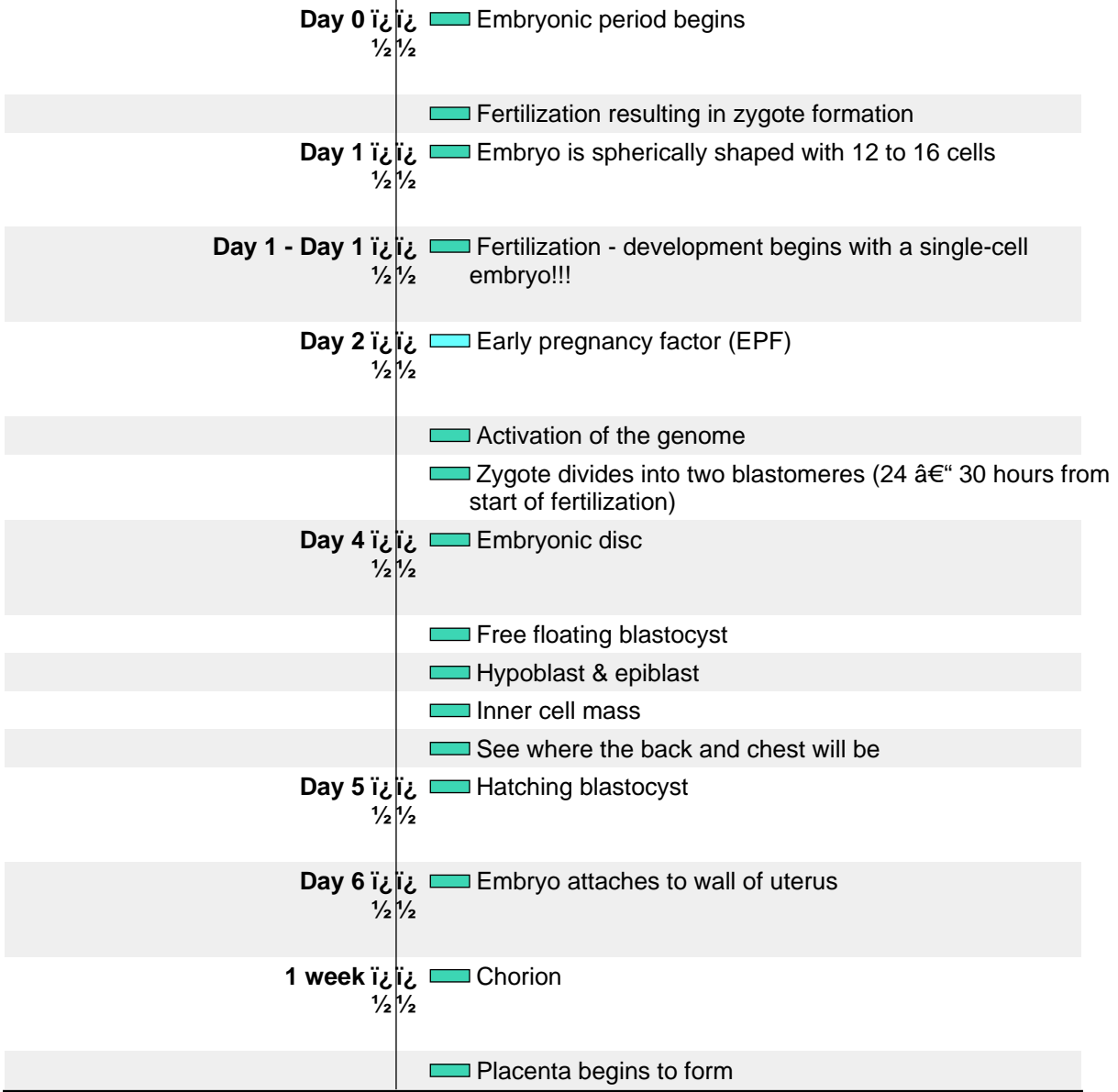


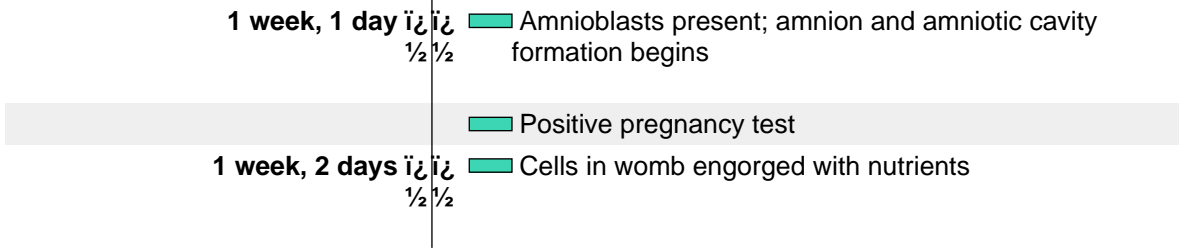
Prenatal Development Timeline

- | | | | |
|---|--|--|---|
| ■ Nervous | ■ Cardiovascular | ■ Muscular | ■ Early Events |
| ■ Special Senses | ■ Respiratory | ■ Skeletal | ■ Growth Parameters |
| ■ Blood & Immune | ■ Gastrointestinal | ■ Endocrine | ■ General |
| ■ Skin/Integument | ■ Renal/Urinary | ■ Reproductive | ■ Movement |










Unit 1: The First Week



Unit 2: 1 to 2 Weeks



| | |
|---|---|
| 1 week, 4 days $\frac{1}{2}$ $\frac{1}{2}$ | Longitudinal axis |
| 1 week, 5 days $\frac{1}{2}$ $\frac{1}{2}$ | Implantation complete |
| | Yolk sac |
| 1 week, 6 days $\frac{1}{2}$ $\frac{1}{2}$ | Primordial blood vessels |
| | Amnion with single cell layer |
| | Chorionic villi |
| 2 weeks $\frac{1}{2}$ $\frac{1}{2}$ | Yolk sac |
| | Yolk sac |
| Unit 3: 2 to 3 Weeks | |
| 2 weeks, 1 day $\frac{1}{2}$ $\frac{1}{2}$ | 3 germ layers |
| | Rostral-caudal orientation |
| 2 weeks, 2 days $\frac{1}{2}$ $\frac{1}{2}$ | Erythroblasts in yolk sac |
| | Three types of blood-forming cells in yolk sac |
| | Amnion with two cell layers |
| | Secondary villi |
| 2 weeks, 4 days $\frac{1}{2}$ $\frac{1}{2}$ | Foregut, midgut, and hindgut |
| | Brain is first organ to appear |
| | Neural plate induced by notochordal process |
| | Connecting stalk |
| 2 weeks, 6 days $\frac{1}{2}$ $\frac{1}{2}$ | Numerous blood islands in umbilical vesicle |
| | Foregut |
| | Stomodeum forming |
| | Beginnings of the heart can be seen |
| | Blood vessels emerge simultaneously in umbilical vesicle, embryo proper, amnion, and connecting stalk |
| | Dorsal aortae (paired) |
| | Paired tubular heart |
| | Forebrain, midbrain, and hindbrain |
| | Neural groove deepens substantially |
| | Three main divisions of brain |
