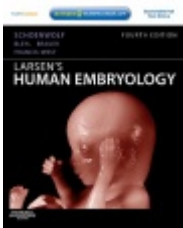


# Development of the Reproductive System



Resources:  
<http://php.med.unsw.edu.au/embryology/>  
Larsen's Human Embryology  
The Developing Human: Clinically Oriented Embryology



Dr Annemiek Beverdam – School of Medical Sciences, UNSW  
Wallace Wurth Building Room 234 – A.Beverdam@unsw.edu.au

# Lecture overview

Sex determination

Embryonic origins of the reproductive system

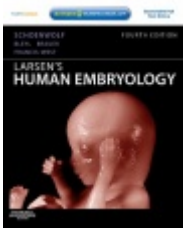
Gonad development

Development of the reproductive tract

Development of the external genitalia

Development of secondary sex characteristics

Disorders of sexual development



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# Sex Determination

Three factors determine sex phenotype:

1. Genetic sex

- chromosomal composition: XX or XY
- determined at conception

2. Gonad development

- Development of testes or ovaries
- Defined during embryonic development

3. Development of secondary sex characteristics

- Hormone dependent
- Defined during puberty

# End product gastrulation:

Trilaminar embryo

## Ectoderm (*Neural crest*)

brain, spinal cord, eyes, *peripheral nervous system*  
epidermis of skin and associated structures,  
*melanocytes, cranial connective tissues (dermis)*

