GESTATION & PREGNANCY

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- **Gestation** is the carrying of an embryo or fetus inside females.

- Mammals during pregnancy can have one or more gestations at the same time (multiple gestations).

- The time interval of a gestation is called the *gestation period*.

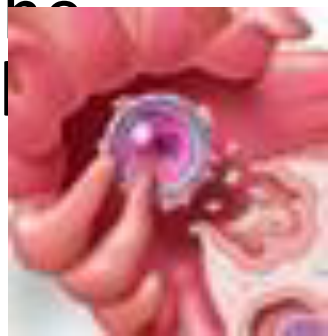
- In human obstetrics, *gestational age* refers to the embryonic or fetal age plus two weeks.

- The **gestation period** is the time in which a fetus develops, beginning with fertilization and ending at birth.

- The embryonic time comprises **56 days**, i.e., 8 weeks **from the moment of fertilization**.

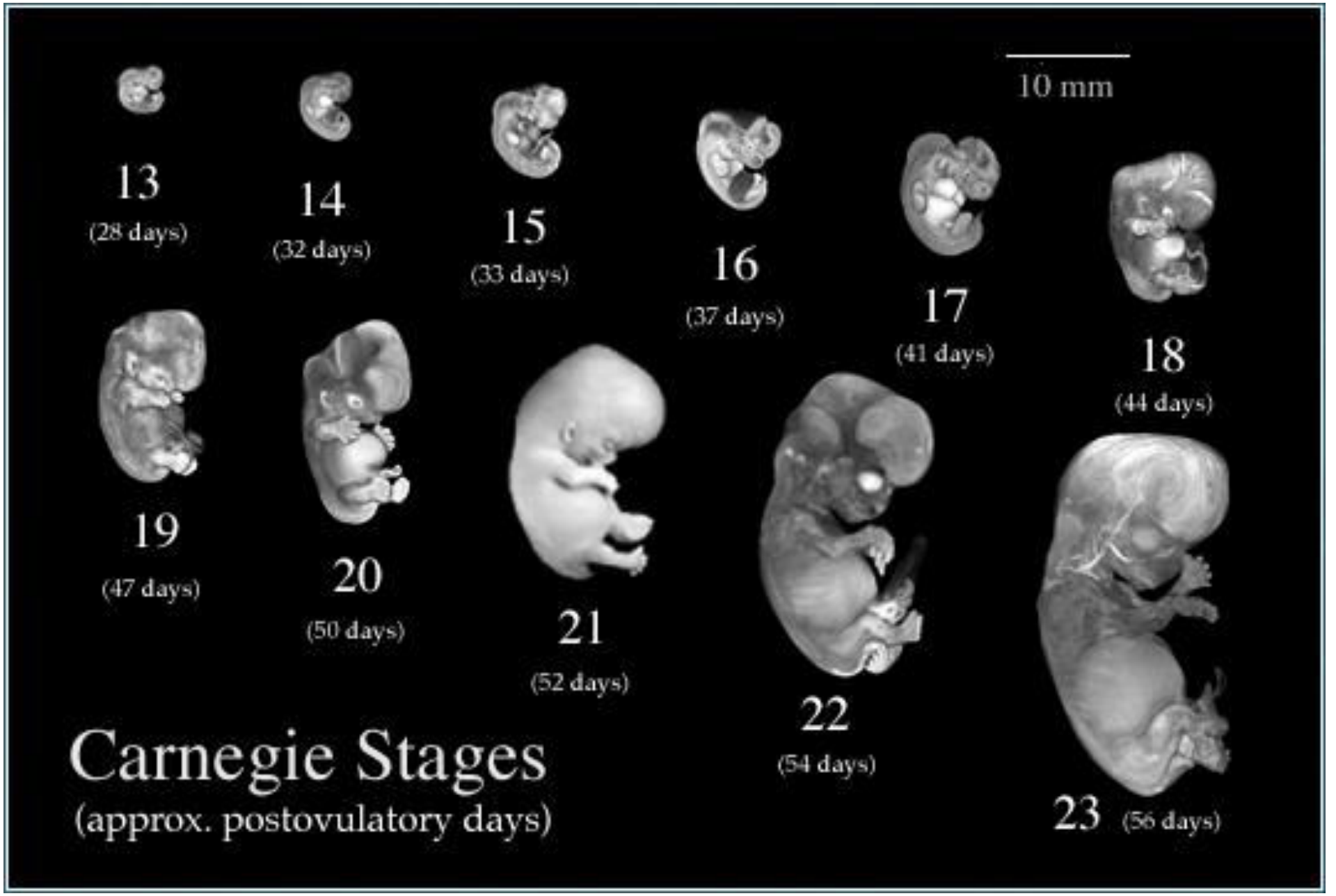
- This is approximately the duration since the woman's last menstrual period (LMP) began.

