


## NURSING

---

### Science lectures



**Prof Peter O'Donoghue**

1

## LEARNING OBJECTIVES

---

### Lecture 5: Overview of Reproduction (Genetics)

- examine sequence of gamete formation and fertilization
- relate processes of implantation and placentation
- review stages of gastrulation and organogenesis

developmental biology

2

## CREATING LIFE

---

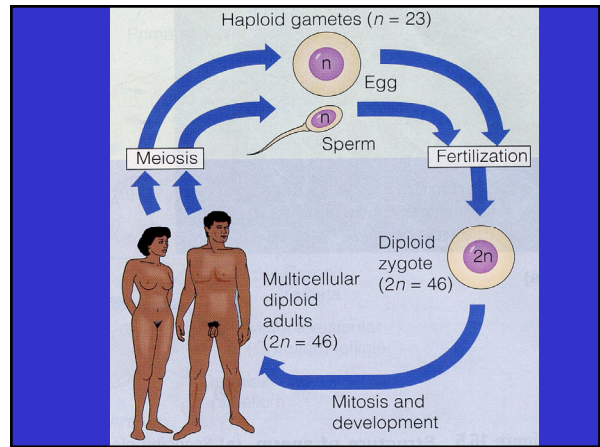
**Evolutionary forces:**

- perpetuation of species!
- survival of strongest?

**Reproductive processes (human)**

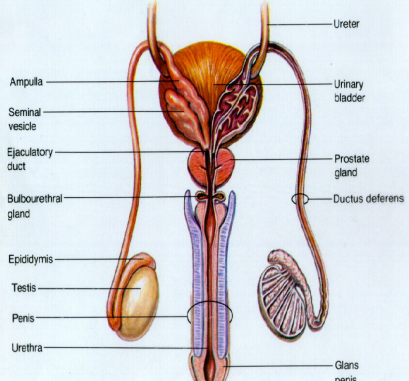
<ul style="list-style-type: none"> <li>• fertilization</li> <li>• pre-embryonic dev.</li> <li>• embryonic dev.</li> <li>• foetal dev.</li> </ul>	<table border="0"> <tr> <td style="padding-right: 5px;">time zero</td> <td rowspan="4" style="font-size: 3em; vertical-align: middle;">}</td> <td rowspan="4" style="vertical-align: middle;">pregnancy (gestation period) ~ 280 days</td> </tr> <tr> <td>weeks 0-2</td> </tr> <tr> <td>weeks 3-8</td> </tr> <tr> <td>weeks 9-birth</td> </tr> </table>	time zero	}	pregnancy (gestation period) ~ 280 days	weeks 0-2	weeks 3-8	weeks 9-birth
time zero	}	pregnancy (gestation period) ~ 280 days					
weeks 0-2							
weeks 3-8							
weeks 9-birth							

3



4

## Male reproductive tract

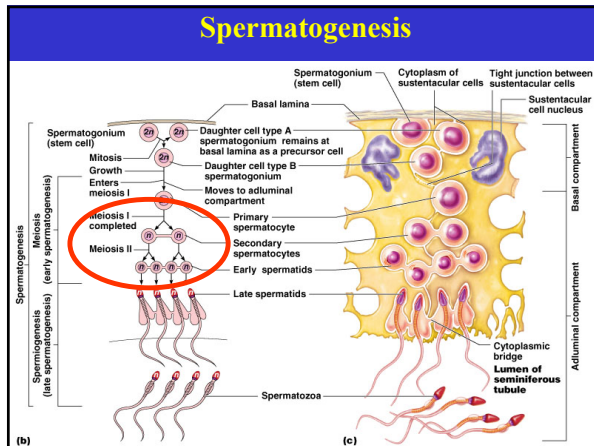


- sperm produced in testis
- stored in epididymis
- secretions from seminal vesicle and prostate assist in female tract
- spermatogonia to spermatozoa 64 days
- life expectancy of sperm 48 to 72 hr