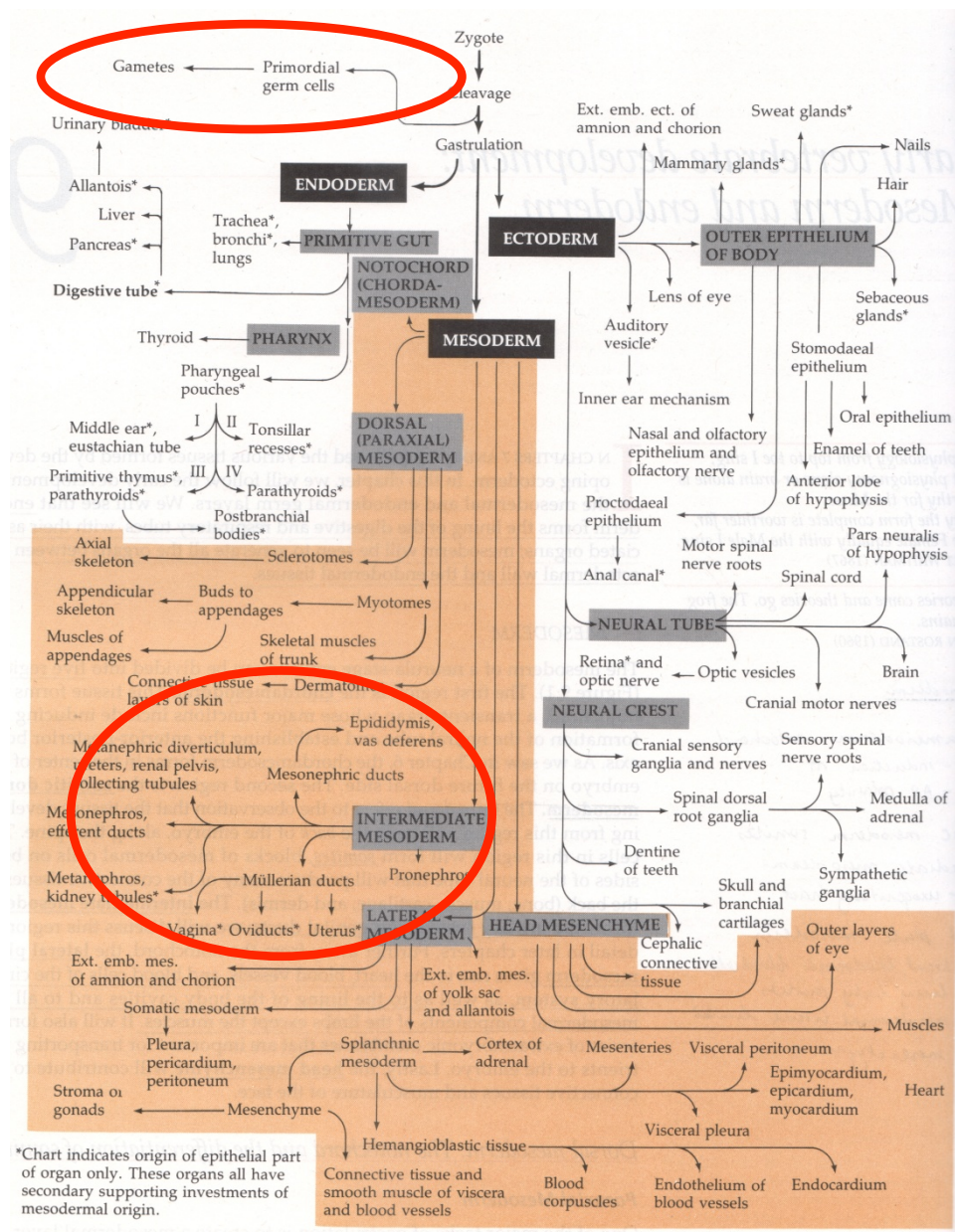
## Mesoderm

musculo-skeletal system, limbs  
connective tissue of skin and organs  
*urogenital system*, heart, blood cells

