King Saudi University
Collage of Applied Medical Science
Rehabilitation Science Department
Electrotherapy-RHS325

Lab Activity: Principle of Electricity for Electrotherapy
SHEET 1: Ohm's Law

Student name ……. Student number……
Course name……Course code…….

Objective: To demonstrate an understanding of the relationship between voltage, amperage, resistance, and the power of an electrical circuit.

Description of Ohm's Law:

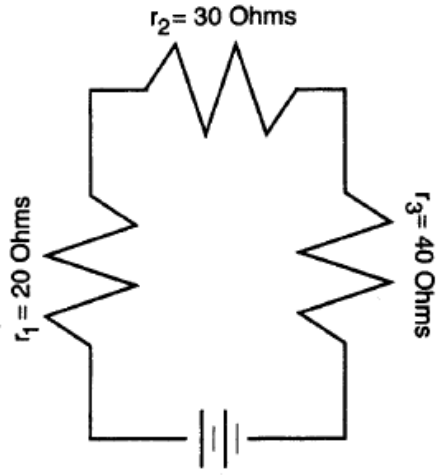
Definition of Terms

Amperage (I):

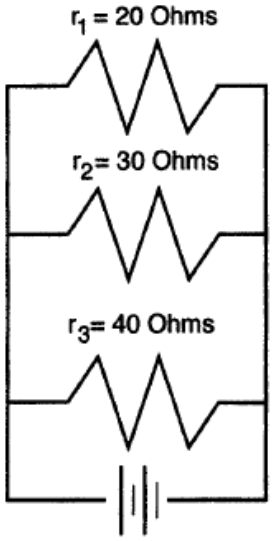
Ohm (Ω):

Voltage (V):

Respond to the following questions using the schematics provided below. Show your work.



Series Circuit



Parallel Circuit

1. What is the characteristics of series circuit and parallel circuit?

Series circuit	Parallel circuit
1-	1-
2-	2-
3-	3-
4-	4-

2. Draw diagram presents electrical circuits in human body

3. in clinical setting: what steps can do to reduce skin resistance before electrode placement

1-

2-

3-

4-

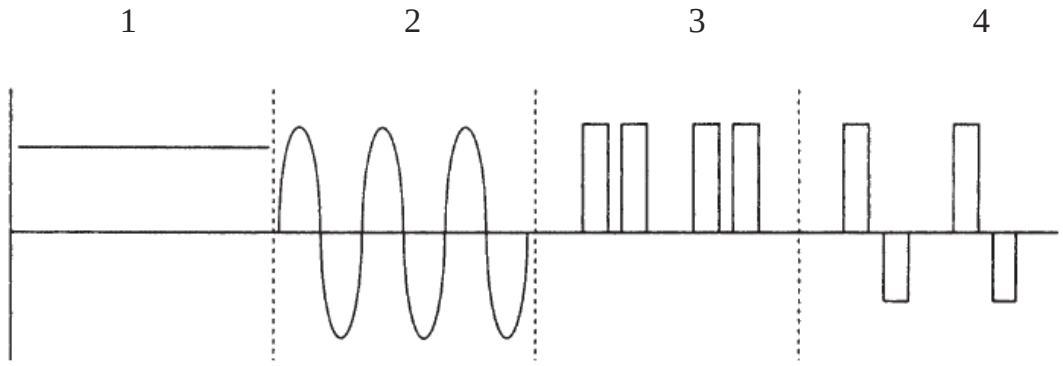
5-

LAB ACTIVITY: Principle of Electricity for Electrotherapy
SHEET 2: Pulse Characteristics

Student name …… Student number……
Course name……Course code…….

Objective:
To demonstrate knowledge and characteristics associated with therapeutic currents.

Label each of the following current types, indicating the specified parameter. If a particular parameter is not applicable to a particular current, leave it blank.



A. Identify the type for each of the above currents and indicating the specified parameter:
   1-
   2-
   3-
   4-

B. Identify/define the amplitude for each of the above currents:

C. Identify/define the peak-to-peak value for each of the above currents:

D. Identify/define the pulse duration, pulse period, and inter-pulse interval for each of the above currents:

E. Identify/define the phase duration for each of the above currents:

Lab Activity: Principle of Electricity for Electrotherapy
SHEET 3: Selective Stimulation of Nerves

Student name ……. Student number……
Course name……Course code…….

