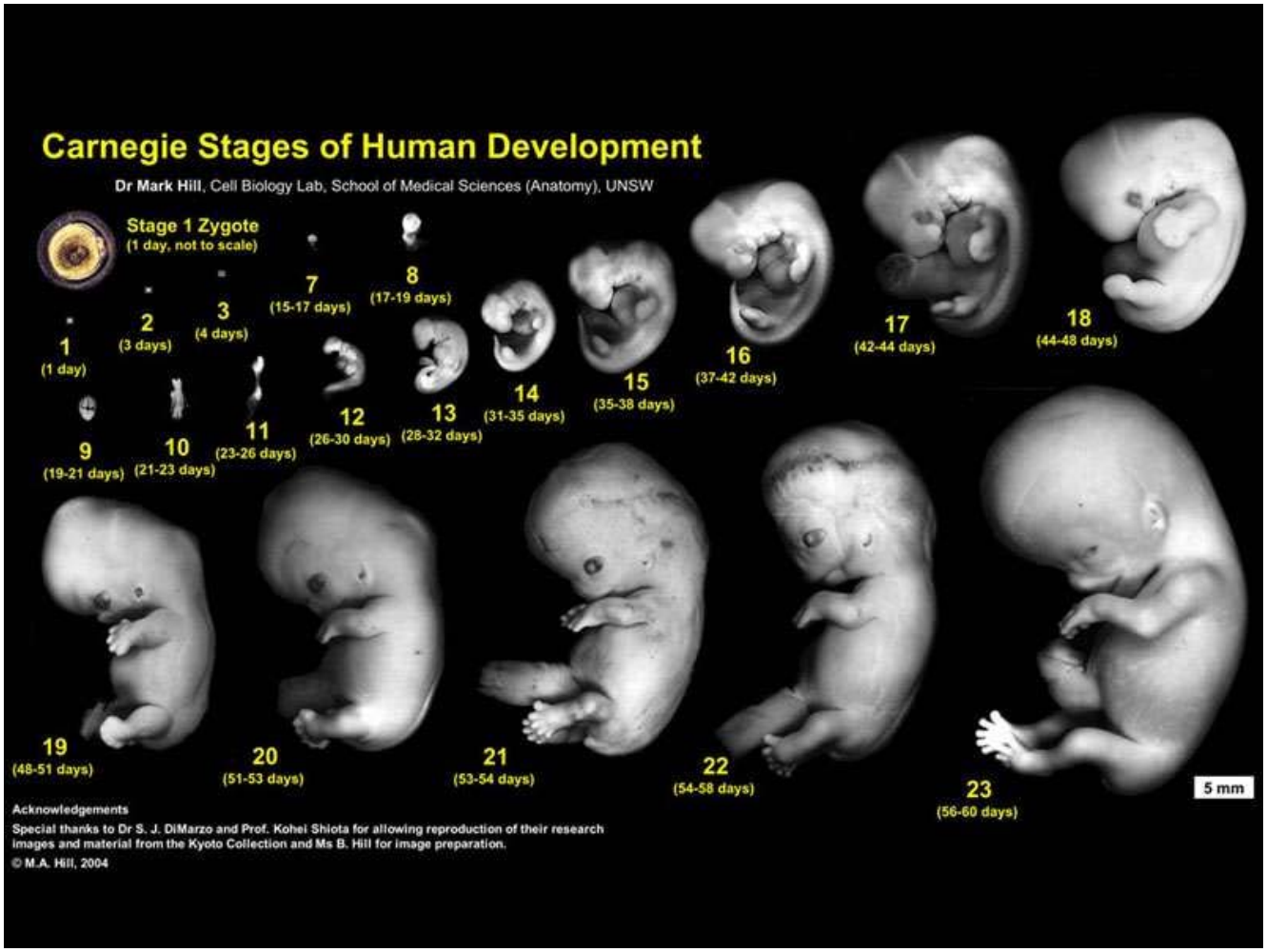
ANAT2341 Embryology Introduction: Steve Palmer



Course overview

Course lecturers – specializations and roles

Staff Contact Details

Position	Name	Email	Availability; times and location
Course Convener	Dr Stephen Palmer	s.palmer@unsw.edu.au	By appointment
Lecturer/tutor	Dr Annemiek Beverdam	a.beverdam@unsw.edu.au	By appointment
Lecturer/tutor	Prof Ken Ashwell	k.ashwell@unsw.edu.au	By appointment
Lecturer/tutor	Prof Edna Hardeman	e.hardeman@unsw.edu.au	By appointment
Lecturer/tutor	Dr Nalini Pather	n.pather@unsw.edu.au	By appointment
Course designer	Dr Mark Hill	Overseas sabbatical	Email via S.Palmer

Steve Palmer 9385 2957

Course overview

Summary, aims and expected outcomes

Credit Points:

6

Summary of the Course

This course will introduce embryological development as a major topic within medical sciences. Students completing this course will have a broad understanding of: human development, some animal models of development and current related research topics. Experts and researchers from within the field contribute to the current course.

Aims of the Course

1. This course will enable students to explore and gain further understanding of embryology through the investigation of development in both humans and animal models with a direct emphasis of their application to emerging research and reproductive technologies.
2. This course will enable students to broadly understand abnormalities in development and current applications to medical research.

Student learning outcomes

At the conclusion of this course the student will be able to:

1. Describe the key events in early and systematic embryological development.
2. Apply developmental theory to abnormalities of development and current medical research techniques.
3. Complete tasks in scientific communication either online, written and by oral presentation.
4. Work in small groups to research a specific topic and deliver a group project.

Course overview

Graduate attributes

The students will be encouraged to develop the following Graduate Attributes by undertaking the selected activities and knowledge content. These attributes will be assessed within the prescribed assessment tasks.

At the conclusion of this course the student will be able to:

1. Investigate embryological development by scholarly enquiry of research literature.
2. Apply developmental theory to anatomical development.
3. Undertake basic research by applying analytical and critical thinking.
4. Create individual and group projects that demonstrate initiative and collaborative work.

Course overview

Means of assessment

Assessment task	Length	Weight	Learning outcomes assessed	Graduate attributes assessed	Due date
Individual Tasks	Short answer and/or multiple choice	20 %	Critical thinking and initiative, information literacy	Scholarly enquiry of research literature	Throughout the semester
Group Project	3000 word referenced review with figures and mid-semester oral presentation	30 %	Information literacy and effective communication	Initiative and collaborative work	Mid-semester presentation and week 11 submission of review
Theory Examination	2 hours	50 %	Engagement with the relevant disciplinary knowledge in its interdisciplinary context	Apply developmental theory to anatomical development	Within the S2 exam period 8th – 26th Nov

Submission of Assessment Tasks

Student individual tasks will be set and submitted on a regular basis during laboratories. Oral presentation of group projects will be during weeks 8 and 9. Group project reports are due on the Sunday of week 11. Late submissions will be penalized by 5%/ day late.

Course overview

Means of assessment

Individual assessments -20% of the final mark – taken during the first 30 mins of laboratory – usually 10 questions – single word answers or multiple choice.

Group project – 30% of the final mark – to be discussed in Lab2

Final exam – 50% of the final mark - 2hr paper – answer 5 questions in a short essay style selected from a list of topics drawn from the lecture material and the textbook chapters.

Course overview

Academic honesty and plagiarism

Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. With regard to the group project work please note the statement:

"Claiming credit for a proportion of work contributed to a group assessment item that is greater than that actually contributed;"

Academic Misconduct carries penalties. If a student is found guilty of academic misconduct, the penalties include warnings, remedial educative action, being failed in an assignment or excluded from the University for two years. The University has also adopted an educative approach to plagiarism and has developed a range of resources to support students.

For more information see: http://www.lc.unsw.edu.au/plagiarism

Course overview

Course schedule

See also online: http://php.med.unsw.edu.au/embryology/index.php?title=ANAT2341_Course_Timetable_2013

Wk No.	Wk Start Monday	Lecture 1 Tuesday 12-1pm Wallace Wurth LG02	Lecture 2 Tuesday 4-5pm Biomedical Theatre E	Laboratory Wed 10am-12 Wallace Wurth G08
2	05 Aug	Fertilization	Week 1 & 2 Development	Lab 1
3	12 Aug	Embryology Introduction	Week 3 Development	Lab 2
4	19 Aug	Mesoderm Development	Ectoderm, Early Neural, Neural Crest	Lab 3
5	26 Aug	Early Vascular Development	Placenta	Lab 4
6	02 Sept	Endoderm, Early Gastrointestinal	Respiratory Development	Lab 5
7	09 Sept	Head Development	Neural Crest Development	Lab 6
8	16 Sept	Musculoskeletal Development	Limb Development	Lab 7 Project Orals
9	23 Sept	Renal Development	Genital	Lab 8 Project Orals
Mid-Semester Break 28th Sept – 7th Oct				
10	07 Oct	Endocrine Development	Integumentary Development	Lab 9
11	14 Oct	Neural	Sensory	Lab 10
Group Project is Due for Submission on Sunday 20th October				
12	21 Oct	Heart	Stem Cells	Lab 11
13	28 Oct	Fetal	Birth and Revision	Lab 12
Study week 2nd – 7th November				
Examinations 8th – 26th November Date TBA				

Course overview

Online link - Timetable

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	2 Nov	Study Week		
	8 to 26 Nov	Examination- TBA		

Course overview

Expected Resources for students

Textbooks - Either of the textbooks listed below are recommended for this course and page references to both are given in each lecture. There are additional embryology textbooks that can also be used, consult course organizer. Both textbooks are currently accessible online through the UNSW Library connection (links are included in online lecture and practical materials).

- Moore, KL, Persuad, TVN & Torchia MG. (2011) **The Developing Human: Clinically Oriented Embryology** (9th ed.). Philadelphia: Saunders.
- Schoenwolf, GC, Bleyl, SB, Brauer, PR & Francis-West, PH. (2009) **Larsen's Human Embryology** (4th ed.). New York; Edinburgh: Churchill Livingstone.

Online materials - Supported by the online education site **UNSW Embryology:**

http://php.med.unsw.edu.au/embryology

Course overview

Other information to be included

- Students are expected to attend all lectures and laboratories and absences require prior arrangement with the course coordinator and/or a medical certificate. See also the UNSW Student conduct policy https://my.unsw.edu.au/student/academiclife/assessment/StudentConductPolicy.html
- Information on relevant Health and Safety policies and expectations as outlined at: http://medicalsciences.med.unsw.edu.au/SOMSWeb.nsf/page/Health+and+Safety
- Theory examination will be a two-hour exam in the examination period semester 2.
- Students should refer to the UNSW website for further advice concerning special consideration in the event of illness or misadventure https://my.unsw.edu.au/student/atoz/SpecialConsideration.html
- Student equity and diversity issues via Student Equity Officers (Disability) in the Student Equity and Diversity Unit (9385 4734). Further information for students with disabilities is available at http://www.studentequity.unsw.edu.au/content/Services/Disabilityservices.cfm

Attendance issues:

1. Lecture content is tested during the laboratory of the following week
2. These tests will mainly be on the lecture material but may also be drawn from the appropriate book chapter
3. The tests occur within the first 30mins of the laboratory – so please be on time
4. At least 80% attendance is expected for the laboratories

ANAT2341 Online

Navigating through the web pages

http://php.med.unsw.edu.au/embryology/index.php?title=ANAT2341_Embryology_2013

Main page

Links

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ANAT2341 Embryology 2013

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Introduction

The course coordinator is Dr Stephen Palmer, my office is located in Wallace Wurth East, second floor room 234.

