Cell membrane

1. 关于物质运输- Lipid-soluble molecules cross the membrane freely because they can dissolve in the lipid bilayer. The lipid bilayer is much less permeable to ions and polar molecules, including water, which cross the plasma by way of specific membrane protein assemblies

2. Electrochemical gradient-The concentration gradient. The charge of the molecule or ion. The membrane potential.

3. different types of carrier protein—uniport, symport, antiport. ubiquitous—The sodium pump is a ubiquitous feature of mammalian cells. It uses ATP to pump Na+ out of cells in exchange for K+ .

4. Primary active transport-The special importance of primary active transport is that it can move solutes against an electrochemical gradient.

Secondary active transport-Cells can exploit ion gradients to transport molecules against their electrochemical gradient. It exploits the different properties of **symport** and **antiport** carriers

5.关于大分子运输—Membrane-bound compartments are used for the transport of **macromolecules** such as enzymes, receptors, and hormones**.**

Exocytosis = secretion of molecules

Endocytosis = absorption of molecules

Phagocytosis (literally, cell-eating) Absorption of solids, such as bacteria, viruses, or the remnants of cells that have undergone apoptosis.

Pinocytosis (literally, cell-drinking) - how cells take in liquids

Receptor-mediated transport specific active event where the cytoplasm membrane folds inward to form coated pits.

Cell biology

6. membrane potential-The activity of the sodium pump leads to the accumulation of potassium ions inside cells. Some of these potassium ions leak out of the cells via potassium channels in the plasma membrane. However, the membrane is much less permeable to sodium ions (10 – 100 times). So sodium ions are unable to replace all the lost potassium ions. As the potassium ions diffuse out of the cell there is a build-up of negative charge inside the cells that can be detected as a potential difference across the plasma membrane - **a membrane potential.**

7. G protein-The effector of both the $G_{\alpha s}$ and $G_{\alpha i/o}$ pathways is the cAMP- generating enzyme adenylcyclase or AC

• The effector of the $G_{\alpha q/11}$ pathway is phospholipase C- β (PLCβ), which catalyses the cleavage of phosphadtidylinositol 4,5- bisphosphate (PIP2) into the second messengers inositol (1,4,5) trisphosphate (IP_3) and diacylglycerol (DAG)

• Primary effectors of Gβγ are various ion channels

• $G_{12/13}$ pathway effectors are RhoGEFS

8. The motor neuron, its axon, and all the muscle fibers supplied by the axon and its branches form a **motor unit**

9. causes release of the neurotransmitter acetylcholine. Binding of acetylcholine to receptors on the muscle fiber leads to a depolarization that initiates an action potential. Within the muscle fiber, the action potential spreads deep into the interior, following infoldings of the plasma membrane called transverse (T) tubules. 2 These make close contact with the sarcoplasmic reticulum (SR), a specialized endoplasmic reticulum. As the action potential spreads along the T tubules, it triggers changes in the SR, opening Ca 2+ channels 3 . Calcium ions stored in the interior of the SR flow through open channels into the cytosol 4 and bind to the troponin complex, 5 initiating the muscle fiber contraction.

10. When muscles contract, they generate force (often measured as tension or stress) and changes in length
i.e. **isotonic** contractions.
• **Concentric** contraction:isatypeofmuscleactivationthat increases the tension on a muscle as it shortens. i.e. a biceps curl with a dumbbell.
• **Eccentric** contraction:duringeccentricmuscle contractions, the muscle fibers are stretched out. The muscle returns to the starting position of the
Isometric Contraction: isometric contractions do not cause any joint movement. There is no lengthening or contraction of muscles.

11.跳跃性传导-Propagation of action potentials in myelinated axons. In a myelinated axon, the depolarizing current during an action potential at one node of Ranvier spreads along the interior of the axon to the next node (blue arrows), where voltage-gated sodium channels enable reinitiation. Thus, the action potential appears to jump from node to node as it travels along the axon (red arrows).Propagation of action potentials in myelinated axons. In a myelinated axon, the depolarizing current during an action potential at one node of Ranvier spreads along the interior of the axon to the next node (blue arrows), where voltage-gated sodium channels enable reinitiation. Thus, the action potential appears to jump from node to node as it travels along the axon (red arrows).

12. 肌肉收缩过程-First, the arrival of an action potential at the synaptic terminal of a motor neuron 1 causes release of the neurotransmitter acetylcholine. Binding of acetylcholine to receptors on the muscle fiber leads to a depolarization that initiates an action potential. Within the muscle fiber, the action potential spreads deep into the interior, following infoldings of the plasma membrane called transverse (T) tubules. 2 These make close contact with the sarcoplasmic reticulum (SR), a specialized endoplasmic reticulum. As the action potential spreads along the T tubules, it triggers changes in the SR, opening Ca 2+ channels 3 . Calcium ions stored in the interior of the SR flow through open channels into the cytosol 4 and bind to the troponin complex, 5 initiating the muscle fiber contraction.

13 两种synapse-
Chemical: most usual type, associated with the secretion of a small amount of chemical (neurotransmitter) from the nerve terminal, and is a one-way signaling mechanism. These are complex because the pre-and post-synaptic membranes are separated by a minute space called the synaptic cleft. Hence, a chemical neurotransmitter is needed from the pre-synaptic fiber.
Electrical: the electrical current generated by the AP is transmitted directly to the post-synaptic cell by electrical coupling because the two cells are in tight contact with each other (gap junctions). This

is fast and reliable. This type of transmission occurs in some retinal cells and in cardiac cells. Also occurs between some glial cells e.g. astrocytes.

