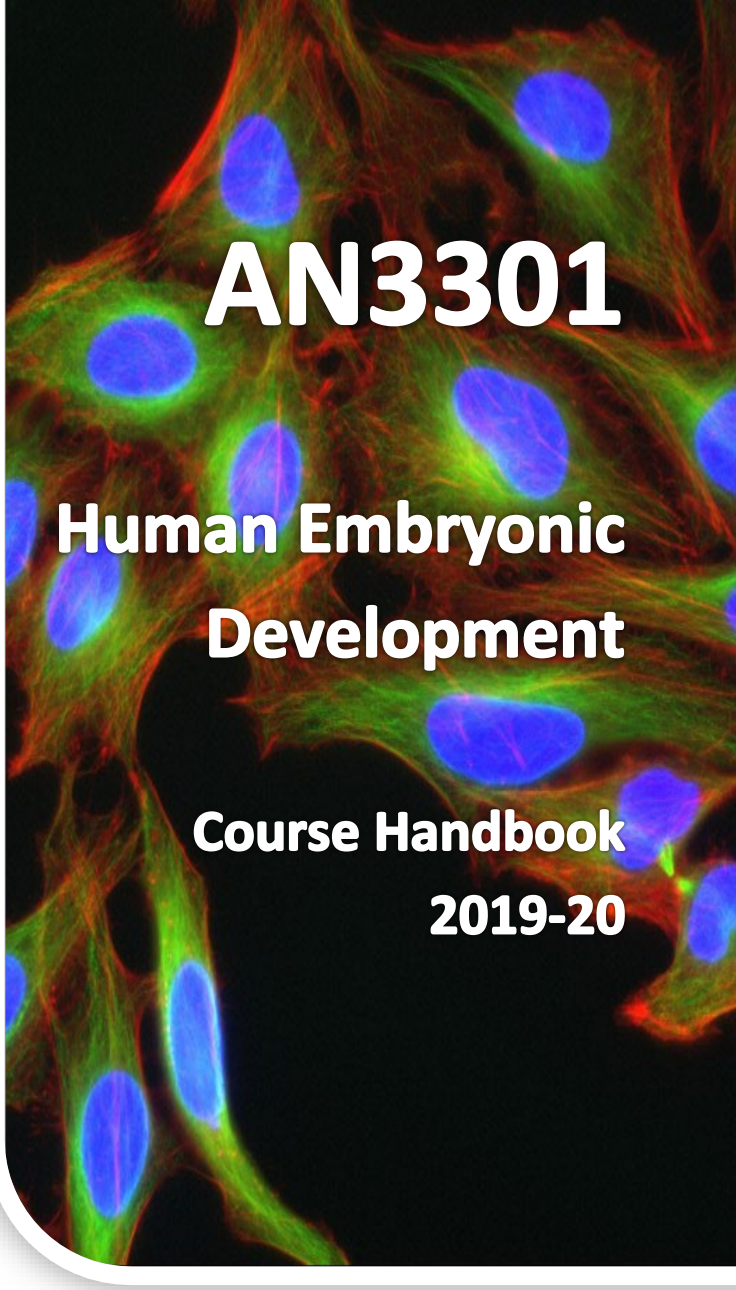
School of Medicine, Medical Sciences & Nutrition



AN3301

Human Embryonic Development

Course Handbook 2019-20

UNIVERSITY OF ABERDEEN

Contents

Cover image:
Confocal micrograph of fluorescently labelled HeLa cells.
Nuclei are labelled in blue, tubulin in green and actin fibres in red.

Courtesy of:
Kevin Mackenzie
Microscopy and Histology Core Facility
Institute of Medical Sciences
University of Aberdeen
http://www.abdn.ac.uk/ims/microscopy-histology

Course Summary

Focusing on human development, this course will examine the question of how a single fertilised cell develops into a fully functioning organism with a complex, highly patterned body structure. The course will begin with an overview of embryonic and foetal development, the major signalling systems sculpting normal development and causes of birth defects. The structural changes underlying the development of each of the major tissues and organs of the body will be discussed in turn, and the genes and signalling pathways involved will be introduced briefly.

The course consists of 3 - 4 one-hour lectures per week, a practical, and time set aside each week for preparation of an individual oral presentation on a specific aspect of abnormal development.

The course is assessed by a 1.5 hr long written examination (70%) and continuous assessment (30%).

Course Aims & Learning Outcomes

1. Provide a broad understanding of the major structural changes underlying the development of the mature body form from an initial single cell.