- The embryonic period lasts 8 weeks and the fetal period from the 9th week to the birth



Embryonic period

- The embryonic time comprises **56 days**, i.e., 8 weeks **from the moment of fertilization**.
- This time span is divided into **23 Carnegie stages** and the **stage classification** is based solely on **morphologic features**.
- Carnegie stages are thus neither directly dependent on the chronological age nor on the size of the embryo.
- This can be illustrated by two examples: The closure of the rostral neuropore occurs by definition in stage 11 and that of the caudal neuropore in stage 12. Further, between the 25th and 32nd days of the pregnancy, the stages are determined according to the number of the somites **9-13** that have been engendered. The individual stages thus differ in how long they last.

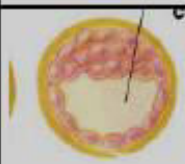
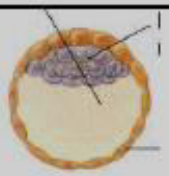

10 mm
13
(28 days)
14
(32 days)
15
(33 days)
16
(37 days)
17
(41 days)
18
(44 days)
19
(47 days)
20
(50 days)
21
(52 days)
22
(54 days)
23
(56 days)
Carnegie Stages
(approx. postovulatory days)

- During the embryonic period most of the organ systems are established and this with an enormous rapidity.
- Cell divisions, movement and differentiation are the basic processes taking place during this phase.
- It is thus hardly surprising that this pregnancy phase is very **vulnerable** and that deformities are produced most often during this time.
- The type of deformity depends on the embryonic developmental stage.

- Human pregnancy can be divided roughly into three trimesters, each approximately three months long.
- The first trimester is from the last period to the 13th week
- The second trimester is from the 14th to 27th week
- The third trimester is from the 28th week to 42 week

- In humans, birth normally occurs at a gestational age of about 40 weeks, though a normal range is from 37 to 42 weeks.

Stages: CLEAVAGE, FERTILIZATION, GROWTH, DIFFERENCIATION
Name of embryo: GASTRULA, EMBRYO, MORULA, BLASTOCYST, ZYGOTE
Processes: NEURALTION, IMPLANTATION, , FERTILIZATION, MITOSIS
Where: UTERINE WALL, FALOPIAN TUBES, VAGINA, OVARIES.

Stages	Fertilization	Cleavage		Differentiation		Growth	
Name of embryo	Zygote	Morula	Blastocyst	Gastrula	Embryo	Fetus	Fetus
Pictures							
Timing	1 day	4 days	6 days	10 days	20 days	4 months	9 months
Processes	**Fertilization** Beginning of human development	**Mitosis** Multiplying until 64 cells	**Implantation** Blastocyst attaches itself to the wall of the uterus	Cells begin to move and specialize Three layers: • Endoderm, • Mesoderm, • Ectoderm.	**Neuralization** Beginning of development of the nervous system (spinal cord)	The fetus increases in size Bones, circulatory and respiratory systems mature	**Childbirth** Fetus is completely form
Where	**Fallopian tubes**	**Fallopian tubes**	**Uterine Wall**	**Uterine Wall**	**Uterine Wall**	**Uterine Wall**	**Vagina**

Embryo_stages_003.mp4

Changes in the First week

- During this period the ovum is in the uterine tube.
- Having been fertilized in the upper part of the tube, it slowly passes down, undergoing segmentation, and reaches the uterus.
- The age of which as from three to four days. It was imbedded in the decidua on the posterior wall of the uterus and enveloped by a decidua capsularis, the central part of which, however, consisted merely of a layer of fibrin.
- The ovum was in the form of a sac, the outer wall of which consisted of a layer of trophoblast; inside this was a thin layer of mesoderm composed of round, oval, and spindle-shaped cells.
- Numerous villous processes—some consisting of trophoblast only, others possessing a core of mesoderm—projected from the surface of the ovum into the surrounding decidua.
- Inside this sac the rudiment of the embryo was found in the form of a patch of ectoderm, covered by a small but completely closed amnion.
- It possessed a minute yolk-sac and was surrounded by mesoderm, which was connected by a band to that lining the trophoblast

Changes in the Second week

- By the end of this week the ovum has increased considerably in size, and the majority of its villi are vascularized.
- The embryo has assumed a definite form, and its cephalic and caudal extremities are easily distinguished.
- The neural folds are partly united.
- The embryo is more completely separated from the yolk-sac, and the paraxial mesoderm is being divided into the primitive segments

Changes in the Third week

- By the end of the third week the embryo is strongly curved, and the primitive segments number about thirty.
- The primary divisions of the brain are visible, and the optic and auditory vesicles are formed.
- Four branchial grooves are present: the stomodeum is well-marked, and the bucco-pharyngeal membrane has disappeared.
- The rudiments of the limbs are seen as short buds, and the Wolffian bodies are visible

WEEK 3

- **Gestational age**: 2 weeks and 0 days until 2 weeks and 6 days old. 15–21 days from last menstruation.
- **Embryonic age**: Week nr 1. 0 (whole) weeks old. 1–7 days from fertilization.

