# Foundations Lecture - Introduction to Human Development

From Embryology

| from Embryology (11 Apr 2014) | **[show] Translate this page** |
|---|---|

## Introduction

Human development is one of the most exciting topics to study not only as a medical student, but also for our fundamental understanding of the human body. Of all health issues in Medicine, fertility and reproduction is a topic that will affect everyone. This lecture is going to take you briefly through key biological concepts in human development, these will later be explored in more detail through the BGD course. I will be using simplified terms in the lecture slides (with developmental term in brackets).

Dr Mark Hill

> *Australian Statistics 23 January 2014 at 03:02:40 PM (Canberra time), the resident population of Australia is projected to be: 23,360,679*. (Similar sized countries - Mozambique, Syria, Madagascar, Romania, Australia, Cote d'Ivoire, Sri Lanka)

The lecture will be followed by a practical class introducing online resources for independent study and working through similar embryology concepts.

> **Links:** Printable Lecture Page (http://php.med.unsw.edu.au/embryology/index.php?title=Foundations_Lecture_-_Introduction_to_Human_Development&printable=yes) | 2013 (http://embryology.med.unsw.edu.au/embryology/index.php?title=Foundations_Lecture_-_Introduction_to_Human_Development&oldid=125526) | 2012 (http://php.med.unsw.edu.au/embryology/index.php?title=Foundations_Lecture_-_Introduction_to_Human_Development&oldid=117829) | PDF version (873 KB, 6 pages)

**[show] Other Foundations links**

## Aims

1. Purpose of learning embryology
2. Basic facts about early human development
3. Appreciate differences between the conceptus, embryo and fetus
4. General understanding of the term “critical periods” of development

**Lecture Concepts:** Embryology Education Support, Human Reproductive Cycle, First Trimester, Second and Third Trimester, Postnatal Development, Abnormal Development

**[show] Lecture Content**

## Four Basic Tissue Types

Tissues and organs of the body consist of combinations of 4 basic tissue organisations:

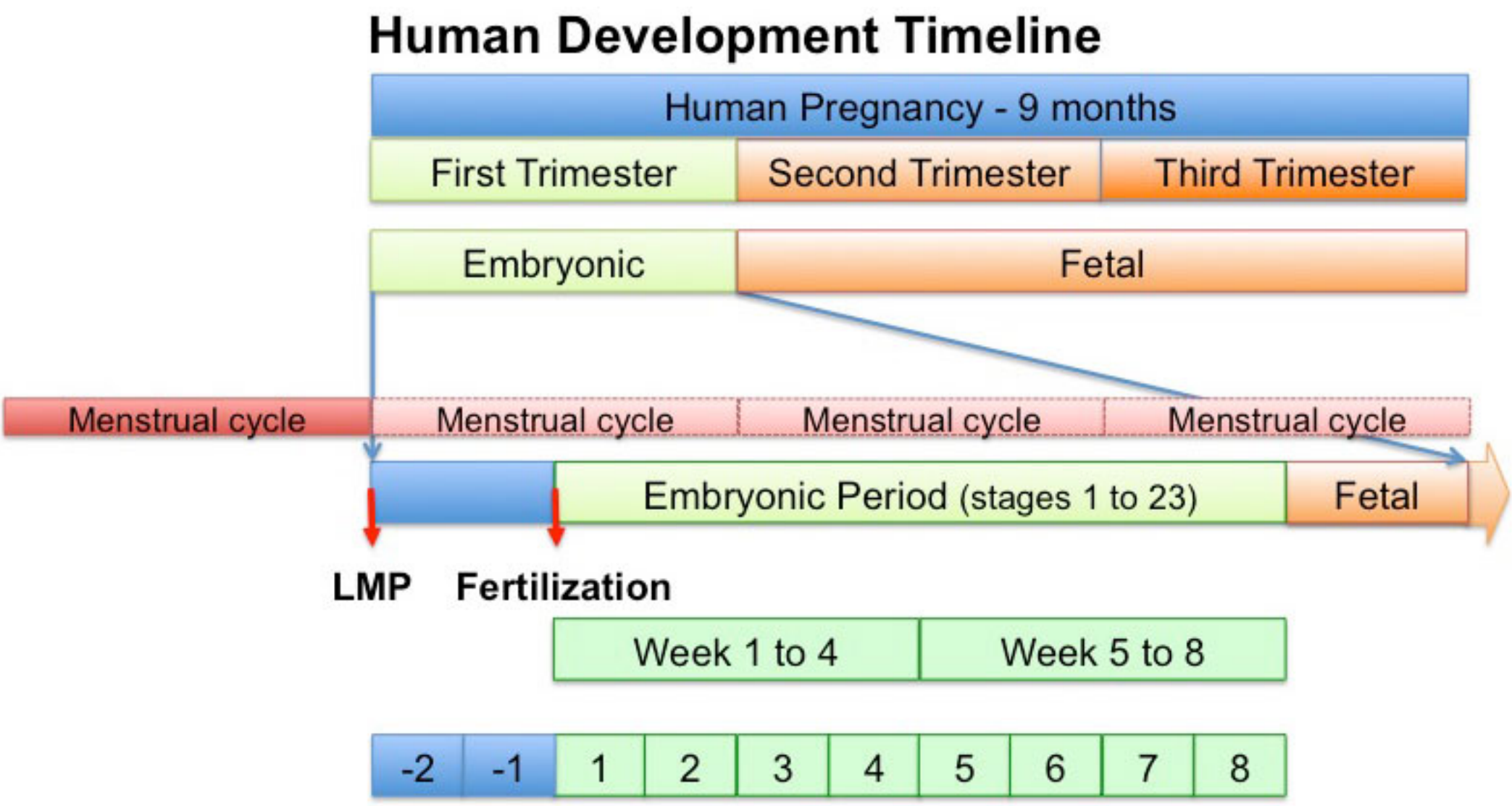
1. Epithelial
2. Connective
3. Muscular

4. Nervous

- Where do they come from?
- How do they develop?

## Human Development Timeline


Stomach Wall containing all 4 basic tissues.




**[show] Last Menstrual Period (LMP) today -> Birth Date - January 30, 2014**

# Embryology Education Support

## UNSW Embryology Online



**Human Development**

Page | Play

Movies

Using these resources (online navigation, organization and printing) will be covered in the introduction to the associated Practical class.

## 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

## Textbooks

- There are many different excellent embryology textbooks
- I have included 2 that cover the clinical topics as well. More Textbooks?

