BIOLOGY

Important hints:

- Name and indicate: We write a **direct answer.**
- Why ,how ,which ,explain ,discuss , justify: they depend on **acquired knowledge.** (We write everything we know about this idea.)
- State: logic **consecutive** answer. (or consecutive steps)
- Analysis: **Condition + Result.** (Before the result we can write :"**shows, provokes, or leads to**.)

_Between any two analysis there must be a connector: but, while, in contrast, on the contrary, moreover. (It is forbidden to use '**then'** in the analysis.)

_Here, if we have an increasing or decreasing graph, we have to say by how much it increases or decreases.

_If we are analysing a curve, the condition is x-axis, and the result is the y-axis.

_If there are steps in the experiment, we use: 'Before , upon and after the experiment'.

- Determine, interpret, deduce: **Analysis + Significance.** (Before the significance we can write: "hence, this means, thus, this shows.")

_Here, the **significance** should be from the document.

- Specify: **Significance+ Analysis.**

_Here, the **significance** is from the acquired knowledge.

- Comparison: Same as analysis.
- Conclude: We write a specific conclusion.
- Draw out: It is like conclusion but more general.
- Describe: We translate the scene as it is without adding or removing information. Connectors used in description are:" then, after that, finally, result is". (It is forbidden to use the connectors used for analysis in description.)
- Hypothesis: Is a concept that's true 100%.
- Pose a problem: We write a question asking about the idea in the form: (Is……? ; What……?)
- Pick out from the text: We write the information found in the text as it is.
- Verify: Confirm using argument and logical reasoning whether something is true or false.

_Here, if there is a biological expression or word which is not defined in the experiment, we have to define it before we start the verification.

➢ Identify: Same as verify.

Fluctuates:is a word used in analysis when the graph increases then decreases a little bit.

Part Four: Systems of Regulation:

♣ Chapter 13: Regulation of glycemia:

- The main source of energy of the most cells is the glucose (especially nervous and muscular cells).
- Glycemia: is the blood glucose concentration.
- Hyperglycemia: high blood glucose concentration (more than 1.2 g/l).
- Hypoglycemia: low blood glucose concentration (less than 0.2 g/l).
- Glycemia constant: normal blood glucose concentration (between 0.8g/l and 1.2 g/l).
- Glucose: Is the main source of energy:
  - Oxidation of glucose:

    Glucose + O_2 ⟶ CO_2 + H_2O + ATP
- ATP: Is the molecular element of energy and it is found in mitochondria.
- Mild Hyperglycemia: glycemia slightly higher than 1.2g/l (but still less than 2g/l).
- Severe Hyperglycemia: glycemia highly greater then 1.2g/l (greater then 2g/l). Here the person having severe hyperglycemia is called diabetic.

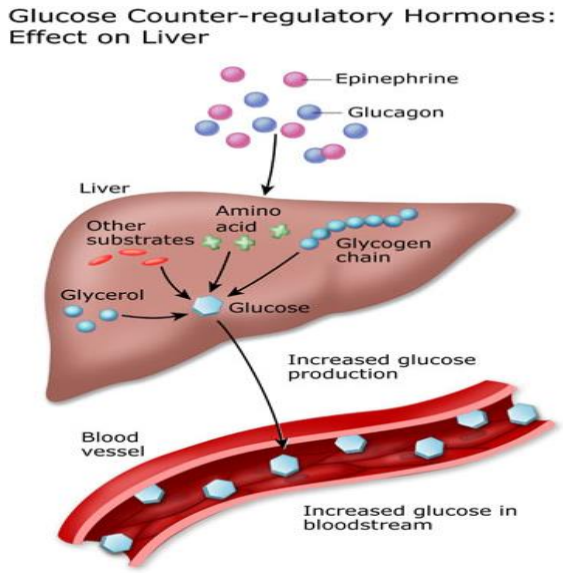
♠ Document 1:Glycemia, a biological test:

➢ Tests of identification of glucose:

1. Fehling solution:glucose + fehling $\xrightarrow{\text{(heat)}}$ brick-red color.
2. Glucometer: is an instrument that measures the concentration of glucose in blood.
3. Strip tests: it measures the concentration of glucose using litmus paper by colors.

- Upon eating a meal rich with carbohydrates, the concentration of glucose in blood increases to hyperglycemia, so there is an organ in the body that absorbs glucose from blood to keep glycemia constant.
- Upon fasting or doing sports (expensure of energy), the concentration of glucose in blood decreases to hyperglycemia, so there is a definite organ that provides blood with glucose to keep glycemia normal.
    - Hence, there is a mechanism in our body that keeps glycemia constant (normal).

♠ Documet 2: The Liver an effector organ in the regulation of glycemia:



- Role of liver:
  1. In case of hypoglycemia: It supplies blood with glucose.
  2. In case of hyperglycemia: It absorbs glucose from blood.

So, liver keeps the glycemia constant in the blood.

