

**Volume 2****Section XV****Pulmonary Surfactant****1249***Jeffrey A. Whitsett***Chapter 113****Historical Perspective 1249***Mary Ellen Avery***Chapter 114****Composition of Pulmonary Surfactant Lipids and Proteins 1251***Jeffrey A. Whitsett***Chapter 115****Physicochemical Aspects of Pulmonary Surfactant 1259***Fred Possmayer***Chapter 116****Structure of Alveolar Epithelial Cells and the Surface Layer During Development 1275***Scott H. Randell and Stephen L. Young***Chapter 117****Regulation of Surfactant-Associated Phospholipid Synthesis and Secretion 1283***Seamus A. Rooney***Chapter 118****Pathophysiology of Respiratory Distress Syndrome and Surfactant Metabolism 1299***Alan H. Jobe***Chapter 119****Hormonal Therapy for Prevention of Respiratory Distress Syndrome 1314***Ian Gross and Philip L. Ballard***Chapter 120****Surfactant Treatment 1321***Alan H. Jobe***Section XVI****Physiology of the Gastrointestinal Tract in the Fetus and Neonate****1337***Steven M. Altschuler***Chapter 121****Trophic Factors and Regulation of Gastrointestinal Tract and Liver Development 1337***Andrew E. Mulberg and John F. Thompson***Chapter 122****Organogenesis, Innervation, and Histologic Development of the Gastrointestinal Tract 1342***Arthur J. Ross III***Chapter 123****Development of the Enteric Nervous System 1354***Delma L. Broussard and Steven M. Altschuler***Chapter 124****Development of Gastric Secretory Function 1364***Chris J. Dickinson***Chapter 125****Gastrointestinal Motility 1373***Taher I. Omari and Colin D. Rudolph***Chapter 126****Fetal and Neonatal Intestinal Motility 1383***Kyung-Rye Moon and A. Craig Hillemeier***Chapter 127****Development of the Exocrine Pancreas 1387***Steven L. Werlin***Chapter 128****Digestive-Absorption Functions in Fetuses, Infants, and Children 1400***Otakar Koldovský***Chapter 129****Pathophysiology of Gastroesophageal Reflux 1418***Steven M. Altschuler and Chris A. Liacouras***Chapter 130****Pathophysiology and Epidemiology of Necrotizing Enterocolitis 1425***Robert M. Kliegman***Section XVII****Liver and Bilirubin Metabolism****1433***William Balistreri***Chapter 131****Organogenesis and Histologic Development of the Liver 1433***Stuart S. Kaufman***Chapter 132****Fetal and Postnatal Hepatic Vasculature and Blood Flow 1442***Colin D. Rudolph and Abraham M. Rudolph*