14 synapse的传导过程-An action potential arrives, depolarizing the presynaptic membrane.The depolarization opens voltage-gated channels, triggering an influx of Ca2+ .The elevated Ca 2+concentration causes synaptic vesicles to fuse with the presynaptic membrane with helping of stopping protein which are V-SNARE and T-SNARE, releasing neurotransmitters into the synaptic cleft. The elevated Ca 2+ concentration causes synaptic vesicles to fuse with the presynaptic membrane, releasing neurotransmitters into the synaptic cleft. When the neurotransmitter bind with the receptor on the post-synaptic membrane, it will trigger an action potential in the post synapse.

15 两种不同的synapse-快和慢
Fast response (ionotropic/ligand-gated): neurotransmitter binds to a channel linked receptor. Few to several hundred milliseconds: e.g. channels open to allow specific ions through Na^+, K^+, Cl^-.

Slow: G-protein direct coupling to the channel. Metabotropic receptors trigger biochemical changes (metabolic-hence the name) rather than direct changes in membrane permeability.

13 EPSP、IPSP和时间空间上整合

depolarisation = excitation = excitatory post-synaptic potential (EPSP)
hyperpolarisation = Inhibition = inhibitory post-synaptic potential(IPSP)

As synaptic potentials are graded, they can summate –unlike action potentials,
Summation is necessary because a single EPSP is rarely sufficiently large to depolarize the postsynaptic neuron to threshold Two kinds of summation: – Temporal summation – Spatial summation

Respiratory system
14.关于呼气和吸气

Inspiration: The diaphragm is the most important inspiratory muscle during quiet breathing. The nerves to the diaphragm cause it to contract and its dome moves downward into the abdomen enlarging the thorax. At the same time, the nerves to the inspiratory intercostal muscles cause them to contract leading to an upward and outward movement of the ribs and a further increase in thoracic size.

Expiration: At the end of inspiration the nerves to the diaphragm and inspiratory intercostal muscles cease firing and these muscles relax. The chest wall and hence the lungs passively return to their original dimensions. As the lungs shrink, air in the alveoli becomes temporarily compressed and therefore alveolar pressure exceeds atmospheric. Therefore air flows from the alveoli through the airways out into the atmosphere. Thus expiration at rest is completely

15 肺泡活性剂

Fortunately the type II alveolar cells produce a phospholipid known as pulmonary surfactant which markedly reduces the cohesive forces on the alveolar surface. Therefore surfactant lowers the surface tension and increases lung compliance, making the lungs easier to expand.

16. 氧和曲线-At any given PO_2 a variety of factors influence the degree of haemoglobin saturation; blood PCO_2 , H^+ concentration, temperature and concentration of a substance produced by erythrocytes, DPG (2,3- diphosphoglycerate). An increase in any of these factors causes the oxygen dissociation curve to shift to the right, which means that, at any given PO_2 , haemoglobin has less affinity for oxygen.

17. 两个notes里所有的公式

·***Compliance:*** Lung compliance is a measure of the ease with which the lungs can be inflated:-

$$\text{Compliance} \quad C = \frac{\text{Change in lung volume}}{\text{Change in inflation pressure}} \quad \text{L/cmH}_2\text{O or L/kPa}$$

Change in lung volume = ΔV
Change in inflation pressure = ΔP

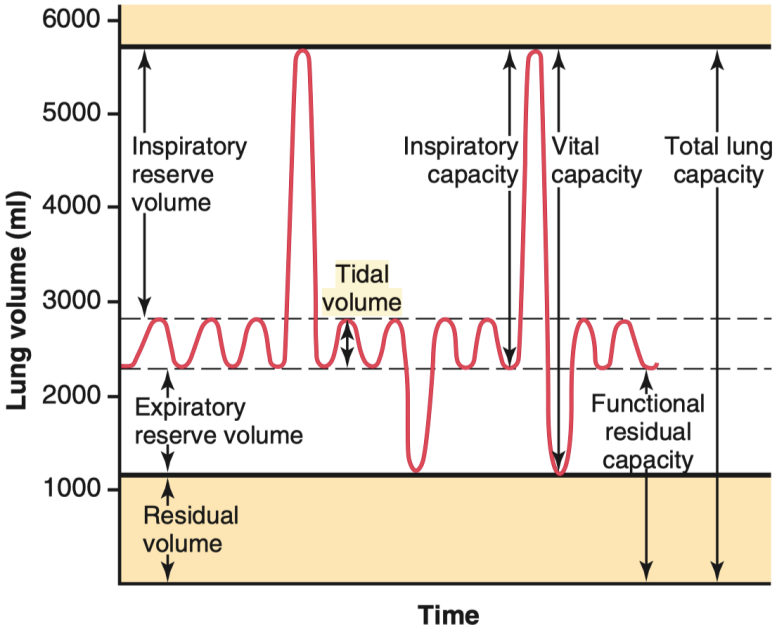
The smaller the ΔP required to produce a given ΔV the more compliant the lungs.

The more difficult the lungs are to inflate (i.e. the greater the ΔP required to produce a given ΔV) the lower the lung compliance.

Lung compliance depends equally on:
1. the elasticity of the lung tissue and
2. the surface tension forces at the gas/liquid interface within the lung.