* Hint:

_In sub-hepatic vein, the normality of glycemia is slightly greater than that of hepatic artery since it goes to all blood organs.

_In hepatic vein, there is always hyperglycemia since it contains nutrients supplied from small intestine.

- Claude-Bernard Experiment: (liver washing): It shows that the liver contains glucose in the form of glycogen(not soluble), and glucose that is soluble.
- In case of hyperglycemia: The liver absorbs excess glucose from the blood and stores it in the form of hepatic glycogen by glycogenesis.

  _If the liver is saturated (full, concentrated) and the case is still hyperglycemia, then another organs interfere such as:

  1. Muscle cells (Myocytes): They absorb excess glucose and store it in the form of muscular glycogen (by glycogenesis).
  2. Adipose cells (Adipocytes or fatty cells): They absorb excess glucose and store it in the form of lipids (lipogenesis).
- In case of hypoglycemia: The liver supplies the blood with glucose by glycogenolysis (hydrolysis of glycogen).

_Hepatic glycogen $\xrightarrow{(E1)}$ glucose 1 phosphate $\xrightarrow{(E2)}$ glucose 6 phosphate $\xrightarrow{(E3)}$ glucose (that goes outside the cells by exocytosis).

- But, if the liver becomes depleted (empty) and the case is still hypoglycemia, then another organs interfere:
  1. Adipocytes: They transform lipids to fatty acids and glycerol "by lipolysis" that went to the liver, then the liver transforms them into glucose by "Neoglucogenesis".
  2. Muscles: In muscles :

  _Muscular glycogen $\xrightarrow{(E1)}$ glucose 1 phosphate $\xrightarrow{(E2)}$ glucose 6 phosphat , but, there is no E3 (glucose 6 phosphatase) in the muscle to transform glucose 6 phosphate into glucose.

  Hence, glucose 6 phosphate stays inside the myocyte cell and supplies it with energy.

- Neoglucogenesis: Is the synthesis of glucose from non-carbohydrates.
  - Hints:

_The membrane of the muscle is permeable only to glucose.

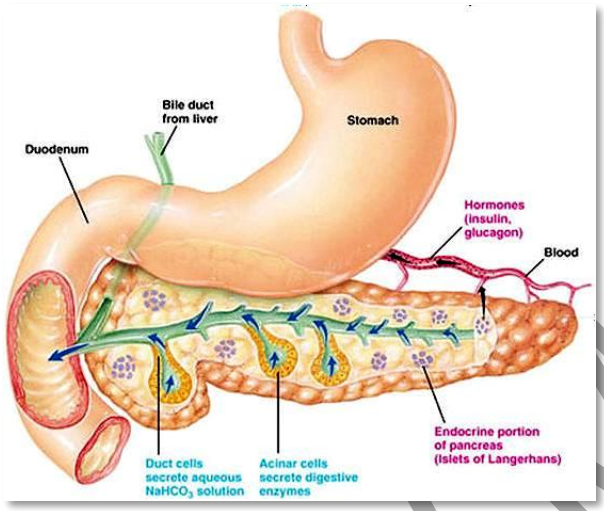
_Only liver supplies blood with free glucose.

_liver contains:

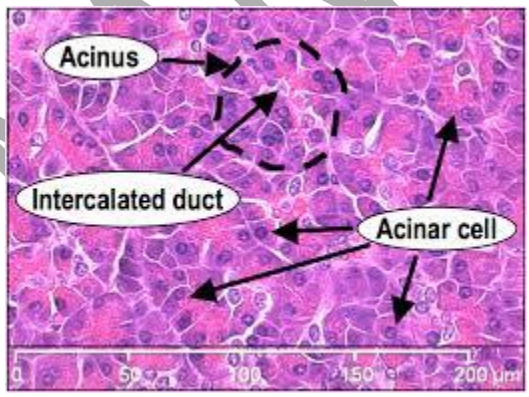
1. Glucose that is very soluble in water.
2. Glycogen that is slightly soluble in water.

♠ Document 3: The pancreas and glycemia:

➢ Pancreas: is a mixed gland that is composed of exocrine glands called Acini and endocrine glands called Islets of Langerhan.



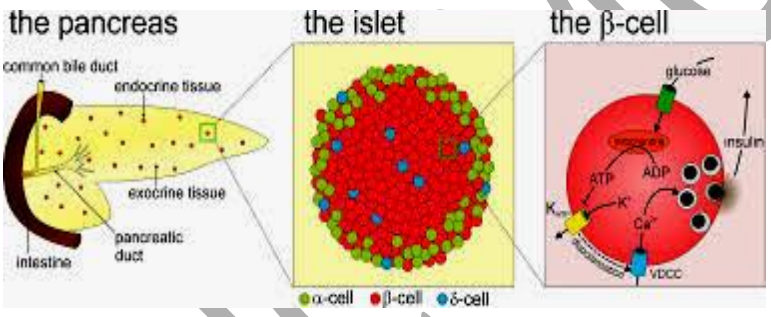
➢ Acini: are exocrine glands that secrete pancreatic juice via pancreatic duct in the small intestine (Duedenom). This juice helps in the digestion role since it contains digestive enzymes.