ANAT2341 is a second semester course commencing in August 2013.

Welcome to Embryology in 2013 and thank you for choosing this exciting topic! In the past 20 years as a researcher I have seen enormous changes in our understanding of this subject and the methods we employ to further our knowledge in this field. This topic and its associated methodologies are now found at the core of scientific investigations and key to current medical research.

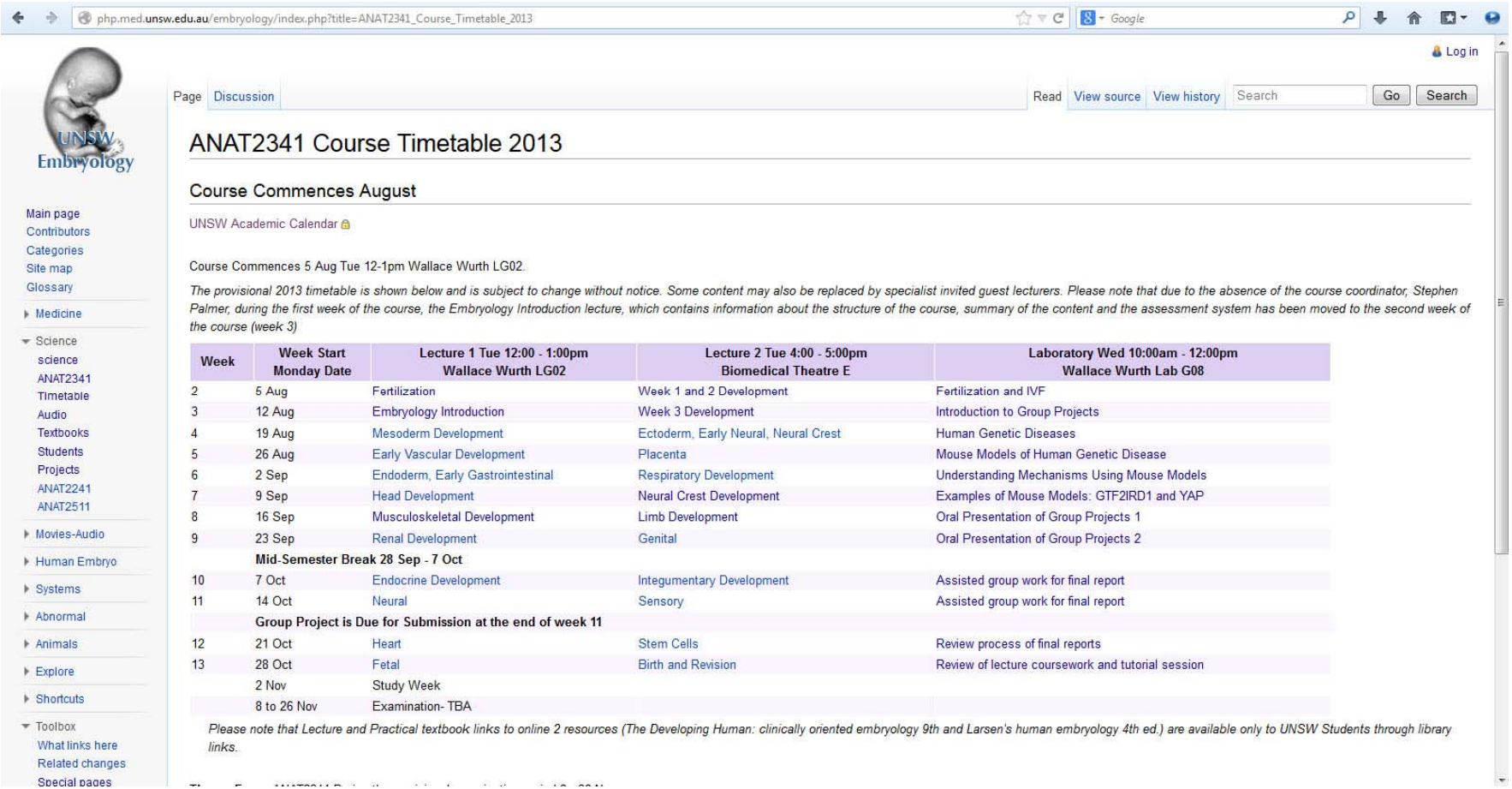
This page will introduce the current course and link to related online resources (bookmark this as your start page). This is a new online resource, content and links will be added during your current course. Feel free to explore the site and prepare yourself for the upcoming course by some background reading.

Course Links

These course links are currently to draft 2013 course materials.

5:22 PM 7/30/2013

Timetable – provides hyperlinks to all of the course units



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ANAT2341 Course Timetable 2013

Course Commences August

UNSW Academic Calendar

Course Commences 5 Aug Tue 12-1pm Wallace Wurth LG02.

The provisional 2013 timetable is shown below and is subject to change without notice. Some content may also be replaced by specialist invited guest lecturers. Please note that due to the absence of the course coordinator, Stephen Palmer, during the first week of the course, the Embryology Introduction lecture, which contains information about the structure of the course, summary of the content and the assessment system has been moved to the second week of the course (week 3)

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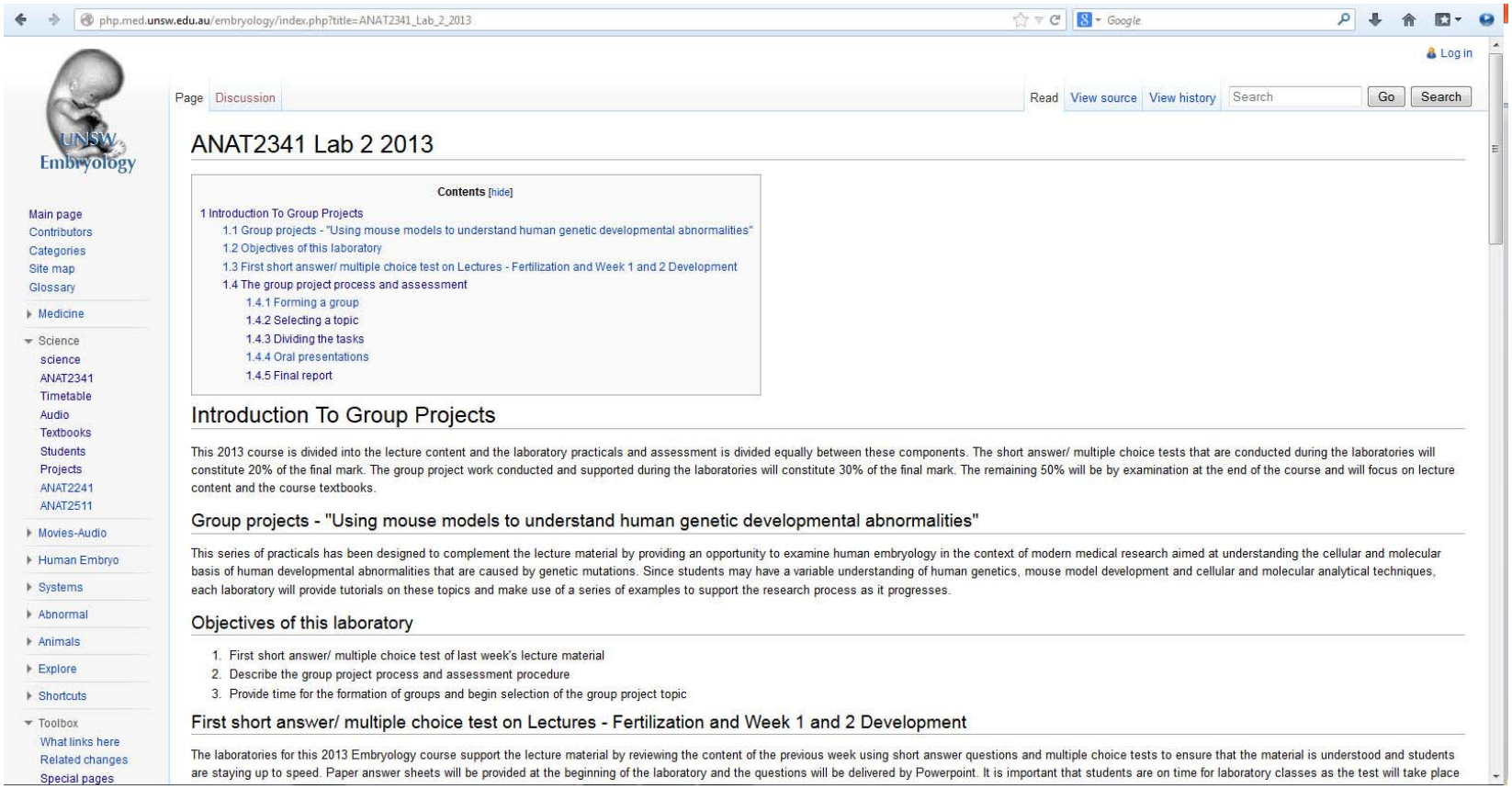
	8 to 26 Nov	Examination- TBA		

Please note that Lecture and Practical textbook links to online 2 resources (The Developing Human: clinically oriented embryology 9th and Larsen's human embryology 4th ed.) are available only to UNSW Students through library links.

For example – The laboratory class 2 – Introduction to group projects



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ANAT2341 Lab 2 2013

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Introduction To Group Projects

This 2013 course is divided into the lecture content and the laboratory practicals and assessment is divided equally between these components. The short answer/ multiple choice tests that are conducted during the laboratories will constitute 20% of the final mark. The group project work conducted and supported during the laboratories will constitute 30% of the final mark. The remaining 50% will be by examination at the end of the course and will focus on lecture content and the course textbooks.

Group projects - "Using mouse models to understand human genetic developmental abnormalities"

This series of practicals has been designed to complement the lecture material by providing an opportunity to examine human embryology in the context of modern medical research aimed at understanding the cellular and molecular basis of human developmental abnormalities that are caused by genetic mutations. Since students may have a variable understanding of human genetics, mouse model development and cellular and molecular analytical techniques, each laboratory will provide tutorials on these topics and make use of a series of examples to support the research process as it progresses.

