LOGO

Safety with Electrical Apparatus

Lecture II

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Safety with Electrical Apparatus

- Physiotherapist and other health care professionals work with patient in hazardous environments such as hospitals and private clinics.

- Defective equipment, errors of judgment based on lack of knowledge concerning safety regulation and principles can cause damage and electrical hazards.

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Electrical Shock

- Electrical shock is the primary concern of clinician. Electrical shock involves the flow of current through human tissues, usually with adverse effect.

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Electrical Shock

- The danger from an electrical shock depends on

1- The type of current

2- How high the voltage is.

3- How the current traveled through the body.

4- The person's overall health.

5- How quickly the person is treated.

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FACTORS HELP INCREASE EFFECT OF ELECTRICAL SHOCK

1- Tissue resistance (impedance): impedance of the skin may range 500,000 ohms for dry skin and 1000 ohms for wet skin.

2- Size of area conducted to electric current.

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Factors help increase effect of electrical shock

3- Current intensity (amplitude)

Current Amplitude

1 mA

16 mA

50 mA

100mA to 3A

6A

Lead to

Physiological Effects

Threshold for tingling sensation

Muscle contraction

Pain and possible fainting

Ventricular fibrillation

Sustained myocardial contraction, temporary respiratory paralysis and burns

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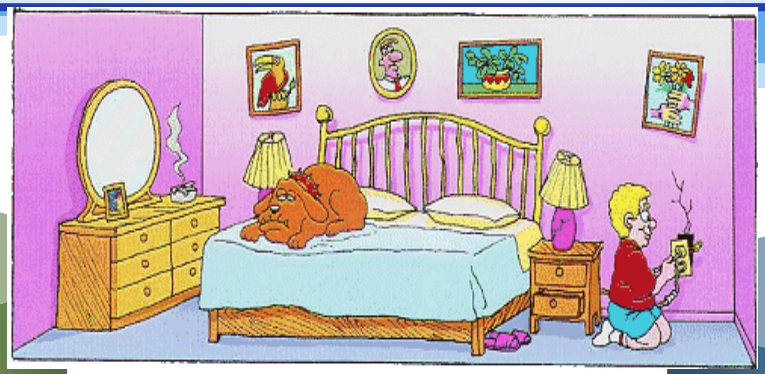
Electric Shock due to Main-type Current



If an electric current is passed through the whole body it tends to spread throughout the low resistance subcutaneous tissues.

Very large current will flow very easy if the skin is wet and according to Ohm's law the current through a 1000 Ω resistance due to 240V would be 240mA which is enough to cause ventricular fibrillation in the heart muscle.

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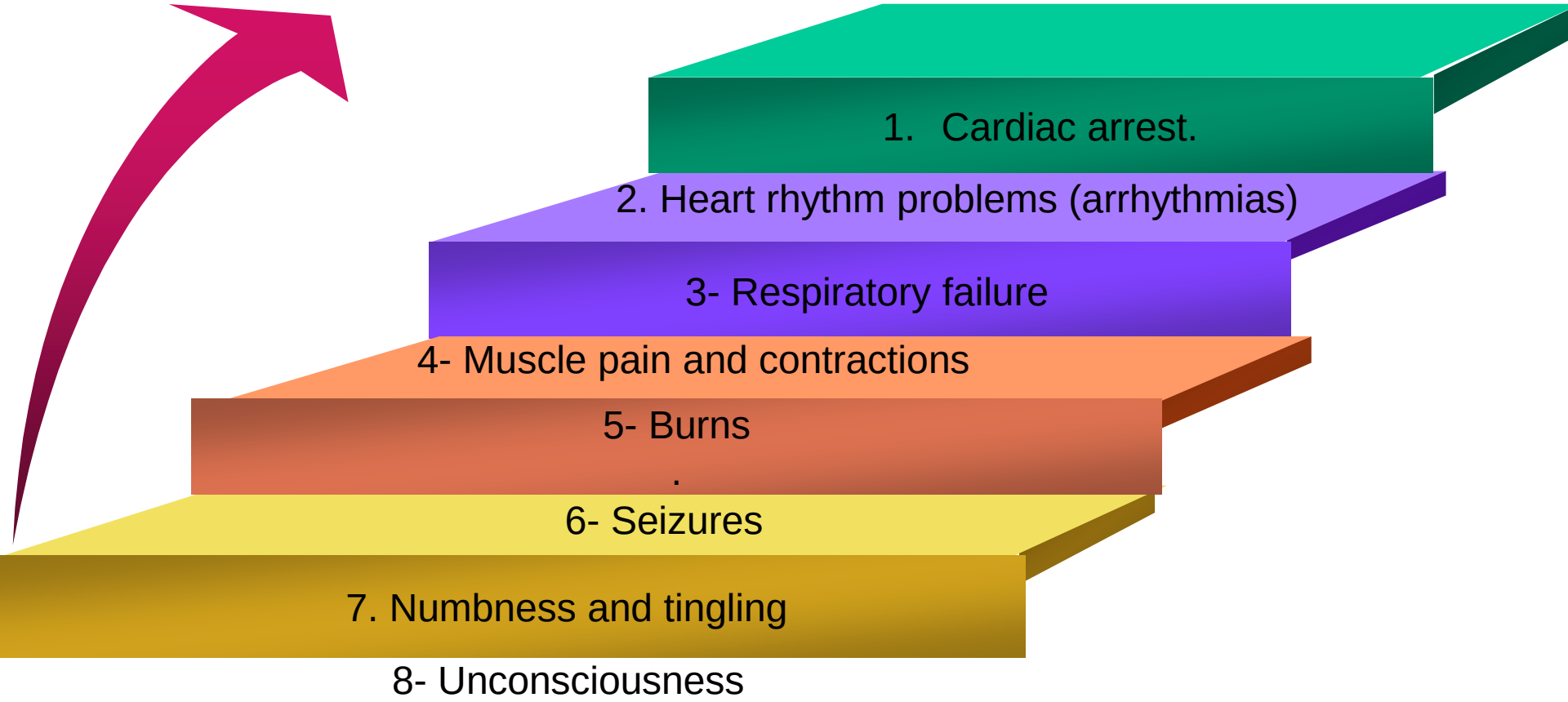
IMMEDIATE TREATMENT OF MAINS CURRENT SHOCK

if any of these signs or symptoms occur:



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IMMEDIATE TREATMENT OF MAINS CURRENT SHOCK

While waiting for medical help, follow these steps:

1- Look first. Don't touch. The person may still be in contact with the electrical source. Touching the person may pass the current through you.

2- Turn off the source of electricity, if possible. If not, move the source away from you and the person, using a non-conducting object made of cardboard, plastic or wood.