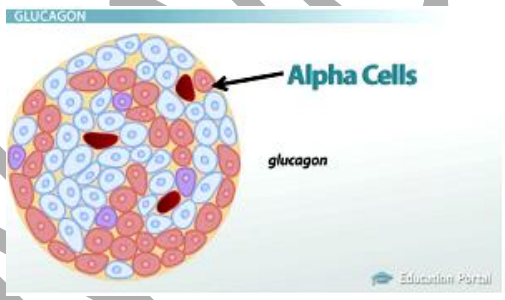


➢ Islets of Langerhan: It contains 2 types of cells:

1. α-cells: they secrete hyperglycemic hormone that increases glycemia in blood which is "Glucagon".
2. B-cells: they secrete hypoglycemic hormone: which is "Insulin".

_ They are named Islets of Langerhan, since they are dispersed in the pancreas like islets and Acini are found between them.





➢ Role of pancreas:

1. Digestive role: by the pancreatic juice that contains digestive enzymes secreted by Acini through pancreatic duct to small intestine.

2. Hypoglycemic role: It decreases glycemia in blood by the secretion of hypoglycemic hormone called insulin in case of hyperglycemia.

- Diabetes: Is due to the disorder in the metabolism represented by permanent hyperglycemia.
- Metabolism: is a series of chemical reactions that takes place in the body. It is of 2 types:
  1. Anabolic (constructive):ex: glucose ⟶ glycogen.
  2. Catabolic (destructive): ex: glycogen ⟶ glucose.
- Types of Diabetes:
  1. Diabetes Mellitus or Juvenile Diabetes(IDDM) : Its cause is the deficiency of secretions of insulin hormone.
     * Its symptoms:
       a) Permanent hyperglycemia (above 1.2g/l).
       b) Glycosuria: presence of glucose in urine.
       c) Polyuria: successive urination.
       d) Dehydration:due to successive urination.

e) Emacination or fitness due to the consumption of protein in muscles.

2. Fat Diabetes or Adult onset Diabetes:

It affects the obese persons and persons that take much sugar and fats in their food.

- Tolerance test of glucose: testing mechanism of regulation of glycemia (normal or not).
- Homeotasis: is the internal constancy of the chemical medium of the body (blood, blood pressure, temperature).

♠ Document 4: Hypoglycemic system:

* Hypoglycemic system is represented by insulin that decreases glycemia in blood.

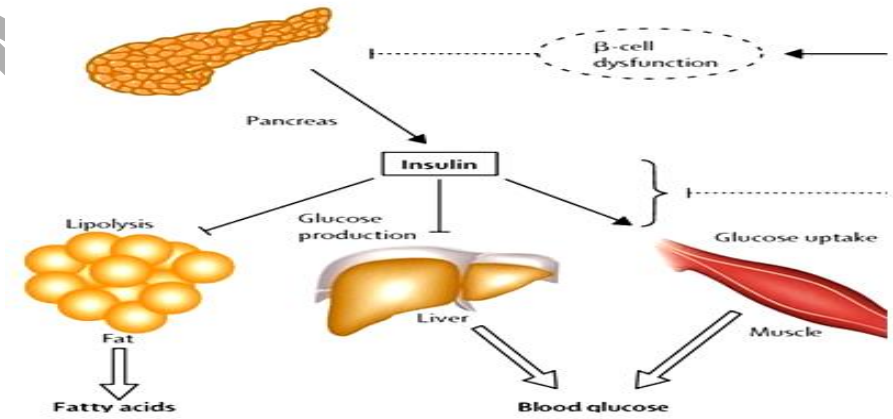
➢ Insulin: It is a peptide composed of 2 chains separated by di-sulfur bridge .

-It is digested easily by protease, so it must be injected in blood for diabetes patient not taken orally.

● Role of insulin:

It is a hypoglycemic hormone (which is released by β-cells of Islets of Langerhan) it decreases the level of glycemia in blood by stimulating glycogenesis in the muscles and hepatic cells , and lipogenesis in adipocytes.

Insulin acts on the cells that have insulin receptors , that are: hepatocytes, myocytes and adipocytes.



* In general: Insulin increases the use and the permeability of the glucose.
* Glycemia in blood and secretions of insulin are proportional.

♠ Document 5:Hyperglycemic system:

- The main hyperglycemic hormone is Glucagon that is secreted by α-cells of Islets of Langerhan of pancreas. It is a peptide formed of 1 chain , stable, so it can't be digested by stomach and can be taken orally.
- Other hyperglycemic hormones that increase glycemia:
    1. Thyroxin which is released by thyroid gland.
    2. Adrenalin that is released by adrenal gland.
    3. Growth Hormone (GH)secreted by APG in encephalon.
    4. Cortisol released by adrenal glands (adrenal cortex).

