

Cell/Chem/H₂O/Blood

BYU PdBio 305 Rhees Cell/Chem/H₂O/Blood

Question	Answer
Respiratory Acidosis is caused by	Over-anesthesia, Lung diseases, Damage to respiratory center
Metabolic Acidosis is caused by	Severe diarrhea, Diabetes mellitus, high intensity exercise, kidney failure
Effects of Acidosis on Body	Disorientation, Coma, Death, Lower pH limit of 6.8-7.0
Respiratory alkalosis is caused by	Fever, Aspirin poisoning, high altitude
Metabolic alkalosis is caused by	Vomiting, excessive sodium bicarbonate ingestion
Effects of alkalosis on body	overexcitability of nervous system, tetany, death, upper limit of pH 7.8-8.0
Liters of water in body	40 liters
Percent of body weight from water	50-60%
% of body weight from ICF	35-40%
% of body weight from ECF	10-20%
% of body weight from Interstitial fluid	10-15%
% of body weight from Plasma	4-5%
Causes of Dehydration/Hypovolemia	vomiting, diarrhea, loss of blood, drainage from burns, lack of ADH due to diabetes insipidus
Symptoms of Dehydration/Hypovolemia	Loss of weight, rise in body temperature, increased heart rate and cardiac output, decreased blood pressure, decreased urine
Causes of hypervolemia	excessive IV administration, psychotic drinking, renal failure leading to decreased urinary output
Symptoms of hypervolemia	decreased body temp., increased blood pressure, edema, weight gain, vomiting, convulsions, coma
ADH	antidiuretic hormone regulates water loss
What regulates ADH and oxytocin?	Hypothalamus and posterior pituitary

Maltose	glucose+glucose
Sucrose	glucose+fructose
Lactose	glucose+galactose
Lipid structure	three fatty acids attached to a glycerol
butyric structure	$\text{CH}_3\text{-(CH}_2\text{)}_2\text{-COOH}$
palmitic structure	$\text{CH}_3\text{-(CH}_2\text{)}_{14}\text{-COOH}$
Stearic structure	$\text{CH}_3\text{-(CH}_2\text{)}_{16}\text{-COOH}$
Oleic	one double bond
Linoleic	two double bonds
Linolenic	three double bonds
# of cells in body	75-100 trillion
# of types of cells	200-250
tissue types	epithelial, connective, muscular, nervous
normal pH	7.4
normal glucose	80-100 mg/100ml
Feedback systems' three parts	monitoring receptor, control center, reactor
% of plasma membrane from protein	55%
% of plasma membrane from carbohydrate	2%
% of plasma membrane from lipid	43%
space between two walls of nuclear membrane	perinuclear cisterna
Rough ER synthesized proteins destination	outside of cell
destination of free ribosome synthesized proteins	within cell
Vitamin A intoxication	cause lysosomes to rupture, destroying intracellular material
Rheumatoid arthritis	Lysosomes release enzymes into joint capsule and digest surrounding tissue
Atrophy of the uterus	lysosome digestive activity
Erythrocytes	red blood cells

Leukocytes	white blood cells
Thrombocytes	platelets
% of whole blood from plasma	53-60%
% of whole blood from formed elements	40-47%
plasma is made up of	water 90%, proteins 7%, electrolytes urea glucose etc. 3%
hematocrit is made up of	erythrocytes 4.5-5.5 million/mm ³ , leukocytes 6-10 thousand/mm ³ , platelets 150-400 thousand/mm ³
leukocytes are made up of	Neutrophils 60-70%, Eosinophils 2-4%, Basophils .15%, Lymphocytes 20-25%, Monocytes 3-8%
serum	plasma minus the coagulation factors
Albumin	functions in osmotic pressure regulation
Globulins	Alpha, Beta, and Gamma
Alpha and Beta globulin	carrier vehicles to prevent substances in blood (e.g. hormones) from leaving the capillary too rapidly
Gamma Globulin	Natural and acquired immunity – Antibodies
Origin of Albumin and the alpha and beta globulins	formed in the liver
Origin of Gamma globulins	formed in the lymphoid tissues of the reticulo-endothelial system (found in the bone marrow, spleen, liver, and lymph nodes)
Erythrocyte Characteristics	no nucleus, can't multiply, biconcave discs, no nucleus or e.r., no protein synthesis
Erythrocyte function	transport hemoglobin (oxygen) and CO ₂
What increases erythrocytes?	Altitude, muscular exercise, temperature, age (higher in infants)
Erythropoiesis	production of red blood cells
Hematopoiesis	production of all blood cells
location of early embryo rbc synthesis	yolk sac
location of middle pregnancy rbc synthesis	liver, spleen, bone marrow
location of adult rbc synthesis	vertebrae, ribs, sternum
pathway for erythropoiesis	stem cell, proerythroblast, basophilic erythroblast, polychromatophilic, erythroblast, normoblast (nucleus lost),

	reticulocyte, mature RBC
Life span of RBC	120 days
# of RBC destroyed per sec and per day	2.5 million, 216 billion
# of molecules of Hb/RBC	200 million
hemoglobin structure	protein globin and four hemes
structure of heme	porphyrin with Fe ⁺⁺ in middle
% of RBC is made of Hb	34%
grams of Hb in 100 ml of blood	15g
ml of oxygen that combines with each gram of Hb	1.34ml
ml of O ₂ for 100ml of blood	20ml
oxyhemoglobin	hemoglobin when saturated with O ₂
carbamino hemoglobin	CO ₂ with Hb
carboxy hemoglobin	CO with Hb
biliverdin	porphyrin with the ring broken
bilirubin	biliverdin is converted to bilirubin to be excreted
jaundice	accumulation of bilirubin (caused by liver disease, excess red cell destruction, bile duct obstruction)
anemia	decreased oxygen-carrying capacity of blood
symptoms of anemia	pale skin, fatigue, rapid heart rate
types of anemia	hemorrhagic, aplastic, nutritional, pernicious, hemolytic, folic acid deficiency
hemorrhagic anemia	blood loss
aplastic anemia	bone marrow destruction-cancer, too many x-rays, chemicals, drugs
Nutritional anemia	not enough iron
folic acid deficiency anemia	impairs normal mitosis
pernicious anemia	vit B12 deficiency which is required for bone marrow maturation; parietal cells in stomach make intrinsic factor necessary for vit B12 absorption
Hemolytic anemia	RBC destruction (sickel cell, erythroblastosis fetalis, lead/arsenic poisoning)
polycythemia	too many RBC

secondary polycythemia	elevation; no RBC pathology
primary polycythemia (erythremia)	tumor of bone marrow-sluggish blood
# of leukocytes	6-12,000/mm ³ (production rate is equal to or greater than that of RBC's)
lifespan of leukocytes	4 days to months
location of leukocytes	most found outside circulation
two types of leukocytes	granulocytes, agranulocytes
types of granulocytes	neutrophils, eosinophils, basophils
types of agranulocytes	lymphocytes, monocytes
% of each leukocyte making up all leukocytes	neutrophils 65-70, lymphocytes 20-24, monocytes 5, eosinophils 1-2, basophils 0-.5
production sites of leukocytes	embryo-bone marrow, liver, spleen; adult-granulocytes-bone marrow, agranulocytes-lymphoid tissues
diapedesis	ability to squeeze through capillary walls (leukocyte ability)
chemotaxis	substance released from infected area to attract leukocytes
fxn of neutrophils	acute conditions; phagocytosis and NET fibers
fxn of eosinophils	allergic conditions
fxn of basophils	secrete anticoagulant heparin and histamine which are important in allergic rxns
fxn of lymphocytes	immune response
fxn of B-lymphocytes	produce antibodies
fxn of T-lymphocytes	destroy specific target cells
fxn of monocytes	chronic conditions; phagocytosis; macrophages which live for months or years
leukemia	too many leukocytes which are immature and useless; not enough RBC's and platelets
leukopenia	not enough WBC's caused by radiation, drugs, chemicals
# of Thrombocytes	platelets- 150-350,000/mm ³
formation of thrombocytes	bone marrow form megakaryocyte cells where pieces of the cytoplasm chip off and are platelets
thrombopoietin	thrombocyte production stimulant
life span of thrombocyte	8 days to many months
fxn of thrombocytes	clotting; platelet plug

platelet chemicals which stimulate vasoconstriction and make other platelets sticky	ADP, serotonin, thromboxane A ₂
platelet chemicals stimulating contraction	myosin and actin
PGI ₂ -prostacyclin	inhibitor of platelet aggregation
nitric oxide	inhibitor of platelet aggregation
Thrombocytopenia	abnormally low # of platelets; excessive bleeding
thrombocytopenia purpura	purple spots on skin from poor blood clotting
pathway for blood clot	prothrombin activator activates prothrombin into thrombin which activates fibrinogen into a loose and then tight fibrin clot; Ca ⁺⁺ is needed to clot
syneresis	clot retraction
clotting factors 1-11	1.fibrinogen 2.prothrombin 3.tissue thromboplastin 4.calcium 5.accelerator globulin 6.none 7.serum prothrombin conversion accelerator 8.antihemophilic globulin (on X chromosome) 9.Christmas factor 10.stuart-power factor 11.plasma thromboplastin antecedent
clotting factors 12-13	12.Contact factor (initiates the overall rxn) 13.Fibrin stabilizing factor
Anticoagulants	Dicoumarol (Coumadin), Heparin, Citrates, Oxalates, EDTA, smooth inside surface of blood vessel
Dicoumarol (Coumadin)	interferes with vit K and thus factors 7,9,10
heparin	interferes with thrombin and prothrombin formation (from basophils)
citrates, oxalates, edta	tie up calcium to stop clotting
edta	oj simpson
fibrinolysis	lysis of clots; plasminogen makes plasmin which degrades fibrin
conditions that cause excessive bleeding in humans	liver disease (decreased clotting factors), vit K deficiency (decreased formation of prothrombin), hemophilia (lack of factor 8 or 9 or any other), thrombocytopenia (decreased platelets)
Thrombocytopenia	decreased platelets (less than 50,000)
Thrombus	clot attached to blood vessel wall
embolus	clot that detaches from the wall and floats freely

external defense against disease	skin, digestive tract, respiratory tract, genitourinary tract
two types of immunity	non-specific and specific
non-specific immunity	inflammation, interferon, fever, natural killer cells, complement system
specific immunity	responds selectively to invaders (antigens) with antibodies which is an immune reaction
two types of specific immune responses	humoral immunity, cell-mediated immunity
humoral immunity	B-lymphocytes secrete antibodies into the blood and lymph
cell-mediated immunity	T-lymphocytes attack host cells that are infected
autoimmunity	formation of antibodies against a person's own tissues
examples of autoimmunity	rheumatic fever, grave's disease
rheumatic fever	antibodies produced against streptococcus bacteria cross react with the heart and kidney tissues
grave's disease	antibodies that stimulate the thyroid gland- mimic TSH
when are blood antibodies formed (ABO)	2-8 months after birth; max levels at 8-10 years
agglutinins	clumping of blood cells from a transfusion reaction
how many Rh blood types are there	6 C,D,E,c,d,e
% of people who are Rh+	85%
erythroblastosis fetalis	hemolytic anemia in the newborn Rh positive baby caused by maternal antibodies against the Rh factor that have crossed the placenta
Rhogam	antibodies against the Rh factor

Cardiac Physiology

BYU PdBio 305 Rhees Cardiac Physiology

Question	Answer
How much blood does the heart pump? L/min	5
How long does it take for all the blood to be pumped through?	one minute
Endocardium	a thin layer of endothelium in the heart
Myocardium	muscle layer (cardiac muscle)
Epicardium	thin external layer covering the heart
Sinoatrial node	SA node or pacemaker; located within the posterior wall of the right atrium; rhythmic impulses originate in the SA node and spread through the atria
Atrioventricular node	AV node; located within the lower right interatrial septum; an impulse is delayed there for about 1/10 of a second to allow the atria to contract before ventricular contraction
Atrioventricular bundle	AV bundle or bundle of HIS; originates in the AV node, dividing into two bundle branches which extend down the two sides of the interventricular septum
Purkinje fibers	originate from the right and left branches, extending to the papillary muscles and lateral walls of the ventricles
Factors that may alter the heartbeat rate	sympathetic and parasympathetic impulses, hormones, body temp., exercise, and emotions
Systole	the phase of contraction
Diastole	the phase of relaxation
4 steps of cardiac cycle	1)mid-diastole 2)Atrial systole 3)Ventricular systole 4)Early diastole
mid-diastole	the atria and ventricles are relaxed, the tricuspid and mitral valves are open, and the aortic and pulmonary

	valves are closed. Blood flows passively from the atria into the ventricles, with 65% to 85% of ventricular filling occurring before the end of t
atrial systole	atria contract and pump the additional 20-30% of the blood into the ventricles. As the atria contract, the vena cava and pulmonary veins narrow; there is some regurgitation. There is about 135 ml of blood in each ventricle.
ventricular systole	pressure changes and the AV valves close “lub”. All 4 valves are closed (isovolumetric ventricular contraction phase). When the pressure on the right exceeds 10 mm Hg and the left exceeds 80 mm Hg the pulmonary and aortic valves open.
Isovolumetric ventricular contraction phase	the moment when all 4 valves are closed and no blood can enter or leave the ventricles.
Minimum diastolic pressure on both sides	10mm Hg and 80 mm Hg
Normal resting condition pressure	24 mm Hg and 120 mm Hg
Stroke volume	volume of blood ejected from either ventricle; 70 to 80 ml
End-systolic volume	Amount of blood remaining in either ventricle at the end of systole; 50 ml
Early diastole	as the ventricles relax, pressure drops; the pulmonary and aortic valves close, preventing backflow “dub”. The tricuspid and mitral valves open, and blood flows from the atria into the ventricles
Sphygmomanometer	the mercury manometer to take blood pressure
Auscultatory method	method to take blood pressure using arterial sounds
Sounds of Korotkoff	the turbulent flow of the blood with each beat creates vibrations that are heard in the stethoscope when taking blood pressure using the auscultatory method
Pulse pressure	the difference between the systolic and diastolic pressures; this pressure difference is what drives blood along the arteries to the capillaries.

