**Basic Principles of Electricity**

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* Basic Principles of Electricity
* Electromagnetic  
  Spectrum
* Electrons
  + Particles Of Matter Possessing A Negative Charge And A Small Mass
  + Net Movement Of Electrons Is An Electrical Current
  + Movement Of Electrons Is Like A Domino Reaction
  + Electrons Will Move From Higher To Lower Potential
* Ampere
* Unit Of Measure Which Indicates Rate At Which Electrons Flow
* 1 amp = movement of 1 coulomb or 6.25x1018 electrons /sec
* Current Flow Is In Milliamps (1/1000) Or Microamps (1/1,000,000)
* Electrical Potential Difference
  + Difference In Concentration of Electrons Between Two Points
  + Electrons Will Not Move Unless A Potential Difference Exists
* Volt
  + Creates The Potential Difference
  + The Electromotive Force Which Must Be Applied To Create Flow Of Electrons
  + Commercial Current Is 120 V or 220 V
* Conductors
* Materials That Permit Free Movement of Electrons
* Composed Of Large Numbers of Free Electrons
* Offer Little Resistance To Current Flow
* Good Conductors
* Metals (copper, gold, silver, aluminum)
* Electrolyte Solutions
* Insulators
* Materials That Resist The Flow Of Electrons
* Contain Few Free Electrons
* Insulator Materials
* Air, Wood, Glass
* Resistance = Electrical Impedance
  + Opposition To Flow Of Electrical Current
  + Measured In Ohms
  + Ohm’s Law Current Flow= Voltage Resistance
* Watt
  + Measure of Electrical Power
  + Watts = Volts X Amps
  + Modalities Use Milliamps or Microamps
* Electrotherapeutic Currents
* Direct (DC) or Monophasic
* Flow of Electrons Always In Same Direction
* Sometimes Called Galvanic
* Alternating (AC) or Biphasic
* Flow of Electrons Changes Direction
* Always Flows From Negative to Positive Pole Until Polarity Is Reversed
* Pulsed or Polyphasic
* Pulses Grouped Together and Interrupted
* Russian and Interferential Currents
* Electrical Generators
* All Are Transcutaneous Electrical Stimulators
* Transcutaneous Electrical Nerve Stimulators (TENS)
* Neuromuscular Electrical Stimulator (NMES) = Electrical Muscle Stimulator (EMS)
* Microcurrent Electrical Nerve Stimulators (MENS) = Low Intensity Stimulators (LIS)
* Electrotherapeutic Currents
* No Relationship Between Type Of Current Used To Power Generator and Type Of Current Output To Patient
* Generators May Be Powered By AC or DC
* Batteries = DC between 1.5 and 9 V
* Wall Outlet = AC at 120 or 220V at 60 Hz
* Waveform or Pulse
* Pulse= Individual Waveform
* Phases (Duration)
* Interpulse Interval
* Direction (Polarity)
* Amplitude
* Rate Of Rise
* Rate of Decay
* Accommodation
* Symmetrical Waveforms
  + Sine
  + Square
  + Triangular
* Symmetrical Waveforms
* Twin Peaked Triangular Waveform
* Found on Most High Volt Generators
* Asymmetric Waveforms
* Faradic
* Exponential
* Sawtooth
* Current Modulation
* Continuous
* Interrupted
* Burst
* Packets
* Pulse Trains
* Beats
* Ramped (Surge)
* Pulse Amplitude
  + Same As Intensity or Voltage
  + Measured In Milliamps or Microvolts
  + Average Current Determined By Interpulse Interval Or Current Duration
* Pulse Duration
  + Length Of Time Current Is Flowing
  + With Monophasic Current Phase Duration Is the Same As Pulse Duration
  + With Biphasic Current Pulse Duration Is Determined By The Combined Phase Durations
  + With Polyphasic Current The Combined Pulse Duration And Interpulse Interval Is The Pulse Period
* Pulse Frequency (CPS, PPS, Hz)
  + Effects The Type Of Muscle Contraction
  + Effects The Mechanism of Pain Modulation
* Electrical Circuits
* Path of Current From Power Source Through Various Components Back To Generator
* Power Source-Conducting Medium - Component Resistors
* Series Circuit
* Parallel Circuit
* Series Circuit
  + One Path For Current To Take
  + Component Resistors Placed End To End
  + Total Resistance = Sum of Resistances
  + Total Voltage = Sum of Voltage Decreases
* Parallel Circuit
  + Component Resistors Placed Side to Side With Ends Connected
  + Current Chooses Path With Least Resistance
  + Resistors Have Lower Resistance But Higher Current Flow Than A Series Circuit
* Current Flow Through Biologic Tissues
  + Combination Of Both Series And Parallel Circuits
  + Tissue Highest In Water And Ion Content Best Conductors - Blood, Nerve, Muscle, Tendon, Skin, Fat, Bone
* Safety In Using Electrical Equipment
* Ground Fault Interruptors
* Constantly compare amount of electricity flowing from wall outlet to whirlpool turbine with the amount returning
* GFI will interrupt current flow in as little as 1/40 of a second