➢ Types of diabetes:

1) Insulin dependent Diabetes Mellitus:

* Its causes:

_ deficiency in the secretion of insulin by β-cells.
_ destruction of β-cells (no release of insulin).
_release of abnormal insulin.

* Treatment: By insulin injections since target organs of insulin have normal receptors.

2) Non- Insulin dependent Diabetes Mellitus:

* Its causes:

_presence of abnormal receptors of insulin on target organs which is not fitted with insulin.

_deficiency in the number of receptors of insulin on target organs.

* Treatment: Adaptation and eating less glucose.

_ Target cells of glucagon are hepatocytes and adipocytes.

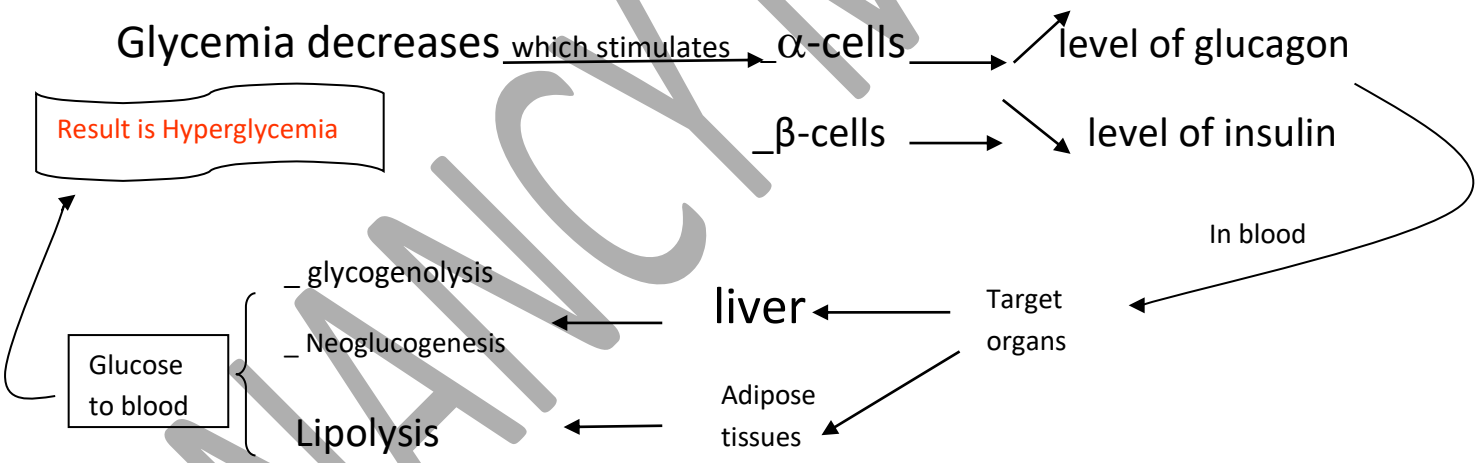
♠ Document 6: Regulation of glycemia by feedback control:

- Stability of glycemia depends on:

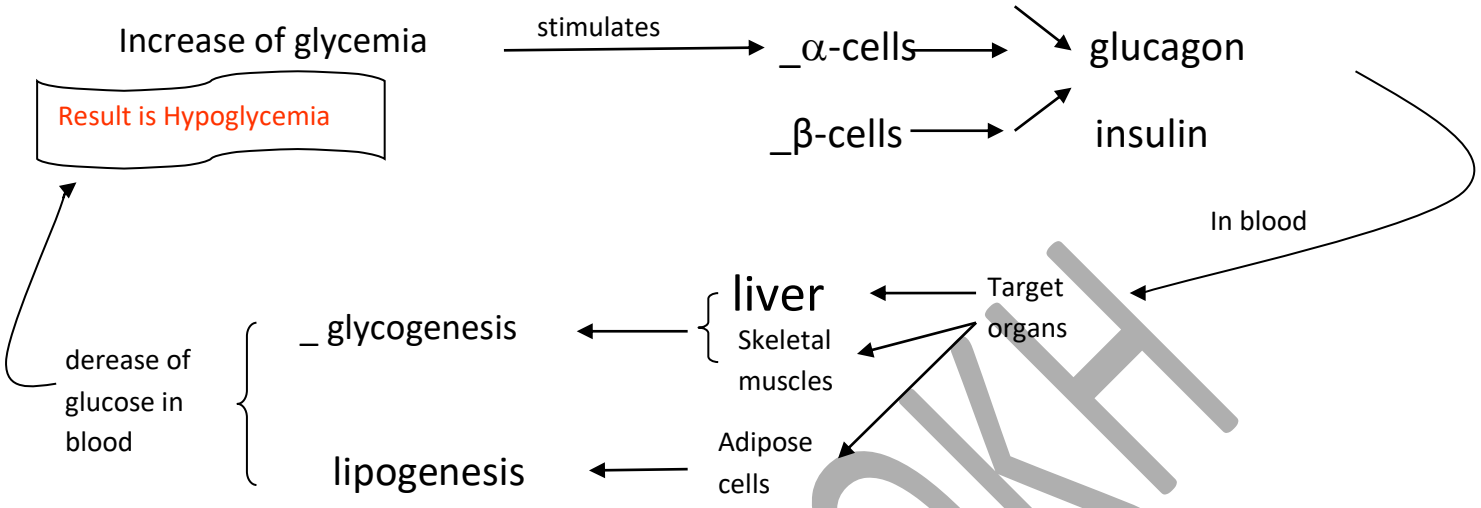
_ Equilibrium between hyperglycemic and hypoglycemic system(secretion of pancreatic hormones).