The relationship between the radius (r) of a small bubble of air in liquid, the transmural pressure (P) across the wall of the bubble and the surface tension (T) at the air/liquid interface is described by **Laplace's equation** P2T/r

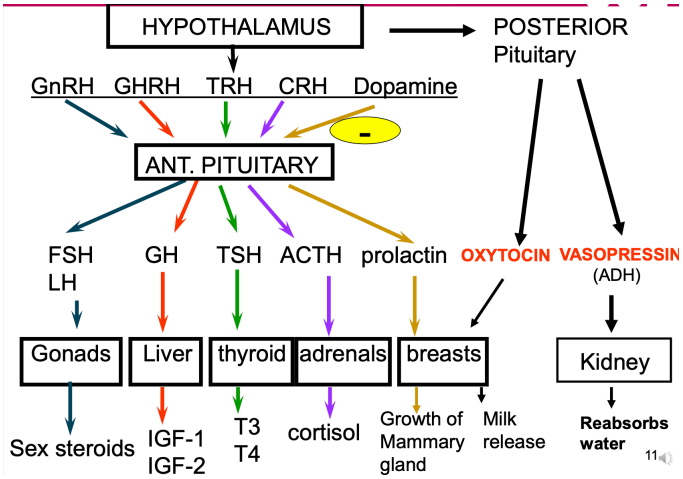
18. 肺活量计算



hormone

19. 亲水和疏水激素的信号传导
· Hydrophilic hormones do not enter the cells and use signal transduction mechanisms to relay information.
·Hydrophobic hormones enter the cells and bind to transcription factors that bind to DNA to initiate gene transcription
20. 所有激素的名字
posterior pituitary secreting(后垂体释放激素）-
GnRH-Gonadotrophin Releasing Hormone
GHRH -Growth Hormone RH
TRH -Thryotrophin RH
Dopamine
CRH -Corticotrophin RH

anterior pituitary secreting（前垂体释放激素）
FSH -follicle stimulating hormone-促卵泡激素
LH- luteinizing hormone-黄体生成素
TSH -thyroid stimulating hormone
（上面glycoproteins made of two subunits-alpha and beta ）
ACTH -adrenocorticotrophin-促肾上腺皮质激素
IGF – insulin-like Growth Factor **(这个是肝secret)**
T3/T4-Thyroid Hormones



21. 关于激素的储存（hormone stored）
GH -stored in Somatotrophs
Prolactin- stored in Lactotrophs
FSH/LH -stored in gonadotrophs
ACTH -stored in corticotrophs
TSH - stored in thyrotrophs

22.需要用到GPCR的亲水hormone
TRH - 3 amino acids (a tripeptide) GnRH - 10 amino acids
GHRH - 44 amino acids
CRH - 41 amino acids
ACTH -39 amino acids
FSH, TSH, and LH are glycoproteins
(half-life therefore longer)
These hormones activate G-protein-coupled receptors and will use either the adenylate cyclase pathway (second messenger, cAMP) or the phospholipase C pathway (second messengers, IP3 and DAG derived from PIP2)

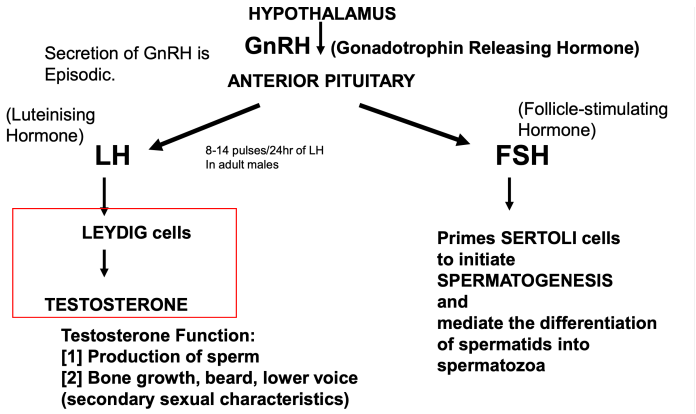
23 生殖激素
Male-
·Testosterone（睾丸激素）由 5-alpha reductase催化然后生成 Dihydrotestosterone（二氢睾酮）

·SRY-SRY gene dictates that a testes is made.
But Endocrines dictates development:

• Testosterone and a glycoprotein hormone called Mullerin inhibiting Hormone (MIH) required for male development. In their absence, female characteristics

·The mullerian duct gives rise to fallopian tubes and uterus and Wolffian duct give rise to Vas deferens and Seminal vesicles.

·Testes（睾丸） – source of germ cells and hormones important for reproductive function. secretion of Androgens: which bring about full masculine development.



·精子的形成: sperm production is controlled by LH and FSH. LH acts on Leydig cells to make testosterone and FSH acts on Sertoli cells to initiate the spermatogenesis.

female-

·**Ovarian Cycle** – produces mature oocyte every 28 days

·**Uterine cycle** – provides the environment for the fertilized ovum to develop

Estradiol causes endometrial thickening in the uterus-雄二醇激素导致子宫内膜增厚

月经周期的激素调控

Follicular phase（卵子生成期）

- Estrogens synthesised by the developing follicle reaches a peak 2 days before ovulation
- The estrogen peak is responsible for the surge of both LH/FSH release
- 12 hr after LH/FSH peak ovulation takes place

Luteal phase（黄体期）

After ovulation, the corpus luteum, under the influence of LH secretes both estrogens and progesterone:

Therefore

•secretory endometrium develops

•Inhibition of secretion of FSH/LH.

A decrease in LH leads to degeneration of the corpus luteum, and a corresponding decrease in estrogens and progesterone.

Therefore endometrium begins to slough at the conclusion of Day 28

after ovulation（排卵期）

Corpus luteum synthesizes and secretes both estrogen and progesterone under the influence of LH/FSH

·Progesterone supports the secretory phase of the endometrium and also depresses LH secretion

·Estrogen alters pituitary sensitivity to GnRH so that the release of LH/FSH diminishes.