SA node rate	72-75 beats/min
AV node rate	50-60 beats/min
ventricles rate	30-40 beats/min
factors that increase heart rate	excitement, anger, pain, hypoxia, exercise, epinephrine, norepinephrine, thyroid hormones, fever, inspiration
bradycardia	less than 60 beats/min
tachycardia	more than 100 beats/min
factors that decrease heart rate	expiration, fear, grief
inotropic	strength of contraction
franks starling's law of the heart	the greater the filling during diastole, the greater the force of contractin during systole
catecholamines	epinephrine and norepinephrin
xanthines	caffeine, theophylline
digitalis	drug used for cardiac failure
factors that have a positive inotropic effect	frank starling, catecholamines, xanthines, digitalis
chronotropic	rate of contraction
dromotropic	rate of conduction of impulse
two ways nerves contrals the heart	chronotropic and inotropic
sympathetic control of heart	increase rate and force of contraction, uses norepinephrine to increase permeability to Na and Ca
max sympathetic stimulation	250 beats/min
parasympathetic control of heart	decrease rate and force of contraction, S.A node-right vagus, A.V. node- left vagus, uses acetylcholine to increase permeability to K ⁺
max parasympathetic stimulation	20-30 beats/min
stroke volume	60-80 ml; amount of blood pumped out of each ventricle per beat

cardiac output	$CO = \text{stroke volume} \times \text{heart rate}$
cardiac output of average person	5.76 Liters/minute
factors causing an increase in cardiac output	anxiety, eating, exercises, increased body temperature, pregnancy
fick method	blood flow=cardiac output; the amount of oxygen consumed by the body in a period of time is divided by the AV difference
fick equation for cardiac output	$CO = (\text{oxygen consumed in ml/min}) / (\text{arterial O}_2 - \text{venous O}_2)$
factors that may alter the heartbeat rate	sympathetic/parasympathetic impulses, hormones, body temperature, exercise, drugs, emotions, stimulation from exteroceptors
ectopic pacemakers	out of place pacemakers
einthoven's triangle	electrodes attached to the left shoulder, right shoulder, and left leg, forming a triangle to take ECGs
cardiac arrhythmia	deviations from normal heart rate or from normal electrical activity of the conduction system
causes of ectopic pacemakers	ischemia, heart damage, dilation of heart, toxic irritants (nicotine, caffeine, alcohol), lack of sleep, anxiety, extremes in body temp, change in body pH
atrial premature beat	premature depolarization of SA node or ectopic pacemaker; some P waves are weird; little clinical significance
AV nodal premature beat	ectopic discharge of the AV node; normal QRS but no P wave before
Premature Ventricular Depolarization	PVD or PVC; ectopic pacemaker in ventricles; no P wave, wide QRS, high voltage, inverted T wave, pause afterwards like a skipped beat
bigeminy	one normal and one PVD
trigeminy	two normal and one PVD
SA block	pacemaker stops for at least one cycle and then resumes; all is identical before and after
first degree AV block	prolonged PR interval; caused by digitalis or vagal

(incomplete)	stimulation
second degree AV block type I (Wenckebach or Mobitz's type 1)	PR intervals lengthen progressively until a ventricle beat is dropped; can be caused by digitalis
second degree AV block type 2 (Mobitz's type 2)	takes 2 or more atrial impulses to stimulate the ventricles; usually 2:1, 3:1, or 4:1; caused by myocardial infarction or myocarditis; may lead to 3rd degree block
third degree AV block (complete)	none of the atrial impulses stimulate the AV node; ventricles are paced independently from the atria; ventricular rate is slower than the atrial rate of contraction; totally random ECG
atrial flutter	ectopic atrial pacemaker; p waves are very rapid and coordinated; 2:1, 3:1, 4:1; treatment-digitalis
Atrial fibrillation	many ectopic pacemakers in atria; irregular p waves; decrease in cardiac output; QRST look normal
Ventricular flutter	single ectopic pacemaker in ventricles; smooth sine wave; extremely dangerous; heart does not fill properly, decreased cardiac output, leads to fibrillation; decreased coronary flow
ventricular fibrillation	caused by many ventricular ectopic pacemakers, uncoordinated, chaotic twitching, bag of worms, blood pressure drops, unless stopped death will occur in short time
myocardial infarction	lack of blood flow to an area of the heart, may be caused by thrombus formation with blockage of vessels, spasms in the coronary arteries without total occlusion, narrowing caused by atherosclerosis; area is electrically dead
classical triad	3 phases of myocardial infarction 1)ischemia 2)injury 3)infarction
ischemia as a ecg	symmetrical inversion of the T wave; most obvious in chest leads; caused by delay in the recovery at the epicardial regions; altered repolarization; take nitroglycerin to correct
injury as a ecg	ST elevation means infarction is fresh (acute)
infarction as a ecg	significant Q wave-much wider than normal; Q may be

	1/3 height of QRS; may last for years; some drugs can cause similar effects
symptoms of myocardial infarction	pain in neck, jaw, back, shoulder, and left arm; vomiting; catecholamines released, increased blood sugar; cardiac troponins in blood; released enzymes; amount of troponin and creatine kinase correlate with severity of infarction
treatment of myocardial infarction	aspirin, heparin, sublingual nitroglycerine, morphine, sulfate, oxygen administration
blood flow equation	pressure/resistance
resistance equation	$(\text{length})(\text{viscosity})/((\text{radius})^4)$
how does radius of arterioles change?	vasoconstriction and vasodilation
laminar flow	flow is greater at the center of the vessel than along the outer edges
blood vessel diameter is mainly regulated by	autonomic nervous system
angiotensin II	causes vasoconstriction; produced as a result of secretion of renin from the kidneys, it may function to help maintain adequate filtration pressure in kidneys when systemic blood flow and pressure are reduced
ADH (vasopressin)	causes vasoconstriction
Histamine	causes vasodilation; promotes localized vasodilation during inflammation and allergic reactions
% circulation in systemic, pulmonary, and heart systems	79% systemic, 12% pulmonary, 9% max heart
percent breakdown of 79% of blood in systemic circulation	15% in arteries, 5% in capillaries, 59% in veins
blood pressure in different vessels	large arteries 100-95; small arteries 95-85; arterioles 85-30; capillaries 30-10; veins 10-0
where does most regulation of blood pressure occur	arterioles

precapillary sphincters	regulate blood flow to capillary. Use myogenic and metabolic mechanisms to regulate blood flow in relation to the local tissues need for oxygen called autoregulation
autoregulation	myogenic and metabolic mechanisms to regulate blood flow in relation to the local tissues need for oxygen
capillary hydrostatic pressure	CP; blood pressure in the capillary
osmotic force	usually stays the same in capillaries due to albumin
edema	excess interstitial fluid in the tissues
three main causes of edema	1)increased capillary hydrostatic pressure 2)decreased plasma proteins (albumin) 3)increased interstitial fluid protein
causes of increased capillary hydrostatic pressure edema	venous obstruction, cardiac failure (congestive heart failure), retention of body salt and fluid
causes of decreased plasma protein edema	kidney damage resulting in loss of plasma proteins, liver damage-decreased plasma protein production, malnutrition-not enough protein in diet
causes of increased interstitial fluid protein edema	increased capillary permeability-inflammation, decreased lymphatic flow
blood pressure can be changed by changing	cardiac output, peripheral resistance, or total blood volume
long term regulation of blood pressure is regulated by	hormones
ADH (vasopressin) effects	decreases urine formation in kidneys which increases blood pressure
diuretic agent effects	inhibit release of ADH, increase urine, decrease blood pressure
alcohol effect on ADH	inhibits ADH increasing urine to dump the alcohol
renin angiotensin system	releases aldosterone which raises blood pressure
aldosterone	hormone which raises blood pressure
steps of renin-angiotensin	decrease in blood pressure->decrease in blood flow to

system up to angiotensin II formation	kidney->juxtaglomerular apparatus in the kidney secretes renin->renin converts angiotensinogen to angiotensin I which is converted to angiotensin II
steps of renin-angiotensin system from angiotensin II to increased blood pressure	3 mechanisms; 1) angiotensin II->increased ADH->water retention->higher bp 2) angiotensin II->adrenal cortex secretes aldosterone->salt and water retention->yes 3) angiotensin II->vasoconstriction of arterioles->increased resistance->higher bp
primary aldosteronism (Conn's syndrome)	results from hypersecretion of aldosterone from the adrenals->hypertension, increased extracellular fluid volume, hypernatremia and potassium depletion; mostly occurs because of an adrenal adenoma (tumor in adrenal cortex)
short term regulation of bp	nervous system controls to mechanism 1) baroreceptors 2) chemoreceptors; both are in medulla
baroreceptors	cardioinhibitory center->parasympathetic->HR down+CO down+vasodilation up->BP down
chemoreceptors	vasomotor center->sympathetic->HR up+CO up+vasoconstriction=BP up
where are baroreceptors located	aortic arch, pulmonary veins, right and left atria, superior and inferior vena cava and in the carotid sinuses
how are baroreceptors stimulated	a change in pressure causes the walls of these arterial regions to stretch or relax and stimulate sensory receptors which stimulate or inhibit the cardioinhibitory center and the opposite to the vasomotor center
where are chemoreceptors located	aortic bodies and in the carotid bodies
how are chemoreceptors stimulated	decreased levels of oxygen and increased levels of CO ₂ and H ⁺ in the blood; impulses sent through the same nerves as the baroreceptors where they stimulate the vasomotor center
what is circulatory shock	inadequate blood flow and/or oxygen delivered to the tissues
4 types of circulatory shock	hypovolemic, anaphylactic, neurogenic, cardiogenic
hypovolemic shock	reduced blood volume as a result of hemorrhage, dehydration, or burns; symptoms: low blood pressure,

	rapid pulse, cold, clammy skin, little urine formation, increased respiration rate, and intense thirst
anaphylactic shock	rapid drop in bp from a severe allergic reaction causing an extreme release of histamine which causes vasodilation and a drop in bp
neurogenic shock	spinal cord damage causes decreased sympathetic activity
cardiogenic shock	inadequate circulation of blood in body tissues due to cardiac failure
body's compensation for circulatory shock	vasoconstriction (except for heart and brain), venoconstriction, increased heart rate and respiration and thirst and hematopoiesis, secretion of epinephrine and norep and adh, spleen contracts, renin-angiotensin system activated
time frame the body restores homeostasis	plasma volume restored in hours, plasma proteins restored in days, blood cells restored in 3-4 weeks
hypertension	high bp; 1/5 people; 12% of all deaths by rupturing a vessel in a vital organ or by causing the heart or kidneys to fail; two types: primary (essential) and secondary
essential or primary hypertension facts	no cause; 90% of all hypertensive patients; 25-50 years old; females more often; hereditary; blacks more often; from high salt intake; psycho emotional stress contributes
essential or primary hypertension characteristics	asymptomatic (people don't know they have it); CO and extracellular fluid volumes are normal but total peripheral resistance is high; increased sensitivity to epi and norepi; many have left ventricular hypertrophy
secondary hypertension	definable causes; 10% of cases; renal artery disease, excess catecholamines (tumor of adrenal medulla), or excess aldosterone (Conn's syndrome)
symptoms of essential hypertension	headaches, dizziness, fatigue, blurring of vision, polyuria, polydipsia, muscle weakness, hypokalemia
dangers of hypertension	may lead to congestive heart failure, cerebral blood vessel damage and stroke; atherosclerosis
general treatment of hypertension	exercise, weight loss, low refined carb diet, not-smoking, restrict salt intake, reduce psycho-emotional stress