2. Describe the early stages in the development of the body plan, and the major developmental events defining the embryonic and foetal periods.

3. Explore how specific tissues and organs develop, and the timescale and progression of events, including processes that may continue after birth.

4. Explain the major causes of birth defects, including teratogenic agents, and their effects.

Course Teaching Staff

Course Co-ordinator:

LE – Professor Lynda Erskine, **l.erskine@abdn.ac.uk**

Other Staff:

CDB – Professor Cosimo de Bari, **c.debari@abdn.ac.uk**

JMC – Professor Martin Collinson, **m.collinson@abdn.ac.uk**

SH – Professor Stefan Hoppler, **s.p.hoppler@abdn.ac.uk**

NV – Professor Neil Vargesson, **n.vargesson@abdn.ac.uk**

Assessments & Examinations

Students are expected to attend all lectures, laboratory classes, demonstrations and tutorials, and to complete all assignments by stated deadlines. The minimum acceptable performance is attendance at 75% of the lectures, presentations and practical classes, and submission of all set course work, written and oral.

The degree examination is held in December, with the re-sit examination in June/July.

Assessment is derived from course work (30%) and a written examination (70%)

Written examination: 70% of the total assessment is based on one 90 min written paper. This will consist of two sections of equal weighting:

Section A: 1 essay out of a choice of 2 (50% of total mark)

Section B: 3 short notes out of a choice of 5 (50% of total mark)

Continuous assessment: 30% of the total marks, consisting of:

1. Practical write up – 10%
2. An oral presentation on a selected aspect of abnormal development - 15%
3. A written summary (400 words maximum) covering the main aspects of the content of the oral presentation – 5%

Topics for the oral presentations will be selected during the 1st week of the course. Preparation time has been included throughout the course, with rooms set aside for self-study.

Key dates for in-course work:

Practical - write up to be submitted on the day (Tuesday 12th November).

Oral presentations – at the start of the course each student will be assigned a 10 min slot for their individual presentation. The presentations will take place on Tuesday 19th November (10-1 and 2-5pm) and Friday 22nd November (2-5pm). Everyone is expected to attend these presentations.

Written summary – submission by Friday 22nd November.

Class Representatives

We value students' opinions in regard to enhancing the quality of teaching and its delivery; therefore in conjunction with the Students' Association we support the Class Representative system.

In the School of Medicine, Medical Sciences & Nutrition we operate a system of course representatives, who are elected from within each course. Any student registered within a course that wishes to represent a given group of students can stand for election as a class representative. You will be informed when the elections for class representative will take place.

What will it involve?

It will involve speaking to your fellow students about the course you represent. This can include any comments that they may have. You will attend a Staff-Student Liaison Committee and you should represent the views and concerns of the students within this meeting. As a representative you will also be able to contribute to the agenda. You will then feedback to the students after this meeting with any actions that are being taken.

Training

Training for class representatives will be run by the Students Association. Training will take place within each half-session. For more information about the Class representative system visit **www.ausa.org.uk** or email the VP Education & Employability **vped@abdn.ac.uk**. Class representatives are also eligible to undertake the STAR (Students Taking Active Roles) Award with further information about this co-curricular award being available at: **www.abdn.ac.uk/careers**.

Problems with Coursework

If students have difficulties with any part of the course that they cannot cope with alone they should notify the course coordinator immediately. If the problem relates to the subject matter general advice would be to contact the member of staff who is teaching that part of the course. Students with registered disabilities should contact Mrs Jenna Reynolds (**medsci@abdn.ac.uk**) in the Medical Sciences Office (based in the Polwarth Building, Foresterhill), or Mrs Sheila Jones (**s.jones@abdn.ac.uk**) in the Old Aberdeen office associated with the teaching laboratories, to ensure that the appropriate facilities have been made available. Otherwise, you are strongly encouraged to contact any of the following as you see appropriate:

- Course student representatives
- Course co-ordinator
- Convenor of the Medical Sciences Staff/Student Liaison Committee (Professor Gordon McEwan)

- Personal Tutor
- Medical Sciences Disabilities Co-ordinator (Dr Derryck Shewan)

All staff are based at Foresterhill and we strongly encourage the use of email or telephone the Medical Sciences Office. You may have a wasted journey travelling to Foresterhill only to find staff unavailable.

If a course has been completed and students are no longer on campus (i.e work from second semester during the summer vacation), coursework will be kept until the end of Freshers' Week, during the new academic year. After that point, unclaimed student work will be securely destroyed.