·The corpus luteum no longer produces estrogens/progesterone

as the levels of LH/FSH drop and regresses to form corpus albicans

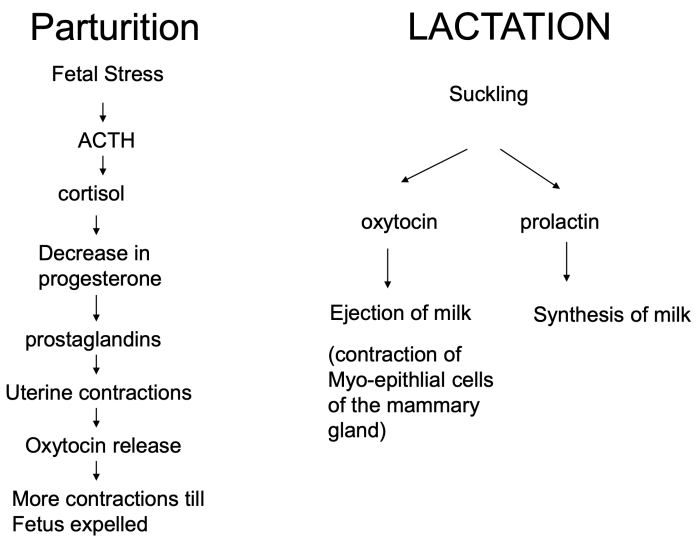
A decrease in estrogens/progesterone leads to the shedding of the endometrium and the cycle restarts again

pregnancy（怀孕期）

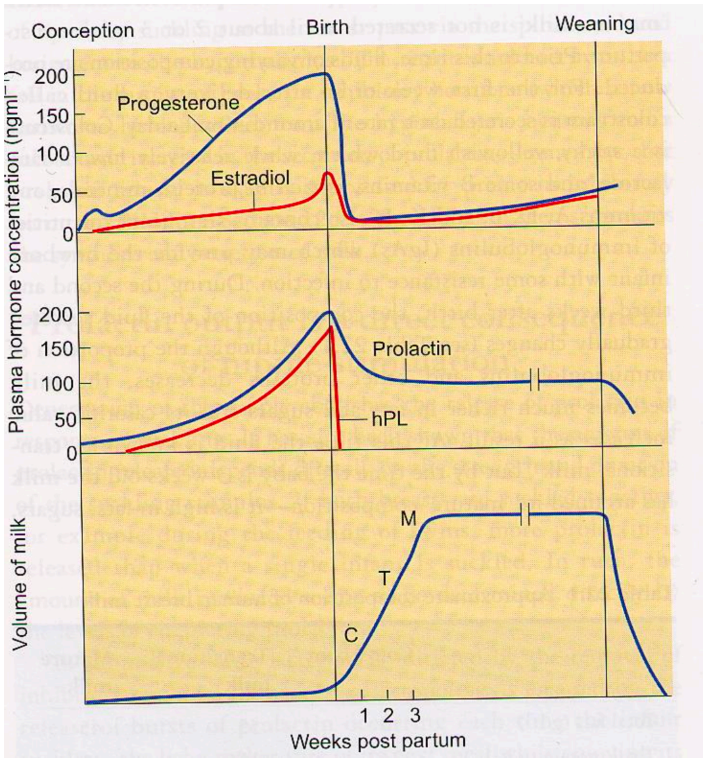
or pregnancy to occur, Sperm must be present between 4 days before and 1 day after ovulation. Sperm remain capable of fertilizing an oocyte for 4-6 days whilst an ovulated oocyte remains viable for 24-48hrs.
If Pregnancy occurs, the fertilised egg secretes HCG (human chorionic Gonadotrophin) and HPL (human placental lactogen)
HCG ~ similar to LH/FSH

HPL ~ similar to prolactin (caused growth of mammary glands)

HCG – the basis of the pregnancy test HCG works like LH. Therefore Corpus Luteum is now maintained for 3 months till placenta takes over the secretion of progesterone and estrogens



- Lactation can carry on
- for months
- During lactation,
- fertility is reduced, primarily
- mediated by prolactin.
- Prolactin suppresses the
- release of GnRH



肾上腺激素

1.Adrenal medulla – part of the sympathetic nervous system
Adrenal Cortex –mesodermal tissue

YOUR ADRENALS ARE ESSENTIAL FOR LIFE

They control:

Blood glucose regulation - Cortisol (breaks protein and fat to building glucose)