Objective:

To understand how adjustment of the pulse duration affects the level of intensity required to stimulate sensory, motor, and pain nerve fibers.

Materials Needed

- Electrical stimulation unit with an adjustable pulse duration (TENS or neuromuscular electrical stimulation recommended). Units with a digital output display produce the most objective results.
- Rubber or self-adhesives electrodes with moisten spongy pad, conducting gel
- Cotton, alcoholic swap and Straps

Procedures

1-Depending on the stimulating unit used, select either a monopolar or bipolar electrode configuration.

Using a monopolar electrode configuration, attach the "dispersive" electrode on the subject's lower back or thigh and the "active" electrode to the anterior portion of the subject's forearm. (This configuration is recommended for high-volt pulsed units).

In a bipolar configuration, placing one electrode on the distal portion of the subject's forearm and the other on the proximal portion of the forearm (Fig. 4–1).

2- Set the stimulation parameters to the following values:

Parameters	**Settings**
Pulse duration:	25 μsec (or lowest possible value)
Pulse frequency:	30 pps
Duty cycle:	100%
Polarity:	Positive

Note: Not all parameters will apply to each unit.

3. Position the stimulation unit so that the subject cannot see the intensity reading
4. Slowly increase the intensity to the level where the subject first reports the sensation of electrical current flow. Record the output intensity on the grid provided.
5. Further increase the intensity until a visible muscle contraction can be seen, and record the output intensity.
6. Continue to increase the intensity until the subject reports discomfort resulting from the stimulation. Reduce the intensity to zero, and record the output intensity
7. Allow the subject recovery time from the stimulation bout.
8. Repeat Steps 3 through 7 using increased pulse dura- tions (e.g., 10 μsec, 20 μsec, 40 μsec, 80 μsec, and 160 μsec).
9. Conclude this activity using the original pulse duration.
10. Using the labeling key provided, plot the changes in the output intensity required

Student Worksheet

Student name ……. Student number……
Course name……Course code…….

Amplitude

50mA							
40mA							
35mA							
30mA							
25mA							
20mA							
15mA							
10mA							
5mA							
0mA	------ **µsec**	------ **µsec**	------ **µsec**	------ **µsec**	------ **µsec**	------ **µsec**	------ **µsec**

Pulse duration in microseconds

Labelling Key

Sensory nerve ●

Motor nerve ■

Pain nerve ❖

Lab Activity: Principle of Electricity for Electrotherapy
SHEET 4: electrodes placement

Student name ……. Student number……
Course name……Course code…….

Objective:

To identify different type of electrodes, as well as the most appropriate site and methods of fixation for these electrodes

Materials Needed

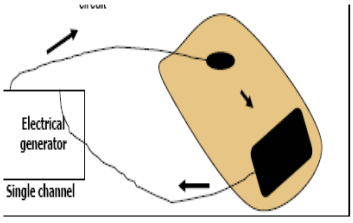
- Electrodes of different types, size and shape (e.g. Rubber or self-adhesives and metal electrodes)
- Spongy pad, conductive gel
- Cotton, alcoholic swap and Straps
- Electrical stimulation unit

Methods of electrodes placement/configuration

Monopolar,

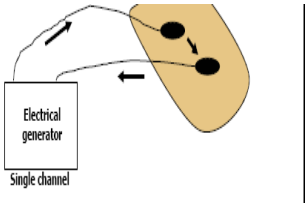
Active electrode (s) [smaller] is stimulating electrode and placed on the target muscle, greatest current density – treatment effect.

Dispersive electrode [larger] – required to complete the circuit, low current density – little or no sensation is felt from this electrode



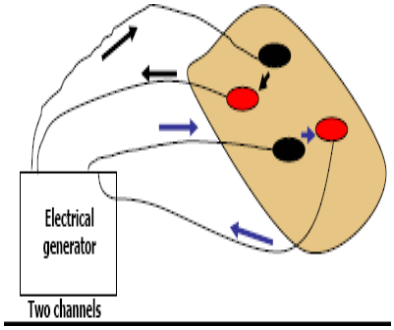
Bipolar

Bipolar: two electrodes are placed on the target muscle, close to the origin and insertion.
Electrodes are of equal (or near equal) size.
Current density will be equal under each electrode