Course Reading List

Langman's Medical Embryology., Lippincott, Williams &Wilkin

Moore KL. Persaud TVN The developing human: clinically oriented embryology. Saunders/Elsevier.

[Related text book: Moore KL, Persuad TVN. Before we are born: essentials of embryology and birth defects]

Additional, specific references, may be provided by individual members of the teaching staff

Lecture Synopsis

Introduction – Professor Lynda Erskine and Professor Neil Vargesson

This short introductory session will provide an overview of the course, and its content, aims and goals. Simbryo software and its uses/benefits will also be introduced.

Lecture 1: Embryonic development – Professor Neil Vargesson

This lecture will examine the early events in embryonic development. Topics that will be covered include, fertilisation and the pre-implantation stages of development, implantation, formation of the bilaminar germ disc, formation of the trilaminar germ disc, and origins of the ectoderm, mesoderm, endoderm and their functions.

Lecture 2: The foetal Period; Teratogens – Professor Neil Vargesson

Following on from embryonic development, this lecture will cover pattern formation, organogenesis, formation of the placenta, growth and foetal milestones. The main causes and risk factors for birth defects will also be discussed.

Lecture 3: Bone development – Professor Cosimo de Bari

This lecture explores the processes of cellular condensation that lead to the formation of cartilage and bone. Processes of intramembranous and endochondral ossification will be studied, and the genetic and cellular pathways that lead to the formation and maintenance of bone. We will all fall off a wall and break a bone at some point in our lives – this lecture will briefly describe the process of bone repair with hints of bone tissue engineering.

Lecture 4: Head and neck development – Professor Lynda Erskine

This lecture will consider the structural development of the head and neck. Major players in this process are the pharyngeal (branchial) arches. The composition of the pharyngeal arches and the various structures derived from them will be described. The development of the face from mesenchyme surrounding the mouth, the separation of the oral and nasal cavities through formation of the palate and the development of the skull (cranium) will also be covered.

Lecture 5: Respiratory system development – Professor Lynda Erskine

Breathing is essential to life, and a major cause of neonatal lethality in premature infants is underdevelopment of the lungs. This lecture will describe the development of the thoracic and abdominal cavities, the formation of the lung buds from the foregut, the development of the trachea, oesophagus, larynx and bronchi, and the maturation of the lungs. Anomalies of respiratory system development will also be introduced.

Lecture 6: Digestive system development - Professor Lynda Erskine

This lecture covers the development of the major derivatives of the foregut (e.g. stomach, liver, pancreas), midgut (most of the intestines) and hindgut (distal part of the colon and anorectal canal). Anomalies of gut development will be introduced briefly.

Lecture 7: Cardiovascular system development – Professor Stefan Hoppler

The cardiovascular system is the first functional organ system to develop in the human embryo, and cardiovascular function is from then on required continuously throughout life. The heart is also one of the most complex organs to develop and, as a consequence, congenital heart defects account for approximately a quarter of all human congenital abnormalities.

This lecture focuses on introducing the normal development of the cardiovascular system; its origin in the lateral plate mesoderm, the formation of the linear heart tube and the major arteries and veins connected to the heart, the morphogenesis of the linear heart tube into a four-chambered heart, and the changes at birth that give rise to separate systemic and pulmonary circulation.

Lecture 8: Development of the integumentary system – Professor Neil Vargesson

The integumentary system protects the body from various kinds of damage, including water loss or abrasion from outside. The system comprises the skin and its appendages. This lecture will discuss the development of the epidermis, dermis, and role of neural crest cells in skin development. Formation of nails, hair, sebaceous and sweat glands will be discussed. In addition, we also will look at the development of the teeth.

Lecture 9: Urinary system development – Professor Neil Vargesson

This lecture will begin by examining the relationship between the development of the urinary and reproductive systems. The development of the kidneys via a series of successively more complex excretory organs, the pronephros, mesonephros and metanephros will be described. The development of bladder and the renal tubules, collecting ducts and resulting structure of the kidneys also will be discussed.

Lecture 10: Genital system development - Professor Neil Vargesson

This lecture will describe the development of the male and female reproductive systems. Topics that will be covered include: formation of the testis, formation of the excretory ducts, descent of the testis, the female genital tract, ovarian development, the development of the uterine tubes, uterus and vagina. Urinary-genital anomalies also will be considered.