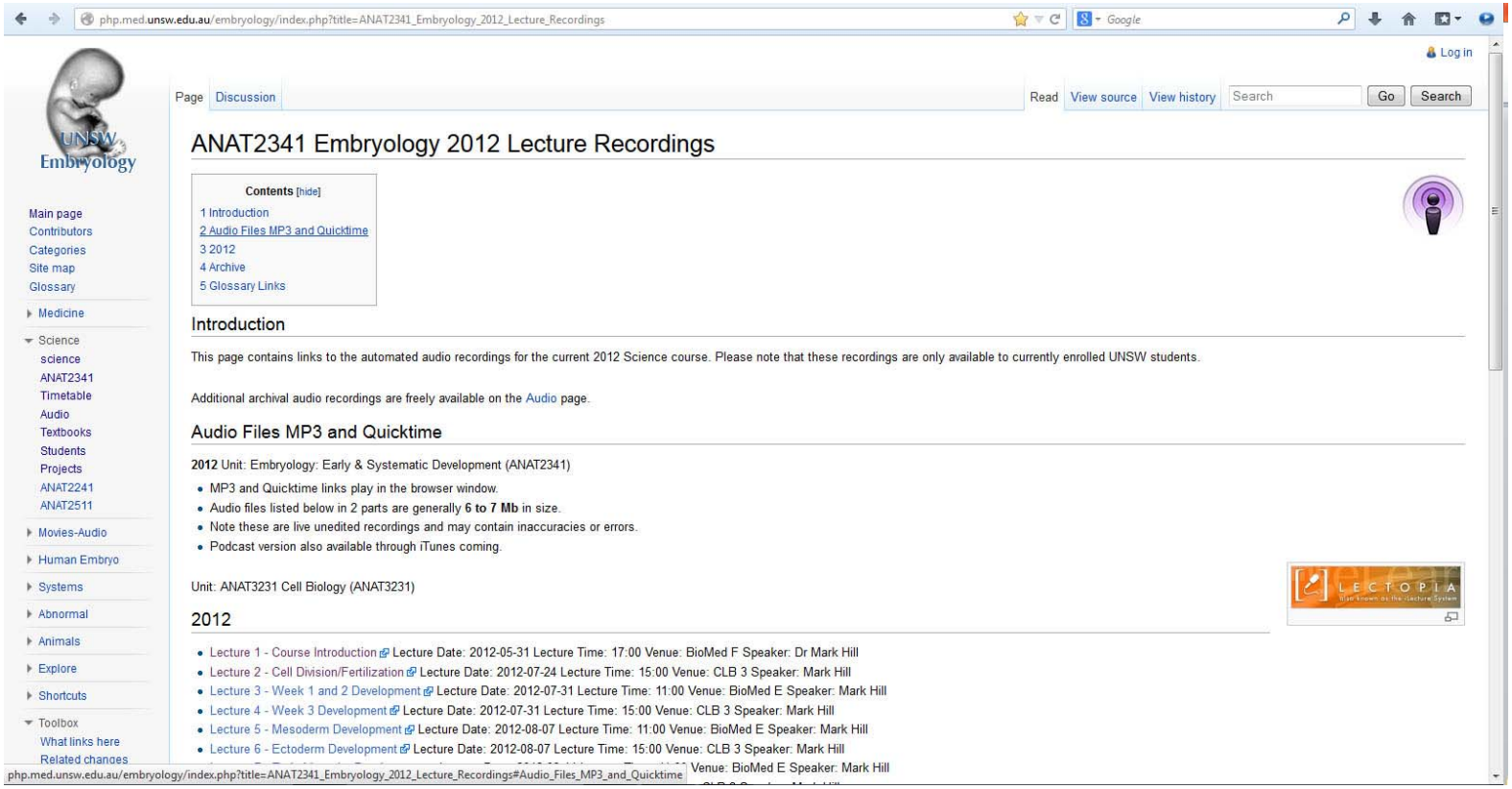
Objectives of this laboratory

1. First short answer/ multiple choice test of last week's lecture material
2. Describe the group project process and assessment procedure
3. Provide time for the formation of groups and begin selection of the group project topic

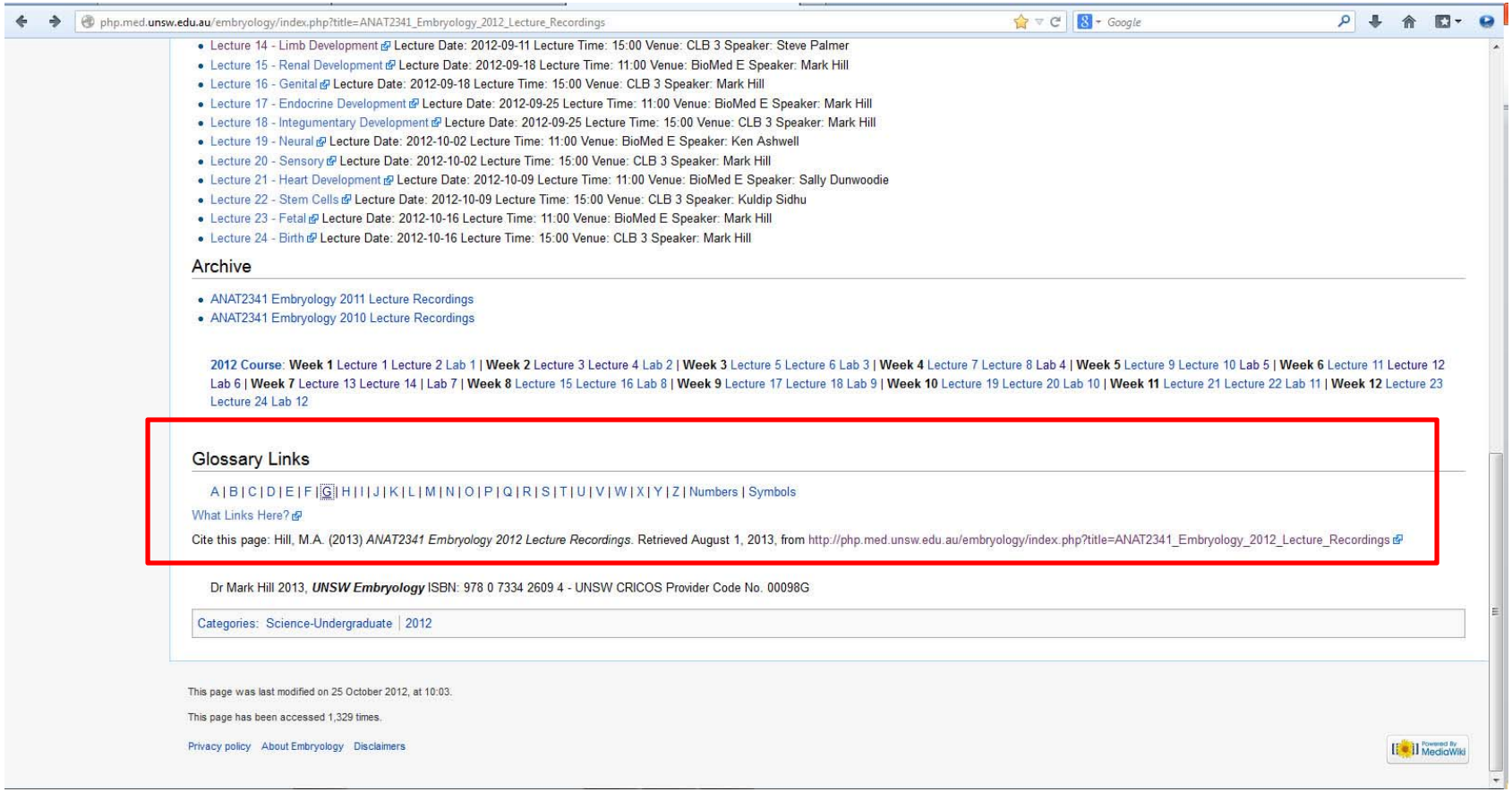
First short answer/ multiple choice test on Lectures - Fertilization and Week 1 and 2 Development

The laboratories for this 2013 Embryology course support the lecture material by reviewing the content of the previous week using short answer questions and multiple choice tests to ensure that the material is understood and students are staying up to speed. Paper answer sheets will be provided at the beginning of the laboratory and the questions will be delivered by Powerpoint. It is important that students are on time for laboratory classes as the test will take place

Audio will be made available as it comes through – previous years are also available



Embryology involves learning a new language – use the Glossary



- Lecture 14 - Limb Development Lecture Date: 2012-09-11 Lecture Time: 15:00 Venue: CLB 3 Speaker: Steve Palmer
- Lecture 15 - Renal Development Lecture Date: 2012-09-18 Lecture Time: 11:00 Venue: BioMed E Speaker: Mark Hill
- Lecture 16 - Genital Lecture Date: 2012-09-18 Lecture Time: 15:00 Venue: CLB 3 Speaker: Mark Hill
- Lecture 17 - Endocrine Development Lecture Date: 2012-09-25 Lecture Time: 11:00 Venue: BioMed E Speaker: Mark Hill
- Lecture 18 - Integumentary Development Lecture Date: 2012-09-25 Lecture Time: 15:00 Venue: CLB 3 Speaker: Mark Hill
- Lecture 19 - Neural Lecture Date: 2012-10-02 Lecture Time: 11:00 Venue: BioMed E Speaker: Ken Ashwell
- Lecture 20 - Sensory Lecture Date: 2012-10-02 Lecture Time: 15:00 Venue: CLB 3 Speaker: Mark Hill
- Lecture 21 - Heart Development Lecture Date: 2012-10-09 Lecture Time: 11:00 Venue: BioMed E Speaker: Sally Dunwoodie
- Lecture 22 - Stem Cells Lecture Date: 2012-10-09 Lecture Time: 15:00 Venue: CLB 3 Speaker: Kuldip Sidhu
- Lecture 23 - Fetal Lecture Date: 2012-10-16 Lecture Time: 11:00 Venue: BioMed E Speaker: Mark Hill
- Lecture 24 - Birth Lecture Date: 2012-10-16 Lecture Time: 15:00 Venue: CLB 3 Speaker: Mark Hill

Archive

- ANAT2341 Embryology 2011 Lecture Recordings
- ANAT2341 Embryology 2010 Lecture Recordings

2012 Course: **Week 1** Lecture 1 Lecture 2 Lab 1 | **Week 2** Lecture 3 Lecture 4 Lab 2 | **Week 3** Lecture 5 Lecture 6 Lab 3 | **Week 4** Lecture 7 Lecture 8 Lab 4 | **Week 5** Lecture 9 Lecture 10 Lab 5 | **Week 6** Lecture 11 Lecture 12 Lab 6 | **Week 7** Lecture 13 Lecture 14 | Lab 7 | **Week 8** Lecture 15 Lecture 16 Lab 8 | **Week 9** Lecture 17 Lecture 18 Lab 9 | **Week 10** Lecture 19 Lecture 20 Lab 10 | **Week 11** Lecture 21 Lecture 22 Lab 11 | **Week 12** Lecture 23 Lecture 24 Lab 12

Glossary Links

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z | Numbers | Symbols

What Links Here?

Cite this page: Hill, M.A. (2013) *ANAT2341 Embryology 2012 Lecture Recordings*. Retrieved August 1, 2013, from http://php.med.unsw.edu.au/embryology/index.php?title=ANAT2341_Embryology_2012_Lecture_Recordings

Dr Mark Hill 2013, ***UNSW Embryology*** ISBN: 978 0 7334 2609 4 - UNSW CRICOS Provider Code No. 00098G

Categories: Science-Undergraduate | 2012

This page was last modified on 25 October 2012, at 10:03.