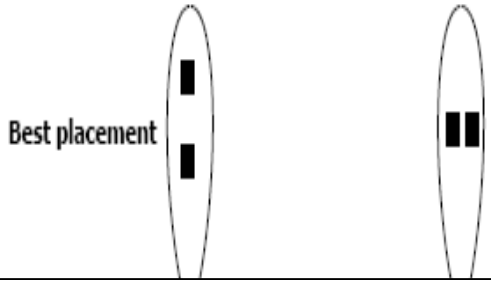
Quadripolar

Quadripolar: four electrodes are placed on the target tissue Interferential



Electrodes orientation

Muscle fibers are 4 times more conductive when the current flows with the direction of the fibers than when it flows across them



Electrodes location

1. On and /or around the painful area.
2. Over specific dermatome corresponding to the painful area.
3. Over specific myotomes corresponding to the painful area.
4. Spinal cord segment.
5. Course of peripheral nerve.
6. Motor point.
7. Over trigger point.
8. Acupuncture point

General guidelines

1. Exam/ investigate of exactly where the pain is located, and outline the most concise and tender area of the pain.
2. Prepare electrodes of suitable size, types and shape
3. Prepare the most appropriate fixation and good conduction through sufficient gel or water on spongy pads
4. Clean the target area with alcohol swipe/ cotton **(Why?)**
5. Determine techniques of electrodes configurations
6. The electrodes should never touch and should be at least, 1 inch apart. **(Why?)**
7. It is advisable not to place the electrodes directly over a joint. Bony prominence **(Why?)/** Areas of the body which could harm patients and or unsafe conditions **(example)**
8. **What therapist can do in the following conditions**
   - ❖ When the pain extends across a significant distance of your body (e.g. sciatica)
   - ❖ When the pain is more focused over a smaller area (e.g. calf pain)
   - ❖ When the pain overlaps a joint (e.g. knee/elbow pain)
   - ❖ When the pain is wide (shoulder/neck pain)
9. Adjust the amount of electricity slowly, gradually and carefully.
10. Proper maintenance electrodes will perform better and last longer

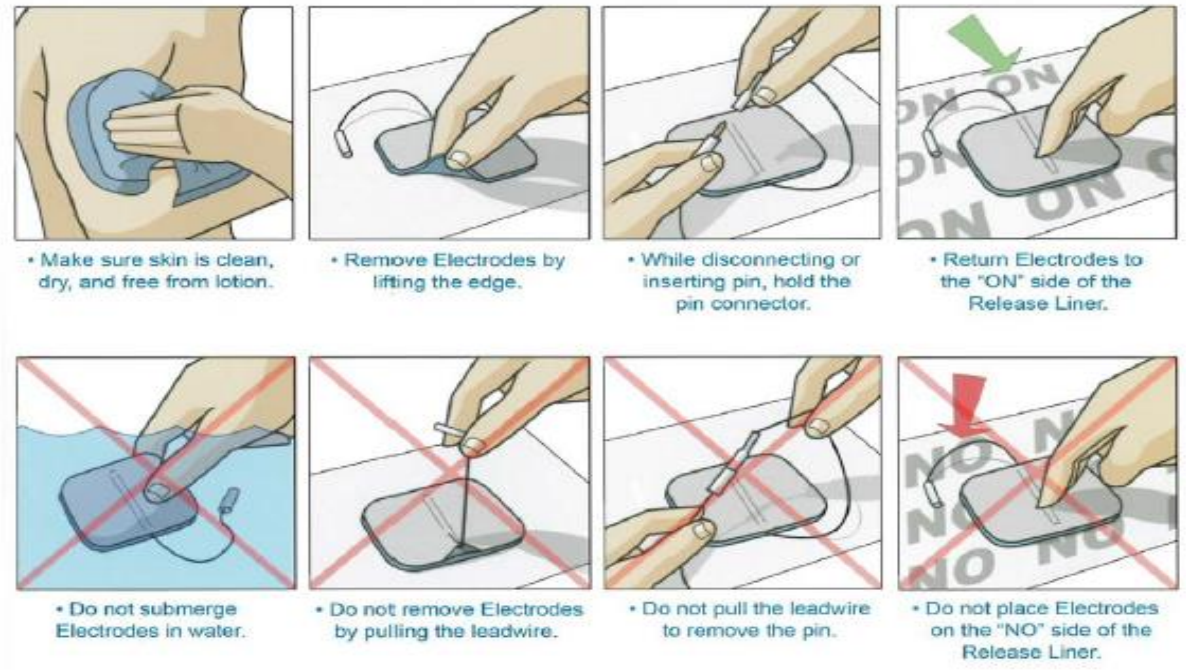
Note 1: The gel used on electrodes will gradually lose adherence and will stop sticking. At this time they have to be replaced.