**Chapter 133**  
**Bile Acid Metabolism During Development 1450**

*John C. Bucuvalas*

**Chapter 134**  
**Bile Secretion and Its Control in the Mature and Immature Organism 1457**

*Emil Chuang and Barbara A. Haber*

**Chapter 135**  
**Hepatic Disposition of Xenobiotics During Prenatal and Early Postnatal Development 1472**

*Zoltán Gregus and Curtis D. Klaassen*

**Chapter 136**  
**Bilirubin Metabolism and Toxicity in the Newborn 1493**

*William J. Cashore*

**Chapter 137**  
**Pathophysiology of Breast-Milk Jaundice 1499**

*Glenn R. Gourley*

**Section XVIII**  
**The Kidney**

1553

*F. Bruder Stapleton*

**Chapter 142**  
**Embryogenesis and Anatomic Development of the Kidney 1554**

*Ellis D. Avner*

**Chapter 143**  
**Functional Development of the Kidney In Utero 1560**

*Edward N. Guillery, Anne-Monique Nuyt, and Jean E. Robillard*

**Chapter 144**  
**Postnatal Maturation of Renal Blood Flow 1573**

*Pedro A. Jose, Aviad Haramati, and Robert D. Fildes*

**Chapter 145**  
**Development of the Renin-Angiotensin System 1579**

*Victoria Fay Norwood, Alda Tufro-McReddie, and Roberto Ariel Gomez*

**Chapter 146**  
**Postnatal Development of Glomerular Filtration 1588**

*Aida Yared and Iekuni Ichikawa*

**Chapter 147**  
**Measurement of Glomerular Filtration Rate in Neonates 1593**

*Jean-Pierre Guignard*

**Chapter 148**  
**Renal Transport of Sodium During Early Development 1600**

*Leonard G. Feld and Wayne R. Waz*

**Chapter 138**  
**Phototherapy for Neonatal Jaundice 1505**

*John F. Ennever*

**Chapter 139**  
**Pathophysiology of Metabolic Disease of the Liver 1514**

*James B. Gibson, David Piccoli, and Gerard T. Berry*

**Chapter 140**  
**Neonatal Cholestasis: Pathophysiology, Etiology, and Treatment 1521**

*Michael R. Narkewicz*

**Chapter 141**  
**Biochemical Assessment of Neonatal Liver Function 1530**

*Katrina J. Allen and Peter F. Whittington*

**Chapter 149**  
**Potassium Transport in Early Development 1612**

*William D. Engle*

**Chapter 150**  
**Transport of Calcium and Phosphorus 1616**

*Charles L. Stewart, Nuel C. Celebrado, Susan E. Mulroney, Frederick J. Kaskel, and Aviad Haramati*

**Chapter 151**  
**Transport of Amino Acids During Early Development 1626**

*Aaron L. Friedman*

**Chapter 152**  
**Developmental Aspects of Organic Acid Transport 1630**

*Deborah P. Jones and F. Bruder Stapleton*

**Chapter 153**  
**Concentration of the Urine 1634**

*Michael A. Linshaw*

**Chapter 154**  
**Dilution of the Urine 1653**

*Michael A. Linshaw*

**Chapter 155**  
**Urinary Acidification 1657**

*Eileen D. Brewer*

**Chapter 156**  
**The Response to Nephron Loss in Early Development 1660**

*Robert L. Chevalier*

**Chapter 157**  
**Neural Regulation of Blood Pressure During Fetal and Newborn Life 1665**

*Jeffrey L. Segar, Jon E. Mazursky, and David C. Merrill*

**Chapter 158**  
**Clinical Significance of Developmental Renal Physiology 1677**

*Luc P. Brion and Lisa M. Satlin*

**Section XIX**  
**Fluid and Electrolyte Metabolism**

1703

*William Oh*

**Chapter 161**  
**Fluid Distribution in the Fetus and Neonate 1703**

*Robert A. Brace*

**Chapter 162**  
**Fetal and Neonatal Body Fluid Composition with Reference to Growth and Development 1713**

*Andrew T. Costarino, Jr., and Yves W. Brans*

**Chapter 163**  
**Colloid Pressure and Osmoregulation in the Pregnant Woman, Fetus, and Neonate 1721**

*Paul Y. K. Wu*

**Section XX**  
**Developmental Hematopoiesis**

1737

*Robert D. Christensen*

**Chapter 166**  
**Developmental Biology of the Hematopoietic Growth Factors 1737**

*Kurt R. Schibler*

**Chapter 167**  
**Developmental Granulocytopoiesis 1753**

*Robert D. Christensen*

**Section XXI**  
**Hemostasis**

1803

*C. Thomas Kisker*

**Chapter 170**  
**Hemostatic Disorders in Newborns 1803**

*Maureen Andrew and Lu Ann Brooker*

**Chapter 171**  
**Normal Hemostasis in the Fetus and Newborn: Vessels and Platelets 1834**

*Marie J. Stuart and Janet E. Graeber*

**Chapter 159**  
**Pathophysiology of Acute Renal Failure in the Neonatal Period 1691**

*Midori Awazu, Tracy E. Hunley, and Valentina Kon*

**Chapter 160**  
**Continuous Hemofiltration in Neonates 1696**

*Joseph R. Sherbotie and Thomas E. Dudley*

**Chapter 164**  
**Regulation of Acid-Base Balance in the Fetus and Neonate 1726**

*Istoan Seri*

**Chapter 165**  
**Hydrops Fetalis and Other Causes of Neonatal Edema and Ascites 1730**

*Roderic H. Phibbs*

**Chapter 168**  
**Developmental Erythropoiesis 1762**

*Robin K. Ohls*

**Chapter 169**  
**Developmental Megakaryocytopoiesis 1787**

*Thomas A. Olson*

**Chapter 172**  
**Pathophysiology of Bleeding Disorders in the Newborn 1848**

*C. Thomas Kisker*

**Chapter 173**  
**Pathophysiology of Neonatal Disseminated Intravascular Coagulation and Thrombosis 1861**

*Marilyn Manco-Johnson and Rachelle Nuss*

## Section XXII Developmental Immunobiology

1869

*Richard B. Johnston Jr.*

**Chapter 174**  
**Host Defense Mechanisms Against Bacteria, Fungi,  
Viruses, and Nonviral Intracellular Pathogens** 1869