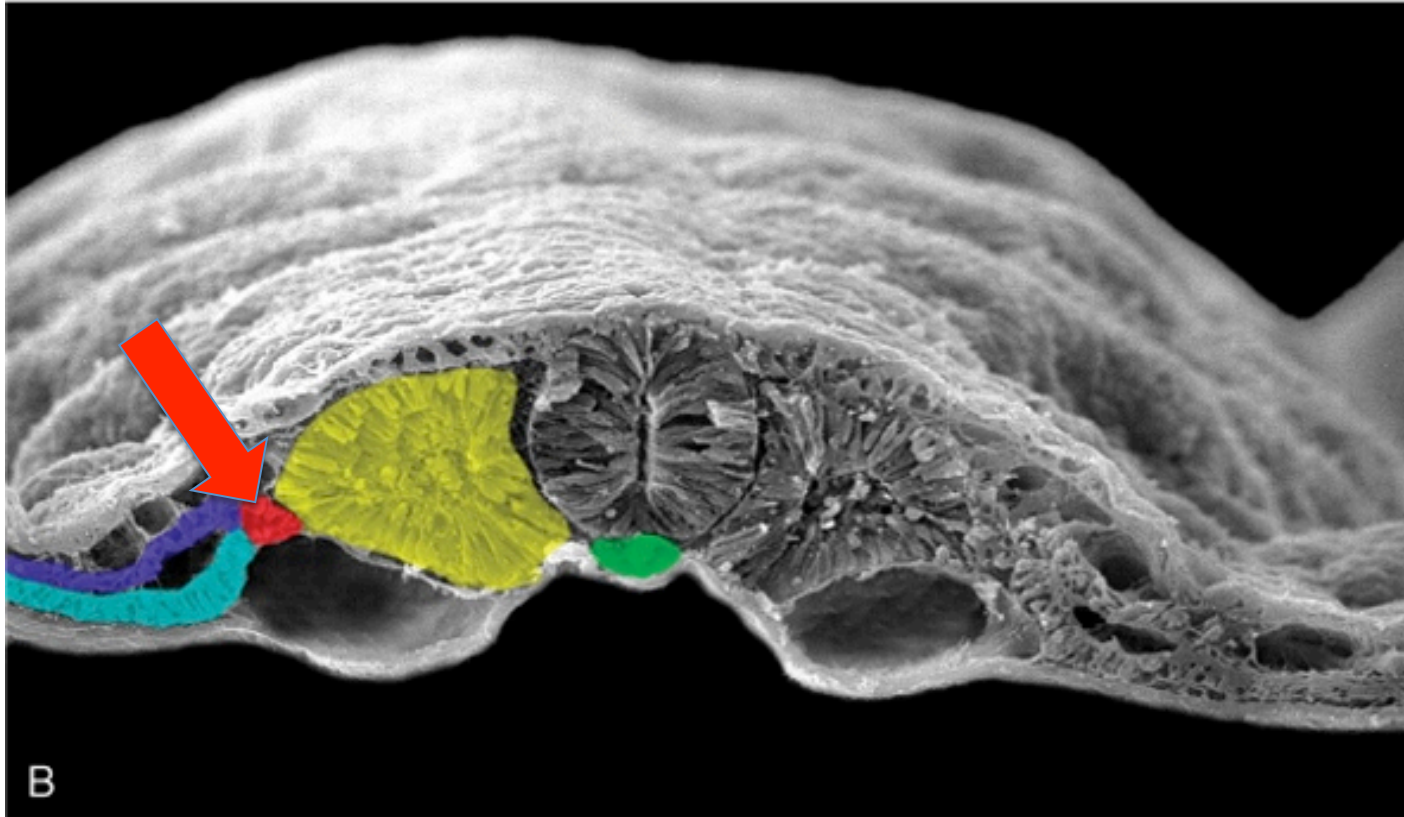
## Endoderm

epithelial linings of gastrointestinal and respiratory tracts

# Embryonic development:



# Intermediate mesoderm



Schoenwolf et al: Larsen's Human Embryology, 4th Edition.  
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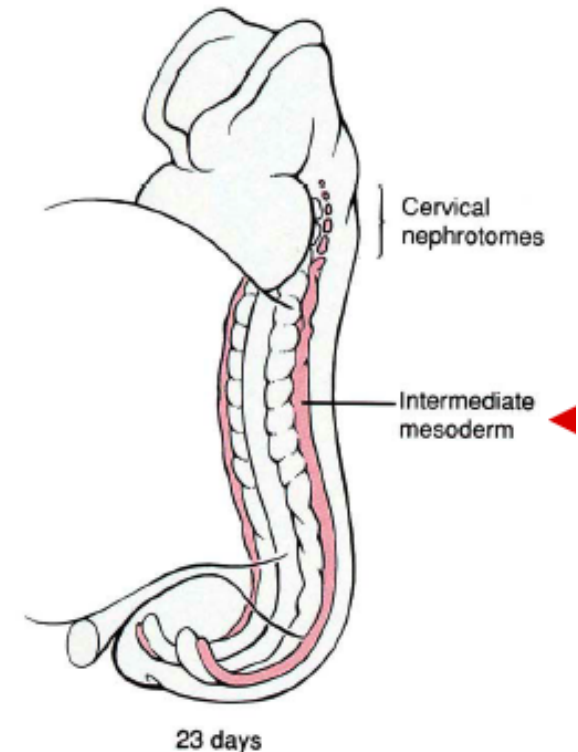
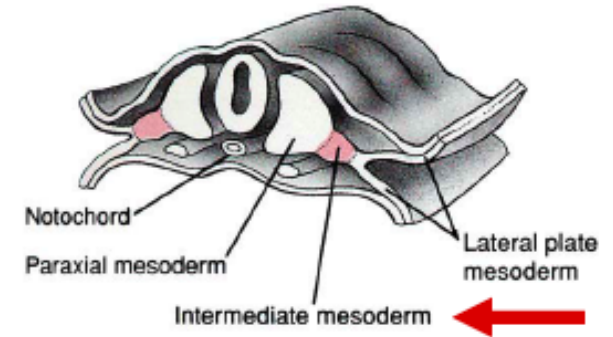
# Gonad development

Intermediate mesoderm gives rise to urogenital system:

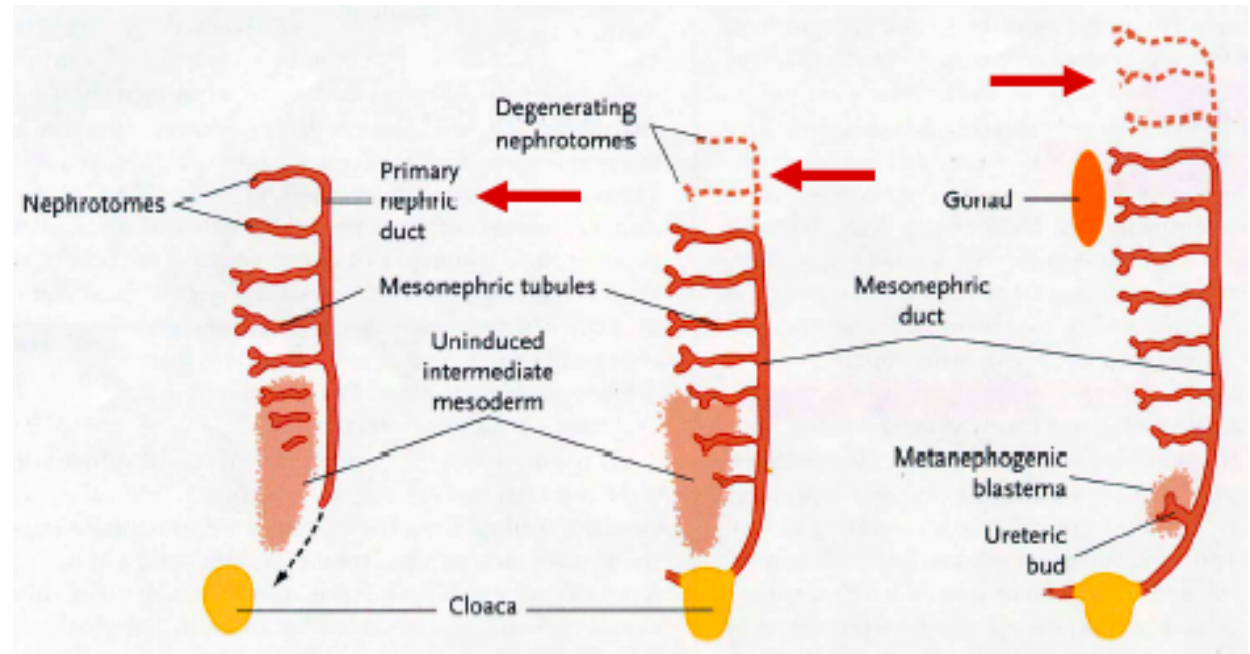
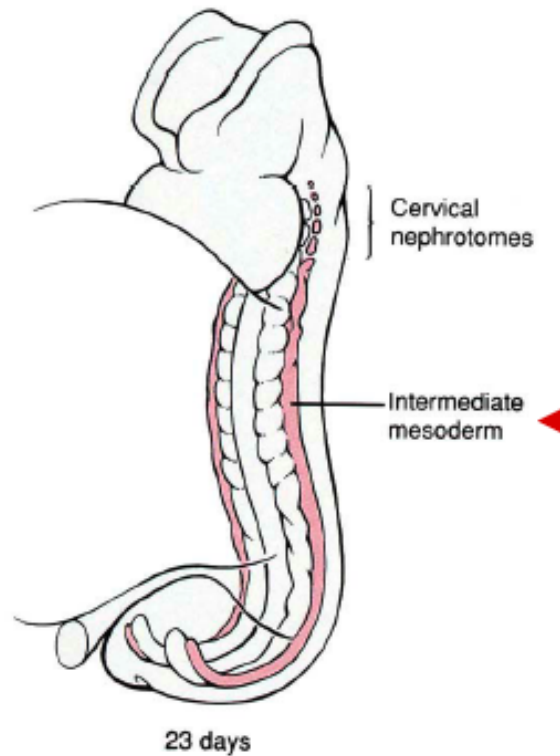
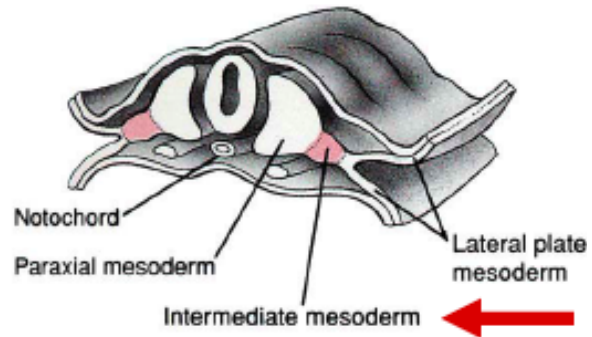
Ductal system develops within intermediate mesoderm

Three regions within intermediate mesoderm:

1. Pronephros: transient
2. Mesonephros:
  - forms mesonephric (Wolffian) duct
  - functional embryonic kidney
  - forms gonads
3. Metanephros:
  - duct forms ureteric bud
  - forms adult kidney