Respiratory System

BYU PdBio 305 Rhees Respiratory System

Question	Answer
Five functions of respiratory system	1)Gas exchange for cellular respiration 2)Sound production 3)assistance in abdominal compression during micturition, defecation, and parturition 4)route for water and heat loss 5)coughing and sneezing out inhaled foreign matter
Internal respiration	process by which gases are exchanged between the blood and the cells
External respiration	gas exchange between the air in the alveoli and blood
Cellular respiration	cells use O_2 for metabolism and give off CO_2 as a waste product
Bronchial tree	trachea>right and left primary bronchi>secondary bronchi>tertiary bronchi>bronchioles>terminal bronchioles>alveolar ducts>alveolar sacs
Pulmonary alveoli	alveolar sacs are formed of many microscopic pulmonary alveoli
How many pulmonary alveoli are there	300 million with 6 times the surface area of the body
Type II alveolar cells secrete what and for what	secrete surfactant to lower the surface tension inside the alveolus
What remove dust particles and other debris from the pulmonary alveolus?	alveolar macrophages
External intercostals muscles	elevate during inspiration
Internal intercostals muscles	contract during expiration
Hypoxia	a deprivation of O_2 in tissues and organs
Eupnea	normal breathing
Dyspnea	difficult or labored breathing
Apnea	temporary cessation of respiration that may follow hyperventilation
Cheyne-strokes	periods of dyspnea followed by periods of apnea (leads to death if

	not stopped)
Respiration rate	12-15 times per minute
O ₂ consumption	250 ml O ₂ per minute at rest
Bronchoconstriction	decreased radius, and increased resistance to flow. Allergy induced spasm of the airways-maybe from histamine release or from parasympathetic stimulation
Bronchodilation	increased radius, and decreased resistance to airflow. Sympathetic stimulation controlled through epinephrine and norepinephrine
Asthma	a disease characterized by recurrent attacks of dyspnea. Often an allergic response to plants, animals, or food products resulting in contraction of the bronchial muscles
Pneumonia	acute infection and inflammation of the lungs with exudation (accumulation of fluid)
Chronic bronchitis	a long term inflammatory condition of the lower respiratory airways, generally triggered by frequent exposure to irritating cigarette smoke, polluted air, or allergens.
Emphysema	collapse of the smaller airways and a breakdown of alveolar walls. Caused by excessive release of destruction enzymes such as trypsin from alveolar macrophages as a defense mechanism in response to chronic exposure to inhaled cigarette smoke or other irr
TV	tidal volume-volume of air moved into or out of the lungs during normal breathing 400-500ml
IRV	Inspiratory reserve volume-max volume beyond the tidal volume that can be inspired in one deep breath- 3000ml
ERV	expiratory reserve volume-max volume beyond the tidal volume that can be forcefully exhaled following a normal expiration- 1100 ml
RV	residual volume-air that remains in the lungs following a forceful expiration- 1200 ml
MRV	minute respiratory volume-volume of air moved in normal ventilation in one minute- 6000ml/min
AVV	alveolar ventilation volume-volume of air that actually ventilates the alveoli. A portion of inspired air does not take part in gas exchange b/c it fills the air passageways (dead air). Dead air makes up about 30% of the tidal volume
How much of the tidal volume does dead air contribute	30%

TLC	total lung capacity-sum of the four lung volumes $TV+ERV+IRV+RV=TLV=5700\text{ml}$
VC	vital capacity- total amount of air that can be exchanged by the lungs- sum of the $TV+IRV+ERV=4600\text{ ml}$
Spirogram	record of pulmonary volumes and capacities
6 Layers of the respiratory membrane	1)surfactant 2)thin layer of fluid-water 3)alveolar epithelium 4)interstitial space 5)capillary basement membrane 6)capillary endothelium
surfactant	phospholipid protein decreases the surface tension of the fluids lining the alveoli and respiratory passages (Hyaline membrane disease or Respiratory distress syndrome)
Four factors affecting gaseous diffusion across the respiratory membrane	1)thickness of the respiratory membrane 2)surface area of the membrane 3)diffusion coefficient of each gas 4)pressure difference across the membrane
Changes in the thickness of the respiratory membrane	edema in the lungs (left heart failure), pneumonia (edema in membrane and fluid in the lungs)
Changes in surface area of the membrane	emphysema-decrease in overall surface area
Changes in diffusion coefficient of each gas	O ₂ has a coefficient value of 1 (it's the standard), CO ₂ has a coefficient of 20 (20 times more soluble than water)
Changes in pressure difference across the membrane	Pressure in Alveolus (O ₂ =104, CO ₂ =40) in capillary (O ₂ =40 and goes to 104, CO ₂ =45 and goes to 40)
Composition of atmospheric Air	N ₂ =78.6, O ₂ =20.8, CO ₂ =0.04, H ₂ O=0.5
Composition of Alveolar air	N ₂ =74.9, O ₂ =13.6, CO ₂ =5.3, H ₂ O=6.2
Composition of expired air	N ₂ =74, O ₂ =15.7, CO ₂ =3.6, H ₂ O=6.2
Percent of O ₂ dissolved in blood	1-3%
Percent of O ₂ carried by hemoglobin	97-99%
What determines whether oxygen is bound or released from hemoglobin?	partial pressure of O ₂
PO ₂ of O ₂ in atmospheric air	21% of 760 mmHg=160mmHg
Alveolar PO ₂ and PCO ₂	PO ₂ =104mmHg, PCO ₂ =40mmHg at sea level

Grams of Hb per 100 ml of blood	15 grams
Ml of O ₂ per 1 gram of Hb	1.34ml
Ml of O ₂ per 100 ml of blood	20ml
Arterial blood is how saturated with O ₂	97%
Venous blood is how saturated with O ₂	75%
During exercise how saturated is arterial blood with O ₂	97%
During exercise how saturated is venous blood with O ₂	25%
the most important factor determining the % Hb saturation of O ₂ is what?	PO ₂ of the blood
factors affecting the O ₂ -Hb dissociation curve	pH, PCO ₂ , temperature, and 2,3-DPG
bohr effect	the O ₂ -Hg dissociation curve shifting to the right from increased acidity, PCO ₂ , temp, or 2,3-DPG
three major ways CO ₂ is transported	dissolved in blood (7-8%), carried by Hg forming carbaminohemoglobin(23-25%), as bicarbonate ion (65-70%)
two types of respiration control	neural and chemical
basic rhythm of respiration is controlled by what	medullary respiratory center in the brain stem
two subgroups in medullary respiratory center	dorsal and ventral
two other respiratory control centers in the pons	apneustic and pneumotaxic
dorsal respiratory group consists mainly of what	inspiratory neurons whose descending fibers stimulate inspiratory muscles. Serves as the major rhythm regulators
the ventral respiratory group contains	both inspiratory and expiratory neurons, which are inactive during quiet breathing, but become active during periods in which demands on ventilation are increased
pneumotaxic center	sends impulses to the dorsal neurons that help "switch off" the

functions	inspiratory neurons, thereby limiting the duration of inspiration
apneustic center function	prevents the inspiratory neurons from being switched off, thus providing an extra boost to the inspiratory drive
herring-breuer reflex	triggered to prevent overinflation of the lungs. Stretch receptors in the lungs are activated by the stretching of the lungs at large tidal volumes
two types of receptors in chemical control of respiration	peripheral and central
peripheral chemoreceptors	located in the carotid bodies and the aortic bodies and are stimulated by decreased PO ₂ and increased H ⁺ concentrations
central chemoreceptors	located in the medulla and respond to changes in brain extracellular fluid levels of PCO ₂ . Increased PCO ₂ stimulates respiration.

Digestive System

BYU Pdbio 305 Rhees Digestive System

Question	Answer
digestive system	simply a "long tube" going through the body which has the sole purpose of extracting useful nutrients from ingested food and fluids. Tube called alimentary canal consisting of the oral cavity, pharynx, esophagus, stomach, small intestine and large intestine
amylase	chemical in mouth that breaks down starch (carb) as the first part of digestion
daily secretion of saliva and pH	800 to 1500 ml; pH 6-7
large parotid	salivary gland
mumps	viral disease of the parotid salivary gland
parotitis	inflammation of parotid gland
ptyalocele	cystic tumor of a salivary gland
how many taste buds and taste cells per bud	4000 buds; 30-100 taste cells/bud
achalasia	lower esophageal sphincter (cardiac sphincter) fails to relax
symptoms of achalasia	dysphagia, substernal pain, food remains in esophagus for hours
causes of achalasia	abnormal parasympathetic stimulation, drinking cold liquids
management of achalasia	careful diagnosis to rule out heart problems; surgery or use of a special dilating balloon
hiatal hernia	protrusion of the upper part of the stomach through the diaphragm and into the thorax; symptoms include gastroesophageal reflux, dysphagia, heartburn, and epigastric pain
chyme	blend of food, saliva, and gastric juices
zymogenic cells	also known as chief cells; secrete pepsinogen which becomes pepsin which digests proteins

parietal cells	secrete HCl and intrinsic factor; HCl kills bacteria and converts pepsinogen; intrinsic factor allows the ileum of the small intestine to absorb vitamin B12 which is required for erythropoiesis (pernicious anemia if lacking in intrinsic factor)
pyloric sphincter	permits passage of chyme and prevents backflow of chyme
pyloric stenosis	narrowing of the pyloric sphincter caused by enlargement of circular muscle fibers. The major symptom is projectile vomiting (more common in males)
3 types of peptic ulcers	gastric, duodenal, and esophageal
peptic ulcer	HCl and pepsin eat away the lining of stomach, esophagus or duodenum
causes of ulcers	stress, poor eating habits, excess vagal stimulation, hypersecretion of HCl or pepsin, hypersecretion of adrenal corticoids, lack of mucus, presence of irritating chemicals in the GI tract (steroids, anti-inflammatory agents, caffeine, alcohol, tobacco, aspirin)
% of population with ulcers	10
treatment of peptic ulcers	surgery or diet or drugs
tagamet	treatment for peptic ulcers; blocks the H ₂ receptors in the stomach and decrease secretion of HCl
Helicobacter pylori	bacteria that may cause peptic ulcers
bacteria that may cause peptic ulcers	Helicobacter pylori
how to kill H. Pylori	three different antibiotics taken three times a day
vomiting	relaxation of cardiac sphincter and strong contraction of the diaphragm and abdominal muscles. caused by toxic food, gagging, too much digestion, intense pain, dizziness, sight or smell of unpleasant things
pH of gastric juice	2
pH of urine	5.7
pH of sweat	4-6.8

pH of saliva	6.4
pH of breast milk	7
pH of blood	7.4
pH of pancreatic juice	7-9
length of small intestine	20 feet
secretion of intestinal juice	1-2 liters/day
pH of intestinal juice	7.6
what % of digestion takes place in small intestine	90
three divisions of small intestine	duodenum, jejunum, ileum
what breaks down proteins	peptidase
what breaks down carbs	carbohydrates
what breaks down fats or lipids	lipase
colon	large intestine
three divisions of large intestine	cecum, colon, anal canal
prevents backflow from large intestine into small intestine	ileocecal valve
four sections of colon	ascending, transverse, descending, sigmoid (pelvic)
functions of large intestine	absorption of water and electrolytes from food materials, storage and expulsion of feces from digestive
peristalsis	parasympathetic constriction and relaxation of the muscles of the intestine or any other canal to move contents along
major laxatives	bulk (bran and fiber), lubricants (mineral oil), mineral salts (Mg; they are not absorbed so they increase the osmotic

	pressure of the fecal material), irritants (speed up rate of preistalsis
peritonitis	infection from burst appendix that spreads from the gut to the lining of the abdominal cavity
irritable bowel syndrom	called spastic colitis; caused by emotional stress
colostomy	abdominal exit is made for the colon
dysentery	inflammation of intestinal mucosa with bleeding and mucus discharge with the stools
liver	largest gland of the body, weighs 3 pounds
liver has lobules containig cells called hepatocytes that produce	bile
8 functions of liver	1produce bile2store iron and copper3store glucose as glycogen4synthesis, storage, and release of vitamins5make fibrinogen and prothrombin for clotting6phagocytosis of foreign material in blood7detox of drugs and alcohol in blood8make plasma proteins
cirrhosis	liver epithelium is replaced by connective tissue causing blockage of sinusoids (caused by alcohol or malnutrition)
hepatitis	inflammation of liver from viruses, protozoa, and bacteria, or by toxic materials
jaundice	yellow color of skin and mucous membranes due to excessive free bilirubin
gallbladder	stores, concentrates, releases bile
amount of secretion daily by gallbladder	600-1000 ml/day
how much liquid can gallbladder store	30-70 ml
cystic duct	from gallbladder to common bile duct
hepatic ducts	from liver to common bile duct
sphincter of ampull	from pancreas, liver and gallbladder into the duodenum

regulation of bile release (4 things)	1presence of fat in si releases cholecystokinin from intestinal mucosa which passes via blood to gallbladder and stimulated gallbladder contraction2rhythmic contraction of gallbladder3peristaltic waves of duodenum relax sphincter of ampulla4vagal stimulat
gallstones	precipitation of cholesterol and bilirubin in bile; hyperconcentration is cuased by:1stasis of bile (too much absorption of water from bile)2high levels of cholesterol3inflammation of gallbladder
endocrine function of pancreas	secretion of insulin and glucagon into the blood
exocrine function of pancreas	secretion of digestive enzymes into the si in response to the presence of chyme in the upper si
amount of pancreatic fluid released each day and pH	1200-1500 ml; pH of 7.1-8.2
pancreatic juice enzymes	amylase, lipase, peptidases or proteolytic (trypsin, chymotrypsin, carboxypeptidase), bicarbonate
trypsinogen s activated to trypsin by	enterokinase enzyme
nervous control of gastric secretion	increased parasympathetic activity, secretion, contraction , release of gastrin (hormone)
hormonal control of gastric secretion	gastrin is a hormone released by G cells in the stomach
what stimulates the secretion of gastrin	food entering stomach, partially digested proteins, alcohol, caffeine, histamine, calcium
gastrin causes the followin	increased gastric juice secretion and peristalsis
two hormones secreted by the si that regulate pancreatic secretion	secretin and cholecystokinin
secretin	secreted by S cells in SI because of drop in pH in duodenum b/c of too much acid; secretin travles in blood to pancreas which secretes bicarbonate

