Proteins

Proteins are absorbed as:

Leaky Gut Syndrome –

Amino Acids (AA)

AA's not immediately needed for protein formation:

-
-

Deamination –

Tramsamination –

Amino Acids in the human:

Essential AA –

Non-essential AA –

All the proteins in the body

Proteins

Proteins are absorbed as: Amino Acids and taken to the liver via the hepatic portal system.

Leaky Gut Syndrome – When larger polypeptides and small proteins get into the blood and the body sees them as antigens.

Amino Acids (AA) – Cannot be stored.

AA's not immediately needed for protein formation:

- Are converted to Glucose
- Can be catabolized to provide energy.

Deamination – an NH_2 is removed and the residue is excreted as urea.

Tramsamination – an amino group is exchanged for a keto group in a keto acid. The AA is converted into a Keto Acid and Keto Acid can be converted to an AA.

Amino Acids in the human: There are approximately 20 different amino acids in the human

Essential AA – The body cannot synthesize these on its own.

Non-essential AA – can be produced by the body from other amino acids, carbohydrates or lipids.

All the proteins in the body are synthesized from the amino acids in the cell cytoplasm on an organelle called the Ribosome.

Proteins (Cont)

AA not needed by the body

Excess AA

The storage form of lipids in the body

When needed for energy

The glycerol is converted

The FA's are broken down

Acetyl-CoA -

Excess Acetyl-CoA –

Acetyl-CoA comes from –

Ketones -

Proteins (Cont.)

AA not needed by the body can be converted to chemicals that enter the Kreb's cycle and therefore produce energy.

Excess AA can be converted into glucose or lipids.

The storage form of lipids in the body is in the form of triglycerides. (One glycerol and three fatty acid)

When needed for energy the triglyceride is broken down into one glycerol and three fatty acids.

The glycerol is converted into pyruvic acid which enters the Kreb's cycle.

The FA's are broken down into numerous two carbon fragments which combine with other substances so as to enter the Kreb's cycle.

Acetyl-CoA - One of the "entry chemicals" into the Kreb's cycle.

Excess Acetyl-CoA – is converted by the liver into Ketone Bodies.

Acetyl-CoA comes from – the metabolism of fatty acids. When starving, dieting, diabetic, or on a high protein diet, we start to burn large amounts of fat because the body lacks glucose. We then start to accumulate excess amounts of ketones.

Ketones - can be a source of energy for the brain, muscles, and other body tissues – as a backup system. However ketones are acidic, and an excess can cause the human body to enter ketosis.

Blood Glucose

Blood Glucose levels are maintained by –

-
-
-
-

Epinephrine –

Growth hormone does

-
-
-
-

Insulin -

-
-

Blood Glucose

Blood Glucose levels are maintained by – hormones. Most of them have the action of increasing the level of blood glucose.

Glucagon – From Alpha Cells in the Isles of Langerhans.

- Glycogenolysis - Glycogen being turned back into glucose
- Gluconeogenesis - AA's to glucose
- Lypolysis – Liberates free FA's and glycerol that can be converted into glucose.
- Raisies the blood sugar levels.

Epinephrine – does the same

Growth hormone does

- Promotes protein synthesis
- Promotes fat lipolysis from adipose tissues for use as energy (vs using glucose)
- Suppresses carbohydrate use for energy
- Promotes the conversion of liver glycogen into glucose which tends to raise glucose levels.

Insulin - The only hormone in the body that lowers blood sugar levels is insulin.

- Promote the movement of glucose into the cell out of the blood stream.
- Promotes glucose storage as glycogen (glycogenesis) or glucose storage as lipids (lipogenesis)

Digestion Review

Saliva

-
-

Liver –

Gall bladder –

Pancreas –

And other things –

Muscularis

Auerbach's –

Muscularis mucosa

Meissner's –

Digestion Review

Saliva

- lubricates food
- a little amalyase (tongue produces lipase)

Liver – bile

Gall bladder – stores bile

Pancreas – digestive enzymes (unleashed in the duadenum) Breaks big things into smaller things. (vs SI, which makes smaller things into things that eventually get absorbed.)

And other things – generally areas of production for hormones/enzymes

Muscularis (muscles of peristalsis)

Auerbach's – myenteric plexus - motility (muscularis)

Muscularis mucosa (thinner and deeper, moves with the villi, filled with more blood supply)

Meissner's – submucosa plexus – more involved with digestion (muscularis mucosa)

Major Hormones (Review)

- **Gastrin-**
- **CCK –**
- **Secretin –**
- **GIP –**

Major Hormones (Review)

- **Gastrin**- more acid
- **CCK** – more bile
- **Secretin** – more bicarb
- **GIP** – more insulin (REACTS TO PRESENCE OF CARBS.)

