

INTRODUCTION TO HUMAN DEVELOPMENT

Interest in human development is widespread largely because of curiosity about our beginnings and a desire to improve the quality of human life. The process by which a baby develops from a single cell is miraculous and few events are more exciting than a human birth.

Human development is a continuous process that begins when an ovum is fertilized by a sperm. Cell division, growth, differentiation, and even cell death, transform the fertilized ovum into a multicellular human being. Although important maturational changes continue to occur during the **postnatal** period (infancy, childhood, adolescence and even adulthood), the formation of the organ systems occurs between fertilization and birth, the prenatal period. The goals of this course are to introduce you to the principals of embryogenesis that are being utilized to diagnose, correct, and ultimately prevent congenital malformations and birth defects. The cloning of the entire spectrum of human genes as well as the continuous development of molecular methods to prevent congenital malformations has revolutionized the entire field of modern embryology. The majority of these lectures will focus on the first eight weeks of life (known as the embryonic period) when the organ systems develop. Additional lectures will briefly introduce fetal maturation, birth, and the neonate.

GLOSSARY OF COMMONLY USED TERMS:

Conceptus: Refers to the embryo and its extra-embryonic membranes, i.e. the products of conception. It includes all structures that develop from the zygote, both embryonic and extraembryonic. Hence, the conceptus includes not only the embryo but also the placenta and its associated membranes.

Congenital malformations (birth defects): structural, behavioral, functional, or metabolic disorders present at birth.

Embryo: This term refers to the developing human during the early stages of development. The term is usually not used until the 2nd week, when a bilaminar (two layered) embryonic disc is formed. The **embryonic period** extends until the end of the eighth week, by which time all major structures and organs have formed.

Fetus: After the embryonic period, the developing human is called a fetus. The **fetal period** (ninth week to birth) is a period of maturation when many established organ systems develop further. The developmental changes that take place during the fetal period are not as dramatic as those that occur during the embryonic period, they are nevertheless very important.

Morphogenesis: encompasses a cascade of complex, orderly sequenced interactions that results in the development of shape of an organ or body form.

Neonate: The newborn; the neonatal period spans the period between birth and the end of the 4th postnatal week.

Organogenesis: all of the events required to establish an organ, organ system, or a major feature of the external body.

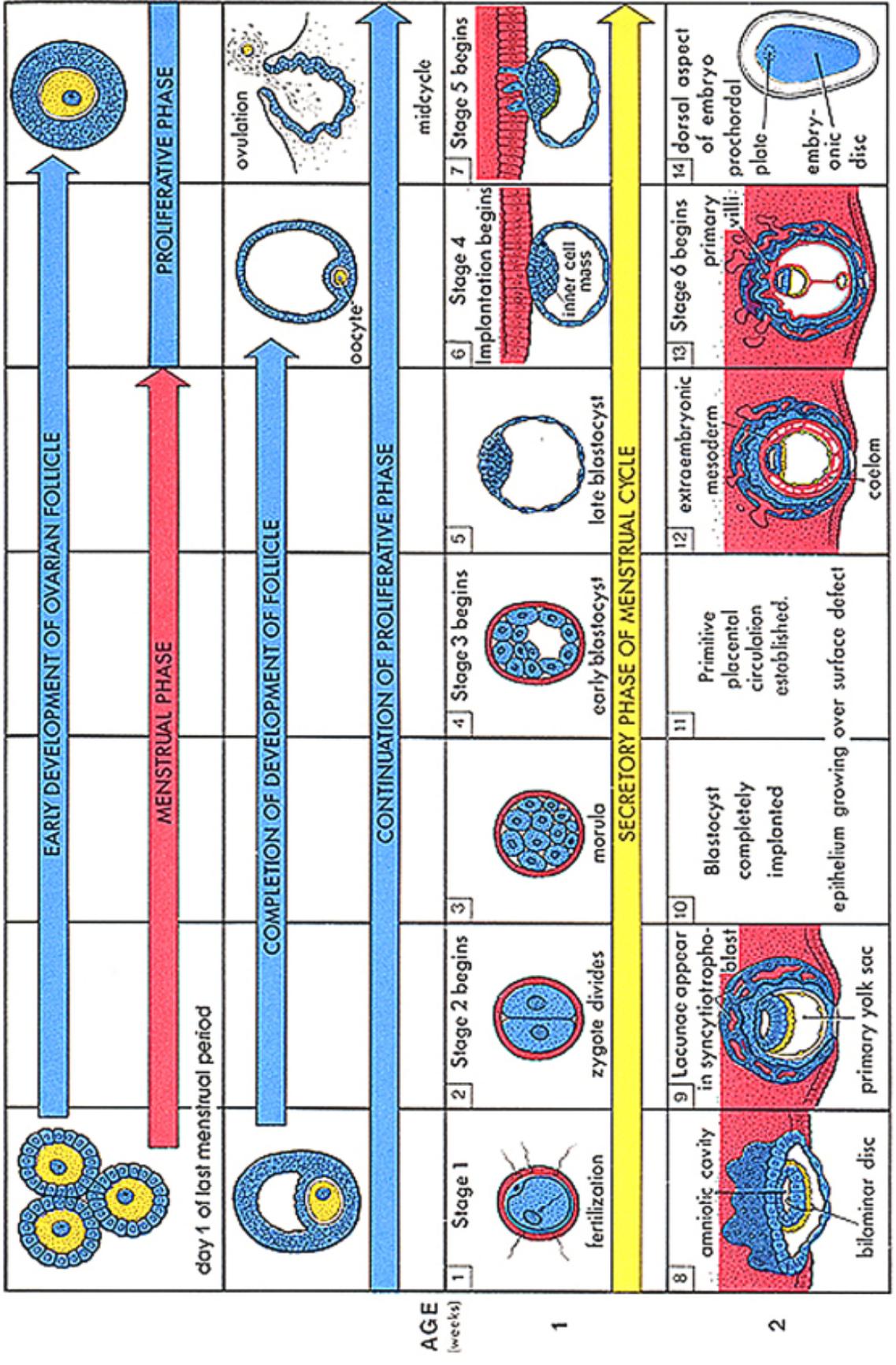
Primordium: the first cells or tissues of an organ to develop, i.e., its earliest stage of development. The term **anlage** has a similar meaning. For example, the primordium or anlage of the upper limb appears on about day 26 (E26).