Note 2: When electrodes get wet from water or sweat they will no longer adhere to your skin and must be replaced.

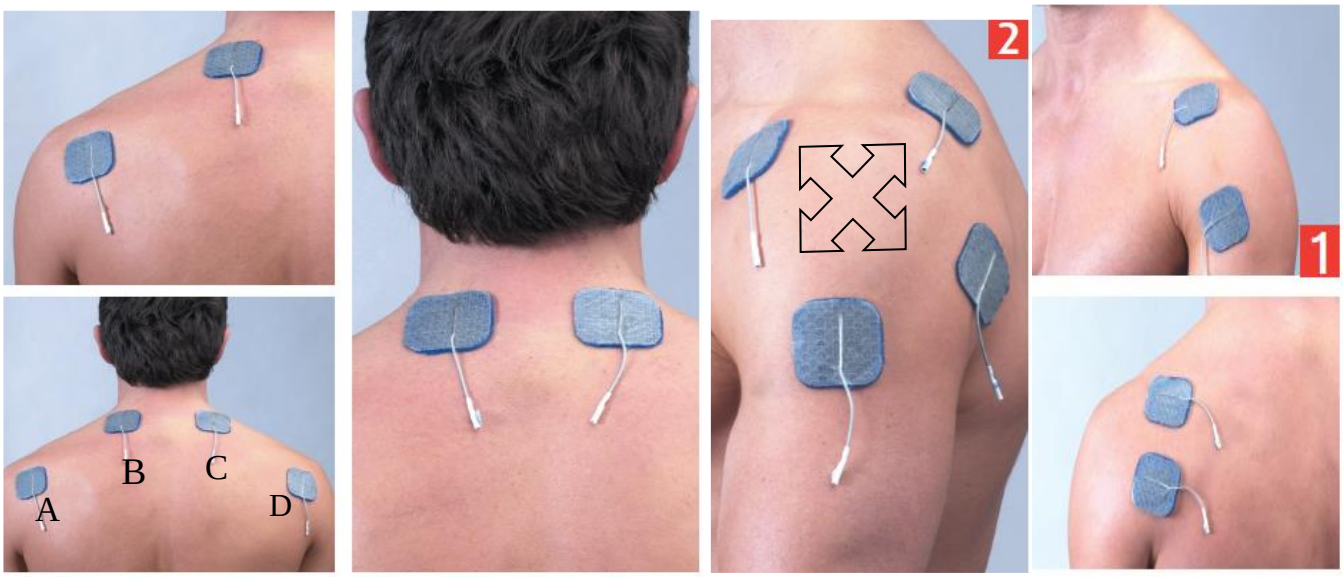
Note 3. The use of hot and cold packs will cause an Electrode's gel to break down over time (E.g. adhesive electrodes).

Note 4: Electrodes are intended for single patient use (e.g. Adhesive electrodes

Do’s and don’ts for electrodes

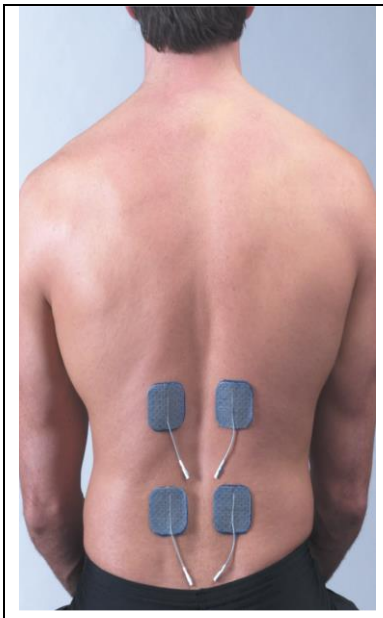


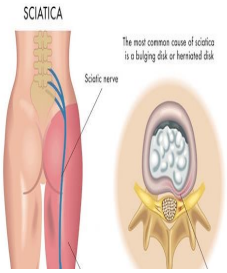
Electrode placement for neck and shoulder