*David B. Lewis*

**Chapter 175**  
**T-Cell Development** 1919

*Marcia McDuffie and Anthony R. Hayward*

**Chapter 176**  
**B-Cell Development** 1924

*Alexander R. Lawton*

**Chapter 177**  
**Mononuclear Phagocyte System** 1931

*Mervin C. Yoder and Steven D. Douglas*

**Chapter 178**  
**Neutrophil Function in Newborn Infants** 1954

*Christian P. Speer and Richard B. Johnston, Jr.*

**Chapter 179**  
**The Complement System of the Fetus and  
Newborn** 1961

*Jerry A. Winkelstein*

**Chapter 180**  
**Cytokines and the Inflammatory Response** 1967

*Laurie Kilpatrick and Mary Catherine Harris*

## Section XXIII Neurology

2083

*Joseph J. Volpe*

**Chapter 187**  
**Development of the Nervous System** 2083

*Scott L. Pomeroy and Rosalind A. Segal*

**Chapter 188**  
**Development of the Blood-Brain Barrier** 2103

*John Laterra, Patricia A. Stewart, and Gary W. Goldstein*

**Chapter 189**  
**Development of Neurotransmitters** 2110

*Michael V. Johnston and Faye S. Silverstein*

**Chapter 190**  
**Biochemistry of Hypoxic-Ischemic Brain Injury** 2118

*Steven M. Rothman*

**Chapter 191**  
**Perinatal Brain Metabolism** 2123

*Robert C. Vannucci and Jerome Y. Yager*

**Chapter 192**  
**Physiologic Aspects of Nuclear Magnetic Resonance  
Spectroscopy** 2137

*Donald P. Younkin*

**Chapter 181**  
**Integrins and Cell Adhesion Molecules** 1980

*M. Michele Mariscalco and C. Wayne Smith*

**Chapter 182**  
**Stimulus-Response Coupling in Phagocytic  
Cells** 2002

*Helen M. Korchak*

**Chapter 183**  
**Fetal Wound Healing** 2015

*N. Scott Adzick*

**Chapter 184**  
**Immunology of Human Milk and Host  
Immunity** 2022

*Sadhana Chheda, Susan E. Keeney, and Armond S. Goldman*

**Chapter 185**  
**Amniotic Fluid Host Defense Mechanisms** 2032

*Richard A. Latta and Stephen J. Smith*

**Chapter 186**  
**Neonatal Pulmonary Host Defense  
Mechanisms** 2040

*Andrew P. Metinko*

**Chapter 193**  
**Electroencephalography in the Premature and Full-  
Term Infant** 2147

*Robert Ryan Clancy*

**Chapter 194**  
**Development of Tone and Reflexes in the Fetus and  
Newborn** 2166

*Alan Hill*

**Chapter 195**  
**Cerebral Blood Flow in Premature Infants:  
Regulation, Measurement, and Pathophysiology of  
Intraventricular Hemorrhage** 2175