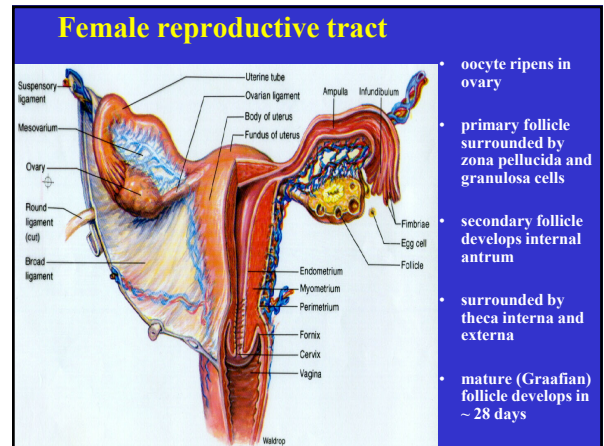
5



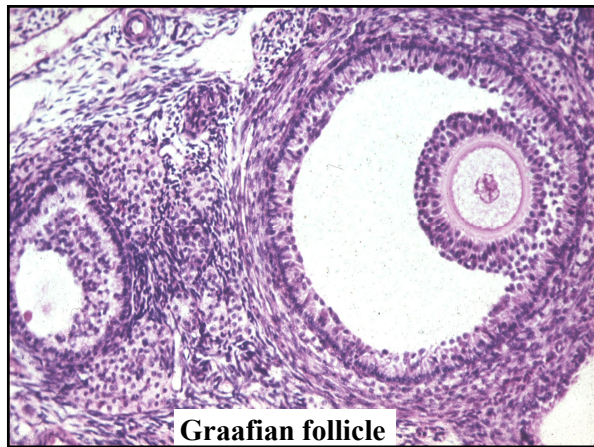
6



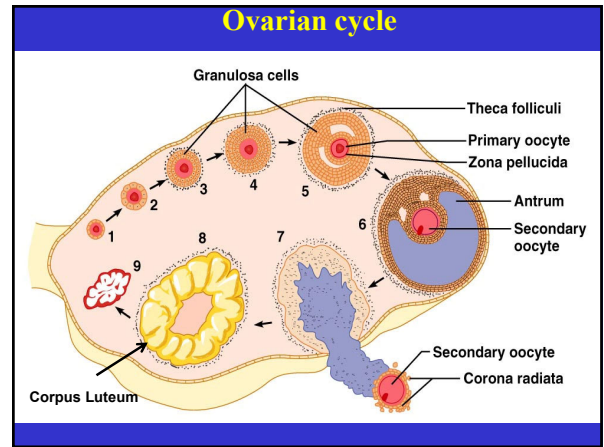
7



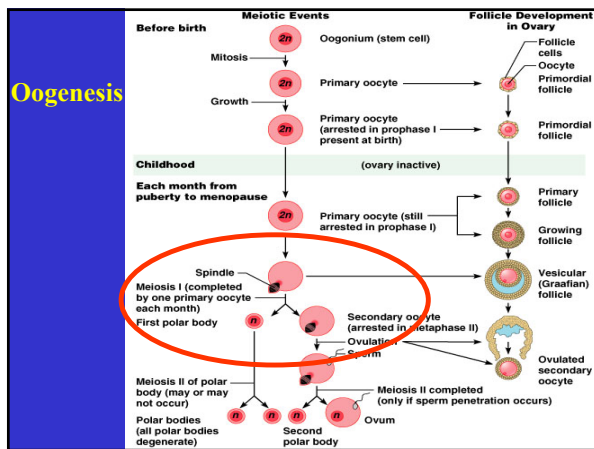
8



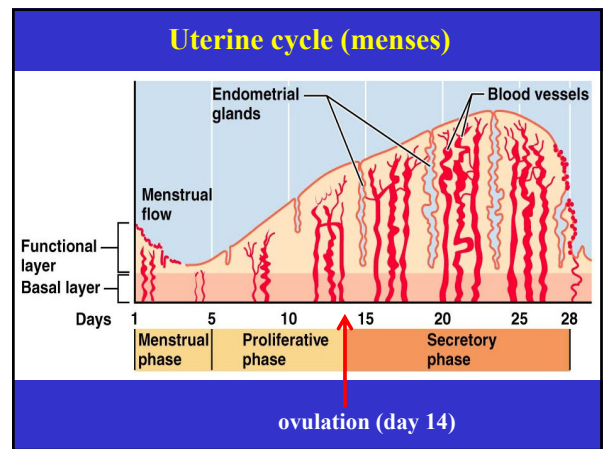
9



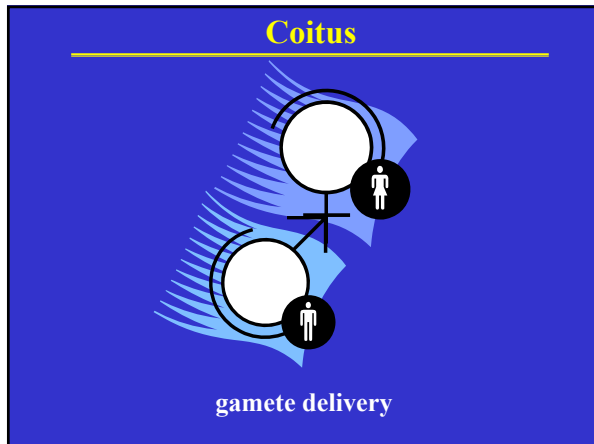
10



11



12



13

### FERTILIZATION

gametes

- oocyte viable 12-24 hours after release from ovary
- sperm viable up to 24-72 hours after ejaculation

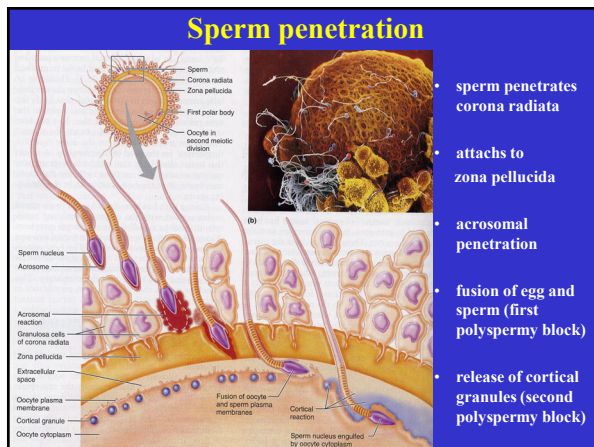
coitus

- made gamete delivery pleasurable

wasteful process: millions of sperm, one winner

- leakage, acidic environment, cervical mucus barrier
- uterine contractions, phagocytosis
- capacitation (acrosome readiness)
- acrosomal activation
- penetration of oocyte wall
- membrane insertion

14



15

### Sperm success

monospermy

- membrane depolarization to other sperm
- cortical reaction (zonal inhibiting proteins)
- swelling of fertilized oocyte

polyspermy

- common in some animal species
- extremely rare in humans

(obvious exception, some multiple births)

16

### Multiple births

**TWINS (1.25%)(older mothers, IVF)**

- Non-identical (fraternal, dizygous)(0.1-1.4%)**
  - two fertilized eggs (MF, FF, MM)
- Identical (monozygous)(0.4-1.5%)**
  - fertilized egg divides (FF, MM)

**Complications**

- development**
  - separate or shared placenta, entanglement, unequal dev.
  - parasitic twins, twin-to-twin transfusion, conjoined twins
- gestation/parturition**
  - miscarriage, early delivery, small size

17

### FERTILIZATION

#### Restoration of diploidy

- male and female pronuclei align
- spindle formation
- diploid zygote (fertilized egg)

