

**Physiological properties  
of  
skeletal muscle**

# Preparation of gastrocnemius muscle of frog;

1. handle or grasp frog firmly then press the tip of mouth.
2. move the pin or needle along the groove until reach to the skull foramen.

**3. push the point of pin into it move and circular it forth and back, left and right , in order to destroy and separate the spinal cord from brain, this process called pithing(i.e destroy of central nervous system).**

**4. then isolate the gastrocnemius muscle or Achilles muscle which put in ringer solution.**

# Composition of ringer solution:

1. NaCl 6.5gm

2. KCl 0.1 gm

3. CaCl<sub>2</sub> 0.2 gm

4. NaHCO<sub>3</sub> 0.01

In one liter

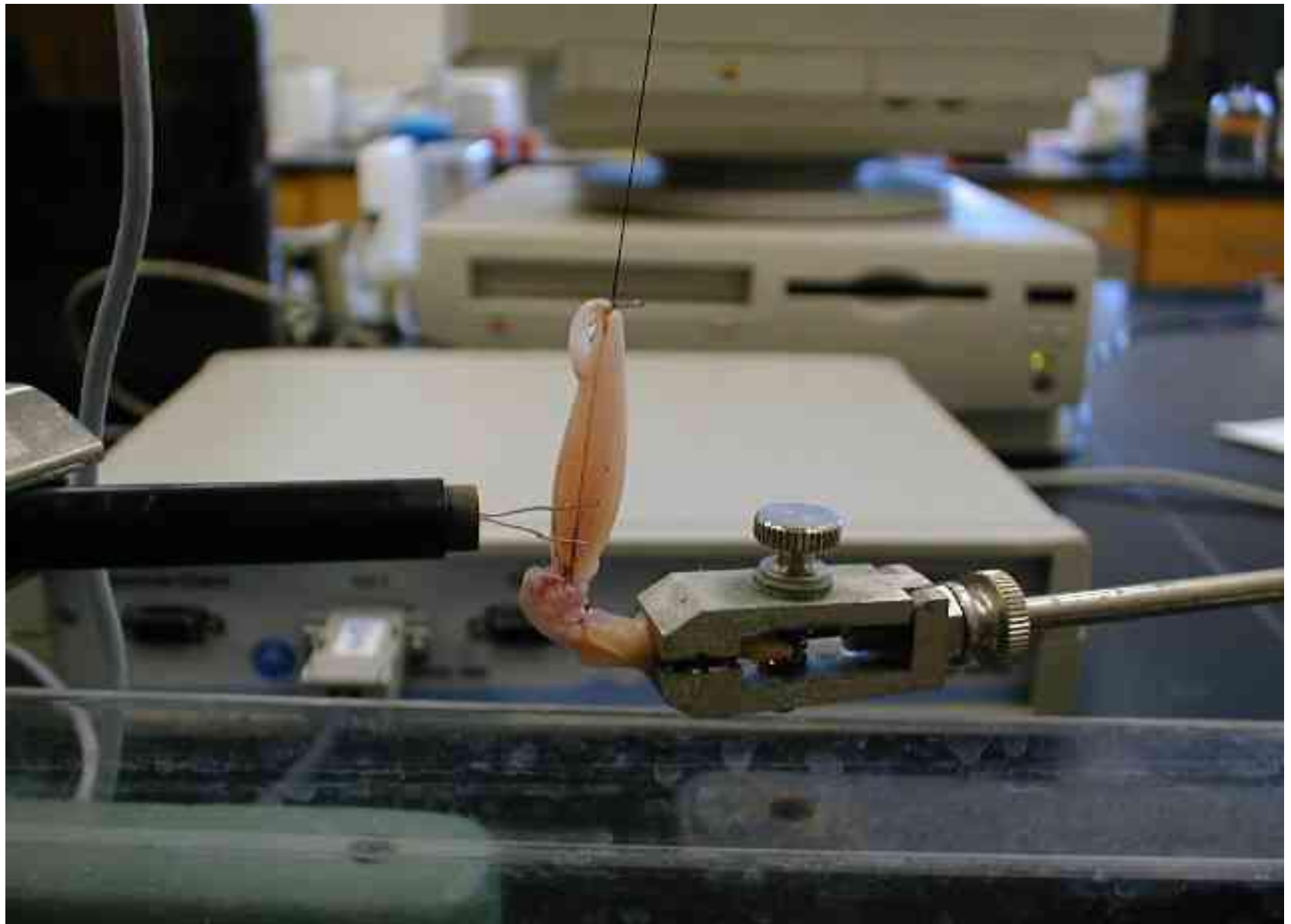
# Functions of ringer solution:

**1.moistring muscle**

**2.provide nutrition ions**

**3.keep it shape without change**

**The properties of muscle studied by apparatus called myograph which composed from electrode, threads, stimulating unit and paper recording movement.**





