SENSORY PHYSIOLOGY…

Sensations & Perceptions

sensation - is an awareness of sensory stimuli in brain

perception - meaningful interpretation or conscious under-standing of sensory data

5 Components of Sensory Physiology:

1. Sensory Receptors - structures that detect changes in external & internal environment modified neurons or epithelial cells eyes, ears, that respond to stimuli

Classes of Receptors

mechano-receptors : mechanical forces

(1) hair cell - deflection = depolarization

(2) stretch receptors of muscles

(3) equilibrium receptor of inner ear

(4) touch receptors of skin

chemo-receptors : chemicals

sense solutes in solvents, taste, smell

osmo-receptors of hypothalmus which monitors blood osmotic pressure

photo-receptors : light

eye, eyespots, infrared receptors of snakes, etc...

thermo-receptors : radiant energy

phono-receptors : sound

electro-receptors : detect currents...

lateral line of fish, electric eels, etc..

noci-receptors : pain receptors...

naked dendrites of skin

2. **Reception -**

ability of receptor to absorb energy of a stimulus

3. **Transduction –**

conversion of stimulus energy into membrane potential, a Receptor Potential... change in permeability of a post-synaptic membrane.

is graded = proportional to strength of stimulus

may be amplified and may be summed

4. **Transmission -**

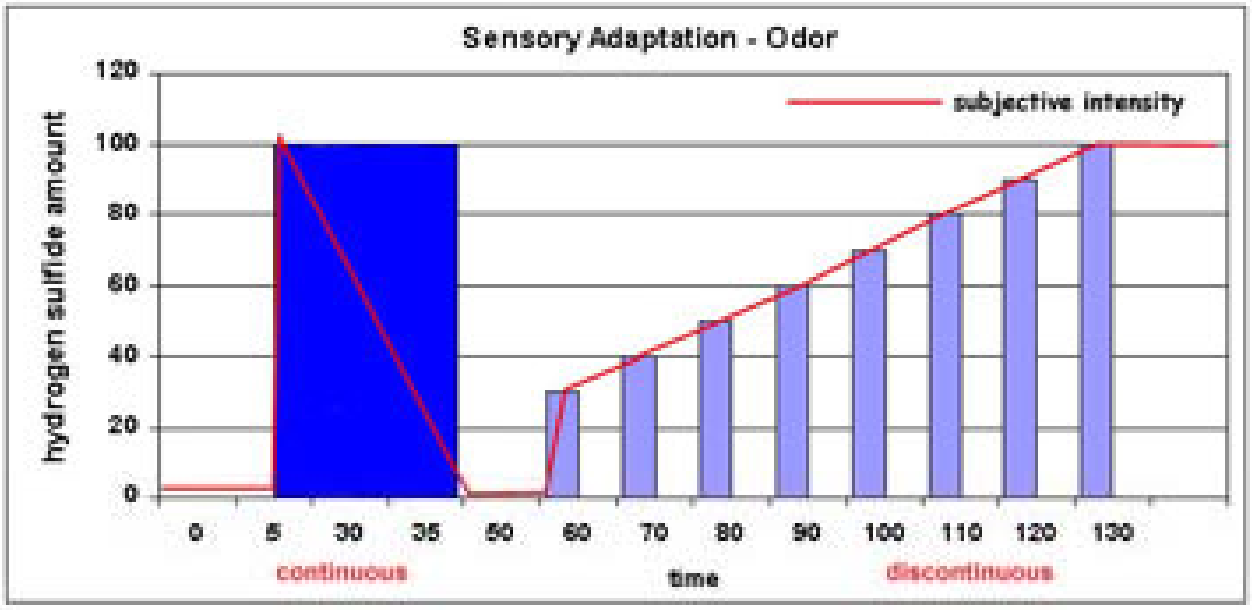
receptor potential transmitted via Ap's to CNS

5. **Integration -**

processing of the frequency of receptor potentials received via summation

Sensory Adaptation – decreased responsiveness by receptor to continual stimulation

a uniformly maintained stimulus of constant intensity is perceived as progressively weaker with time, while a variable intensity stimulus of short duration is perceived as stronger.