CCK cholecystokinin in pancreatic secretion regulation	released when proteins, fats, and fatty acids enter si. It stimulates the secretion of pancreatic juice rich in enzymes to aid digestion
CCK cholecystokinin in bile secretion	released from I cells in duodenum and upper jejunal mucosa when fats and proteins enter si. stimulates contraction of gallbladder and release of bile to digest lipids
anabolism	construction of complex molecules from simple building blocks
catabolism	breaking down process
essential nutrients	cannot be formed in the body so they must be ingested. Ex: amino acids, vitamins, minerals
nervous tissue can only use what as energy source	glucose
breakdown of fats	fat-bile->fat globules-lipase->glycerol and fatty acids
breakdown of protein	protein->polypeptides->small polypeptides and aa->aa=amino acids
rate of transport of glucose into most cells in the body is greatly increased by	insulin
glycogen	form of storing glucose; many glucose molecules stuck together end to end
process of making glycogen from glucose is called	glycogenesis
glycogenolysis	breaking down glycogen to glucose molecules
glycolysis	splitting glucose into two molecules of pyruvic acid
cell respiration	when O ₂ is present, the two pyruvic acid molecules are converted to 2 acetyl coenzyme A's by a process called pyruvate decarboxylation
krebs cycle	citric acid cycle; acetyl portion of acetyl CoA is degraded to CO ₂ and H atoms; occur in matrix of mitochondria;
electron transport	oxidation of hydrogen atoms

chain	
summary of ATP production	glycolysis 2+krebs cycle 2+electron transport chain 32=36
% of calories in our diet from fats	40-45; in addition, an average of 20-50% of the carbs ingested are converted into fatty acids
when large quantities of fatty acids are broken down into acetyl CoA, 2 molecules of Acetyl CoA condense to form one molecule of	acetoacetic acid
can proteins be converted into acetyl CoA	yes

Endocrinology

BYU PdBio 305 Dr. Rhees Endocrinology

Question	Answer
endocrine glands	anterior pituitary, posterior pituitary, thyroid, parathyroid pancreas, adrenal cortex, adrenal medulla, ovaries, testes
receptor	integral membrane protein that receives hormones
target cell has how many receptors for a particular hormone?	2000-100,000
down-regulation	when a hormone is present in excess the number of target cell receptors may decrease
steroids	lipids that are derived from cholesterol. These are lipid soluble and will thus cross the plasma membrane and enter cells rapidly. Estrogens, progesterone, testosterone, aldosterone, cortisol
biogenic amines	synthesized by modifying amino acids; T3 and T4, epinephrine, histamine, serotonin
peptides and proteins	these hormones consist of chains of 3 to 200 amino acids. Oxytocin, ADH, Insulin, parathyroid hormone, calcitonin, CCK and gastrin
how are most hormones transported in the blood?	carrier proteins
master gland	anterior pituitary, now known to be controlled by the hypothalamus. has structure of an endocrine gland
seven hormones of anterior pituitary	growth hormone GH, Adrenocorticotrophic hormone ACTH, Thyroid stimulating hormone TSH, prolactin PRL, follicle stimulating hormone FSH, luteinizing hormone LH, melanocyte stimulating hormone MSH
two hormones of posterior	antidiuretic hormone ADH, oxytocin

pituitary	
the hypothalamus makes hormones for which pituitary	posterior
the hypothalamus transports hormones down the axons of the neurosecretory cells for which pituitary	posterior
which pituitary is controlled by substances made in the hypothalamus	anterior
releasing or inhibitory hormones	hypothalamic substances which regulate the anterior pituitary; CRH stimulates ACTH; TRH stimulates TSH and a little prolactin; GnRH or LHRH stimulates FSH and LH; GIH or somatostatin inhibits GH
Growth Hormone	GH or somatotropin; stimulates the uptake of amino acids into cells; stims growth of long bones and soft tissues; closure of epiphyseal cartilage stops growth of long bones-puberty (sex hormones)
pituitary adenoma causes	acromegaly and gigantism
gigantism & acromegaly	gigantism-excess GH before puberty; acromegaly-excess GH in adults
symptoms of acromegaly/gigantism	overgrowth of bone, particularly of the skull and mandible; nose thickened and puffy, large ears, large tongue, large hands, increased sweating, fatigue, and weight gain
Pituitary Dwarfism	lack of GH or GRH before puberty; may also be caused by hypothalamic-pituitary tumor; symptoms-small body, normal proportions; mild obesity w/ lack of appetite
How to diagnose pituitary dwarfism	inadequate rise in serum GH after provocative stimulus such as Arginine infusion, oral levodopa, or clonidine
Prolactin	stimulates the production of milk; promotes breast development in pregnancy
Thyroid stimulating hormone-	promotes and maintains growth and development of

TSH	the thyroid gland and stimulates it to secrete thyroxine (T4) and triiodothyronine (T3)
Follicle Stimulating Hormone FSH	stimulates growth and development of the follicle to maturity, stimulates the follicle to secrete estrogens, stimulates testicular growth, enhances production of androgen-binding protein in the Sertoli cells (this increases the concentration of testosterone near
Luteinizing hormone LH	acts with FSH in the development of the follicle, promotes ovulation, responsible for the formation of the corpus luteum, stimulates corpus luteum to produce estrogen and progesterone, stimulates production of testosterone by the interstitial cells in males
Adrenocorticotropin ACTH or corticotropin	Promotes and maintains normal growth and development of the adrenal cortex and stimulates the secretion of the glucocorticoids (cortisol); also affects the secretion of the androgens and the mineralocorticoids (aldosterone). ACTH is a polypeptide that is 39 a
osteoblast activity	stimulated by GH
epiphyseal cartilage	stimulated by GH; makes space for bone formation
somatomedins	GH exerts growth-promoting effects indirectly by stimulating somatomedins; somatomedin IGF is an insulin-like growth factor
GH does not act directly on its target cells to bring about	cell division, enhanced protein synthesis, or bone growth
where is IGF-I made	liver mostly
production of IGF-I is controlled by	nutritional status, age, and tissue specific factors
what closes the epiphyseal plate?	sex hormones among other things
hormones of the posterior pituitary	oxytocin and ADH (vasopressin)
where are posterior pituitary hormones synthesized	in the hypothalamus and then transported intracellularly to the posterior pituitary from which they are released

oxytocin functions	stimulate milk secretion and strong uterine contractions
milk secretion physiology	oxytocin causes contraction of myoepithelial cells surrounding mammary alveoli (women not secreting enough milk are given an oxytocin nasal spray)
uterine contraction physiology	oxytocin alters transmembrane ionic currents in myometrial smooth muscle cells to produce sustained uterine contractions. Sensitivity to oxytocin of uterine muscle increases during pregnancy.
diabetes insipidus	lack of ADH (often due to damage to the pituitary or the hypothalamus. loss of 75% of ADH secretory neurons is necessary before polyuria is evident)
Alcohol's effect on ADH	decrease release of
Narcotics effect on ADH	increase release of
symptoms of lack of ADH	polyuria, polydipsia, dehydration, fever, dry tongue, delirium
where are catecholamine hormones secreted	adrenal medulla; these are epinephrine and norepinephrine (these supplement the action of the sympathetic nervous system)
what does the adrenal cortex secrete in general	corticosteroids
chromaffin cells do what	secrete catecholamines in the adrenal medulla
corticosteroid hormones of the adrenal cortex	mineralocorticoids, glucocorticoids, and gonadocorticoids
three zones of adrenal cortex	zona glomerulosa, zona fasciculata, zona reticularis
other name for mineralocorticoids	aldosterone
other name for glucocorticoids	cortisol (hydrocortisone)
other name for gonadocorticoids	sex hormones
action of mineralocorticoids (aldosterone)	regulate the concentration of extracellular electrolytes, especially sodium and potassium, water balance
regulation of mineralocorticoids	renin-angiotensin system (angiotensin II)

(aldosterone)	
action of glucocorticoids (cortisol)	influence the metabolism of carbohydrates, proteins, and fats; promote vasoconstriction; anti-inflammatory; decrease antibody production
regulation of glucocorticoids (cortisol)	ACTH from the adenohypophysis of the pituitary gland in response to stress
action of gonadocorticoids (sex hormones)	supplement the sex hormones from the gonads
addison's disease	inadequate secretion of glucocorticoids and mineralcorticoids which results in hypoglycemia, Na^+ and K^+ imbalance, dehydration, hypotension, weight loss, and general weakness
cushing syndrome	hypersecretion of corticosteroids generally caused by a tumor of the adrenal cortex or by oversecretion of ACTH by the pituitary. Symptoms are puffy face, hyperglycemia, hypertension, decreased antibodies, and muscle weakness
adrenogenital syndrome	alteration of enzymes required to produce mineralcorticoids and glucocorticoids, results in an increase in the production of sex hormones. symptoms: masculinization of females, facial and body hair, acne, paleness, increased muscularity, atrophy of breasts
what does the thyroid gland produce	thyroxine (T_4) and triiodothyronine (T_3), and calcitonin
physical structure of thyroid	two lateral lobes interconnected by an isthmus (neck area)
histological structure of thyroid	spherical sacs called thyroid follicles. Humans have about one million follicles. Each follicle is lined with principal cells which synthesize T_3 and T_4 and contain a protein-rich fluid called colloid. Between the follicles are perifollicular cells which
action of triiodothyronine and thyroxine	regulate metabolism; increase rate of protein synthesis; increase rate of energy release from carbs; regulate growth; stimulate maturity of nervous system; regulate body temp

regulation of T3 and T4	hypothalamus and release of TSH from adenohypophysis of the pituitary gland
Action of Calcitonin (thyrocalcitonin)	lowers blood calcium by inhibiting the release of calcium from bone tissue
regulation of calcitonin	calcium levels in the blood
cretinism	insufficient secretion of T4 and T3 in infants and children. Stunted growth, thickened facial features, large protruding tongue, abnormal bone growth, mental retardation, decreased metabolic rate, general lethargy. Treat with T3 and T4
myxedema	insufficient secretion of T4 and T3 in adults. Weight gain, slow pulse, dry brittle hair, decreased basal metabolic rate, lack of energy, sensation of coldness, diminished perspiration, weakness. treat with T3 and T4
goiter	a pathological enlargement of the thyroid gland due to insufficient iodine intake. Take iodine.
graves' disease (thyrotoxicosis)	excessive secretion of T4 and T3. Loss of weight, rapid pulse, warm, moist skin, increased appetite, increased basal metabolic rate, tremor, goiter, exophthalmos (bulging eyes); muscular weakness. Treatment: surgical removal of a portion of thyroid gland,
what percent of calcium is in crystalline form	99%
If the non crystalline calcium, what percent is in cells and what percent is in extracellular fluid	of 1%, .9% is inside the cells and .01% is in the extracellular fluid
parafollicular or C cells	produce calcitonin in the thyroid gland; lower the blood calcium and phosphates by: 1. decreasing bone resorption by inhibiting the activity of osteoclasts 2. stimulating urinary excretion of calcium and phosphate by inhibiting their reabsorption in the k
parathyroid glands	four small glands attached to the posterior surface of the thyroid glands. Principal or chief cells in the

	parathyroid glands secrete parathyroid hormone (PTH) or parathormone.
what happens in the absence of PTH	death in a few days from hypocalcemia
functions of PTH (parthormone)	stimulates the activity of osteoclasts to reabsorb bone (remove Ca^{++} from bones), stims the kidneys to reabsorb ca^{++} from the filtrate, promotes the formation of 1,25 dihydroxyvitamin D3
1, 25 dihydroxyvitamin D3 function	helps raise the plasma calcium and phosphate levels by stimulating 1. intestinal absorption of Ca^{++} and Phosphate 2. reabsorption of Ca^{++} from bones 3. renal absorption of ca^{++} and phosphate so that less is excreted in the urine
hyperparathyroidism	usually caused by a tumor in one of the parathyroid glands. Is characterized by hypercalcemia- muscle weakness, neurological disorders, decreased alertness, poor memory
hypoparathyroidism	used to be caused by removal of parathyroids during thyroid surgery. Could lead to death. Other symptoms- hypocalcemia, increased neuromuscular excitability
endocrine gland in the pancreas	islets of langerhans (clusters of cells); alpha cells secrete glucogon, beta cells secrete insulin
Glucogon	elevates blood glucose by stimulating glycogenolysis in the liver, this helps the body maintain sufficient blood glucose levels during fasting and starvation
Insulin	promotes the cells to take up glucose; some tissue do not require insulin for glucose uptake (brain, kidney, intestinal, and red blood cells); stimulates glycolysis; lowers blood glucose levels
diabetes mellitus	insulin deficiency
genetic factors in diabetes mellitus	predisposition of diabetes is inherited, the genetic factors are complex (on chromosome 6), over 20% of the relatives of diabetic patients have abnormal glucose tolerance curves

other possible causes (not hereditary) of diabetes mellitus	environmental chemicals and drugs, infectious agents (mumps virus, rubella, pancreatitis), autoimmune events (antibodies damage the beta cells, anti-insulin receptor antibodies)
two types of diabetes mellitus	type I-insulin-dependent (juvenile onset), type II-noninsulin-dependent (maturity onset)
type I insulin-dependent (juvenile onset) diabetes mellitus	requires insulin injections (there is no insulin being secreted), often severe and complicated by ketoacidosis, onset usually in youth but may occur at any age
type II noninsulin-dependent (maturity onset) diabetes mellitus	90-95% of diabetes, injections not required, patient usually obese, may use oral hypoglycemic drugs to stimulate insulin release from beta cells, insulin resistance is a factor for 60-80% of patients with type II diabetes
how to diagnose diabetes mellitus	oral glucose tolerance test; oral administration of 1.75 g/Kg of glucose after at least 3 days on a 300 g carbohydrate diet
symptoms of diabetes mellitus	glycosuria, polyuria (glucose acts as an osmotic diuretic), polydipsia, hyperglycemia, weakness, loss of weight, acetone breath (ketoacidosis), acetone in the urine
increased risk of infection due to diabetes mellitus	factors that increase infection 1. pathogens proliferate rapidly b/c of excess glucose 2. hypoxia-glycosylated hemoglobin in RBC's impedes the release of O ₂ 3. decreased blood flow to infected area b/c of vascular damage 4. white blood cells have impaired
insulin excess results in	insulin shock (hyperinsulinism)
gestational diabetes mellitus (GDM)	refers to diabetes that occurs during pregnancy (in 1 to 14% of pregnancies) and then disappears following delivery
GLUT4	transporter that moves glucose across the membrane

