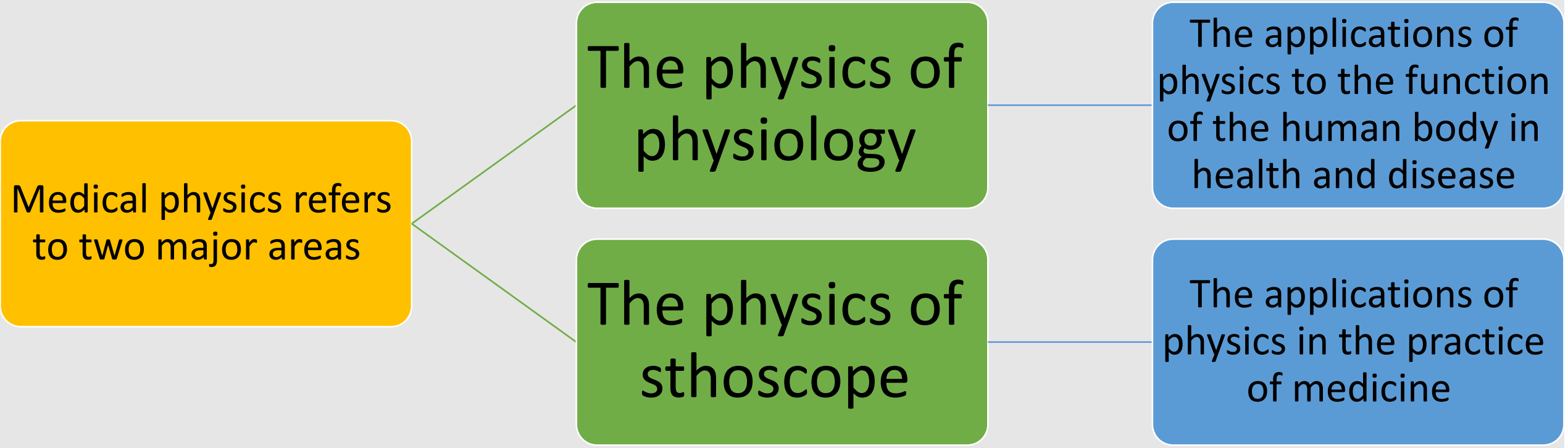
- **Computed tomography (CT) scanner.**
- **Magnetic resonance imaging (MRI).**
- **Positron emission camera (PEC).**
- **Electroretinography (ERG).**

