Anatomy Test 4 - Nervous system

Function of the nervous system
1) perceives changes in the environment (internal/external)
2. conveys this information to the CNS
3. integrates, analysis, or stores this info w/in the CNS
4. initiates and coordinates a response to the information

3 Functional components to nervous system:
-sensory - in toward CNS- how warm, pain, hungry, information in
-integration
-motor

Nervous tissue = (cells) neurons + neuroglia

nervous tissue forms (organs)
CNS - Brain/ spinal cord
PNS - cranial nerves/spinal nerves/sensory receptors/ganglia

CNS - integrating information
info in sending info out
located centrally
brain + spinal cord
housed in cavities
cranial + spinal cavity

PNS - cranial nerves -12 pairs
spinal nerves - 31 pairs
receptors - tiny organs - specific to types of sensation
photoreceptors, chemoreceptors
ganglia- structures/ organ house
2 neurons come together in cell body
sensitive to changes

CNS
in coming - sensory information - afferent division - ascending pathway
outgoing - efferent- descending pathway - motor commands

SAME
sensory afferent motor efferent

Sensory division - afferent
from organs, or body wall
somatic sensory - skin, muscles, joints, bone
tickles, slaps, step on nail, position of body in space
visceral sensory - gas pains, hunger, nausea, pain in organs
not conscious of --BP, PH
receptors checking + regulating
Motor division -- efferent
somatic motor - skeletal muscle only
synapse w/ skeletal muscle
visceral motor - involuntary
warm--sweat

autonomic nervous system
1. sympathetic division

"fight or flight"
those responses that
stressed or frightened ready to fight
HR inc, blood to muscles, pupil enlarges
salivary glands- stop secreting --dry mouth of speech

2. parasympathetic division
rest + digest
salivating
pupils constrict

antagonist systems in general

somatic - neurons directly to muscles
autonomic - cardiac, smooth, glands, adipocytes
    cardiac + smooth--visceral muscle

effectors
end organ- end destination of neuron

neurons
1. impulse transmitting cells
2. high metabolic rate (great need for O2 and glucose)
3. cells cannot divide (stem cells until age 4)
4. transmitting "axons" found in bundles (nerves)
5. extreme longevity (100 + years)
6. structure
    a) dendrite (receptive portion of neuron)
        sends signal towards cell body
    b) cell body (soma)
    c) axons/nerve fibers (conductive process)
        sends signal away from body
    d) synaptic knobs (release neurotransmitter

PICTURE

dendrite→soma→axon→synaptic knobs→out

neuron→ neuron
neuron→effectors
grey in color

Types of neurons
structural difference in neurons : look different
a) multipolar neurons
    most common 99%
    most carry motor impulses/interneurons

b) unipolar
    cell body sits off to side
    most carry sensory impulses

dendrites and axon act as one "pole"

c) bipolar neurons
found in special sense organs -eyes

d) anaxonic neurons
star like (no obvious anatomical axon)
located in central nervous tissue and in special sense organs

Neuroglia "nerve glue" glial cells
1. cannot generate impulse - but neuron can not send impulse w/out
2. can divide - 75% of tumors formed by neuroglia
3. supportive cells
4. neuroglia of the CNS
a) oligodendrocytes (CNS) - mylenating the axon- wrap around
b) astrocytes "star like" - blood, brain barrier - make sure crosses over is safe
c) microglia "little eaters" - destroy debris, pathogens
d) ependymal cells - line central canal of spinal cord and ventricles
cerebral spinal fluid and maintain it, synthesize it, and circulate it
5. neuroglia of PNS
a) satellite cells - located in ganglia
b) schwann cell - myelinate axons - white matter
(grey matter unmyelinated axons)

4/7
Dura Mater- most superficial - endosteum of cranium attached to bone - in certain spots splits and forms a sinus--venous blood flows

Arachnoid- wet saran wrap layer--spider web appearance
Pia Mater- outermost layer of brain in vagination - deepest layer

Dura Mater- attached tightly to crista galli of ethmoid bone
also divides 2 hemispheres
left + right falx cerebri **
transverse fissure- tentorium cerebelli***- has a sinus
cerebellum and occipital lobe

spinal cord- has same 3 layers
pia mater towards spinal cord
dura mater not attached to vertebra
epidural space- fat pad

cerebral spinal fluid - CSF
produced by capillaries + **ependymal cells** ---choroid plexus
bring fluid in from blood
ventricles- fluid w/in
choroid plexus floor of lateral ventricle, roof of 3rd, back of 4th
fluid baths brain and spinal cord
arachnoid granulations reabsorb the fluid - arachnoid villi absorb
every 8 hours recirculated
granulations formed 3-4 years old
before that done by capillaries
if not work well - ****hydrocephalus**- fluid not drawn back
know basic description and flow of cerebral spinal fluid
cerebral aqueduct - goes to 4th ventricle

in children hydrocephalus not as serious as adults
in adults usually a tumor that blocks a duct - plates are fused and pressure builds