This page has been accessed 1,329 times.

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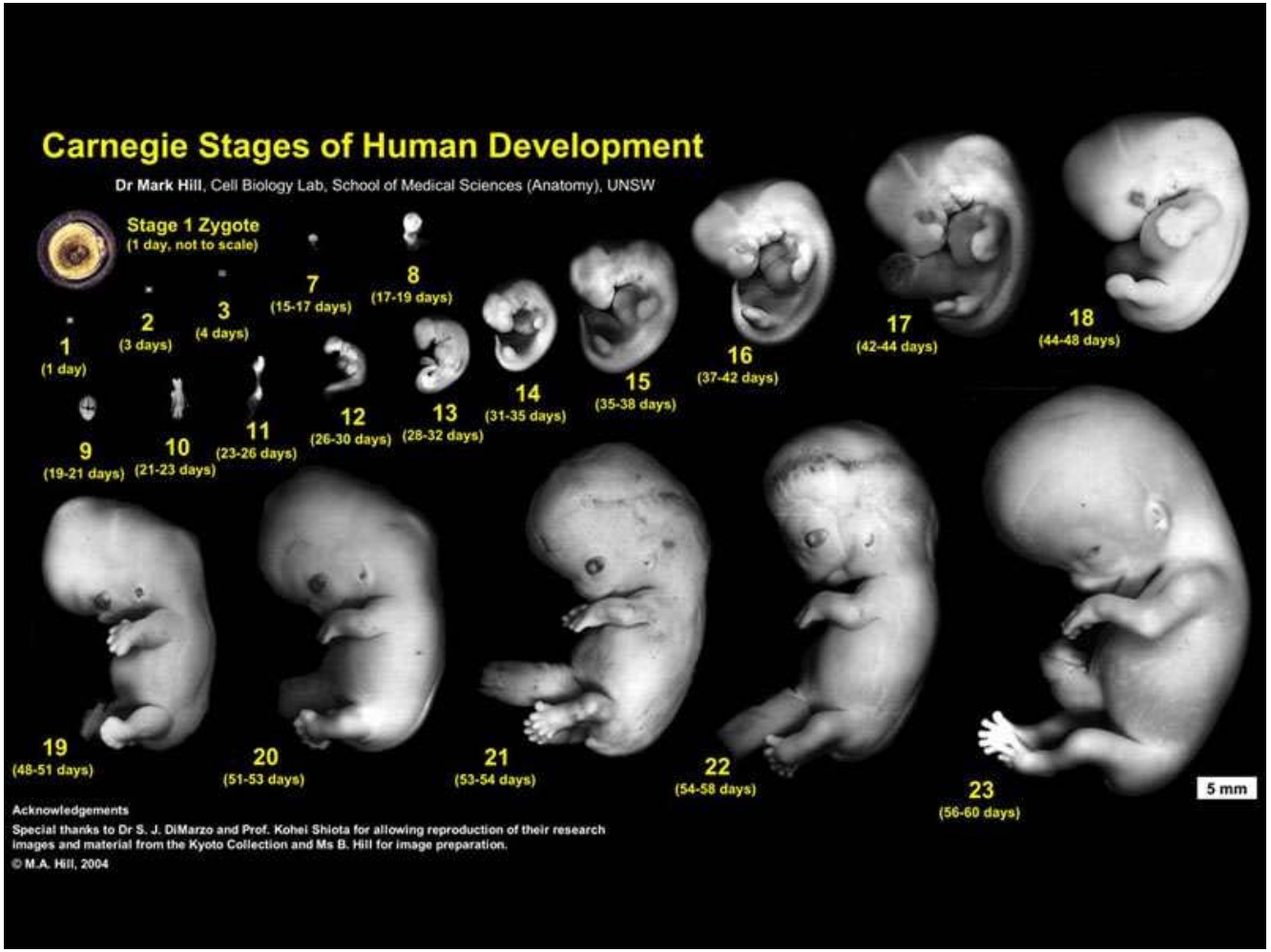
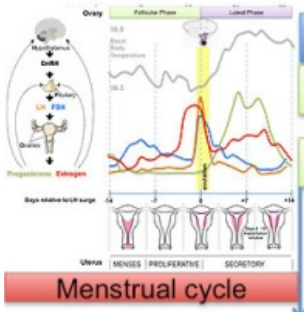
C for Carnegie stages

Carnegie stages are a system of classifying embryonic development based on the external features and related internal changes that affect appearance and growth of the embryo. Note that the stages are not directly dependent on either age or size, but upon the appearance of specific embryonic features. Early human and other species embryos can be classified by these stages. The term “Carnegie stages" are named after the famous USA Institute which began collecting and classifying embryos in the early 1900's



Human Development Timeline



Human Pregnancy - 9 months

First Trimester	Second Trimester	Third Trimester

Embryonic	Fetal

Embryonic Period (stages 1 to 23) | Fetal

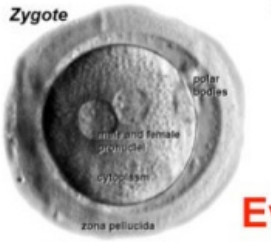
Last Menstrual Period | **Fertilization** | **Positive**