Urinary System

BYU PdBio 305 Rhees Urinary System

Question	Answer
urinary system consists of what	kidneys, ureters, urinary bladder, urethra
urinary system does what	regulates water balance, electrolyte balance, acid-base balance, rids body of waste of metabolism, foreign chemicals, drugs, and food additives, and serves as a minor endocrine organ and produces renin and erythropoietin
where are kidneys located	between the levels of the 12th thoracic and the 3rd lumbar vertebrae
hilus	concave medial surface of kidney
renal cortex	outer portion of kidney which contains capillary tufts and convoluted tubules
renal medulla	inner portion of kidney and contains renal pyramids and renal columns
acute renal failure	sudden loss of kidney function, usually associated with shock or intense renal vasoconstriction, that lasts from a few days to many weeks
cystitis	inflammation of the urinary bladder
hematuria	blood in the urine
hemodialysis	method of clearing waste products from the blood in which blood passes by the semipermeable membrane of the artificial kidney and waste products are removed by diffusion
nocturia	night urination
oliguria	urinary volumes less than 500ml/day
polyuria	excessive urine output
uremia	retention of urinary constituents in the blood, owing to kidney dysfunction

Nephron and parts	functional unit of the kidney, consisting of the glomerulus, glomerular capsule (Bowman's capsule), the proximal convoluted tubule, the nephron loop (loop of Henle), the distal convoluted tubule, and the collecting duct
how many nephrons/kidney	over 1 million nephrons per kidney
glomerulus	consists of a network of about 50 capillaries. The capillary endothelium lining the glomerulus has many circular fenestrations, or pores, which are larger and more numerous than anywhere else in body.
permeability of glomerulus	100-1000X more permeable than typical capillaries
glomerular capsule (Bowman's capsule)	double-walled cuplike structure composed of squamous epithelium. Outer layer is continuous w/ the proximal tubule. Inner layer is composed of podocytes that are closely associated with the glomerular capillaries
proximal convoluted tubule	single layer of cuboidal cells containing microvilli (as a brush border) that greatly increase the surface area. Terminates in the first portion of the nephron loop, called the descending limb of the nephron loop
nephron loop	has descending and ascending thin limbs and an ascending thick portion. Thin segments are lined w/ flat squamous cells that lack microvilli, as do the cuboidal cells that compose the thick segment, which runs between the afferent and efferent arterioles
distal convoluted tubule	begins at the macula densa, a mass of specialized epithelial cells of the tubule wall, located next to the afferent arteriole. Shorter and less microvilli than the proximal convoluted tubule. last part of nephron and empties into the collecting duct
3 major fxns of nephron	glomerular filtration, tubular reabsorption, tubular secretion
glomerular filtrate	portion of the blood plasma that enters the capsule. amounts to about 180L/day=45 gallons/day
mechanisms that cause such large amounts of glomerular filtrate	1)high hydrostatic pressure of the blood (45 to 60 mmHg) in the glomerulus 2)large numbers of pores, which are larger than most pores in blood capillaries

substances in blood that are in glomerular filtrate and those that aren't	in filtrate: water, electrolytes, glucose, amino acids, urea, hormones, vitamins; not in: plasma proteins, RBC's, WBC's and platelets because they're too big
presence of RBC's or protein in the urine indicates what?	hydrostatic pressure in the glomerular capillaries is excessively high or that there is a defect in the glomerular membrane
glomerular filtration rate (GFR)	about 120 ml/minute, 7.5 L/hour, 180 L/day
regulation of GFR	via vasoconstriction and vasodilation of afferent arterioles results from both extrinsic (sympathetic nerves) and intrinsic (locally produced chemicals) mechanisms
Measurement of GFR	measure excretion and plasma concentration of a substance that is freely filtered into Bowman's capsule and is not secreted or reabsorbed by tubules. measure amount of substance in urine per unit time
inulin	a polymer of fructose (extracted from plants). since it is not produced by the body and not secreted or reabsorbed it is used to measure the GFR
GFR equation	$\frac{(\text{urine volume (ml/min)}) (\text{inulin conc. in urine (mg/ml)})}{(\text{inulin conc. in plasma (mg/ml)})}$
tubular reabsorption	transfer of fluid and solutes out of the lumen of the nephron through the interstitial space and into the peritubular capillaries
% of filtrate reabsorbed from the renal tubules	99%
% of water reabsorbed by tubular reabsorption	99%
% of sodium reabsorbed by tubular reabsorption	99.5%
% of glucose reabsorbed by tubular reabsorption	100%
% of urea reabsorbed by tubular reabsorption	50%
% of phenol reabsorbed by tubular reabsorption	0%

tubular reabsorption occurs throughout the "blank", but primarily in the "blank" portion	renal tubules, proximal convoluted
trans-epithelial transport	transport of substances by tubular reabsorption
% of reabsorbed material that is reabsorbed through the proximal convoluted tubule	80%
% of reabsorbed material that is reabsorbed through the nephron loop	6%
% of reabsorbed material that is reabsorbed through the distal convoluted tubule	9%
% of reabsorbed material that is reabsorbed through the collecting duct	4%
parts of reabsorption physiology that are under ADH control	distal convoluted tubule and collecting duct
two ways substances are reabsorbed by the nephron	diffusion (H ₂ O and urea) and active transport (glucose)
aldosterone	regulates the reabsorption of Na ⁺ in the distal and collecting duct (renin-angiotensin-aldosterone system)
where is glucose reabsorbed?	proximal tubule
normal glucose concentration in blood	100mg/100ml
transport maximum (T _m)	the concentration of transported molecules needed to saturate the carriers and thus achieve maximal transport rate (especially used with glucose levels)
T _m of glucose	375mg/minute
tubular secretion	the secretion or movement of substances from the peritubular capillaries into the lumen of the tubule

most important substances secreted in tubular secretion	hydrogen ions (H^+), potassium ions (K^+), and some organic anions (penicillin)
where are H^+ ions secreted?	in all tubular regions
where are K^+ ions usually reabsorbed and secreted?	reabsorbed in the proximal tubule and actively secreted in the distal tubule and collecting duct
aldosterone's effect on Na^+ and K^+	stimulate K^+ secretion and Na^+ reabsorption
how do the kidneys control acid-base balance?	secretion of H^+ ions into the tubules and the reabsorption of bicarbonate
are the amounts H^+ secreted and bicarbonate reabsorbed interdependent?	yes

Muscle Physiology

BYU PdBio 305 Rhees Muscle Physiology

Question	Answer
Motor unit	a single motor neuron and the muscle fibers it innervates
muscle fibers per motor unit	3-6 in hand and eye; 120-500 in large muscles of the back
myoneural junction	junction of motor neuron and muscle; it loses its myelin sheath and divides into a number of terminal buttons or end-feet
6 events at a myoneural junction (1-3)	1) Action potential travels over the axon terminal and triggers the entry and release of calcium into the terminal 2) Ca^{++} triggers the exocytosis of vesicles of ACh 3) ACh diffuses across the space and binds with receptors in the muscle cell
Events at a myoneural junction (4-6)	4) Binding brings about the opening of sodium channels generating an action potential in the muscle cell 5) Current flow throughout the muscle cell via the transverse (T) tubule system 6) ACh is broken down by acetylcholinesterase
differences between a synapse and a myoneural junction	one to one transmission of action potentials at a myoneural junction; myoneural junction is always excitatory
three types of muscle tissue	smooth, cardiac, skeletal
mesoderm	all 3 muscle cell types are derived from it
contractile fibers	all 3 types of muscle cells are composed of them
smooth muscle	elongated, lack cross striations, and under involuntary control, and have one nucleus which is located at the center of the cell
smooth muscle cells control contraction of what	internal organs, walls of blood vessels, digestive system, ducts of reproductive glands, the ureters, the bladder, and skin
myogenic	spontaneous muscle contraction

neurogenic	muscle contraction induced through innervation
cardiac muscle fiber characteristics	cross-striations, one centrally-located nucleus, involuntary control, bifurcated to form a syncytium
skeletal muscle fiber characteristics	elongated, multinucleate, voluntary control, well developed cross striations
function of skeletal muscle	movement of bones, maintenance of body posture, facial expression, and breathing movements
sarcolemma	plasma membrane in muscle cell
fiber	muscle cell
sarcoplasm	cytoplasm in muscle cell
sarcoplasmic reticulum	endoplasmic reticulum in muscle cell
Myofibril	a muscle fiber contains many small, round parallel bundles (100-1000s) called myofibril
Myofilament	each myofibril is composed of still smaller units called myofilaments
Actin	thin contractile protein in the muscle cell
Myosin	thick contractile protein in the muscle cell
Sarcomeres	the contractile proteins are arranged into compartments
A bands	dark bands in myofilaments
I bands	lighter bands in myofilaments
Anisotropic	A bands
Isotropic	I bands
H zone	lighter central regions of the A bands contain only myosin (no myosin heads)
Z line	where the actin filaments of adjacent sarcomeres join
Actin filaments are composed of	actin, tropomyosin, and troponin
G-actin	globular individual actin molecules
F-actin	double spherical chains (double helix) called fibrous actin
Tropomyosin covers how	7

many G-actin subunits	
Troponin I	unit that binds to actin
Troponin T	portion that binds to tropomyosin
Troponin C	component that binds calcium (initiates contraction)
Myosin filaments	thick myofilaments
Light meromyosin	LMM filaments make up the rodlike backbone of the myosin filaments
Heavy meromyosin	HMM filaments form the shorter globular lateral cross bridges (heads) which link
Binding sites on the myosin cross bridge	actin binding site and an ATPase binding site
Isometric contraction	when a muscle develops tension but does not shorten
Isotonic contraction	a contraction in which the muscle shortens
Twitch contractions	when an isolated muscle is attached to a device that senses and records changes in muscle length and the muscle then receives a single stimulus, the contraction response is referred to as a twitch
Three phases of a twitch	1)latent period which is the time from actual stimulation until contraction begins 2)contraction period 3)relaxation period
Wave summation or temporal summation	first muscle twitch is not completely over when the second one begins and thus the muscle is already in a partially contracted state when the second twitch begins, the degree of muscle shortening in the 2nd contraction is greater than with just a single m
Tetanus	occures when the stimuli are applied in a very rapid succession and the contractions fuse together and cannot be distinguished one from the other
Slow-twitch fibers	found mostly in the postural muscles such as in the back and legs and have a twitch duration of about 100msec; derive energy from oxidative metabolism; have small diameters, many mitochondria, many capillaries, small amounts of glycogen storage
Red fibers	slow-twitch fibers; the red color is due to the high

	concentration of myoglobin which binds O ₂
Fast-twitch fibers	found mostly in fine, skilled movements and twitch for about 7 msec; fatigue quickly; derive energy from glycolysis; large fibers, high storage of glycogen and few mitochondria
White fibers	fast-twitch fibers; they are white because they contain little myoglobin
Why is fast-twitch muscle fast?	has more sarcoplasmic reticulum than slow-twitch muscle; also has fast myosin
Causes of muscle fatigue (first 2)	1)ATP use exceeds ATP production 2)lactic acid (H ⁺) accumulation interferes with ATP production and muscle contraction
Causes of muscle fatigue (second 2)	3)glycogen depletion and therefore hypoglycemia may occur 4)inhibition of excitation-contraction coupling. That means inhibition of release of Ca ⁺⁺ from the lateral sacs
Sarcoplasmic reticulum of cardiac muscle	is not as extensive
Intercalated disks	manner in which cardiac muscle cells are interconnected
2 functions of intercalated disks	1)provide gap junctions that allow impulses to travel from one cell to another 2)provide desmosomes that anchor one cell to another
Cardiac muscle cell refractory period	long absolute and relative refractory periods making tetanus impossible
Automaticity	factors that increase intracellular Ca ⁺⁺ in the cardiac muscle such as catechoamines and digitalis, which slow the heart down, will increase the force of contraction. Cholinergic agents will decrease Ca ⁺⁺ concentrations and decrease the contraction force
Contraction of cardiac muscle	the action potential does not release Ca ⁺⁺ from sarcoplasmic reticulum but is released from the extracellular fluid; the increase of Ca ⁺⁺ releases Ca ⁺⁺ in the sarcoplasmic reticulum (calcium induced calcium release)
What smooth muscle lacks	sarcomeres, striations, t-tubule systems