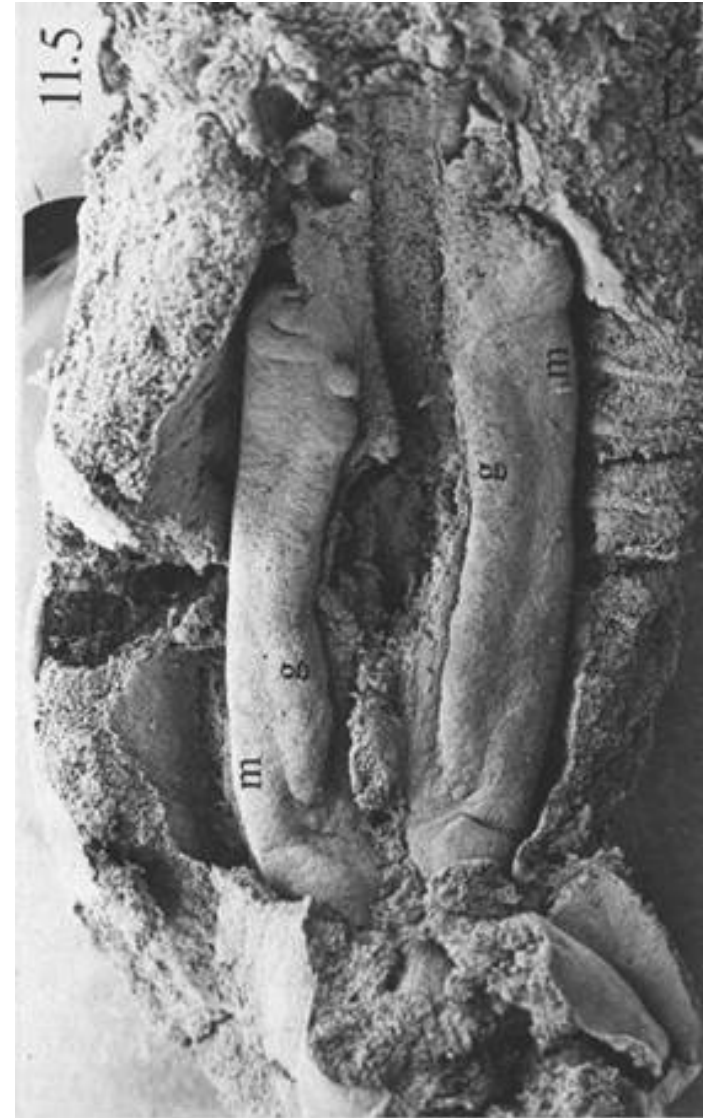
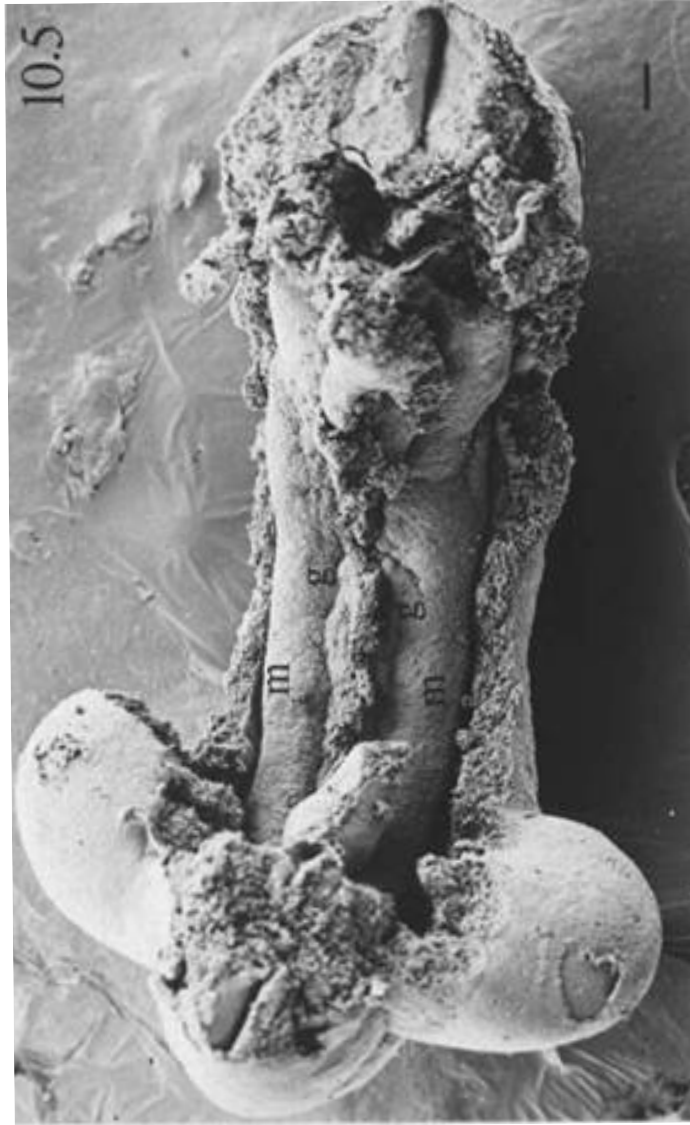


