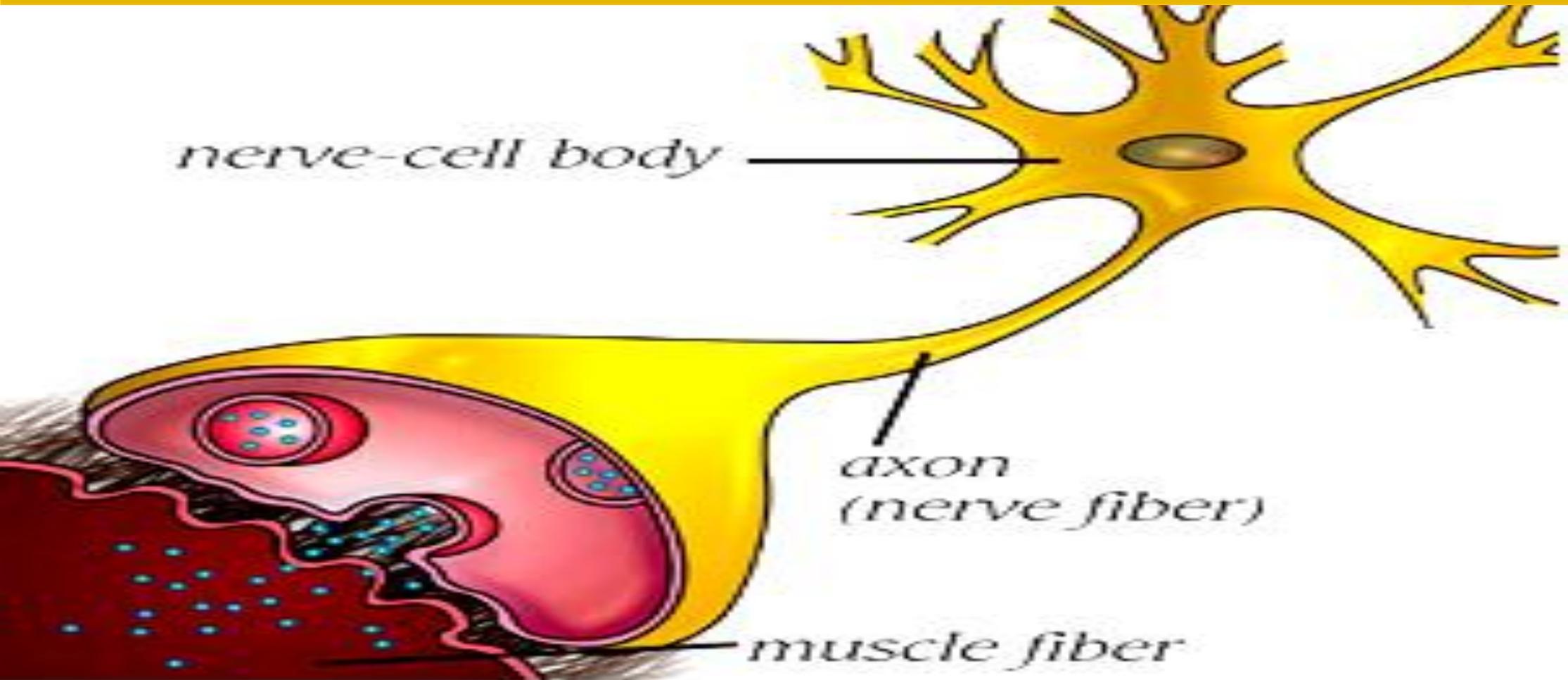


Excitable Membrane Physiology



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Excitability

- **Definition:** It is the ability of any living tissue to respond to a stimulus.
- The most excitable tissues in the body are nerves & muscles (skeletal, cardiac and smooth) = excitable tissues.
- **Types of stimuli:**

I-According to the Nature of the Stimulus:

Electrical , mechanical (as pressure), chemical & thermal.

Electrical stimuli are usually used because:

- a. It is similar to the natural stimulus inside the body.
- b. Its intensity, duration and site of application can be easily controlled.
- c. Can be repeated for several times.
- d. Do not damaged the tissue.

●There are two types of electric currents:

a. Galvanic current is a constant current (from a battery). It is usually of a low intensity and a long duration.

b. Faradic current is an alternating current. It is usually of a high intensity and of a short duration that is used in laboratories.

II-According to the Strength of the Stimulus:

- a. Subthreshold* (subminimal).
- b. Threshold* (minimal = Rheobase (R)).
- c. Submaximal* (supraminimal).
- d. Maximal* .
- e. Supramaximal*.

▪ All or None Rule (Law)

-Definition: Stimulation of single nerve or muscle fiber by a stimulus of threshold intensity or over \Rightarrow giving maximal response but if stimulated by subthreshold stimulus gives no response at all.