Week 1 to 4	Week 5 to 8

-2	-1	1	2	3	4	5	6	7	8

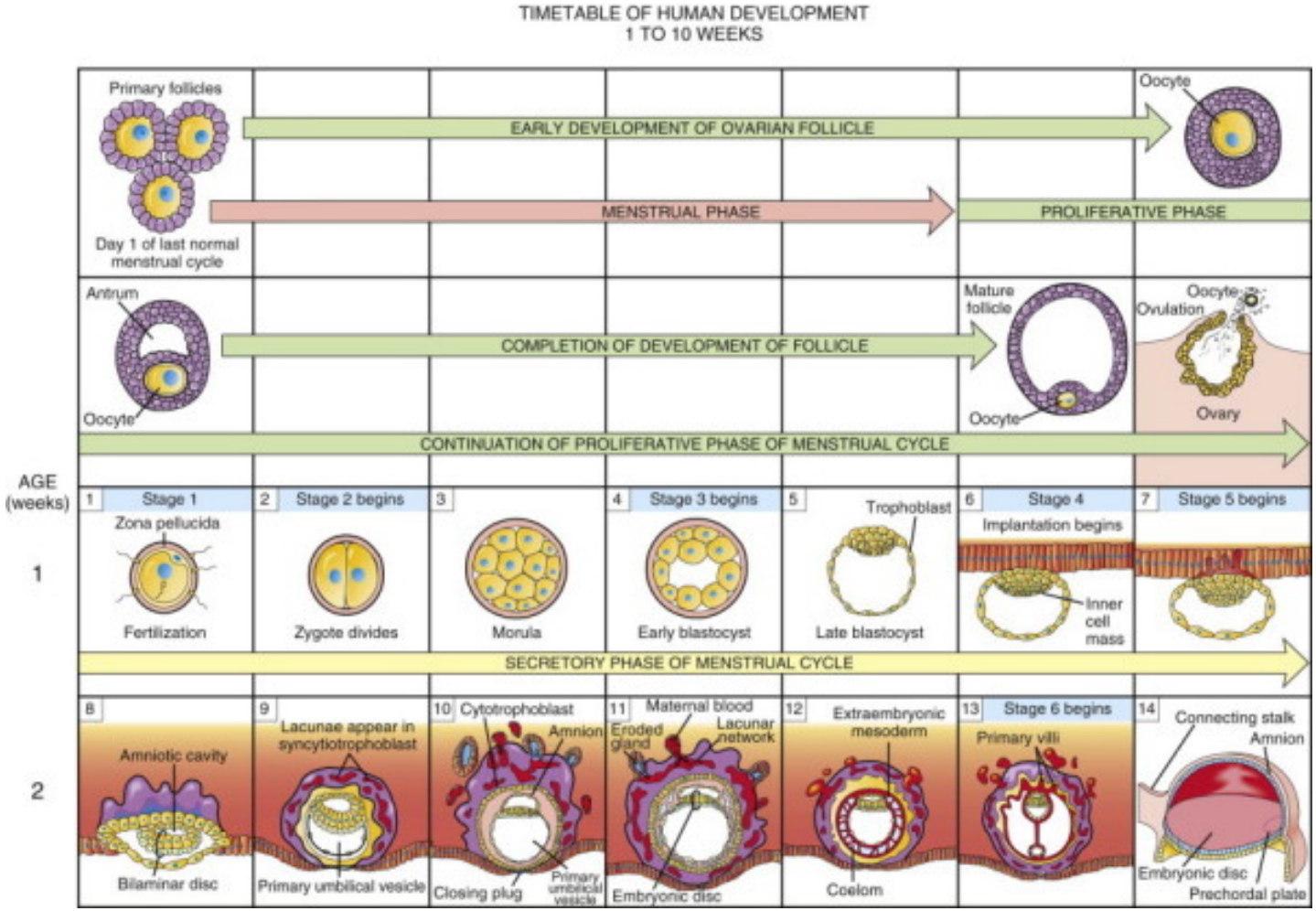
Fertilization

Week 1	Week 2	Week 3	Week 4

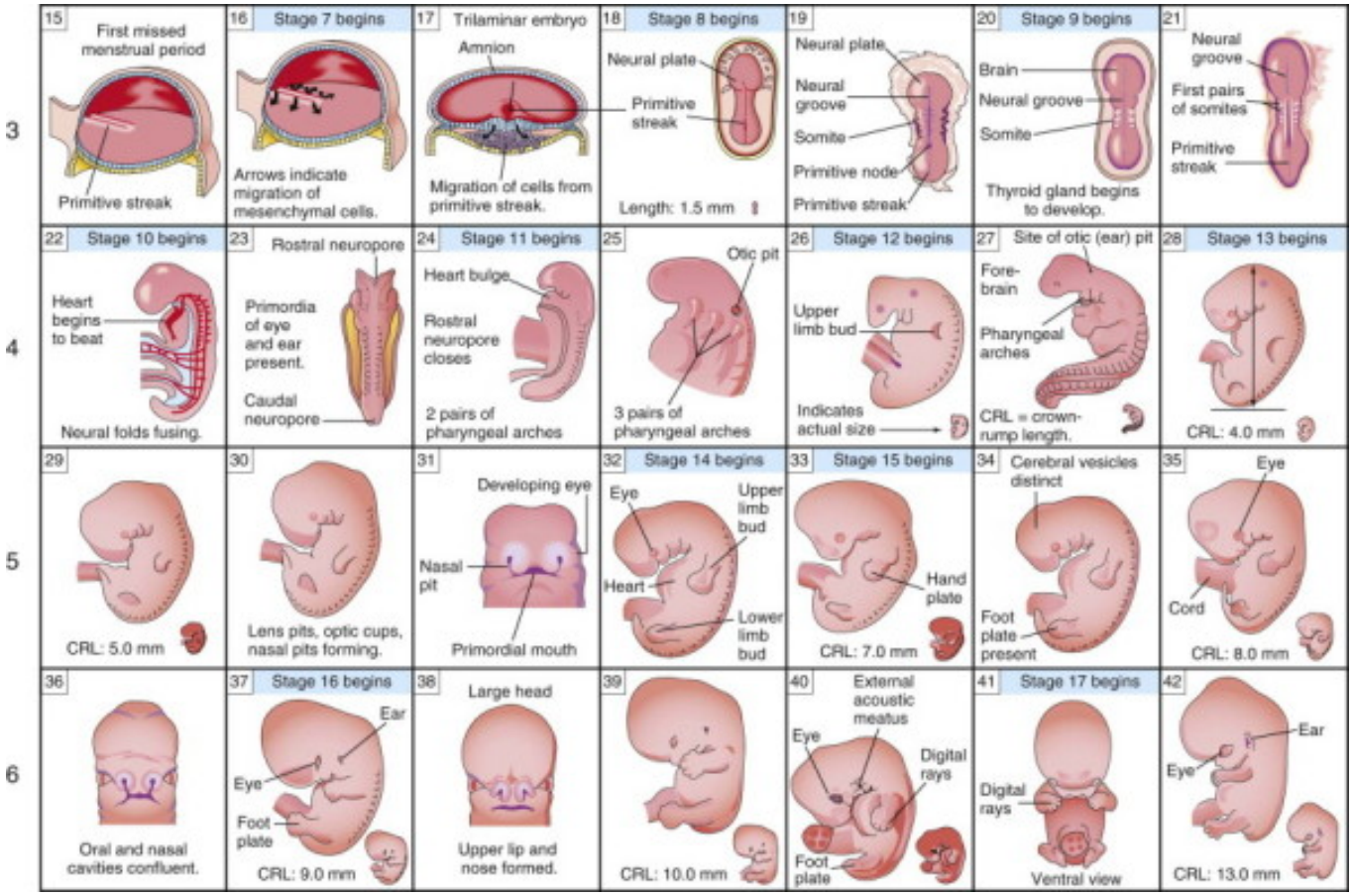


Events

zygote
morula
blastocyst
bilaminar
trilaminar
implantation
blastocyst hatching
gastrulation
folding
somitogenesis
cardiogenesis
neurogenesis
placodes

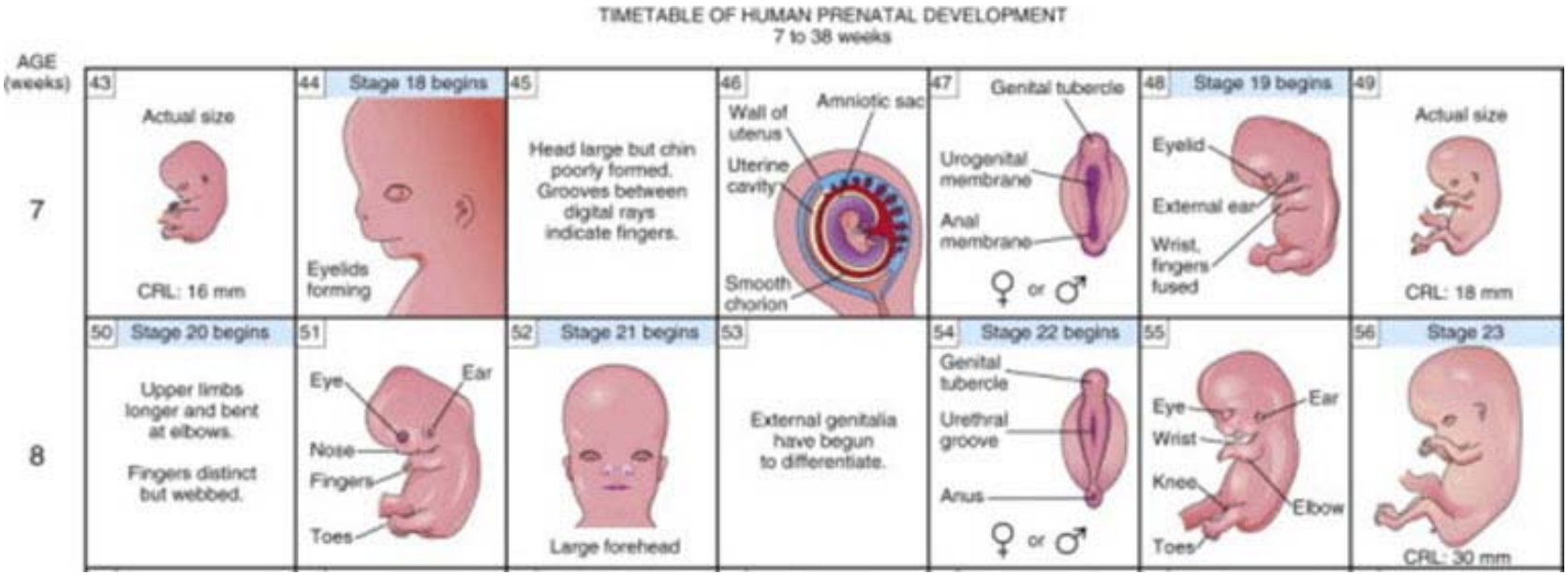


Moore, K.L., Persaud, T.V.N. & Torchia, M.G. *The developing human: clinically oriented embryology*, (Elsevier Saunders, Philadelphia, Pa. ; Edinburgh, 2013).



Moore, K.L., Persaud, T.V.N. & Torchia, M.G. *The developing human: clinically oriented embryology*, (Elsevier Saunders, Philadelphia, Pa. ; Edinburgh, 2013).

8 weeks is the end of the **embryonic** period in humans – most of the events we will be looking at during the course will be within the first 8 weeks – this is followed by the **fetal** period



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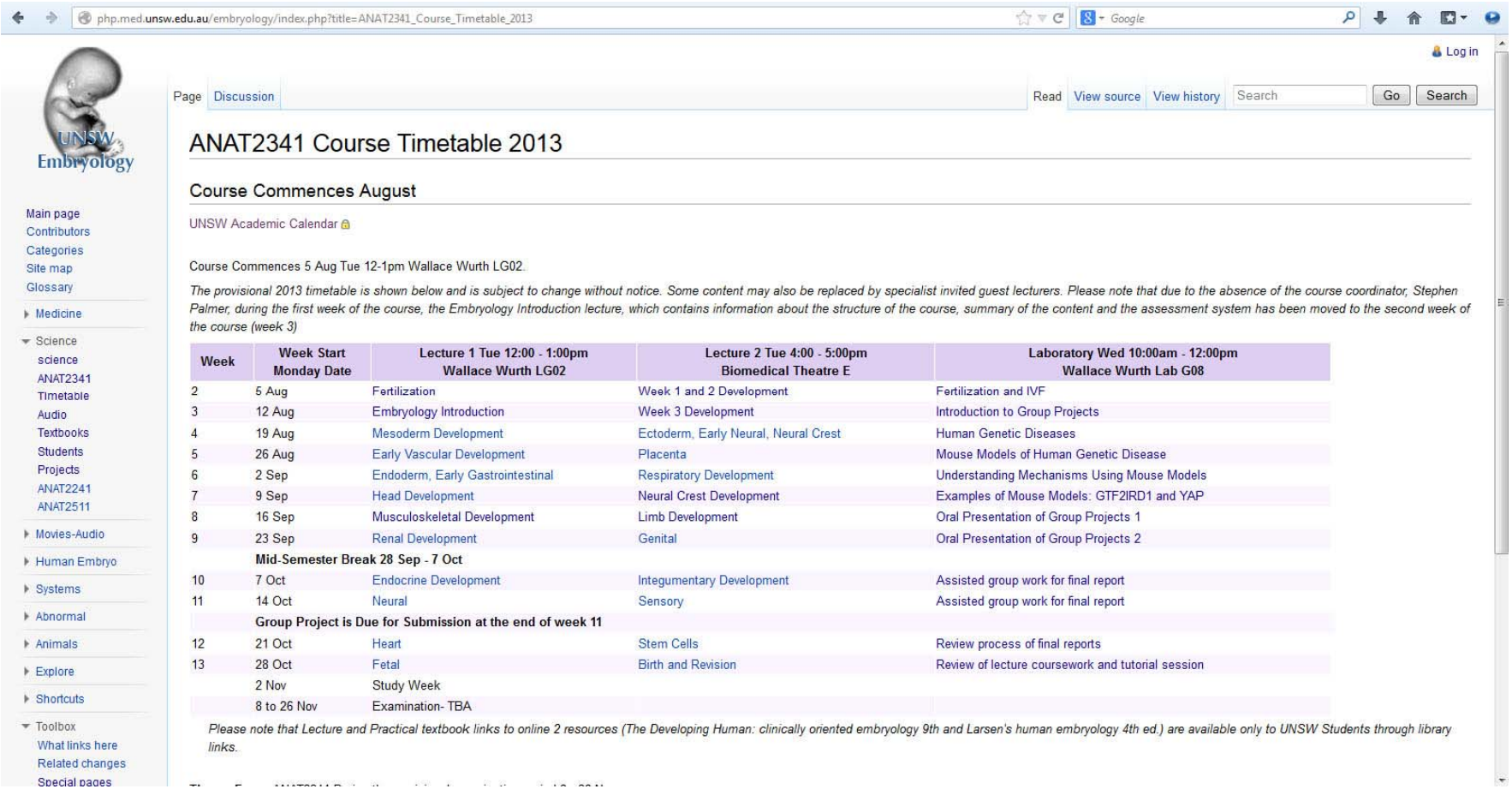
Overview of the course:

Embryology integrates many different disciplines, anatomy, cell biology, evolution, genetics, cell-signaling, molecular biology, biochemistry.



