Benha University
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Histology and Cytology Department

***H**istology **E**xam (**F**ood **Q**uality **C**ontrol)*(برنامج جودة ومراقبة الأغذية)

١٧ January 201٧ **1St year 1St Semester** Time allowed: -3 hours

***Please* answer the following questions and illustrate your answers with diagrams.**
من فضلك دعم جميع الإجابات بالرسوم التوضيحية **Total Marks (50)**

A- Describe the histological structure of the following:-:-

1. Omasum.

It's sometimes described as a "honeycomb." Notice that in the reticulum, there is a muscularis mucosae, of rather odd type. It consists of bands of smooth muscle which run through the tops of the ridges of the honeycomb, and which are more or less isolated from the lower levels, nearer the wall. It can be shown in gross specimens that this smooth muscle is continuous with that of the esophagus. The contraction of the muscularis mucosae serves to contract the openings of the honeycomb, somewhat like a purse-string closes a purse.
L. epith, the epithelium on the surface is a keratinized stratified squamous type, and there are no glandular elements.
L. propria , consists of collagen and elastic CT , smooth muscle band in the upper part of the papillae that continue with the muscle of the esophagus.
Submucosa, consists of collagen and elastic fibers which blend with that of the lamina propria, submucosal plexus was present
Muscularis externa, consists of 2 layers which obliquely arranged, myentric plexus and ganglia present
Serosa, loose CT covered by mesothelium
The rumen is an enormous space filled with chewed and half-chewed materials the cow has ingested, swallowed, regurgitated, and swallowed again (often several times). A combination of mechanical mastication and cellulase enzymatic action on the hard cellulosic material of the bovine diet permits the breakdown of these otherwise-indigestible materials. The cow who "chews her cud" is methodically grinding the food into smaller and smaller bits, allowing the symbionts more and more surface area on which to work.
Projecting from the wall are numerous finger-like projections. These are the ruminal papillae, which are somewhat conical in view.

2. Coronary artery.

wall has internal, middle, external elastic lamina to prevent occlusion of the artery during heart contraction
outer part of T. Media has circulay arranged smooth muscle fiber and inner part of T. Media has mixture of SM cell & C.T longitudinally arranged
but now this orientation seem to be not correct , the new suggestion support the following structure
No 3 elastic lamina as described before but
T. intima:-
characterized by endothelium and subendothelial amorphous substance, elastic fibers, monocytes
some muscle fibers escape from the T. media and longitudinally arranged in the farest part of the T. intima
Both of the internal and external elastic lamina as that of the medium artery

B- In Table, compare between the histological structure difference of:

1- Surface Epithelium.

Simple epithelium is a single layer of cells with every cell in direct contact with the basement membrane that separates it from the underlying connective tissue. In general, it is found where absorption and filtration occur. The thinness of the epithelial barrier facilitates these processes. In general, simple epithelial tissues are classified by the shape of their cells. The four major classes of simple epithelium are: (1) simple squamous; (2) simple cuboidal; (3) simple columnar; (4) pseudostratified.
(١)simple squamous; which is found lining areas where passive diffusion of gases occur. e.g. skin, walls of capillaries, linings of the pericardial, pleural,and peritoneal cavities, as well as the linings of the alveoli of the lungs.
(٢)simple cuboidal: these cells may have secretory, absorptive, or excretory functions. examples include small collecting ducts of kidney,pancreas and salivary gland.

(٣)simple columnar; cells can be secretory, absorptive, or excretory; Simple columnar epithelium can be ciliated or non-ciliated; ciliated columnar is found in the female reproductive tract and uterus. Non-ciliated epithelium can also possess microvilli.
(٤)pseudostratified columnar epithelium; can be ciliated or non-ciliated. The ciliated type is also called respiratory epithelium as it is almost exclusively confined to the larger respiratory airways of the nasal cavity, trachea and bronchi.
Stratified epithelium[edit]
Stratified epithelium differs from simple epithelium in that it is multilayered. It is therefore found where body linings have to withstand mechanical or chemical insult such that layers can be abraded and lost without exposing subepithelial layers. Cells flatten as the layers become more apical, though in their most basal layers the cells can be squamous, cuboidal or columnar.
Stratified epithelia (of columnar, cuboidal or squamous type)

2- Larynx and trachea.