**[show] The Developing Human: Clinically oriented embryology**

**[show] Larsen's Human Embryology**

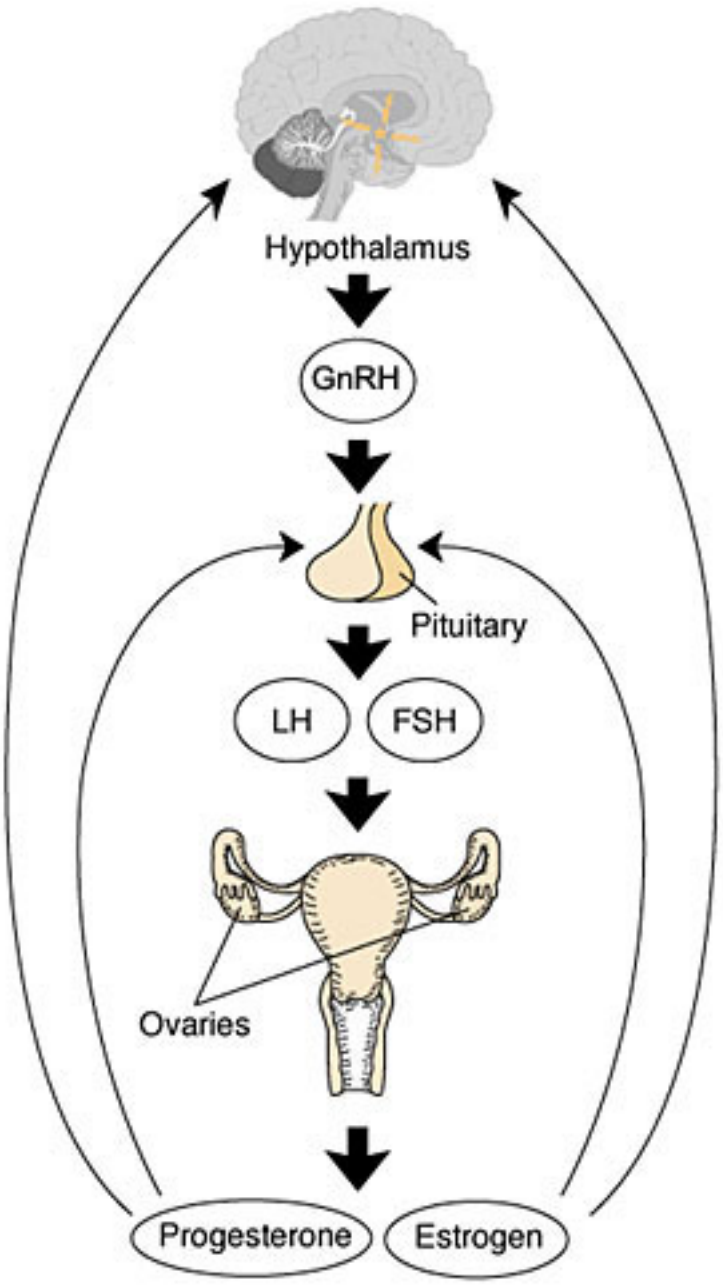
**Links:** More Embryology Textbooks

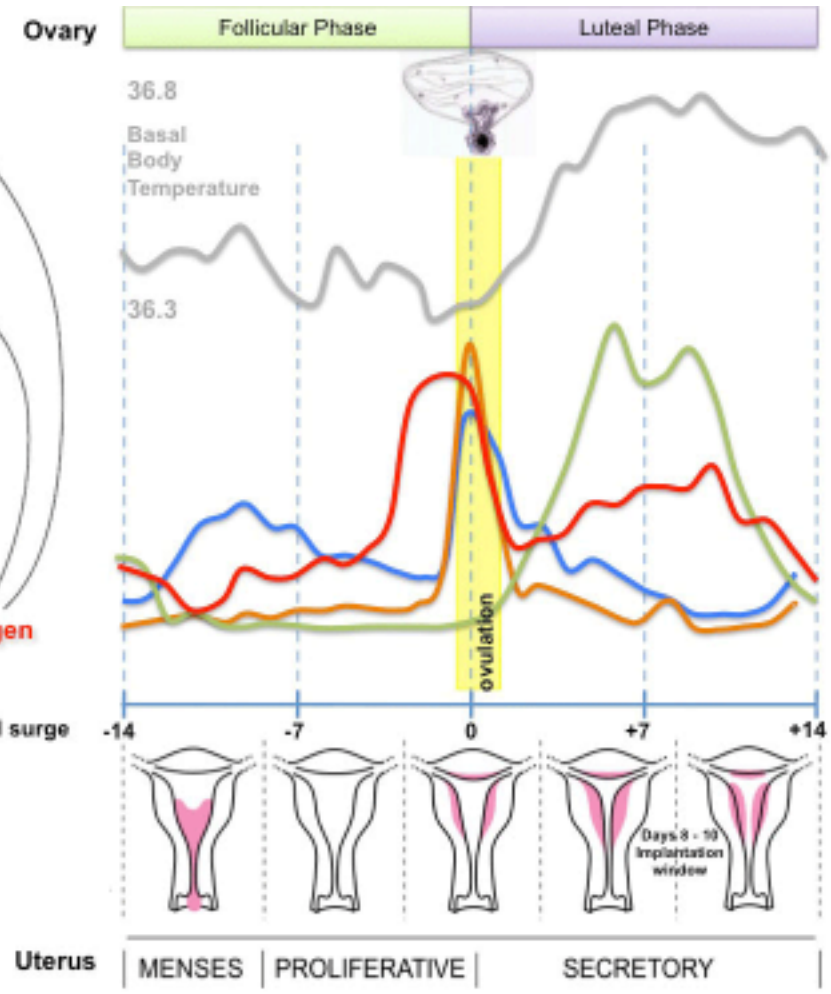
# Human Reproductive Cycle

- Meiosis in gonad produces haploid gametes
  - testis the sperm (spermatozoa)
  - ovary the egg (oocyte)
- there are several differences in when and how gametes are formed in the male and female gonad.

## Female

- Menstrual Cycle a regular cycle of reproduction (28 days)
- begins at puberty
- release of 1 egg (oocyte) every cycle
- Endocrine controlled (HPG axis)
  - Hypothalamus
  - Pituitary
  - Gonad



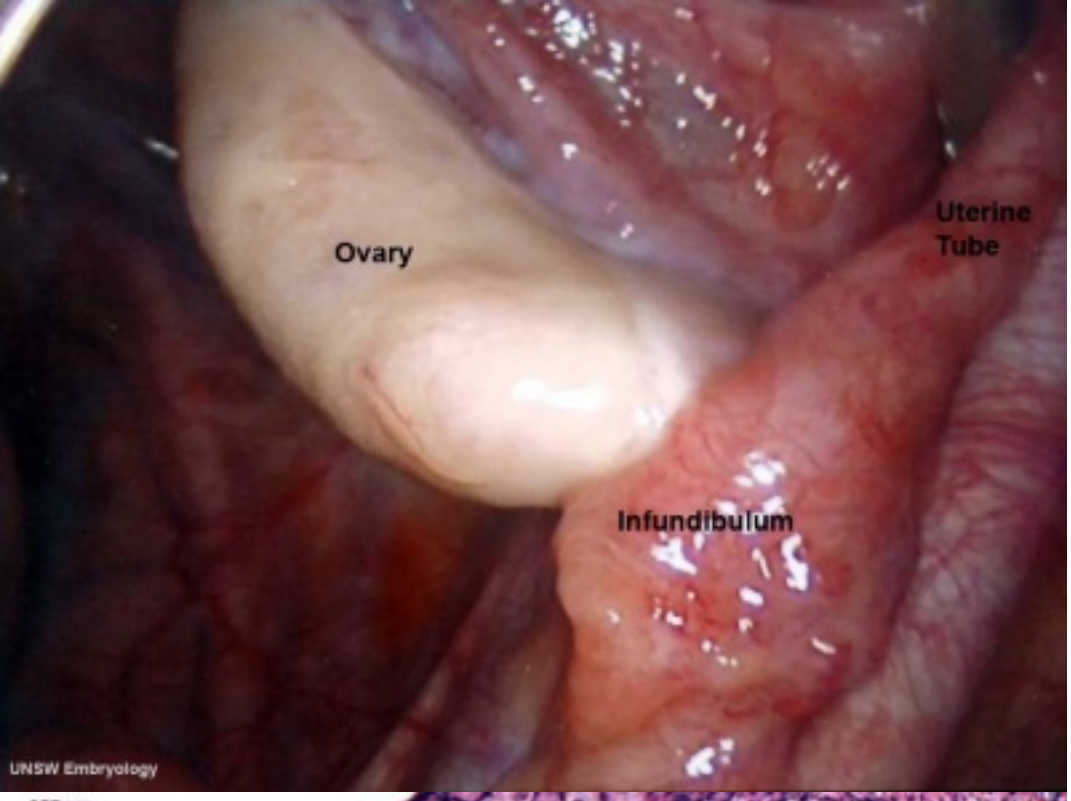




# Male

- begins at puberty
- continuous production of sperm (spermatozoa, human male 2,000/second)
- release millions of spermatozoa (require activation, capacitation)

