# Embryology summary

| ORGAN | ORIGIN | WEEK OF DEVELOPMENT |
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| oral cavity | Cephalic part : ectodermal in origin(Hard palate<br>Sides of the mouth , Lips , Enamel of the teeth)<br>Caudal part : endodermal in origin(Tongue . Soft palate<br>. Palatoglossus and palatopharyngeal folds<br>. Floor of the mouth<br>. pharynx)<br>The buccopharyngeal membrane separate between ectoderm and endoderm. | These two points are separated by the buccopharyngeal membrane, this membrane disappears during the 3rd week of development |
| salivary glands | Parotid gland(ecto)<br>Sublingual gland(endo)<br>Submandibular gland(endo) | During the 7th week they arise as groups of a solid outgrowth of cells from the epithelial cells of walls of the developing mouth, is grows through the underlying mesenchyme (connective tissue) |
| Tongue | -The anterior 2/3 part of the tongue: forms from of two lateral lingual swellings and one medial swelling (The tuberculum impar), these structures form from the First pharyngeal arch.<br>- The posterior 1/3 part of the tongue: forms from the copula, or hypobranchial eminence ( median swelling formed by mesoderm of the second, third, and part of the fourth arch.<br>- Q: What forms the arches?<br>a) The lateral lining of the arch is formed by ectoderm<br>b) inside the arch is formed by mesoderm<br>c) The medial lining of the arch is formed by endoderm | The tongue appears in embryos of approximately 4 weeks<br>Tongue develops when the stomodeum and pharynx meet |
| Muscles of the tongue | myoblasts originating in occipital somites, mesoderm innervated by hypoglossal nerve | |
| pharynx | : from the upper 4 pharyngeal arches<br>-endoderm: pharynx in the neck<br>-mesoderm: pharyngeal arches | |

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| | -ecto: pharyngeal clefts | |
| anterior abdominal wall | -somatoplueric mesoderm (meso attached to ecto)then tangentially divides into three layers:<br>• Ext. oblique<br>• Int. oblique<br>• Trans. abdominus<br>-The splanchnic layer with the endoderm is called Splanchnopleuric mesoderm:vescira<br>-**rectus abdominus muscle from the myotome(exception)** | after formation of the abdominal Wall, right and left sides of mesenchyme fuses together at the 3rd month into the midline to form the Linea alba |
| the umbilicus and the umbilical cord | umbilical cord come from the placenta in the uterus and reach the umbilicus of the fetus.<br>-The amnion and the chorion fuse together<br>The amnion encloses the body stalk and the yolk sac with their blood vessels to form the tubular umbilical cord<br>The mesenchyme core of the cord (Whartons jelly) form a loose connective tissue which embed the following:<br>1) Remains of yolk sac that connect with the midgut.<br>2) Vittelline duct: connection between the yolk sac and the midgut.<br>3) Remains of allantois: connection between the umbilicus and the urinary bladder Note:<br>Both vitelline duct and the remains of the yolk sac must obliterate completely, as we don't want feces or urine to be execrated from the umbilicus.<br>4) Umbilical blood vessels : we have two types of blood vessels:<br>a- Arteries: We have 2 arteries that carries deoxygenated blood from the fetus to the chorion (placenta) from fetus to mother | |

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| | b- 2 veins carry oxygenated blood from the placenta from mother to fetus<br>the right vein will soon disappear | |
| lung buds | 1st origin  endodermal layer: forms the epithelium of the internal lining of the larynx, trachea, and bronchi, as well as that of the lungs.<br>2nd origin  mesoderm layer: especially the splanchnic mesoderm surrounding the foregut, it forms cartilaginous, muscular, and connective tissue components of the trachea and lungs.<br>• Initially the lung bud is in open communication with the foregut<br>• When the diverticulum expands caudally, however, two longitudinal ridges, the **tracheoesophageal ridges,** separate it from the foregut<br>• Subsequently, when these ridges fuse to form the **tracheoesophageal septum,** the foregut **is divided into a dorsal portion, the esophagus, and a ventral portion, the trachea and lung buds**<br>• The respiratory primordium maintains its communication with the pharynx through the laryngeal orifice(epiglottis). | approximately 4 weeks old, the respiratory diverticulum (lung bud) appears as an outgrowth from the ventral wall of the foregut |
| The Foregut: | | |
| esophagus | -lung bud as above<br>-The muscular coat (meso), which is formed by surrounding splanchnic mesenchyme, is striated in its upper two-thirds so innervated by the vagus nerve while the lower third is a smooth muscle so innervated by the splanchnic plexus. | |
| Stomach | 1. The stomach rotates 90◦ clockwise around its | The stomach appears as a fusiform (spindle) dilation of the foregut in the fourth |