It is an elongated structure of irregular shape.
Its wall contain hyaline & elastic cartilage
It connect pharynx to trachea.
Its lumen is narrowed by 2 fold.
Upper pair of folds → vocal cord (false)
Lower pair of folds → True cord (true)
Above the vocal cord is the vestibular portion but below it is the respiratory portion.
- Is formed from 4 cartilage connected together with fibroelastic C.T.

1- T. Mucosa:-

L. epithelialis. "epith on caudal epiglottis contain taste buds.
Vestibule → st. sq. epith. Non keratinized.
Respiratory part → Psudostratified ciliated columnar with goblet.

Lamina propria →

Fibroelastic in nature contain seromucoid gland and some immune cells.
Lymphatic infiltration & lymph. Nodule on either side of epiglottis
In pig, small ruminant and cat → para epiglottis tonsil.

NB

Seromucoid gland present except at level of ventricular & vocal ligament which contain elastic fiber.

2- T. Submucosa → thin layer of C.T

3- Laryngeal Cartilage →

That support & prevent collapse of larynx.
They are plates arranged in different level & connected together by fibroelastic C.T.
Hyaline → thyroid, cricoids, arytenoids.
Elastic → epiglottis with its cuniform & corniculate process and tip of arytenoids

4- Laryngeal Muscle: →

Intrinsic → sound production
Extrinsic → deglutition of food.
N.B-The cartilage between Ms may show ossification in the advanced age.
It is flexible tubular C.T organ lined with respiratory epithelium, which contains Clara cells and neuroendocrine (APUD) cells.
Various hyaline cartilage interconnected through inter annular ligament.
That provide continuous opening of the lumen through the C shape cartilage.
The C shape cartilage makes the trachea flat for facilitation of the esophagus above it.

1- Mucosa:-

It appear without folds because lack of substantial submucosal C.T.
L. epith. Respiratory epith.
L. propria fibroelastic CT & lymphocytic infiltration at deep part (Dense elastic lamina).
2- Submucosa:- Loose C.T.
Seromucoid gland & their duct pierce the dense elastic lamina to empty it's content in the inner surface of the trachea.

3- Tracheal cartilage:-

C. Shape series of cartilage arranged
the free border closed with bundle of smooth muscle.
Above free border → Cat , Dog.
Within the free border → Pig, Horse, Ruminant.

4- Tunica Adventitia :- layer of loose C.T rich in blood vessels and nerves.

2- R.E.R and S.E.R.

I-Rough endoplasmic reticulum (r.E.R)

Membranous organelles. An endoplasmic reticulum (ER) in a cell is a system of membranes, which is the site of manufacture of proteins and lipids. The "rough" component of the term "Rough Endoplasmic Reticulum" or "RER" indicates that there are ribosomes attached to the surfaces of the endoplasmic reticulum.

Three dimension network of branching & anastomosing membrane.
Bounded and flatten tubules.
Widen sacs like structure "Cisternae" within the meshes of the cisternae
Ribosome present on the surface of the sacs gives rough appearance.

L.M

Appear as basophilic substance of the cytoplasm "ergastoplasm " so it called" chromidal substance" due to similarity to chromatin of the nucleus.

NB (rER+ ribosome) in Nerve cell called Nissl's body.

E.M.

Parrelled stack of flatten cisternae.
It continues with nuclear envelope.
Ribosome gives granular appearance.

Function :-

Synthesis of intracellular protein
Synthesis of protein that segregated & transferred to Golgi apparatus as transferred vesicle.
Play role in glycogen biosynthesis.
Its fluid filled channel facilitates diffusion of metabolite through the cytoplasm.

II-Smooth endoplasmic reticulum (sER):-

Membranous network devoid of ribosome
The cisternae more tubular interconnected and communicate with r.E.R& nuclear envelope.
It believed now that s.E.R derived from r.E.R after loosing attached ribosome.

Function →

Biosynthesis of phospholipids & fatty acid.
Resynthsis of absorbed lipid and transport it to absorptive intestinal cell.
Biosynthesis of cholesterol & steroid hormones.
Share in metabolism of cholesterol.

3- Plasma and mast cells.