3- Check for signs of circulation (breathing, coughing or movement). If absent, immediately start to clear air-way, mouth-to-mouth cardiopulmonary resuscitation (CPR) and external cardiac massage.

4. Transfer the victim to the nearest hospital.

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Electric Burn

All forms of powerful electric stimulation of the skin can cause burns especially unidirectional currents.

This can be avoided by ensuring that the contact surface between the electrode and the skin is well covered with gel (the better the contact, the lower the resistance).

Patients with reduced skin sensitivity run the greatest risk of being burnt.

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Electric Burn

Burns can be avoided among these patients by lowering frequency stimulation to its lowest possible effective level to treatment considerably lower amounts of energy to the skin than high frequency.

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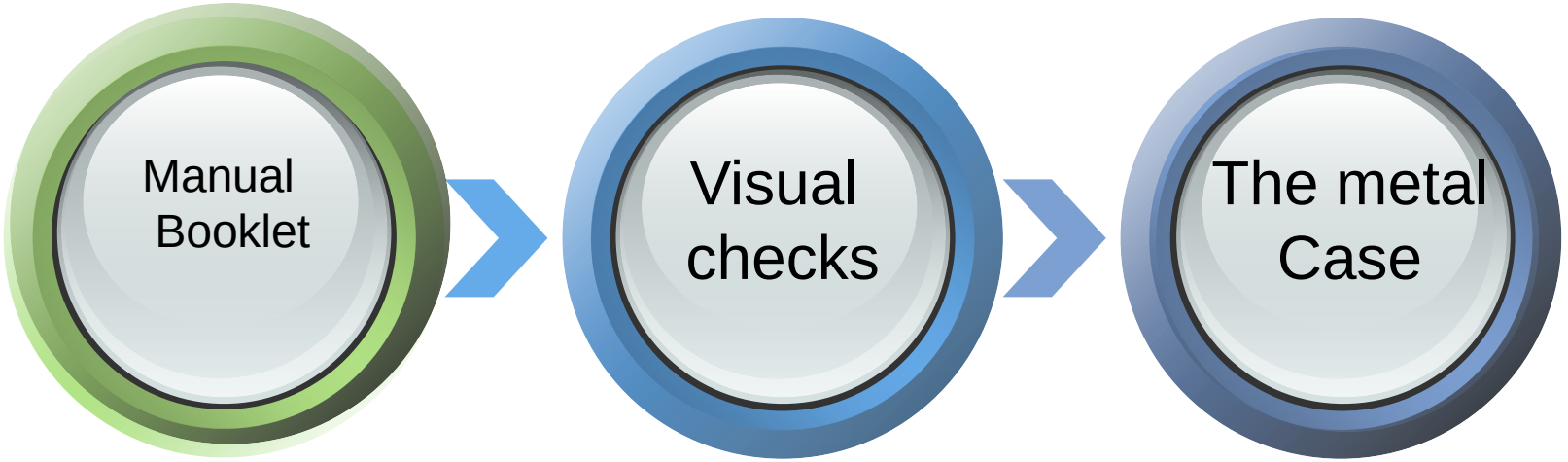
Safety Features of Electrical Apparatus Supplied from the Mains



evaluates equipment Safety and performance should be consulted before placing equipment in the clinic.

must be made before using any electrotherapy equipment.

Connect the metal case of the apparatus to the large earth terminal of the three-pin plug and socket.

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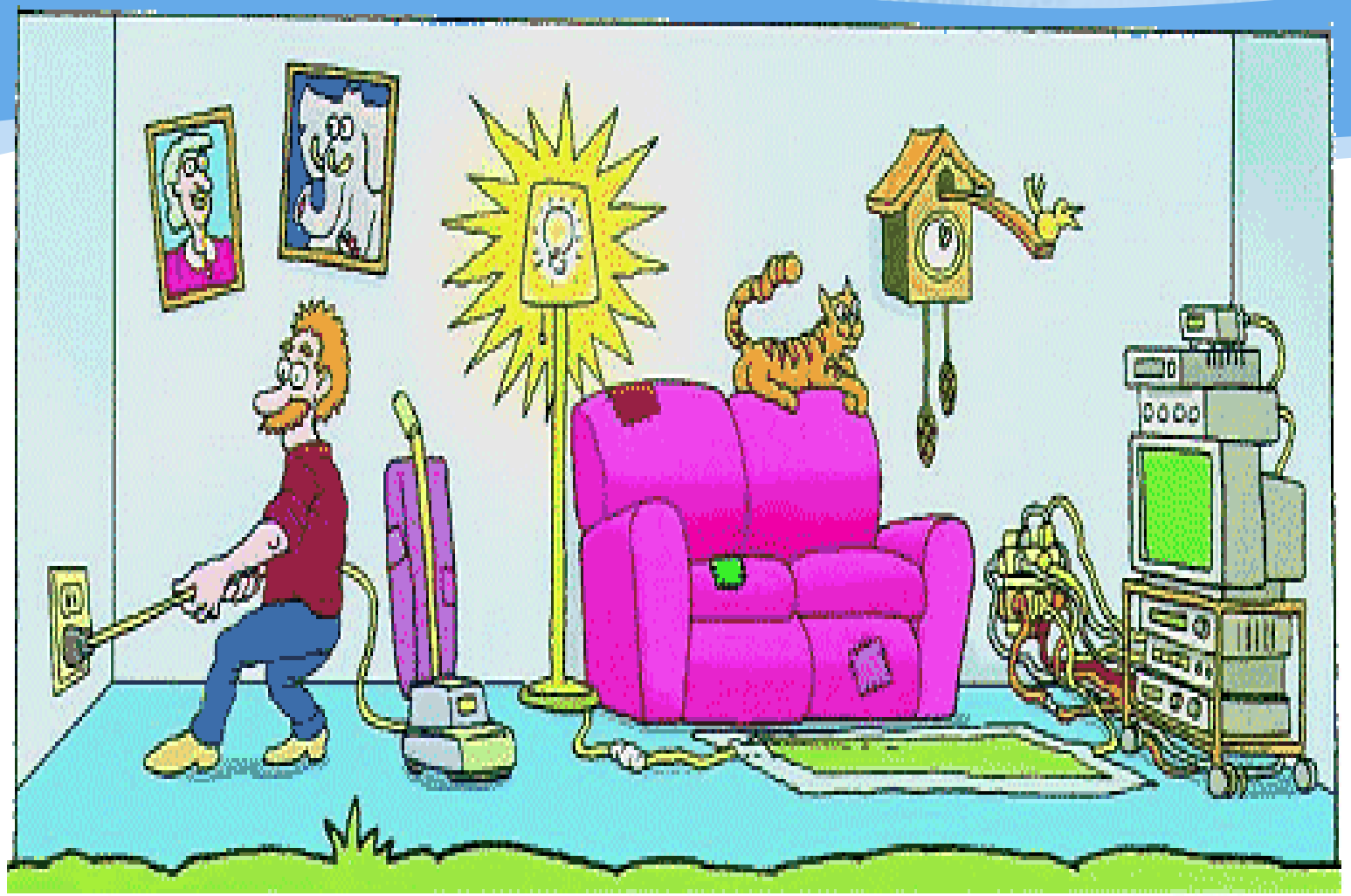