Working in the area of
- medical instrumentation

Medical engineer

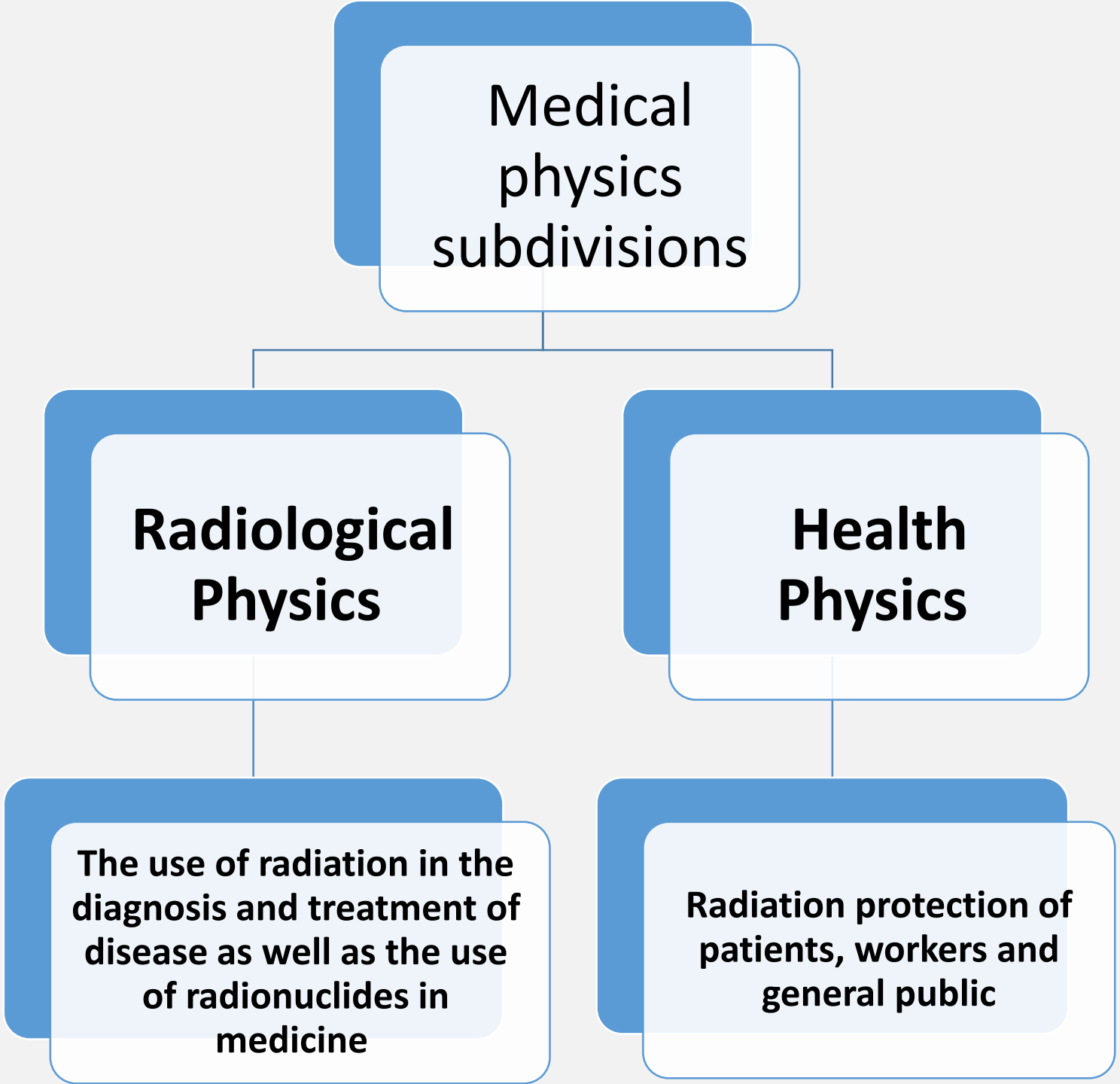
Working in the area of
- Radiological physics

Medical physicist


Medical physics refers to two major areas
The physics of physiology
The physics of sthoscope
The applications of physics to the function of the human body in health and disease
The applications of physics in the practice of medicine

Aim of the medical Physics

Application of the concepts and methods of physics to understanding the function of human body in health and diseases


Medical physics subdivisions
Radiological Physics
Health Physics
The use of radiation in the diagnosis and treatment of disease as well as the use of radionuclides in medicine
Radiation protection of patients, workers and general public

Application of physics in medicine

- Diagnostic
- Therapy
- Patient monitoring

Diagnostic

Stethoscope

Manometer(blood pressure)

Sphygmomanometer

Electrocardiograph(ECG)

X ray

Electroencephalograph(EEG), Electromyography(EMG)

Ultrasound, tuning Fork

Magnetic Resonance Imaging (MRI)

Flow meter, Spirometer to study the function lungs

Audiometer

Optics, Laser, Gamma camera to study the function of kidney, liver, and lungs

Computer tomography (CT scan)

Therapy

Radiotherapy

Cobalt sixty(Co sixty)