Mast cell:-

Mast cells play a central role in inflammatory and immediate allergic reactions.
Mast cells contain special cytoplasmic granules, which store mediators of inflammation. The extra cellular release of the mediators is known as degranulation
Large ovoid cell
Cytoplasm intensely contains basophilic granules, which obscure spherical centrally located nucleus.
It present in many parts of the body & Mast cells settle in connective tissues and usually do not circulate in the blood stream.

Function

Secrete heparin "anticoagulant ".
Secrete SRS- slow reacting substance of anaphylaxis
E.C.F.A "eosinophilic chemotactic factors of anaphylaxis.
Both SRS-A , Ec.F-A are produced by mast cell but not stored in it.
Surface of mast cell contain specific receptor for IGE.
Not detected by H&E. By Toluidine blue → reddish purple granule "metachromsia ".

Plasma Cell (clock face, wheel with spokes):-
Large ovoid cell.
Basophilic, cytoplasm due to richness with R.E.R. Few numbers in C.T
Spherical nucleus, eccentrically located contain compact coarse heterochromatin of equal size resemble wheel with spokes giving the nucleus clock face appearance.
Juxtanuclear Golgi apparatus with centriole occupy region of the cytoplasm which appear pale
Function →
Antibodies production.
Present in inflammation "chronic site of bacterial penetration.
C- Write short notes on your internet research **(Small intestine).**
The small intestine is divided into duodenum (25-30 cm), jejunum (about first two-fifths of the rest) and ileum. The three segments merge imperceptibly and have the same basic histological organization.
The Mucosa
The mucosa of the small intestine has various structural features which considerably increase the luminal surface area and consequently support the main function of the small intestine - the absorption of the degraded components of the food.
Plicae circularis (of Kerkering) are macroscopically visible, crescent-shaped folds of the mucosa and submucosa. Plicae circularis extend around one-half to two-thirds of the circumference of the lumen of the small intestine.
Duodenum
permanent structures, i.e. their presence does not depend on the state of distension of the small intestine.
They are absent from the first few centimeters of the duodenum and the distal part of the ileum and are particularly well developed in the jejunum.
They increase the surface area of the mucosa.
The entire intestinal mucosa forms intestinal villi (about one mm long), which increase the surface area. The surface of the villi is formed by a simple columnar epithelium. Each absorptive cell or enterocyte of the epithelium forms numerous microvilli (1 µm long and about 0.1 µm wide). Microvilli increase the surface area . the core of the villi is formed by loose CT containing (leucocyte, plasma cell, smooth muscle cells, fibroblast, lymphocytes and single lymphatic capillary in the center of the vilus forming the central lacteal.
Between the intestinal villi we see the openings of simple tubular glands, the crypts of Lieberkühn.
They extend through the lamina propria down to the muscularis mucosae. Undifferentiated cells close to the bottom of the crypts regenerate the epithelium (epithelial cell turnover time is less than one week). Other epithelial cells in the crypts correspond largely to those in the epithelium of the intestinal villi.
One exception is Paneth cells (pyramidal cell, spherical nucleus, acidophilic granular cytoplasm) which are located at the bottom of the crypts. They release a number of antibacterial substances, among them lysosome, and are thought to be involved in the control of infections.
One function of the crypts of Lieberkühn is the secretion of "intestinal juice" (about 2 liter/day), which in its composition closely resembles extra cellular fluid and which is rapidly reabsorbed. The only enzymes which can be demonstrated in the intestinal juice are enteropeptidase (or enterokinase), which activates the pancreatic enzyme trypsin, and small amounts of amylase.
In addition to enterocytes, the epithelium is composed of mucus-secreting goblet cells and endocrine cells.
In addition to gastrin- and somatostatin-producing cells, we also find endocrine cells secreting cholecystokinin and secretin. Cholecystokinin stimulates the secretion of digestive enzymes in the pancreas and the contraction of the gall bladder. Secretin stimulates the pancreas to release "pancreatic juice", which is rich in bicarbonate ions. Secretin also amplifies the effects of cholecystokinin.
The lamina propria is, similar to the lamina propria of the stomach, unusually cell rich. Lymphocytes often invade the epithelium or form solitary lymphoid nodules in the lamina propria.
Lymph nodules may form longitudinal aggregations of 30-50 nodules in the lamina propria of the ileum. These large aggregations are called Peyer's patches.
The muscularis mucosae have two layers and extend into the intestinal villi, where the smooth muscle cells form a longitudinal bundle in the centre of the villi. , which is thin and incomplete in dog
The Submucosa
The submucosa contains glands only in the duodenum. Submucosal glands of the duodenum are also called