Contraction of smooth muscle	slower, requires less energy; innervated by neurons (autonomic nerves); other smooth muscle cells are not innervated and contract in response to hormones or local factors
Smooth muscle mechanism	myosin-regulated; actin and myosin only interact when the myosin is phosphorylated
Ca ⁺⁺ involvement in smooth muscle	intracellular messenger that sets off a series of events that result in the phosphorylation of myosin. Most Ca ⁺⁺ comes from the extracellular fluid
Ca ⁺⁺ to phosphorylation in smooth muscle tract	increased intracellular Ca ⁺⁺ binds to and activates calmodulin which binds to and activates another myosin kinase which phosphorylates myosin which binds with actin so cross-bridge cycling can begin
Autonomic innervation of smooth muscle cells	postganglionic neurons travel across smooth muscle cell's surface and release neurotransmitters from multiple bulges (varicosities) as an action potential passes along the axon.
Varicosities	bulges on the postganglionic axon in smooth muscle cells that release neurotransmitters as an action potential passes along the axon
Adrenergic receptors (alpha and beta)—effects on smooth muscle cells (norepinephrine)	Alpha(1) receptors--cause smooth muscles to contract or be stimulated; Beta (2) receptors—cause smooth muscles to relax or be inhibited

Nervous System

BYU PdBio 305 Rhees Nervous System

Question	Answer
Two divisions of nervous system	central nervous system, peripheral nervous system
Central nervous system	brain and spinal cord
Peripheral nervous system	nervous outside the brain and spinal cord
CNS composed of...	white matter and gray matter
Gray matter	nerve cell bodies
White matter	myelinated axons
Nerve tract	group of nerve fibers within the CNS with a common origin and a common destination (ascending and descending)
Nucleus	cluster of nerve cell bodies within the CNS
Nerve	group of nerve fibers in the PNS with a common origin and common destination- afferent (sensory) and efferent (motor)
Ganglion	cluster of nerve cell bodies in the PNS
Structural components of nervous system	CNS and PNS
Fxn components of nervous system	Autonomic Nervous system (ANS), Somatic nervous system
4 principal fxns of the nervous system	1. Orientation of body to internal and external environments. 2. Coordination and control of body activities. 3. Assimilation of experiences requisite to memory. 4. Programming of instinctual behavior (more important in vertebrates other than humans).
Cerebral palsy	pathology of the brain causing paralysis, lack of coordination, and other dysfunctions of motor and sensory mechanisms.
Coma	varying degrees of unconsciousness that may be the result of any one of a number of causes

Neurological examination	mental assessment following trauma to the CNS. 5 categories: 1. Mental status and speech 2. cranial nerves 3. motor system 4. sensory system 5. reflexes
Paraplegia	permanent paralysis of both legs due to injury or disease of the spinal cord.
Quadriplegia	permanent paralysis of arms and legs due to spinal cord injury or certain diseases.
Neuron	nerve cell; structural and functional unit of the nervous system
3 components of neuron	cell body, dendrites, axons
cell body	enlarged portion of the neuron containing the nucleus, Nissl bodies (layered rough ER), neurofibrils (strands of protein), and other organelles
dendrites	cytoplasmic extensions which receive stimuli and conduct impulses to the cell body
Axons	cylindrical processes that conduct impulses away from the cell body
Length of axons	few millimeters in the CNS to over a meter in the PNS
Schwann cells	long axons are generally myelinated with schwann cells in the pns
Oligodendrocytes	long axons are generally nyelinated with oligodendrocytes in the CNS
Nodes of Renvier	segments in the myelin sheath
Presynaptic terminals	where axon terminates
How are neurons classified?	direction of impulse conduction, the number of cytoplasmic processes, and the are of innervation
Impulse conduction direction neurons	afferent (sensory), efferent (motor), interneurons
Afferent	sensory neurons transmit nerve impulses to the CNS
Interneurons (internuncial or	conduct impulses between sensory and motor

association neurons	neurons
Efferent	motor neurons conduct impulses away from the CNS
Number of processes neurons	multipolar, bipolar, unipolar
Multipolar neurons	have one axon and two or more dendrites
Bipolar neurons	one axon and one dendrite
Unipolar neurons	have a single process, which branches into an axon and a dendrite
Area of enervation neurons	somatic afferent, somatic efferent, visceral afferent, visceral efferent
Somatic afferent neurons	within the skin, muscles, and joints receive stimuli and convey impulses to the CNS
Somatic efferent neurons	convey impulses from the CNS to skeletal muscles
Visceral afferent neurons	convey impulses to the CNS from the internal organs
Visceral efferent neurons	convey impulses from the CNS to internal organs (cardiac muscle, glands, and smooth muscle within visceral organs)
Resting membrane potential	when a neuron is not conducting an impulse (resting), there is a difference in electrical charge between the inside and the outside of the cell membrane
Resting membrane charge difference	more positive ions outside the membrane and more negative ions on the inside
3 mechanisms responsible for the imbalance in particles across the membrane	Na-K pump moves Na ⁺ outside and K ⁺ inside; cell membrane is more permeable to K ⁺ than Na ⁺ so K ⁺ moves out faster than Na ⁺ moves in; membrane doesn't allow negative proteins through and therefore keep more anions inside than outside
3 action potential synonyms	spike, nerve impulse, discharge
Do action potentials diminish as they are conducted down an axon?	no
What constitutes the code as	the frequency and pattern of the action potential

well as the destination of the impulse?	
Are action potentials similar in all organisms?	yes
Membrane potential	present in all cells
Current in membrane potential	-60 to -80 mV (inside cells)
Action potential recorded by...	oscilloscope
Time for action potential to occur	2 msec (1000 per sec)
5 Characteristics of action potential	rising phase, overshoot, falling phase, undershoot or hyperpolarization, gradual restoration of the resting potential
Sequence of action potential (first 5 steps)	1. Adequate stimulation 2. open sodium channels 3. Sodium ions move inward 4. Threshold level (all or none) 5. Depolarization of membrane
Sequence of action potential (steps 6-10)	6. Reverse polarization 7. Acts as a stimulus 8. Decreased sodium permeability and increased potassium perm 9. K ⁺ moves out (repolarization) 10. prep for next impulse
Action potential 1	adequate stimulation of membrane-physical, chemical, temperature-different neurons/different stimuli
Action potential 2	Increased membrane permeability to sodium at site of stimulation (open sodium channels)-permeability favors sodium over potassium
Action potential 3	sodium ions move inward- inside of the membrane becomes less negative
Action potential 4	there is a critical level- threshold level- generator potential (-55 mV) that must be crossed in order to trigger an action potential- "all or none" (voltage gated sodium channels open)
Action potential 5	if the action potential is triggered the transmembrane potential reaches zero (depolarization of membrane)
Action potential 6	sodium ions continue to move inward and the inside

	of the membrane becomes positive (reverse polarization) relative to the outside
Action potential 7	reverse polarization acts as a stimulus to the adjacent regions
Action potential 8	decreased permeability of sodium channels and increased (continued) permeability of potassium channels – voltage-gated potassium channels are opened
Action potential 9	potassium ions move out, making the outside positive (repolarization)
Action potential 10	to prepare for the next impulse, pumps transport sodium back out of the neuron, and potassium back into the neuron
All or none	nerve and muscle fibers obey the all or none law, meaning that a threshold stimulus evokes an action potential, and that a subthreshold stimulus evokes no response
Absolute refractory period	during the interval from the onset of an action potential until repolarization is about 1/3 completed, a second stimulus cannot elicit another response because the channels are already open
Relative refractory period	following the absolute refractory period is an interval during which the neuron will not respond to a normal threshold stimulus, but a very strong stimulus can depolarize the membrane and produce a second action potential
Sodium Channel structure is formed by what?	a single, long polypeptide
How many domains are on the sodium channel structure?	4 distinct domains
each sodium channel domain consists of what?	6 transmembrane alpha helices
Tetrodotoxin (TTX)	sodium channel toxin which binds to and physically blocks the Na ⁺ pores
Saxitoxin	sodium channel toxin that blocks Na ⁺ pores

Batrachotoxin	sodium channel toxin that causes the Na ⁺ channels to open and stay open much longer than normal, thus altering the action potentials
delayer rectifier	movement of K ⁺ during repolarization occurs about the same time the Na ⁺ channels close (one msec later)
orthodromic conduction	impulses moving in the normal direction (natural)
antidromic conduction	backward propagation (experimentally) of impulse
average impulse travel time	10m/sec (vary from .5m/sec to 100m/sec)
Myelinated speed vs. unmyelinated	myelinated is much faster
Nodes of ranvier	interruptions in the myelin sheath that make it myelinated
Salutatory conduction	the leaping of action potentials on myelinated neuron (increases speed and conserves energy)
Schwann cells	form the myelin sheath in the pns
Oligodendroglia	form the myelin sheath in the cns
Multiple sclerosis (MS)	2nd most common cns disease next to epilepsy. Autoimmune disease in which the body's natural defenses attack the myelin in the CNS. Myelin sheath becomes damaged and this interferes with nerve conduction. More common in cold areas
Symptoms of MS	disturbances in speech, disturbances in vision, numbness, fatigue, depression, loss of coordination, uncontrollable tremors, loss of bladder control, memory problems, paralysis
Treatment of MS	ACTH, exercise, physical therapy
Tay-Sachs disease	an inherited disease in which the myelin sheaths are destroyed by excessive accumulation of lipids within the membrane layers
Local anesthesia	drugs (cocaine and lidocaine) that block the initiation of action potentials in neurons. They are injected into the area of the body to be anesthetized.
Lidocaine binding site	S6 alpha helix of domain IV
Synapse	anatomical junction between two neurons where the

	electrical impulse in one neuron initiates a series of events influencing the excitability of the 2nd
Parts of a synapse	axon terminal, synaptic cleft, postsynaptic membrane
Axon terminals	small rounded or oval knobs which are referred to as synaptic knobs, boutons, and end feet, or presynaptic terminals. Present within axon terminals are synaptic vesicles containing a neurotransmitter: Ach, Norepi
Synaptic cleft	microscopic space between the 2 neurons
Postsynaptic membrane	cell membrane of the postsynaptic neuron which contains specific receptors for the neurotransmitter
Synapse sequence of events (first 3)	impulse reaches the axon terminal of the presynaptic neuron, Ca^{+} enters the presynaptic neuron causing release of neurotransmitter into synaptic cleft, neurotransmitter diffuses across synaptic cleft and is detected by receptors on the postsynaptic neuron
Synapse sequence of events (#4 and #5)	the postsynaptic membrane is either stimulated or inhibited depending upon the types of neurotransmitter involved, the neurotransmitter either diffuses out of the cleft or is metabolized
Characteristics of a synapse	1. Synaptic delay 2. Synaptic fatigue 3. One-way conduction
Drugs may influence synaptic transmission by altering any of the following steps	synthesis of the neurotransmitter, release of the neurotransmitter, binding of the neurotransmitter with the receptor, destruction of the neurotransmitter
Diseases which affect synaptic transmission	parkinson's disease-lack of neurotransmitter (dopamine), Myasthenia Gravis-block neurotransmitter (Ach) receptors, Botulism-inhibition of Ach release, Nerve Gas- anti cholinesterase
Synaptic Integration	an single neuron can be, and often is, simultaneously stimulated by excitatory and inhibitory transmissions from different presynaptic

	neurons.
Excitatory/inhibitory neurotransmitters	neurotransmitters may be excitatory, causing the postsynaptic neuron to become active, or inhibitory, preventing the postsynaptic neuron from becoming active
Synaptic excitation	excitatory neurotransmitters increase the postsynaptic membrane's permeability to sodium ions.
EPSP	excitatory postsynaptic potential- altered membrane potential said to be hypopolarized-two ways in which EPSP's may combine to reach threshold and initiate an action potential: spatial summation, temporal summation
spatial summation	several presynaptic neurons simultaneously release neurotransmitters to a single postsynaptic neuron; these EPSP's produced at different synapses may summate in the postsynaptic dendrites and cell body
Temporal summation	the EPSP's may summate as the result of the rapid successive discharge of neurotransmitter from the same presynaptic terminal
Synaptic inhibition	inhibitory neurotransmitters increase the postsynaptic membrane's permeability to Cl ⁻ and K ⁺ , resulting in a hyperpolarized membrane that exhibits an inhibitory postsynaptic potential (IPSP)
Glycine	amino acid that is a neurotransmitter known to be involved in the production of IPSP's. Its action is messed up by strychnine and tetanus toxin which produce convulsions and muscular hyperactivity.
GPSP	Grand postsynaptic potential-composite potential on the postsynaptic membrane due to the sum of all EPSP's and IPSP's occurring at the same time
6 classes of neurotransmitters	1. Acetylcholine 2.amino acids 3.amines 4.polypeptides 5.purines 6.gases
Amino acid neurotransmitters	glutamate, GABA (gamma-aminobutyric acid)-inhibitory, Glycine-mainly inhibitory

