

BRUCE M. CARLSON



HUMAN EMBRYOLOGY AND DEVELOPMENTAL BIOLOGY

FOURTH EDITION

A Student **CONSULT** Title

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Developmental Tables

Carnegie Stages of Early Human Embryonic Development (Weeks 1-8)

Age (days)	External Features	Carnegie Stage	Crown-Rump Length (mm)	Pairs of Somites
1	Fertilized oocyte	1	0.1	
2-3	Morula (4-16 cells)	2	0.1	
4	Free blastocyst	3	0.1	
5-6	Attachment of blastocyst to endometrium	4	0.1	
7-12	Implantation, bilaminar embryo with primary yolk sac	5	0.1-0.2	
13-15	Trilaminar embryo with primitive streak, chorionic villi	6	0.2-0.3	
16	Gastrulation, formation of notochordal process	7	0.4	
18	Hensen's node and primitive pit, notochord and neurenteric canal, appearance of neural plate, neural folds, and blood islands	8	1-1.5	
20	Appearance of first somites, deep neural groove, elevation of cranial neural folds, early heart tubes	9	1.5-2.5	1-3
22	Beginning of fusion of neural folds, formation of optic sulci, presence of first two pharyngeal arches, beginning heart beat, curving of embryo	10	2-3.5	4-12
24	Closure of cranial neuropore, formation of optic vesicles, rupture of oropharyngeal membrane	11	2.5-4.5	13-20
26	Closure of caudal neuropore, formation of pharyngeal arches 3 and 4, appearance of upper limb buds and tail bud, formation of otic vesicle	12	3-5	21-29
28	Appearance of lower limb buds, lens placode, separation of otic vesicle from surface ectoderm	13	4-6	30-31
32	Formation of lens vesicle, optic cup, and nasal pits	14	5-7	
33	Development of hand plates, primary urogenital sinus, prominent nasal pits, evidence of cerebral hemispheres	15	7-9	
37	Development of foot plates, visible retinal pigment, development of auricular hillocks, formation of upper lip	16	8-11	

Carnegie Stages of Early Human Embryonic Development (Weeks 1-8)—cont'd

Age (days)	External Features	Carnegie Stage	Crown-Rump Length (mm)	Pairs of Somites
41	Appearance of finger rays, rapid head enlargement, six auricular hillocks, formation of nasolacrimal groove	17	11-14	
44	Appearance of toe rays and elbow regions, beginning of formation of eyelids, tip of nose distinct, presence of nipples	18	13-17	
48	Elongation and straightening of trunk, beginning of herniation of midgut into umbilical cord	19	16-18	
51	Bending of arms at elbows, distinct but webbed fingers, appearance of scalp vascular plexus, degeneration of anal and urogenital membranes	20	18-22	
52	Longer and free fingers, distinct but webbed toes, indifferent external genitalia	21	22-24	
54	Longer and free toes, better development of eyelids and external ear	22	23-28	
57	More rounded head, fusion of eyelids	23	27-31	

Data from: O'Rahilly R, Müller F: *Developmental stages in human embryos*, Pub. 637, Washington, DC, 1987, Carnegie Institution of Washington.

Major Developmental Events during the Fetal Period

External Features	Internal Features
8 Weeks	
Head is almost half the total length of fetus	Midgut herniation into umbilical cord occurs
Cervical flexure is about 30 degrees	Extraembryonic portion of allantois has degenerated
Indifferent external genitalia are present	Ducts and alveoli of lacrimal glands form
Eyes are converging	Paramesonephric ducts begin to regress in males
Eyelids are unfused	Recanalization of lumen of gut tube occurs
Tail disappears	Lungs are becoming glandlike
Nostrils are closed by epithelial plugs	Diaphragm is completed
Eyebrows appear	First ossification begins in skeleton
Urine is released into amniotic fluid	Definitive aortic arch system takes shape
9 Weeks	
Neck develops and chin rises from thorax	Intestines are herniated into umbilical cord
Cranial flexure is about 22 degrees	Early muscular movements occur
Chorion is divided into chorion laeve and chorion frondosum	Adrenocorticotrophic hormone and gonadotropins are produced by pituitary
Eyelids meet and fuse	Corticosteroids are produced by adrenal cortex
External genitalia begin to become gender specific	Semilunar valves in heart are completed
Amniotic fluid swallowed	Fused paramesonephric ducts join vaginal plate
Thumb sucking and grasping begin	Urethral folds begin to fuse in males