18

## ⇒ PRE-EMBRYONIC PERIOD

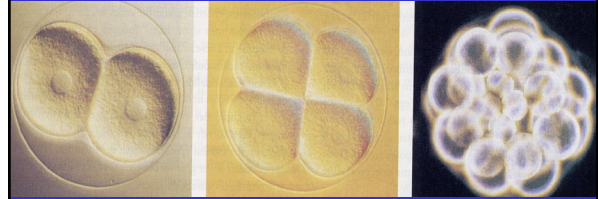
Three major events in first two weeks after fertilization:

- cleavage (mitotic division)
- implantation (uterine wall)
- placentation (nurturing)

19

## Cleavage

- rapid cell division without growth
- all by mitosis

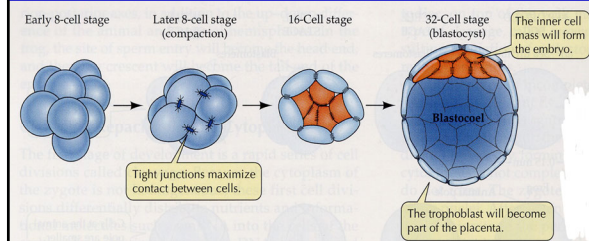


20

## Blastocyst formation

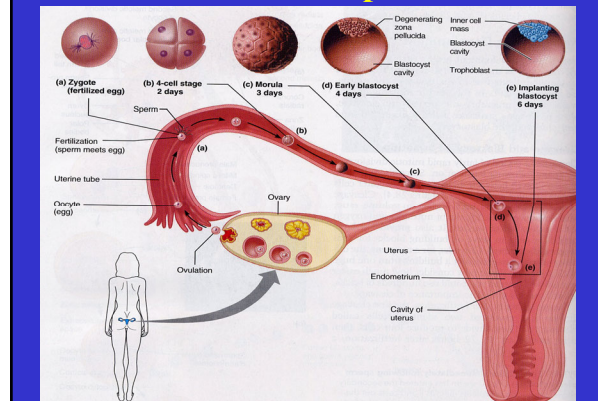
now cellular specialization begins

- internal cells (embryonic disc) → embryo
- external cells (trophoblast wall) → placenta



21

## Site of development



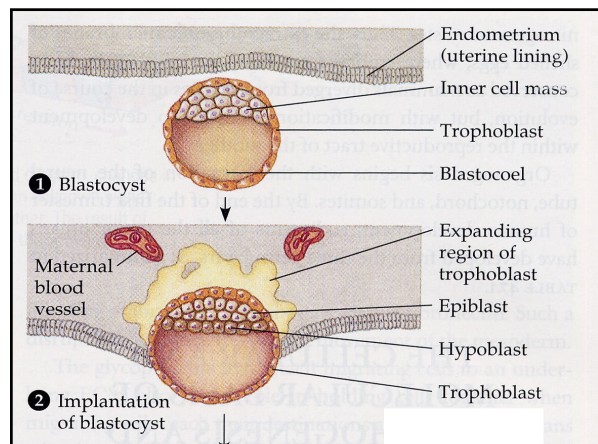
22

## Implantation

blastocyst embeds in uterine endometrium (takes ~ 1 week)

- endometrium must be receptive (right balance of ovarian hormones in blood - oestrogen/progesterone)
- adherence to mucosa
- secrete digestive enzymes
- secrete growth factors

23



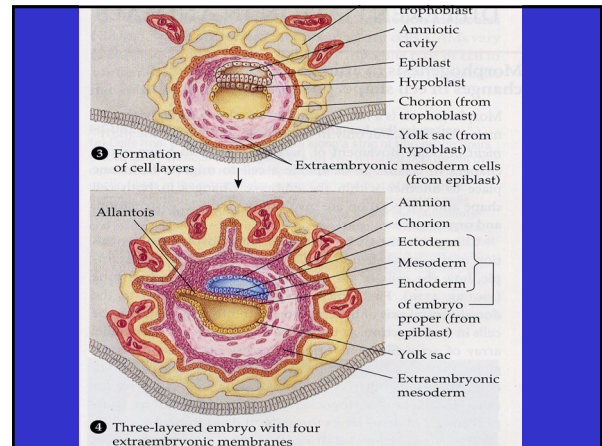
24

## Implantation

- blastocyst becomes immersed in pool of blood
- hormones secreted by blastocyst, then chorion
- menses prevented by hCG (human chorionic gonadotrophin)
- presence forms basis for pregnancy testing (present in blood/urine from 1-16 weeks)



