

**VTPP 652 Fetal and Embryo Physiology
Spring Semester 2018
Course Syllabus**

3 Credit Hours

Brief Course Description

The purpose of this course is to provide graduate level students with an introduction to the biochemical processes essential to gametogenesis, early embryonic development and pregnancy. This course will provide a framework upon which to build a basic understanding of the physiology of pregnancy and several developmental disorders that arise due to biomedical miss-regulation or environmental agents. Students will be expected to synthesize structural functional relationships between the gametes and reproductive organs and describe the interaction between the developing fetus, placental membranes, maternal tissues and the environment. Graduate level students will also be expected to participate in a weekly journal club, and required to answer essay style questions describing the scientific findings and research strategies detailed within the assigned manuscripts.

Prerequisites

Students must be enrolled as graduate students in the life sciences.

Meeting Times & Important Dates

VTPP 652 will meet every **Tuesday and Thursday 8:45 AM - 10:00 AM in Room 120 - National Center for Therapeutics Manufacturing (NCTM)**. This building is located off Discovery Dr. next to the new College of Veterinary Medicine. Busses run to this location every 12 minutes. There will be two mid-term examinations and a final. Please note the dates below. Absence from the examination will result in a grade of 0 unless a medical note from a Physician is provided (<http://student-rules.tamu.edu/rule07>)

Midterm 1	Tuesday February 20th - In class
Midterm 2	Thursday March 29th - In class
Writing Assignment	Due April 15th
Final Exam	Friday May 4th 1:00 to 3:00 PM (in NCTM room 120)

Instructor Information

Michael C. Golding, PhD.
Associate Professor
Department of Veterinary Physiology
and Pharmacology
Texas A&M University
College Station, Texas 77843-4466
979-862-1332
mcgolding@tamu.edu

Charles R. Long, MSc. PhD.
Professor
Department of Veterinary Physiology
and Pharmacology
Texas A&M University
College Station, Texas 77843-4466
979-845-2331
clong@cvm.tamu.edu

Overall Course Objectives

Welcome to VTPP 652 - Fetal and Embryo Physiology. This course is intended to provide Graduate Students with a survey of the molecular and physiologic processes at work during pregnancy. We will begin with the production of sperm and egg and travel through pregnancy to the events initiating labor. The topics discussed in this course are intended to be used as a framework for students to better understand the developmental origins of both birth defects and disease. The specific learning objectives for this course have been distilled from those prescribed by the American Physiological Association, the American Congress of Obstetricians and Gynecologists as well as major areas in Maternal-Fetal medicine highlighted by the National Board of Medical Examiners. This course will draw upon subject matter covered in anatomy, cell biology, genetics, and physiology and will require students to synthesize these separate disciplines into a comprehensive whole. **This course is intended to prompt graduate students to shift from memorization and recitation to the development of skill sets necessary for the life-long learning required of professionals.**

Specific Learning Objectives

- Identify the cell types and anatomical structures necessary to gametogenesis.
- Describe spermatogenesis and the role of Sertoli and Leydig cells in this process.
- Graphically illustrate the timing of changes in blood levels of key sex hormones and correlate these with structural changes in both the uterine endometrium and ovary during the menstrual cycle.
- Explain the physiological basis of steroid hormone contraception (“birth control pill”).
- Describe the process of fertilization, including capacitation and the acrosome reaction.
- Illustrate and explain the movement of the blastocyst towards the uterine wall.
- Describe the process of implantation and explain the major physiological functions of the placenta.
- List the protein hormones secreted by the placenta and describe their roles in maintaining pregnancy / controlling gestation length.
- Define the terms: stem cell, differentiation, commitment, and specification and explain their relevance to mammalian development.
- Discuss the maternal physiologic and anatomic changes associated with pregnancy.
- Discuss the diagnosis of pregnancy using biochemical methodologies.
- Diagram the structures of the developing embryo.
- Describe the relationship between fetal and maternal tissues.
- Describe the developmental origins of the circulatory system.
- Trace the flow of blood between maternal and fetal tissues for a given gestational age.
- Define the normal length of gestation and describe how this is established / maintained.
- Discuss anatomical and physiological characteristics for a given gestational age.
- Identify a pregnancy at risk for complications, including poor maternal or fetal outcomes.
- Describe the make up of the uterus and cervix
- List the hormonal changes involved in the onset of labour
- Describe how the cervix and uterus change in response to labour
- Define Epigenetics and describe the relationship between gene expression and environmental factors.
- Define the term teratogen and describe potential mechanisms of action for this class of agents.
- List the major assisted reproductive technologies in agricultural and clinical practice and describe their use and implications.