# Ovary

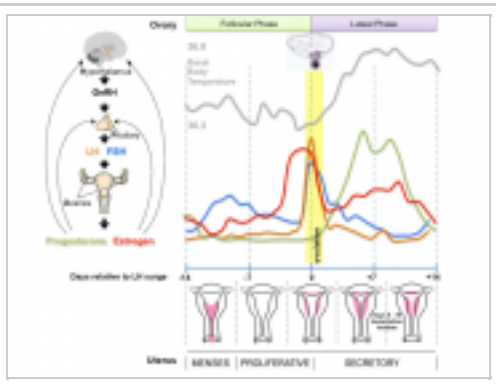
- Paired organs
- lying in the peritoneal cavity



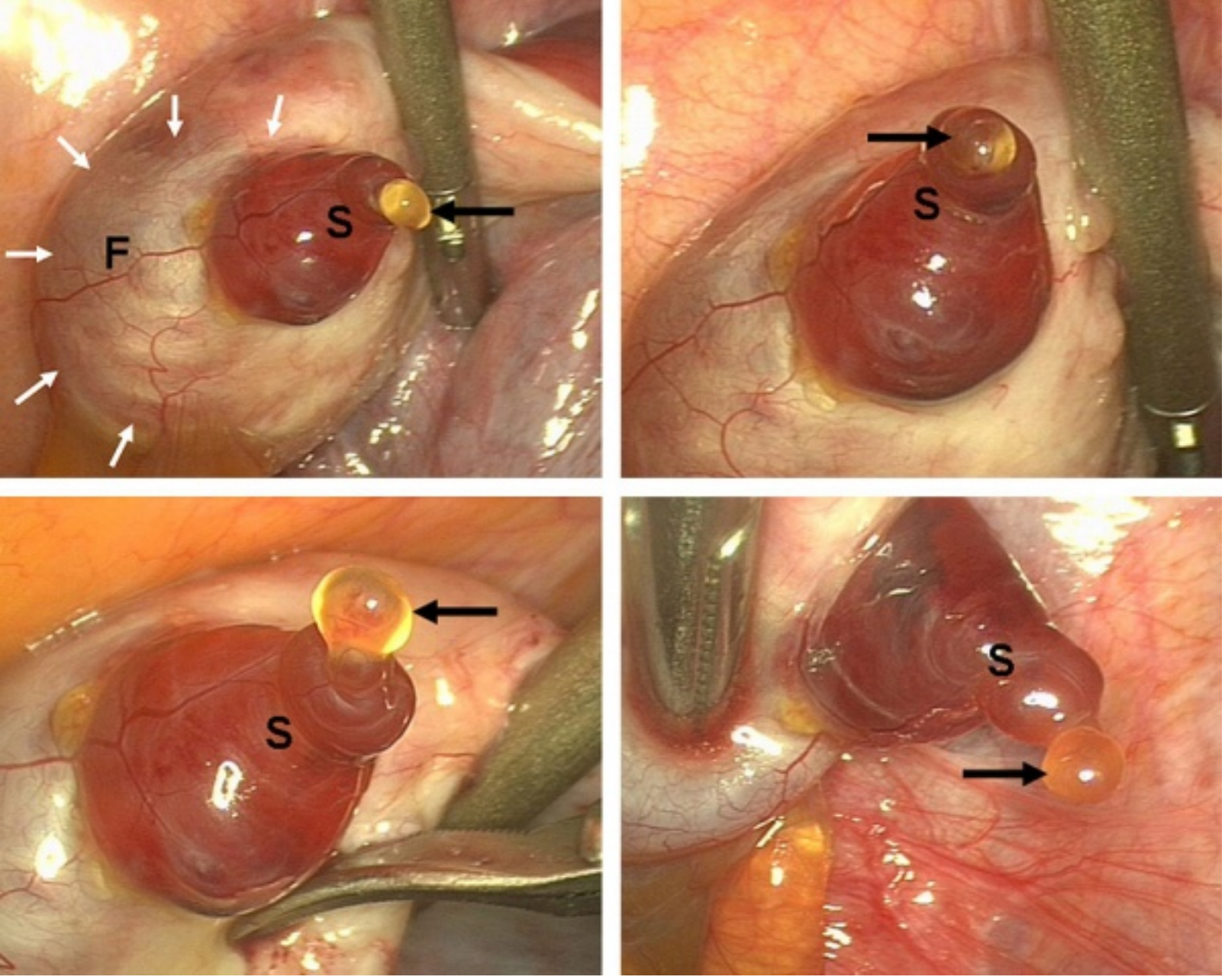


# Ovulation

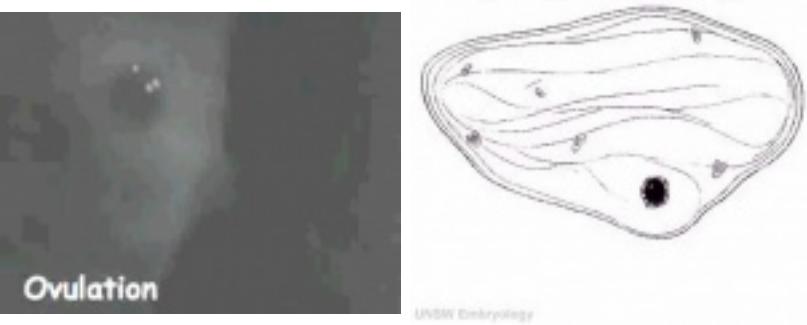
- ovulation is the release of the egg (oocyte) at about the middle of the menstrual cycle