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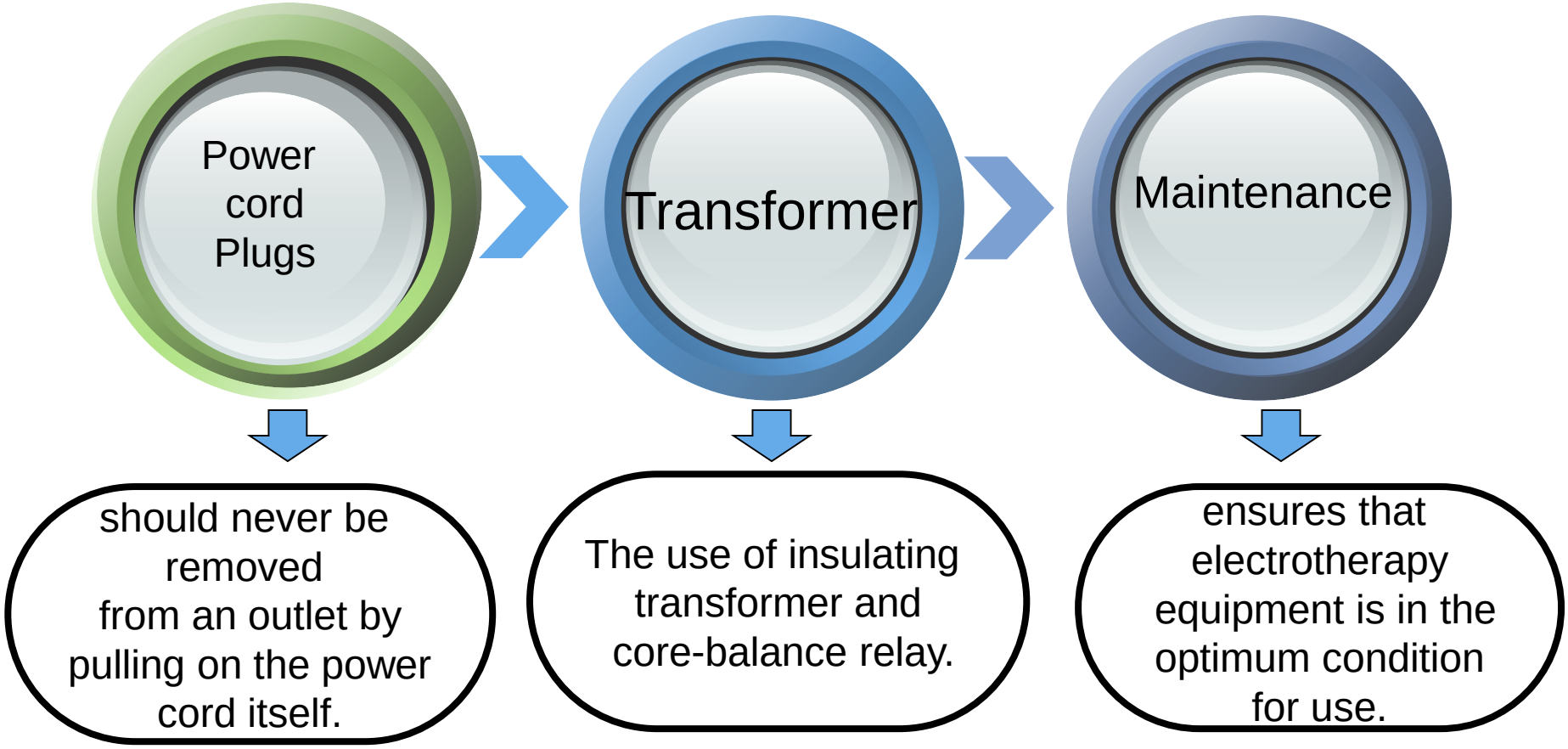

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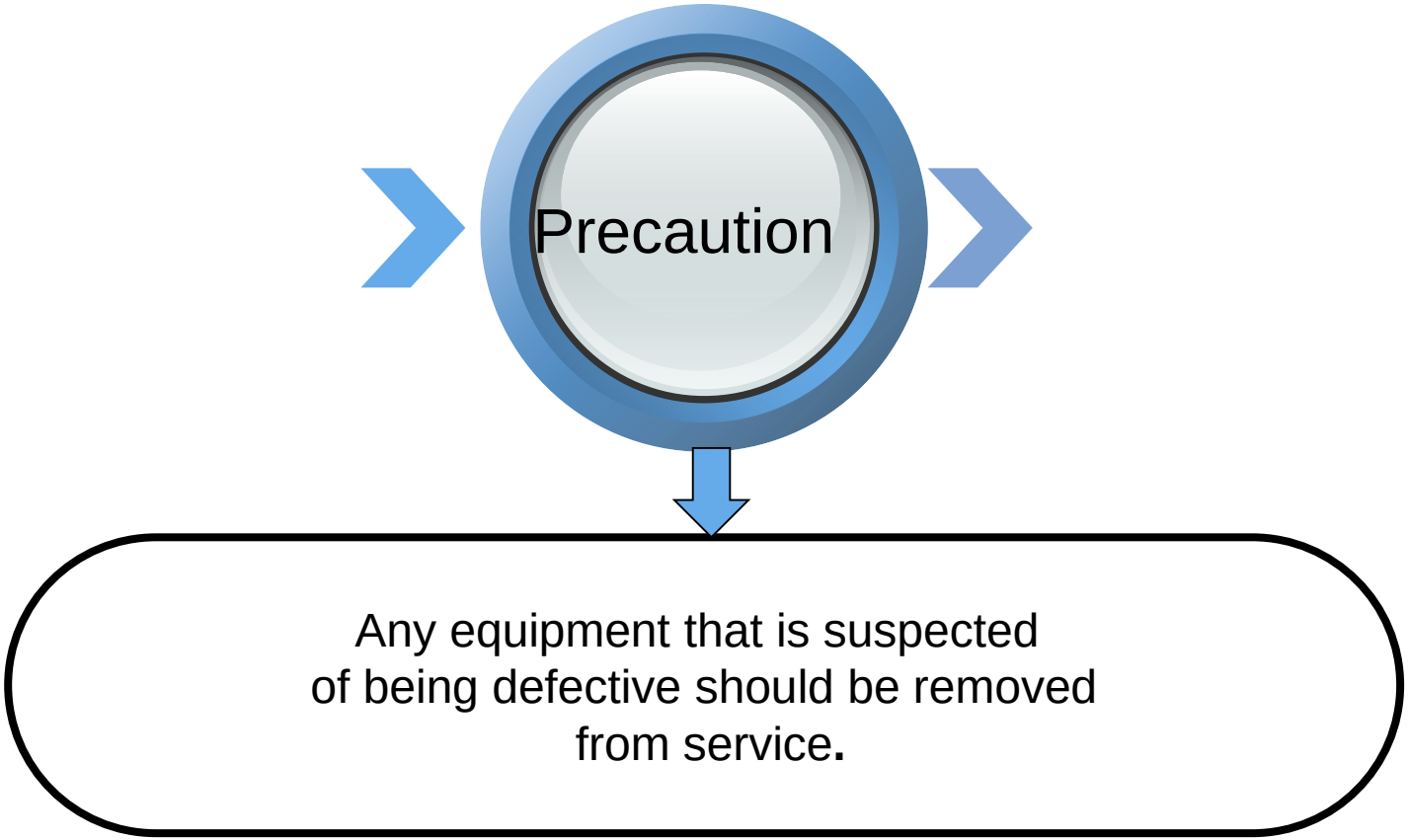