| | Neural crest: Rostral and facial |

| | |
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| <p>3 weeks   </p> <p>$\frac{1}{2}$ $\frac{1}{2}$</p> | <p> Blood and blood vessels</p> |
| <p>Unit 4: 3 to 4 Weeks</p> | |
| <p>3 weeks, 1 day   </p> <p>$\frac{1}{2}$ $\frac{1}{2}$</p> | <p> Midgut emerging</p> |
| | <p> Respiratory outgrowth</p> |
| | <p> Atria (right and left) far apart</p> |
| | <p> Circulatory system function begins</p> |
| | <p> Endocardial tubes fuse forming tubular heart</p> |
| | <p> Heart begins beating</p> |
| | <p> Pericardium</p> |
| | <p> Primary head vein</p> |
| | <p> Sinus venosus</p> |
| | <p> Tubular heart begins folding</p> |
| | <p> Umbilical arteries</p> |
| | <p> Umbilical veins (right and left)</p> |
| | <p> Neural tube</p> |
| | <p> Body cavities</p> |
| | <p> Hyoid arch</p> |
| <p>3 weeks, 3 days   </p> <p>$\frac{1}{2}$ $\frac{1}{2}$</p> | <p> Thyroid complete</p> |
| | <p> Cystic primordium</p> |
| | <p> Liver</p> |
| | <p> Membrane between future mouth and throat may begin to rupture</p> |
| | <p> Internal carotid arteries</p> |
| | <p> Neuropore (near brain) closes</p> |
| | <p> Notochord</p> |
| <p>3 weeks, 5 days   </p> <p>$\frac{1}{2}$ $\frac{1}{2}$</p> | <p> First part of pancreas</p> |
| | <p> Pharyngeal arch 3</p> |
| | <p> Lung bud</p> |
| | <p> Descending aorta</p> |
| | <p> Unidirectional circulation</p> |
| | <p> Brain involves 40% of neural tube</p> |
| | <p> Lowermost spinal cord formation begins</p> |
| | <p> Neural tube closes (lower back)</p> |
| | <p> Somites: Pairs 21 through 29</p> |
| | <p> Upper limb primordium at level of somites 8 to 10</p> |
| | <p> Progressively C-shaped embryo</p> |
| <p>4 weeks   </p> <p>$\frac{1}{2}$ $\frac{1}{2}$</p> | <p> Skin is so thin, you can see through it!</p> |