- Fertilization of the ovum to form a new human organism, the human zygote.

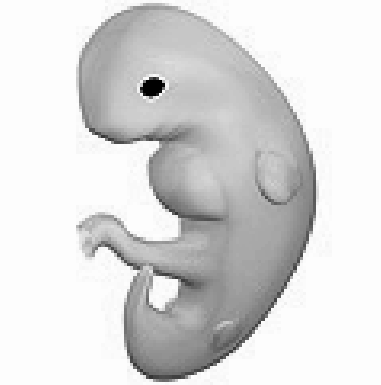
(day 1 of fertilization)

The zygote undergoes mitotic cellular divisions, but does not increase in size. This mitosis is also known as cleavage. A hollow cavity forms marking the blastocyst stage. (day 1.5–3 of fert.)

- The blastocyst contains only a thin rim of trophoblast cells and a clump of cells at one end known as the "embryonic pole" which include embryonic stem cells.
- The embryo hatches from its protein shell (zona pellucida) and performs implantation onto the endometrial lining of the mother's uterus. (day 5–6 of fert.)
- If separation into identical twins occurs, 1/3 of the time it will happen

Changes in the Fourth week (twenty-seven to thirty days old)

- The embryo is markedly curved on itself, and when viewed in profile is almost circular in outline.
- The cerebral hemispheres appear as hollow buds, and the elevations which form the rudiments of the auricula are visible.
- The limbs now appear as oval flattened project



WEEK 4

- **Gestational age**: 3 weeks and 0 days until 3 weeks and 6 days old. 22–28 days from last menstruation.
- **Embryonic age**: Week nr 2. 1 week old. 8–14 days from fertilization.

- Trophoblast cells surrounding the embryonic cells proliferate and invade deeper into the uterine lining. They will eventually form the placenta and embryonic membranes. The blastocyst is fully implanted day 7–12 of fert.
- Formation of the yolk sac.
- The embryonic cells flatten into a disk, two cells thick.
- If separation into identical twins occurs, 2/3 of the time it will happen between days 5 and 9. If it happens after day 9, there is a significant risk of the twins being conjoined.
- Primitive streak develops. (day 13 of fert.)
- Primary stem villi appear. (day 13 of fert.)

Changes in the Fifth week (twenty-seven to thirty days old)

- The embryo is less curved and the head is relatively of large size.
- Differentiation of the limbs into their segments occurs.
- The nose forms a short, flattened projection.
- The cloacal tubercle is evident.

WEEK 5

- **Gestational age**: 4 weeks and 0 days until 4 weeks and 6 days old. 29–35 days from last menstruation.
- **Embryonic age**: Week nr 3. 2 weeks old. 15–21 days from fertilization.

- A notochord forms in the center of the embryonic disk. (day 16 of fert.)
- Gastrulation commences. (day 16 of fert.)
- A neural groove (future spinal cord) forms over the notochord with a brain bulge at one end. Neuromeres appear. (day 18 of fert.)
- Somites, the divisions of the future vertebra, form. (day 20 of fert.)
- Primitive heart tube is forming. Vasculature begins to develop in embryonic disc. (day 20 of fert.)

Changes in the sixth week

- The curvature of the embryo is further diminished.

- The branchial grooves—except the first—have disappeared, and the rudiments of the fingers and toes can be recognized

WEEK 6

- **Gestational age**: 5 weeks and 0 days until 5 weeks and 6 days old. 36–42 days from last menstruation.
- **Embryonic age**: Week nr 4. 3 weeks old. 22–28 days from fertilization.

- The embryo measures 4 mm (1/8 inch) in length and begins to curve into a C shape.
- The heart bulges, further develops, and begins to beat in a regular rhythm. Septum primum appears.
- Branchial arches, grooves which will form structures of the face and neck, form.
- The neural tube closes. The ears begin to form as otic pits. Arm buds and a tail are visible.
- Pulmonary primordium, the first traits of the lung appear. Hepatic plate, the first traits of the liver appear.
- Buccopharyngeal membrane ruptures. This is the future mouth. Cystic diverticulum, which will become the gallbladder, and dorsal pancreatic bud, which will become the pancreas appear.[
- Urorectal septum begins to form. Thus, the rectal and urinary passageways become separated. Anterior and posterior horns differentiate in the spinal

Changes in the seventh and Eighth week

- The flexure of the head is gradually reduced and the neck is somewhat lengthened.
- The upper lip is completed and the nose is more prominent.
- The nostrils are directed forward and the palate is not completely developed.
- The eyelids are present in the shape of folds above and below the eye, and the different parts of the auricula are distinguishable.
- By the end of the second month the fetus measures from 28 to 30 mm. in length