Paracrines and Neurocrines

Paracrine

-
-

Neurocrines

-
-
-
-

Hydrolysis vs condensation –

Paracrines and Neurocrines

Paracrine – stimulate things close by

- Somatostatin
- Histimine

Neurocrines

- Vasoactive
- intestinal peptide
- Brombesin
- Encephalon

Hydrolysis vs condensation – breaking down of food stuff that requires water (in the presence of an enzyme) vs condensation where an enzyme is release as things are put back together.

Macronutrients:

Starch –

Lipids –

- –
- –

Proteins –

Chylomichron –

Macronutrients

Starch – broken into dextrose (kind of) – breaks down into Disaccharides (sucrose (glucose+ fructose), maltose (glucose+glucose), lactose(glucose+galactose))

Lipids – triglycerides -(lipase) glycerol + fatty acids

- phospolipids almost the same thing
- cholesterol (cholesterolase)

Proteins –Polypeptides, peptides, and then dipeptides and finally - Amino Acids

Chylomichron – large fat molecules covered with protein that eventually get transported by the lymphatic system into the blood stream. (don't make it through the portal hepatic system)

Endocrine Physiology

1.
2.
3.
4.
5.
6.
7.
8.

These glands produce hormones that:

Endocrine Physiology

1. Pituitary
2. Pineal
3. Thyroid
4. Parathyroid
5. Thymus
6. Pancreas
7. Adrenal
8. Gonads

These glands produce hormones that: are chemicals produced by specific types of cells and are then emptied into the inter-cellular spaces around these cells.

Hormones

High hormone levels –

Low hormone levels –

Hormones exert their influence

Direct action –

Secondary messengers

The output of hormones is regulated by two methods.

-
-

Hormones

High hormone levels – number of hormone receptors on a target cell will decrease to help limit the effect of the excess hormones.

Low hormone levels – the number of hormone receptors on a target cell will increase to "catch" as much f the limited hormone supply as possible.

Hormones exert their influence by altering the metabolism of the specific target cells.

70% of patients will have some form of thyroid problem. (muscle test – front of hand makes organ stronger, with back of hand will make it weaker – if there's no problem with the organ, it shouldn't make too much difference)(You have to be 30%-40% to register, this will catch it within about 5%)

Direct action – They penetrate the cell membrane and act on a target organelle directly.

Secondary messengers (aka second messengers) – if they cannot penetrate the cell membrane, they stimulate something in the cell membrane (a secondary messenger) that transmits the hormonal message thru the cell membrane. The original hormone would then be called the first messenger. (some books say the substance inside the cell)

The output of hormones is regulated by two methods.

- Negative feedback (most common) when a stressor causes the body to deviate from normal and the body fights to regain equilirbrium. This is called negative feedback.
- Positive feedback – less common.

Pituitary Gland

Location –
The gland consists of
Infundibulum -
The anterior lobe -
The posterior lobe -

Pituitary Gland

Location – base of hypothalmus lying just behind the optic chiasm. *(Pituitary tumors often cause blindness.)*
The gland consists of Two lobes – Larger anterior and smaller posterior
Infundibulum – the pituitary stalk connecting the pituitary to the hypothalmus.
The anterior lobe does it's own hormone produce, but is regulated by the hypothalamus.
The posterior lobe just stores stuff the hypothalmus makes.

Anterior Lobe

The anterior lobe is described as:

Trophic cells

Somatotrophes

- **Secrete**
- **Volume wise** –
- **Function** –
- **Conditions:**
    -
    -
    -

Anterior Lobe

The anterior lobe is described as: chords of epithelial cells that contain granules of stored hormones. There are five different types of cells that secrete 6 different hormones.

