

Contents

Chapter 1	An Overview of Developmental Events, Processes, and Abnormalities	1
	The First and Second Weeks	2
	The Embryonic Period	
	The Early Embryonic Period	3
	The Late Embryonic Period	4
	The Fetal Period	5
	Histological Concepts	
	Samples of Epithelia and Connective Tissue	6
	Skin and Embryonic Connective Tissue	7
	Induction	8
	Apoptosis	9
	Segmentation and Early Pattern Formation	
	Genetic Determination of Embryonic Axes and Segments	10
	Segmentation and Segment Fates	11
	Cell Adhesion and Cell Migration	12
	Cell Differentiation and Cell Fates	13
	Growth Factors	14
	Classification of Abnormal Processes	15
	Classification of Multiple Anomalies	16
	Normal Versus Major Versus Minor Malformations	17
	Marfan Syndrome	18
	Apert and De Lange Syndromes	19
	Examples of Deformations	20
	Example of a Deformation Sequence	21
	Drug-Induced Embryopathies	22
	Terminology	23
Chapter 2	Early Embryonic Development and the Placenta	27
	Adult Uterus, Ovaries, and Uterine Tubes	28
	Ovary, Ova, and Follicle Development	29
	The Menstrual Cycle and Pregnancy	30
	The First Week:	
	Ovulation, Fertilization and Migration Down the Uterine Tube	31
	Ectopic Pregnancy	32
	Tubal Pregnancy	33
	Interstitial, Abdominal, and Ovarian Pregnancy	34
	The Second Week:	
	Implantation and Extraembryonic Membrane Formation	35
	The Third Week: Gastrulation	36
	Events Related to Gastrulation:	
	Neurulation and Early Placenta and Coelom Development	37
	The Fourth Week: Folding of the Gastrula	38
	The Vertebrate Body Plan	39

Formation of the Placenta	40
The Endometrium and Fetal Membranes	41
Placental Structure	42
External Placental Structure; Placental Membrane	43
Placental Variations	44
Placenta Previa	45
Summary of Ectodermal Derivatives	46
Summary of Endodermal Derivatives	47
Summary of Mesodermal Derivatives	48
Terminology	49
Chapter 3 The Nervous System	51
Formation of the Neural Plate	52
Neurulation	53
Neural Tube and Neural Crest	54
Neural Tube Defects	
Defects of the Spinal Cord and Vertebral Column	55
Defects of the Brain and Skull	56
Neuron Development	57
Development of the Cellular Sheath of Axons	58
Development of the Spinal Cord Layers	59
Development of the Spinal Cord	60
Peripheral Nervous System	
Development of the Peripheral Nervous System	61
Somatic Versus Splanchnic Nerves	62
Growth of the Spinal Cord and Vertebral Column	63
Embryonic Dermatomes	64
Adult Dermatomes	65
Development of the Brain	
Early Brain Development	66
Further Development of Forebrain, Midbrain, and Hindbrain	67
Development of Major Brain Structures	68
Growth of the Cerebral Hemispheres	69
Derivatives of the Forebrain, Midbrain, and Hindbrain	70
Development of the Forebrain	
Forebrain Wall and Ventricles	71
Relationship Between Telencephalon and Diencephalon	72
Cross Sections of the Midbrain and Hindbrain	73
Production of Cerebrospinal Fluid	74
Development of Motor Nuclei in the Brainstem	75
Segmentation of the Hindbrain	76
Development of the Pituitary Gland	77
Development of the Ventricles	78
Congenital Ventricular Defects	79
Terminology	80

Chapter 4	The Cardiovascular System	83
	Early Vascular Systems	84
	Vein Development	
	Early Development of the Cardinal Systems	85
	Transformation to the Postnatal Pattern	86
	Vein Anomalies	87
	Aortic Arch Arteries	88
	Artery Anomalies	
	Aortic Arch Anomalies	89
	Anomalous Origins of the Pulmonary Arteries	90
	Intersegmental Arteries and Coarctation of the Aorta	91
	Summary of Embryonic Blood Vessel Derivatives	92
	Formation of Blood Vessels	93
	Formation of the Heart Tube	
	Formation of the Left and Right Heart Tubes	94
	Formation of a Single Heart Tube	95
	Chambers of the Heart Tube	96
	Bending of the Heart Tube	97
	Partitioning of the Heart Tube	98
	Atrial Separation	99
	Spiral (Aorticopulmonary) Septum	100
	Completion of the Spiral (Aorticopulmonary) Septum	101
	Ventricular Separation and Bulbus Cordis	102
	Adult Derivatives of the Heart Tube Chambers	103
	Fetal Circulation	104
	Transition to Postnatal Circulation	105
	Congenital Heart Defect Concepts	106
	Ventricular Septal Defects	107
	Atrial Septal Defects	108
	Spiral Septum Defects	109
	Patent Ductus Arteriosus	110
	Terminology	111
Chapter 5	The Respiratory System	113
	Early Primordia	114
	Formation of the Pleural Cavities	115
	The Relationship Between Lungs and Pleural Cavities	116
	Visceral and Parietal Pleura	117
	Development of the Diaphragm	118
	Congenital Diaphragmatic Hernia	119
	Airway Branching	
	The Airway at 4 to 7 Weeks	120
	The Airway at 7 to 10 Weeks	121
	Development of Bronchioles and Alveoli	122
	Bronchial Epithelium Maturation	123

