KINESIOL 1Y03

1: The Body Plan

Anatomy and Physiology

anatomy: study of the body's structures and features associated with those structures
physiology: study of the processes and functions of those structures and their develipment
form = function

Functional Levels

chemical: interaction of atoms
cell: structural and functional unit of living organisms
tissue: group of similar cells and the materials surrounding them
organ: two or more tissues working together
organ system: ground of organs functioning together
organism: any living thing; organ systems work together to maintain homeostasis

Directional Terminology

right/left: describes the subject's right/left, not the viewer's
anatomical position: body erect, face forward, feet together, palms face forward, standing
supine: lying face upward
prone: lying face downward
superior/inferior: up/down
cephalic/caudal: towards head/tail (used for torso)
medial/lateral: towards the middle/sides
proximal/distal: close to/far from a starting point (typically the torso; used for linear structures)
superficial/deep: close to/far from the surface
anterior/posterior: front/back
ventral/dorsal: front of body/back of body

Body Planes

sagittal: vertically through right and left (can be midsagittal or parasagittal)
frontal/coronal: vertically through anterior and posterior
transverse/cross: horizontally through superior and inferior, or cut at a right angle to the length of an organ
oblique: non-90 degree angles
longitudinal: cut along the length of an organ

Dorsal Body Cavities

cranial cavity: houses the brain
vertebral cavity: houses the vertebral canal

Ventral Body Cavities

thoracic cavity: contains lungs and heart
mediastinum region: thoracic cavity sans lungs
abdominal cavity: below the diaphragm; contains stomach, intestines, liver, spleen, pancreas, kidneys, etc.
pelvic cavity: within the pelvic bones; contains urinary bladder, some large intestine, reproductive organs, etc.

Serous Membranes

Thin layer of **epithelial tissue** that covers the **organs** and **cavity walls**.
Continuous membrane that **folds on itself** to form two layers with **fluid between them** to reduce **friction**.
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visceral serous membrane: inner membrane surrounding the organ
parietal serous membrane: outer membrane in contact with the cavity walls
pericardium: around the heart
pleura: around the lungs
peritoneum: around organs of the abdominal cavity; each organ is surrounded individually by the continuous membrane, forming peritoneal folds (mesenteries)
retroperitoneal organs: organs found in the abdominal and pelvic regions behind (outside) the serous membranes

Head Region

frontal: forehead
orbital: eyes
nasal: nose
oral: mouth
otic: ear
buccal: cheek
mental: chin
cranial: skull
occipital: base of skull

Neck Region

cervical: neck
clavicular: collarbone
nuchal: base of neck

Trunk Region

thoracic: thorax
- ***pectoral***: *chest*
- ***sternal***: *breastbone*
- ***mammary***: *breast*

abdominal: abdomen
- ***umbilical***: *navel*

pelvic: pelvis
- ***inguinal***: *groin*
- ***pubic***: *genital*

dorsal: back
- ***scapular***: *shoulder blade*
- ***vertebral***: *spinal column*
- ***lumbar***: *loin*

sacral: between hips
gluteal: buttock
perineal: perineum

Upper Limb Region

acromial: point of shoulder
axillary: armpit
brachial: arm (shoulder to elbow)
antecubital: front of elbow
olecranon: point of elbow
antebrachial: forearm
manual: hand
- ***carpal***: *wrist*
- ***palmar***: *palm*
- ***dorsum***: *back of hand*
- ***digital***: *fingers*

Lower Limb Region

coxal: hip
femoral: thigh
patellar: kneecap
popliteal: hollow behind knee
crural: leg (knee to ankle)
sural: calf
pedal: foot
- ***talus***: *ankle*
- ***dorsum***: *top of foot*
- ***plantar***: *sole*
- ***calcaneal***: *heal*
- ***digital***: *toes*

summary sheet by Jasmine Ah Yong for KINESIOL 1Y03 (2022)

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2: Homeostasis

Homeostasis

homeostasis: existence and maintenance of a relative constant environment within the body; the tendency of an organism to maintain internal equilibrium by adjusting its physiological processes
set point: ideal normal value of a variable; can change temporarily