_ Nervous system through stimulation of adrenal glands in hypoglycemia.

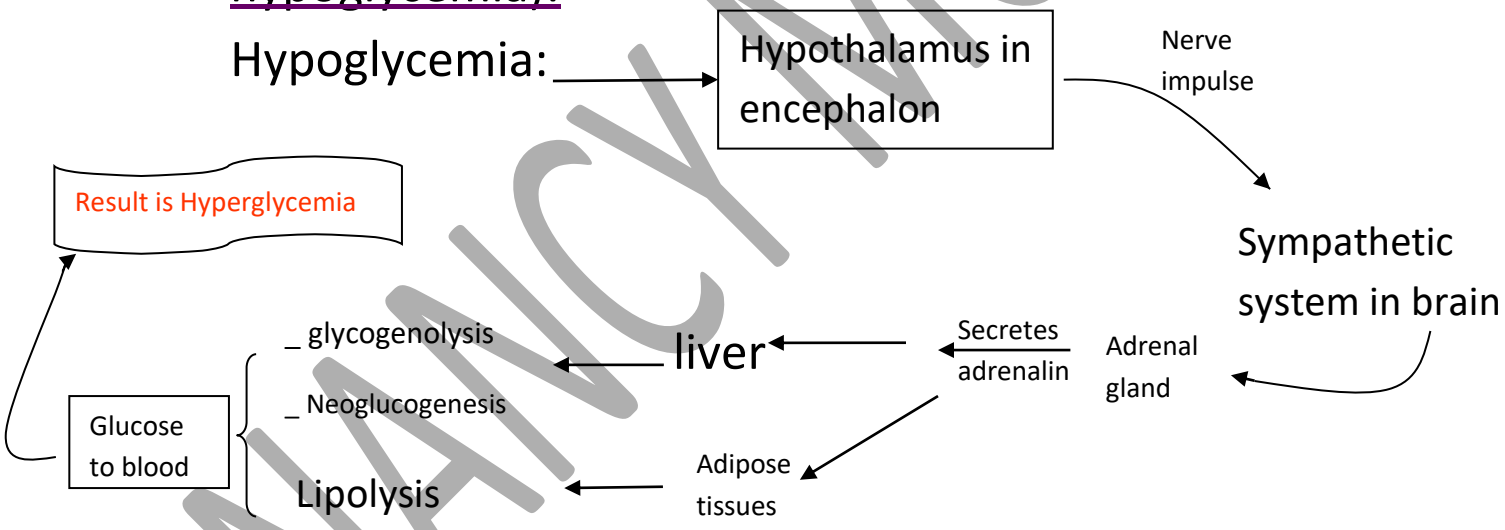
➢ Case of hypoglycemia:



➢ Case of hyperglycemia:



- Neuro-hormonal regulation of glycemia: (case of hypoglycemia):



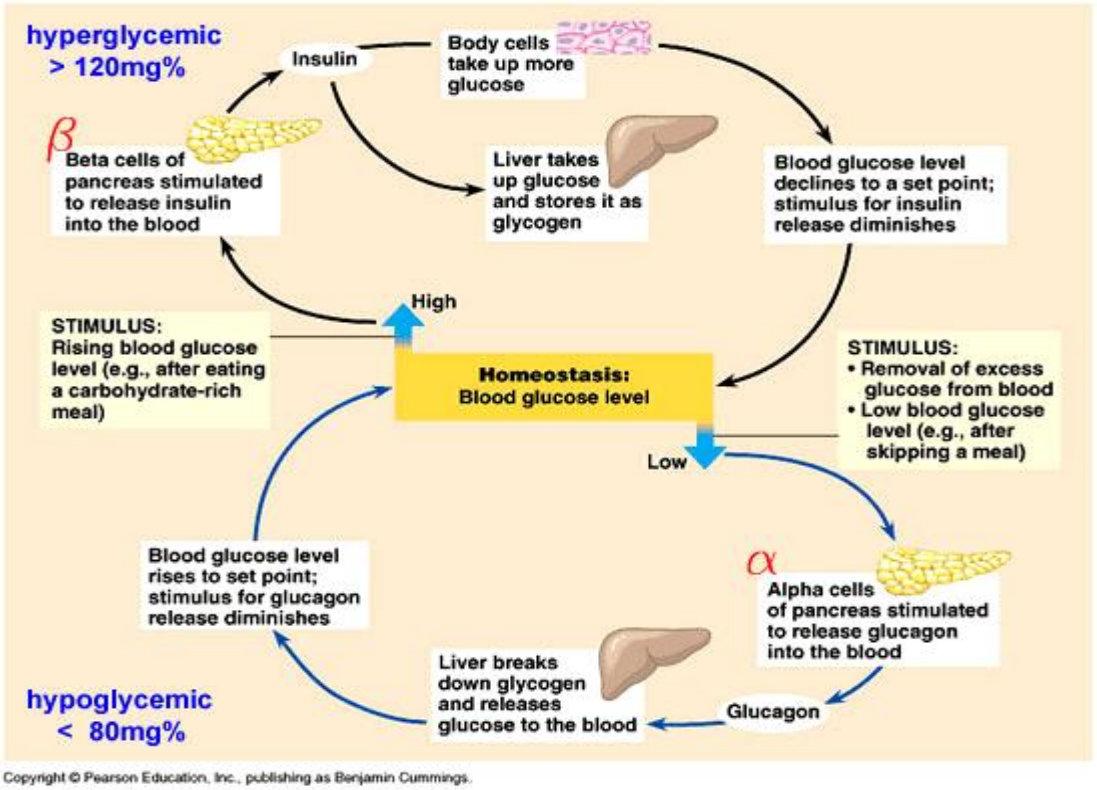
- Auto- regulation of glycemia:

Glycemia is regulated by the glycemic value itself, by pancreatic hormones ,so, insulin & glucagon cooperate in a closed negative feedback control.

In all corrective measures, the stimulus consists of either rise or fall in glycemia inducing rise or fall in glycemia (negative feedback control).

* The stimulus of nervous system “hypothalamus” is the glucose molecule.

- Drawing for action of liver in both cases(hyper and hypoglycemia):



♣ Chapter 15: Regulation of the female sexual hormones:

- Human reproduction in mammals is regulated by hormones.
- Specifically, reproduction in females is accompanied by cyclic events that constitute sexual cycle.
- This cycle is because of the fluctuations in the levels of sexual hormones.

♠ Document 1: The sexual cycle:

- The sexual cycle consists of: _ ovarian cycle
  _uterine cycle

  Both cycles are synchronized and they last 28 days.

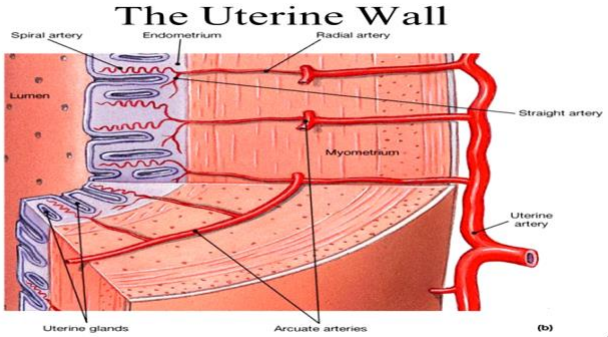


Figure 28.19b

From the uterine wall we are interested for 3 layers that are from outside to inside: serous layer

_Myometrium

_Endometrium.

- Endometrium consists of 3 layers:
  i) Basal layer
  ii) Functional layer
  iii) Glandular layer (this layer consists of glands that give nutrients for the embryo before the formation of umbilical cord).

- Uterine cycle: It passes in 3 stages:
  1) Menstruation: It lasts 7 days during which endometrium is sloughed off where blood vessels are cut causing bleeding (menses).
  2) Proliferation phase(Multiplication phase):It lasts 7 days:

_It is the rebuilding of endometrium.

_Endometrium starts thickening.

_Formation of blood vessels in form of spirals.

_Formation of endometrial glands at the level of glandular layer.

Secretory phase: It lasts 14 days: During which endometrium is highly developed and it becomes more thick, blood vessels are highly developed and tube- like glands secrete nutrients (glycogen).

* Note that the first 2 stages of uterine cycle (menstruation and proliferation) are synchronized with the follicular phase , while the last stage(secretory phase) is synchronized with luteal phase.

♠ Document 2:Cyclic evolution of ovarian hormones:

➢ Ovarian hormones are:

1) Estrogen(estradiol): It is secreted by the cells of theca interna and by granulose. It is secreted all over the cycle since the cells of granulose are presented in the ovaries all over the cycle. The secretion of estrogen is cyclic depending on the development of granulose in the ovary.

   * Its role:

   i) Growth of blood vessels.

   ii) Development of cervical glands.

   iii) Multiplication of uterine and vaginal mucosa.

   iv) Development of the tube-like glands of endometrium.

2) Progesterone: It is secreted by the ruptured follicles of granulosa .It is secreted only during luteal phase. Also, its secretion is cyclic depending on the development of granulosa.

   * Its role:

      i) It increases the body temperature.