American Physiological Society - Learning Objectives <http://www.the-aps.org/MedPhysObj> - Learning Objectives 77 - 105

American Congress of Obstetricians and Gynecologists - Educational Objectives, A Core Curriculum in Obstetrics and Gynecology, Ninth Edition - Learning Outcomes for Sections 1A - D.

National Board of Medical Examiners - Subject Exam for Obstetrics and Gynecology - Learning Objectives pulled from tested materials covered on the SHELF exam.

Learning Outcomes and Goals

The purpose of this course is to follow mammalian development from the earliest stages of gametogenesis, through fertilization, to the point the fetus is ready to begin terrestrial life. We will focus on the unique physiology of the placenta and its role in both facilitating fetal metabolism and orchestrating the timing of human development. Understanding the nuances of normal fetal physiology is the basis for prenatal diagnosis and the institution of successful therapy.

Learning Outcomes:

By the end of the course, the graduate student will have:

- developed an understanding of basic endocrinology and how hormones regulate physiological processes
- a firm understanding of how cellular differentiation controls organ development
- a better understanding of the developmental origins of
 - the central nervous system
 - the cardiovascular system
 - the reproductive organs
 - the limbs and integumentary system
- exposure to collection and analysis of clinical data
- knowledge of teratogens and their relation to the development of birth defects
- a greater understanding of the relationship between maternal-fetal physiology and complications during pregnancy including:
 - insight into critical thinking in the clinical setting
 - goals and mechanisms of some pharmacologic agents
 - surgical techniques used to correct cardiovascular birth defects
 - the physiological basis of clinical assisted reproductive technologies
- developed skill sets necessary to critically evaluate the scientific literature
- become proficient answering essay style questions using the primary literature as a reference

Text Book

Primary Text - Primary Text - Serves to supplement the notes given in class
Human Embryology and Developmental Biology - Bruce M Carlson
ISBN 978-0-323-05385-3

Secondary Resources

The Developing Human - Clinically Orientated Embryology
ISBN 978-1-4377-2002-0
Larsens Human Embryology
ISBN 978-0-443-06811-9
Mayo Clinic - Guide to a Healthy Pregnancy
ISBN-13: 9781561487172
What to Expect when you are expecting
ISBN-10: 0761148574

Grading policies

Grading scale A= 90-100
 B= 80-89
 C= 70-79
 D= 60-69
 F= 0-59

Course Breakdown

Midterm 1	25%	Tuesday February 20th
Midterm 2	25%	Thursday March 29th
Writing Assignment	10%	(Due April 15th)
Journal Club	10%	(Will appear as portion of midterm and final)
Final Exam	30%	Friday May 4th 1:00 to 3:00 PM (in NCTM room 120)

Examinations:

Two midterm examinations and a final examination will be written to assess a student's understanding of the information discussed in class with particular emphasis on the **specified learning objectives** and assigned readings. All students enrolled in VTPP 652 will take the examinations at the scheduled lecture days/times on the following dates: **February 20th, and March 29th**. The two midterm examinations will consist of two parts: Part A will be a combination of multiple choice, short answer, and/or essay questions which will be written in class, Part B will be a take home essay covering a major, unifying concept covered in the assigned journal articles. For the final examination, the major essay question will be completed during the exam period (see "Journal Club" below). Seating for examinations is on a random basis.