Teratogen: an environmental agent that has the capacity to cause abnormal development and birth defects. Because the basic organs develop during the 4th and 5th embryonic weeks, exposure to a teratogen during that period can be particularly detrimental to normal development.

Trimester: Obstetricians divide the nine calendar months, or period of gestation, into three month periods called trimesters (stages of intrauterine development). The critical period of development occurs during the first trimester.

Zygote: a diploid cell resulting from fertilization of an ovum (mature female germ cell) by a sperm. A zygote is the beginning of a new human being.

TIMETABLE OF HUMAN PRENATAL DEVELOPMENT
1 to 6 weeks



15	first missed menstrual period primitive streak	16	Stage 7 begins notochordal process	17	intra-embryonic mesoderm trilaminar embryo	18	Stage 8 begins neural plate primitive streak length: 1.5 mm I	19	neural fold notochord embryonic coelom	20	Stage 9 begins brain neural groove somite Thyroid begins to develop.	21	neural groove 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	CR: 9.0 mm	37	Stage 16 begins foot plate	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

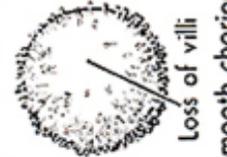
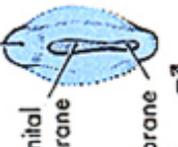
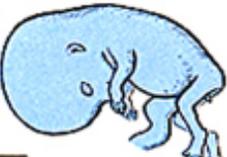
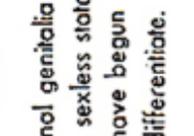
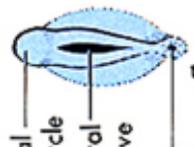
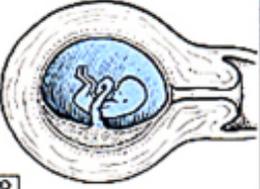
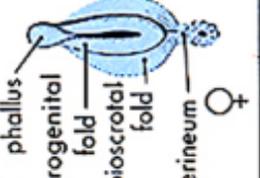
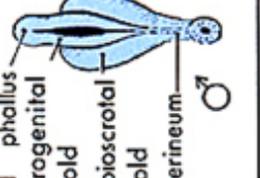
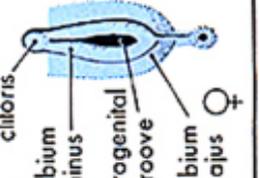
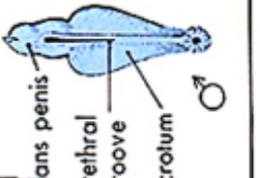
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TIMETABLE OF HUMAN PRENATAL DEVELOPMENT 7 to 38 weeks

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