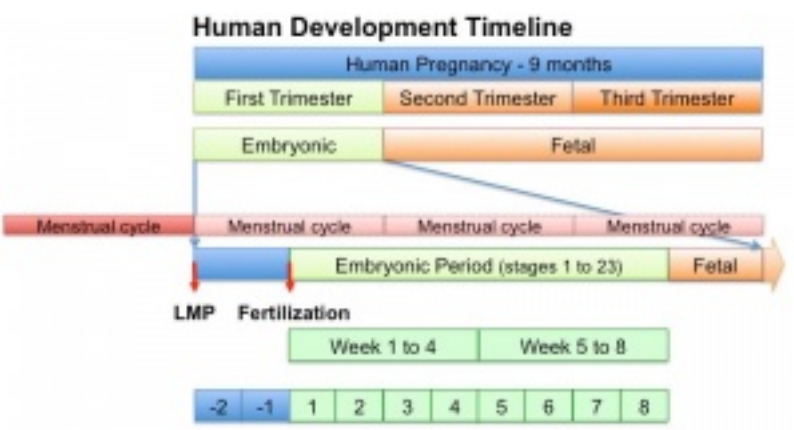
Human Menstrual Cycle




**Human ovulation**



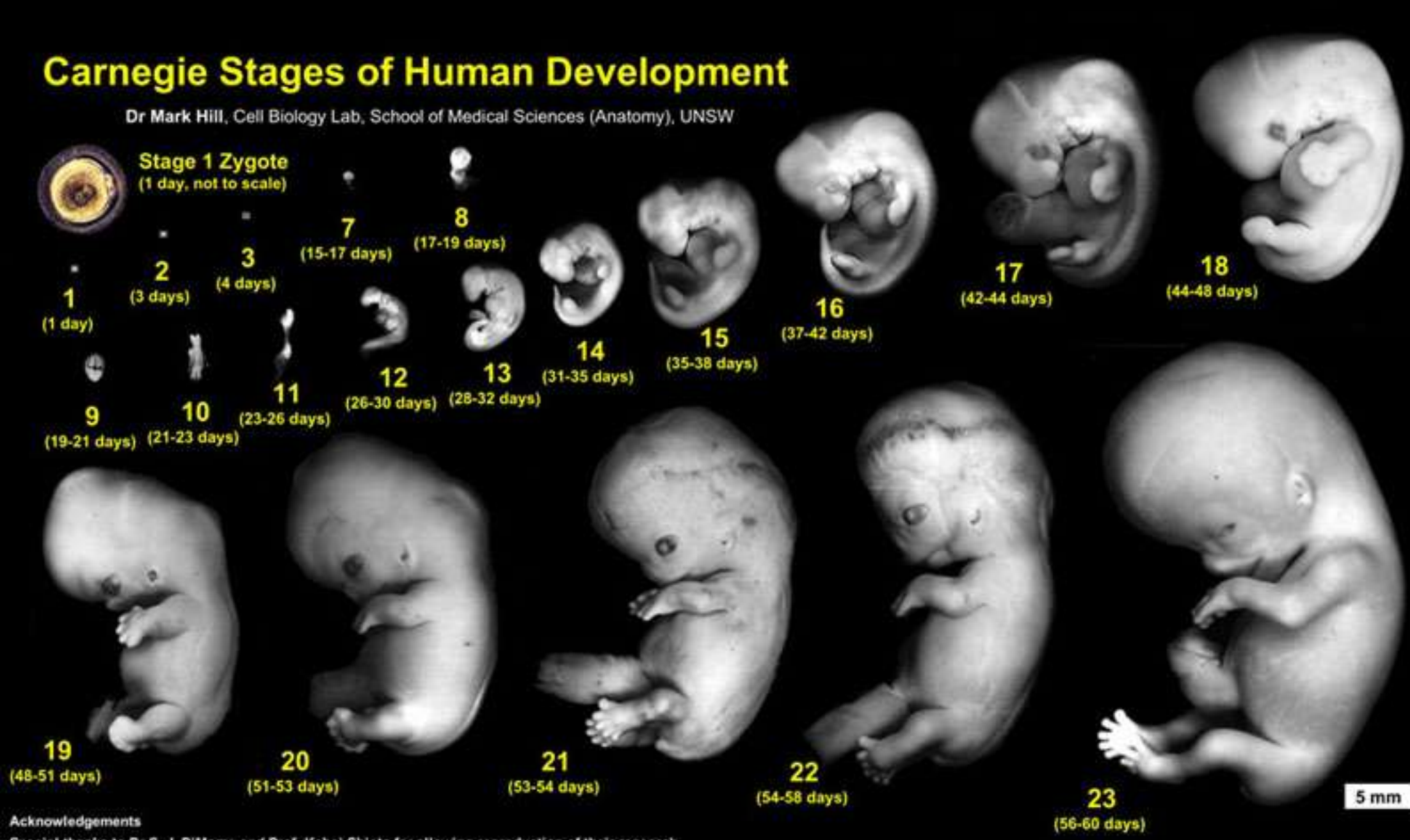

## Trimesters

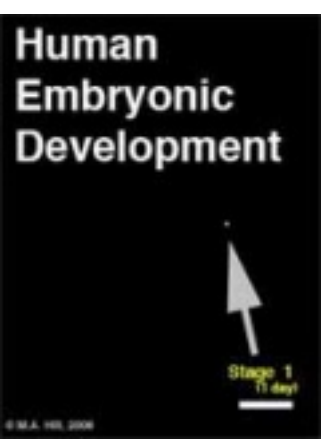



- Divide the pregnancy into 3 "blocks" of about 3 months (trimesters)
- First Trimester - embryonic period (organogenesis)
- Second and Trimester - fetal period (growth)

# First Trimester

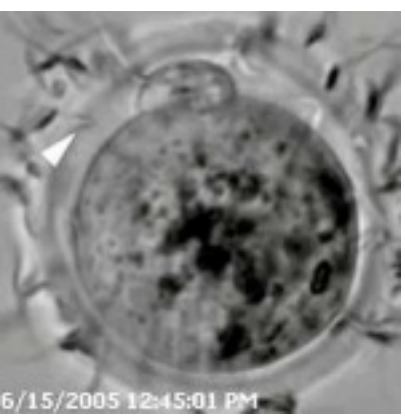
- Embryonic Period - Week 1 to 8 (first trimester)
- Establish the basic structure of organs and tissues (Organogenesis)
- development and growth of the placenta (Placentation)




# Fertilization

- the process of the 2 haploid gametes (egg and sperm) fusing and combining genetic material.
- **conceptus** - the entire product of fertilization