Major Developmental Events during the Fetal Period—cont'd

External Features

10 Weeks

Cervical flexure is about 15 degrees
Gender differences are apparent in external genitalia
Fingernails appear
Eyelids are fused
Fetal yawning

11 Weeks

Cervical flexure is about 8 degrees
Nose begins to develop bridge
Taste buds cover inside of mouth

12 Weeks

Head is erect
Neck is almost straight and well defined
External ear is taking form and has moved close to its definitive position in the head
Yolk sac has shrunk
Fetus can respond to skin stimulation
Bowel movements begin (meconium expelled)

4 Months

Skin is thin; blood vessels can easily be seen through it
Nostrils are almost formed
Eyes have moved to front of face
Legs are longer than arms
Fine lanugo hairs appear on head
Fingernails are well formed; toenails are forming
Epidermal ridges appear on fingers and palms of hand
Enough amniotic fluid is present to permit amniocentesis
Mother can feel fetal movements

5 Months

Epidermal ridges form on toes and soles of feet
Vernix caseosa begins to be deposited on skin
Abdomen begins to fill out
Eyelids and eyebrows develop
Lanugo hairs cover most of body

6 Months

Skin is wrinkled and red
Decidua capsularis degenerates because of reduced blood supply

Internal Features

Intestines return into body cavity from umbilical cord
Bile is secreted
Blood islands are established in spleen
Thymus is infiltrated by lymphoid stem cells
Prolactin production by pituitary occurs
First permanent tooth buds form
Deciduous teeth are in early bell stage
Epidermis has three layers

Stomach musculature can contract
T lymphocytes emigrate into bloodstream
Colloid appears in thyroid follicles
Intestinal absorption begins

Ovaries descend below pelvic rim
Parathyroid hormone is produced
Blood can coagulate

Seminal vesicle forms
Transverse grooves appear on dorsal surface of cerebellum
Bile is produced by liver and stains meconium green
Gastric glands bud off from gastric pits
Brown fat begins to form
Pyramidal tracts begin to form in brain
Hematopoiesis begins in bone marrow
Ovaries contain primordial follicles

Myelination of spinal cord begins
Sebaceous glands begin to function
Thyroid-stimulating hormone is released by pituitary
Testes begin to descend

Surfactant begins to be secreted
Tip of spinal cord is at S1 level

*Major Developmental Events during the Fetal Period—cont'd***External Features**

Lanugo hairs darken

Odor detection and taste

7 Months

Eyelids begin to open

Eyelashes are well developed

Scalp hairs are lengthening (longer than lanugo)

Skin is slightly wrinkled

Breathing movements common

8 Months

Skin is pink and smooth

Eyes are capable of pupillary light reflex

Fingernails have reached tips of fingers

9 Months

Toenails have reached tips of toes

Most lanugo hairs are shed

Skin is covered with vernix caseosa

Attachment of umbilical cord becomes central in abdomen

About 1 L of amniotic fluid is present

Placenta weighs about 500 g

Fingernails extend beyond fingertips

Breasts protrude and secrete "witch's milk"

Internal Features

Sulci and gyri begin to appear on brain

Subcutaneous fat storage begins

Testes are descending into scrotum

Termination of splenic erythropoiesis occurs

Regression of hyaloid vessels from lens occurs

Testes enter scrotum

Larger amounts of pulmonary surfactant are secreted

Ovaries are still above brim of pelvis

Testes have descended into scrotum

Tip of spinal cord is at L3

Myelination of brain begins