- **Gestational age**: 6 weeks and 0 days until 6 weeks and 6 days old. 43–49 days from last menstruation.
- **Embryonic age**: Week nr 5. 4 weeks old. 29–35 days from fertilization.
- The embryo measures 9 mm (1/4 inch) in length.
- Lens pits and optic cups form the start of the developing eye.
- Nasal pits form.
- The brain divides into 5 vesicles, including the early telencephalon.
- Leg buds form and hands form as flat paddles on the arms.
- Rudimentary blood moves through primitive vessels connecting to the yolk sac and chorionic membranes.
- The metanephros, precursor of the definitive kidney, starts to develop.
- The initial stomach differentiation begins.

Gestational age: 7 weeks and 0 days until 7 weeks and 6 days old. 50–56 days from last menstruation.
Embryonic age: Week nr 6. 5 weeks old. 36–42 days from fertilization.

The embryo measures 13 mm (1/2 inch) in length. Lungs begin to form.

The brain continues to develop.

Arms and legs have lengthened with foot and hand areas distinguishable.

The hands and feet have digits, but may still be webbed.The gonadal ridge begins to be perceptible.

The lymphatic system begins to

Changes in the Third month

- The head is extended and the neck is lengthened.
- The eyelids meet and fuse, remaining closed until the end of the sixth month.
- The limbs are well-developed and nails appear on the digits.
- The external generative organs are so far differentiated that it is possible to distinguish the sex.
- By the end of this month the length of the fetus is about 7 cm., but if the legs be included it is from 9 to 10 cm.

WEEK 9

- **Gestational age**: 8 weeks and 0 days until 8 weeks and 6 days old. 57–63 days from last menstruation.
- **Embryonic age**: Week nr 7. 6 weeks old. 43–49 days from fertilization.

- The embryo measures 18 mm (3/4 inch) in length.
- Fetal heart tone (the sound of the heart beat) can be heard using doppler.
- Nipples and hair follicles begin to form.
- Location of the elbows and toes are visible.
- Spontaneous limb movements may be detected by ultrasound.
- All essential organs have at least begun.
- The vitelline duct normally closes.

Fetal Period

- From the 10th week of gestation (8th week of development), the developing organism is called a fetus.
- All major structures are already formed in the fetus, but they continue to grow and develop.
- Since the precursors of all the major organs are created by this time, the fetal period is described both by organ and by a list of changes by weeks of gestational age.
- Because the precursors of the organs are now

Fetal Period

Table 3.3 Fetal Stage of Development

Time Period	
Weeks 9–12	 9-12
Weeks 13–16	 13-16

Table 3.3 Fetal Stage of Development

Time Period	
Weeks 17–20	 17-20
Weeks 21–38	 21-38

Changes in the *Weeks 10–12*

- **Gestational age**: 9 weeks and 0 days until 11 weeks and 6 days old.
- **Embryonic age**: Weeks nr 8–10. 7–9 weeks old.

- Embryo measures 30–80 mm (1.2–3.2 inches) in length.
- Ventral and dorsal pancreatic buds fuse during the 8th week
- Intestines rotate. Facial features continue to develop.
- The eyelids are more developed.
- The external features of the ear begin to take their final shape.
- The head comprises nearly half of the fetus' size.The face is well formed.
- The eyelids close and will not reopen until about the 28th week.
- Tooth buds, which will form the baby teeth, appear.
- The limbs are long and thin.
- The fetus can make a fist with its fingers.
- Genitals appear well differentiated.
- Red blood cells are produced in the liver.

Changes in the *Weeks 13 to 16*

- **Gestational age**: 12 weeks and 0 days until 15 weeks and 6 days old.
- **Embryonic age**: Weeks nr 11–14. 10–13 weeks old.

- The fetus reaches a length of about 15 cm (6 inches).
- A fine hair called lanugo develops on the head.
- Fetal skin is almost transparent.
- More muscle tissue and bones have developed, and the bones become harder.
- The fetus makes active movements.
- Sucking motions are made with the mouth.
- Meconium is made in the intestinal tract.
- The liver and pancreas produce fluid secretions.
- From week 13, sex prediction by obstetric ultrasonography is almost 100% accurate.
- At week 15, main development of external genitalia is finished.

Changes in the 21st week

- **Gestational age**: 18 weeks old.
- **Embryonic age**: Week nr 17. 16 weeks old.

- The fetus reaches a length of 20 cm (8 inches).
- Lanugo covers the entire body.
- Eyebrows and eyelashes appear.
- Nails appear on fingers and toes.
- The fetus is more active with increased muscle development.
- "Quickening" usually occurs (the mother and others can feel the fetus moving).
- The fetal heartbeat can be heard with a stethoscope.