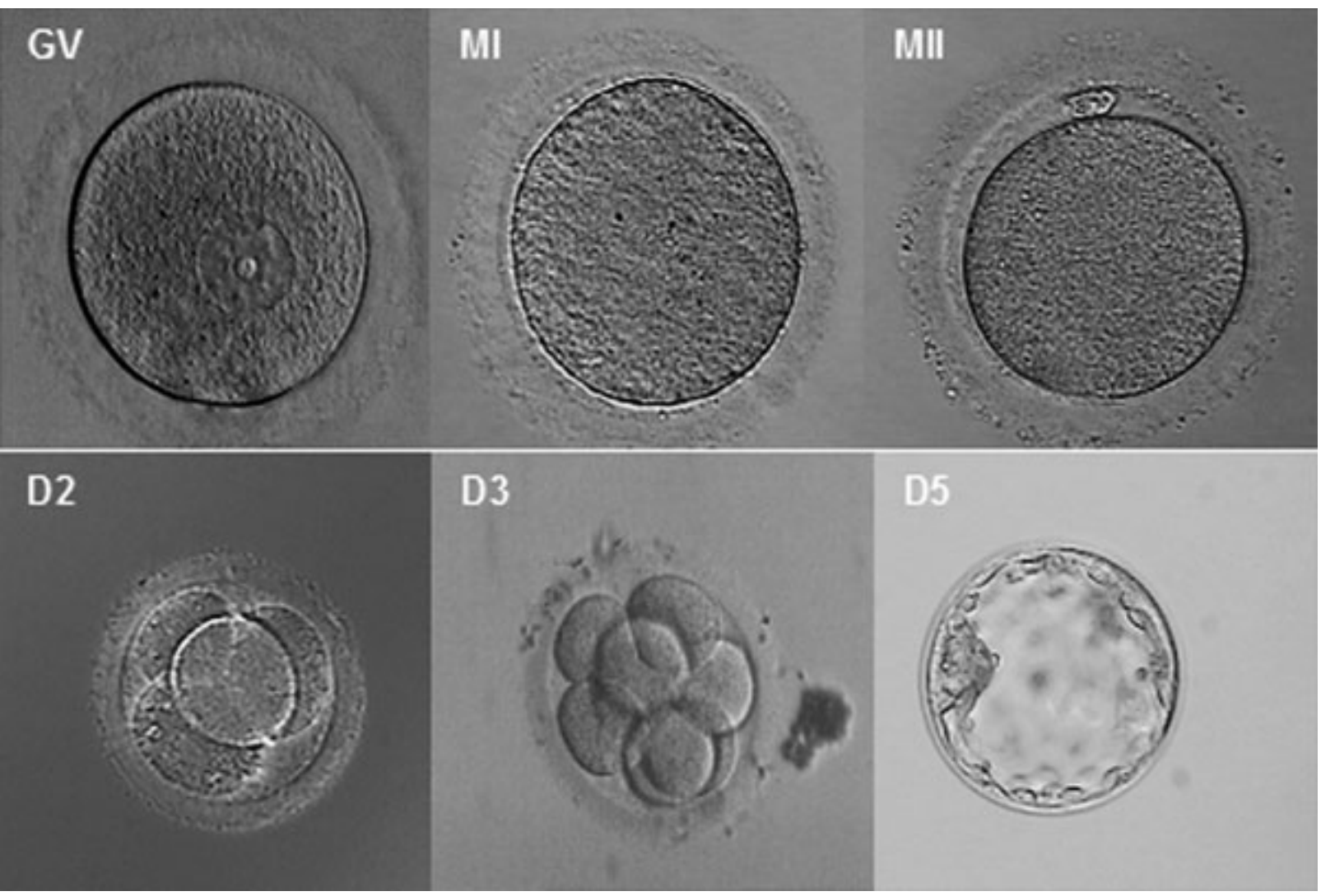


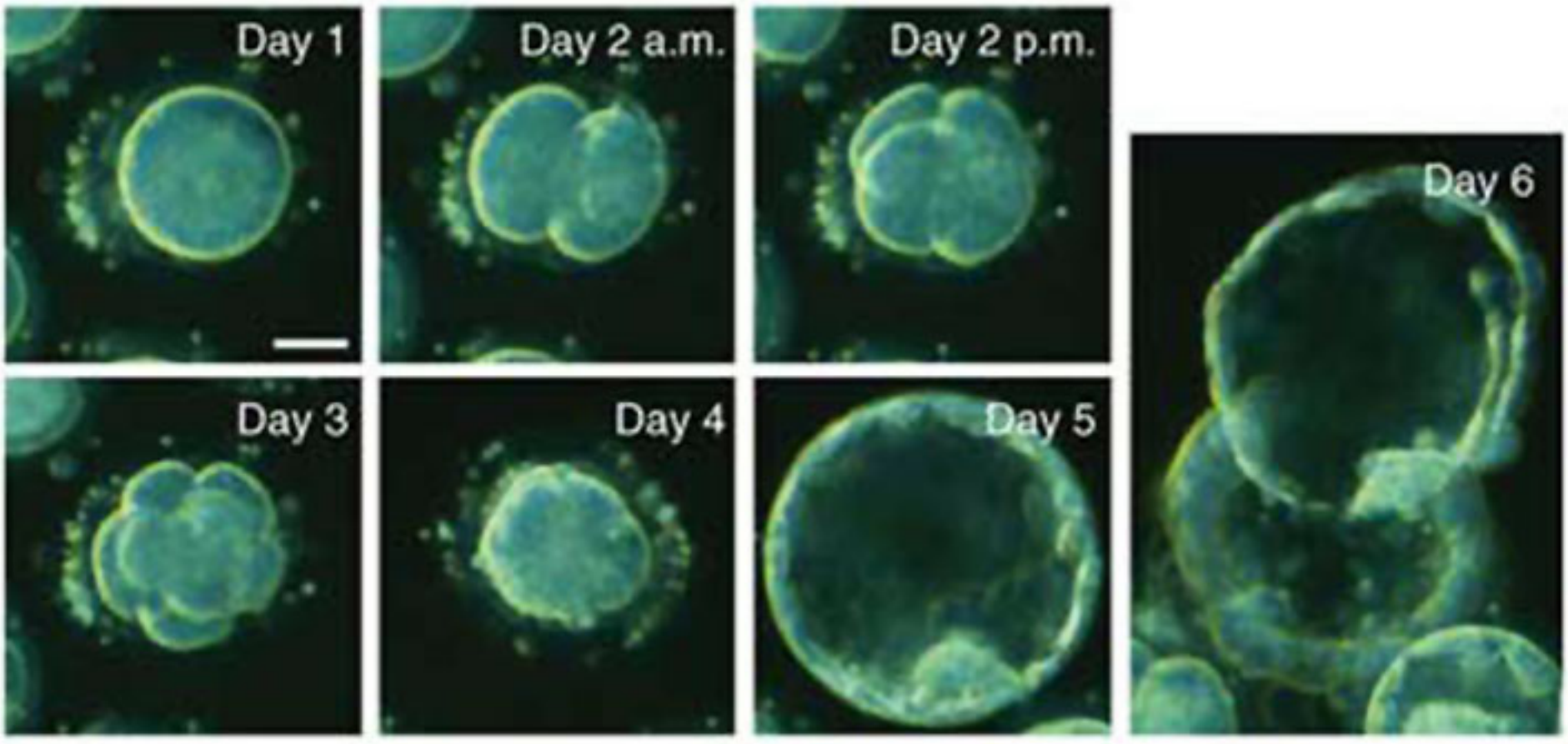


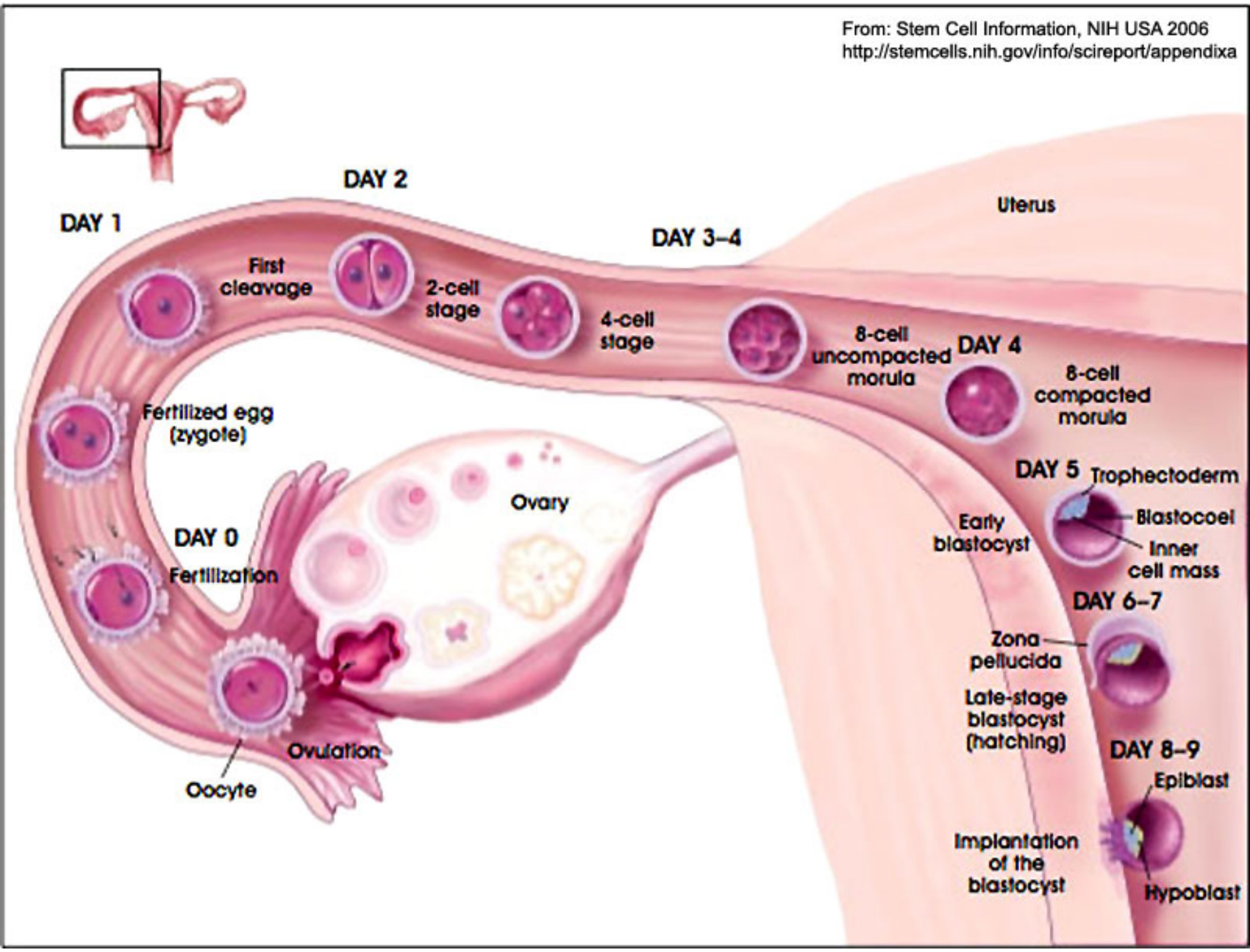
# Week 1

- occurs freely floating in uterus

- occurs during week 1 following fertilization
- last menstrual period (LMP) week 3
- mitosis to form solid ball of cells (morula), then hollow ball (blastocyst)

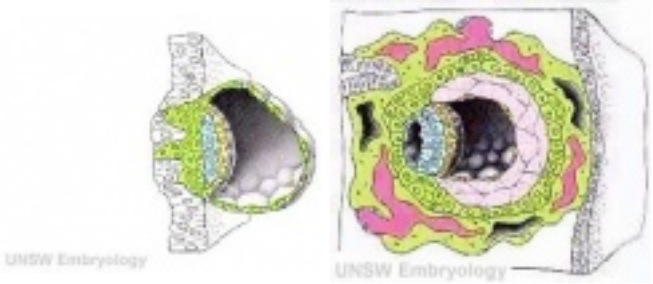





## Week 2

- Implantation - initial attachment to uterine wall, and then invasion of the uterine wall.