-The all or none rule can be applied to:

1-Single nerve fiber.

2-Single skeletal muscle fiber or single motor unit.

3-Cardiac muscle fibers (either 2 atria or 2 ventricles).

4-Smooth muscle fibers (visceral=single unit type).

▪ Response of Tissues not obey All or None Rule

- a. *Subthreshold*** (subminimal) stimulus producing no response.
- b. *Threshold*** (minimal) stimulus produces a weak stimulation.
- c. *Submaximal*** (supraminimal) stimulus producing intermediate response between minimal and maximal.
- d. *Maximal*** stimulus produces a maximal stimulation.
- e. *Supramaximal*** stimulus produces a maximal stimulation.

Factors Affecting Effectiveness of a Stimulus

1-The rate of application.

2-The strength of stimulus.

3-The duration of application.

1- Effect of the Rate of Application:

-Sudden onset of stimulus is more effective than slowly applied stimulus. Slow increase of stimulus intensity

 accommodation and no response.

2- Effect of Strength of Stimulus and the Duration of Application = Strength –Duration Curve.

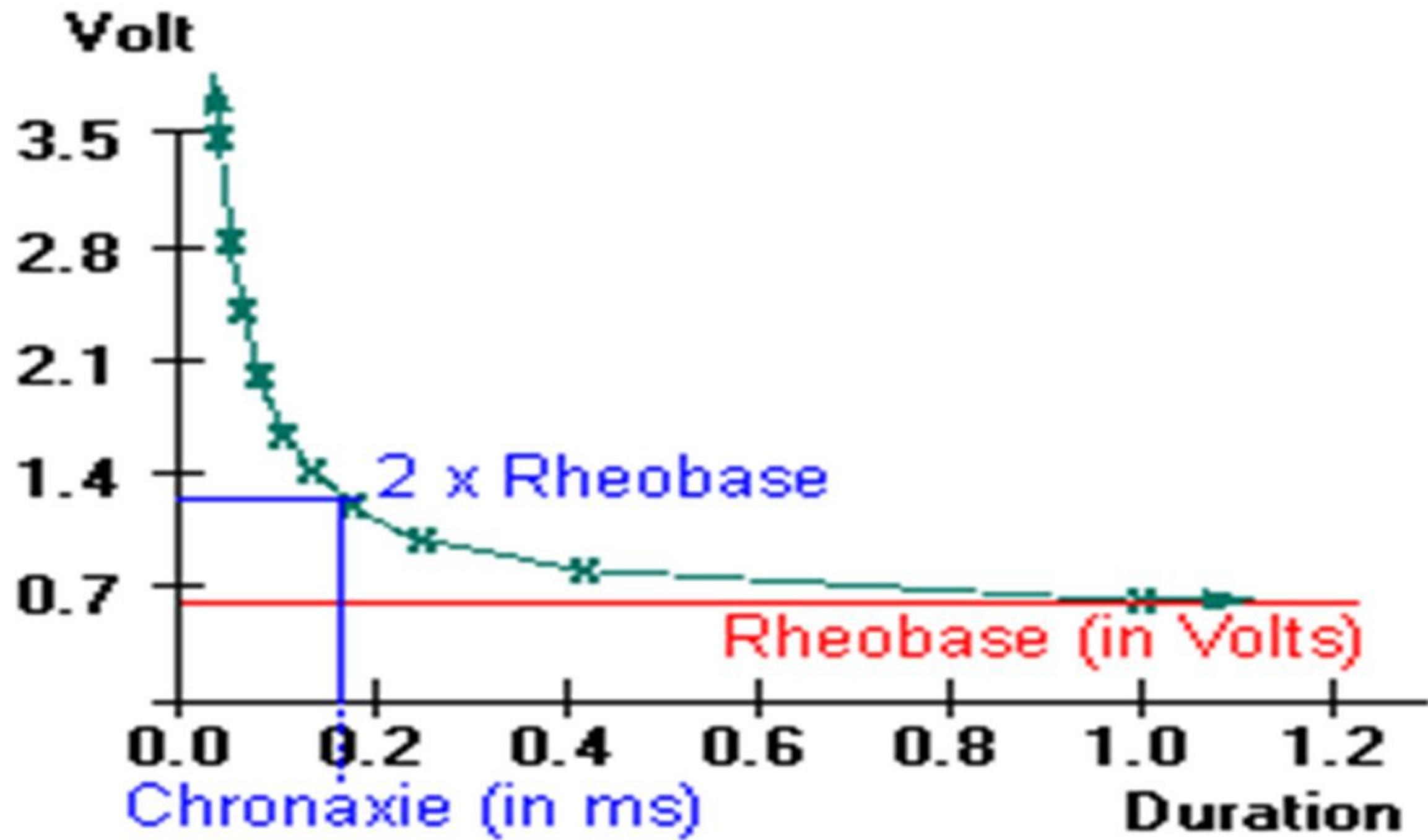
Definition: It is relationship between the strength of a given stimulus and the time needed by this stimulus to produce a response.

