

Lecture #	Lecture Title	Length of Lecture and Associated Readings/Practice Questions (in minutes)	Contact Hours	CEUs	Lecturer	Behavioral Objectives Participants will:	Content Overview
Lecture 1	Introduction to Course/Basic Human Biology/Molecular Genetics	90	1.5	0.15	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Discuss basic concepts of genetics, including the cell cycle, trait inheritance, mitosis/meiosis, and crossing over. 2. List the types of human tissue. 3. List the human organ system and basic properties of each. 4. Recite terms used to describe human anatomy 	Instructor discusses the basics of human genetics and how it relates to embryology. Also discusses basic concepts that are necessary for understanding embryology including tissue types, levels of organization of the human body, types of body cavities, and other common terms.
Lecture 2	Weeks 1 & 2 of Development	90	1.5	0.15	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Describe the three germ layers of the embryo. 2. Explain gametogenesis and fertilization. 3. Describe the first week of human development. 4. Identify chromosomal anomalies and the techniques of assisted reproduction. 5. Describe early components of the embryo/placenta, including the amniotic cavity, the yolk sac, mesoderm, and the trophoblasts. 	Instructor discusses and demonstrates the three germ layers of the embryo and what tissues/organs they give rise to. Discusses gametogenesis and fertilization. Also, covers the development of the early placenta including development of the primary, secondary, and tertiary villi. Finally discusses the two trophoblasts, two embryonic blastocysts, yolk sacs, and the clinical correlation with molar pregnancies.
Lecture 3	Weeks 3 & 4 of Development/Teratology	105	1.75	0.175	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Describe gastrulation. 2. Describe differentiation of intraembryonic mesoderm. 3. Describe the process and regulation of cell migration. 4. Describe the process of neurulation. 5. Explain somite differentiation. 6. List the steps involved in embryonic folding. 7. Describe the embryologic basis of neural tube defects. 	The process of gastrulation is described and demonstrated in detail including the primitive streak and formation of the definitive germ layers. Examples of disorders related to abnormal gastrulation such as caudal regression are described. Development of mesodermic structures and cell migration are discussed. Neurulation and embryonic basis of neural tube defects is described. The concept of embryonic folding is introduced.
Lecture 4	Molecular Mechanism of Limb Development	90	1.5	0.15	Shelia Bell, PhD	<ol style="list-style-type: none"> 1. List genes that control limb development and describe their effects. 2. Describe different types of limb defects and associated syndromes. 3. Explain the apical ectodermal ridge and progress zone as they relate to the establishment of proximal/distal limb patterning. 	The lecturer discusses the three axes of limb development and the molecular mechanisms of common limb malformations including specific genes and which axes they influence. This includes a discussion of the apical ectodermal ridge and progress zone and how they establish proximal/distal limb patterning.
Lecture 5	Neural Tube Defects	90	1.5	0.15	Susan Wiley, MD/Braydon Sellet	<ol style="list-style-type: none"> 1. Explain the embryologic basis of neural tube defects. 2. Describe the epidemiological and clinical features of spina bifida. 3. Describe prenatal testing and prenatal intervention for spina bifida. 4. Describe psychosocial aspects of spina bifida. 5. Describe learned patient perspectives on growing up with spina bifida. 6. Describe learned patient perspectives on relationships, family planning, and navigating adult healthcare with spina bifida. 	This lecturer covers the embryonic basis of common neural tube defects in detail. The prevalence, risk factors for, clinical manifestations of, and management of common neural tube defects are discussed. A patient with spina bifida discusses the psychosocial concerns and lived experience of having spina bifida.