Students who have withdrawn from or Q-dropped the course are not considered as officially enrolled in the course, and thus, may not take examinations or attend lectures.

Writing Assignment

Wikipedia is a free, multilingual collaborative encyclopedia, which is quickly becoming the largest and most popular general reference source in the world. In the United States alone, Wikipedia receives 2.7 billion monthly page views from people of all walks of life. The name Wikipedia derives from the fusion of the Hawaiian term Wiki meaning "quick" and encyclopedia. The entries placed on Wikipedia are typically very succinct, pithy and to the point. In the event the reader would like to read more on the subject or verify the information, articles list the reference or source(s) the information being discussed was derived from.

During the semester, students enrolled in VTPP 652, Fetal and Embryo Physiology are required to complete a writing assignment designed to familiarize them with a gene of their choice, controlling a developmental process of interest. Students will submit a "Wikipedia style entry" summarizing what is known about their gene and properly reference the **PRIMARY sources** they derived this information from. This entry will be approximately one paragraph in length - 150 to 250 words and will summarize the research they have conducted on their gene of interest. The text will be written in the students own words and should be understandable to a general audience.

Article Break Down

Below are some loose guidelines on the information that should be included in your article.

- 1) What type of molecule is your gene of interest?
i.e. transcription factor vs signaling molecule or structural protein...
- 2) What does this molecule do? i.e. what is its biological role?
- 3) What organ system or developmental structure is this gene involved in patterning?
- 4) Are there any diseases or defects associated with this gene? Have scientists generated a gene "knockout" model?

Students will compile and summarize the above information into a single paragraph, and upload this information onto Wikipedia. A copy of this entry should be sent to Dr. Golding - mcgolding@tamu.edu by April 15th. Other than these loose guidelines, the content of the article and the subjects discussed are wide open and subject to the students creativity and interests.

Journal Club

Journal clubs are a core aspect of graduate and professional education. The journal club section of this course is intended to provide graduate level students exposure to the most current research in biochemistry, developmental biology, genetics, and physiology that underpin the major concepts discussed in class. For graduate education, it is important that students comprehend not only the facts and statistics presented during lecture, but also how this information was derived. As such, each week students will be assigned a new article taken from the most current primary literature relevant to the core topics discussed in lecture. Students will be expected to synthesize the data and research strategies outlined in each paper, then utilize this information as the basis for an essay question. The essay style questions examining the assigned journal articles will appear as a take home portion for each of the midterms and as a major question answered during the final examination. (The essay question for the final is **NOT** take home) These three essay questions will account for 10% of the final grade (2.5% for each midterm essay question and 5% for the question administered during final exam).

Graduate and professional students must become familiar with the role the primary literature plays in establishing evidence based medical practice and identifying areas of funding priority in biomedical research. It is highly suggested that students organize themselves into groups to facilitate discussion of the assigned journal articles. Drs. Golding and Long will be happy to answer specific questions on the assigned articles, but will not offer any formal class time to their discussion. This is intended to be an aspect of your education for independent study.

Midterm 1	2.5%	Tuesday February 20th - In class
Midterm 2	2.5%	Thursday March 29th - In class
Final Exam	5%	Friday May 4th 1:00 to 3:00 PM (in NCTM room 120)
Total 15%		

VTPP 652 Course Topics

Week 1 January 16 & 18

Lecture 1 - Differentiation & Cell Specialization (Golding)

Molecular Basis for Embryonic Development
Differentiation & Cell Specialization
Stem Cells and Niches

Lecture 2 - Epigenetics Development & Disease (Golding)

Chromatin Structure
DNA Methylation and Post-Translational Histone Modification
Epigenetic Programming, Cellular Identity, Development and Disease

Week 2 January 23 & 25

Lecture 3 - Germ Stem Cells and Sexual Determination (Golding)

Germ Cell Origins & Development
Sexual Differentiation
Development of the Gonad

Lecture 4 - Spermatogenesis II (Long)