Trophic cells

Somatotrophes

- **Secrete** growth hormone.
- **Volume wise** – the number one pituitary hormone.
- **Function** – stimulates the growth of all body tissue. (also stimulates nerve tissue) Continues to be secrete throughout life.
- **Conditions:**
    - **Dwarfism** – lack of height due to a deficiency of growth hormone in childhood.
    - **Gigantism** – An excess of height due to excess growth hormone in childhood.
    - **Acromegaly** – Production of excessive amounts of growth hormone after the growth plates of the long bones have ossified. This results in a widening of the bones rather than length. (Ed Sullivan, Richard Boone, Andre the Giant, et

More Anterior Pituitary Trophic Cells

Thyrotrophs

- **Secrete**
- **Function**
- **Conditions**
    -
    -

Corticotrophes

- **Secrete**
- **Function**
- **Conditions**
    -
    -

More Anterior Lobe Trophic Cells

Thyrotrophs

- **Secrete** – TSH (Thyroid Stimulating Hormone)Thyrotropin
- **Function** – cause the thyroid to secrete thyroid hormone which increases the bodies metabolic rate
- **Conditions**
    - **Creatinism** – A dwarf that is due to a lack of TSH instead of Growth hormone.
    - **Graves Disease** – a type of hyperthyroidism

Corticotrophes

- **Secrete** – adrenocorticotrophic hormone (ACTH)
- **Function** – reacts with the cortex of the adrenal gland to secret adrenal hormones (mostly – cortisol)
- **Conditions**
    - **Addison's Disease** – associated with hyposecretion of the adrenal cortex.
    - **Cushing's Disease –** associated with hypersecretion of the adrenal cortex. (Adrenal glands - cortex – stimulated by hormones, medulla by autonomic nervous systems)

More Anterior Pituitary Trophic Cells

Gonadotrophes

- **Secrete**
    - **Function**
    - **Condition**
        -
- **Secrete**
    - **Functions**
    - **Conditions**
        -
        -

Mammotrophes

- **Secrete**
- **Function**
- **Condition**
    -

More Anterior Pituitary Trophic Cells

Gonadotrophes

- **Secrete** Follicle Stimulating Hormone (FSH)
    - **Function** stimulates the production of egss or sperm cells.
    - **Condition**
        - Hyposecretion – retards the production of eggs or sperm.
- **Secrete** Leuteinizing Hormone - LH is also called interstitial cell-stimulating (ICSH) hormone in men.
    - **Functions** - stimulates ovulation of eggs in women and the production of testosterone in men.
    - **Conditions**
        - Hypo secretion – retards the maturation of eggs.
        - Precoius syndrome – onset of puberty earlier than normal (used to be 10)

Mammotrophes

- **Secrete** prolactin (lactogenic hormone)
- **Function** – stimulates the development of glandualar breast tissue during preganacy and the production of milk after birth.
- **Condition**
    - Hypo secretion – causes no problems other than the inability to breast feed. Hypersecretion is generally related to a pituitary tumor and causes inappropriate lactation, lack of menstruation, etc. In males it results in impotence.

Posterior Pituitary Lobe

Consists of

Secretes:

-
-

Conditions

-

Posterior Pituitary Lobe

Consists of – cells called pituicuytes.

Secretes:

- **Oxytocin** – contraction of smooth muscles in the walls of the uterus in birth. (what gives the push) it also stimulates the breasts to eject milk.
- **Antidiuretic hormone (ADH)** – promotes the retention of fluids by the kidney.

Conditions

- **Diabetes insipidus** – too little ADH

Pineal gland

Location:

Secretes:

-

Pineal Gland

Location: toward the back of the brain

Secretes:

- Melatonin – the control of the circadian rhythm. (24h cycle of the body) (temp and BP run highest in the evening) (MD's say this is a landmark for xrays. It calcifies as we turn older.)

Thyroid

Located –

Produces:

-
-
-

Actions:

-
-

Other Names:

-
-

Iodine:

-
-

T7 is carried through the body:

Thyroid

Located – In the throat anterior to the lower portion of the thyroid cartilage. (in lay terms, the Adam's apple) It's a double lobed thing. Test both sides.

Produces:

- **Thyroxine** – (T4) – Most abundant of hormones that speed up metabolism, but less active. Is converted to t3.
- **Triioodothyronine** (T3) – produced in smaller quantities, but the more active form. Speeds us up.
- **Thyrocalcitonin** (or just calcitonin) Deals with calcium levels in the blood. Lowers calcium blood levels by moving it into the bones.

Actions:

- T3 T4 increase in metabolic activity
- Thyrocalcitonin has at its function the lowering of calcium levels.

Other Names:

- T7 hormone is a combination of T4 and T3.
- Thyroid hormone also means T4 and T3.

Iodine:

- The trace element iodine is necessary for the production of T7
- but not thyrocalcitonin.

T7 is carried through the body: bound to a protein called Thyroid Binding Globulin (TBG). Only a small amount is active and flowing freely in the blood. The TBG takes it to the cells where it then becomes active.