# **Molecular basis of muscle fiber contraction:**

**1. whole skeletal muscle is made up of many cells called muscle fiber (myofibrils).**

**2. muscle fiber are striated that it has light and dark bands.**

**3. the striation are due to the placement of protein filaments of myosin and actin.**

**4. during contraction actin filament move past myosin filament**

**5.the unit of muscle called sarcomere shorten.**

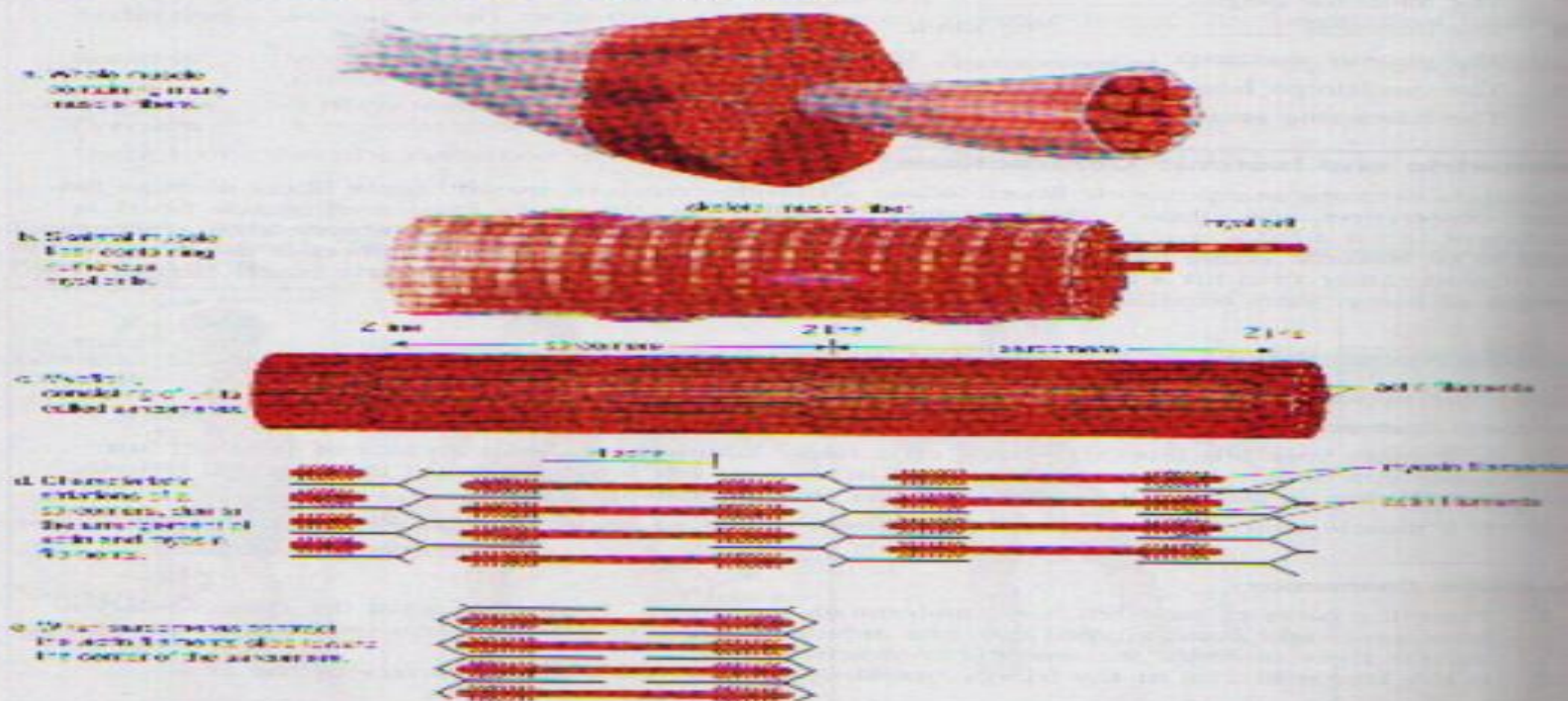
**6.ATP serves as energy source for sarcomere contraction.**

## 19.4 Mechanism of Muscle Fiber Contraction

A whole skeletal muscle is made up of many cells called **muscle fibers** (myofibrils) (Fig. 19.7). Muscle fibers are striated—that is, they have alternating light and dark bands. These striations can be observed in a light micrograph of muscle fibers in longitudinal section.

Electron microscopy has shown that striations are due to the placement of protein filaments of myosin and actin. During contraction, actin filaments move past myosin filaments, and units of the muscle, called **sarcomeres**, shorten. ATP serves as the immediate energy source for sarcomere contraction. Potassium ( $K^+$ ) and magnesium ( $Mg^{2+}$ ) ions are cofactors for the breakdown of ATP by myosin.

Figure 19.7 Microscopic structure of a muscle fiber.



## Types of muscle contraction:

**1.isotonic contraction: when muscle fiber is sufficient to lift a load ( many muscle fiber change length as they lift the load) (shorten).**

**2.isometric contraction: when muscle fiber is used only to support rather than lift .(no change).**

## **Experimental procedure:**

### **1. effect of stimulus strength :**

- a. by using a very low speed and by action of stimulation of skeletal muscle directly record the first twitches obtained with threshold.**
- b. gradually increase voltage in stepwise and record the muscle twitches obtain.**
- c. continuous this process until no further increase in twitch high (maximal response).**

## **2.single muscle twitch:**

**a. record a single muscle twitch in response to single stimulation.**

**b. calculate the contraction and relaxation and mark the latent period.**

# **Causes of latent period:**

**1.transport of ions.**

**2.chemical reaction.**

**3.physical factor.**



### **3.effect of prolonged twitch:**

- a. stimulate the muscle continuously with maximum voltage at high frequency.**
- b. record response from initial activation to complete fatigue by using slow paper speed.**
- c. identically the various changes in muscle as it continuously to contract.**

# **Causes of stair case phenomena : (treppe)**

**-repeated stimulation of skeletal muscle causing summation of force of contraction.**

## **Causes of tetanus:**

**-Continues stimulation lead to increase quantity of calcium.**

## **Causes of fatigue:**

**-decrease O<sub>2</sub> and ATP and Ca.**

**-increase lactic acid.**

## **Abnormalities of skeletal muscle fiber:**

**1. Muscle hypertrophy: forceful muscular activity lead to increase in muscle size.**

**2. Muscle atrophy: either by degeneration or placed in casts.**

**3. Rigor mortis :after death all muscle fiber under go state of contraction (rigid because loss of ATP).**