# Gonad development



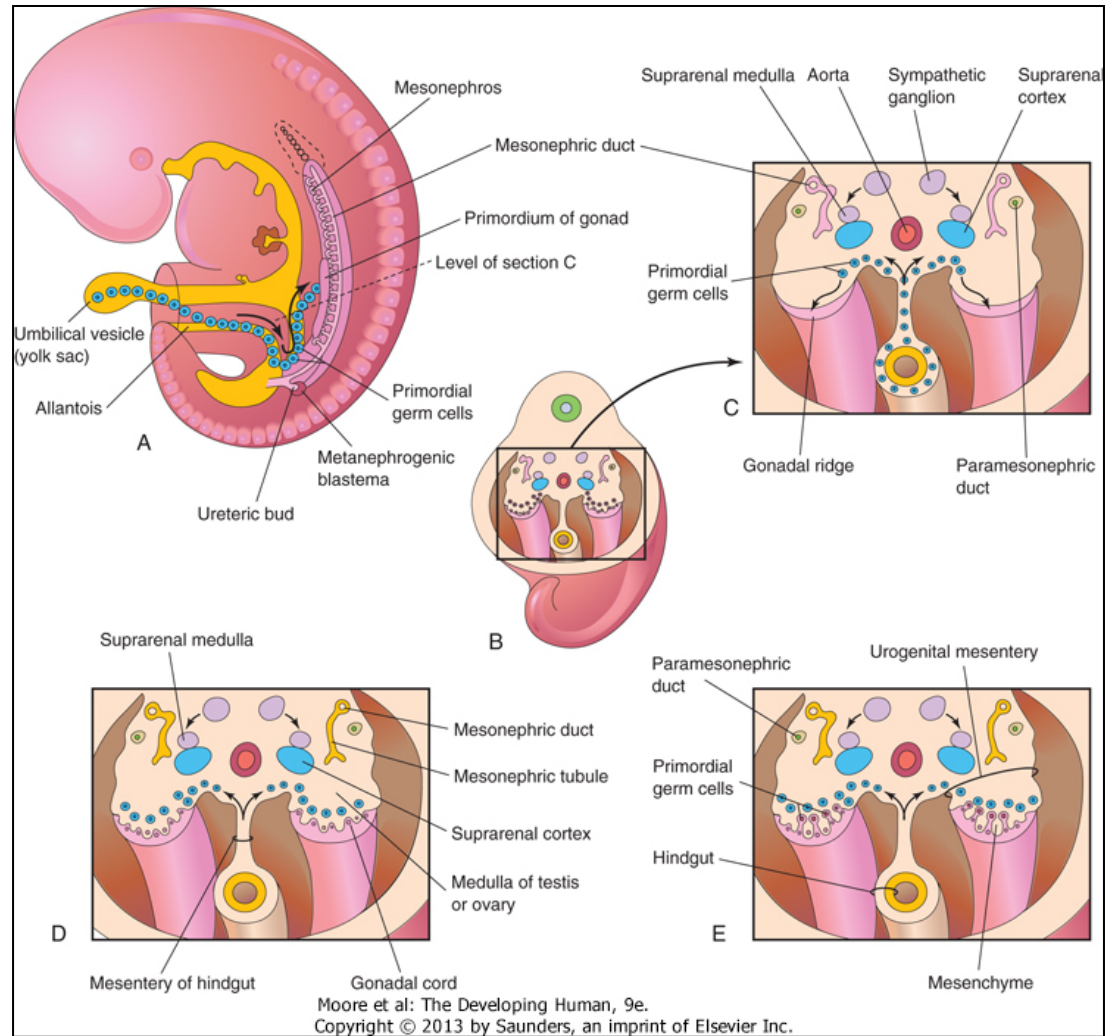


# Gonad development