Example of Sensory Organ - the Human Eye

EYE - a specialized sensory organ capable of light reception in vertebrate animals, formed visual images are then carried to the visual center of the brain = perception.

Parts - of a simple eye -

roughly spherical with opaque sides & back, with transparent front & interior

lens - focuses light on rod & cone cell of retina - cuboidal epithelia

retina - layer of nerve tissue of millions of light receptor cells

rod & cone cells - transmits signals of varying light intensity

fovea - structure near center of retina, where cone cells give max sharpness of vision

optic nerve - retinal cells record light images & transmit to optic nerve, which exits eyeball behind the optic disk (blind spot) to the visual centers of brain.

sclera - tough outer shell of eyeball, made of dense fibrous tissue

cornea - stratified squamous epithelia, chief refractory part of eye allows light to pass & aids in focusing.

vitreous humour - transparent jellylike material, helps eye keep its spheroid shape.

aqueous humour - anterior chamber, filled with a watery fluid

iris - muscular curtain that opens/closes to regulate amount of light entering eye through the pupil (opening of iris into eye)-

Some common vision disorders- correctable by eye glasses

myopia (near-sightedness) -
lens' point of focus falls within the vitreous body,
so that when light reaches the retina it is out of focus

hyperopia (farsightedness) -
point of focus falls behind the retina (out of focus)

astigmatism - results from defects in the corneal curvature
rays of light don't form a point of focus on the retina.

night blindness - lack of chromophore retinal

color blindness - lack of trichromatic pigments

glaucoma - result of increased pressure of fluids in the eye,
produces defects in field of vision, lead sto vision loss

Optical Illusions

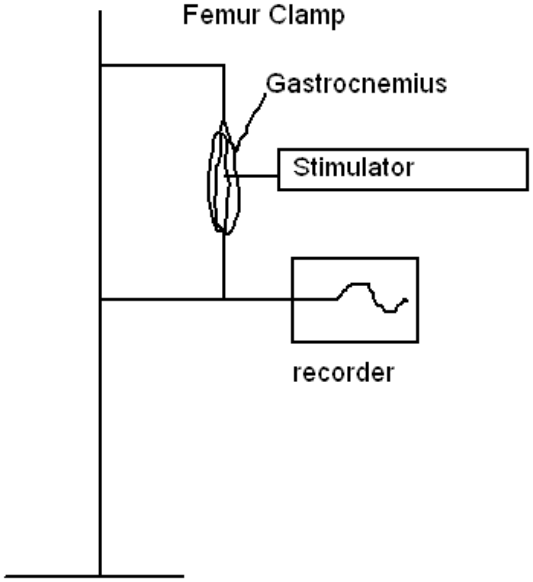
- illustrate difficulty of perception & understanding
what you see is actually what you see?

Seen as columns of Xs and Os rather than rows of alternating Xs and Os.

X O X O X O X O X O
X O X O X O X O X O
X O X O X O X O X O
X O X O X O X O X O

another example: MUSCLE PHYSIOLOGY

model: skeletal neuromusclar junction (see web fig)
an innervated muscle fiber
muscles can only contract (pull)



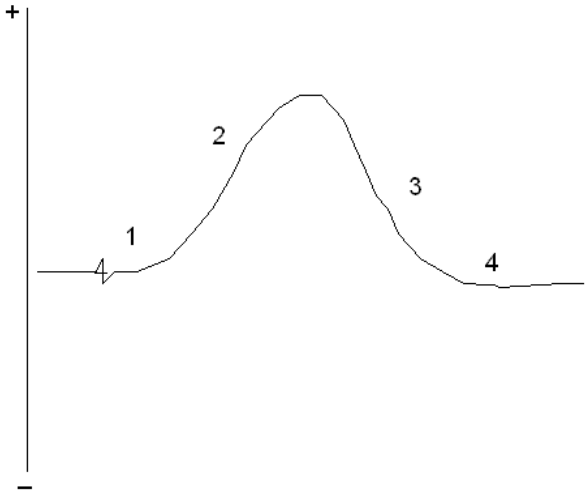
4 parts of a Muscle twitch
[CONTRACTION]