Week 23

- *G*estational age: 22 weeks old.
- Embryonic age: Week nr 21. 20 weeks old.

- The fetus reaches a length of 28 cm (11.2 inches).
- The fetus weighs about 500g.
- Eyebrows and eyelashes are well formed.
- All of the eye components are developed.
- The fetus has a hand and startle reflex.
- Footprints and fingerprints continue forming.
- Alveoli (air sacs) are forming in lungs.

Week 26

Gestational age: 24 weeks old.
Embryonic age: Week nr 25. 24 weeks old.

•The fetus reaches a length of 38 cm (15 inches).
•The fetus weighs about 1.2 kg (2 lb 11 oz).
•The brain develops rapidly.
•The nervous system develops enough to control some body functions.
•The eyelids open and close.
•The cochleae are now developed, though the myelin sheaths in neural portion of the auditory system will continue to develop until 18 months after birth.
•The respiratory system, while immature, has developed to the point where gas exchange is possible.

Week 31

- Gestational age: 30 weeks old.
- Embryonic age: Week nr 29. 28 weeks old.

- The fetus reaches a length of about 38–43 cm (15–17 inches).
- The fetus weighs about 1.5 kg (3 lb 0 oz).
- The amount of body fat rapidly increases.
- Rhythmic breathing movements occur, but lungs are not fully mature.
- Thalamic brain connections, which mediate sensory input, form.
- Bones are fully developed, but are still soft and pliable.
- The fetus begins storing a lot of iron, calcium and phosphorus.

Week 35

Gestational age: 34 weeks old.
Embryonic age: Week nr 33. 32 weeks old.

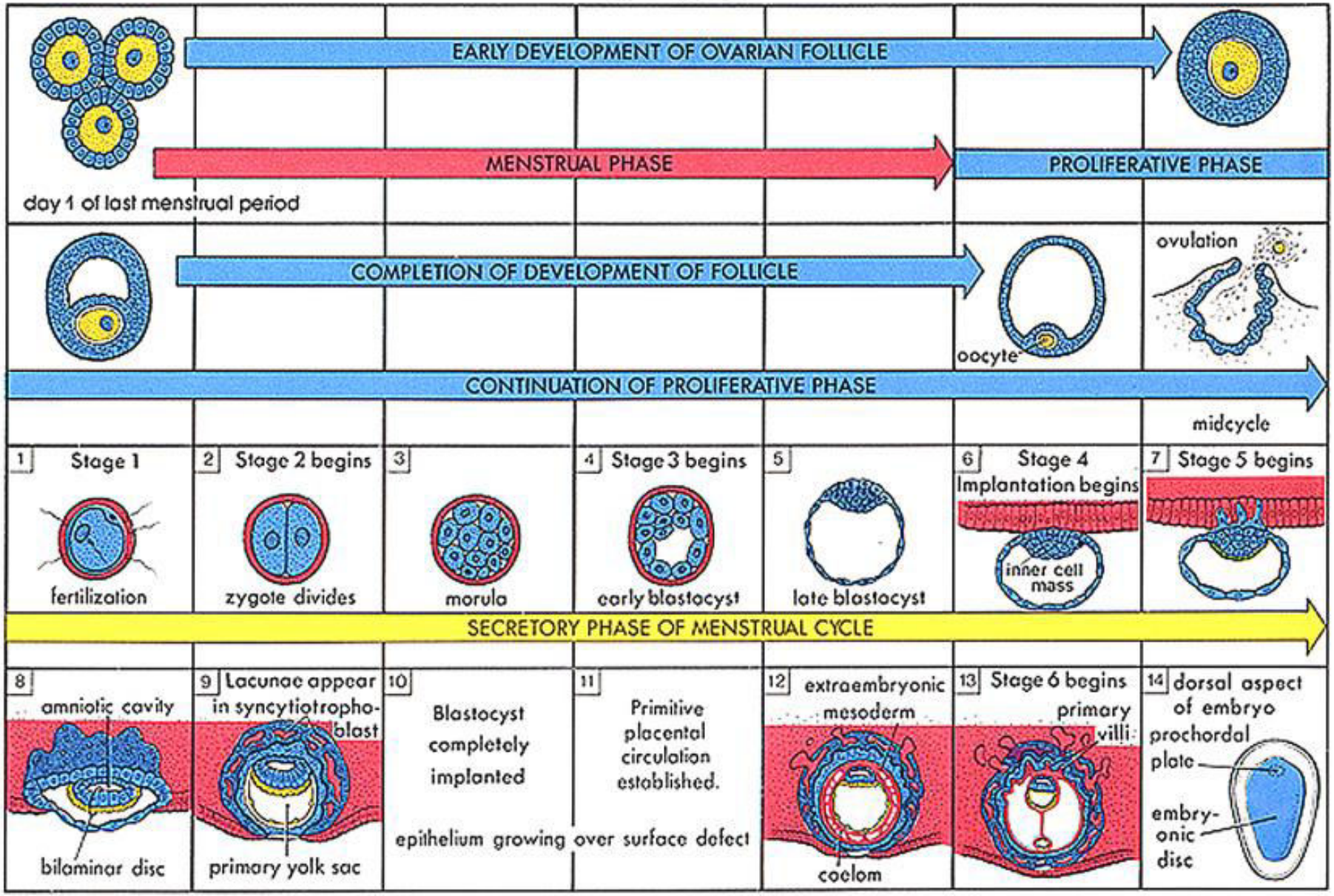
•The fetus reaches a length of about 40–48 cm (16–19 inches).
•The fetus weighs about 2.5 to 3 kg (5 lb 12 oz to 6 lb 12 oz).
•Lanugo begins to disappear.
•Body fat increases.
•Fingernails reach the end of the fingertips.
•A baby born at 36 weeks has a high chance of survival, but may require medical interventions.