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Other Electrotherapy Apparatus

1

It is recommended that electrical stimulation apparatus should be kept at least 2 meters away from other electrotherapy devices (SWD/PSWD machines).

2

The output of some machines like interferential therapy devices can be affected by close proximity to an operating SWD/PSWD machine.

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Electrodes Safety

1. If carbon rubber electrodes are used, care should be taken to ensure proper contact for proper current flow.

2. When conductive gels are used, the gel will create a glaze over the surface of the electrodes with long term use.

3. The glaze may prevent the flow of current over the entire electrode surface.

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Electrodes Safety

1. Cleaning the electrodes periodically with a mild soap and water and soft brush is recommended.

2. It is not good practice to use conducting mist sprays with other conducting agents

3. because the saline content of the spray may destroy the carbon content of the electrodes thus rendering the electrodes useless.

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Terminology

Accommodation (ability)

The capacity of nerve tissue to protect itself against impulses that increase in strength slowly (by inactivation of pores in the membrane, the action potential cannot formed). The muscle fibers have less accommodation power.

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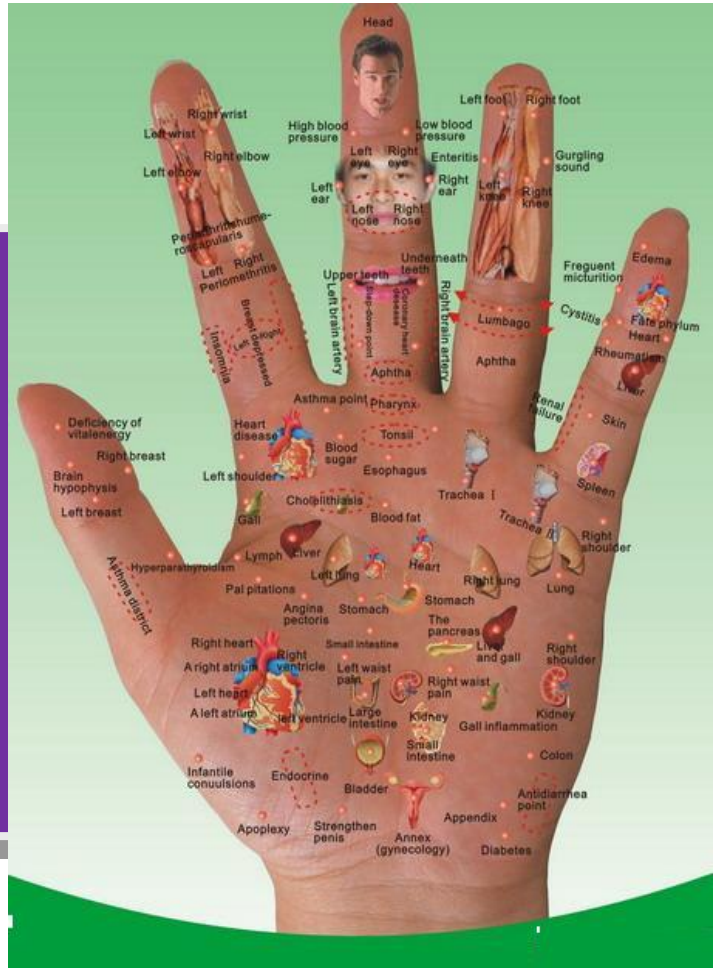
Terminology

Acupuncture point

Acupuncture point is considered as a place where a small bundle of A δand sympathetic efferent fibers pierce the deep fascia to become more superficial.