Brunner's glands. Their secretion is mucous and slightly alkaline due to bicarbonate ions (pH 7-8). The amount of bicarbonate is however too low to neutralize the acidic contents of the duodenal lumen. Instead, the secretion of Brunner's glands protects the duodenal mucosa - similar to the mucus which protects the gastric mucosa.
This gland is serous (dog &ruminant), mucous (pig &horse) and Seromucoid (cat).
Muscularis externa, consists of inner circular and outer longitudinal SMF
Serosa, loose C. T blends with the mesothelium of the peritoneum.
Large Intestine
The large intestine constitutes the terminal part of the digestive system. It is divided into three main sections: cecum including the appendix, colon, and rectum with the anal canal.
The primary function of the large intestine is the reabsorption of water and inorganic salts. The only secretion of any importance is mucus, which acts as a lubricant during the transport of the intestinal contents.
The surface of the mucosa is relatively smooth as there are no plicae circulares or intestinal villi.
Crypts of Lieberkühn are present and usually longer and straighter than those of the small intestine.
Goblet cells account for more of the epithelial cells than in the small intestine.
There is only little lamina propria squeezed between the glands. The muscularis mucosae again form two layers.
Considerable amounts of fat may be found in the submucosa.
The appearance of the muscularis externa is different from that of the small intestine. The inner circular layer of muscle forms the usual sheath around the large intestine, but the outer longitudinal muscle layer forms three flattened strands, the taenia coli. Only a thin layer of longitudinal muscle surrounds the inner circular muscle layer between the taenia coli.
The adventitia forms small pouches (appendices epiploicae) filled with fatty tissue along the large intestine.
Cecum:
- varies in size within species.
-Substantially, nodules scattered throughout all length of cecum.
- Absence of villi.
Colon:-
- Thick mucosa because increase thickness of gland.
- Increase lymph nodules (increase goblet cell)
- L. Muscularis is interrupted in pig & Horse.
- Outer longitudinal Ms of T. muscularis become flat form large Ms., bands with elastic fiber.
- Taenia ceci and Taenia coli of horse has more elastic fiber than S.M
Rectum
- Mucosa of rectum is smooth
- Increase number of goblet cells and outer longitudinal SMF contain more elastic fiber
- Retro peritoneal portion of rectum lack of serosa
- Near junction with anus (Ruminant), the rectal mucosa thrown into longitudinal folds
(Rectal column are depression between the rectal sinuses)

D- Give the histological structural relationship of the following:-

1. Lysosome.

Membranous organelles contain hydrolytic enzyme act on pH medium (acidic). Lysosomes are tiny sacs filled with enzymes that enable the cell to utilize its nutrients and are responsible for destroying the cell after it has died. However, there are some circumstances (diseases/conditions) in which lysosome begin to 'break-down' living cells.
800 nm in diameter.It derived from Golgi complex.
L.M → vesicle of basophil, eosinophil and/ neutrophil.
E.M → homogenous round vesicle bounded with thin membrane.
Chemically they are lipoprotein complex, their cavity filled with hydrolytic enzyme.
How lysosome are formed.
The lysosome are the freshly formed secretory vesicle contain hydrolytic enzyme “primary lysosome”
It comes from r.E.R as transfer vesicle contains enzyme synthesis with ribosome of r.E.R.
When they grow up in the saccules of the Golgi they bud off from the mature face of the Golgi as secretory vesicle.

Secondary lysosome, when the primary lysosome phagocytosis any undesirable vesicle in the cytoplasm then called secondary lysosome.
If fuse with phagocytic vesicle" "phagosome" when enzyme digest vesicle → result residual body.
If fuse with torn, old cytoplasmic content "cytolysosome or autophagic vacuole".
Function:-
Have active role in intracellular metabolism e.g. Carbohydrate.
Have active role in phagocytosis, pinocytosis, and autophagy and autolysis.
Breakdown of excessive secretory granules.
Share in normal secretory activity of some cells as thyroid gland.