## Normal Implantation

- Uterine body
  - posterior, anterior, superior, lateral (most common posterior)
  - inferior implantation - placenta overlies internal os of uterus **Placenta Previa**

## Abnormal Implantation

- Ectopic Sites
  - external surface of uterus, ovary, bowel, gastrointestinal tract, mesentery, peritoneal wall
  - If not spontaneous then, embryo has to be removed surgically
- Uterine - tubal pregnancy (most common ectopic)


## Detect Pregnancy

- Clinically can be detected following implantation (week 2)
- Last Menstrual Period (LMP) - today ? ..... Birth Date - January 30, 2014

# Week 3

- 3 Key processes commence

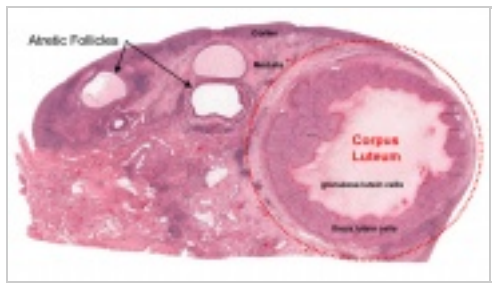
pregnancy test

### 1. Gastrulation

- the formation of the 3 layer embryo (trilaminar embryo)
  - All tissues of the body are formed from these 3 embryonic tissue layers (germ layers)

1. **Ectoderm** (epithelium)
2. **Mesoderm** (connective tissue)
3. **Endoderm** (epithelium)

- simplified explanation of the 3 layer contributions



Ovary - corpus luteum secretes hormone to support pregnancy.

## Ectoderm

- forms the central and peripheral nervous system and epithelium of the skin

## Endoderm

- forms gastrointestinal tract organs and the epithelium of the gastrointestinal and respiratory tracts

## Mesoderm

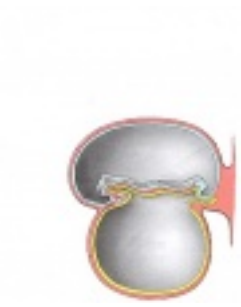
- forms the body connective tissues: blood, bone, muscle, connective tissue skin, gastrointestinal and respiratory tracts

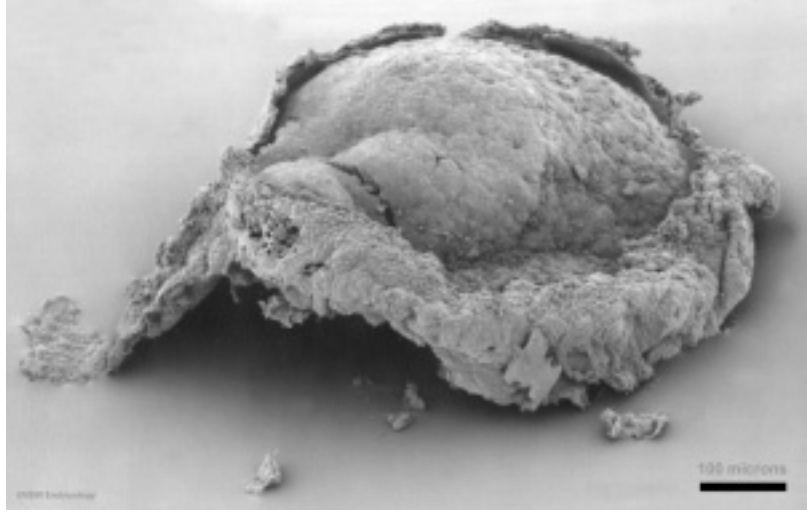
### 2. Somitogenesis

- segmentation of the mesoderm into **somites**
- forms the axial body plan

### 3. Neuralation

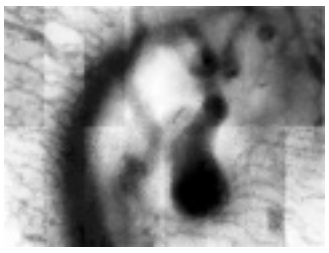
- segmentation of the ectoderm
- separates the neural tissue from the skin (epidermis)