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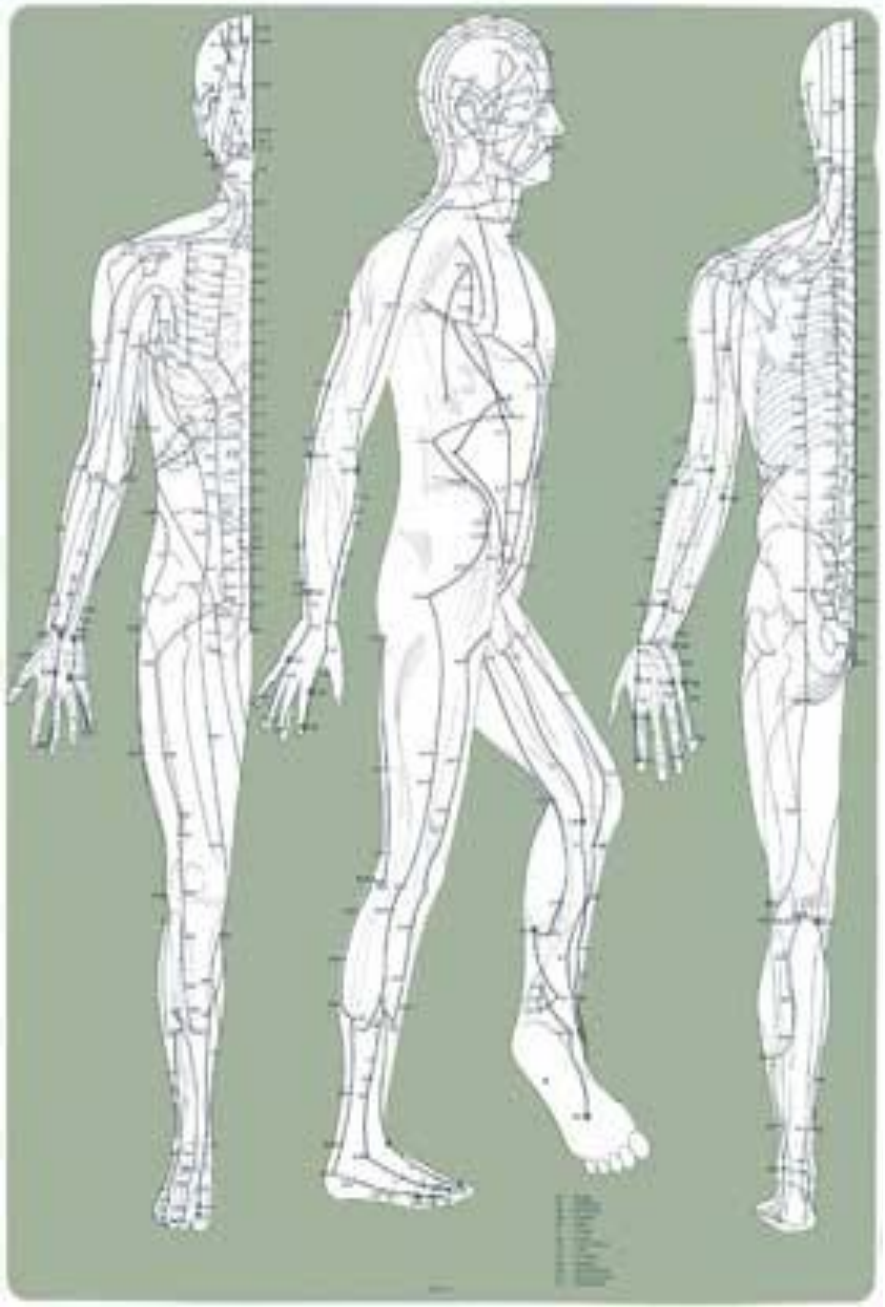
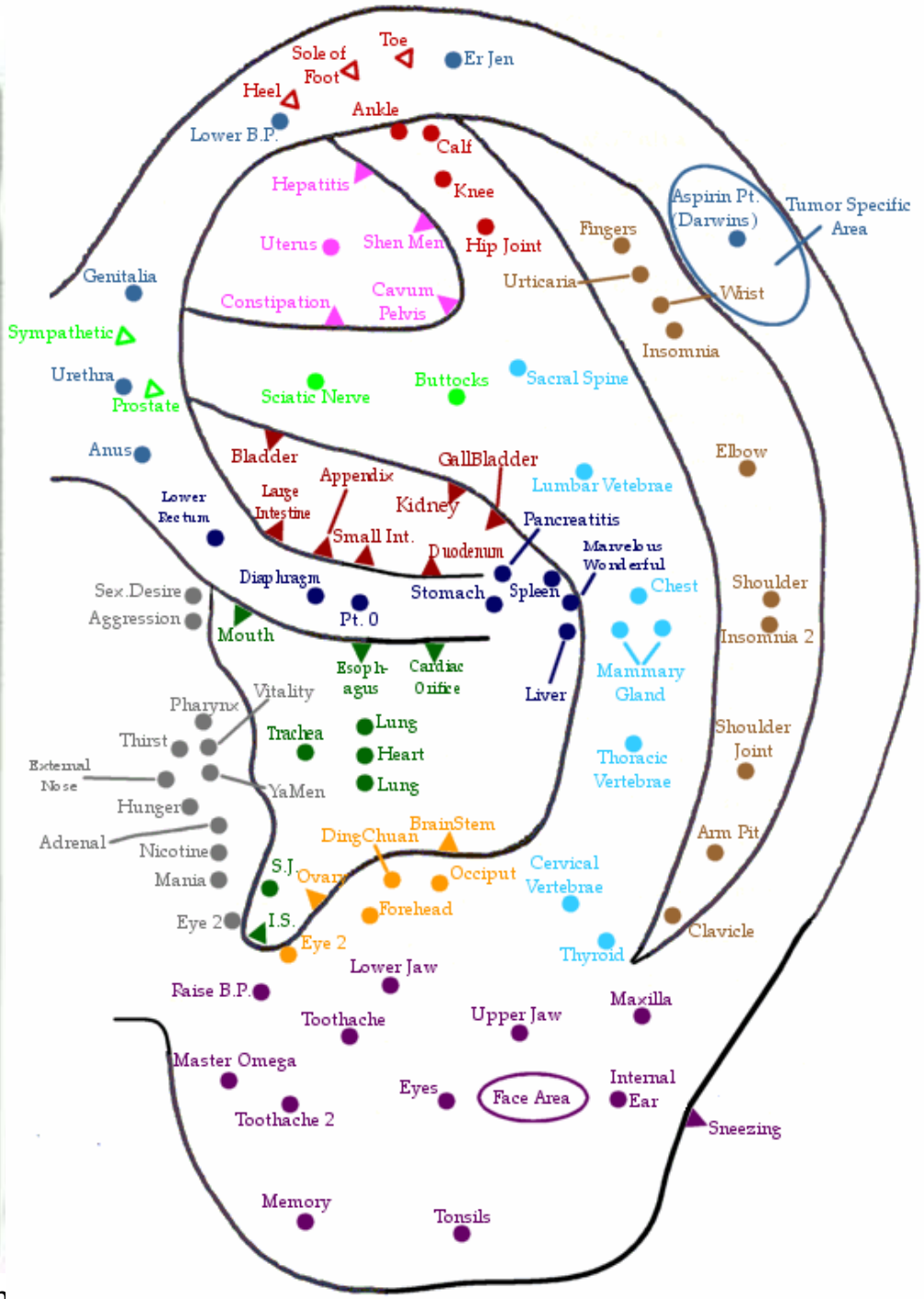
MERIDIAN CHART





Terminology

Acetylcholine

A neurotransmitter that is essential for transmission of nerve impulses. Like transmission of motor nerve impulse to the muscle fibers.

Neurotransmitter release at the neuromuscular junction.mht

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Terminology

Adaptation

Concerning electrotherapy adaptation means the reduction in nerve response and this is usually an undesired effect. Limiting adaptation can be done by changing current frequency.