1) latent period - 5 msec
time between application of AP
& initiation of contraction

2) contraction - 40 msec
muscle shortens
& does its work

3) relaxation - 50 msec
muscle elongates
& returns to original position

4) refractory period - 2 msec
time of recovery
between stimulations



Summation - a 2nd contraction before the 1st subsides

Tetany - sustained contractions

Fatigue - under repeat stimulation, contraction get feebler, lactate accumulates, fatigue, contractions stop

Shivers - involuntary-summed muscle contractions which release waste heat, that warms body

2 TYPES of MUSCLE FIBERS

determined both genetically and functionally
based upon how fast they can produce a contractile twitch

Every muscle composed of varying % composition of two types

TYPE I SLOW TWITCH	TYPE II FAST TWITCH
Tonic muscle (red)	Tetanic muscles (white)
Leg muscles	Pectoral muscles
slower contraction times (110 msec)	faster contraction times (50 msec)
continuous use muscles	one time use muslces
for endurance performance(marathoners)	for power & speed (sprinters)
good for long slow sustained contractions and prolonged performance	good in rapid contraction short time and brief performance
not easily fatigued	easily fatigued
contain myoglobin (red)	no myoglobin (white)
more capillary beds greater max VO2	less capillary beds
smaller in size	larger in size
lower glycogen content	higher glycogen content
poor anaerobic glycolysis	predominant anaerobic glycolysis
	easily converts glycogen to lac w/o O2
predominant aerobic enzymes & aerobic metabolism	some aerobic capacity
higher fat content	lower fat content
more miotchondria-Beta Oxidation high	fewer mito. - Beta Oxidation low
poorly formed sarcoplasmic reticulum	well formed sacroplasmic reticulum
slower release of Ca = slow contractions	quick release of Ca =rapid contractions
tropinin has lower affinity for Ca	troponin - higher affinity for Ca

Vertebrate Skeletal Muscle - structure

sarcomere - repeat unit of striated muscle, delimited by Z-lines

I band - "clear zone around Z-line (isotropic)

A band - dark region in center of sarcomere (anisotropic)

M line - mid point of sarcomere

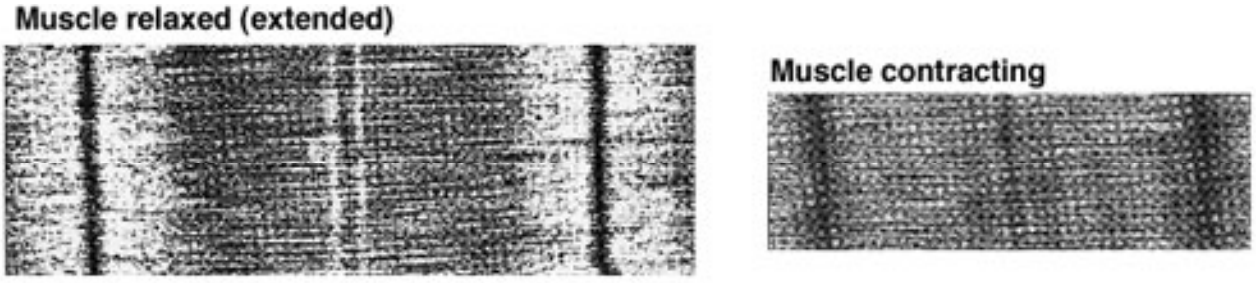
H zone - clear region in cnter of sarcomer around M line

SLIDING FILAMENT THEORY of Muscle Contraction

A band remains constant in size

H Zone becomes denser

I band varies in length becoming shorter



Muscle Cell Proteins

myosin - 2 polypeptides forming a helix with globular end, which has ATPase activity & an affinity to bind actin

THICK FILAMENT

G-actin - globular protein which polymerizes into THIN FILAMENT, contains a myosin binding site

tropomyosin - fiberlike protein which helically wraps around actin thin filament

troponin - globular protein which binds Ca+2

Muscle Contraction Cycle & Role of Ca - review

The Performance Enhancing Drugs of the Future...