Amine neurotransmitters	derived from a single amino acid- Norepinephrine (noradrenaline), Epinephrine (adrenaline), Dopamine-made from tyrosine, Serotonin (5-hydroxytryptamine) made from tryptophan, histamine-made from histidine
Polypeptide neurotransmitters	substance P, endorphins and enkephalins
Gas neurotransmitters	Nitric Oxide (NO)-made from oxygen and arginine, freely diffuses into cells and binds to proteins, has a half-life of 2-30 seconds and is difficult to study
Cerebrum	largest and most prominent part of the brain (80% of total brain mass)
Grooves or valleys, called fissures or sulci in brain	Longitudinal fissure, Central fissure, Lateral fissure
Gyri	convolutions or folds in brain
Corpus callosum	two cerebral hemispheres are connected to each other by a thick band called corpus callosum, which is made up of 300 million neural axons allowing the 2 sides to communicate and cooperate
Right hemisphere	creative and artistic perception
Left hemisphere	logic, analytical ability, language
Lobes of cerebrum	frontal, parietal, temporal, occipital
Frontal lobe	motor area, elaborate thought, speaking ability
Parietal lobe	sensory area, somesthetic (body feelings-touch, pressure, heat, cold, pain); proprioception (body positions)
Temporal lobe	hearing
Occipital lobe	visual input
Cerebral cortex	outer portion of cerebrum-3/16"-gray matter (six layers of neurons)
Functions of the cerebrum	all conscious fxns, interpretations of sensations, understanding of language, intelligence, memory, emotional feelings
Functions of the thalamus	recognition of crude sensations of pain, temp., touch; feelings of pleasantness and unpleasantness;

	production of complex reflex movements; relay center-receives all sensory input, except for smell, then relays it to the sensory cortex
Hypothalamus functions	controls the pituitary (hormones; thyroid, growth, reproduction, adrenal), water balance (ADH), appetite and food intake (glucostats-receptors for glucose), body temp., direct and indirect inputs to the autonomic nervous system
Hypothalamus blood brain barrier	not very well developed
Cerebellum functions	Control muscle action (planning and execution of voluntary movements), postural reflexes, equilibrium
Medulla Oblongata functions	controls heart rate, blood pressure, respiration, reflexes of vomiting, coughing, hiccupping
Pons function	center for the 5th, 6th, 7th, and 8th cranial nerves
Midbrain function	center for the 3rd and 4th cranial nerves
Brain stem consists of	medulla, pons, and midbrain
Reticular activating center	widespread network of interconnected neurons running throughout the entire brain stem and thalamus.
Function of reticular activating center	It controls the overall degree of alertness, wakefulness and sleep. General anesthetics suppress the neurons in this center and damage to these neurons may lead to a coma.
12 cranial nerves	1.Olfactory 2.Optic 3.Oculomotor 4.Trochlear 5.Trigeminal 6.Abducens 7.Facial 8.Vestibulocochlear 9.Glossopharyngeal 10.Vagus 11.Acessory 12.Hypoglossal
12 cranial nerves supply what?	head and neck (with exception of the vagus nerve-X)
spinal cord # and locations	31 pairs of spinal nerves; 8 cervical-neck; 12 thoracic-chest; 5 lumbar-abdominal; 5 sacral-pelvic; 1coccygeal-tailbone
Cauda equina	horse's tail-thick bundle of elongated nerve roots at

	the lower vertebral canal
Cranial nerve I	olfactory-smell
Cranial nerve II	optic-sight
Cranial nerve III	oculomotor-movement of eyeball, focusing, and change in pupil size
Cranial nerve IV	Trochlear-movement of eyeball
Cranial nerve V	Trigeminal-Sensations from face, teeth, and tongue; movement of jaw, chewing muscles
Cranial nerve VI	Abducens-movement of eyeball
Cranial nerve VII	Facial-taste buds at the front of the tongue; movement of facial muscles, secretion of saliva and tears
Cranial nerve VIII	vestibulocochlear-hearing, balance, and posture
Cranial nerve IX	Glossopharyngeal-taste buds at the back of the tongue; swallowing and secretion of saliva
Cranial nerve X	Vagus-visceral sensations; visceral muscle movement (80% parasympathetic)
Cranial nerve XI	accessory-swallowing and head and neck movements
Cranial nerve XII	hypoglossal-speech and swallowing
Gray matter in spinal cord	neuron cell bodies
Central canal in spinal cord	cerebrospinal fluid (CSF)
White matter in spinal cord	myelinated axons
Anterior, posterior, and lateral columns of gray matter	divides the white matter into 3 areas called funiculi (posterior lateral, anterior)
Funiculi	nerve tracts are located in the 3 funiculi; tracts are either ascending or descending; name of most tracts indicates a. funiculus in which the tract is located b. location of its cells of origin c. level of destination
2 ascending funiculi tracts	anterior spinothalamic, lateral spinothalamic
anterior spinothalamic	ascending funiculi tract that conducts sensory impulses for crude touch and pressure

lateral spinothalamic	ascending funiculi tract that conducts pain and temp impulses
2 descending funiculi tracts	anterior corticospinal, lateral corticospinal
anterior corticospinal	descending funiculi tract that conducts motor impulses from the cerebrum to spinal nerves and outward through anterior horns for coordinated movements
lateral corticospinal	descending funiculi tract that conducts motor impulses from the cerebrum to spinal nerves through anterior horns for coordinated movements
Reflex arc	simplest type of sensory-to-motor nerve pathway
Reflex arc consists of	receptor (detect stimulus), sensory neuron (transmits a nerve impulses to the CNS, and center (usually involving an interneuron)
Reflex arc receptor and function	the portion of a dendrite or a specialized receptor cell in a sensory organ; sensitive to specific type of stimulus
Reflex arc Sensory (afferent) neuron and function	dendrite, cell body, and axon; transmits impulse from receptor to the CNS
Reflex arc interneurons description and function	dendrite, cell body, and axon of a neuron within the brain or spinal cord; serves as processing center; conducts impulse from sensory neuron to motor neuron
Reflex arc motor (efferent) neuron description and function	dendrite, cell body, and axon; transmits impulse from CNS out to an effector
Reflex arc effector description and function	a muscle or gland outside the nervous system; responds to stimulation by motor neuron and produces a reflex or physiological response
Blood brain barrier	tight jxn between endothelial cells lining the capillaries; cells surrounded by foot processes by the astrocytes
Electroencephalogram	graphic record of the evoked activity being emitted from neurons within the brain
4 EEG's	alpha, beta, theta, delta
Alpha waves	8-12 waves/sec; parietal and occipital lobes; awake,

	relaxed, eyes closed. Increased blood sugar and corticoids and elevated body temperature increase the incidence of alpha waves
Beta waves	13-25 waves/sec; frontal lobes; visually orientating or thinking
Theta waves	5-8 waves/sec; temporal and occipital lobes; common in newborn infants and adults experiencing severe emotional stress
Delta waves	1-5 waves/sec; cerebrum; infants and sleeping adults; presence in awake adults is abnormal
Neurological assessment	deviation from normal EEG patterns are clinically significant in diagnosing trauma, mental depression, hematomas, and various diseases, such as tumors, infection, and epilepsy
Brain death (4 points)	unresponsive, absence of non-spontaneous unassisted respiration for three minutes, absence of CNS reflexes and fixed dilated pupils, a flat EEG for at least 10 minutes
Description of CSF	slightly alkaline solution containing more sodium, chloride, and magnesium ions than blood plasma, but less calcium, potassium, and glucose. In addition, CSF contains some proteins, urea, and leukocytes.
Formation of CSF	CSF is continuously produced within the blood at specialized capillaries, called choroids plexuses, along the roofs of the ventricles of the brain. More CSF is formed by ependymal cells lining the ventricles and central canal.
Normal CSF fluid pressure	10 mm Hg
Pathway of flow of cerebrospinal fluid (CSF)	Lateral ventricles, interventricular foramen (of Monro), Third ventricle, Cerebral aqueduct (of Sylvius), Fourth ventricle, subarachnoid space, reabsorption at the Arachnoid villi
Functions of CSF	Cushions the brain, allows for exchange of nutrients and wastes within nervous tissue, buoys the brain up

Hydrocephalus	abnormal accumulation of CSF in the ventricles and subarachnoid or subdural space. It may be caused by excessive production of or blocked flow of CSF. Hydrocephalus frequently causes the cranial bones to thin and the cerebral cortex to atrophy.
Lumbar puncture	withdrawal of CSF from the subarachnoid space in the region of the lumbar vertebrae
Hydrocephalus	characterized by excess fluid in the cranial vault, subarachnoid space, or both. May occur at any stage of life.
Acute hydrocephalus	develops in a couple of hours in persons who have sustained head injuries
Idiopathic or normal-pressure hydrocephalus	can occur where the CSF volume increases, but the pressure may or may not increase
Types of hydrocephalus	noncommunicating and communicating
Noncommunicating hydrocephalus	obstruction of CSF flow between ventricles; caused by congenital abnormality, aqueduct stenosis, compression by tumor
Communicating hydrocephalus	impaired absorption of CSF (caused by infection with adhesions, high venous pressure in sagittal sinus, head injury) or increased CSF secretion (caused by secreting tumor (choroid plexus))
Pathophysiology of hydrocephalus	obstructed CSF is under pressure, causing atrophy of the cerebral cortex and degeneration of the white matter tracts, there is selective preservation of gray matter.
Clinical manifestations of hydrocephalus	headache, vomiting, altered vital signs, deep coma. In congenital hydrocephalus in infants the cranial circumference is enlarged
Sleep stages	relaxation-alpha, non-REM, and REM
NonREM	Slow sleep, S state, quiet sleep
REM	active sleep, fast sleep, D state
Autonomic nervous system effector organs	cardiac muscle, smooth muscle, visceral organs and glands
Divisions of the autonomic	1) sympathetic division 2) parasympathetic division

nervous system	
Sympathetic division	prepares the body for intense physical activity in emergencies through adrenergic effects
Parasympathetic division	opposite to those of the sympathetic division (rest or digest)
Neurotransmitters of sympathetic and parasympathetic divisions	sympathetic- norepinephrine; parasympathetic- acetylcholine
Anatomical origin of sympathetic division	thoracic and lumbar regions (T1 to T12 and L1 to L2 or 3)
Anatomical origin of parasympathetic division	cranial and sacral regions (cranial nerves 3,7,9,10 (80% comes from 10)
Three effector organs in sympathetic division that norepinephrine is not used as the neurotransmitter	sweat glands, smooth muscles in blood vessels going to skeletal muscles, and the adrenal medulla
Similarities between para/sympathetic divisions	1. Preganglionic neurons are myelinated; postganglionic are non-myelinated 2. Efferent outflow divided into pre and post ganglionic neurons 3. Pre ganglionic neurotransmitter is actylcholine
Differences between para/sympathetic divisions	sympathetic-short preganglionic neuron, long postganglionic neuron; parasympathetic- long preganglionic neuron and short postganglionic neuron
Cholingeric receptors	nicotinic and muscarinic- mumbrane receptor proteins located on autonomic postganglionic neurons or on effector organs that are regulated by acetylcholine or other molecules with similar activity
Nicotinic receptors	located at the ganglia in both sympathetic and parasympathetic divisions
Muscarinic receptors	located on all effector organs innervated by ostganglionic neurons of the parasympathetic division
Cholinergic	all preganglionic autonomic neurons and all postganglionic parasympathetic neurons are

	cholinergic- they use acetylcholine as a neurotransmitter
Nicotine derived from	tobacco
Muscarinic derived from	some poisonous mushrooms
Antimuscarinic agent	atropine
Muscarinic stimulants	acetylcholine, carbachol, methacholine, and bethanechol
Adrenergic receptors	membrane receptor proteins located on autonomic effector organs that are regulated by catecholamines (epi or norepi). Two types: alpha and beta
Alpha 1 tissue location	smooth muscles
Alpha 1 effect	stimulation of smooth muscle: vasoconstriction, uterine contraction, dilation of pupil, intestinal sphincter contraction, and pilomotor contraction
Beta 1 tissue	cardiac
Beta 1 effect	stimulation of cardiac muscle: increase in heart rate and force of contraction
Beta 2 location	smooth muscle
Beta 2 effect	inhibition of smooth muscle: vasodilation, uterine relaxation, intestinal relaxation, bronchodilation
Alpha 1 stimulants and degree	norepinephrine stimulates more than epinephrine
Beta 1 stimulants and degree	norepinephrine and epinephrine are about equal
Beta 2 stimulants and degree	epinephrine is much stronger than norep
Isoproterenol	a synthetic catecholamine stimulates mainly beta 2 receptors stronger than alpha 1 receptors.
G-proteins	all adrenergic receptors act via G-proteins
Alpha receptor stimulators cause	vasoconstriction and are used as decongestants
Alpha receptor blockers are used to	lower high blood pressure
Beta receptor stimulators are used to	stimulate the heart and cause bronchodilation
Beta blockers are used to	slow the heart rate