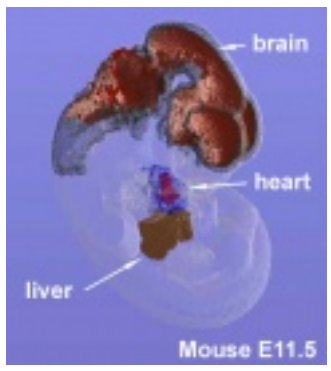


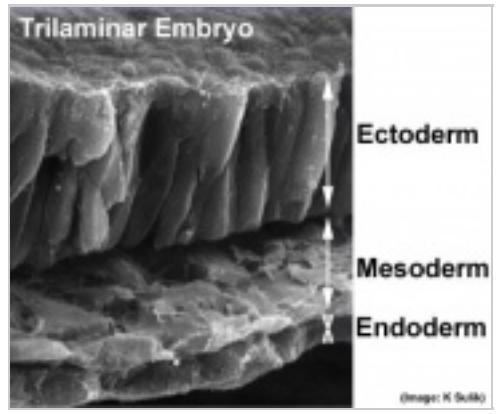


## Week 4

- heart formation (cardiogenesis)
- first functioning organ



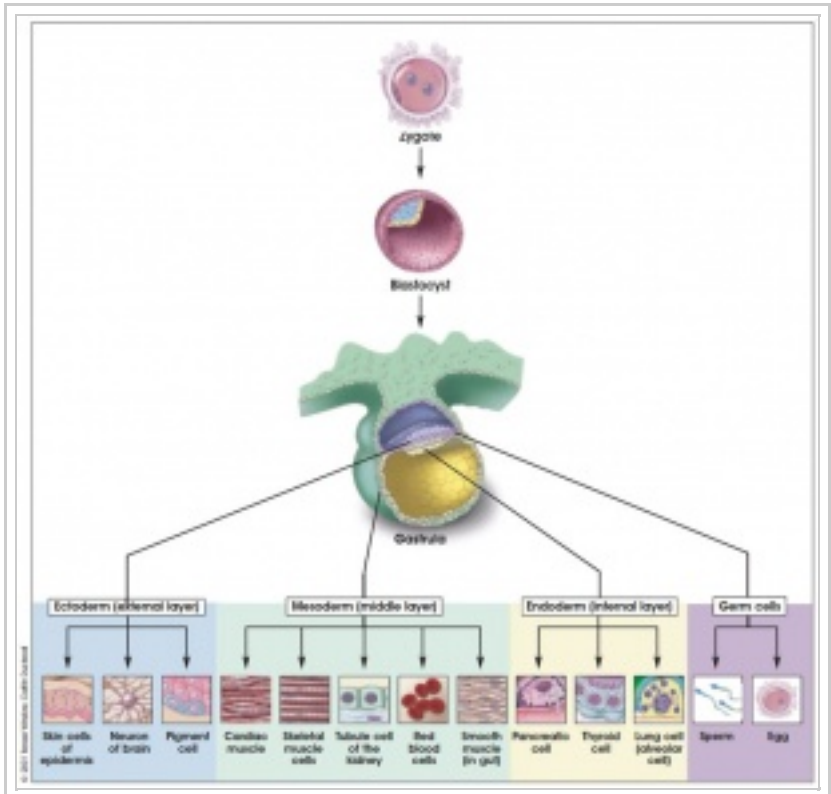



Trilaminar embryo

## Week 4-8

- early development of the other organs, tissues and limbs



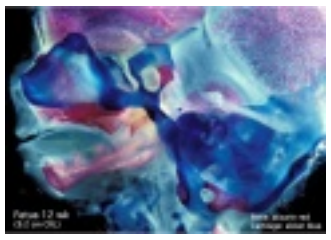

Trilaminar embryo and tissue origins

## Placenta

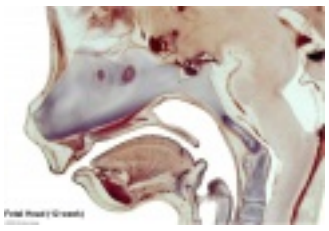
- Materno/fetal organ
- No exchange of blood
- Many different roles
  - can be "sampled" as part of a prenatal diagnostic test
- interaction between implanting conceptus and uterine wall (endometrium)
- The uterine lining following implantation (Decidua)
  - forms 3 distinct regions, at approx 3 weeks
  - **Decidua Basalis** - implantation site
  - **Decidua Capsularis** - enclosing the conceptus
  - **Decidua Parietalis** - remainder of uterus
- uterine cavity is lost by 12 weeks

# Second and Third Trimester

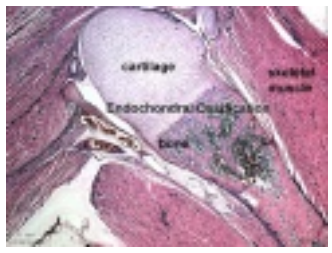
- **Week 9 to 37** - Fetal Development
- Continuing growth and differentiation of organs formed in embryonic period
  - some organs have a later development - neural, genital, respiratory, bones
  - some continue to develop after birth - neural, genital, respiratory, bones
- growth in size, length (Second Trimester)
- growth in weight (Third Trimester)



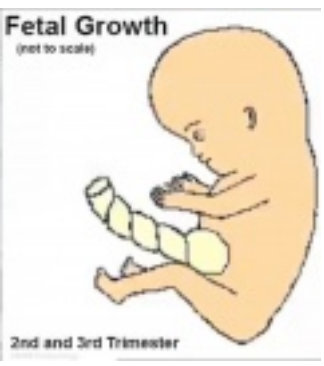
Fetal Head 12 cartilage and bone formation (12 week)

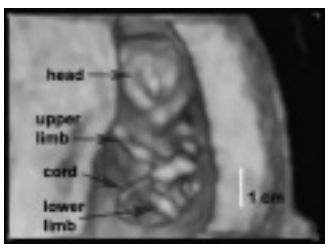


Fetal Head head structures and the brain (12 week)




Fetal knee region





# Postnatal Development

## Birth

- birth (parturition) is a complex physiological process between the fetus and mother
- thought to be initiated by the fetus


Historic teaching model of birth

## Maternal Birth Stages

1. Dilatation
2. Expulsion
3. Placental
4. Recovery

Australian Birth Rate 1998-2007

## Newborn

Newborn (perinatal) needs to activate many systems and establish independent regulation (homeostasis)

- **Lung function** - Fluid drainage, Gas exchange, muscular activity
- **Circulatory changes** - Closure of 3 vascular shunts
- **Thermoregulation** - metabolic rate, fat metabolism
- **Nutrition** - gastrointestinal tract function, peristalsis
- **Waste** - kidney function
- **Endocrine function** - loss of placenta, maternal hormones


MRI Birth

# Abnormal Development

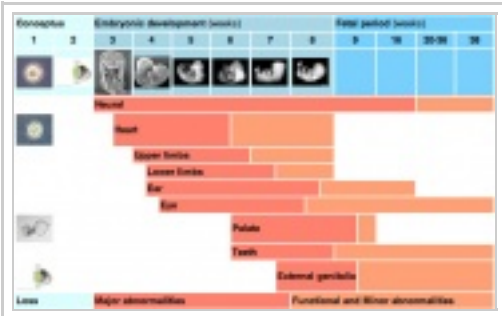
## Critical Periods of Development

Three main causes:

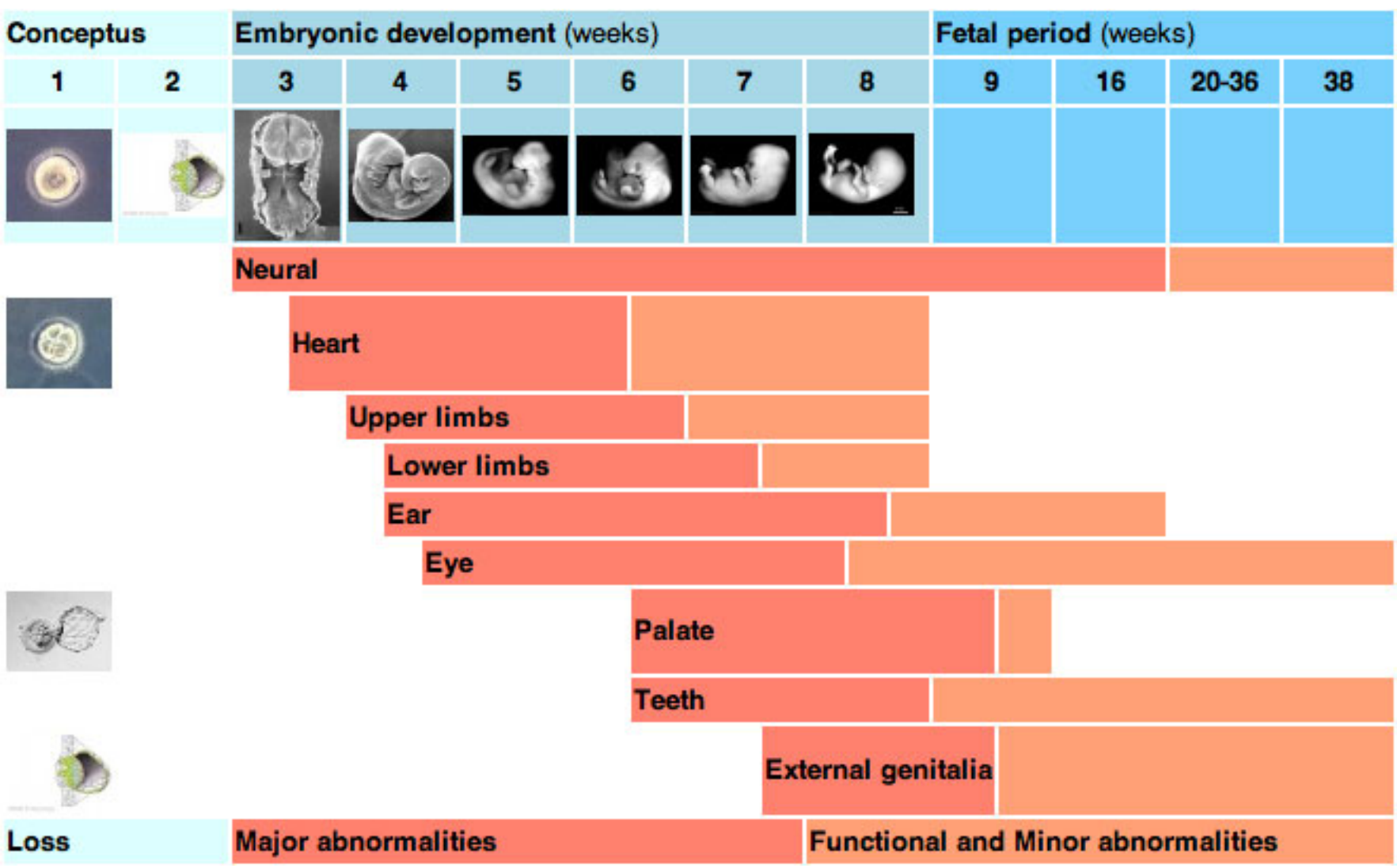
1. Genetic
2. Environmental
3. Unknown

- First trimester most critical
- Different effect depending on time of insult (teratogen)