not steroids, but the introduction of artificial genes:

What kind of genes

1. **genes for myosin type transcriptions factors, which activate genes for dormant myosin isoforms...**
   for ex: say an ancient type IIb isoform that's faster than any known Type II isoform of today
2. **or IGF-I* (insulin-like growth factor)**
   IGF-I is a growth factor structurally related to insulin. IGF-I is produced in response to GH & induces subsequent cellular activities, particularly on bone growth. IGF-Ihas autocrine and paracrine activities, & like the insulin receptor, it has intrinsic tyrosine kinase activity. Owing to their structural similarities IGF-I can bind to the insulin cell membrane receptor.

Normal Muscle Cell Growth includes:

1. satellite cell recruitment... divide & fuse with muscle cells
2. growth factors as IGF-I... promotes satellite cell proliferation
3. growth inhibition factors, such as myostatin.

Current research - H.L. Sweeney at U. Penn... has used adeno-associated virals (AAV) to infuse IGF-I gene into muscle cells in normal mice: overall size & growth rates up 15% to 30% in mice genetically engineered to overproduce IGF-I :
injection of AAV-IFG-I into one leg of lab rats with weight training program :
= 2x increase in strength in treated leg
= longer period before gained strength is lost
= sedentary rats showed 15% increased strength

Myostatin... is a muscle inhibitory growth factor

blocks muscle growth, promotes atrophy and slow muscle cell growth,

may function antagonistically with IGF-I,

discovered by Se-jin Lee at Johns Hopkins in 1997

Belgian Blue cattle* are due to defective myostatin gene

defective myostatin genes = considerably larger muscle mass

a human case study - 2004

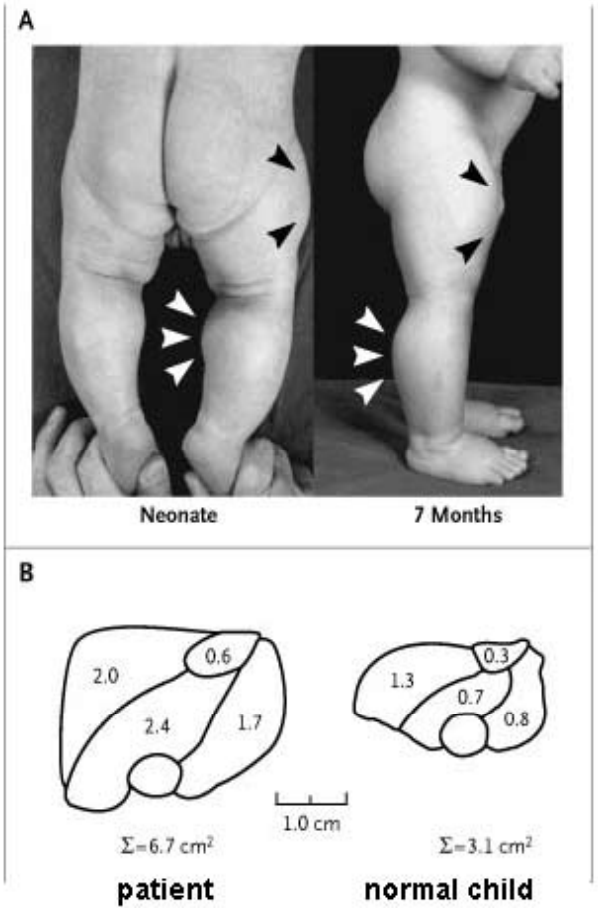
may be useful in muscle debilitating muscle diseases as:

muscular dystrophy –

sarcopenia - age related muscle loss

cachexia - aggressive muscle loss in cancer & HIV patients

myoclonus - abnormal muscle contractions



Wyeth pharmaceuticals is at work on myostatin inhibitors

1st drugs to date are antibodies to myostatin and some clinical trials are set to begin in M.D. patients

Finis

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Τέλος

Extremidade

Конец

Avsluta

The end