*Jeffrey M. Perlman*

**Chapter 196**  
**Intraventricular Hemorrhage in the Premature  
Infant: Morphologic Characteristics** 2187

*Joseph J. Volpe*

**Chapter 197**  
**Adverse Drug Effects on the Fetal Nervous System 2200**

*David A. Stumpf*

**Chapter 198**  
**Trophic Factor, Nutritional and Hormonal Regulation of Brain Development 2215**

*Jeanette Pleasure and David Pleasure*

**Section XXIV**  
**Special Sensory Systems in the Fetus and Neonate 2249**

---

**Chapter 200**  
**Retinal Development and the Pathophysiology of Retinopathy of Prematurity 2249**

*Graham E. Quinn*

**Chapter 201**  
**Early Development of the Human Auditory System 2255**

*Lynne A. Werner*

**Section XXV**  
**Calcium, Phosphorus, and Magnesium Metabolism 2287**

---

*Reginald C. Tsang*

**Chapter 203**  
**Calcium-Regulating Hormones 2287**

*Jorge A. Prada*

**Chapter 204**  
**Calcium, Phosphorus, and Magnesium Transport Across the Placenta 2296**

*M. Zulficar Mughal, Shahid M. Husain, and Reginald C. Tsang*

**Chapter 205**  
**Neonatal Calcium, Phosphorus, and Magnesium Homeostasis 2308**

*Ran Namgung and Reginald C. Tsang*

**Section XXVI**  
**Orthopedics 2351**

---

*Denis S. Drummond*

**Chapter 208**  
**The Growth Plate: Embryologic Origin, Structure, and Function 2351**

*David J. Zaleske*

**Chapter 209**  
**Intrauterine Compression Syndromes: Effects of Mechanics on Endochondral Ossification 2360**

*William W. Robertson, Jr.*

**Chapter 210**  
**Defective Limb Embryology 2363**

*Benjamin A. Alman and Michael J. Goldberg*

**Chapter 199**  
**Ontogenesis of Striated Muscle 2226**

*Harvey B. Sarnat*

**Chapter 202**  
**Development of Taste and Smell in the Neonate 2276**

*Beverly J. Cowart and Gary K. Beauchamp*

**Chapter 206**  
**Pathophysiology of Neonatal Hypocalcemia 2329**

*Francis Mimouni and Reginald C. Tsang*

**Chapter 207**  
**Osteopenia and Rickets of Prematurity 2335**

*Winston W. K. Koo and Jean J. Steichen*

**Chapter 211**  
**Congenital Vertebral Anomalies and Their Sequelae 2365**

*Denis S. Drummond*

**Chapter 212**  
**The Congenital Muscle Diseases 2369**

*James W. Teener, Kenneth H. Fischbeck, and John T. Sladky*

**Chapter 213**  
**Skeletal Dysplasia and Dwarfism: Physiology and Pathophysiology 2373**

*Jennifer M. Moriatis, Elaine H. Zackai, and Frederick S. Kaplan*

**Chapter 214**  
**Pathophysiology of Neonatal Osteomyelitis and Septic Arthritis** 2382

*John A. Ogden*

**Section XXVII**  
**The Pituitary**

2395

---

*Selna Kaplan and Melvin Grumbach*

**Chapter 216**  
**Neurosecretions and Neurotransmitters of the Fetal Hypothalamus** 2395

*Desmond P. Gilmore*

**Chapter 217**  
**Growth Factor Regulation of Fetal Growth** 2401

*Lorraine E. Levitt Katz and Pinchas Cohen*

**Chapter 218**  
**Growth Hormone and Prolactin** 2409

*P. D. Gluckman*

**Chapter 219**  
**Luteinizing Hormone and Follicle-Stimulating Hormone Secretion in the Fetus and Newborn** 2420

*Leona Cuttler*

**Section XXVIII**  
**The Fetal Adrenal and Fetal Thyroid Systems**

2447

---

*Delbert A. Fisher*

**Chapter 222**  
**Fetal and Neonatal Adrenocortical Physiology** 2447

*Jeremy S. D. Winter*

**Section XXIX**  
**The Ovary and Testis**

2469

---

*Selna Kaplan and Melvin Grumbach*

**Chapter 224**  
**Sex Determination** 2469

*Marisol L. Lopez, Robert P. Erickson, and Stan R. Blecher*

**Chapter 225**  
**Germ Cells and the Indifferent Gonad (Genital Ridge)** 2475

*Jan E. Jirásek*

**Chapter 226**  
**Differentiation of the Ovary** 2484

*Anne Grete Byskov and Lars Grabow Westergaard*

**Chapter 215**  
**Standards and Measurements: Fetus and Neonate** 2386

*Robert N. Hensinger*

**Chapter 220**  
**Development of the Corticotropin-Releasing Factor Adrenocorticotrophic Hormone/Beta-Endorphin System in the Mammalian Fetus** 2431

*James C. Rose, Jeffrey Schwartz, Jennifer Green, and DeWana Ray Kerr*

**Chapter 221**  
**Fetal and Neonatal Neurohypophyseal Hormones** 2442

*Rosemary D. Leake*

**Chapter 223**  
**Fetal and Neonatal Thyroid Physiology** 2460

*Daniel H. Polk and Delbert A. Fisher*

**Chapter 227**  
**Testicular Development** 2492

*Bernard Gondos*

**Chapter 228**  
**Testicular Descent** 2499

*Ronald S. Sutherland and Barry A. Kogan*

**Index** 2505