| | |
|--|---|
| | Esophagus primordia |
| | Intestines growing in length |
| | Pancreas: Ventral pancreas |
| | Pharynx |
| | Small & large intestines |
| | Bronchial buds |
| | Lungs begin filling chest cavity |
| | Trachea |
| | Circulatory system "well established" |
| | Functioning two-chamber heart |
| | Heart chambers bulging with fluid |
| | Heart now functions as two parallel pumps |
| | Heart rate (about) 113 beats/min |
| | Most cranial nerve ganglia |
| | Cerebellum |
| | Fourth ventricle |
| | Amnion surrounds embryo |
| | Limb buds - the first sign of arms and legs |
| | Lower limb buds |
| | Umbilical cord emerging |
| | Upper and lower limb buds |

Unit 5: 4 to 5 Weeks

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| 4 weeks, 3 days $\frac{1}{2}$ $\frac{1}{2}$ | Early eyes |
| 4 weeks, 3 days - 5 weeks $\frac{1}{2}$ $\frac{1}{2}$ | Germ cells migrate to gonads |
| 4 weeks, 4 days $\frac{1}{2}$ $\frac{1}{2}$ | Lungs: Right and left primary (or main stem) bronchi |
| | Sinu-atrial (SA) node |
| | Eyes located on sides of head |
| | Lens pits |
| | Nose: Nasal pits |
| | Brain enlarges 50% since Carnegie Stage 13 |
| | Brain: Cerebral hemispheres appear and begin rapid growth |
| | Brain: Lateral ventricles |
| | Hypothalamus |
| 4 weeks, 5 days $\frac{1}{2}$ $\frac{1}{2}$ | Caecum |
| | Blood vessels penetrate diencephalon |
| | Coronary arteries (terminal end) |
| | Optic chiasm |
| | Brain with five main sections |

| | |
|------------------|---|
| | <ul style="list-style-type: none"> First nerve fibers Most cranial nerves seen Synapses among motor neurons in spinal cord Third ventricle |
| 5 weeks ½ | <ul style="list-style-type: none"> ACTH [adrenocorticotropin hormone] Growth hormone Pituitary gland Limb buds form hand plates Permanent kidneys Bronchial tree branching accelerates Lobar pattern mimics adult pattern Pacemaker cells Head is one third of entire embryo |

Unit 6: 5 to 6 Weeks

| | |
|---|--|
| 5 weeks, 1 day ½ | <ul style="list-style-type: none"> Wrist joints are forming |
| 5 weeks, 2 days ½ | <ul style="list-style-type: none"> Thyroid detaches from pharynx Atrioventricular (AV) node Circle of Willis almost complete Cochlear nerve present Musculocutaneous, radial, ulna, and median nerves enter upper limb bud All cranial nerves identifiable |
| 5½ weeks ½ | <ul style="list-style-type: none"> Initial tooth formation |
| 5½ weeks - 6 weeks ½ | <ul style="list-style-type: none"> Subtle movement begins |
| 5 weeks, 4 days ½ | <ul style="list-style-type: none"> Cartilage formation |
| 5 weeks, 5 days ½ | <ul style="list-style-type: none"> Nerve cells differentiating |
| 5 weeks, 5 days - 7 weeks, 1 day ½ | <ul style="list-style-type: none"> Melanocytes in epidermis |
| 5 weeks, 6 days ½ | <ul style="list-style-type: none"> Cartilage in occipital sclerotomes (1-4) Primordial vermiform appendix All spinal nerves present Dura begins forming in basal area |