	Congenital Anomalies of the Lower Airway	124
	Airway Branching Anomalies	125
	Bronchopulmonary Sequestration	126
	Palate Formation in the Upper Airway	127
	The Newborn Upper Airway	128
	Terminology	129
Chapter 6	The Gastrointestinal System and Abdominal Wall	131
	Early Primordia	132
	Formation of the Gut Tube and Mesenteries	133
	Foregut, Midgut, and Hindgut	134
	Abdominal Veins	135
	Foregut and Midgut Rotations	136
	Meckel's Diverticulum	137
	Lesser Peritoneal Sac	138
	Introduction to the Retroperitoneal Concept	139
	Midgut Loop	140
	Abdominal Ligaments	141
	Abdominal Foregut Organ Development	142
	Development of Pancreatic Acini and Islets	143
	Congenital Pancreatic Anomalies	144
	Development of the Hindgut	145
	Congenital Anomalies	
	Duplication, Atresia, and Situs Inversus	146
	Megacolon (Hirschsprung's Disease)	147
	Summary of Gut Organization	148
	Development of the Abdominal Wall	149
	Umbilical Hernia	150
	The Inguinal Region	151
	Anterior Testis Descent	152
	The Adult Inguinal Region	153
	Anomalies of the Processus Vaginalis	154
	Terminology	155
Chapter 7	The Urogenital System	157
	Early Primordia	158
	Division of the Cloaca	159
	Congenital Cloacal Anomalies	160
	Pronephros, Mesonephros, and Metanephros	161
	Development of the Metanephros	162
	Ascent and Rotation of the Metanephric Kidneys	163
	Kidney Rotation and Migration Anomalies	
	Kidney Rotation Anomalies and Renal Fusion	164
	Kidney Migration Anomalies and Blood Vessel Formation	165
	Hypoplasia	166
	Ureteric Bud Duplication	167

Ectopic Ureters 168
 Bladder Anomalies 169
 Allantois/Urachus Anomalies 170
 Primordia of the Genital System 171
 8-Week Undifferentiated (Indifferent) Stage 172
 Anterior View of the Derivatives 173
 Paramesonephric Duct Anomalies 174
 Homologues of the External Genital Organs 175
 Hypospadias and Epispadias 176
 Gonadal Differentiation 177
 Testis, Epididymis, and Ductus Deferens 178
 Descent of Testis 179
 Ova and Follicles 180
 Summary of Urogenital Primordia and Derivatives 181
 Summary of Genital Primordia and Derivatives 182
 Terminology 183

Chapter 8 The Musculoskeletal System 185
 Myotomes, Dermatomes, and Sclerotomes 186
 Muscle and Vertebral Column Segmentation 187
 Mesenchymal Primordia at 5 and 6 Weeks 188
 Ossification of the Vertebral Column 189
 Development of the Atlas, Axis, Ribs, and Sternum 190
 Bone Cells and Bone Deposition 191
 Histology of Bone 192
 Membrane Bone and Skull Development 193
 Bone Development in Mesenchyme 194
 Osteon Formation 195
 Compact Bone Development and Remodeling 196
 Endochondral Ossification in a Long Bone 197
 Epiphyseal Growth Plate
 Epiphyseal Growth Plate 198
 Peripheral Cartilage Function in the Epiphysis 199
 Structure and Function of the Growth Plate 200
 Pathophysiology of the Growth Plate 201
 Ossification in the Newborn Skeleton 202
 Joint Development 203
 Muscular System: Primordia 204
 Segmentation and Division of Myotomes 205
 Epimere, Hypomere, and Muscle Groups 206
 Development and Organization of Limb Buds 207
 Rotation of the Limbs 208
 Limb Rotation and Dermatomes 209
 Embryonic Plan of the Brachial Plexus 210
 Divisions of the Lumbosacral Plexus 211
 Developing Skeletal Muscles 212
 Terminology 213

Chapter 9	Head and Neck	215
	Ectoderm, Endoderm, and Mesoderm	216
	Pharyngeal (Branchial) Arches	217
	Ventral and Midsagittal Views	218
	Fate of the Pharyngeal Pouches	219
	Midsagittal View of the Pharynx	220
	Fate of the Pharyngeal Grooves	221
	Pharyngeal Groove and Pouch Anomalies	222
	Pharyngeal Arch Nerves	223
	Sensory Innervation Territories	224
	Development of Pharyngeal Arch Muscles	
	Early Development of Pharyngeal Arch Muscles	225
	Later Development of Pharyngeal Arch Muscles	226
	Pharyngeal Arch Cartilages	227
	Ossification of the Skull	228
	Premature Suture Closure	230
	Cervical Ossification	231
	Torticollis	232
	Cervical Plexus	233
	Orbit	234
	Ear Development	235
	Adult Ear Organization	236
	Summary of Ear Development	237
	Cranial Nerve Primordia	238
	Cranial Nerve Neuron Components	239
	Parasympathetic Innervation and Unique Nerves	240
	Development of the Face	
	Development of the Face: 3 to 4 Weeks	241
	Development of the Face: 4 to 6 Weeks	242
	Development of the Face: 6 to 10 Weeks	243
	Palate Formation	
	Palate Formation	244
	Interior View of Palate Formation; Roof of Oral Cavity	245
	Congenital Anomalies of the Oral Cavity	246
	Floor of the Oral Cavity	247
	Developmental Coronal Sections	248
	Tooth Structure and Development	249
	Dental Eruption	250
	Terminology	251
Appendix	Summary of Common Congenital Anomalies Throughout the Body and Their Embryonic Causes	253