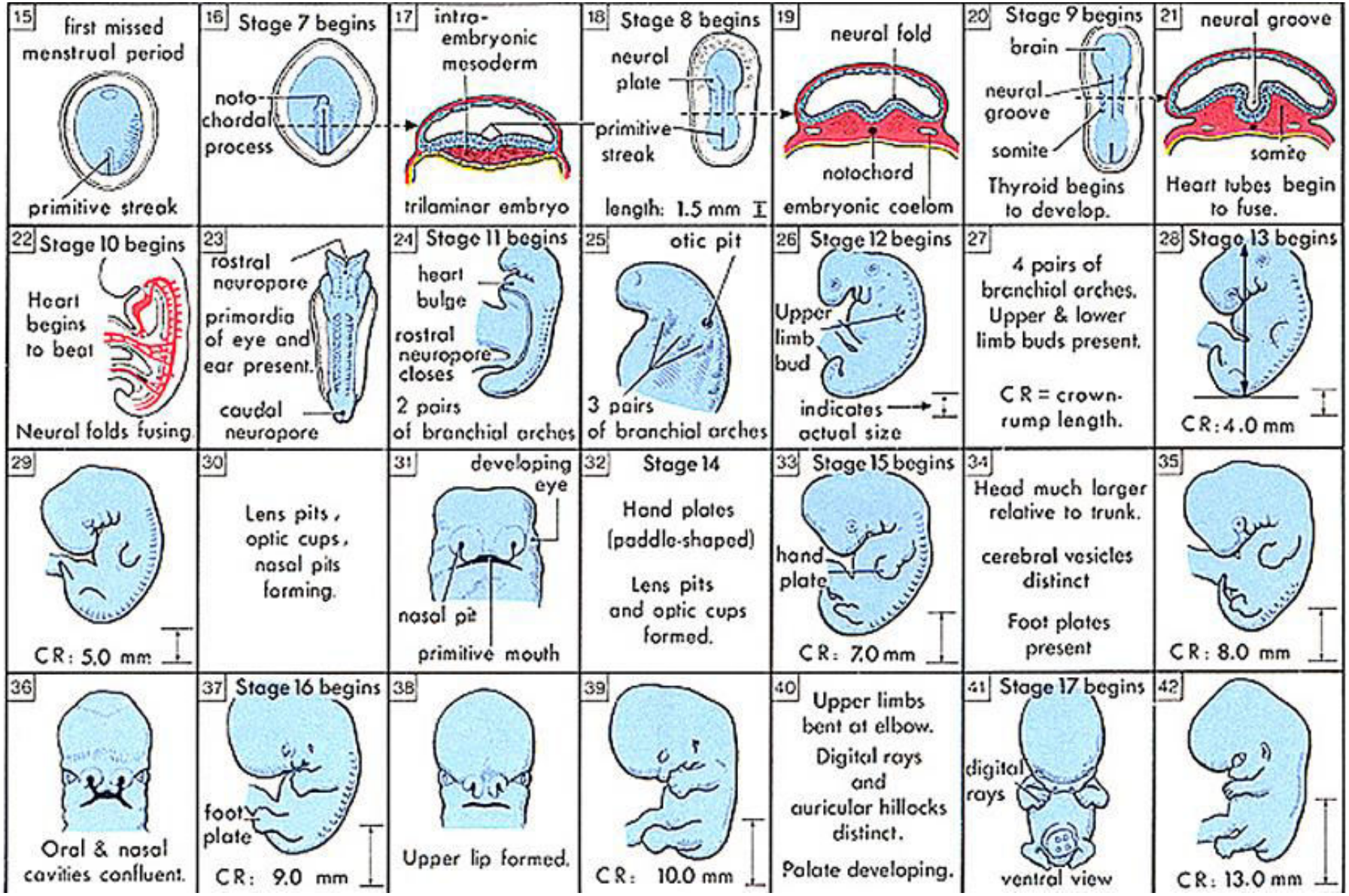
Weeks 36 to 40

- **Gestational age**: 35 and 0 days until 39 weeks and 6 days old.
- **Embryonic age**: Weeks nr 34–38. 33–37 weeks old.