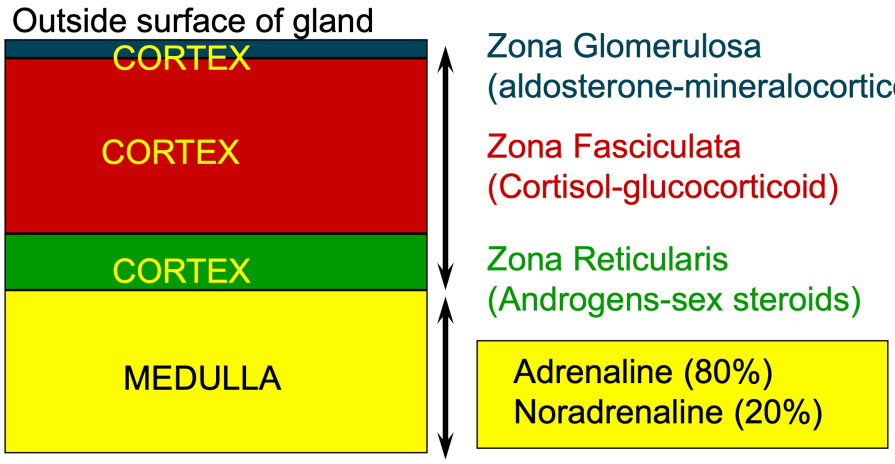
protein turnover - cortisol

Na and K balance - aldosterone

survival in the time of stress – cortisol/adrenaline

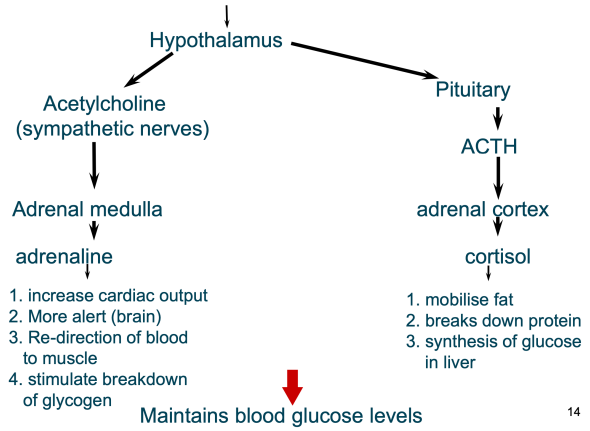
Modulation of tissue response in

injury and infection - cortisol



2. 血管紧张素和肾素的调节
Functioning as a hormone, angiotensin II triggers vasoconstriction, increasing blood pressure and decreasing blood flow to capillaries in the kidney (and elsewhere). Angiotensin II also stimulates the adrenal glands to release a hormone called aldosterone. Aldosterone causes the nephrons' distal tubules and collecting duct to reabsorb more Na + and water, increasing blood volume and pressure.

Because angiotensin II results in increased blood pressure, drugs that block angiotensin II production are widely used to treat hypertension (chronic high blood pressure). Many of these drugs are specific inhibitors of angiotensin converting enzyme (ACE), which catalyzes one of the steps in the production of angiotensin II.



	Glucagon	Adr	cortisol	GH
Glycogenolysis	x	x		
Gluconeogenesis	x	x	x	x
Lipolysis	x	x	x	x
Inhibition of glucose uptake in muscle			x	x
Proteolysis			x	

Glycogenolysis - breakdown of glycogen
Gluconeogenesis - synthesis of glucose from fatty acids etc
Lipolysis - breakdown of fats (produces fatty acids)

3.肾上腺素的两种不同受体和信号通路
·心脏—beta受体—cAMP—提高心心率 血糖—肌肉收缩
·肝脏—alpha受体—PLC--糖异生 升高血压—汗液排放
4. 胰岛素的两个作用-Actions of Insulin:—Uptake of glucose, amino acids by muscle and adipose tissue, Storage of fuels- stimulates synthesis of triglycerides,
proteins, and glycogen. High glucose stimulates insulin release.
5. 一型糖尿病: Lack of insulin means high plasma glucose –hyperglycemia, Glucose in urine and therefore loss of water. Breakdown of fat and proteins to provide alternative metabolic fuel. Daily Injections of insulin are required to survive (Type I Diabetes Mellitus)
6.二型糖尿病： In this case, insulin is present but the cells do not respond to insulin.
Insulin-stimulated Glucose uptake is impaired due to defects in Signal Transduction.
Defects can occur in Akt phosphorylation or in the proteins that mediate GLUT4 translocation to the cell surface

甲状腺素
1.The thyroid hormone synthetic process occurs in three major steps:
- Production and accumulation of the raw materials
- Synthesis of the hormones on a scaffold of precursors—catalyzed by thyroid peroxidase.
- Release of the free hormones from the scaffold and secretion into blood

all these processes are stimulated by TSH from the anterior pituitary gland.
2. 甲亢-Thyroid disorders common, affects 1-2% of the population
HYPERTHYROIDISM (Graves disease) where antibodies stimulate the TSH receptor leading to: goitre, protrusion of eyeballs, weight loss, nervousness, increased BMR
3. 甲减- HYPOTHYROIDISM autoimmune destruction of thyroid so no thyroid hormones are made causing: sensitive to cold, loss of hair, impaired memory, mental dullness, lethargy, weight gain, decreased BMR Lack of thyroid hormones in childhood – mentally impaired cretinism
4. 甲状腺受体的信号通路-The unliganded thyroid hormone receptor (TR) is located in the nucleus bound to DNA at the thyroid hormone response element (TRE) In the absence of T3, the TR dimerizes with the retinoid X receptor and associates with co-repressor proteins. The binding of T3 leads to the dissociation of these factors, the recruitment of transcriptional co-activators, and a sequence of events recruiting DNA- dependent RNA polymerase leading to transcription.
5. 形态转换-
Modification that increases activity（增加活性）-Deiodination of thyroxine (T4) to tri-iodothyronine (T3) by type 1/2 selenodeiodinase

Modification that decreases activity（减少活性） - Inactivation of T4 and T3 by the formation of

reverse T3 and di-iodothyronine (T2) by type 3 selenodeiodinase

生长激素
1.对身体的影响-**Long-term effects:**
- GH stimulated amino acid uptake by muscle and liver and increases protein synthesis
- Stimulates growth and calcification of cartilage into bone resulting in bone length growth

Short-term effects:
- Influences fat and carbohydrate metabolism
- During starvation, persistent low glucose increases GH release resulting in sparing of glucose for the CNS by increasing fat utilization

心脏和血液

1. Function of blood

- Maintenance of cellular function – through the establishment of correct ion gradients between the intracellular and extracelluar phases.
- Gaseous exchange - carriage of O_2 and CO_2 between tissues & lungs.
- Delivery of other nutrients - between the gut, liver and kidney for absorption, metabolism and excretion.
- Carriage of hormones - endocrine gland secretions are carried to target tissues.
- Protection against invading organisms - blood provides an immunological function.
- Thermoregulation - heat is exchanged with the outside world by regulating blood flow to the skin.

2. 凝血异常

Hypercoagulability is when the blood clots too much or too easily. This is dangerous because those clots can develop or get lodged within small blood vessels and cause severe, life-threatening problems including: stroke, DVT, which can lead to a pulmonary embolism, and even a heart attack. **Hypocoagulability** will cause excess bleeding. Without proper clotting, even minor injuries can cause loss of a lot of blood, and increases the risk for injuries to organs and blood vessels. This causes the following symptoms:

- Nosebleeds that are hard to stop
- Bleeding gums
- Wounds that take much longer to heal
- Bruises.