Male Reproductive Endocrinology
Spermatogenesis
Sperm Production

Week 3 January 30 & February 1

Lecture 5 - Meiosis & Oogenesis I (Long)

Meiosis
Germ Cell reprogramming
Oogenesis

Lecture 6 - Meiosis & Oogenesis II (Long)

Hormone Signaling and Ovarian Function
Follicular Development and Estrous
Oocyte Growth, Maturation and Ovulation

Week 4 February 6 & 8

Lecture 7 - Ovulation (Long)

Ovulation
Oocyte Growth
Cell Signaling Mechanisms Regulating Oocyte Growth and Ovulation

Lecture 8 - Fertilization I (Long)

Transport of Gametes and Fertilization
Fertilization
Sperm / Egg Interactions

Week 5 February 13 & 15

Lecture 9 - Fertilization II (Long)

Embryo Development
Embryo Polarity
Epigenetic Programming

Lecture 10 - Assisted Reproductive Technologies & Epigenetics (Long)

Assisted Reproductive Technologies in Humans and Livestock
Epigenetic Regulation of Development and X-Inactivation
Developmental Anomalies associated with ARTs

Week 6 February 20 & 22

Lecture 11 - Midterm 1 (February 20th in class)

Lecture 12 - Implantation and Maternal Recognition of Pregnancy (Golding)

Uterine Endometrium & Embryo Implantation
Twinning and Conjoined Fetuses
Maternal Recognition of Pregnancy

Week 7 February 27 & March 1

Lecture 13 - Placental Physiology I (Golding)

Placental Differentiation & Physiology
Blood Flow in the Placenta
Placenta and Membranes in Multiple Pregnancies

Lecture 14 - Placental Physiology II (Golding)

Placentation and Extraembryonic Membranes
Extraembryonic Tissues – Yolk Sac and Blood Islands
Preeclampsia and Complications

Week 8 March 6 & 8

Lecture 15 - The Mammalian Body Plan (Golding)

Gastrulation and the Mammalian Organizer
Formation of the Primitive Streak and Notochord
Axis specification and Embryo Symmetry

Lecture 16 - The Mammalian Body Plan II (Golding)

Molecular Properties of the Mammalian Organizer
Morphogenic Gradients and Embryonic Specification
Induction and the formation of the three Germ Layers

March 12th - 16th - SPRING BREAK

Week 9 March 20 & 22

Lecture 17 - The Mammalian Body Plan III (Golding)

Formation of the Neural Tube and body Segments
Lateral Folding and the formation of the Gut Tube
Establishment of the 4-Week Old Embryo

Lecture 18 - Development of the Nervous System I (Golding)

Induction of the Nervous System
Peripheral vs Autonomic Nervous Systems
Structural Changes in the Central Nervous System

Week 10 March 27 & 29

Lecture 19 - Development of the Nervous System II (Golding)

Induction of the Nervous System
Peripheral vs Autonomic Nervous Systems
Structural Changes in the Central Nervous System

Lecture 20 - Midterm 2 (March 29th - in class)

Week 11 April 3 & 5

Lecture 21 - Development of the Cardiovascular System I (Golding)

Formation of the Heart Structures
Formation of the heart Chambers & Fetal Shunts
Cardiac Malformations & Treatments

Lecture 22 - Development of the Cardiovascular System II (Golding)

Cardiac Malformations & Treatments
Development of vascular systems: Early & Late Fetal Circulatory Systems
Developmental regulation of Hemoglobin

Week 12 April 10 & 12

Lecture 23 - Limb Development (Golding)

Histogenesis and the Organization of Organ Systems
Formation of the Limb Bud and Positioning in the Body
Outgrowth and Morphogenic Control.