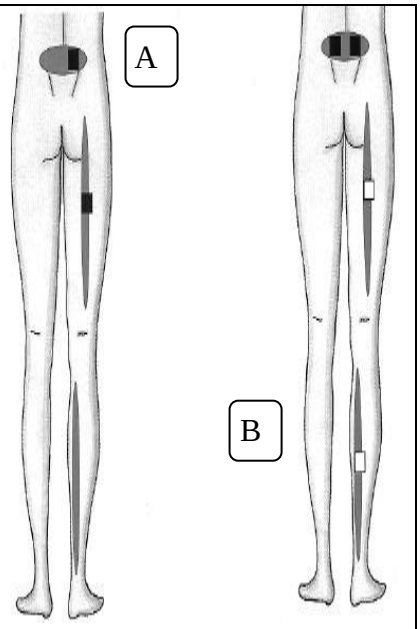


When treating a long area, for example on your shoulders, place the electrodes as indicated in the picture. Connect the lead wires to the electrodes closest to each other. In the example picture use wire 1 to connect A and B and wire 2 to connect C and D.	When treating a larger area of shoulder, place the electrodes as indicated in the picture building a big square. Connect the lead wires diagonal (X shape) to achieve the best treatment.	When treating localised area of shoulder (anterioror posterior), place the electrode as in picture avoid bony prominance
Indications: • Rheumatism/ Whiplash/Slipped disk/Cervical strain/ Head ache/Arthritis	**Indications:** Rheumatism Subluxation/ dislocation/sprain/Arthritis/ Frozen shoulder	

Electrode placement for lower back and sciatica







When treating larger area, of back, place the electrodes as indicated in the picture building a big square. Connect the lead wires diagonal (x-shaped) to achieve the best treatment. In the example picture use wire 1 to connect A and D and wire 2 to connect B and C.
Note1: therapist can use two electrodes of bag size)
Note 2: Electrode placed at level of L4-5 and extended either above / bellowed according the roots involved and distribution of pain

Note 3: therapist place the electrode on either side of back (RT or LT) according to pain

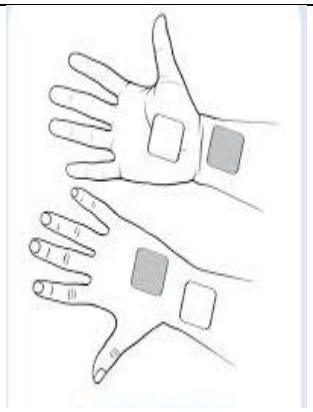
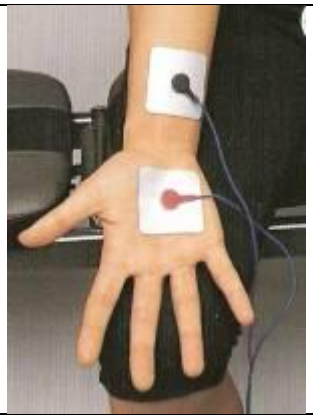
When treating larger area, of back, and pain radiating to the posterior aspect of the thigh(A), Or below knee (sciatica-B) place the electrodes as indicated in the picture

For A: one electrode on affected side parspinal; (e.g. L1-5, L4-5, L5-S1), and the other electrode in mid of thigh

For B(sciatica) channel one: two electrodes praspinal at level of L4-S1),
channel two;
One electrode at sciatic notch (not in picture) or mid of the thigh, and other electrode on mid of leg/ on peroneal nerve just two figure width below head of fibula head/ or anterolateral aspect of leg just above the lateral mallious,

Indications:
• Back pain
• Bilateral radiation
• Dysmenorrhoea
• Labour pain
• Slipped disk

Electrode placement for elbow /wrist and hand

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>When treating a lateral elbow pain (e.g. Tennis elbow), place the electrodes as indicated in the picture. Connect the lead wires to the electrodes closest to each other on the lateral side of elbow and according to target area of pain</td><td>If lateral elbow pain (tennis elbow=lateral epicondylitis) unspecified and radiation to both upper arm and forearm, place the electrodes as in picture</td></tr>
<tr><td>When treating carpal tunnel place the electrodes as indicated in the picture. Connect the lead wires to the electrodes closest to each other above and below wrist creases , either on the palmer or dorsal surface of hand</td><td>  </td><td>  </td></tr>
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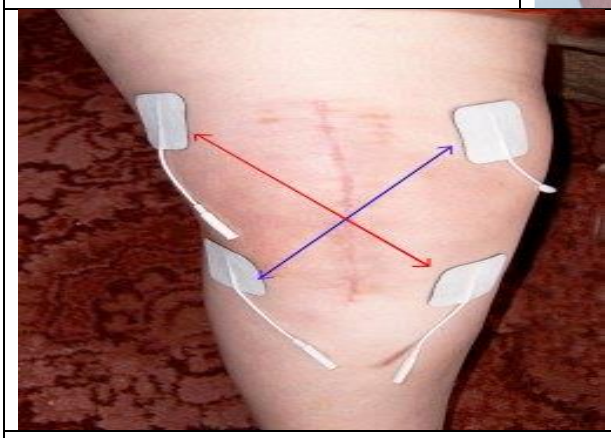
Electrode placement for knee/ankle pain