Lecture 11: Nervous system development – Professor Lynda Erskine

The nervous system is arguably the most complex tissue in our body, composed of billions of cells connected together in a very precise fashion. Normal nervous system development is essential for making us who we are and defining all of our interactions with the world around us. This lecture will introduce the development of the central nervous system (brain and spinal cord) from the neural tube, and generation of the different neuronal and glial cell types. Neural tube defects, such as spina bifida as well as other brain anomalies will be discussed. The formation of the ventricular system and the development of major brain regions will be described briefly. The development of the peripheral nervous system from neural crest cells also will be considered.

Lecture 12: Development of the eye and ear – Professor Lynda Erskine

Vision and hearing are two of our most precious senses. This lecture will look at the development of the anatomical structures important for these senses - the eye and ear. Topics that will be discussed include:

Eye development: Development of the optic vesicle, lens induction and development, cellular differentiation in the retina, development of the other structures of the eye (iris, ciliary body, sclera, choroid and vitreous), development of the eye lids, eye anomalies.

Ear Development: Development of the external, middle and inner ear. Deafness and external ear anomalies will be introduced.

Lecture 13: Limb development – Professor Neil Vargesson

Although vertebrate limbs take many different shapes and functions, for walking, flight, swimming and manipulation, the basic growth and patterning of the pentadactyl limb has a very uniform and well-studied basis, which will be covered in this lecture. The origins of the limb bud and the two-way interaction between the apical ectodermal ridge and the underlying limb mesenchyme will be studied. The genes and signalling pathways that make forelimbs different from hindlimbs, arms different from hands, and fingers from thumbs also will be discussed.

Lecture 14: Thalidomide embryopathy – Professor Neil Vargesson

This lecture will describe and discuss the notorious teratogen Thalidomide. Included in the lecture will be discussions on why the drug was made, the defects it caused, what we know about this drug today and its current uses (and risks).

Lecture 15: Signalling systems in development – Professor Martin Collinson

In order to understand human embryology, we need to understand how cells talk to each other. Despite the incredible complexity of embryonic development, most developmental processes are controlled by a few, highly conserved families of signalling molecules. This lecture will introduce the major players, including the fibroblast growth factors (FGFs), wingless-family proteins (Wnts), bone morphogenetic proteins (BMPs) and Hedgehog-family ligands (Hh).

Lecture 16: Somite and Muscle development - Professor Martin Collinson

Many tissues in the body have their origins in the somites, balls of mesodermal tissue that form on either side of the developing body axis, and are the clearest physical evidence that we are segmented animals. The development of somites is one of the most spectacular examples of how dynamic changes in gene expression control morphogenesis, and this lecture will describe this process. The somites also give rise to muscles of the axis, body wall and limbs, and the dynamic processes of cell specification, migration and muscle block formation will be explained.

Practical/Lab/Tutorial Work

Laboratory work will take place in the College teaching laboratories in the Polwarth Building, Foresterhill.

Handouts detailing the work to be carried out in the practical will be posted on MyAberdeen.

Please read the student notes concerned with behaviour and safety in the laboratories.

The practical work required in this course may present difficulties to students with special educational needs. For such students, alternative arrangements will be made. Any student with special needs should make these known to the Course Co-ordinator when registering for the class, and should then also discuss their needs with the School Disabilities Co-ordinator, to ensure that they have the best possible outcome.

University Policies

Students are asked to make themselves familiar with the information on key institutional policies which been made available within MyAberdeen (**https://abdn.blackboard.com/bbcswebdav/institution/Policies**). These policies are relevant to all students and will be useful to you throughout your studies. They contain important information and address issues such as what to do if you are absent, how to raise an appeal or a complaint and indicate how seriously the University takes your feedback.

These institutional policies should be read in conjunction with this programme and/or course handbook, in which School and College specific policies are detailed. Further information can be found on the **University[1]s Infohub webpage** or by visiting the Infohub.