DEVELOPMENT OF BRAIN
35 billion neurons- 98% of neural tissue in brain
start w/ dorsal hollow nerve cord then swelling of brain into 3 areas forebrain, midbrain, hind brain
corpus collosum white matter allow hemispheres to communicate
developmental regions of the brain → **-encephalons**
picture:

forebrain enlarges to telencephalon -lateral ventricles, cerebral cortex, cerebral, hemispheres, corpus collosum
diencephalon- has 3rd ventricle
midbrain-- mesencephalon
hind brain - metenephalon - 4th ventricle
myelencephalon

TELENCEHALON
Cerebrum - conscious thought, memory, learning
frontal lobe- primary motor cotex (conscious control of motor neurons, & higher order thought)
occipital lobe- primary visual cortex (conscious awareness of visual information)
parietal lobe - primary sensory cortex (conscious perception of touch, pain, temp, taste)
temporal lobe - primary auditory cortex & primary (smell) olfactory cortex (conscious awareness of sound & smell)

cerebral hemispheres divided by longitudinal fissure
transverse fissure- cerebellum and cerebrum
lateral fissure - separate lobes

outpockets - gyri
invagination - sulci
central sulcus separates frontal (motor output) from parietal lobe(sensory input)
frontal lobe- primary motor cortex - social appropriateness
occipital lobe- visual cortex

cerebral cortex- gray matter
cell bodies + unmyelinated neurons
white matter -myelinated neurons -fat surrounds
corpus collosum - 1000s of axons cut in half in picture
commissural fibers crossover fibers from one hemispheres to other

basal ganglia (cerebral nuclei) - contain neurons that cooperate with the cerebral cortex in controlling large subconscious movements (such as swinging arms while walking) involved in starting, stopping, and intensity of movements.
problem w/area can't smooth movements, jerky, shaky movements, Parkinson's disease

DIENCEPHALON
Thalamus- sensory "relay station" or "switchboard" for cerebral cortex; primitive awareness of sensory information. It is considered the "gateway" to the cerebral cortex because ANY communication to the cerebral cortex MUST go through the thalamus where info is edited (amplified/inhibited)

dot in middle
only one pathway not go through thalamus - olfactory tract -smell

hypothalamus- main control center for the autonomic nervous system (regulates HR, BP, digestive movement, body temp, salivary and sweat glands, hunger/thirst) center of emotions (rege, fear, pleasure, and sex drive) sleep-wake cycles: endocrine control
below thalamus
autonomic control + endocrine system
can monitor the blood

MESENCEPHALON
Cerebral Peduncles - "little feet of the cerebrum"; contain pyramidal (corticospinal) tracts descending from the cortex towards the spinal cord
primarily axons
one region of brain to specific region of spinal cord

Corpora Quadrigemina - "quadruplets"; Involved in visual reflexes (tracking of our eyes on a moving object); Involved in auditory reflexes ("startle reflex" to loud sound)

METENCEPHALON
PONS- bridge between cerebral cortex and cerebellum for coordination of voluntary movement; respiratory centers for regulate smooth transitions between inhalation /exhalation
or bridges up from brain stem to cerebellum
enlarged circle area of brain stem

Cerebellum- receives info about; equilibrium (inner ear), current movement of body(porprioceptors), motor commands from cerebral cortex. This allows the cerebellum to smooth and coordinate body movements & maintain posture/equilibrium.
mini brain
covered by tentorum cer?
vermis- worm like structure connects to halves
white matter- arbor vitae- tree like
inner ear, stretch receptors, position of body + motor outputs- coordination action
cerebellum used to learn to dance and to hit a ball

MYELENCEPHALON
Medulla oblongata- pathway for pyramidal tract, sensory relay; subconscious movement for equilibrium; visceral centers for autonomic functions (adjusts force/rate of HB, BP control, pattern/rate of breathing, reg. vomiting, hiccupping, swallowing, sneezing, coughing) Work in conjunction w/hypothalamus.
respiratory senses, visceral senses, breathing,
if dens breaks goes into

know regions
example- 1 pointer - 3 questions
what developmental region? dicephalon
what region of brain? thalamus
what cavity? 3rd ventricle