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| | longitudinal axis(the first rotation), causing its left side to face anteriorly and its right side to face posteriorly<br>the posterior wall grows faster and to the left, the anterior wall slower and to the right, so the greater curvature will form firstly and to the left while the lesser curvature to the right<br>2. stomach attached to the anterior wall of the abdomen by ventral gastromesentery and posterior gastromesentery attached with posterior abdominal wall.<br>With rotation: dorsal become left side / ventral becomes right side<br><br>3. The dorsal mesentery forms the greater omentum, greater curvature and the ligaments of the stomach with spleen and with other parts(posteriorly)<br>4.The ventral mesentery forms the lesser omentum and ligaments of the liver<br>5.The left and right vagus nerve with rotation the left become anterior and the right posterior to the stomach.<br>6. growth the stomach rotates around an anteroposterior axis, such that the caudal or pyloric part moves to the right and upward and the cephalic or cardiac portion moves to the left and slightly downward. | week of development during the following weeks, its appearance and position change greatly as a result of the different rates of growth in various regions of its wall and the changes in position of surrounding organs |
| spleen | 1.the spleen primordium appears as a mesodermal proliferation between the two leaves of the dorsal mesogastrium.<br>2. With continued rotation of the stomach, the | the fifth week of development |

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| | dorsal mesogastrium lengthens, and the portion between the spleen and dorsal Cephalic end<br>Caudal end<br>remain attached to the posterior Ventral mesogastrium<br>Posterior mesogastrium midline swings to the left and fuses with the peritoneum of the posterior abdominal wall.<br>3. The posterior leaf of the dorsal mesogastrium and the peritoneum along this line of fusion degenerate. | |
| liver | - the hepatic diverticulum, or liver bud, consists of rapidly proliferating cells that penetrate the septum transversum, that is, the mesodermal plate between the pericardial cavity and the stalk of the yolk sac.<br>-the connection between the hepatic diverticulum and the foregut (duodenum) narrows, forming the bile duct<br>-Liver cords differentiate into the parenchyma (liver cells) and form the lining of the biliary ducts.<br>-A small ventral outgrowth is formed by the bile duct, and this outgrowth gives rise to the gallbladder and the cystic duct<br>-During further development, epithelial liver cords intermingle with the vitelline and umbilical veins, which form hepatic sinusoids<br>-Hematopoietic cells, Kupffer cells, and connective tissue cells are derived from mesoderm of the septum transversum | The liver primordium appears in the middle of the third week as an outgrowth of the endodermal epithelium at the distal end of the foregut |
| duodenum | The terminal part of the foregut and the cephalic part of the midgut form the Duodenum | -the cephalic part starts rotation in $6^{th}$ week in the umbilicus cord<br>-then back to the abdomen in the $10^{th}$ week |

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| | -as a part of foregut, proximal to the liver bud:As the stomach rotates CLOCKWISE, the duodenum takes on the form of a C-shaped loop and rotates to the right so the rotation of duodenum with the rotation of the stomach) the rotation in the right side and backwards and form the C-shaped of duodenum.<br>This rotation, together with rapid growth of the head of the pancreas, swings the duodenum from its initial midline position to the left side of the abdominal cavity - With rotation the common bile duct that was in the right side become in the left side of the duodenum<br>-as cephalic part of midgut:it rotates COUNTERCLOCKWISE:270 degree<br>--mesentry: -The duodenum and head of the pancreas press against the dorsal body wall, and the right surface of the dorsal mesoduodenum fuses with the adjacent peritoneum.<br>-Both layers subsequently disappear, and the duodenum and head of the pancreas become fixed in a retroperitoneal position.<br>-The entire pancreas thus obtains a retroperitoneal position.<br>-The dorsal mesoduodenum disappears entirely except in the region of the pylorus of the stomach, where a small portion of the duodenum (duodenal cap) retains its mesentery and remains intraperitoneal | -During the second month, the lumen of the duodenum is obliterated by proliferation of cells in its walls. However, the lumen is recanalized shortly thereafter<br>Since the foregut is supplied by the celiac artery and the midgut is supplied by the superior mesenteric artery, the duodenum is supplied by branches of both arteries |
| pancreas | The pancreas is formed by two buds originating from the | in the third month of fetal life, pancreatic islets (of |