Feedback Systems

stimulus: the factor that causes deviation from the set point
receptor: monitors the value of some variable (sends out signal if it changes)
control center: establishes the set point, decides if a response is needed, usually found in the CNS
effector: changes the value of the variable
response: produced by the effector based on control center

Negative Feedback

negative feedback system: resists any deviation from the set point; makes up most feedback systems
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One example is **temperature control**. **Thermal receptors** detect the change, and neurons in the pre-optic area of the hypothalamus interpret these signals. This **stimulates heat losing or promoting** centers in the hypothalamus. When we get **too hot**, the body **releases sweat**. To prevent blood pressure from dropping, the **heart speeds up** and we get **thirsty**. Blood vessels near the skin **dilate** so warm blood is cooled by the surface. When we get **too cold**, our muscles contract and we **shiver**. Blood vessels in the skin **constrict** to decrease flow of warm blood near the surface.

Positive Feedback

positive feedback system: exacerbates the deviation from the set point; typically occurs due to a pathological issue
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Hemorrhage is an example of a **problematic** positive feedback system. There is a **drop in blood pressure**, so the **heart can't pump** and slows down, so the blood pressure **drops more**.
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Birth contractions are an example of a **normal** positive feedback system. **Contractions** occur, which **dilates** the cervix, sending impulses to the brain to trigger **oxytocin release**. This diffuses through the pituitary gland to the uterus and stimulates **more forceful contractions**.

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3: Embryology I

Reproductive Basics

gametes: sex cells, produced by gonads
ovaries: female gonads; there are two bilateral ovaries
menstrual cycle: way of tracking female reproductive cycles

__menstruation__: bleeding; c. day 1-7
__ovulation__: one ovary matures a female gamete cell and prepares to release it; c. day 14

secondary oocytes: the cells released by ovulation; have only finished the first meiotic division; haploid cell
uterine/fallopian tube: passage for secondary oocytes
ampulla: site of fertilization; about 100-200 sperm make it here
vagina: about 20 million sperm are deposited here; sperm are self-propelled
uterus: about 1% of sperm make it here; connected to vagina through cervix; sperm are propelled by contractions caused by oxytocin and semen released during sex
fertilization: can occur 6 days before ovulation (sperm can survive 6 days) or 1 day after (oocytes are viable for 24 hours)

Prenatal Development

germinal period: first two weeks of development; cells are multiplying and forming the primitive germ layers
embryonic period: week 3-8; organ systems develop
fetal period: week 9-38 (birth); organ systems grow and mature

Timing Age

clinical age: based on the first day of the last menstrual period; during the first two weeks of this age, the cells don't actually exist; pregnancies are about 40 clinical weeks
embryological/post-ovulatory age: starts at actual fertilization; 14 days less than clinical age; 38 weeks on average; **this is what we normally use**

Secondary Oocytes

haploid cell: have half the number of chromosomes held within the nucleus
polar body: the other cell created during meiosis; smaller than the secondary oocyte, and serves no purpose other than getting rid of genes
corona radiata: loosely packed follicular cells around the oocyte

__follicle__: series of cells surrounding the oocyte and helping to support it
__navigation__: sperm can navigate here on their own

zona pellucida: layer adhering to the plasma membrane of the oocyte

__ZP3 glycoprotein__: species specific receptor required for the sperm to make it through
__acrosomal reaction__: tip of sperm binds to ZP3 and starts digesting zona pellucida; multiple sperm are required

plasma membrane: covers the secondary oocyte

__integrin α1β6__: receptor on the plasma membrane that prevents polyspermy
__fast block to polyspermy__: binding causes fast depolarization
__slow block to polyspermy__: calcium ions and water are released, causing the oocyte to shrink, the zona pellucida to nature, and the ZP3 to deactivate

Fertilization

sperm tail: disintegrates after binding
ovum: secondary oocyte nucleus moves to the side and undergoes second meiotic division
pronuclei: sperm head becomes male pronucleus and ovum nucleus becomes female pronucleus
zygote: diploid formed by the fusion of the two haploid pronuclei
cleavage: within 24 hours, the zygote cleaves to form two cells; this continues
morula: day 5; 12+ cells that have formed a solid ball thing, about the same size as the original cell; during hatching, it breaks free from the zona pellucida