High voltage

Ultrasound

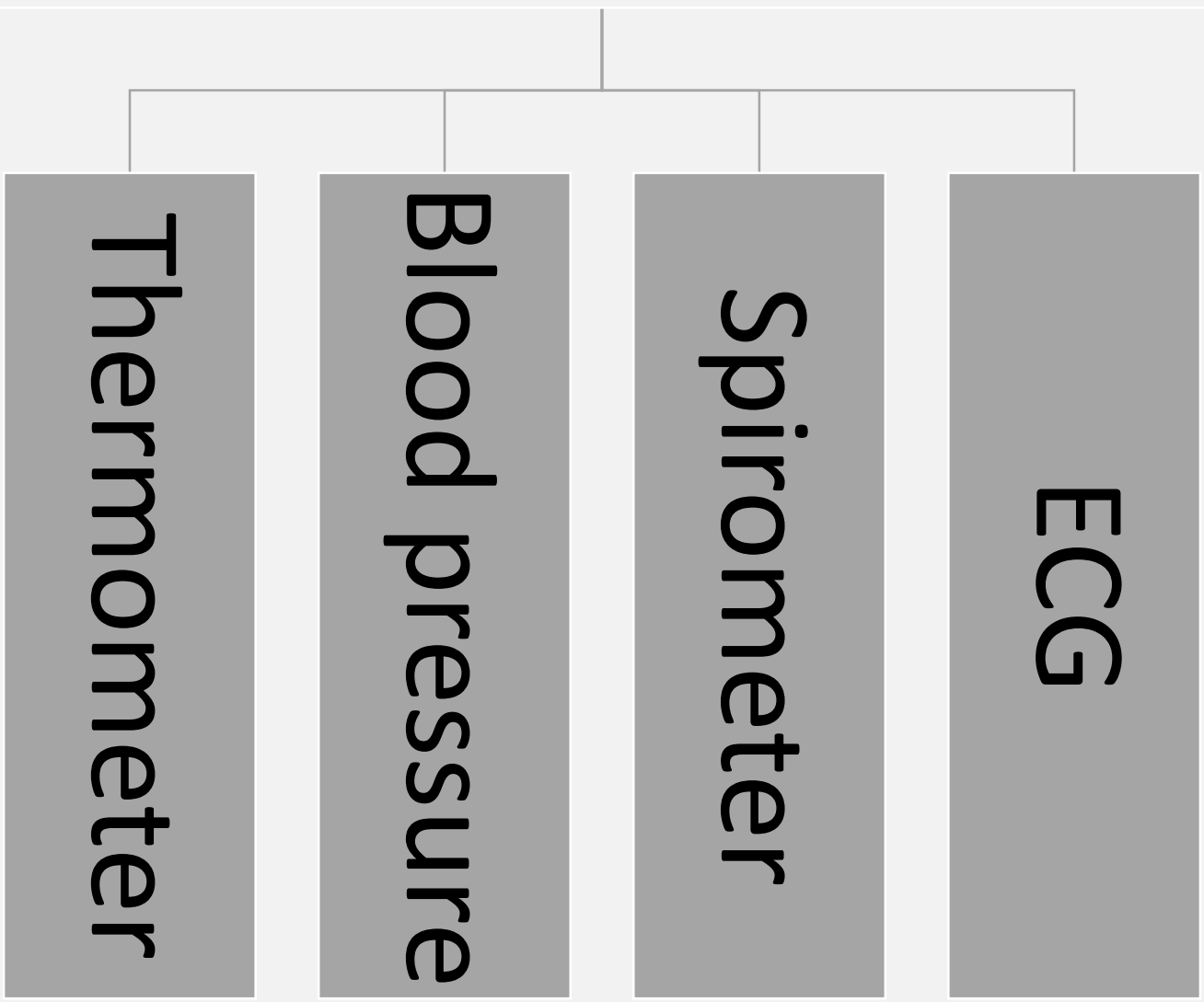
infrared

Radio frequency

Heating

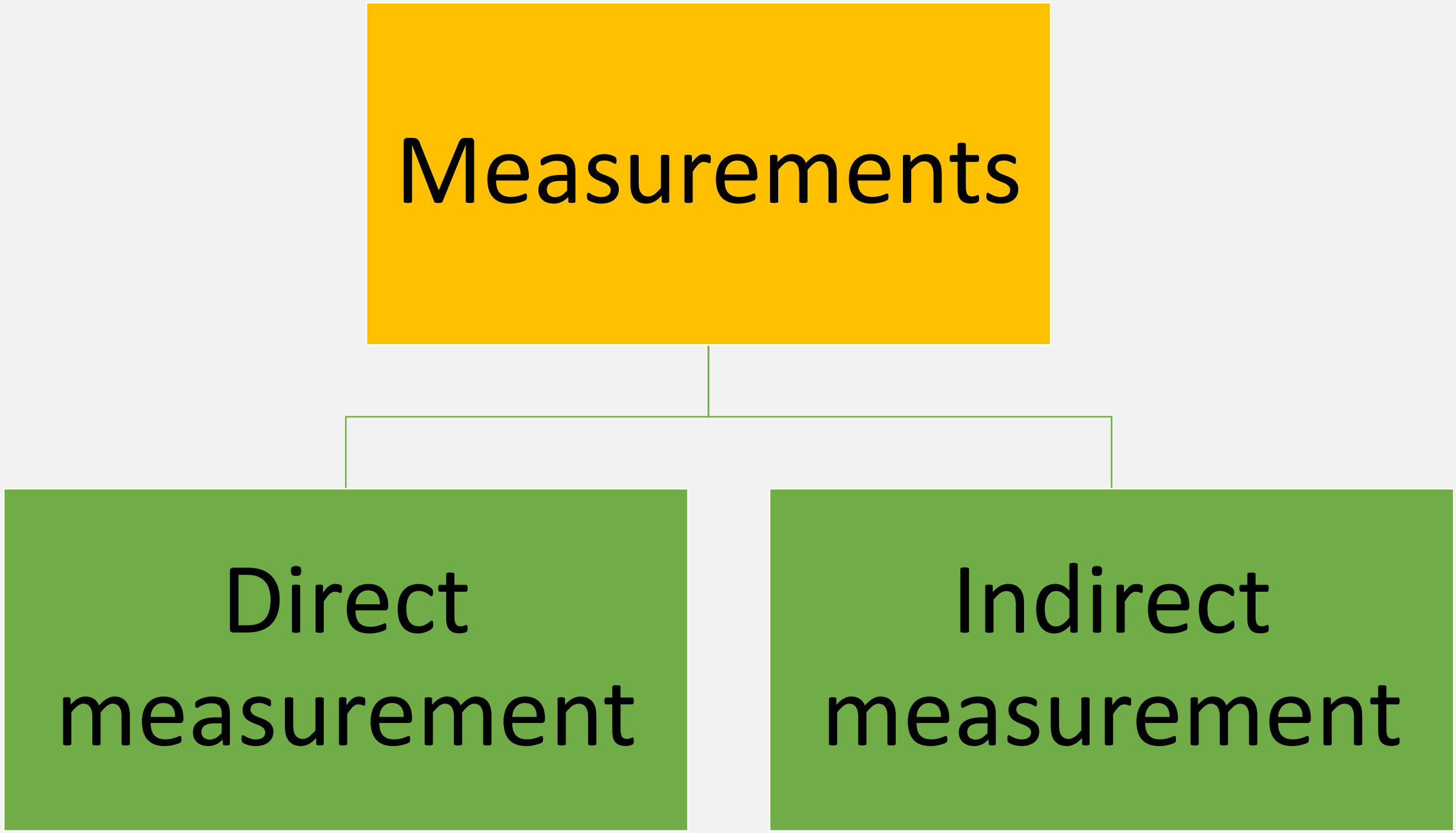
Laser

Patient monitoring



Measurements

Gives a number to that property	The result of a measurement is normally in two parts :a number and a unit of measurement	Measurements are always made using instrument of some kind	Tells us about a property of something


Measurements
Direct measurement
Indirect measurement

There are two methods for performing dimensional measurements: Direct measurement and Indirect measurement.

With direct measurements, measuring instruments such as Vernier calipers, micrometers, and coordinate measuring machines are used to measure the dimensions of the target directly. These measurements are also known as absolute measurements.

Measurements can be performed over a wide range specified by the scale of the measuring instrument, but there is also the chance that the measurement will be wrong due to erroneous readings of the scale.