Cranial nerves know #s and names

off of cerebrum - olfactory nerve
rest off of brain stem
#4 small one
#5 large one
#11 look like 11 off sides

start in front and move back
nose, lots around eyes and then back
#10-vagus- drops down to heart, lungs it's the wanderer

old owls on tree tops are forever viewing green valleys and hills
some say money matters but my brother says big brains matter most

s= senses
m=motor
b=both

4 cranial nerves- parasympathetic
know chart - what is the sensory / motor function
know brain chart or picture from lab book

cranial nerves can carry motor neurons only, sensory neurons only or both
different than spinal nerves

SPINAL CORD
position in body
1. Foramen magnum → L1/L2 (conus medullaris)
a) spinal cord growth stops at about 4 years of age
b) vertebral column continues to grow until full height (~18 inches)

cauda equina - horse tail off conus medullaris

Functions of vertebral column
1. sensory/motor innervation below the neck (via spinal nerves)
2. Two-way conduction between body & brain (tracts)
3. Reflex center! - acts on own - some info in and respond to it

Protection
1. no attachment of dura mater to bone w/in spinal cavity
2. epidural space filled w/ connect, tissue, fat & vessels
3. cerebral spinal fluid - cushions cord
4. meninges (ends at S2) dura mater, arachnoid, pia mater
    a) dentriculate ligament- anchors cord laterally
    b) filum terminale (coccygeal lig) anchors cord caudally
    c) dura mater in cranial cavity- anchors cord cranially

gray matter inside
white matter outside

gray matter of spinal cord
1. mostly cells bodies + interneurons unmyelinated
2. "H" shape surrounding the central canal
3. the "wings" of the gray matter represent the
    -dorsal (posterior) horn (sensory axons & interneurons)
    -ventral (anterior) horn (somatic- voluntary- motor cell bodies) to skeletal muscle
    -lateral horn- visceral motor/visceral sensory
DAVE
dorsal afferent ventral efferent

White matter of spinal cord - travel up and down
1) white matter on outside of cord
2. myelinated/unmyelinated axons

3. axons arrange in common "tracts" or "funiculi" / column
    a) funiculi (lateral/anterior/posterior)
    travel up, down or across one side to another
2 tracings need to know
    motor tracing and sensory tract
    b) axons that share structural or functional similarities (ascending/descending)

Dermatones
if on al 4's
4 plexuses - neurons brake off nerve wrap around other nerves
cervical
brachial
lumbar plexus- front of legs
sacral- back of legs, bottom of foot, 1 feeds to top of foot
****all spinal nerves carry both sensory and motor

PNS
motor division
somatic + visceral (autonomic)
autonomic-
    sacral and cranial - parasympathetic
    central area- sympathetic
4/14/03
peripheral neuron
    neurons found traveling in a nerve
    somatic - 1
    autonomic-2 →synapse in a ganglion -protect a cell body
find somatic neurons in every segment
autonomic found in regional sections

sympathetic
    blood flow to stomach stop
    not salivate
    HR inc
    sweat
    Thorocolumbar T1-L2
    preganglionic neuron + postganglionic neuron
    adrenal medulla only one w/single neuron(norepenephrine, epinephrine)
parasympathetic-craniosacral CN3,7,9,10 S2-S4

pain helps prevent death →warning
picture-

most sensory info makes it to thalamus
thalamus holds things in check
doesn't bring everything to conscious level
occipital love- flashes of light--sight

Receptors
1.vary in structure and function
2. if stimulus is sufficiently strong (meets AP threshold) impulse AP occurs
3. receptors show some "stimulus specific" quality
4. threshold varies for various stimulus
(eye--light (usually/pressure]

Sensory adaptation
threshold changes- at first receptors easily stimulated - then tolerance occurs and greater stimulus is needed
(bath, smells,clothes) ex. thong underwear,perfume in room

general receptors- touch receptors- spread thoughout body
receptor fields- smaller on hand, larger on back
special sense receptors- receptors concentrated

Receptor types
mechanoreceptor-detect mechanical physical change
    touch, stretch- digestive organs, deep breath
    proprioceptors- where body position is in space
        in muscles, tendons, joints
        where hand position is even not looking at it
thermoreceptors- detect temp
photoreceptors- detect light
chemoreceptors-detect chemical change(taste/smell)
nociceptors -(free nerve ending) detect pain
        dendrites-sensitive to chemicals released when tissue is damaged
    all the receptors can act as pain receptors