- The fetus is considered full-term at the end of the 39th week of gestational age.
- It may be 48 to 53 cm (19 to 21 inches) in length.
- The lanugo is gone except on the upper arms and shoulders.
- Fingernails extend beyond fingertips.
- Small breast buds are present on both sexes.
- Head hair is now coarse and thickest.
- The development is continued postnatally with adaptation to extrauterine life and child development stages.

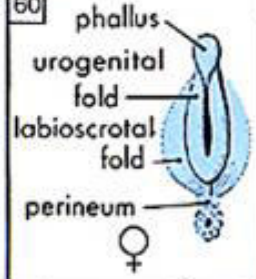
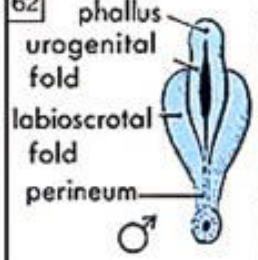
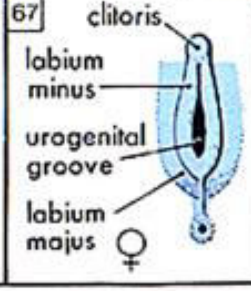
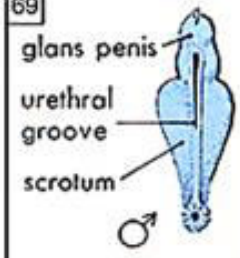
TIMETABLE OF HUMAN PRENATAL DEVELOPMENT
1 to 6 weeks