Newborn infant (perinatal period)

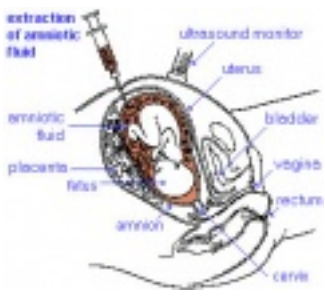


Human critical periods of development

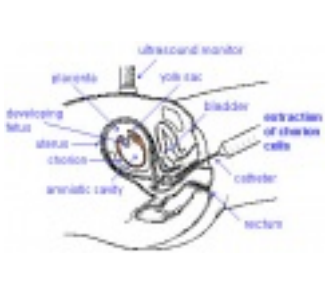



## Diagnosis

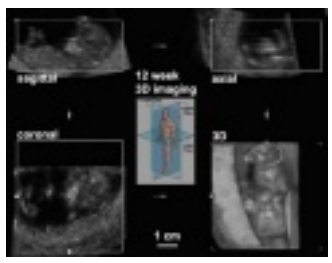
- Prenatal diagnosis - number of different techniques (non-invasive, invasive) for determining normal development
- Neonatal diagnosis (APGAR test, Guthrie test)
- Maternal diagnosis - often pregnancy will expose maternal health problems




Amniocentesis




Chorionic Villus Sampling




Ultrasound

Apgar scoresheet

Gutherie card


Xray congenital dislocation hip

Newborn hearing test

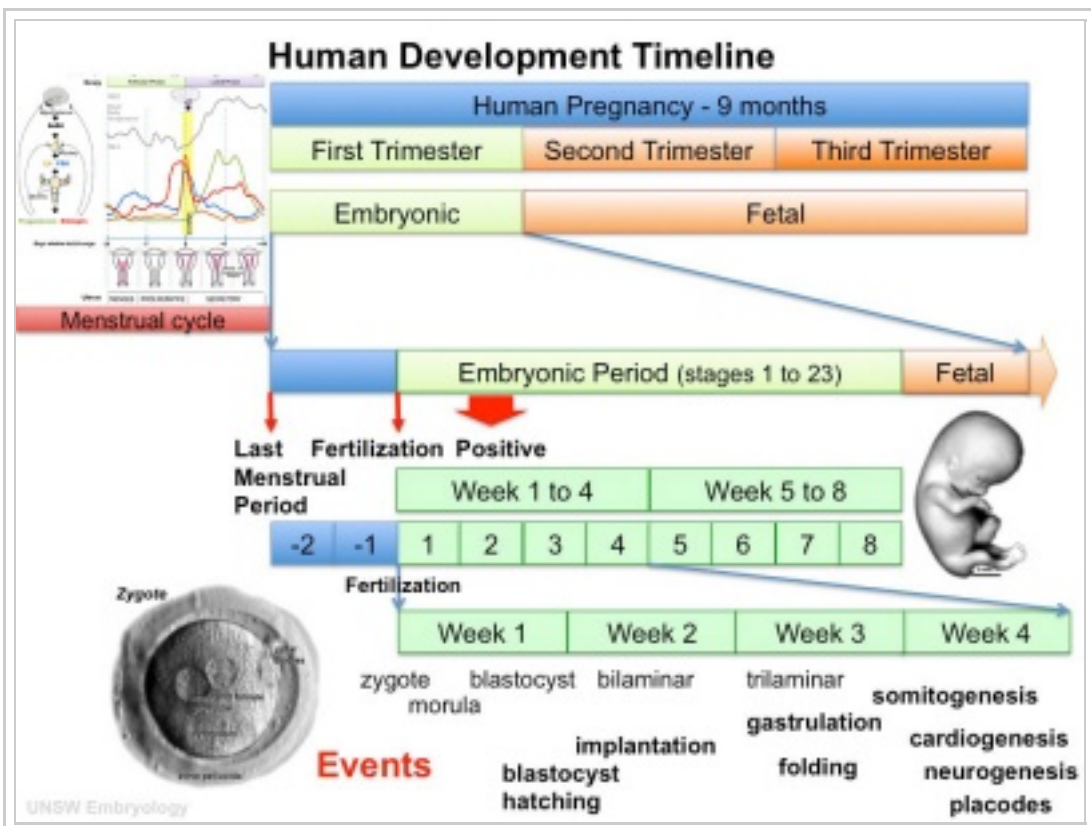
Finished!

# Additional Information

*Content shown under this heading is not part of the material covered in this class. It is provided for those students who would like to know about some concepts or current research in topics related to the current class page.*

## Revision Notes

- You don't need to know everything today, this is an introduction.
- Use the glossary to help understand new terms.
- Don't confuse "germ cell layers" (ectoderm, mesoderm, endoderm) with "germ cells" (egg, spermatazoa).
- Remember the difference between "clinical weeks" (last menstral period) and "embryonic weeks" (from ovulation/fertilisation, 2 weeks later).
- With abnormalities
  - think about the types of prenatal dianostic techniques that are now available
  - the 2 major types (genetic and environmental)
  - the effect of maternal age/health/lifestyle.



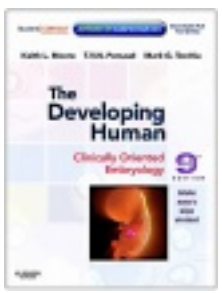

Human development timeline

## Textbooks

Hill, M.A. (2013) *UNSW Embryology* (13th ed.). Sydney:UNSW.

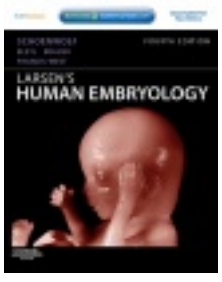
- Menstrual Cycle | Oocyte | Spermatozoa | Meiosis | Mitosis
- Fertilization | Zygote | Morula | Blastocyst | Implantation

- Week 1 | Week 2 | Week 3
- Science Lecture - Fertilization | Lecture - Week 1 and 2



Keith L. Moore, T.V.N. Persaud, Mark G. Torchia. (2011). *The Developing Human: clinically oriented embryology* (9th ed.). Philadelphia: Saunders.

- Chapter 1 - Introduction to the Developing Human (http://er.library.unsw.edu.au/er/cgi-bin/eraccess.cgi?url=http://www.mdconsult.com/books/page.do?eid=4-u1.0-B978-1-4377-2002-0..00001-1&isbn=978-1-4377-2002-0&uniqId=330028653-2#4-u1.0-B978-1-4377-2002-0..00001-1)



Schoenwolf, G.C., Bleyl, S.B., Brauer, P.R. and Francis-West, P.H. (2009). *Larsen's Human Embryology* (4th ed.). New York; Edinburgh: Churchill Livingstone.

The following chapter links only work with a UNSW connection and can also be accessed through this UNSW Library connection (http://searchfirst.library.unsw.edu.au/primo_library/libweb/action/search.do?vid=UNSW&fn=search&vl(freeText0)=UNSW_SFX14190000000047996) .

- Chapter 1 - Gametogenesis, Fertilization, and First Week (http://www.mdconsult.com/books/linkTo?type=bookPage&isbn=978-0-443-06811-9&eid=4-u1.0-B978-0-443-06811-9..10001-6)

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Foundations Practical - Introduction to Human Development

# Glossary Links

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What Links Here? (http://php.med.unsw.edu.au/embryology/index.php?title=Special:WhatLinksHere/Foundations_Lecture_-_Introduction_to_Human_Development)

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Categories: Medicine | Foundations | 2014

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