The information included in the institutional area for 2019/20 includes the following:

- Absence
- Appeals & Complaints
- Student Discipline
- Class Certificates
- MyAberdeen
- Originality Checking
- Feedback
- Communication
- Graduate Attributes
- The Co-Curriculum

Medical Sciences Common Grading Scale

Grade	Grade Point	Category	Honours Class	Description
A1	22	Excellent	First	• Outstanding ability and critical thought • Evidence of extensive reading • Superior understanding • The best performance that can be expected from a student at this level
A2	21			
A3	20			
A4	19			
A5	18			
B1	17	Very Good	Upper Second	• Able to argue logically and organise answers well • Shows a thorough grasp of concepts • Good use of examples to illustrate points and justify arguments • Evidence of reading and wide appreciation of subject
B2	16			
B3	15			
C1	14	Good	Lower Second	• Repetition of lecture notes without evidence of further appreciation of subject • Lacking illustrative examples and originality • Basic level of understanding
C2	13			
C3	12			
D1	11	Pass	Third	• Limited ability to argue logically and organise answers • Failure to develop or illustrate points • The minimum level of performance required for a student to be awarded a pass
D2	10			
D3	9			
E1	8	Fail	Fail	• Weak presentation • Tendency to irrelevance • Some attempt at an answer but seriously lacking in content and/or ability to organise thoughts
E2	7			
E3	6			
F1	5	Clear Fail	Not used for Honours	• Contains major errors or misconceptions • Poor presentation
F2	4			
F3	3			
G1	2	Clear Fail/ Abysmal	-	• Token or no submission
G2	1			
G3	0			

Course Timetable AN3301: 2019-20

Date	Time	Place	Subject	Session Type	Staff
Week 13					
Mon 21 Oct	15:00-15:15	1:143/1:144	Introduction, Simbryo	Lecture	LE/NV
	15:15-16:00	1:143/1:144	Embryonic development	Lecture	NV
	16:00-17:00	1:143/1:144	The foetal period; teratogens	Lecture	NV
Tue 22 Oct					
Wed 23 Oct					
Thu 24 Oct					
Fri 25 Oct	14:00-15:00	BMP	Bone Development	Lecture	CDB
	15:00-16:00	BMP	Head and Neck	Lecture	LE
	16:00-17:00	BMP	Presentation topic selection	Tutorial	LE
Week 14					
Mon 28 Oct	15:00-16:00	1:143/1:144	Respiratory System	Lecture	LE
	16:00-17:00	1:143/1:144	Digestive System	Lecture	LE
Tue 29 Oct					
Wed 30 Oct					
Thu 31 Oct					
Fri 1 Nov	14:00-15:00	BMP	Cardiovascular System	Lecture	SH
	15:00-16:00	BMP	Integumentary System	Lecture	NV
Week 15					
Mon 4 Nov	15:00-16:00	1:147	Urinary System	Lecture	NV
	16:00-17:00	1:147	Genital System	Lecture	NV
Tue 5 Nov					
Wed 6 Nov					
Thu 7 Nov					
Fri 8 Nov	14:00-15:00	BMP	Nervous system	Lecture	LE
	15:00-16:00	BMP	Eye and Ear	Lecture	LE
	16:00-17:00	BMP	Presentation preparation*	Self-Study	
Week 16					
Mon 11 Nov	15:00-16:00	1:147	Limb Development	Lecture	NV
	16:00-17:00	1:147	Thalidomide	Lecture	NV
Tue 12 Nov	10.00-16:00	2:054/CR3	Practical - Comparative Embryology	Practical	LE/NV
Wed 13 Nov					
Thu 14 Nov					
Fri 15 Nov	14:00-15:00	BMP	Signalling Systems	Lecture	JMC
	15:00-16:00	BMP	Somite and Muscle	Lecture	JMC
	16:00-17:00	BMP	Presentation preparation*	Self-Study	-
Week 17					
Mon 18 Nov	15:00-16:00	1:147	Presentation Preparation	Self-Study	
	16:00-17:00	1:147	Presentation Preparation	Self-Study	
Tue 19 Nov	10.00-13.00	BMP D2	Anomalies presentations	Presentation	LE/NV
	14:00-17:00	BMP LT	Anomalies presentations	Presentation	LE/NV
Wed 20 Nov					
Thu 21 Nov					
Fri 22 Nov	14:00-16:00	BMP	Anomalies presentations	Presentation	LE/NV
	16:00-17:00	BMP	Feedback, exam preparation etc	Tutorial	LE/NV

Staff

CDB – Professor Cosimo de Bari
JMC – Professor Martin Collinson
LE – Professor Lynda Erskine (Course co-ordinator)
SH – Professor Stefan Hoppler
NV – Professor Neil Vargesson

Venues

BMP, Biomedical Physics Lecture Theatre, Foresterhill
1:143/144 - Polwarth Building, Foresterhill
1:147 - Polwarth Building, Foresterhill
2:054/CR3 - Polwarth Building, Foresterhill
Workshop – Medical Physics Building, Foresterhill
L7CR – Level 7 Conference Room, IMS Building, Foresterhill