3. **arterioles**: the last arteries with muscular walls, regulate local tissue flow

4. net filtration ≈ hydrostatic pressure – oncotic pressure (Starling's hypothesis) high hydrostatic pressure or low oncotic pressure→**edem**

5. 心脏的动作电位为什么有平台期（plateau in the action potential of heart muscle）

Phase 0 (depolarization), fast sodium channels open. When the cardiac cell is stimulated and depolarizes, the membrane potential becomes more positive. Voltagegated sodium channels (fast sodium channels) open and permit sodium to rapidly flow into the cell and depolarize it. The membrane potential reaches about +20 millivolts before the sodium channels close.

Phase 1 (initial repolarization), fast sodium channels close. The sodium channels close, the cell begins to repolarize, and potassium ions leave the cell through open potassium channels.

Phase 2 (plateau), calcium channels open and fast potassium channels close. A brief initial repolarization occurs and the action potential then plateaus as a result of (1) increased calcium ion permeability and (2) decreased potassium ion permeability. The voltage-gated calcium ion channels open slowly during phases 1 and 0, and calcium enters the cell. Potassium channels then close, and the combination of decreased potassium ion efflux and increased calcium ion influx causes the action potential to plateau.

Phase 3 (rapid repolarization), calcium channels close and slow potassium channels open. The closure of calcium ion channels and increased potassium ion permeability, permitting potassium ions to rapidly exit the cell, ends the plateau and returns the cell membrane potential to its resting level.

Phase 4 (resting membrane potential) averages about −90 millivolts.

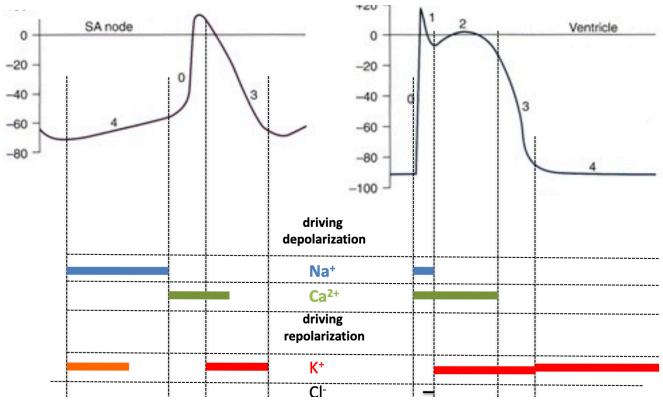
6.关于心脏特殊的钙离子通道（L type calcium）-L type calcium channels (slow calcium channels), which are also called calcium-sodium channels. This second population of channels differs from the fast sodium channels in that they are slower to open and, even more important, remain open for several tenths of a second.

7.heart cycle
Phase I: Period of filling-Phase I in the volume-pressure diagram begins at a ventricular volume of about 50 milliliters and a diastolic pressure of 2 to 3 mm Hg. The amount of blood that remains in the ventricle after the previous heartbeat, 50 milliliters, is called the endsystolic volume
Phase II: Period of isovolumic contraction. During isovolumic contraction, the volume of the ventricle does not change because all valves are closed. However, the pressure inside the ventricle increases to equal the pressure in the aorta,
Phase III: Period of ejection. During ejection, the systolic pressure rises even higher because of still more contraction of the ventricle. At the same time, the volume of the ventricle decreases because the aortic valve has now opened and blood flows out of the ventricle into the aorta.
Phase IV: Period of isovolumic relaxation-At the end of the period of ejection, the aortic valve closes and the ventricular pressure falls back to the diastolic pressure level.

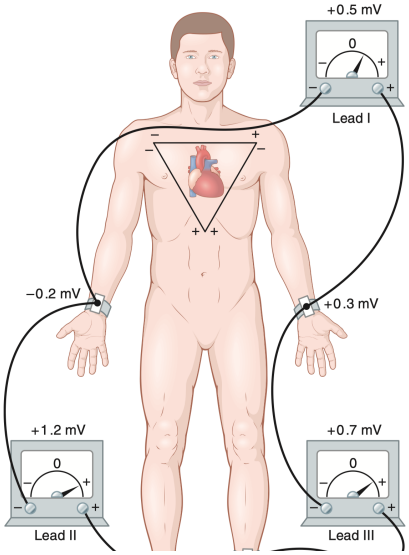
8. Concepts of Preload and Afterload- For cardiac contraction, the preload is usually considered to be the end-diastolic pressure when the ventricle has become filled.
The afterload of the ventricle is the pressure in the aorta leading from the ventricle.

9. **Frank-Starling mechanism**
Frank-Starling mechanism means that the greater the heart muscle is stretched during filling, the greater is the force of contraction and the greater the quantity of blood pumped into the aorta. Or, stated another way: Within physiological limits, the heart pumps all the blood that returns to it by way of the veins.

10. **Mechanism of Sinus Nodal Rhythmicity(SNA的action potential为什么和别的不一样）**-there is a difference in the function of these channels in the sinus nodal fiber because the “resting” potential is much less negative—only –55 millivolts in the nodal fiber instead of the –90 millivolts in the ventricular muscle fiber. Therefore, only the slow sodium calcium channels can open (i.e., can become “activated”) and thereby cause the action potential that any time the membrane potential remains less negative than about –55 millivolts for more than a few milliseconds, the inactivation gates on the inside of the cell membrane that close the fast sodium channels become closed and remain so. Therefore, only the slow sodium calcium channels can open and thereby cause the action potential



Einthoven's Law.
Lead I potential + Lead III potential = Lead II potential
Lead I. In recording limb lead I, the negative terminal of the electrocardiograph is connected to the right arm and the positive terminal is connected to the left arm
Lead II. To record limb lead II, the negative terminal of the electrocardiograph is connected to the right arm and the positive terminal is connected to the left leg.
Lead II. To record limb lead II, the negative terminal of the electrocardiograph is connected to the right arm and the positive terminal is connected to the left leg.