Interpretation of the Curve:

A-The stronger the stimulus the shorter is the time needed to exit and vice versa.

B- Rheobase (R) (threshold) is the minimum stimulus strength required to stimulate, below which no excitation occur whatever the duration may be prolonged.

strength of stimulus



C- Utilization time (UT)

Definition: It is the time needed by the rheobase to stimulate.

D- Chronaxie (C):

Definition: It is a minimal duration required for stimulation by a current of double the rheobase.

Significance of Chronaxie:

1-It is used to measure the excitability. Longer the chronaxie, lesser is the excitability.

2-It is used to compare excitability of different tissues. Nerve fiber has shorter chronaxie value than a muscle fiber indicating greater excitability of the nerve.

Test your self

• The minimal stimulus strength that can required to stimulate is called:

- A. Superthreshold.
- B. Subthreshold.
- C. Threshold.
- D. Supraminimal

Regarding stimulus applied to a nerve or muscle :

- A. threshold & submaximal stimuli lead to same action potential.
- B. threshold stimulus is maximum stimulus required to excite the tissue.
- C. single nerve fiber does not obey all or non law.
- D. subthreshold stimulus produce complete action potential.

•Tissues that obey all or non law :

A. multi-unit smooth muscles.

B. both ventricles & both atria of the heart.

C. Skeletal muscle motor units.

D. Whole nerve fibers.

• **From the strength-duration curve, all the following statements are true EXCEPT:**

- A. Rheobase is the threshold galvanic current which can excite the nerve.
- B. Chronaxie is the current of twice the rheobase intensity needed to excite the nerve.
- C. The stronger the current the shorter the duration required to excite.
- D. The longer the chronaxie, lesser is the excitability.

Regarding All or Non rule:

- A. for stimulation occur, stimulus needs to reach the threshold
- B. if the stimulus is sub-threshold No stimulation occur
- C. Supraminimal stimulus produces the same action of supramaximal
- D. all of the above

• **About the strength duration curve:**

- A. Chronaxie means the intensity of the stimulus that produces a response
- B. Chronaxie means the intensity of the double rheobase that produces a response.
- C. Longer the chronaxie, greater is the excitability..
- D. The weaker the stimulus the longer is the time needed.

• **Concerning the strength duration curve:**

- A. The rheobase is the maximum current required to stimulate.
- B. The chronaxy is the duration of the needed by the rheobase to stimulate.
- C. a muscle fiber has shorter chronaxie value than a nerve fiber.
- D. Nerve is more excitable than cardiac muscle

Electrical stimuli are usually used in laboratories because:

- a. It is similar to the natural stimulus inside the body.
- b. Its intensity, duration and site of application can be easily controlled.
- c. Can be repeated for several times.
- d. All of the above.

From the strength-duration curve, all the following is true EXCEPT:

- A. The stronger the current the shorter the duration required to excite .
- B. The threshold current which can excite the nerve is called the rheobase.
- C. The utilization time is a common measure of excitability.
- D. There's a inverse relationship between strength and duration of the stimulus.

A constant current is

- A. Used in laboratories
- B. Called the Faradic current
- C. short duration
- D. usually of a low intensity and a long duration
- E. None of the above

Supramaximal stimulus producing

A. Supramaximal stimulation

B. Maximal stimulation

C. Minimal stimulation

D. Supramaximal stimulation

If the stimulus is increased gradually the nerve will producing

- A. no stimulation.
- B. weak stimulation.
- C. an intermediate response between minimal and maximal.
- D. maximal stimulation.

Rheobase indicates:

- a. Strength of current
- b. Duration of current
- c. Velocity of nerve conduction
- d. Rate of discharge

• **Chronaxie is:**

- A. the time needed for the rheobase to stimulate a nerve fiber.
- B. the minimum duration of a stimulus needed to excite the nerve.
- C. a measurement of excitability.
- D. the utilization time.

• **The Strength-Duration curve:**

- A. is the relationship between the duration of the stimulus and amplitude of response.
- B. has a rheobase which is 2 times chronaxie.
- C. has a chronaxie which is the time needed by double the rheobasic strength to stimulate the nerve.
- D. strong stimuli of extreme short duration can excite the nerve.

• The excitability of the tissue would be greater in the tissue showing:

- A. Lesser chronaxie
- B. Lesser rheobase
- C. More chronaxie
- D. Accommodation