Measurements Unites in Medicine

Measurements unites in medicine divided into two groups:

1.Standard Unites: some quantities in medicine are measured in the same units for measurement in standard units e.g. force in newton, work in joule, power in watts etc.

2. Nonstandard units: Some other quantities in medicine are measured in special units which are different from the units used for measurement of the same quantities out of the field of medicine. These units are called nonstandard units. e.g.: in medicine the pressure is measured in mmHg or cmHg instead of Newton/square meter (N/m2) or dyne/square centimeter (dyne/cm2), and energy in kilocalorie (Kcal) or calorie (Cal) instead of Joule.

Repetitive and nonrepetitive measurements

There are two groups of physical measurements in the body which are the repetitive and non-repetitive measurements.

1. The repetitive measurement is the number of repetition per second (sec), minute (min) and hour (hr), e.g.: for normal person the pulse rate of the heart a proximally equal 70/min, breathing rate equals16/min for men and 20/min for women.

2. The non-repetitive quantities mean that some movements in the body are not repetitive uniformly ,such as the time of the function of the kidney to remove the waste from the blood, food digestion in the body, time intervals of nerve signals, and eye movement.

Accuracy of measurement

The measurement in medicine should be very accurate and the percentage of error should be as low as possible, otherwise the diagnosis or treatment will lead to risky results. Therefore, we should have devices of the best reliable makes.

The measurement error is a result of several reasons such as:

1. **The measuring instruments: The error can happen due to a device or technical error.**
2. **Psychological reasons: The blood pressure and pulse rate can be affected during the measurement by several psychological rather than reasons.**

The inaccurate measurements can lead to wrong directions which are of two types:

A. **A false negative error occurred when a patient is diagnosed to be free of particular disease when he/she does have it.**

B. **A false positive error occurred when the patient is diagnosed to have a particular disease when he/she does not have it.**

Reduction of diagnostic errors and measurement uncertainties

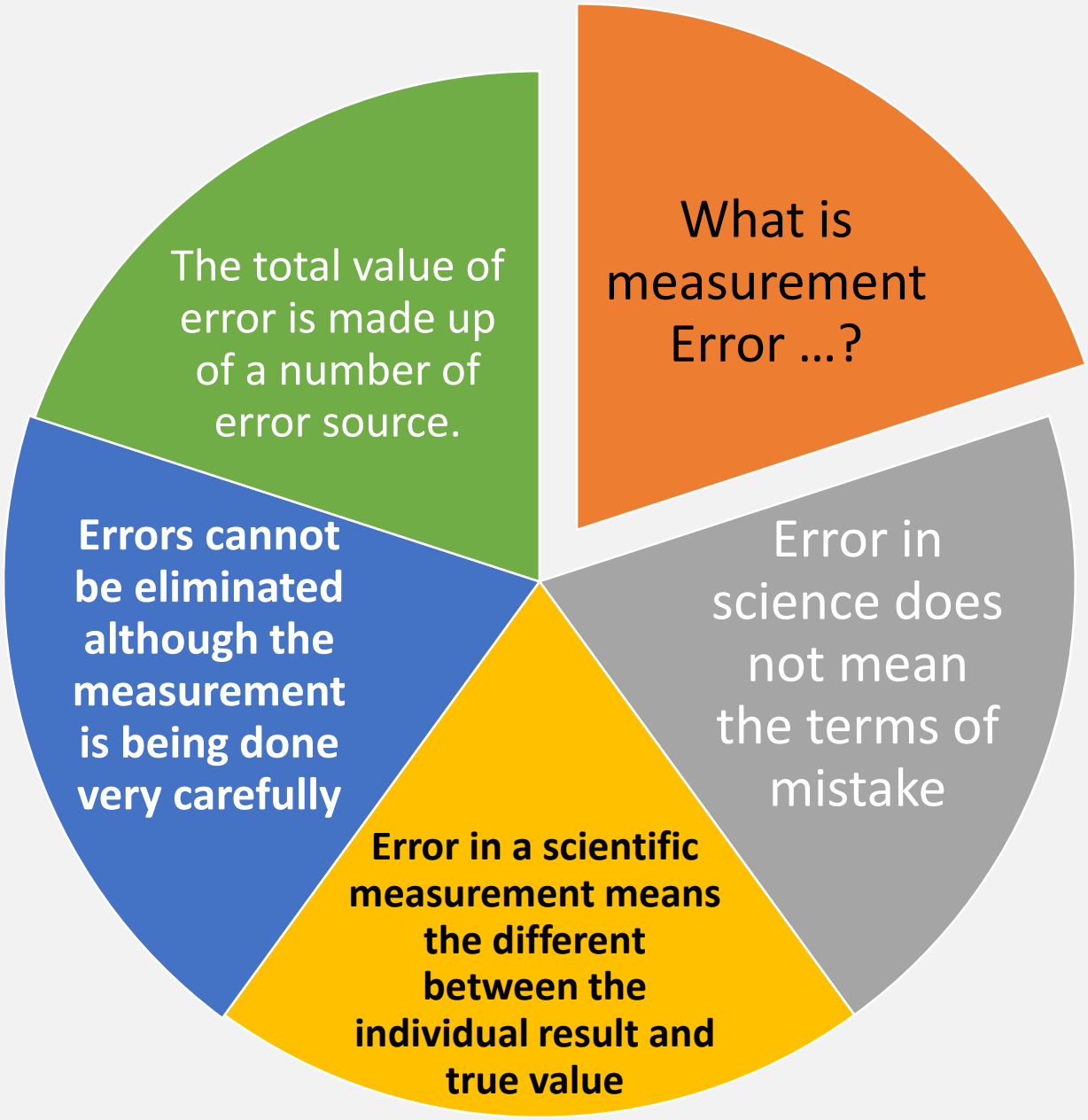
The positive and negative errors and the uncertainties of measurements can be reduced by several ways such as:

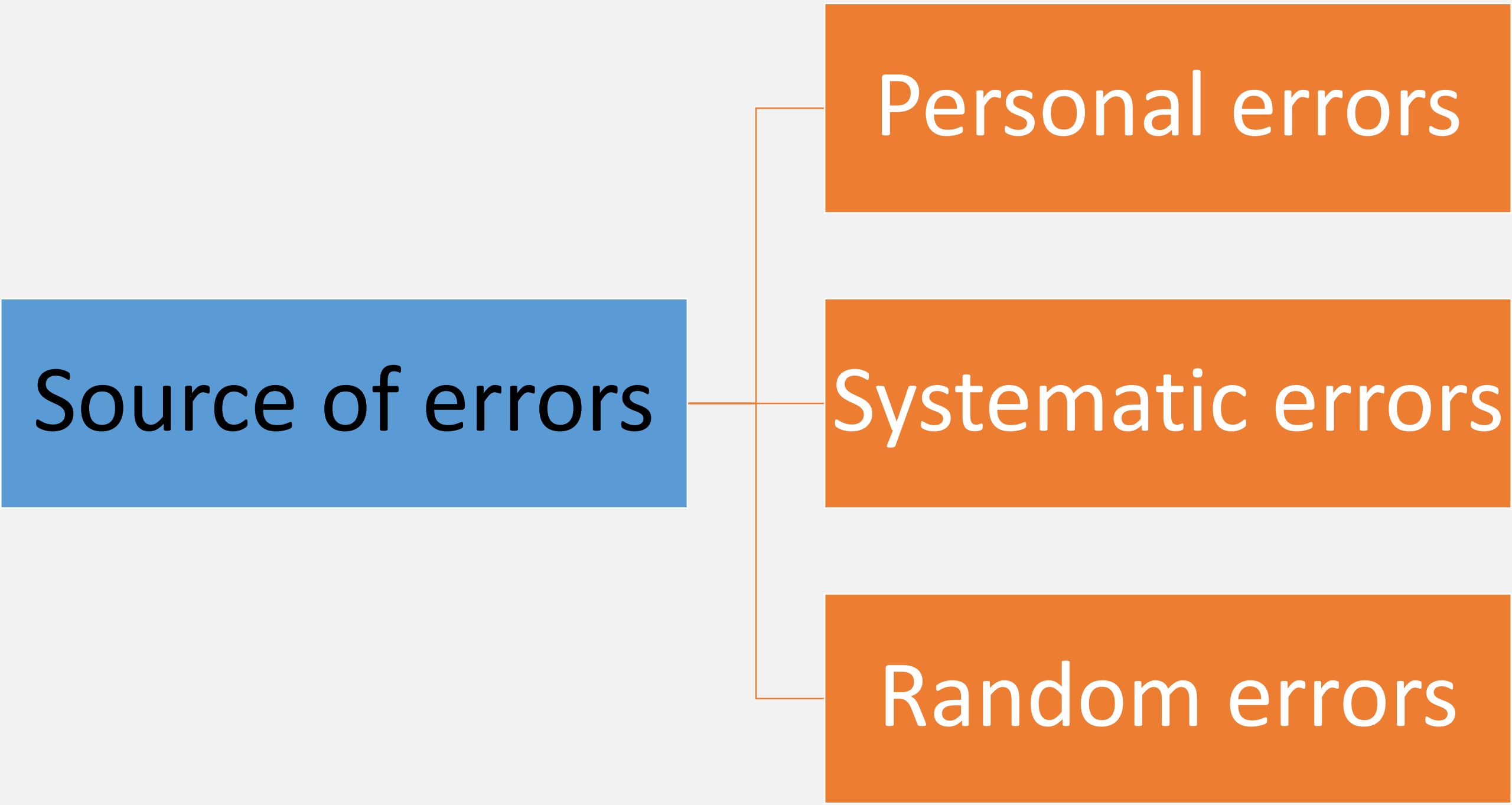
1. **Research in the causes of misleading laboratory test values.**
2. **Repeating the measurement.**
3. **Care in taking the measurement.**
4. **Development of new clinical tests.**
5. **Better instrumentation.**
6. **Using reliable instruments.**
7. **Calibration of instruments relative to standard or already calibrated measuring instruments.**