Taste- gustation
1. use chemoreceptors
    most found in papillae
    some on palate/pharynx/larynx
2. ~10,000 receptors- release through adulthood (3000)
3. 4 primary taste sensations
    sweet-tip of tongue
    sour-sides of tongue
    bitter- back of tongue
    salty- front sides of tongue
filiform papillae- flame shape- no taste buds on
fungiform papillae- dispersed throughout tongue
cicumvillate paillae- v-shaped in back

4. work w/ smell to detect variations of taste (raspberry)
if cannot smell can not taste raspberry

dry tongue - not taste anything
chemoreceptors need liquid to work
Cranial nerves of gustation--vagus, glossopharyngeal, facial (front of tongue)

Smell- olfaction
located roof of nasal cavity
1. use chemoreceptors
    receptors embedded in mucous membrane
    found in 1 inch patch on roof of nasal cavity
olfactory
2. ~10-20 million receptors (50 billion in blood hound)

3. 4 molecules of gas can cause an action potential
4. sends sensory info to temporal lobe
5.only one to bypass thalamus

Vision
1. most complex
2.70% of all body receptors are found in eye
3. use photoreceptors
    cones- detect color (3 types) visual acuity(sharpness) - if color blind miss a cone
    rods- detect light/dark
4. 3 tunics
Fibrous tunic
    sclera-"white of eye" (opaque)
    cornea- "window of the eye" (no blood vessels)
vascular tunic
    choroids- pigmented layer (absorb light)
    cilliary body- muscle that suspends/moves lens
    iris- muscular diaphragm used to adjust light (pigmented)
    lens-clear/flexible
    blue eyes- pigment just in back
    brown- pigment throughout
nervous tunic - retina****
    made of nervous tissue
    contains of photoreceptors
    fovea**- concentration of cones only at back of eye - focal point- small depression
    optic disc**- "blind spot" where optic nerve exits
        back of eye- no photoreceptors
lacrimal gland- lateral
    tearing across the eye- to medial side- drains into nasal cavity

For test know developmental area, origin, brain area, invagination

EAR
3 regions of the ear
outer ear
pinna -ear flap
auditory canal (lined w/ hair/wax)
typmpanic membrane (skin covered)- thin membrane
    wax- cleans ear, sloughs off debris and insecticide

Middle ear
auditory tube- connects ear to throat
    usually closed, opens w/chewing and contraction
infants is wider so milk bacteria cause ear infection
    that's why have head up when feeding
have a cold-swell up make auditory canal had to open
    pressure in ear
equalizes pressure in and out of middle ear
    allows membrane to vibrate properly
middle ear ossicles- only bones in skull w/synovial joints
    allows more flexibility
maleous-touches typmpanic membrane
incus-middle bone
stapes-looks like stirrup attached to oval window- causes vibration of oval window
if anticipating loud bang and tense muscles tighten to prevent harsh vibration

ear ossicles- bones malleus--incus--stapes
auditory tube- connects ear to pharynx & adjust pressure air filled

Inner ear
bony labyrinth (canals w/in temporal bone)
membraneous labyrinth (inside bone)
    contains cochlea (hearing)
contains semicircular canals/vestibule (enlarged area)(equilibrium)

Hearing
1. mechanoreceptors found in chochlea
2. stapes vibrates against oval window (moves fluid)
3. hair cells bend as sound waves more fluid (endolymph) and membranes in cochlear duct
    organ or corti
perilymph in bony part

Equilibrium
1. mechanoreceptors found in semicircular canals- right angles to each other
    receptors in ampullae, receptors ben
    (dynamic equilibrium) movement of body/head ex. spin in circles, summersaults
2. mechanoreceptors found in vestibule - in saccule, utricles---little crystals
    (static equilibrium) position of head/gravity ex. up in an elevator, forward in car
3. send info to cerebellum to interpret
know difference between 2 movements

when basilar membrane moves, distorts hair cells, sound waves

Endocrine system

Exocrine glands example- sweat glands, salivary glands
    -secrete product into duct (tube)
    -secrete directly in desired location

endocrine glands example- thyroid gland
    -secrete hormone into bloodstream
    -hormone travels through body to all cells
    -only cells w/ receptor affected
    - not effect any cell that does not have a receptor for that hormone
    -goes out to whole body

pancreas - endocrine + exocrine (pancreatic enzymes to sm intestine)