11. 非正常心率
tachycardia—心率过快：The term "tachycardia" means fast heart rate, which usually is defined as faster than 100 beats/min in an adult. Some causes of tachycardia include increased body temperature, stimulation of the heart by the sympathetic nerves, or toxic conditions of the heart.
Bradycardia—心率过慢：Vagal Stimulation Causes Bradycardia. Any circulatory reflex that stimulates the vagus nerves causes release of acetylcholine at the vagal endings in the heart, thus giving a parasympathetic effect. Perhaps the most striking example of this phenomenon occurs in patients with carotid sinus syndrome.
Disorders of Cardiac Repolarization—The Long QT Syndromes-Disorders that delay repolarization of ventricular muscle after the action potential cause prolonged ventricular action potentials and therefore excessively long Q-T intervals on the ECG, a condition called long QT syndrome (LQTS).

12. 第一心音和第二心音：The First Heart Sound Is Associated with Closure of the A-V Valves. .The second heart sound results from sudden closure of the semilunar valves (i.e., the aortic and pulmonary valves) at the end of systole.

消化道
1. 调控消化道的神经-The enteric nervous system is composed mainly of two plexuses. An outer plexus lying between the longitudinal and circular muscle layers called the **myenteric plexus(motor)** or Auerbach's plexus, and an inner plexus, called the **submucosal plexus** or Meissner's plexus**(sensory)** which lies in the submucosa

2. 副交感神经的细分-Parasympathetic Stimulation Increases Activity of the Enteric Nervous System. The parasympathetic supply to the gut is divided into cranial and sacral divisions. The **sacral parasympathetics** originate in the second, third, and fourth sacral segments of the spinal cord and pass through the pelvic nerves. The **postganglionic neurons** of the gastrointestinal parasympathetic system are located mainly in the myenteric and submucosal plexuses.

3.Afferent Sensory Nerve Fibers From the Gut-80 percent of the nerve fibers in the vagus nerves are afferent rather than efferent

4. 胃肠道反射-Gastrointestinal Reflexes-1. Reflexes that are integrated entirely within the gut wall enteric nervous system. 2. Reflexes from the gut to the prevertebral sympathetic ganglia and then back to the gastrointestinal tract. 3. Reflexes from the gut to the spinal cord or brain stem and then back to the gastrointestinal tract

5. Gastrin-胃液的分泌
Gastrin is secreted by the “G” cells of the antrum of the stomach in response to stimuli associated with ingestion of a meal, such as distention of the stomach, the products of proteins, and gastrin-releasing peptide, which is released by the nerves of the gastric mucosa during vagal stimulation
胃液的作用：The primary actions of gastrin are (1) stimulation of gastric acid secretion and (2) stimulation of growth of the gastric mucosa.

6. **Cholecystokinin (CCK)** is secreted by “I” cells in the mucosa of the duodenum and jejunum. CCK also inhibits stomach contraction moderately.

7. **分泌素-Secreti**n, the first gastrointestinal hormone discovered, is secreted by the “S” cells in the mucosa of the duodenum in response to acidic gastric juice emptying into the duodenum from the pylorus of the stomach.

Hormone	Stimuli for Secretion	Site of Secretion	Actions
Gastrin	Protein Distention Nerve *(Acid inhibits release)*	G cells of the antrum, duodenum, and jejunum	Stimulates Gastric acid secretion Mucosal growth
Cholecystokinin	Protein Fat Acid	I cells of the duodenum, jejunum, and ileum	Stimulates Pancreatic enzyme secretion Pancreatic bicarbonate secretion Gallbladder contraction Growth of exocrine pancreas Inhibits Gastric emptying
Secretin	Acid Fat	S cells of the duodenum, jejunum, and ileum	Stimulates Pepsin secretion Pancreatic bicarbonate secretion Biliary bicarbonate secretion Growth of exocrine pancreas Inhibits Gastric acid secretion
Gastric inhibitory peptide	Protein Fat Carbohydrate	K cells of the duodenum and jejunum	Stimulates Insulin release Inhibits Gastric acid secretion
Motilin	Fat Acid Nerve	M cells of the duodenum and jejunum	Stimulates Gastric motility Intestinal motility

8.Glucose-dependent insulinotropic peptide (also called gastric inhibitory peptide [GIP]) is secreted by the mucosa of the upper small intestine, mainly in response to fatty acids and amino acids but to a lesser extent in response to carbohydrate. It has a mild effect in decreasing motor activity of the stomach and therefore slows emptying of gastric contents into the duodenum when the upper small intestine is already overloaded with food products.

9.消化道的血液循环
The blood vessels of the gastrointestinal system are part of a more extensive system called the **splanchnic circulation.** It includes the blood flow through the gut plus blood flows through the spleen, pancreas, and liver.

10. **Hunger Contractions**. Besides the peristaltic contractions that occur when food is present in the stomach, another type of intense contractions, called hunger contractions, often occurs when the stomach has been empty. Hunger contractions are most intense in young, healthy people who have high degrees of gastrointestinal tonus; they are also greatly increased by the person’s having lower-than-normal levels of blood sugar. When hunger contractions occur in the stomach, the person sometimes experiences mild pain in the pit of the stomach, called hunger pangs. Hunger pangs usually do not begin until 12 to 24 hours after the last ingestion of food; in people who are in a state of starvation, they reach their greatest intensity in 3 to 4 days and gradually weaken in succeeding days.