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ANAT2341 Course Timetable 2013

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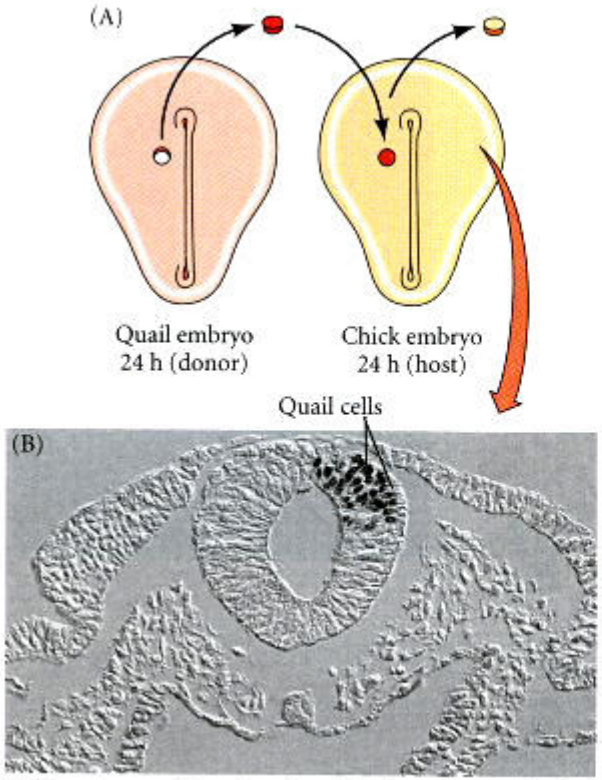
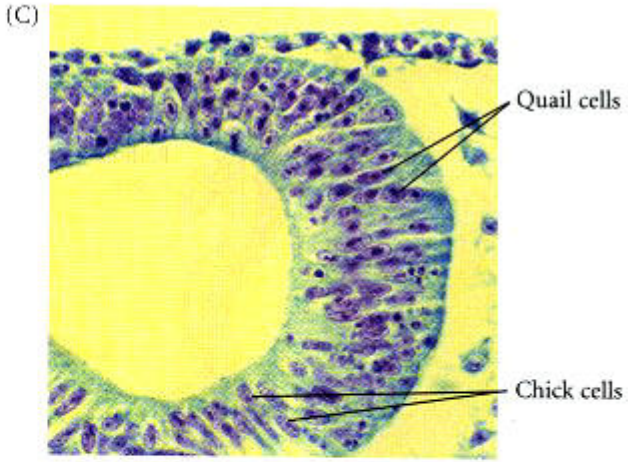
Anatomical – observation, naming and **fate mapping**

Anatomical – observation, naming and **fate mapping**

Fate mapping – the chick – quail grafting system



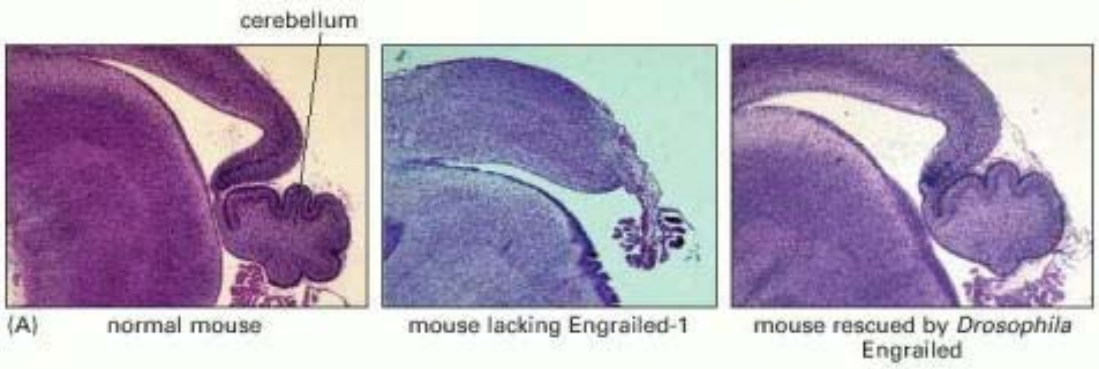
Chick embryo with region of quail cells on the neural tube



Nicole Le Dourin From: Comparative Embryology
Developmental Biology. 6th edition.
Gilbert SF.
Sunderland (MA): Sinauer Associates; 2000.

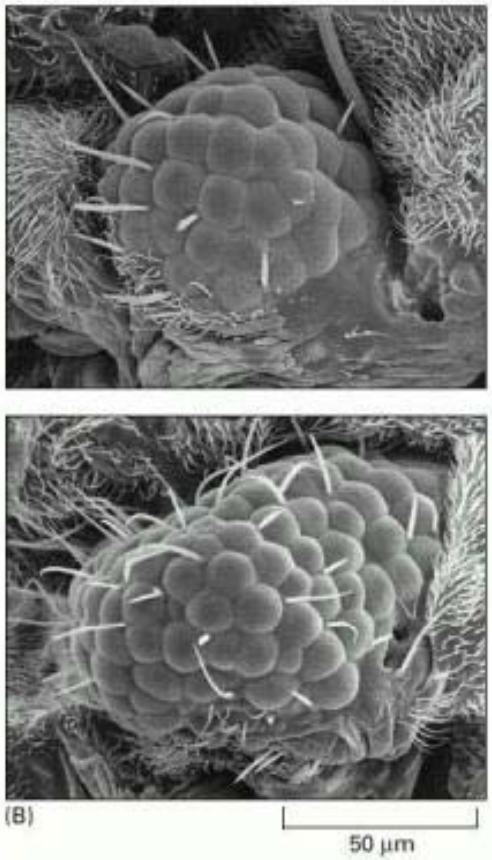
Using animal models to study mechanisms of human development

The sequence of a gene can be conserved throughout evolution and the function of the protein encoded by the gene can also be highly conserved

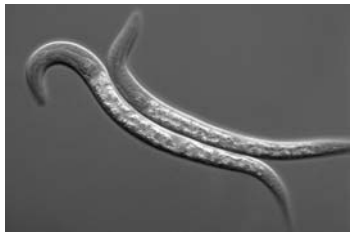


Example 1: Mutation of the mouse *Engrailed* gene leads to a failure of normal cerebellum development in the mouse brain. If a Drosophila fruit fly gene with a similar DNA sequence is substituted, cerebellum development seems normal.

Example 2: By mis-expression of the Drosophila *Eyeless* gene in a fly's leg it is possible to induce an extra eye (TOP). If a gene with similar sequence from a squid is used (*Pax6*) the same thing happens (BOTTOM).



If we assume that a gene in the human does roughly the same job as it does in other animals – we can use animal models to study genetic disease.



Caenorhabditis elegans: nematode worm, external development in egg, transparent, **fate of every cell (about 1000) mapped**, short life-cycle, rapid development, very cheap and easy to keep, **easy to manipulate gene expression (feed them DNA**), genome sequenced to completion, very poor relevance to human development,

Drosophila melanogaster: fruitfly, external development in egg, **excellent for genetics**, short life-cycle, rapid development, easy and cheap to keep, genome sequenced to completion, poor relevance to human development.

Xenopus laevis: African clawed frog, external development in egg, easy and moderately inexpensive to keep, short life-cycle, rapid development, very poor for genetics, genome not sequenced due to tetraploidy, **very good for grafting studies and fate mapping,** better relevance to human development.

Animal models continued:

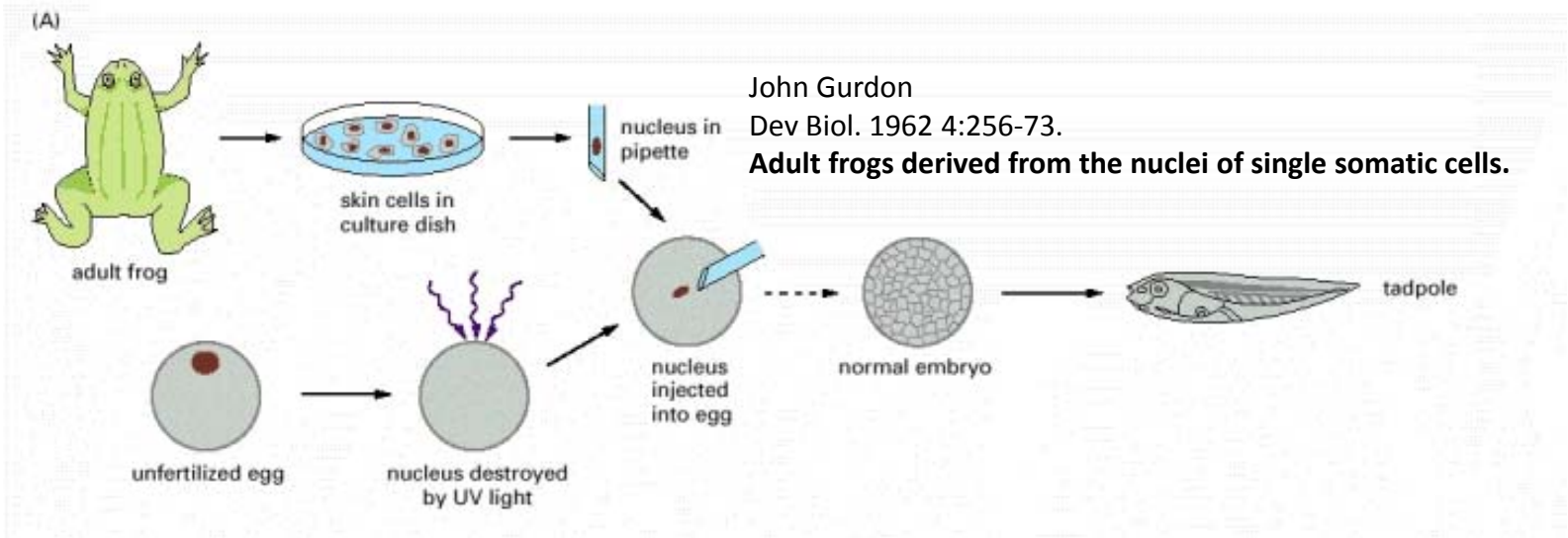
Gallus gallus: Chicken, external development in egg, easy and cheap to produce (eggs), relatively rapid development, very poor for genetics, genome sequence incomplete, **very good for grafting studies (chick/quail grafting) and fate mapping**, good relevance to human development.

Danio rerio: Zebrafish, external development in egg, easy and moderately inexpensive to keep, short life-cycle, rapid development, good for transient genetic manipulation, translucent embryo, genome sequenced to completion, good relevance to human development, **good all-round model**.

Mus domesticus: Mouse, internal development in uterus (virtually impossible for grafting studies), very expensive to keep, 20 day gestation, 8 weeks before sexually mature, difficult and expensive genetic manipulation, genome sequenced to completion, **excellent relevance to human development**,

The nucleii of all somatic cells contain <u>the same chromosomal DNA content</u> and have the potential to make a *clone.*

Somatic cell nuclear transfer in frogs and sheep



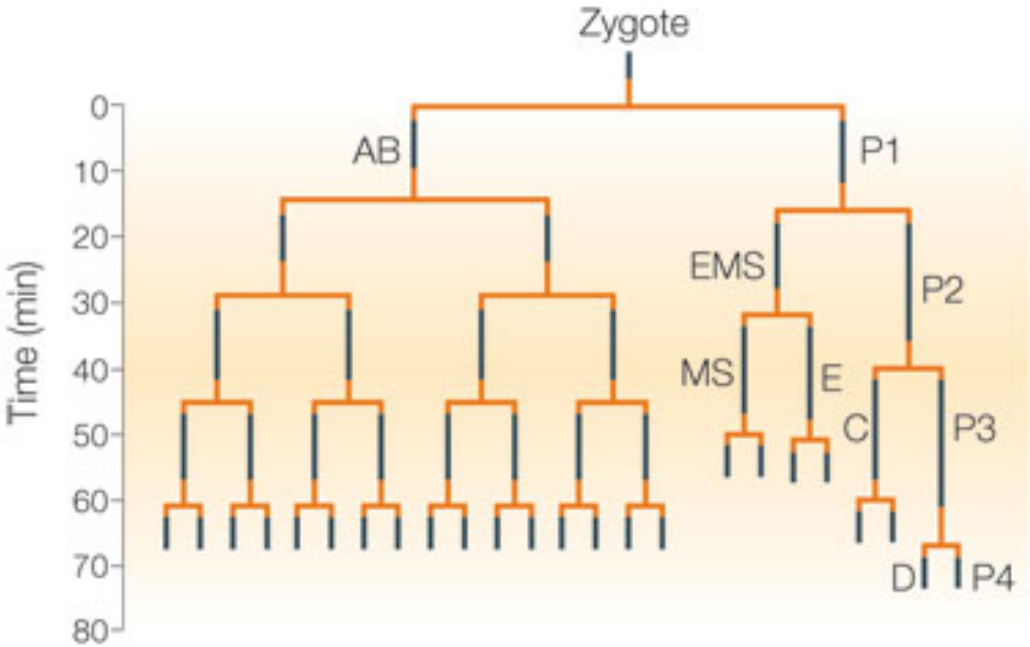
John Gurdon
Dev Biol. 1962 4:256-73.
Adult frogs derived from the nuclei of single somatic cells.