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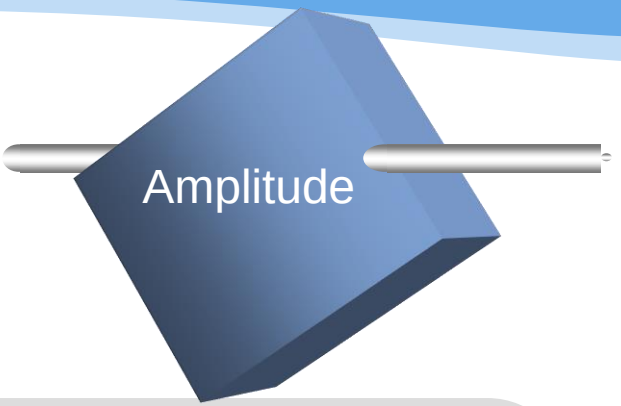
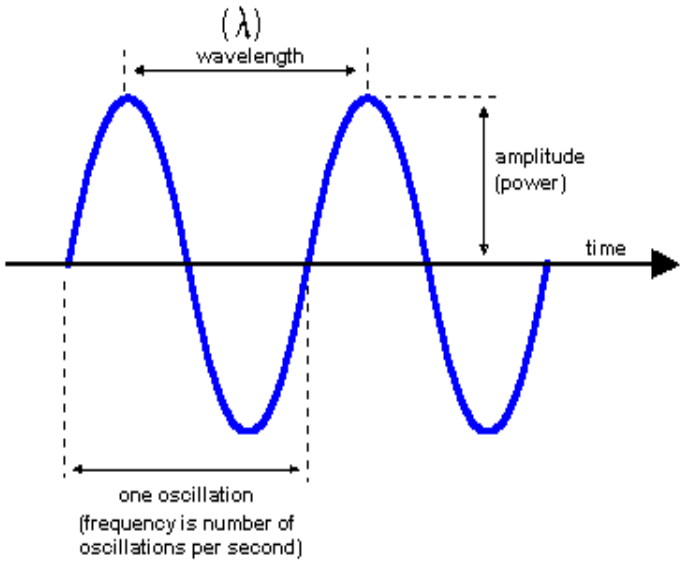
Terminology



It is the magnitude of voltage or current. If the current is unidirectional and constant, the peak or the average value can be specified. If the current is bidirectional or alternating, there are at least three commonly used descriptors.



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Terminology

It is the rate at which electrons move past a given point. An ampere is equal to 1 coulomb (C) per second. Ampere indicates the rate of electron flow. A milliampere (mA) is one thousandth of an ampere; a microampere (μA) is one millionth of an ampere.

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Terminology

It is a chemical compound that causes a loss of sensitivity to mechanical and noxious stimulation. An anesthetic will temporarily inactivate the sodium channels that make it impossible for an action potential to originate.

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Terminology

The ability of tissue (or other material) to store electricity.
For a given current intensity and pulse duration
The higher the capacitance the longer before a response. Body tissues have different capacitance.
From least to most:
- Nerve (will fire first, if healthy)
- Muscle fiber
- Muscle tissue

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Terminology

- Increase intensity (with decrease pulse duration) is needed to stimulate tissues with a higher capacitance.
- Muscle membrane has 10x the capacitance of nerve

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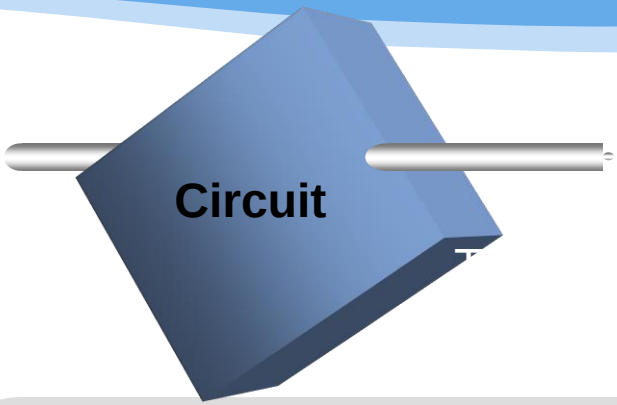

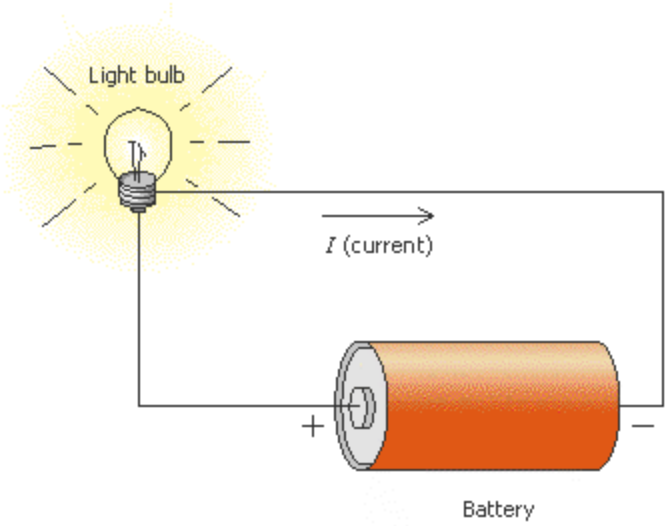

Circuit is a closed loop of conductor through which charges can flow.

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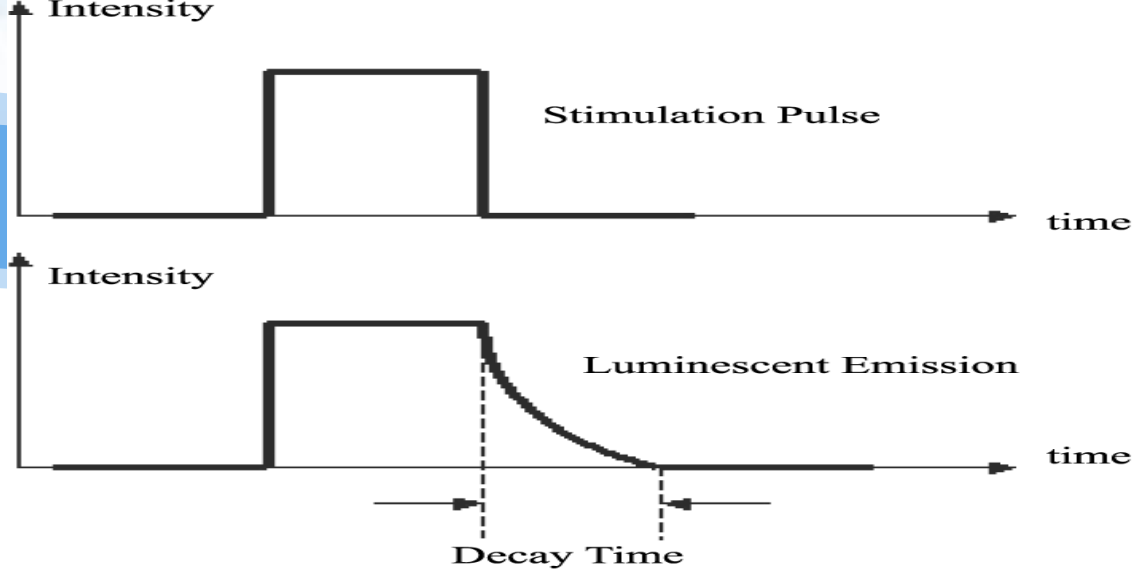

Conductor

substance through which electrical charges can easily flow.