The medical measurements proceed the treatment

The medical measurements that the physician should proceed before deciding how to treat a patient include kinds of measurements which are:

1. **The routine measurements: these measurements include the body temperature, pulse rate, blood pressure and body weight.**
2. **The other required tests according to the case of the patient: the doctor can decide the other required measurements for the patient such as: Laboratory investigation, Body signals investigations and Machinery tests.**


What is measurement Error …?
Error in science does not mean the terms of mistake
Error in a scientific measurement means the different between the individual result and true value
Errors cannot be eliminated although the measurement is being done very carefully
The total value of error is made up of a number of error source.


Source of errors
Personal errors
Systematic errors
Random errors

Personal errors

Personal error comes into existence due to making an error in reading a scale. It is due to faulty procedure adopted by the person making measurement.

Systematic errors

These are errors associated with particular instruments or techniques, such as an improperly calibrated instrument. Any measurement, x, may include a small error.

Random errors•

Random errors from unknown and unpredictable variations in errors and are some times beyond the control of the observer.

Fundamental Quantities and Their Units

Quantity	SI Units (symbol)
Length	Meter (m)
Mass	Kilogram (Kg)
Time	Second (s)
Temperature	Kelvin (K)
Electric Current	Ampere (A)
Luminous Intensity	Candela (Cd)

Prefixes for Powers of Ten

Power	Prefix	Abbreviation	Power	Prefix	Abbreviation
10^{-24}	yocto	y	10^{3}	kilo	k
10^{-21}	zepto	z	10^{6}	mega	M
10^{-18}	atto	a	10^{9}	giga	G
10^{-15}	femto	f	10^{12}	tera	T
10^{-12}	pico	p	10^{15}	peta	P
10^{-9}	nano	n	10^{18}	exa	E
10^{-6}	micro	μ	10^{21}	zetta	Z
10^{-3}	milli	m	10^{24}	yotta	Y
10^{-2}	centi	c			
10^{-1}	deci	d			