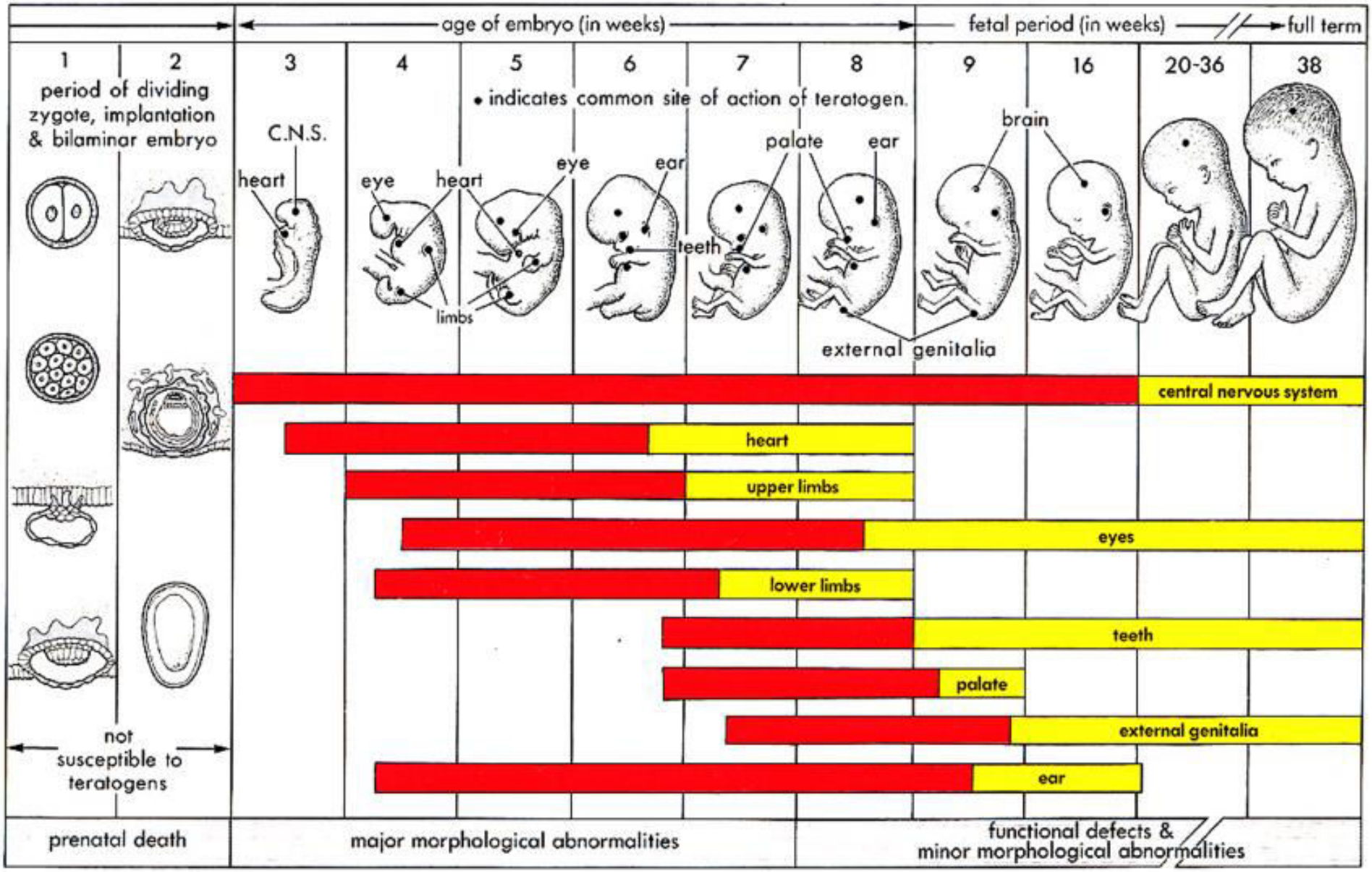



3
4
5
6
15
first missed menstrual period
primitive streak
16
Stage 7 begins
noto-chordal process
17
intra-embryonic mesoderm
trilaminar embryo
18
Stage 8 begins
neural plate
primitive streak
length: 1.5 mm
19
neural fold
notochord
embryonic coelom
20
Stage 9 begins
brain
neural groove
somite
Thyroid begins to develop.
21
neural groove
somite
Heart tubes begin to fuse.
22
Stage 10 begins
Heart begins to beat
Neural folds fusing
23
rostral neuropore
primordia of eye and ear present.
caudal neuropore
24
Stage 11 begins
heart bulge
rostral neuropore closes
2 pairs of branchial arches
25
otic pit
3 pairs of branchial arches
26
Stage 12 begins
Upper limb bud
indicates actual size
27
4 pairs of branchial arches. Upper & lower limb buds present.
CR = crown-rump length.
28
Stage 13 begins
CR: 4.0 mm
29
CR: 5.0 mm
30
Lens pits, optic cups, nasal pits forming.
31
developing eye
nasal pit
primitive mouth
32
Stage 14
Hand plates (paddle-shaped)
Lens pits and optic cups formed.
33
Stage 15 begins
hand plate
CR: 7.0 mm
34
Head much larger relative to trunk.
cerebral vesicles distinct
Foot plates present
35
CR: 8.0 mm
36
Oral & nasal cavities confluent.
37
Stage 16 begins
foot plate
CR: 9.0 mm
38
Upper lip formed.
39
CR: 10.0 mm
40
Upper limbs bent at elbow.
Digital rays and auricular hillocks distinct.
Palate developing.
41
Stage 17 begins
digital rays
ventral view
42
CR: 13.0 mm

TIMETABLE OF HUMAN PRENATAL DEVELOPMENT

7 to 38 weeks

AGE (weeks)							
7	43  CR: 16.0 mm	44 Stage 18 begins  Eyelids beginning	45 Tip of nose distinct. Digital rays appear in foot plates.  CR: 17.0 mm	46  Loss of villi Smooth chorion forms.	47 genital tubercle  urogenital membrane anal membrane ♀ or ♂	48 Stage 19 begins Trunk elongating and straightening.	49  CR: 18 mm
8	50 Upper limbs longer & bent at elbows. Fingers distinct.	51 Anal membrane perforated Urogenital membrane degenerating. Testes and ovaries distinguishable.	52 Stage 21 begins 	53 Stage 21 External genitalia still in sexless state but have begun to differentiate.	54 Stage 22 begins  genital tubercle urethral groove anus ♀ or ♂	55 Beginnings of all essential external & and internal structures are present.	56 Stage 23  CR: 30 mm
9	57 Beginning of fetal period.	58 	59 Genitalia show some ♀ characteristics but still easily confused with ♂.	60  phallus urogenital fold labioscrotal fold perineum ♀	61 Genitalia show fusion of urethral folds. Urethral groove extends into phallus.	62  phallus urogenital fold labioscrotal fold perineum ♂	63  CR: 50 mm
10	64 Face has human profile. Note growth of chin compared to day 44.	65 	66  Face has human appearance.	67  clitoris labium minus urogenital groove labium majus ♀	68 Genitalia have ♀ or ♂ characteristics but still not fully formed.	69  glans penis urethral groove scrotum ♂	70  CR: 61 mm


age of embryo (in weeks)
fetal period (in weeks)
full term
1
2
3
4
5
6
7
8
9
16
20-36
38
period of dividing zygote, implantation & bilaminar embryo
• indicates common site of action of teratogen.
C.N.S.
heart
eye
heart
eye
ear
teeth
palate
ear
brain
limbs
external genitalia
central nervous system
heart
upper limbs
eyes
lower limbs
teeth
palate
external genitalia
ear
not susceptible to teratogens
prenatal death
major morphological abnormalities
functional defects & minor morphological abnormalities