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| | endodermal lining of the duodenum(epithelial growth)<br>Whereas the dorsal pancreatic bud is in the dorsal mesentery(in the left side), the ventral pancreatic bud is close to the bile duct<br>-When the duodenum rotates to the right and becomes Cshaped, the ventral pancreatic budmoves dorsally in a manner<br>similar to the shifting of the entrance of the bile duct.<br>-Finally the ventral bud comes to lie immediately below and behind the dorsal bud<br>-Later the parenchyma and the duct systems of the dorsal and ventral pancreatic buds fuse together.<br>-The ventral bud forms the uncinate process and inferior part of the head of the pancreas<br>-The remaining part of the gland(pancreas) is derived from the dorsal bud.<br>-The main pancreatic duct (of Wirsung) is formed by the distal part of the dorsal pancreatic duct and the entire ventral pancreatic duct.<br>-The proximal part of the dorsal pancreatic duct either is obliterated or persists as a small channel, the accessory pancreatic duct (of Santorini). | Langerhans) develop from the parenchymatous pancreatic tissue and scatter throughout the pancreas.<br>-Insulin secretion begins at approximately the fifth month<br>-Glucagon- and somatostatin-secreting cells also develop from parenchymal cells.<br>-Splanchnic mesoderm surrounding the pancreatic buds<br>forms the pancreatic connective tissue |
| midgut | | |
| The cephalic limb of the loop develops into the distal part of the duodenum,<br>the jejunum, and proximal part of the ileum.<br> The caudal limb becomes the distal part of<br>the ileum, the cecum, the appendix, the | 1. Physiological Herniation: Development of the primary intestinal loop is characterized by rapid elongation, particularly of the cephalic limb.<br> In the development of midgut, as a result of the rapid growth | 1.physiologic herniation: they enter the extraembryonic cavity in the umbilical cord through the umbilical ring during the sixth week of development<br>2.rotation OF MID GUT:<br>* During Herniation the rotation will be 90o (during 6th week) |

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| ascending colon, and the proximal twothirds of the transverse colon.<br>□ The apex of the cephalic and caudal limb is<br>called vitelline duct (That's connect the apex<br>with umbilicus) | and expansion and enlargement of the liver and heart the abdominal cavity temporarily becomes too small to contain all the intestinal loops so physiologic herniation happens*It happens when the loops of small intestine enter umbilical cord around superior mesenteric artery within vitelline duct.<br>2. Rotation of the midgut:<br>In the umbilical cord: COUNTERCLOCK WISE 90 degree, elongation and looping for small intestine and only elongation for large intestine<br>180 CC in the abdomen, the sum is 270 CC<br>3. Retraction of herniated loops: herniated intestinal loops begin to return to the abdominal cavity.□ Is thought that regression of the mesonephric kidney, reduced growth of the liver, and expansion of the abdominal cavity play important roles of retraction of the hernia .<br>□ During the retraction the proximal portion of the jejunum, the first part to reenter the abdominal cavity, comes to lie on the left upper side of the abdominal cavity . | Physiological Herniaton<br>Rotation of the midgut :<br>* During 10th and 11th weeks, there will be another 180o to return intestine (hernia) into the abdominal cavity<br>3.retraction of herniated loop: $10^{th}$ week |

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| | ⍰ The later returning loops (like the cecum) gradually settle more and more to the right | |
| appendix | The cecal bud, as a small conical dilation of the caudal limb of the primary intestinal loop, is the last part of the gut to reenter the abdominal cavity from umbilical cord.<br>⍰ Temporarily it lies in the right upper quadrant directly below the right lobe of the liver<br>⍰ From here it descends into the right iliac fossa, placing the ascending colon (and give bud called appendicular bud forms the appendix) and hepatic flexure on the right side of the abdominal cavity<br>- Since the appendix develops during descent of the colon, its final position frequently is posterior to the cecum or colon.<br>⍰ These positions of the appendix are called retrocecal or retrocolic, respectively. | which appears at about the sixth week |
| Hindgut | | |
| -distal third of the transverse colon, the descending colon, the sigmoid, the rectum, and the upper part of the anal canal<br>- The endoderm of the hindgut also forms the internal lining of the bladder and urethra | The terminal portion of the hindgut enters into the posterior region of the **cloaca, the primitive anorectal canal;** the ***allantois enters into the anterior portion, the primitive urogenital sinus***<br>• The cloaca itself is an endodermlined cavity covered at its ventral boundary by surface ectoderm.<br>**• This boundary between the endoderm and the ectoderm forms the cloacal membrane** | |

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| | • A layer of mesoderm, the urorectal septum, separates the region between the allantois and hindgut.<br>• This septum is derived from the merging of mesoderm covering the yolk sac and surrounding the allantois<br>• **At the end of the seventh week, the cloacal membrane ruptures, creating the anal opening** for the hindgut and a ventral opening for the urogenital sinus.<br>• Between the two, the tip of the urorectal septum forms the perineal body<br>• proliferation of ectoderm closes the Caudal most region of the anal canal.<br>• **During the ninth week, this region recanalizes**<br>• Thus, the caudal part of the anal canal originates in the ectoderm, and it is supplied by the inferior rectal arteries, branches of the internal pudendal arteries | |
| Lowe half of anal canal | Proctodeum(ecto) | |

اللهم صلّ على سيدنا محمد

Best of luck

**Done by: Noor Abu Hantash**