Lecture 24 - Limb Growth & Regenerative Medicine (Muneoka)

Core Concepts Underpinning Regenerative Medicine
The Limb as a Model for Regeneration - Salamander Limb Regeneration
Regeneration in Mammals & Therapeutic Applications

Week 13 April 17 & 19

Lecture 25 - Organogenesis & Maturation (Golding)

Organogenesis and Maturation - Kidney, Liver, Pancreas & Lungs
Respiratory System Maturation Surfactant
Fetal Adrenal Cortex
Maternal and Fetal Thyroid Hormone - Neurogenesis and Body Growth

Lecture 26 - Birth Defects & Developmental Disorders (Golding)

History of Congenital Malformations - Changing perspectives
General Principles of Congenital Malformations
Developmental Disturbances and Pregnancy Loss
Common birth defects & Potential Treatments

Week 14 April 24 & 26

Lecture 27 - Maternal Nutrition & Developmental Toxicology (Golding)

Fetal Nutrition and Birth Defects
Teratogens and Environmental Agents Causing Disease
Fetal Alcohol Syndrome
Evidence-based behavioral and educational treatments
Fad, myth, and pseudoscience in the treatment of developmental disabilities

Lecture 28 - Birth & Parturition (Golding)

Fetal Endocrinology and Parturition
Fetal Adrenal Cortex and Placental Communication
Positive Feedback and Uterine Contractions
APGAR Scores and Healthy Babies

Final Exam - Friday May 4th 1:00 to 3:00 PM (in the NCTM room 120)

Grade Appeals:

Questions regarding grading of exams must be brought to the attention of the instructor within **one week** following return of these materials. Grades will not be changed following this one week grade appeal period.

Attendance:

Class attendance is expected. Your arrival to the class on time will be appreciated. Should you arrive late, please enter the classroom as quietly as possible and apologize to the students who you may disrupt as you take your seat in the classroom.

“The university views class attendance as an individual student responsibility. Students are expected to attend class and to complete all assignments.”

“If the student is seeking an excused absence, the student must notify the instructor as soon as possible after the absence, but **no later** than the end of the second working day after the last date of absence.”

Make-up examinations will **only** be given for excused absences. The format for make-up examinations will not necessarily be the same as for scheduled examinations; the format will be at the instructor's discretion (e.g. short answer, essay, oral, etc.).

The instructor will designate the date and time of make-up examinations.

Please see Student Rule 7 (<http://student-rules.tamu.edu/rule07>) for clarification.

Classroom Communication:

The university has established a formal process for handling of student grievances associated with any course. If there are major concerns about the conduct of a course, which cannot be resolved by meeting with the instructor of a course, a Classroom Communication Concerns form should be completed and submitted to the appropriate department head.

For more information on Classroom Policies please visit the official TAMU website by following this link <http://student-rules.tamu.edu/>

Americans with Disabilities Act:

TheThe Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call [979-845-1637](tel:979-845-1637). For additional information, visit <http://disability.tamu.edu>.

Academic Integrity and Scholastic Dishonesty:

“It is the responsibility of students and instructors to help maintain scholastic integrity at the university by refusing to participate in or tolerate scholastic dishonesty.”

“An Aggie does not lie, cheat, or steal or tolerate those who do.”

For additional information, please visit: <http://aggiehonor.tamu.edu>.

All examinations in this course are closed book, closed note, and closed neighbor exams. Video recording devices and other technological means may be used to supplement documentation of acts involving Scholastic Dishonesty. The instructors of this course regard Scholastic Dishonesty as a **very serious offense** and disciplinary action will be taken. Sanctions will include a grade of zero on the examination and a grade of “F” or “F*” in the course. All violations of the Aggie Honor Code in this course will result in a letter of reprimand being made a part of the student’s records. Upon appeal of an accusation of Scholastic Dishonesty, the Honors Council can institute additional sanctions including separation from the University.

Folks: do not be confused, these instructors do not tolerate cheating. If you engage in an act of scholastic dishonesty, there is a very high probability that you will be caught. The capabilities and talents of the instructors to identify and verify cheating and their commitment to prosecute cheaters should not be underestimated. Almost every semester, one or more students fail to take this warning seriously. Please do not jeopardize your reputation, academic studies or future professional career.

See Aggie Honor Code at aggiehonor.tamu.edu