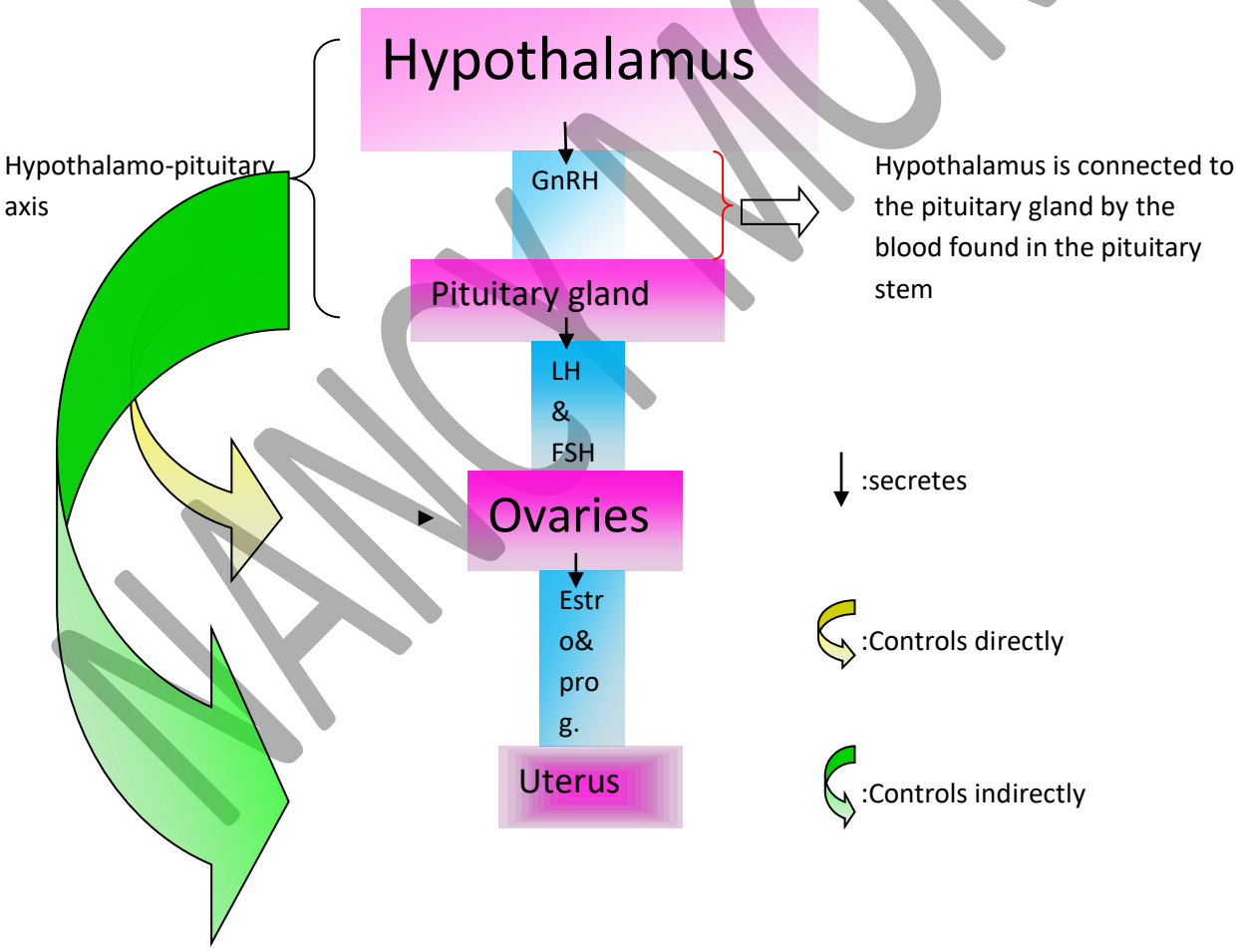
      ii) Inhibition of uterine contractions.

iii) Stimulation of the gland secretions I uterine mucosa and cervix.

iv) Development of the uterine lace.

♠ Document 3: Hypothalamo-pituitary axis and ovarian secretions:

➢ Hypothalamo-pituitary axis: it acts as one unit and it is found in the brain. It is composed of hypothalamus(which is composed of neuro-hormonal cells that secrete GnRH), and of pituitary glands that secrete LH and FSH.



- Role of FSH and LH:
  - During follicular phase: LH and FSH hormones stimulate the development of the follicles.
  - At day 13: Peak LH triggers ovulation.
  - During luteal phase: LH and FSH help in the transformation of the raptured follicle to yellow body.
- GnRH: Gonadotropin releasing hormone.
- LH: Luteinizing hormone.
- FSH: Follicular stimulating hormone.
- FSH and LH are called gonado-tropic hormones.

♠ Document 4: Ovarian feedback control on the hypothalamo-pituitary axis:

- Ovarian hormones exert a feedback control on the secretions of GnRH by hypothalamus and the secretion of LH and FSH by pituitary gland.