Lecture 6	Preimplantation Diagnosis	90	1.5	0.15	Leandra Tolusso, MS, LGC	<ol style="list-style-type: none"> 1. Define types of preimplantation genetic testing 2. Describe process and genetic laboratory techniques of preimplantation genetic testing. 3. Discuss ethical issues related to preimplantation diagnosis. 4. Discuss genetic counseling issues related to preimplantation diagnosis. 	A detailed discussion of assisted reproductive technologies including the laboratory procedures and risks related to ovarian stimulation, egg retrieval, sperm retrieval, ICSI, and in vitro fertilization. The procedures, limitations, and benefits of PGD are discussed with specific emphasis on the embryonic stage. Ethical concerns and counseling issues are also discussed.
Lecture 7	Embryonic Folding/Begin Vasculature	90	1.5	0.15	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Explain embryonic folding. 2. Describe the development of intraembryonic coelom and the lungs. 3. Explain the embryologic basis of lung and diaphragm abnormalities. 	Detailed pictures, explanations and demonstrations are used to illustrate embryonic folding including lateral, cranial, and caudal folding. Development of the coelom and how this gives rise to lung development is covered. Clinical examples of abnormal lung development are used including congenital diaphragmatic hernia, esophageal atresia, impact of poly and oligohydramnios, as well as hereditary surfactant B deficiency.
Lecture 8	Vasculature/Begin Heart Development	90	1.5	0.15	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Describe the process of vasculogenesis and early vessel formation. 2. Describe the development of arterial, venous, and lymphatic systems. 3. Describe the initial development of the heart. 4. Describe the remodeling of the venous return to the heart. 5. Describe the embryological basis of vasculature malformations. 	Development of the early vasculature is discussed including including aortic arch development and remodeling, venous development, and lymphatic system development. The development of the early heart tube and folding of the heart is discussed as well as a beginning of discussion of how errors in this process give rise to common congenital heart defects.
Lecture 9	Finish Heart Development	90	1.5	0.15	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Describe the division of the atrioventricular canal. 2. Describe the formation and remodeling of the atria, ventricles, and outflow tracts. 3. Describe embryonic circulation and how circulation changes at birth. 4. Describe heart defects that are due to abnormal heart development. 	A continuation of the discussion of how errors in embryonic heart development give rise to specific common congenital heart defects. This also includes a discussion of how circulation occurs in the fetus and changes in this circulation that happen at birth.
Lecture 10	Clinical Aspects of Congenital Heart Anomalies	90	1.5	0.15	Timothy Knilians, MD	<ol style="list-style-type: none"> 1. Describe the anatomic basis of specific heart defects. 2. Describe the embryologic basis of heart defects. 3. Describe the clinical symptoms and manifestations of heart defects. 4. Describe surgical or other treatments for heart defects. 	Congenital heart defects that were introduced in the previous lecture are covered in more detail including their detection at birth, their clinical manifestations, and their treatment in the newborn period and beyond.
Lecture 11	Urogenital System	90	1.5	0.15	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Describe the basic anatomy of the urogenital system. 2. Describe the formation of the kidneys. 3. Describe the maturation of the cloaca. 4. Describe the development of the internal and external reproductive structures. 5. List disorders that result when urogenital system does not develop properly. 	development of the nephrons and the migration of the kidney structures is covered. The development of the internal and external reproductive structures are discussed including how and when these structures develop differently in males and females. Clinical features and embryonic basis of disorders of the urogenital system are covered including bladder extrophy, ectopic ureters, androgen insensitivity syndrome, hypospadias, and sex chromosome abnormalities.
Lecture 12	Sex Determination	90	1.5	0.15	David Repaske, MD	<ol style="list-style-type: none"> 1. Consider the societal aspects of gender differentiation/identification. 2. Describe the processes of sex determination and sex differentiation. 3. List the genes that control sex determination/differentiation. 4. Describe disorders of sex determination/differentiation. 	The chromosomal and molecular basis of sex determination during embryonic development are explored in more detail. The differences between sex determination and gender identification are explored. Common disorders of sexual development and their related genes are discussed.