Coulomb

is indicating the number of electrons.

Current

Current is the flow of free electrons from one place to another. The unit of current is the ampere (A)

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Terminology

Current Density

The amount of charge per unit area. This is usually relative to the size of the electrode. Density will be greater with a small electrode, but also the small electrode offers more resistance.

Decay time

The time required for the wave to go from its peak to 0 V.

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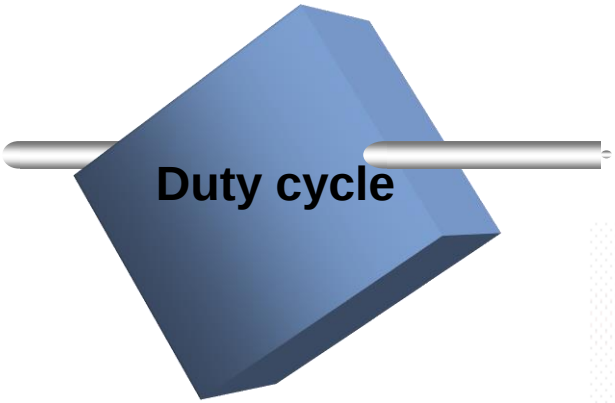
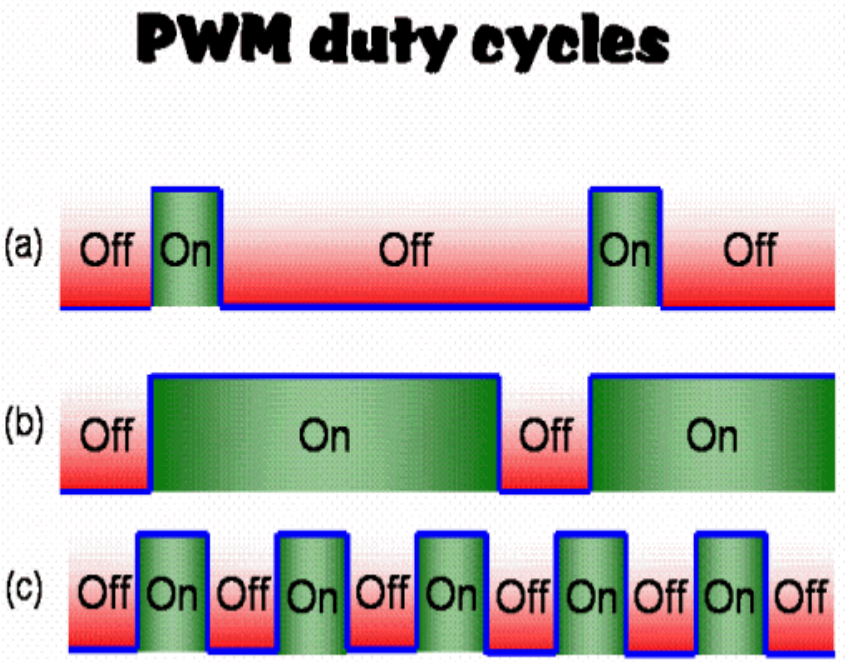


It is the proportion of on time to the total cycle current time. Example: if the pulses are generated for 0.1 second and stopped (inter-pulse) for 0.2 second, the duty cycle would be 1:3 or 33%.



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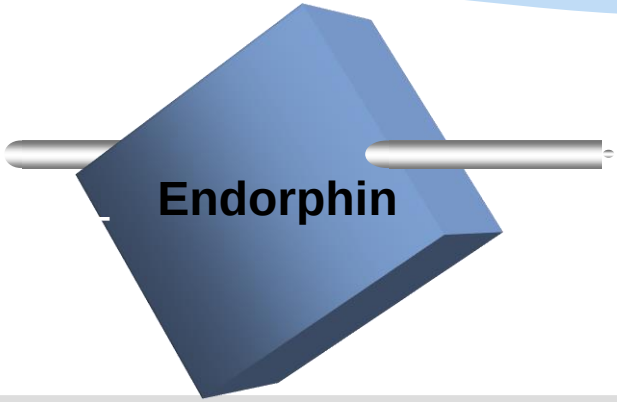

A collective substance that released in the central nervous system and have a pain modulating effect.

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Terminology

The part of the healing process of a superficial wound in which the skin (epithelial tissue) grows on the wound to close it.

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Terminology

Type II muscle fibers with a high contraction speed. The fibers are thick and produce a lot of strength. This muscle fiber subdivided into two types; type II A highly oxidative and relative fatigue resistance and type II B less oxidative and easy fatigue. The fibers are innervated from the big alpha motor neuron (∂ motor neuron).

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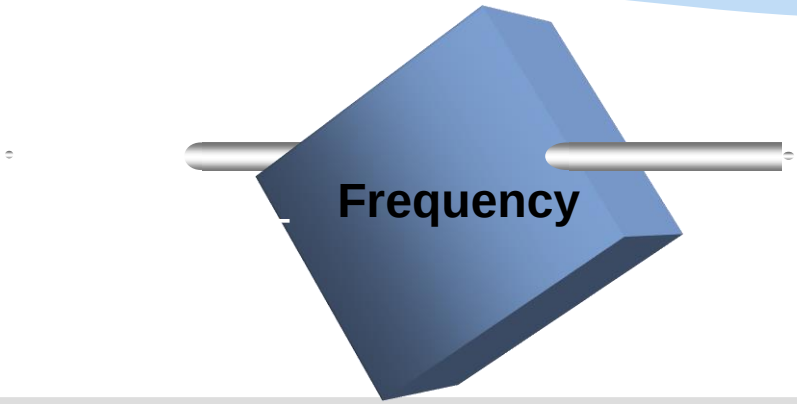

It is the number of cycles per second or millisecond (thousandth of a second), or microsecond (millionth of a second). The unit of frequency is Hertz (Hz). A thousand cycles per second is a KiloHertz (KHz).

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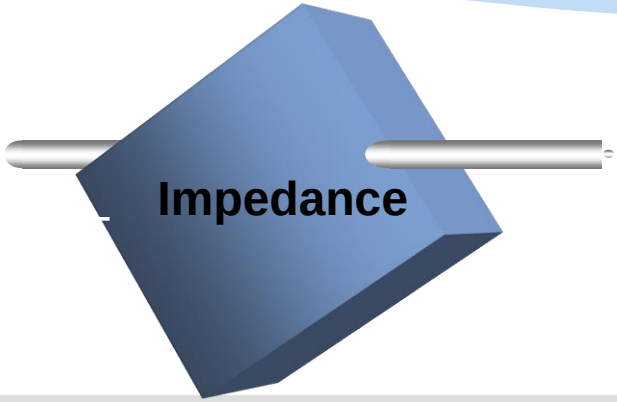

Is the resistance of the biological tissues that oppose the current flow. Symbol for impedance is (Z).