Mechanoreceptors	detect mechanical deformation of the receptor or the cells adjacent to the receptor. Ex: touch, deep pressure, hearing, equilibrium, arterial pressure
Thermoreceptors	detect changes in temperature, some detecting cold and others detecting warmth. These receptors may be stimulated by changes in metabolic rate.
Nociceptors	pain receptors which detect damage in the tissues, whether it is physical or chemical damage
Electromagnetic or photoreceptors	detect light on the retina of the eye
Chemoreceptors	detect taste in mouth (sweet, salt, sour, and bitter), smell in the nose, oxygen and carbon dioxide levels in the blood
Sensory receptors adaption	adapt either partially or completely to their stimuli after a period of time
Tonic receptors	do not adapt at all or adapt slowly (muscle stretch receptors)
Phasic receptors	adapt rapidly-usually no longer responding to a maintained stimulus, but when the stimulus is removed, the receptor typically responds with a slight depolarization called the off response (watch, rings, clothing)
Pain threshold in people	there is a uniformity in the pain threshold for all people. People are not more or less sensitive to pain. People react differently to pain. Stoic people react far less intensely than do more emotional people.
Pain	protective mechanism that brings to conscious an awareness that tissue damage is occurring or is about to occur
Three types of pain	cutaneous, deep pain, visceral pain
Cutaneous pain	localized upon the surface of the body; pricking, sharp, burning—usually occurs first, short duration; can be localized or diffuse; referred to as fast pain (30m/s)—A-delta myelinated fibers
Deep pain	from muscles, tendons, and joints

Visceral pain	from visceral organs; both deep pain and visceral pain are usually poorly localized; dull, aching, nauseous, throbbing—occurs 2nd, persists longer; both are conducted by B neurons, which are unmyelinated and slow (1-12m/s)—C fibers
Damage cells	prostaglandins, bradykinin, substance P, Glutamate
Prostaglandins	a special group of fatty acid derivatives that are cleaved from the lipid bilayers of plasma membranes
Bradykinin	activated by enzymes released from damaged cells
Substance P	pain neurotransmitter
Glutamate	pain neurotransmitter
analgesic system	CNS contains a neuronal system that suppresses pain.
endorphins and enkephalins	chemicals the body releases in response to outside stimuli like exercise or stress
2 locations where pain may be blocked	periaqueductal gray matter (surrounding the cerebral aqueduct) and in the reticular formation, where they block (via presynaptic inhibition) the release of substance P
Chronic pain	occurs in absence of tissue injury. May result from damage within the pain pathways in the peripheral nerves or in the CNS. Abnormal chronic pain is sometimes referred to as neuropathic pain
Action of Aspirin, acetaminophen, and ibuprofen	diminish pain by inhibiting prostaglandin production and release
function of opiate drugs such as codeine and morphine	act directly on pain centers in the brain
referred pain	not always felt over the organ from which it's derived (heart pain felt in left arm)
2 mechanisms of referred pain	1)Embryonic origin of the organ 2)Cross over of first order neurons with second order neurons in the spinal cord
Epilepsy	a chronic disorder resulting from sudden, uncontrolled discharge of activity by neurons in the

	brain (seizure)
manifestations of seizure activity	loss of consciousness, tonic and/or clonic muscle contraction which can be either generalized or localized
clonic muscle contraction	repeated, rhythmic contractions (seizures)
causes of epilepsy	hyperglycemia, febrile disorders, head injury, drugs, birth trauma, brain tumors, stroke, metabolic disorders
drugs used to treat epilepsy	phenytoin, phenobarbital, and valproate
alzheimer's disease symptoms	trouble remembering recent events, loss of memories of the past, confusion, forgetfulness, hallucination, paranoia, violent changes in mood
neural structural changes from alzheimer's disease	1)great loss of neurons in specific regions of the hippocampus and cerebral cortex 2)plaques of abnormal proteins deposited outside neurons 3)tangled protein filaments with neurons

Reproduction

BYU PdBio 305 Dr. Rhees Reproduction

Question	Answer
gonadal development depends on what	Y chromosome
how does the presence of a Y chromosome result in a male?	sex-determining region Y gene (SRY) is present on the short arm of the Y chromosome and encodes for a protein called the Testis Determining Factor (TDF). This protein induces the formation of the testes
primary sex structures	ovaries, testes
development of secondary sex structures depends on	presence or absence of the hormone testosterone
androgens	testes secrete androgens and make male structures; ovaries can't secrete androgens resulting in female structures
wolffian ducts	up until the 7th week of development, embryos of each sex possess wolffian ducts (form internal male structures)
mullerian ducts	up until the 7th week of development, embryos of each sex possess mullerian ducts (form internal female structures)
mullerian inhibiting factor	causes regression of the mullerian ducts; females become females because of lack of mullerian inhibiting factor and testosterone
human chorionic gonadotropin	hormone released by the placenta; stimulates early testicular secretion of testosterone which induces development of the wolffian ducts into the male reproductive tract (epididymis, ductus deferens, ejaculatory duct, and seminal vesicles)
male reproductive tract	epididymis, ductus deferens, ejaculatory duct, and seminal vesicles
female reproductive tract	oviducts, uterus, and vagina

external reproductive structures require	dihydrotestosterone or DHT
genitalia are mostly formed after how many weeks	16
differentiation of the male and female brain also depends on the presence or absence of what	testosterone
differences in male and female brain	size of hypothalamic nuclei, cyclic release of gonadotropin, and sexual behavior
how long does puberty last	3-5 years
menstruation started in 1840 at what age	17
sebaceous glands	stimulated to secrete oil (acne) during puberty
progesterone	female hormone related to menstruation period
precocious puberty	early puberty; early development of secondary sex characteristics; caused by abnormal exposure of immature females to estrogen or males to androgens; often caused by tumors of the gonads or adrenal glands
delayed puberty	menarche has failed to occur by age 17, testes failed to develop by age 20
spermatogenesis works best in what temp	colder
testes are divided into	testicular lobules (250 compartments)
Each lobule in the testis contains	a coiled seminiferous tubule and interstitial cells (Leydig cells)
function of seminiferous tubules	produce sperm; they also contain Sertoli cells which play a role in nurturing the sperm cells
function of Leydig cells	produce testosterone; are located outside of the seminiferous tubules
epididymis	small coiled tube which measures about 20 feet, lies along the top and side of the testes; site of maturation of sperm
capacitation	sperm's capacity to fertilize is enhanced by exposure to

	secretions of the female reproductive tract; the ductus epididymis also secretes "sperm forward-mobility protein," which causes a movement pattern of the sperm
vas deferens (ductus deferens)	tubes that carry sperm from the epididymis up into the abdominal cavity to the ejaculatory duct near the bladder; at the end of the vas deferens is an expanded region called the "ampulla" which serves as a reservoir for sperm
vasectomy	a small incision is made in the scrotum, the vas deferens is tied in two places and the segments between the ties are removed
Ejaculatory ducts	carry sperm from vas deferens to urethra
urethra	tube extending from the urinary bladder through the floor of the pelvic cavity and then through the penis; carries urine from bladder and sperm from ejaculatory duct
male sex accessory organs	seminal vesicles, prostate gland, bulbourethral glands; these glands secrete seminal plasma which mixes with the sperm to form semen or seminal fluid
seminal vesicles	secrete seminal plasma (more than half of total semen volume); fluid contains fructose to give energy to sperm; fluid also contains prostaglandins which stimulate contraction of the male and female reproductive tracts which helps in sperm transport
prostate gland	lies below the bladder and is doughnut shaped; urethra passes through the small hole in the center; secretes alkaline fluid (13-33% of volume) that helps protect the sperm from the acidic environment of the male urethra and female vagina
bulbourethral glands	secrete alkaline fluid, which acts as a lubricant
male fertility	depends on quantity and quality of sperm; 2-6 ml, 20 million sperm/ml, 60% normal shape
number of sperm produced daily	200 million/day
sperm live how long	3-4 days
sperm count per ejaculation	40 million to 250 million; below 20 million may mean infertility problems

how many sperm enter fallopian tube	100-100,000
how many sperm make it to the egg	few hundred
zygote	fertilized egg
what happens to dead sperm in female	phagocytized by leukocytes
infertility is due to whom	50% man 50% woman
structure of sperm	head (contains nucleus with 23 chromosomes), acrosome (enzyme filled vesicle), tail (for movement), midpiece (contains a large number of mitochondria)
uterus	pear shaped organ situated in the pelvic cavity above the urinary bladder and in front of rectum- 3 inches long, 2 wide, 1 thick; larger in multiparous women
two main regions of the uterus	corpus or body, uterine isthmus or cervix (neck)
two main components of the wall	endometrium (shed during menstruation) and myometrium (smooth muscle, contraction of the uterine wall results in expulsion of the fetus at birth)
fallopian tubes, oviducts, or uterine tubes	serve as ducts for ovaries (diameter of drinking straw); fertilization usually takes place there)
ovaries	among the most vascular organs of the body
ovarian follicles	female germ cells or oocytes are enclosed inside the ovary in tissue sacs called ovarian follicles
how many follicles do newborn girls have	500,000
how many follicles are released through ovulation	400
ovulation	production of mature egg;when there is estrogen present, the immature oocyte will go from a primary, to secondary, to tertiary follicle. the large follicle that develops during the cycle is called a graafian follicle. It is this follicle that breaks ope
secretion	production of female hormones

Estrogen	estradiol, estrone, and estriol; estradiol is the principle estrogen; produced by follicle, corpus luteum, and placenta, stimulates development of secondary sex structures, promote myometrial contractions, inhibit FSH secretion
progesterone	produced by corpus luteum and placenta; stimulate development of secondary sex structures; inhibits contraction of uterine muscle
average human menstrual cycle length	29.5 days
day 1 of ovarian cycle	menstruation starts, estrogen and progesterone levels are low, FSH stimulates the development of the follicle (the egg inside the follicle), several follicles start to develop-follicle secrete estrogen
day 7 of ovarian cycle	usually only one follicle continues to develop and secrete estrogens; others degenerate; estrogen levels increase as the follicle grows into a graafian follicle;several days before ovulation, more LH are released from anterior pituitary
day 14 of ovarian cycle	high levels of LH stimulate ovulation; LH surge occurs 16 hours before ovulation; expulsion of egg from the mature follicle--ovaries usually alternate
indications of ovulation	rise in basal body temperature due to progesterone; slight pain over ovary; vaginal secretory pattern
fertile period length	4-6 days
destiny of follicle cell after ovulation	LH stimulates the transformation of follicle cell into a corpus luteum (yellow body)
cells of corpus luteum secrete	estrogens and progesterone
day 23 of ovarian cycle if pregnancy occurs	the corpus persists; Human chorionic gonadotrophin (HCG) maintains the corpus luteum during pregnancy, which in turn maintains the levels of estrogen and progesterone
HCG	human chorionic gonadotrophin; is detectable in the blood and urine as early as 8-10 days after fertilization so it's used in pregnancy kits; similar to GH and

	prolactin; has anti-insulin effects to divert glucose from mother to fetus
day 23 of ovarian cycle if no pregnancy	corpus luteum begins to degenerate on about day 23 or 24; with degeneration of the corpus luteum, the levels of estrogens and progesterone drop
day 27 of ovarian cycle (no pregnancy)	low levels of estrogen and progesterone cause ischemia in the endometrium, which initiates the beginning of the next cycle in one to two days
menstrual cycle names	day 1-5 menstrual phase; 6-14 postmenstrual, preovulatory, or follicular phase; day 14 ovulation; day 14-27 premenstrual, postovulatory, or luteal phase; day 27-28 ischemic phase
implantation takes place how many days after fertilization	6-7 days
intrauterin implantation	usually implants in the upper posterior wall of uterus; cervical implantation
extrauterine implantation	rare; called ectopic pregnancy (anywhere outside the uterus); tubal, abdominal, ovarian
pregnancy lasts how long	38 weeks (9.5 months)
pre-embryo	first 2 weeks after conception
embryo	3-8 weeks after fertilization; most critical period for damage to occur to baby
how much weight should a pregnant mother gain	25 pounds
during pregnancy, which hormones increase	estrogens, progesterone, HCG (human chorionic gonadotrophin which peaks at 2nd month), Glucocorticoids from the adrenal glands, T3 and T4 from thyroid, parathyroid hormone
change in pituitary during pregnancy	increases in size and activity
change in blood volume and cardiac output during pregnancy	increase
parturition	act of giving birth

factors that increase contractibility of the uterus	increased estrogen levels, secretion of oxytocin from posterior pituitary, formation of prostaglandins in the uterus
labor is divided into three stages	1)cervical dilation-up to 10 cm 2)delivery of the baby 3)delivery of the placenta (afterbirth)
when does menopause start	52
menopause (what happens)	follicle does not develop and therefore LH and FSH remain high and estrogens and progesterone remain low
treatment for menopause	estrogen replacement therapy using premarin; there's recent evidence that ERT might not be so good
benefits of ERT	relieves hot flashes, insomnia, vaginal dryness, mood swings, and heart disease
risks of ERT	increased risk of endometrial and breast cancer, weight gain, and gall bladder disease
tubal ligation	tying off both uterine tubes and thus preventing the transport of sperm or egg through the tubes