Lecture 13	Gastrointestinal Development/Gastrointestinal Anomalies	90	1.5	0.15	DJ Lowrie, PhD, Loren Pena, MD	<ol style="list-style-type: none"> 1. Describe the basic anatomy of the gastrointestinal system. 2. Describe the development of the GI tract. 3. Describe anomalies of the GI tract that can occur due to abnormal development. 	The basic anatomy and embryonic development of the GI tract are discussed including development of the foregut, midgut, and hindgut as well as the rotation of the intestines and development of the GI lumen. Gastroschisis, Omphalocle, and common anomalies of gut rotation are covered. Clinical manifestations, embryonic basis, and management of common GI anomalies are discussed including pyloric stenosis, congenital diaphragmatic hernia, TEF, duodenal atresia, annular pancreas, and Meckel's diverticulum.
Lecture 14	Developmental Field Defects	45	0.75	0.075	Robert Hopkin, MD	<ol style="list-style-type: none"> 1. Describe developmental field theory. 2. Compare the relationship of developmental field defects to the stages of embryonic development. 3. Describe developmental field defects. 	The idea of developmental fields and how they can be used to explain patterns of birth defects and sensitive periods of embryonic development are covered using clinical examples.
Lecture 15	Head & Neck I	105	1.75	0.175	DJ Lowrie, PhD	<ol style="list-style-type: none"> 1. Describe the normal development of the central nervous system. 2. Describe abnormalities of the central nervous system. 3. Describe the structure and development of the pharyngeal arches. 	The components of the human skull, including chondrocranium, membrane bones, and visceral skeleton, are discussed. Anomalies of the central nervous system such as hydrocephaly and lissencephaly are covered. Pharyngeal arches 1, 2, 3, 4, and 6 are discussed.

						4. Describe the development of the cranial nerves, face, and nasal cavity. 5. Describe the remodeling of the pharyngeal clefts.	including the developmental involvement of pharyngeal clefts, pharyngeal pouches, and pharyngeal arch cartilage. The instructor also discusses the various facial prominences (frontonasal process, mandibular swellings, and maxillary swellings) and how they interface during development. Development of the hard and soft palates, nasal septum, and choanae are also discussed in detail.
Lecture 16	Head & Neck II	75	1.25	0.125	DJ Lowrie, PhD	1. Describe the development of the tongue, thyroid gland, and pharyngeal pouches. 2. Describe anomalies of the oral cavity and its derivatives. 3. Describe development of the eye and causes of congenital eye anomalies. 4. Describe the normal development of the ear and causes of congenital ear anomalies.	The anterior and posterior sections of the tongue are contrasted and discussed in terms of facial nerve involvement. Migration of the thyroid gland through the neck is covered in detail. Development of the eye is covered from the formation of the optic cup through development of the lens, retina, and sclera. Congenital defects of the eye are discussed, including aniridia, aphakia, and coloboma. Discussion of the ear covers both middle and outer ear development.
Lecture 17	Head & Neck Anomalies/Molecular Genetics of Human Deafness	90	1.5	0.15	John Greinwald, MD	1. Describe the anatomy and appearance of the normal ear. 2. Describe the symptoms and causes of craniofacial structural and functional abnormalities. 3. Describe the etiology and epidemiology of hearing loss. 4. List genes associated with hearing loss and their characteristics.	The embryonic development of the ear and hearing are discussed using clinical examples. This includes discussion of common anomalies of ear development and their molecular basis as well as the epidemiology and genetics of hearing loss.
Lecture 18	Craniofacial Syndromes	90	1.5	0.15	Howard Saal, MD	1. Describe the embryologic basis of, syndromes that are associated with, and treatment for cleft lip and/or palate. 2. Describe syndromes that result in craniofacial anomalies. 3. Describe the embryologic basis of and syndromes that are associated with craniosynostosis.	The embryonic basis of common craniofacial disorders is discussed as well as the clinical manifestations and treatment of these disorders. The embryonic basis of craniosynostosis and common syndromes and their genes are also covered.
Total		1590	26.5	2.65			