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Terminology

Resistance is the property of a substance which opposes current flow.

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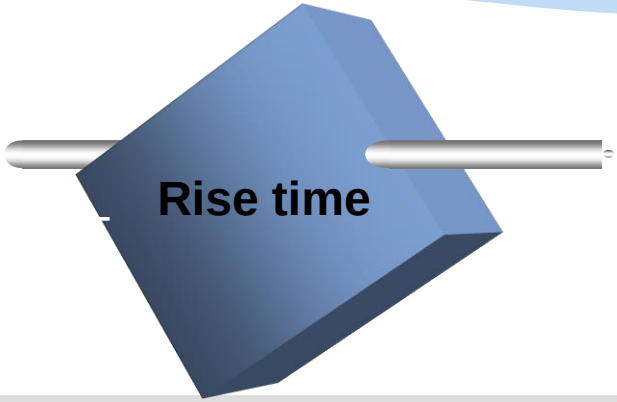

Rise time refers to the time required for the wave form to go from 0 V to its peak amplitude.

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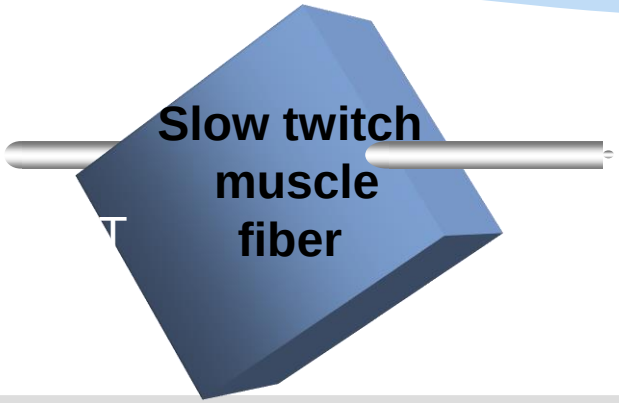

Slow twitch or red muscle fibers are highly vascular and slow to contract and relax.

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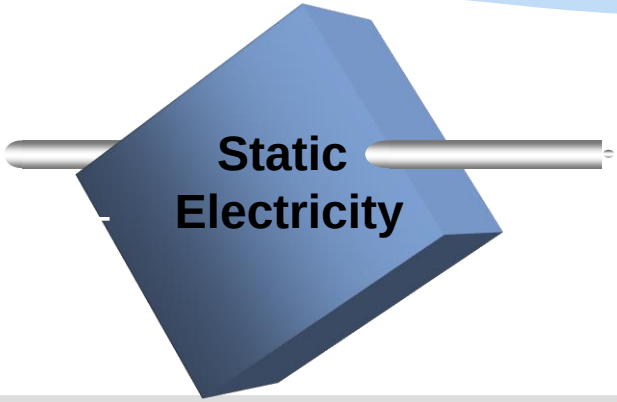

It is a collection of positive (+) or negative (-) charges on none conducting material such as rubber or plastic. If the charges come in contact with a conductor as metal, the negative charged electrons travel through the conductor to neutralize any collection of positive charge.

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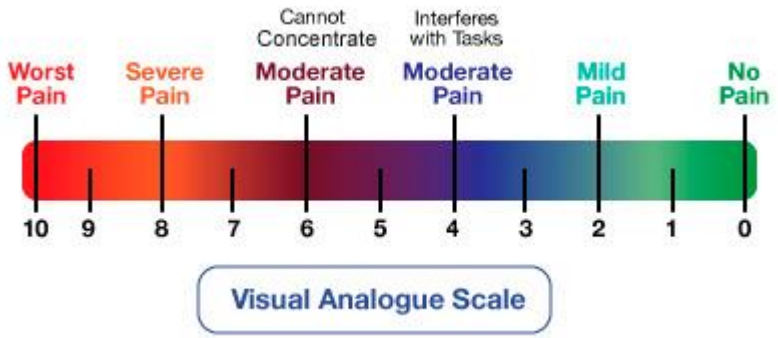

VAS is an acronym for Visual Analogue Scale. It is an important measure about pain awareness. It is a 10 cm line start with no pain and ended with worst pain.

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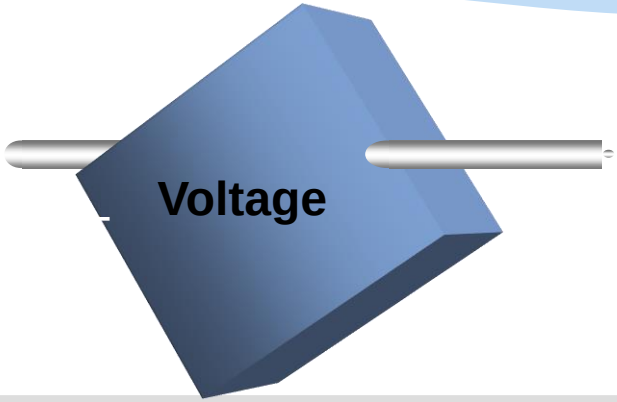

Is the difference in concentration of free electrons and is referred to as the electromotive force (EMF), electrical potential difference, or voltage. In order for electrical current to flow there must be one location with high concentration of free electrons and another one with low concentration of free electrons. The electron will flow from high concentration to low concentration. The great difference in concentrations leading to great potential of electrical flow. The unit of electromotive force or potential difference is the volt (V). One volt is the electromotive force required to move one ampere of current through a resistance of one ohm (Ω).

Electromotive force (V) = Current (A) X Resistance.

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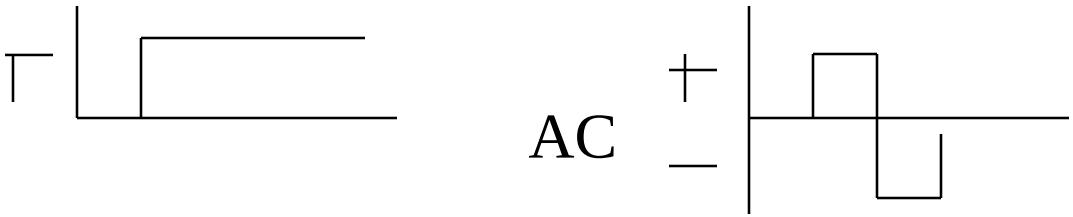
Terminology

Wave forms

NEXT

Wave forms are the direction of current flow. The basic wave forms are unidirectional (DC), and bidirectional (alternating current, AC).



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Thank You !

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