| | |
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| | <ul style="list-style-type: none"> Frontal and temporal poles of cerebral hemispheres Somites: Pairs 38 and 39 |
| | <ul style="list-style-type: none"> Synapses in spinal cord between interneurons and primary afferent neurons |
| 6 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Face withdraws from light touch around mouth |
| | <ul style="list-style-type: none"> Blood forming in liver Nipples along side of trunk Adrenal glands Glucagon in pancreas |
| | <ul style="list-style-type: none"> Handplates develop subtle flattening Joints Tooth buds (primary teeth) Diaphragm is largely formed Intestines fill base of umbilical cord External ears Synapses form in spinal cord Crown-heel length 1.6 cm |

Unit 7: 6 to 7 Weeks

| | |
|---|---|
| 6 weeks, 2 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Elbow regions sometimes identifiable |
| | <ul style="list-style-type: none"> Hands polygon-shaped Humerus, radius, and ulna Toe rays sometimes present Deltoid muscle Submandibular gland primordia Inferior vena cava Left coronary artery arises from aorta Optic fibers Eyelid folds sometimes present Brainwave activity has begun Cerebrospinal fluid production begins |
| 6$\frac{1}{2}$ weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> The hands begin to move |
| | <ul style="list-style-type: none"> Volar pads on palms Bones first form in the collar bones and lower jaw |
| 6 weeks, 5 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Beginnings of occipital and sphenoid bones |
| | <ul style="list-style-type: none"> Cartilaginous styloid process Limbs point forward (ventrally) Anal membrane Lung, left: Oblique fissure defines upper and lower lobes |

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| | <ul style="list-style-type: none"> ■ Circulus arteriosus (Circle of Willis) complete ■ Right coronary artery arises from aorta ■ Tricuspid and mitral valves ■ Primitive nasal cavity ■ Eyelids: Upper and lower lids present and growing ■ Occipital pole of cerebral hemispheres |
| 6 weeks, 6 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> ■ Feet polygon-shaped ■ Cloacal membrane ruptures |
| 7 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> ■ Head rotates ■ Leg movements ■ B lymphocytes in liver ■ Ovaries ■ Testes begin to differentiate ■ Insulin in pancreas ■ Foot plates notched ■ Hiccups ■ Tendons attach muscle to bone ■ The heart has four chambers and is nearly complete. ■ The heart rate peaks at 165 to 170 beats per minute. ■ Crown-heel length 2.2 cm |

Unit 8: 7 to 8 Weeks

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| 7 weeks, 1 day $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> ■ Upper limbs with slightly flexed elbows ■ Sacrocaudal spinal cord formation (secondary neurulation) complete |
| 7 weeks, 1 day - 8 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> ■ Stomach: Folds in stomach wall |
| 7 weeks, 2 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> ■ Arteries and veins of heart complete |
| 7 weeks, 3 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> ■ The knee joints have arrived ■ Wrists slightly flexed ■ Eyelids growing rapidly ■ Cerebral hemispheres cover more than half of diencephalon |
| 7 $\frac{1}{2}$ weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> ■ Hands begin to touch face ■ The hands touch each other as do the feet! ■ Fingertips thicken |

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| | <ul style="list-style-type: none"> Plantar pads toes EKG pattern similar to adult |
| 7 weeks, 4 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> The fingers are free |
| 7 weeks, 5 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Bone-forming cells called osteoblasts emerge |
| | <ul style="list-style-type: none"> Hands can reach one another and fingers can overlap Brain: Internal capsule with connections to epithalamus, dorsal thalamus, and mesencephalon Cerebral hemispheres cover 75% of diencephalon Cortical plate expanding rapidly |
| 7 weeks, 6 days $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> The toes are free |
| 8 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Complex response to touch More frequent hand-to-face contact Mouth opens & closes Squinting The embryo floats and rolls over in the womb Hairs first appear in eyebrows & around mouth Skin multi-layered, loses transparency Male embryos are making testosterone already! The embryo's joints are similar to adult joints Diaphragm complete Esophagus: Longitudinal muscles Urethra Urine production and release Peristalsis in large intestine Occasional breathing motions begin Blood supply to the brain closely resembles adult pattern Cranial nerve distribution mimics adult pattern Retina: Four of the ten adult layers present Tympanic membrane "The hindbrain "presents striking resemblance to that of the newborn." Brain represents 43% of embryo Grey and white matter Right- and left-handedness emerges Crown-heel length 4.3 cm Embryo contains approximately 1 billion (10^9) cells Embryonic Period Ends The 8-week embryo has formed more than 4,000 permanent body parts. |