Viable offspring derived from fetal and adult mammalian cells NATURE | VOL 385 | 27 FEBRUARY 1997

I. Wilmut, A. E. Schnieke*, J. McWhir, A. J. Kind* & K. H. S. Campbell

Dolly the sheep
Nucleus from a mammary cell derived from a 6 year old ewe

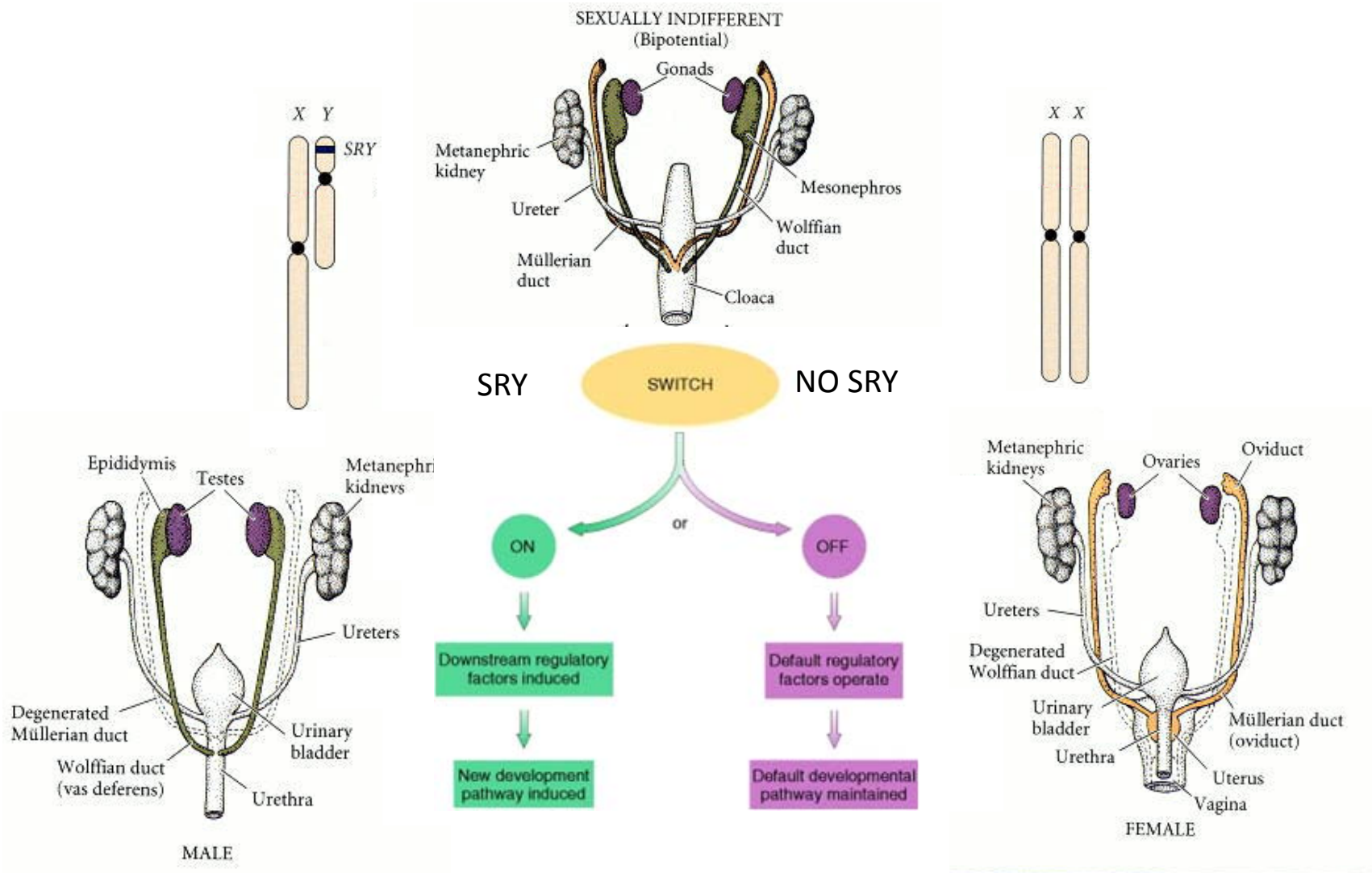
Q: How do all of the different cell types arise?
A: **lineage restriction**



AB (hypodermis, neurons, muscle, others)
MS (neurons, muscle, somatic gonad, others)
E (intestine)
C (hypodermis, neurons, muscle)
D (muscle)
P4 (germ line)

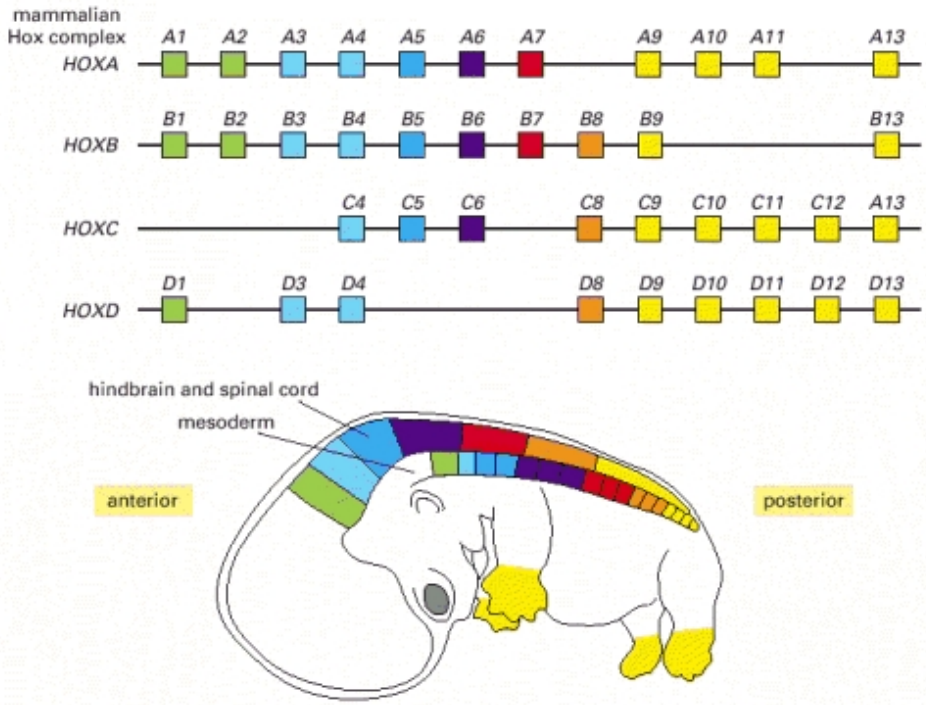
The early cell division stages of *Caenorhabditis elegans* embryo and the lineage restriction of the cells

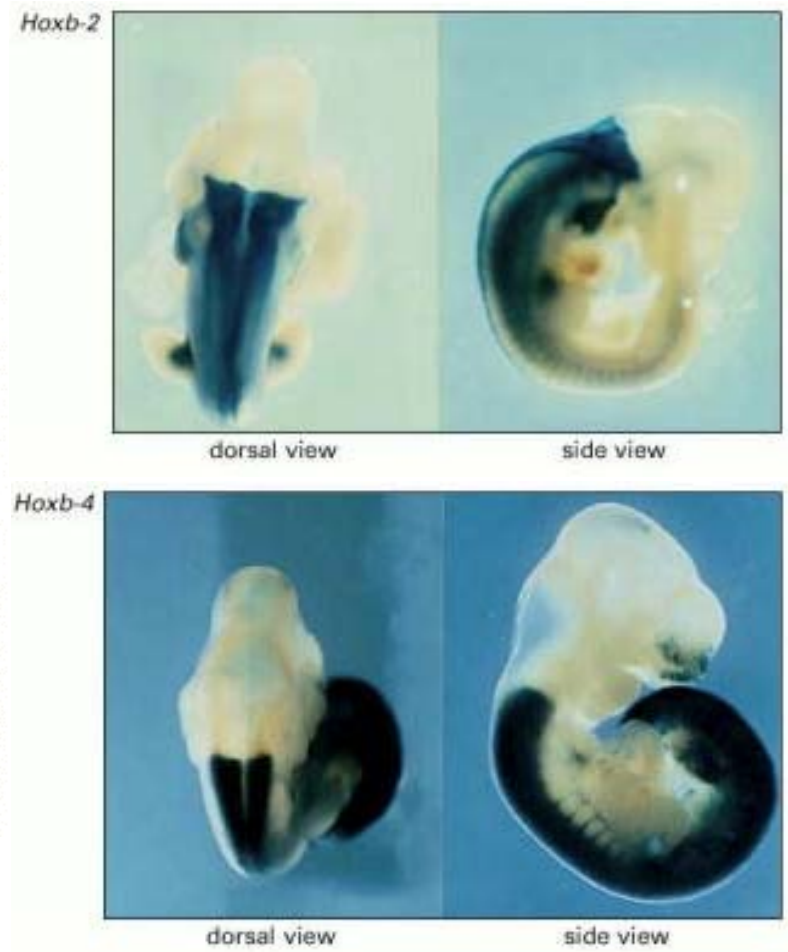
How does lineage restriction work?
Cell fate is controlled by molecular switches – transcription factors that control the expression of other genes and thus differentiation.