11. 为什么胃不会消化自己**---Gastric mucosal barrier** The functional (bicarbonate secretion) and structural (mucus; cell junctions) protection of gastric mucosa against acid and pepsin. Alcohol, aspirin, and bile salts are 'barrier breakers' and may cause gastric ulcer formation. Most gastric ulcers are due to the effect of Helicobacter pylori causing the breakdown of the gastric mucus barrier

12.促进胃蠕动的因素-Gastric Factors That Promote Emptying-Effect of Gastric Food Volume on Rate of Emptying.

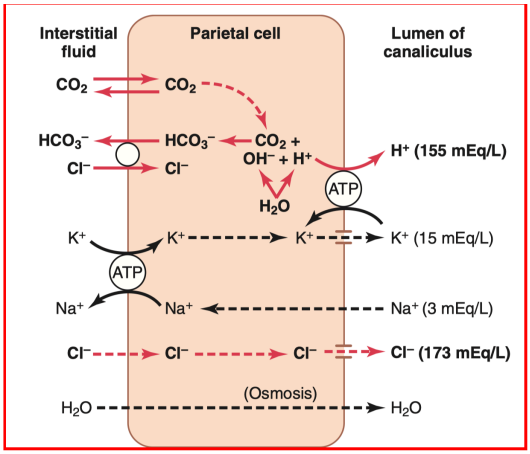
Increased food volume in the stomach promotes increased emptying from the stomach. However, this increased emptying does not occur for the reasons that one would expect. It is not increased storage pressure of the food in the stomach that causes the increased emptying because, in the usual normal range of volume, the increase in volume does not increase the pressure much. However, stretching of the stomach wall does elicit local myenteric reflexes in the wall that greatly accentuate activity of the pyloric pump and at the same time inhibit the pylorus.

Effect of the Hormone Gastrin on Stomach Emptying. In Chapter 65, we discuss how stretching of the stomach wall and the presence of certain types of foods in the stomach—particularly digestive products of meat—elicit release of the hormone gastrin from the G cells of the antral mucosa. This has potent effects to cause secretion of highly acidic gastric juice by the stomach glands. Gastrin also has mild to moderate stimulatory effects on motor functions in the body of the stomach. Most important, it seems to enhance the activity of the pyloric pump. Thus, gastrin likely promotes stomach emptying.

13. 抑制胃蠕动的因素—Powerful Duodenal Factors That Inhibit Stomach Emptying-Inhibitory Effect of Enterogastric Nervous Reflexes From the Duodenum. When food enters the duodenum, multiple nervous reflexes are initiated from the duodenal wall. These reflexes pass back to the stomach to slow or even stop stomach emptying if the volume of chyme in the duodenum becomes too much. These reflexes are mediated by three routes: (1) directly from the duodenum to the stomach through the enteric nervous system in the gut wall, (2) through extrinsic nerves that go to the prevertebral sympathetic ganglia and then back through inhibitory sympathetic nerve fibers to the stomach, and (3) probably to a slight extent through the vagus nerves all the way to the brain stem, where they inhibit the normal excitatory signals transmitted to the stomach through the vagi. All these parallel reflexes have two effects on stomach emptying: First, they strongly inhibit the “pyloric pump” propulsive contractions, and second, they increase the tone of the pyloric sphincter.

14. 关于唾液分泌-Saliva Contains a Serous Secretion and a Mucus Secretion. The principal glands of salivation are the parotid, submandibular, and sublingual glands; in addition, there are many tiny buccal glands. Daily secretion of saliva normally ranges between 800 and 1500 milliliters, as shown by the average value of 1000 milliliters in **The parotid glands secrete almost entirely the serous type of secretion, whereas the submandibular and sublingual glands secrete both serous secretion and mucus.** Saliva contains especially large quantities of potassium and bicarbonate ions. when copious quantities of saliva are being secreted, the sodium chloride concentration is about one half or two-thirds that of plasma, and the potassium concentration rises to only four times that of plasma.

15 关于胃液的分泌-CHARACTERISTICS OF THE GASTRIC SECRETIONS-stomach mucosa has two important types of tubular glands: oxyntic glands (also called gastric glands) and pyloric glands. The oxyntic (acid-forming) glands secrete hydrochloric acid, pepsinogen, intrinsic factor, and mucus. The pyloric glands secrete mainly mucus for protection of the pyloric mucosa from the stomach acid. They also secrete the hormone gastrin.
The main driving force for hydrochloric acid secretion by the parietal cells is a hydrogen-potassium pump



(H+ -K+ adenosine triphosphatase [ATPase])
Parietal Cells of the Oxyntic Glands Are the Only Cells That Secrete Hydrochloric Acid.

16. 吸收维生素VB12
Secretion of Intrinsic Factor by Parietal Cells. The substance intrinsic factor, which is essential for absorption of vitamin B 12in the ileum

17. Inhibition of Gastric Secretion by Other Intestinal Factors-—glucose-dependent insulinotropic peptide (gastric inhibitory peptide), vasoactive intestinal polypeptide, and somatostatin—also have slight to moderate effects in inhibiting gastric secretion.

18. 关于胃液分泌的第三期：Intestinal Phase. After chyme leaves the stomach and enters the small intestine, pancreatic secretion becomes copious, mainly in response to the hormone secretin. secretin inhibit the secretion of gastrin and stimuli the secretion of pancreatic.

19 关于胆汁分泌-BILE SECRETION BY THE LIVER
胆汁的作用：First, bile plays an important role in fat digestion and absorption, not because of any enzymes in the bile that cause fat digestion, but because bile acids in the bile perform two functions: (1) They help emulsify the large fat particles of the food into many minute particles, the surface of which can then be attacked by lipase enzymes secreted in pancreatic juice, and (2) they aid in absorption of the digested fat end products through the intestinal mucosal membrane. Second, bile serves as a means for excretion of several important waste products from the blood. These waste products include in particular bilirubin, an end product of hemoglobin destruction, and excesses of cholesterol.