Thyroid Conditions

Hyperthyroidism

-
-
-

Goiter

-

Thyroid Conditions

Hyperthyroidism

- any condition where the thyroid gland is producing excess thyroid hormone.
- The most commonly noticed system is the bug-eyed appearance of the patient This is called exopthalamos.
- Hyperthyroidism is a decrease in T7 production. T3/T4 is controlled by TSH negative feedback. Low T7 stimulates TSH, High T7 levels inhibits TSH.

Goiter

- low levels of iodine, will increase the number and size of thyroid cells. Guess what, an increase in the amount of iodine causes the same size problems.

Parathyroid Gland

Location:

Secretes:

Normal calcium blood levels

Low blood calcium levels

High blood calcium levels

Calcium/Magnesium Relationship:

Calcium/Phosphorus Relationship:

A change, up or down, in either Ca or Mg –

PTH regulates:

The two main substances that will raise blood Ca levels are

Blood calcium levels are lowered by

You can live without:

Parathyroid Gland

Location: Four small glands embedded onto the surface of the thyroid gland. (On the back side)

Secretes: Parathyroid hormone (PTH) which increases blood calcium levels

Normal calcium blood levels are 8.5 to 10.5 mg/dl

Low blood calcium levels cause parathyroid hormone production which causes the release of calcium from the bones.

High blood calcium levels cause decrease parathyroid hormone production and also cause an increase in thyrocalcitonin.

Calcium/Magnesium Relationship: There is a direct calcium/Mg relation ship.

Calcium/Phosphorus Relationship: an inverse CA/P relationship.

A change, up or down, in either Ca or Mg – tends to be mirrored by the other.

PTH regulates: Ca excretion/secretion at the level of the kidney. Meaning it will influence the kidney to retain or secrete Ca as needed to maintain proper blood levels.

The two main substances that will raise blood Ca levels are - PTH and Vitamin D

Blood calcium levels are lowered by thyrocalcitonin.

You can live without: the thyroid gland, you cannot live without the parathyroid glands.

Adrenal glands (Cortex)

Outer cortex

Outer Layers

Produces:

Function

The major one is

Middle Zone:

Produces:

Function

The major one is:

Inner Layer

Produces:

The above three:

Adrenal Glands (Cortex)

Outer cortex – three distinct cell layers (electrolyte balance)

Outer Layers

Produces: Mineralocorticoids

Function – regulate electrolyte and water level balance. By promoting the absorption of sodium and the secretion of potassium by the kidneys.

The major one is Aldosterone.

Middle Zone:

Produces: Glucocorticoids in the middle zone. (glucose balance – raises glucose by decrease glucose metabolism).

Function to raise glucose levels by decreasing glucose metabolism.

The major one is: (cortisol – the major Glucocorticoid.)

Inner Layer

Produces: also secretes Glucocorticoids plus some sex hormones (almost negligible)

The above three: all come under the heading of steroids.

Adrenal Glands (Medulla)

Inner medulla

Produces:

Functions:

Adrenal Glands (Medulla)

Inner medulla

Produces: Epinephrine and Norepinephrine.

Functions: These two hormones effects the sympathetic nervous system.

Pancreas

Produces:

Isles of Langerhans -

- **Alpha cells**
    - **Produces:**
    - **Functions:**
- **Beta cells**
    - **Produces:**
    - **Functions:**
- **Delta cells**
    - **Produces:**
    - **Functions:**

The only one we cannot live without:

Pancreas

Produces: digestive enzymes and hormones.

Islets of Langerhans - Three types of cells found here.

- **Alpha cells** (20% of island cells)
    - Produces: Glucagon
    - Functions: which raising blood sugar levels by converting glycogen into glucose.
- **Beta cells (70% of islet cells)**
    - **Produces:** Insulin
    - **Functions:** lowering blood glucose levels by speeding up glucose absorption into the cells. (via facilitated diffusion)
- **Delta cells** (5% of cells)
    - **Produces:** Somatostanin
    - **Functions:** lowers insulin production and increases Glucagon production.

The only one we cannot live without: is insulin.

Gonads

Male and Female gonads:
Male gonads secrete –
Female gonads secrete –

Gonads

Male and Female gonads: Testes and Ovaries

Male gonads secrete – testosterone – producing secondary sexual characteristics, enhances the sex drive

Female gonads secrete – Estrogen – produced secondary sex characteristics. Female sex drive apparently from androgens in the adrenal cortex.