2. Nasal cavity.

Nasal cavity consists of 3 parts
Vestibular region (cuteaneous).
Olfactory region
Respiratory region

1- Vestibular part is the continuation of the integument that covers the face
The epithelium lining changes from rostral region to the caudal region
Its keratinized epithelium rostrally, non keratinized in the midsection and stratified cuboidal or psudostratified caudally.
Horse→ the initial part include diverticulum nasi which lined with the integument contain hair, sweat and sebaceous gland
Domestic animal→ the lining epith is pigmented st. sq. epith non keratinized which present also in vestibular caudal portion of the (Horse)
Simple branched tubuloacinar serous or seromucoid gland present in the propria submucosa which contains blood vessels, nerves and dense CT
The lateral nasal gland is a compound gland that moistens the vestibular mucosa in the dog but absent in large ruminant.

2- Respiratory region

The junction between Respiratory and vestibular region are lined with transitional epithelium.
Mucosa→ Pseudostratified columnar ciliated with goblet cells.
Submucosa→ loose CT
← Venous plexus which give the mucosa it's errectile character & pronounced red color
Submucosa→ directly attached to → periosteum which lines the bone Perichondrium ← which line hyaline of septum nasi. The area may call pesudoerrectile tissue in human because it appears congested.

3- Olfactory Region:-

It consists 3 types of cells:-

<u>Supporting (sustenticular cells)</u>

Tall columnar & their free surface carry microvilli.
It contains pigmented granules "give color of olfactory yellow color.
Oval light stain nuclei with the proximal portion.
Basal portion always bifurcated.

E.M

Extensive Golgi in the portion "SER, lysosome.
Pigmented inclusion "vesicle appear secretory in nature". Nuclei contain euchromatin than olfactory cell.
Microvilli in the apical portion. basal border extend toward the basement membrane.
Desmosomes & hemidesmosome between adjacent cell in addition to junction complex that connect cell to dendritic bulb

<u>2- Olfactory cell "bipolar cell, Receptor cell</u>

It distributed between supporting cells.
It's bipolar nerve cell.
Apical border is modified dendrites extend as cylindrical process.
- The basal border of the cell tapers into thin process l um which is an axon (one of the fiber of the olfactory nerve).

- The dendrites expand on the surface to form the olfactory vesicles from which delicate olfactory hair extend (6:8 olfactory cilia).
The axon deeply penetrates the L-propria (unmyelinated nerve fiber).
These specialized cilia appear to be the component of the sense organ, which is exited with the ouder substance.

3-Basal cell (stem cell) :-

Form single layer of small conical elements with dark nuclei.
Branching process which interlacing with each other & the bifurcated end of the supporting cell.
It may consider the store cell for the other cells.

Lamina propria:-

It is continuous with the dense C.T forming the periosteum of the cribriform plate. Numerous pigment cells, lymphoid, blood plexus.
It contain Bowman's gland" tubuloalvoelar gland.
The secretion of Bowman's glands keeps the nose moist.
Make freshness of the bipolar cilia.
Solvent for the ouderous gases which affect the cilia

3. Cell membrane.

It also known as plasmalemma & plasma membrane (trilaminar structure)
is composed of dense layer of cytoplasm surround the eukaryotic cell
is composed of 2 layer of dense protein in between present phospholipids
Its thickness range from 8:10 nm
only can seen with E.M & appear as protein swim in a sea lipid
carbohydrate present in conjugated form either glycoprotein or glycolipid
some pores present 0.35-0.8 nm in membrane
it appears as trilaminar structure , outer and inner dark layer and middle light layer , this configuration due to→
it appear like that due to deposition of reduced osmium stain on the hydrophilic side of the cell membrane
These are some "theories of the structure of cell membrane
Linear theory
Molecular theory
Fluid mosaic theory

1-Linear Theory, as the cell membrane appear as 3 line, 2 dense bilayer
Phospholipids→ hydrophilic and one light intermediate→ hydrophobic

2-Fluid Mosaic theory, globules of protein move freely through the cell membrane. They are floating & changing their position from time to time.
Protein → extrinsic" peripheral" are present in one side of the lipid bilayer "outside" & closely bounded to the cytoplasmic side "has non polar bond"
Intrinsic (integral) present between lipid bilayer from side to side & some times attached to microtubules or microfilament of the cytoplasm. "Has both polar and polar band ".