Nervous system
1. short-term effects (seconds to minutes)
2. very specifically targeted (directly on effector)
3. neurotransmitter at synapse
4. immediate response/recovery

Endocrine
1. long term effects(minutes to days)
2. general response (many effectors-varied response)
3. hormones into circulation
4. seconds to hours response/recovery

Negative feedback

gland secrete insulin

blood sugar levels rise — blood sugar levels decline

homeostasis
(normal blood sugar levels)

Parathyroid + Ca2+ levels in blood
low Ca levels in blood
activates
parathyroid — feedback (stops action)
produces
PTH — increase in blood Ca levels
effect
kidney→ decreases Ca excreted in urine
bone→increases osteoclast activity
therefore increase Ca blood levels

continues until level of calcium at proper level

<u>Positive feedback</u> - rare - drastic effect quickly

gland secrete oxytocin

uterine wall stretches — uterine wall contracts

exacerbates the situation
ex. giving birth, or bleeding

Oxytocin & birth
Fetus putting pressure on uterus
activates
hypothalamus to neurohypophysis
produces
oxytocin
effect
increases uteran contractions
fetus places more pressure on uterus (feedback increases action)

must have complete end of process--birth finally occurs

Act as Neuro-Endocrine Glands
Hypothalamus
-as an endocrine gland
-produces hormones (ADH & oxytocin)- sends to pituitary
-as a regulatory gland
-produces "tropic" regulatory hormones to stimulate/inhibit secretion

"reads" blood
-regulate autonomic centers to stimulate adrenal medulla

decide if too high or too low in hormones
can direct release of hormones
the "master gland"

Pituitary gland(hypophysis):
-as an endocrine gland
-produces hormones (adenohypophysis) -- anterior pituitary
-glandular part- developed from oral ectoderm
-as a neural structure
stores hormones of hypothalamus (neurohypophysis)
outpocket of the brain
hormones release from here

Adrenal gland
-as an endocrine gland
-produces hormones (both cortex and medulla)
-glandular part- derived from mesoderm (developed from posterior abdominal wall)
cortex

-as a neural structure
-acts as a post ganglionic neuron! (release epinephrine, norepinephrine)
-derived from neural crest cells (develop from nearby sympathetic ganglia)
medulla

anterior pituitary-huge effect
numerous effect

ex.growth hormone
too much before puberty - more ventricle growth --gigantism
dwarfism- too little throughout life
after puberty- thickening the bone after growth plates set

Thyroid gland
thyroxine (TH) increase oxygen consumption, rate of energy, utilization, and heat production, increase metabolism
hypothyroidism --feel cold
TSH- produced to make thyroid bigger to produce more thyroxine

Review
meninges-protective membranes of CNS
dura mater- two layers
endosteal -outer
meningeal-inner layer
split apart form dural sinus
superior sagital sinus runs between longitudinal fissure
arachnoid
arachnoid villi-absorb cerebral spinal fluid into blood
pia mater- adheres to brain
spinal cord- extension off of pia mater
denticulate ligaments-lateral support to spinal cord

ventricles -2 lateral
third ventricle

fourth ventricle
CSF within
CSF goes around outside brain and spinal cord
subarachnoid space
found w/in central canal of spinal cord

choroids plexus-where CSF
ependymal cell
interventricular foramen-in between ventricles
lateral→third

brain
forebrain--telencephalon
cerebral cortex,corpus collosum, internal capsule, lateral ventricle
diencephalons
3rd ventricle,thalamus, hypothalamus
midbrain mesenscephalon

hind brain
metencephalon
myencephalon---4th ventricle, medulla oblongata

lobes of cerebrum
frontal-motor cortex
parietal -sensory cortex,taste
temporal-hearing,equilibrium, smell
occipital-vision
cerebellum- 2 hemispheres
vermis attaches 2
fine tunes movements, equilibrium
learned movements
proprioceptors-where body in space

medulla oblongata-visceral motor control
ascending + descending tracts from spinal cord

spinal cord-conus medullaris
nerves- cauda equina
filum terminale- extension of pia mater

epidural space-superficial to dura mater

gray matter in core opposite of brain
white matter- faciculus tracts

dorsal horn - sensory (afferent)
dorsal root ganglion- cell bodies-afferent cell bodies
ventral horn- efferent cell bodies

dorsal and ventral ramus-afferent + efferent
dorsal- back, neck
ventral- rest of the body

plexus -network of branches
cross section of nerve