__totipotent__: at this point, the cells can differentiate into every different cell type

blastocyst: day 6; cells are pushed to the side and the middle is filled with fluid

__trophoblast__: the cell layer; forms placenta, embryonic membrane, etc.
__blastocele__: the fluid-filled cavity
__inner cell mass__: will become the embryo proper
__pluripotent__: at this point, the cells can differentiate into many different cell types but not all

Day 7: Implantation

implantation: day 7; inner cell mass is oriented towards the uterine endometrium; allows formation of placenta and sharing of nutrients
uterine endometrium: wall closest to the cavity of the uterus; thick and vascular at time of implantation

Days 8-12: Differentiation

syncytiotrophoblasts: invade into uterine wall and digest some of the blood cells to create a blood connection

__multinucleated__: lose their plasma membranes and mush together
__human chorionic gonadotropin hormone__: released into maternal blood supply to stop menstrual cycle; also detectable in urine

cytotrophoblasts: maintain a wall between the maternal blood and the embryo proper

Days 14-20

connecting stalk: embryo proper forms a connecting stalk between it and the placenta; eventually becomes the umbilical cord
cytotrophoblasts: start to form finger-like projections
syncytiotrophoblasts: digest walls of the maternal arterioles

__lacuna(e)__: pools of maternal blood used as a supply of nutrients and oxygen for the embryo

Month 1

cytotrophoblast chords: form from the projections; surround the syncytiotrophoblasts and lacunae to prevent maternal/embryonic blood mixing
embryo: starts making its own blood and blood vessels
extraembryonic mesoderm cells: start building extra blood cells outside the embryo
primitive chorion: syncytiotrophoblast, cytotrophoblast, extraembryonic mesoderm
developing placenta: primitive chorion, lacunae, endometrium

Mature Chorion

chorion: created by chorionic villi to separate maternal/embryonic blood, made of syncytiotrophoblasts and a thin basement membrane around the fetus
chorionic villi: fill in with blood vessels from the fetus, surrounded by lacuna; connected to fetus via umbilical cord

__umbilical arteries__: carry deoxygenated blood away from fetus's heart
__umbilical veins__: carry oxygenated blood toward fetus' heart

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4: Embryology II

Bilaminar Embryonic Disk

inner cell mass: organized into two chambers surrounded by cells; similar to two balloons squished on top of another
epiblast: top layer; will become the embryo
hypoblast: lower layer; will help form some extraembryonic tissues
amniotic sac/amnion: layer of cells above the hypoblast; will eventually surround the whole embryo
yolk sac: not important in humans; gets smaller as important things happen
extraembryonic tissues: hypoblast cells, amniotic sac, and syncytiotrophoblast contribute to these

Days 13-14: Gastrulation

gastrulation: differentiation of the epiblast into 3 germ layers
primitive streak: cells proliferate in the epiblast to form a thickened layer of cells; forms closer to the caudal end
endoderm: cells move to the hypoblast and take over; eventually forms the digestive system and lungs
mesoderm: cells sandwich between endoderm and epiblast; eventually form the blood supply, bones, and muscle
ectoderm: cells stay where they were; eventually form the skin and nervous system
trilaminar embryonic disk: endoderm, mesoderm, and ectoderm; forms between the epiblast and hypoblast

Day 16-18: Notochord

notochord: solid cells from the mesoderm forming a cylinder under the ectoderm; involved in induction to signal the thickening of the neural plate
neural plate: thickened region of the ectoderm; primitive version of the CNS
oropharyngeal membrane: thinner region on the cephalic side; becomes the mouth
cloacal membrane: thinner region on the caudal side; becomes the anus

Days 18-26: Neural Tube

neural folds: lateral ends of neural plate begin to rise
neural groove: formed by neural folds; begins in midline and moves towards cephalic and caudal ends
neural crests: formed from neural folds as they get higher; start moving together

neural crest cells: *cells in the region of the crests that start to break off as the crests come together*

neural tube: cylinder is closed and eventually becomes spinal cord and brain; top layer becomes skin, crests form sensory and post-ganglionic autonomic portions of the PNS, as well as some connective tissue in the head
somites: formed from the mesoderm layer alongside the neural tube; eventually become vertebral column, ribs, and some skeletal muscle