Unit 9: 8 to 9 Weeks

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|-----------------|--|
| 8½ weeks ½ ½ | <ul style="list-style-type: none"> Eyelids completely fused |
| 9 weeks ½ ½ | <ul style="list-style-type: none"> Neurons synapse in cerebral cortex (marginal zone) Bends hip & knee if sole of foot touched Drinking fluid is becoming routine Sucking the thumb The young fetus now sighs, stretches, moves the head, opens the mouth, and moves the tongue Tongue movement Female fetuses have early reproductive cells in their ovaries Thyroid gland weighs 2 grams Small intestine peristalsis Face, hands, and feet sense light touch |

Unit 10: 9 to 10 Weeks

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|---------------------------|--|
| 9 weeks - 10 weeks ½ ½ | <ul style="list-style-type: none"> Early vocal cords |
| 9½ weeks ½ ½ | <ul style="list-style-type: none"> My weight will rise more than 75% this week I yawn when I want |
| 9 weeks, 4 days ½ ½ | <ul style="list-style-type: none"> Yawns |
| 10 weeks ½ ½ | <ul style="list-style-type: none"> Eyes roll downward reflexively Palatine tonsils Fingernails and toenails begin to grow! Three-layered epidermis Tiny unique fingerprints have arrived! Now, all the bones are getting harder Tooth buds (secondary teeth) Glomeruli formation begins Physiologic herniation ends Corpus callosum begins Crown-heel length 7.5 cm |

Unit 11: 10 to 11 Weeks

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|----------------------------|--|
| 10 weeks - 12 weeks ½ ½ | <ul style="list-style-type: none"> Langerhans cells enter epidermis |
| 10½ weeks ½ ½ | <ul style="list-style-type: none"> Volar and plantar pads regress |

| | |
|---|---|
| 11 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> The face now makes complex expressions Immunological competence Intermediate layer Nose & lips completely formed Now you can tell if your baby is a girl or a boy! Thyroid gland weighs 12 grams Intestines absorb water & glucose Auditory cells: inner & outer hair cells Crown-heel length |
|---|---|

Unit 12: 11 to 12 Weeks

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| 11 weeks - 12 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Weight increases by 60% this week |
|--|---|

| | |
|---|---|
| 12 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Hands touch the mouth up to 50 times per hour T lymphocytes leave thymus Many different hormones are present in pituitary gland Thyroid gland produces hormone Palate fuses Upper limbs reach final proportion Bladder resembles smooth muscle Bowel movements Liver: Bile production begins There are taste buds all over the mouth Corpus callosum Crown-heel length 12 cm Head circumference 10 cm |
|---|---|

Unit 13: 3 to 4 Months

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|---|---|
| 13 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Teeth are growing Cilia lining airways Most of body sensitive to touch Crown-heel length 15 cm |
|---|---|

| | |
|---|---|
| 14 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Girls move their jaws more than the boys do Light touch to mouth evokes turn toward stimulus 4-lobed cerebral cortex Cerebellum resembles adult structure Crown-heel length 17 cm Fat deposits in cheeks |
|---|---|

| | |
|--|---|
| 15 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Stem cells arrive in bone marrow |
| | <ul style="list-style-type: none"> Body fat emerges throughout the body |
| | <ul style="list-style-type: none"> Glucagon in fetal bloodstream |
| | <ul style="list-style-type: none"> Digestive enzymes |
| | <ul style="list-style-type: none"> Crown-heel length 19.5 cm |
| 16 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Quickening |
| | <ul style="list-style-type: none"> Fat deposits upper & lower limbs |
| | <ul style="list-style-type: none"> Tooth enamel |
| | <ul style="list-style-type: none"> Bronchial tree nearly complete |
| | <ul style="list-style-type: none"> Hormonal stress response to invasive procedures |
| | <ul style="list-style-type: none"> Crown-heel length 21 cm |