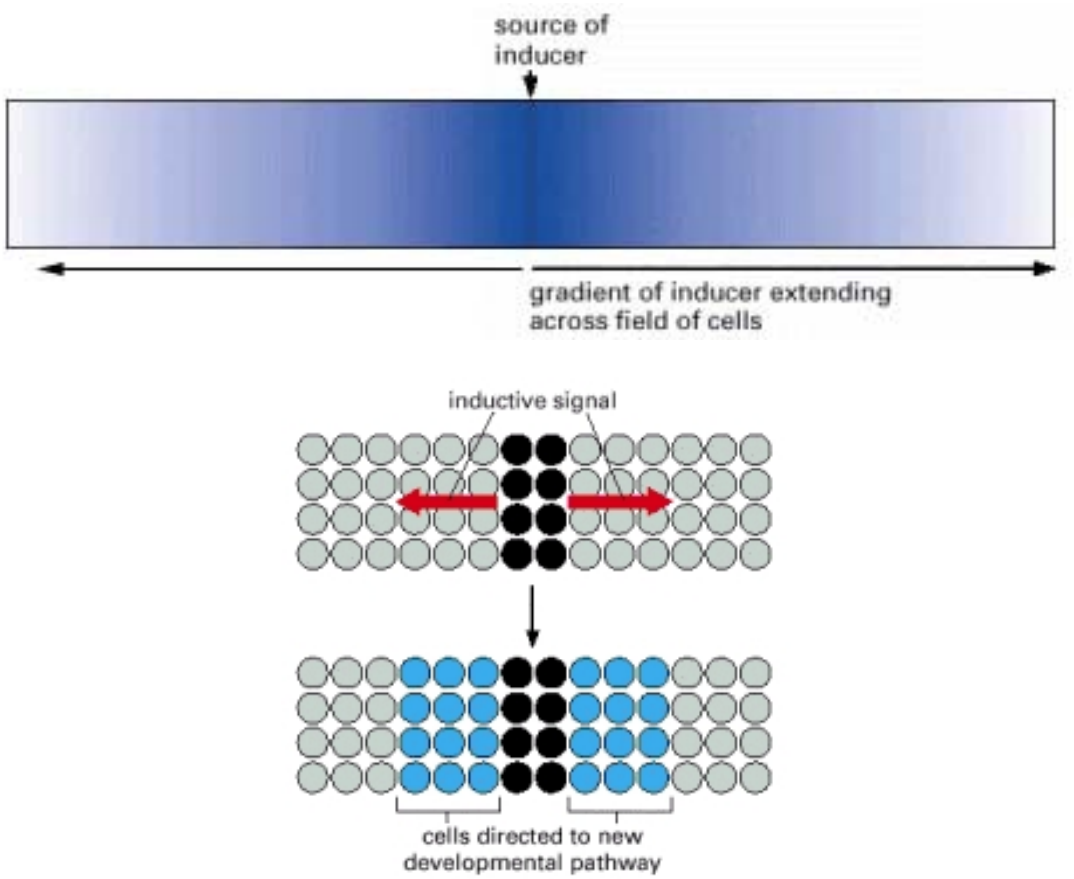
Developmental transcription factor proteins are expressed in restricted ***spatial*** patterns e.g. the Hox proteins

mRNA in-situ hybridization

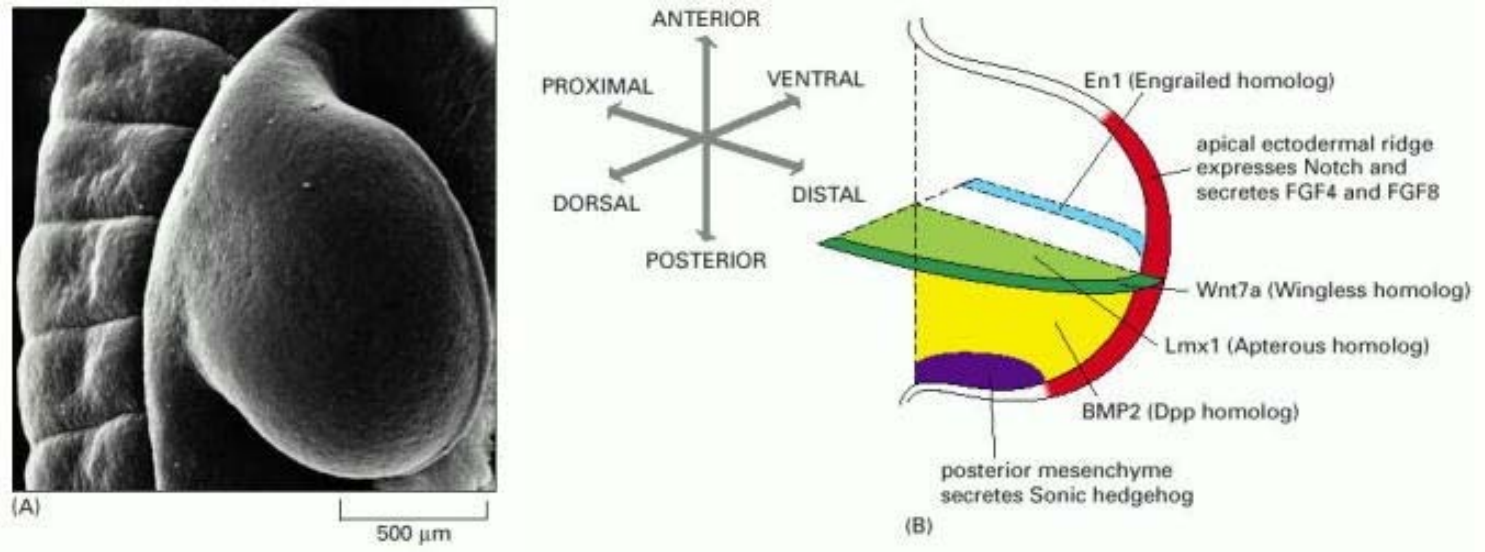




Production of the inducer from a point source generates a diffusion gradient across a field of cells. If sufficient receptors are activated in the receiving cells to generate a threshold intracellular signal then cell fate is switched.



The 3-dimensional organization of the vertebrate limb bud uses a number of spatial cues



A wing bud of a chick embryo at 4 days of incubation. The scanning electron micrograph shows a dorsal view. At the distal margin of the limb bud a thickened ridge can just be seen

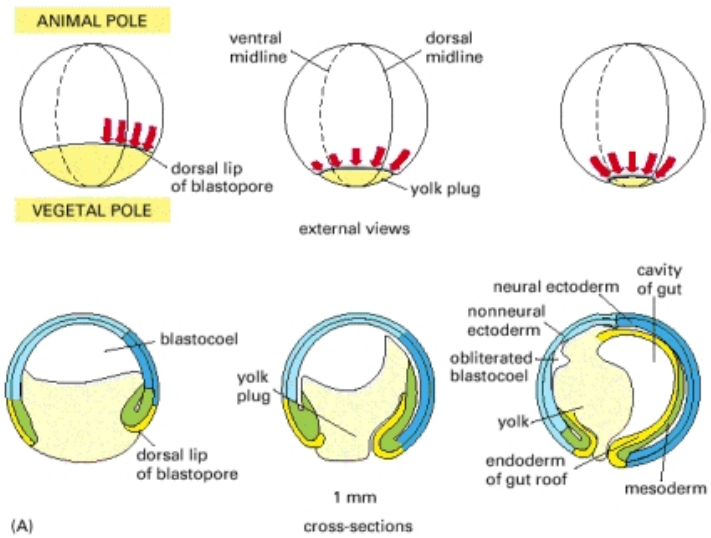
The apical ectodermal ridge (AER).

Expression patterns of key signaling proteins and DNA-binding transcription factors in the chick limb bud.

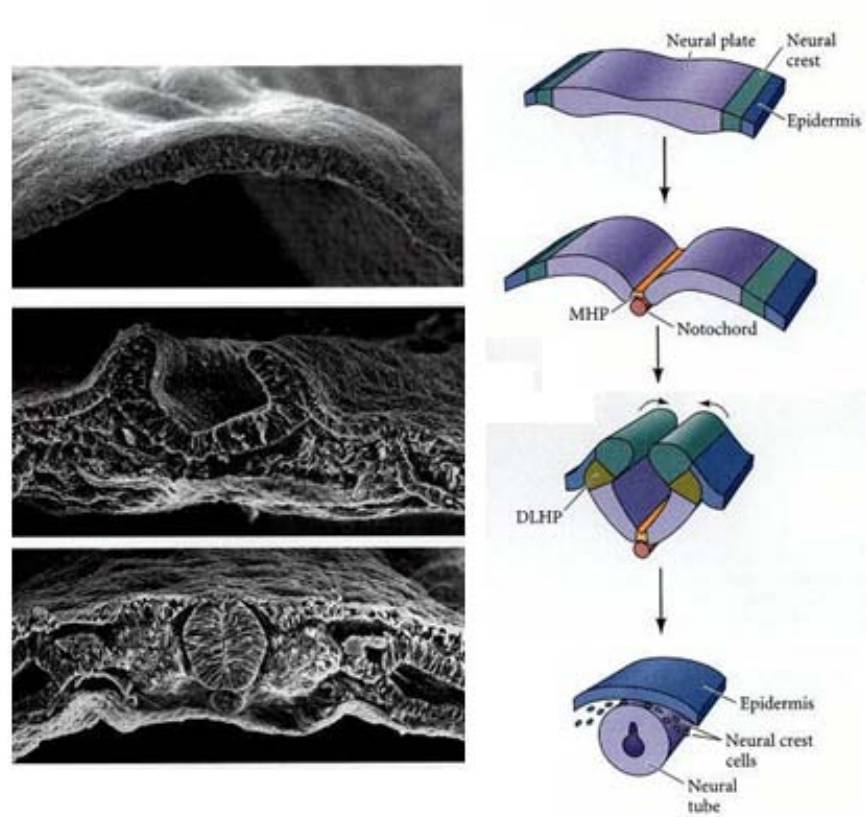
Sonic hedgehog	diffusible morphogen
FGF4	diffusible morphogen
FGF8	diffusible morphogen
Wnt7a	diffusible morphogen
BMP2	diffusible morphogen
Notch	cell-cell signaling
En1	DNA-binding transcription factor
Lmx1	DNA-binding transcription factor

Cell migration and movement – mass movements of cell populations relative to others to reorganize shape, e.g. gastrulation and formation of the neural tube

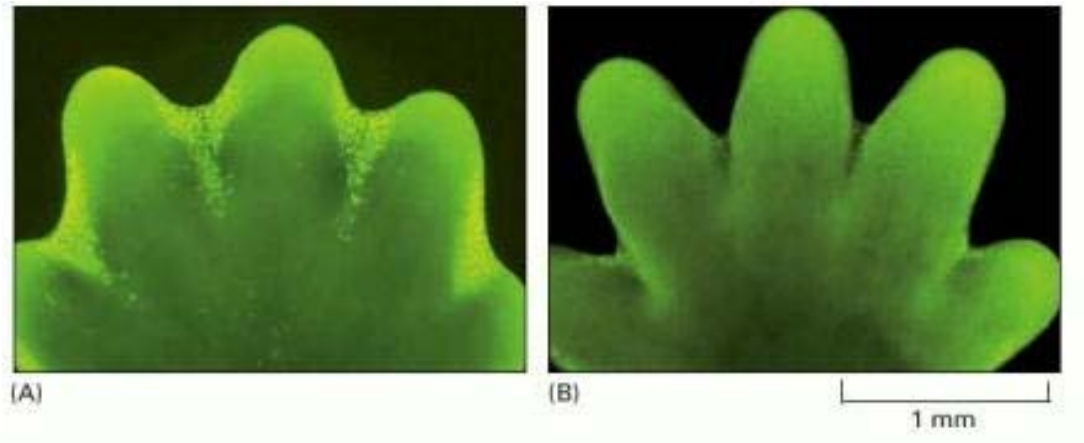
Gastrulation



Neurulation



Morphogenesis by apoptosis of temporary developmental structures e.g. tissue between the digits in the mouse paw



Fluorescent green marker indicates cells undergoing apoptosis

Remember 1st short answer/ multiple choice test is tomorrow.

Make sure you have revised notes from the 1st 2 lectures of last week