When treating anterior knee place the electrodes as indicated in the picture. Connect the lead wires to the electrodes closest to each other above and below patella,

When treating medial or lateral knee place the electrodes as indicated in the picture. Connect the lead wires to the electrodes closest to each other



When treating postoperative knee pain following TKAP, ACL reconstruction or unspecified arthritis pain, place the electrodes as indicated in the picture building a big square. Connect the lead wires diagonal (X shape) to achieve the best treatment.

When treating lateral ankle pain (e.g. lateral ankle sprain) place the electrodes as indicated in the picture. Connect the lead wires to the electrodes closest to each other; one electrode is below or posterior second electrodes is placed anterior or above (one inch) to lateral mallouls,

When treating calf muscle pain and in tendinopathy place the electrodes as indicated in the picture. Connect the lead wires to the electrodes closest to each other; one electrode is just above the tendon and second electrodes in middle half of the calf muscles

LAB ACTIVITY
SHEET 5: Identification of Motor Points

Student name ……. Student number……
Course name……Course code…….

Objective:

To be able to locate and identify motor points for specific muscles.

Materials Needed:

Electrical stimulation unit with a hand-held electrodes (probe)

Description of Motor Points

- ❖ A point on the skin where an electrical stimulus will cause the maximum contraction of an underlying muscle.
- ❖ Area of greatest excitability on the surface of the skin overlying superficial muscles that can produce maximum contraction with minimum amount of current intensity.
- ❖ Motor point is the region in muscle where a great density of terminal motor end plates is found near the surface.
- ❖ The point where the motor nerve enters the muscle.
- ❖ Motor point lies at muscles belly between the proximal one third and distal 2/3 of muscle belly or fleshy part of the muscle fibers.

The exact locations of motor points tend to vary from individual to individual, but their approximate locations have been identified in many motor point charts Figure 1-3).

Motor points are not to be confused with trigger points, which are hypersensitive areas that develop secondary to trauma (although they do frequently tend to be found close to each other).

Procedures:

1. Attach the dispersive electrode to the thigh or upper arm, depending on the area being examined.
2. Prepare the stimulation unit to the hand-held applicator mode
3. Attach the inactive electrode to the thigh or upper arm, and manually move the hand-held applicator with one hand while controlling the output intensity with the other.
4. Set the stimulation parameters to the following values:

   Parameters Settings

   Pulse duration: 25 to 50μsec
   Pulse frequency: 50pps
   Polarity of the active electrode: Negative
   Duty cycle: 100%

Note: Not all parameters will apply to each unit.

5. Reset the generator's output intensity to zero, and wet the applicator's tip with water or gel.

6. Place the applicator tip on the subject's forearm, and slowly increase the intensity to where a slight muscle contraction is visible (Fig. 4–1).

7. Use the applicator tip to identify the point(s) on the skin that result in strong, isolated contractions of the following muscles:

Upper Extremity

1. Abductor pollicis longus
2. Extensor digiti minimi
3. Extensor indicis
4. Flexor carpi radialis
5. Flexor carpi ulnaris

Lower Extremity

1. Abductor digiti minimi
2. Extensor hallucis longus
3. Extensor digitorum brevis
4. Plantaris
5. Tibialis anterior

8. The intensity of the stimulation may need to be adjusted as the applicator is moved over the skin. Most applicators have an intensity adjustment knob located on them.

   Note: Reduce the intensity to zero before applying or removing the applicator from the subject's skin.