25



26

## Placentation

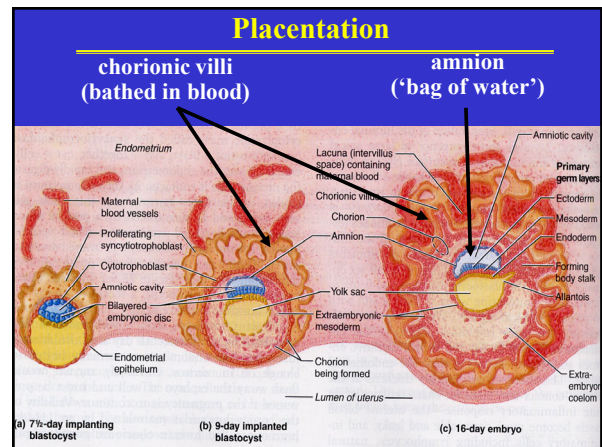
externally:

- trophoblast forms chorion, then chorionic villi
- forms blood-filled lacunae (intervillous spaces)

internally:

- inner forms amnion
- fills with amniotic fluid (cushions embryo)

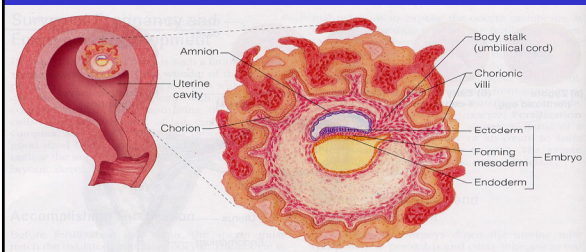
27



28

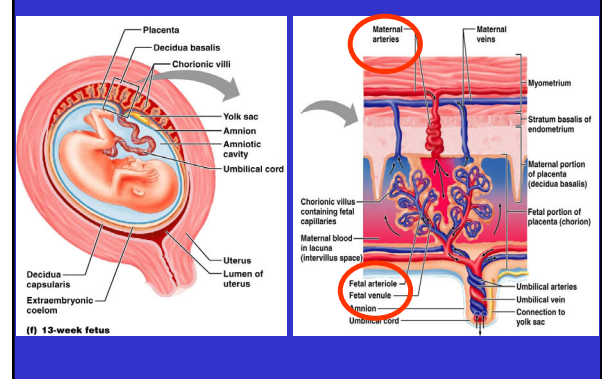
## Placenta

- provides nutrients
- provides oxygen
- metabolic waste disposal
- endocrine organ
- formed by 4.5 weeks
- incl. umbilical cord
- maternal and foetal blood do not mix



29

## Placenta



30

## ⇒ EMBRYONIC PERIOD

---

two major events 3-8 weeks after fertilization:

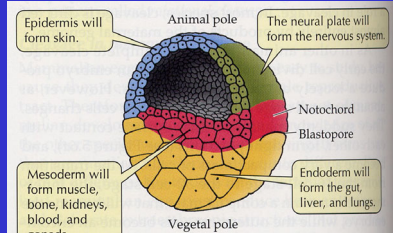
- gastrulation (germ layers)
- organogenesis (organ development)

31

## Gastrulation

---

- formation of three primary germ layers involving cell rearrangements and cell migration
- cell fates now become determined