3) Molecular theory: it indicates biochemical structure of the cell membrane.
Phospholipids" hydrophilic head, hydrophobic tail.
Protein "integral and peripheral"
Carbohydrate "glycoprotein and glycolipid.
Cholesterol has fixing rule that it make phospholipids backed tightly together.

Function:

1-Protective
2-Regulate transport in and out of cell or subcellular domain.
3-Allow selective receptivity and signal transduction by providing ansmembrane receptors that bind signaling molecules.
4-Allowcellrecognition
5- Provides anchoring sites for cytoskeletal filaments or components of the extra-cellular matrix. This allows the cell to maintain its shape and perhaps move to distant sites.
6- Help compartmentalize subcellular domains or microdomains
7- Provide a stable site for the binding and catalysis of enzymes.
8- Regulate the fusion of the membrane with other membranes in the cell via specialized junctions)

9- provide a passageway across the membrane for certain molecules, such as in gap junctions.
10- Allow directed cell or organelle motility

4. Liver.

Sheets of connective tissue divide the liver into thousands of small units called lobules. A lobule is roughly hexagonal in shape, with portal triads at the vertices and a central vein in the middle.
The lobule is the structural unit of the liver and rather easy to observe. In contrast, the hepatic acinus is more difficult to visualize, but represents a unit that is of more relevance to hepatic function because it is oriented around the afferent vascular system.
The parenchymal cells of the liver are hepatocytes. These polygonal cells are joined to one another in anastomosing plates, with borders that face either the sinusoids or adjacent hepatocytes. The ultrastructure appearance of hepatocytes reflects their function as metabolic superstars, with abundant rough and smooth endoplasmic reticulum, and Golgi membranes. Glycogen granules and vesicles containing very low density lipoproteins are readily observed.
Hepatocytes make contact with blood in sinusoids, which are distensible vascular channels lined with highly fenestrated endothelial cells and populated with phagocytic Kupffer cells. The space between endothelium and hepatocytes is called the Space of Disse, which collects lymph for delivery to lymphatic capillaries.
Bile originates as secretions from the basal surface of hepatocytes, which collect in channels called canaliculi. These secretions flow toward the periphery of lobules and into bile ductules and interlobular bile ducts, ultimately collecting in the hepatic duct outside the liver.
The hepatic duct is continuous with the common bile duct, which delivers bile into the duodenum. In most species, bile is diverted through the cystic duct into the gall bladder. The columnar epithelium of the gall bladder is devoted largely to absorption of water and electrolytes. The liver lobules are the structural and functional units of the liver. The lobule is surrounded by 6 portal tracts and centered on the centrolobular vein, which is a terminal twig of the hepatic vein. The portal vein ramifications in the portal tracts give off a series of branches between adjacent portal tracts, which in turn give rise to sinusoids draining blood towards the center of the lobule.
The liver parenchymal cell (hepatocyte) is a polygonal cell with a central nucleus. Hepatocytes are arranged in plates one cell thick with a sinusoid on either side, with a radial arrangement in the center of the lobule. The virtual cleft between the sinusoidal lining cells and the hepatocyte surface is the space of Disse. Fenestrated endothelial cells line the sinusoids. Kupffer cells, which are members of the mononuclear phagocyte system, bulge out on the luminal side of the sinusoids. Hepatic stellate cells (Ito cells) are perisinusoidal pericytes located in the space of Disse.The portal tracts at the lobulary periphery are composed of connective tissue, ensheathing branches of the hepatic artery, portal vein, bile duct, and lymphatics. Ductules (or cholangioles) connect interlobular bile ducts with the lobular canaliculi, which are formed between adjacent hepatocytes.
Hepatocytes are polygonal in shape, with clearly outlined margins. The cytoplasm is granular and eosinophilic, usually rich in glycogen, with basophilic perinuclear aggregates of rough endoplasmic reticulum. The nucleus is centrally placed, with one or more nucleoli. Lipofuscin may occur as fine, light brown granules, mostly in centrolobular hepatocytes

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سوف يعقـــد امتحـــان الشفـــوي بعد الآمتحـــان النـــظرى
مباشـــــرة بالقســـــم

GOOD LUCK
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