9. Using the labeling key, mark the location of each motor point identified on the accompanying charts.

Sheet for Motor Points-Upper limb

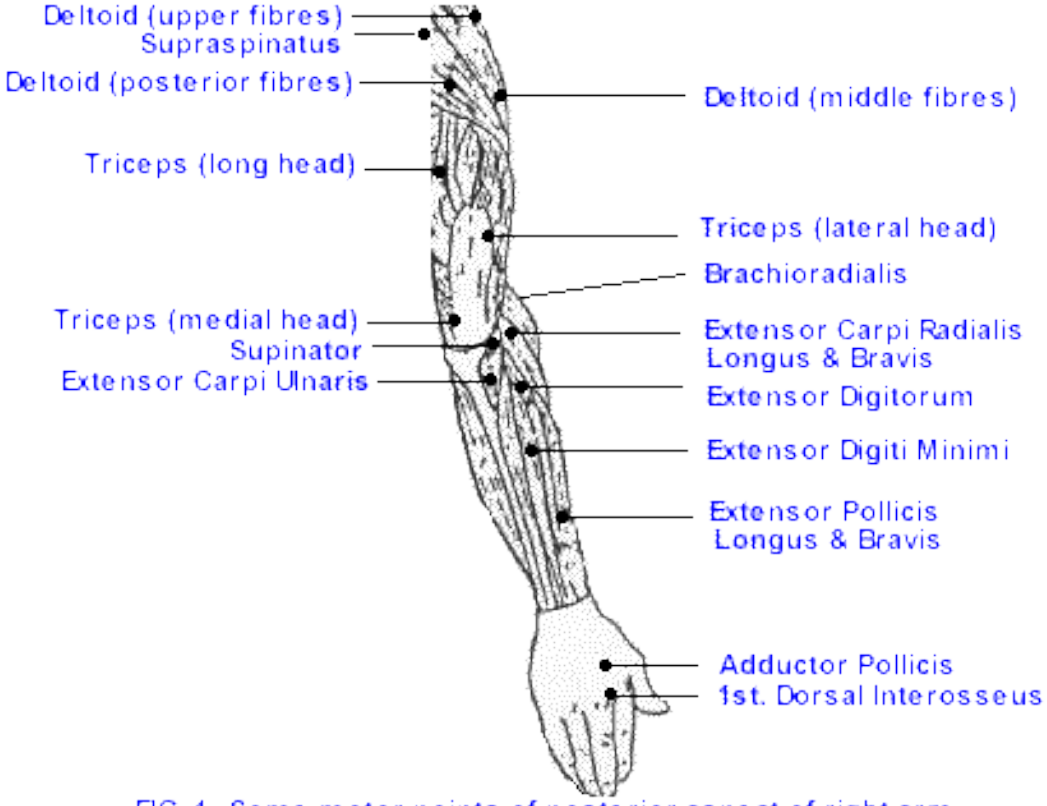


FIG. 1--Some motor points of posterior aspect of right arm.