➢ Mechanism of this feedback control:

1) During follicular phase of the ovarian cycle, (first 14 days):
   i) In the first 7 days: The level of estrogen is low, which leads to the increase in the secretions of GnRH in hypothalamus, thus increases the secretions of LH and FSH. So, ovarian hormones exert a negative feedback control on the hypothalamus as well as the pituitary gland.
   ii) In the second 7 days: The moderate level of estrogen leads to a slightly decreasing in the secretions of GnRH in the hypothalamus as well as decrease in the secretions in LH and FSH in the pituitary gland. Hence, ovarian hormones exert a negative feedback control on the hypothalamus as well as on the pituitary gland.

iii) Before ovulation: The level of estrogen increases sharply to reach peak value, which leads to the increase in the secretions in GnRH as well as the increase in the secretions of LH and FSH to their peak values. So, estrogen exerts a positive feedback control on the hypothalamus as well as on the pituitary gland.

iv) During luteal phase: The levels of estrogen and progesterone reach peak values, leading to the decrease in the secretions of GnRH as well as secretions of LH and FSH , so, estrogen and progesterone exert a negative feedback control on the hypothalamus as well as on the pituitary gland.

* Hint: During pregnancy, corpus luteum is present and called pregnant yellow body, which leads to high secretions of estrogen and progesterone that exert a negative feedback control on pituitary gland and keeps the level of LH and FSH low. So, peak value of LH wouldn't be reached , hence, no ovulation and no menstruation.

♣ Chapter 16:Birth control:

♠ Document 1: Contraceptive methods:

- Contraceptive methods are of 3 types:

1) Prevention of fertilization: by using:

i) For males:

_male condom “sheath of latex rubber” placed over the penis to prevent the semen from entering to vagina.

_Vasectomy(cut of vas deference): It is a surgical procedure that involves cut of vas deference, thus preventing the passage of sperms from the testes to the penis.

ii) For females:

_Using diaphragm that is shallow cup of plastic or thin rubber placed in vaginaso that it covers the external portion of t5he cervix preventing the passage of sperms to it.

_Tubal ligation: it is a method by which the oviducts are surgically blocked to make them incapable for transporting

ova, then preventing spermatozoa penetration.

2) Prevention of ovulation:

It is done by using contraceptive pills that are of 2 types:

i) Mixed pills(combination pills): they contain high amounts of estrogen and progesterone that exerts a negative feedback control on the secretion of GnRH in hypothalamus, and leads to the decrease of these secretions and consequently decreases the secretions of LH and FSH preventing the peak value of LH , thus preventing ovulation.
ii) Mini pill: it contains a large amount of progesterone that increases the secretion of mucus in cervical glands, hindering sperms to enter the uterus.

3) Prevention of implantation of embryo:

By IUD (Intra Uterine Device).

* Hint: IUD makes inflammation and high amount of menstruation.

♠ Document 2: Contragestive methods:

- Contragestive methods are of 2 types:
    1) Mechanical method: it depends on sucking the embryo from the uterus. It can be done between the 8^{th} and the 16^{th} week of pregnancy.
    2) Chemical method: By using an abortion pill:RU_{486}.
        - Hint: progesterone has specific receptors in the endometrial cells, so the combination between progesterone and its receptors in the endometrial cells in the uterus , leads to the thickening of endometrium and the fixation of the embryo.
- How do RU_{486} act:

RU_{486} has the same spatial configuration of progesterone, so it occupies its receptors in endometrial cells thus inhibiting the thickening of the endometrium, which inhibits protein synthesis , thus leading to the atrophy of the endometrium and its sloughing off (abortion).

_Before taking RU_{486} we inject estrogen in the uterus in order to make it sensitive to progesterone(development of cells of endometrium which leads to the presence of more progesterone receptors thus icreasing effect of progesterone).

_ After taking RU_{486}, the woman is exposed to the injection in muscle with prostaglandins, that leads to the contraction of the uterus , thus facilitating abortion.

* Hint: both progesterone and RU_{486} will be present in blood after taking RU_{486} pill, but the amount of RU_{486} is much larger than that of progesterone.
* RU_{486} is competitive to progesterone.

♠ Document 3:Medically assisted procreation:

- Techniques used in case of infertility and situations:
  1) Artificial insemination.
     - Situation:
       _cervical factors that prevent fertilization.
       _husband has low amount of sperms.
  2) In vitro fertilization(IVF) followed by embryo transformation.
     - Situation: The woman has blocked oviduct that prevents the passage of sperms.

➢ Causes of infertility:

- In woman:
  1) ovulation troubles.
  2) obstruction or impairing of oviduct.
  3) troubles in the receptivity of the sperm.
  4) hormonal troubles (in LH,FSH,GnRH, estrogen…).
- In man:
  1) Oligo spermia: insufficient number of sperms.

2) Azoospermia: Absence of sperms in the ejaculate due to:

_ absence of production of sperms by testes(no spermatogenesis) leading to the atrophy of testes.

_ blockage of vas-deference.

3) Astheno spermia: reduced sperm motility.

4) Terato spermy: high level of abnormal sperms.