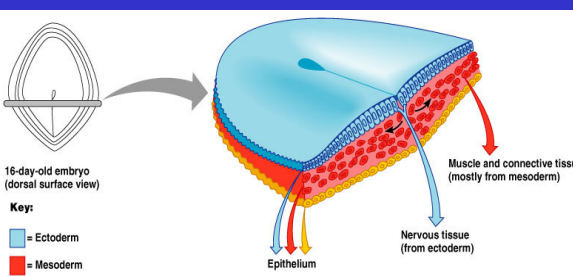


32

## Germ layers

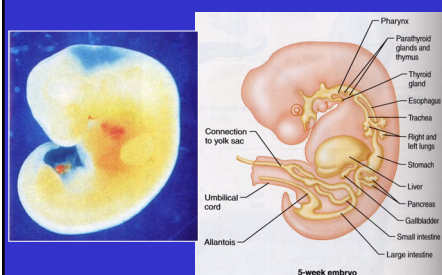
---

precursor for organogenesis



33

## Organogenesis



most organs evident in 5 week embryo

all organs evident in 8 week embryo (~1")

34

## Organogenesis

---

**Endodermal origin** (epithelia + organs)  
lining of gastrointestinal tract, respiratory tract and urinary bladder, tonsil, thyroid, parathyroids, thymus, liver, pancreas, epithelial lining of tympanic cavity and eustachian tube

**Mesodermal origin** (connective tissue + organs)  
supporting tissues such as connective tissue, bone and cartilage, striated and smooth muscle, blood and lymph vessels, kidneys, gonads and their ducts, cortex of adrenal, spleen

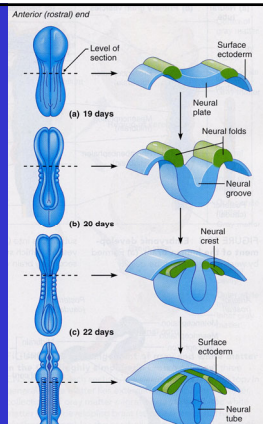
**Ectodermal origin** (skin + nerves)  
Central and peripheral nervous system, sensory epithelium of ear, nose and eye, epidermis, hair, nail, subcutaneous glands, pituitary gland and enamel of teeth

35

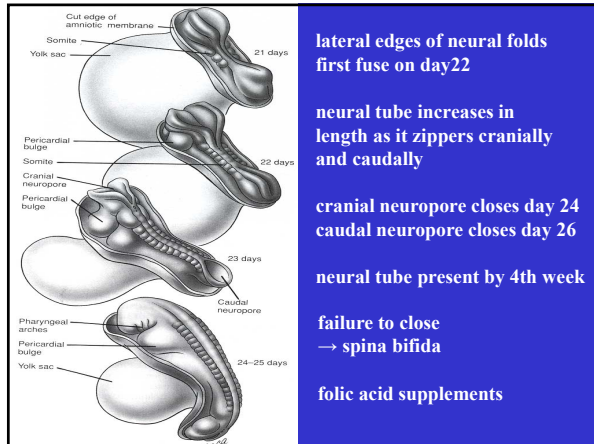
## Neurulation

---

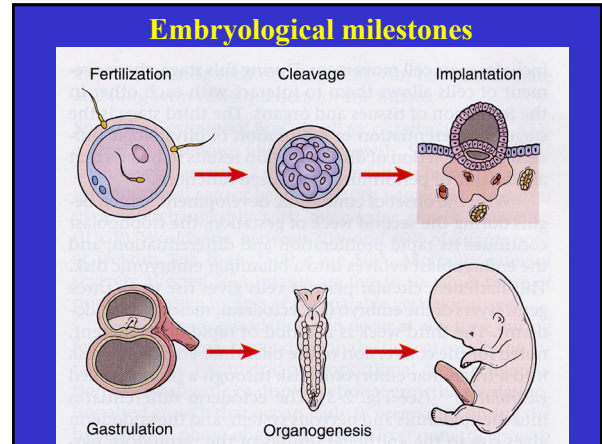
- neural tube formation
- hallmark of higher organisms
- major event in embryology
- ectoderm folds over on itself to form neural tube
- gives rise to central and peripheral nervous systems



36



37



38