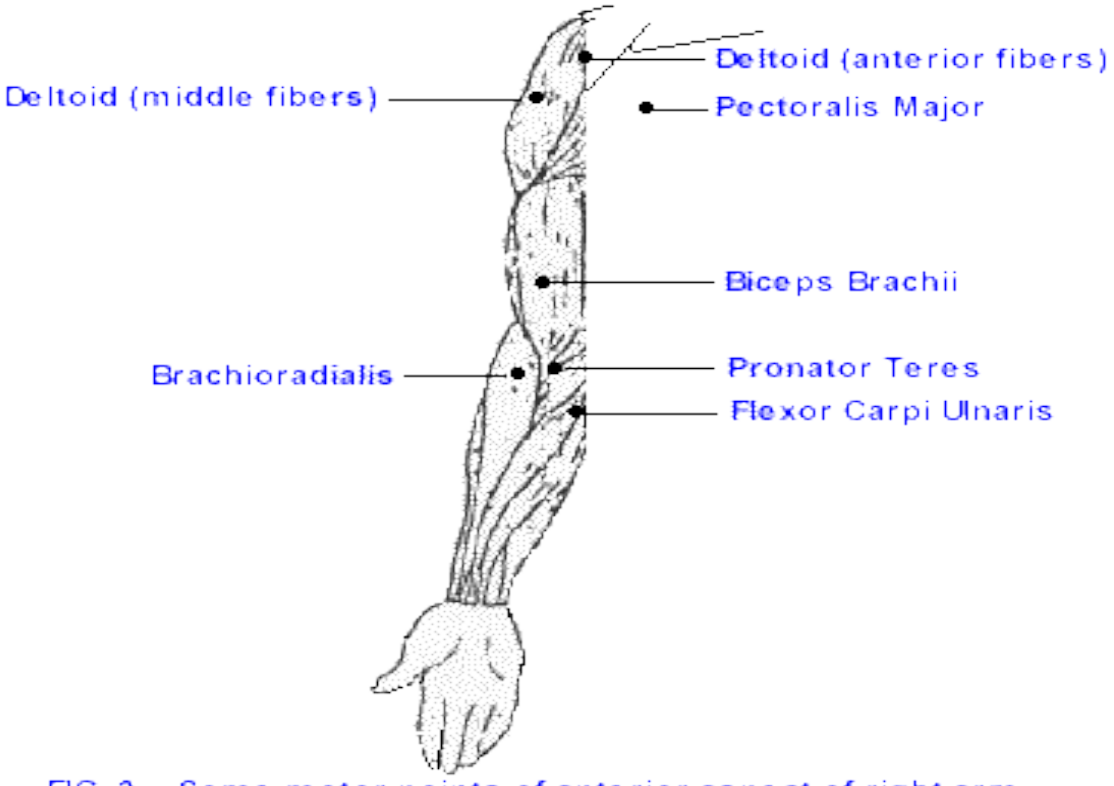
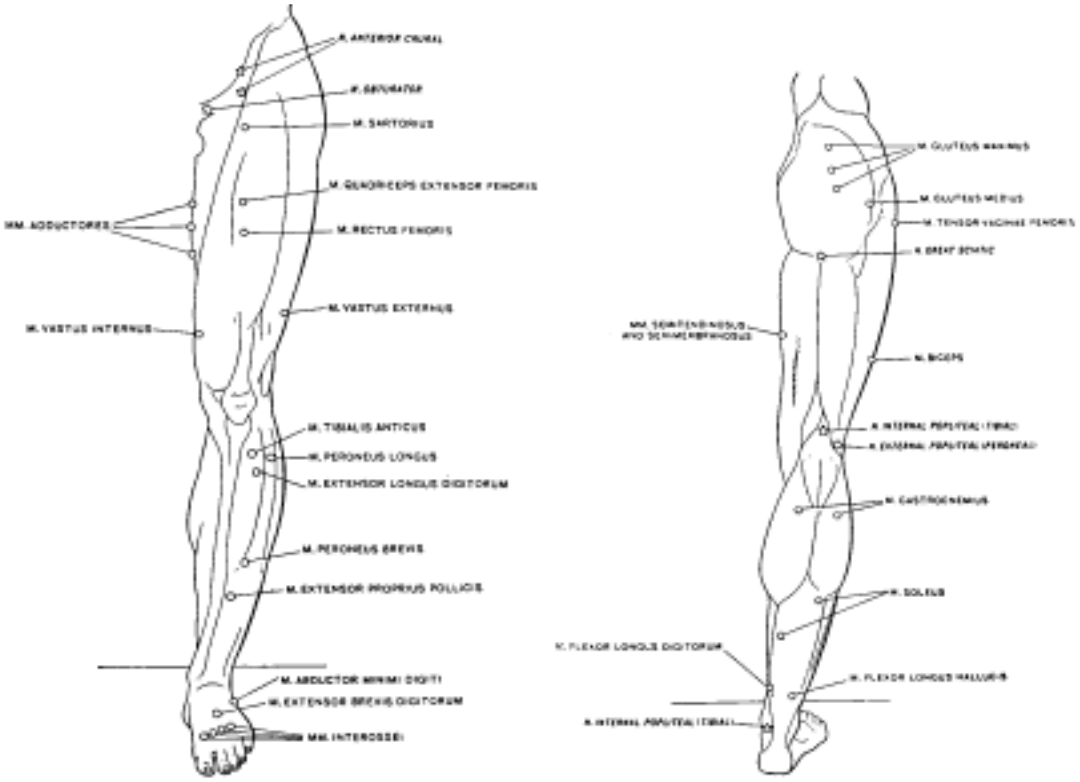


FIG. 2 -- Some motor points of anterior aspect of right arm

Sheet for Motor Points-lower limb



M = Muscle
N = Nerves

Sheet for Motor Points-Face

Activity Questions

1. Compare your findings with those of your subject. Do the motor points approximate those on the chart?

2. What would explain any differences? If you are using a unit where a polarity change is possible, try the following: Change the polarity from negative to positive. Move to an identified motor point and increase the intensity until a similar contraction is elicited. Did the required intensity change from your initial trial?

3. Is it possible to obtain a muscle contraction if electrode placement is not over a motor point? Why or why not?