Unit 14: 4 to 5 Months

| | |
|--|--|
| 17 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Retina has discrete layers |
| 18 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Cream-like substance protects skin |
| | <ul style="list-style-type: none"> Sweat glands |
| | <ul style="list-style-type: none"> Insulin secretion |
| | <ul style="list-style-type: none"> Speaking motion of larynx |
| | <ul style="list-style-type: none"> Corpus callosum complete |
| 19 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Melanin production |
| | <ul style="list-style-type: none"> Number of oogonia peak (at about 7 million) within fetal ovaries |
| | <ul style="list-style-type: none"> Daily cycles in biological rhythms |
| 20 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> All skin layers and structures |
| | <ul style="list-style-type: none"> Surfactant production (low levels) |
| | <ul style="list-style-type: none"> Hearing and responding to sound begins |
| | <ul style="list-style-type: none"> Hearing and responding to sound begins |
| | <ul style="list-style-type: none"> Crown-heel length 28 cm |
| | <ul style="list-style-type: none"> Head circumference 20 cm |

Unit 15: 5 to 6 Months

| | |
|---|---|
| 20 weeks - 24 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Eyelids separate, eyes open and close |
| 21 weeks $\frac{1}{2}$ $\frac{1}{2}$ | <ul style="list-style-type: none"> Stratum corneum |

| | |
|-----------------------------------|--|
| 21 weeks - 22 weeks ½ ½ | □ If born prematurely from this point on, survival is possible |
| 22 weeks ½ ½ | ■ Cornea structure |
| | ■ Behavioral states |
| 23 weeks ½ ½ | □ Brain weight 100 grams |
| 24 weeks ½ ½ | ■ Blink-startle response; females before males |
| | □ Crown-heel length 34.5 cm |


Unit 16: 6 to 7 Months

| | |
|-----------------------------------|---|
| 25 weeks ½ ½ | ■ Intestinal lining contains all adult cell types |
| | ■ Rods & cones |
| | ■ The ability to taste |
| 26 weeks ½ ½ | ■ Additional fat deposits decrease wrinkles |
| | ■ Tear production |
| | ■ The ability to smell has arrived |
| 26 weeks - 38 weeks ½ ½ | ■ Brain weight increases 400% to 500% |
| 27 weeks ½ ½ | ■ Pupils react to light |
| 28 weeks ½ ½ | ■ Distinguishes sounds of different frequencies |
| | □ Crown-heel length 39.5 cm |


Unit 17: 7 to 8 Months


| | |
|------------------------|--|
| 30 weeks ½ ½ | ■ Breathing motions are common even though there is no air in the womb |
| | ■ 6-layered cerebral cortex |
| | □ Head circumference 30 cm |
| 32 weeks ½ ½ | ■ Esophagus: Lower esophagus muscles functional |
| | ■ Glomeruli formation complete |
| | ■ Alveoli |
| | ■ Memory - music preferences |
| | □ Crown-heel length 45 cm |


Unit 18: 8 to 9 Months

32 weeks - 36 weeks  Prenatal food affects newborn taste preferences
 $\frac{1}{2}$ $\frac{1}{2}$


34 weeks  Rapid weight gain
 $\frac{1}{2}$ $\frac{1}{2}$

35 weeks  Firm grip
 $\frac{1}{2}$ $\frac{1}{2}$


 Amniotic fluid volume peaks


36 weeks  Surfactant production accelerates
 $\frac{1}{2}$ $\frac{1}{2}$


 Brain weight 300 grams


 Crown-heel length 48.5 cm

Unit 19: 9 Months to Birth


37 weeks  Fetus drinks an estimated 15 oz (or 450cc) of amniotic fluid/day
 $\frac{1}{2}$ $\frac{1}{2}$

38 weeks  Air breathing begins
 $\frac{1}{2}$ $\frac{1}{2}$


 By term, the typical umbilical cord measures 20 to 24 inches (50 to 60 cm)

 Heart beats 54 million times before birth

 Major circulatory changes


 Spinal cord ends at third lumbar vertebrae

 Brain weight 350 grams

 Crown-heel length 50 cm

 Fetus initiates labor

 Head circumference 35 cm

 Time to be born!