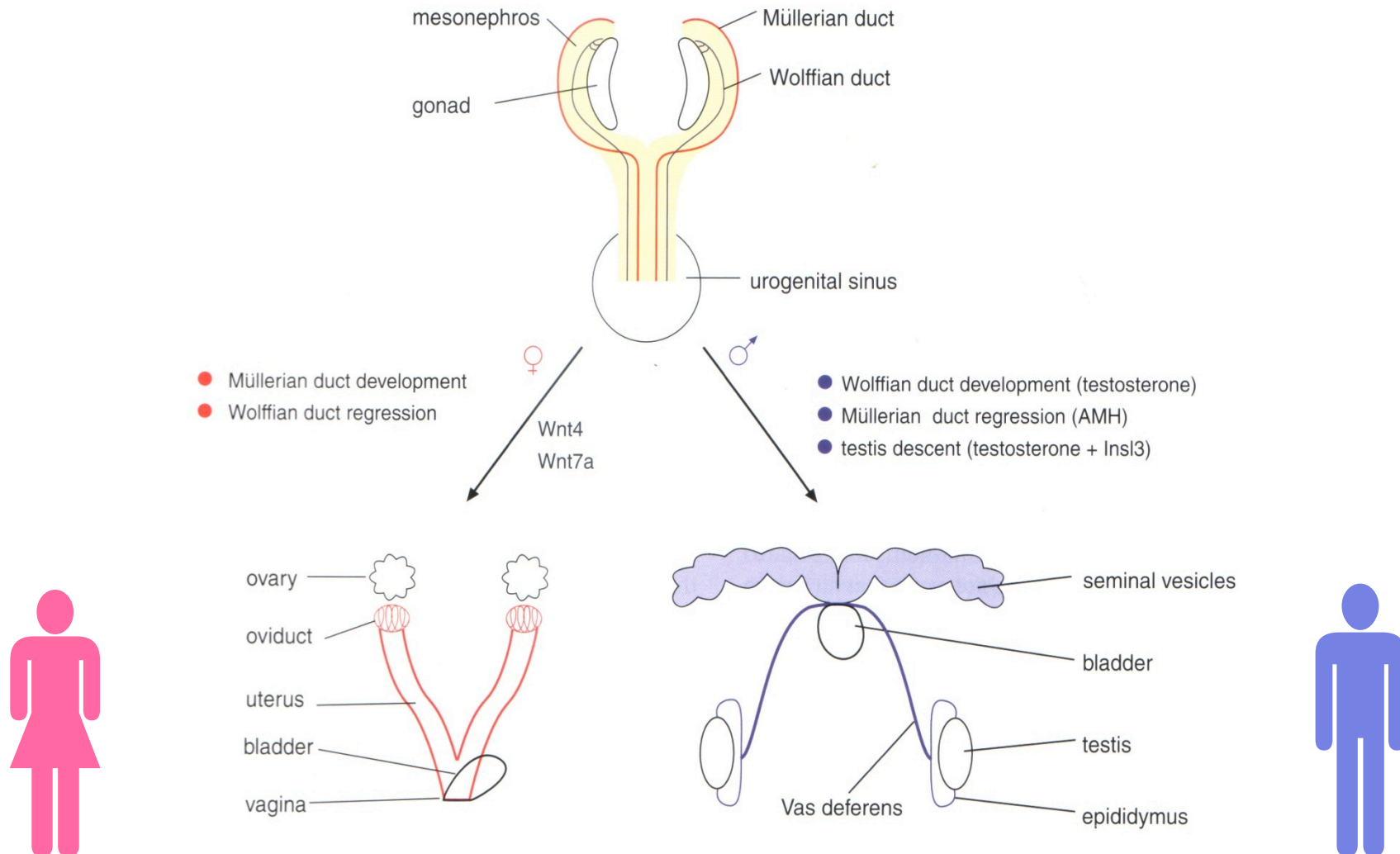
# Gonad development

## Gametogenesis



# GonadDevelopment

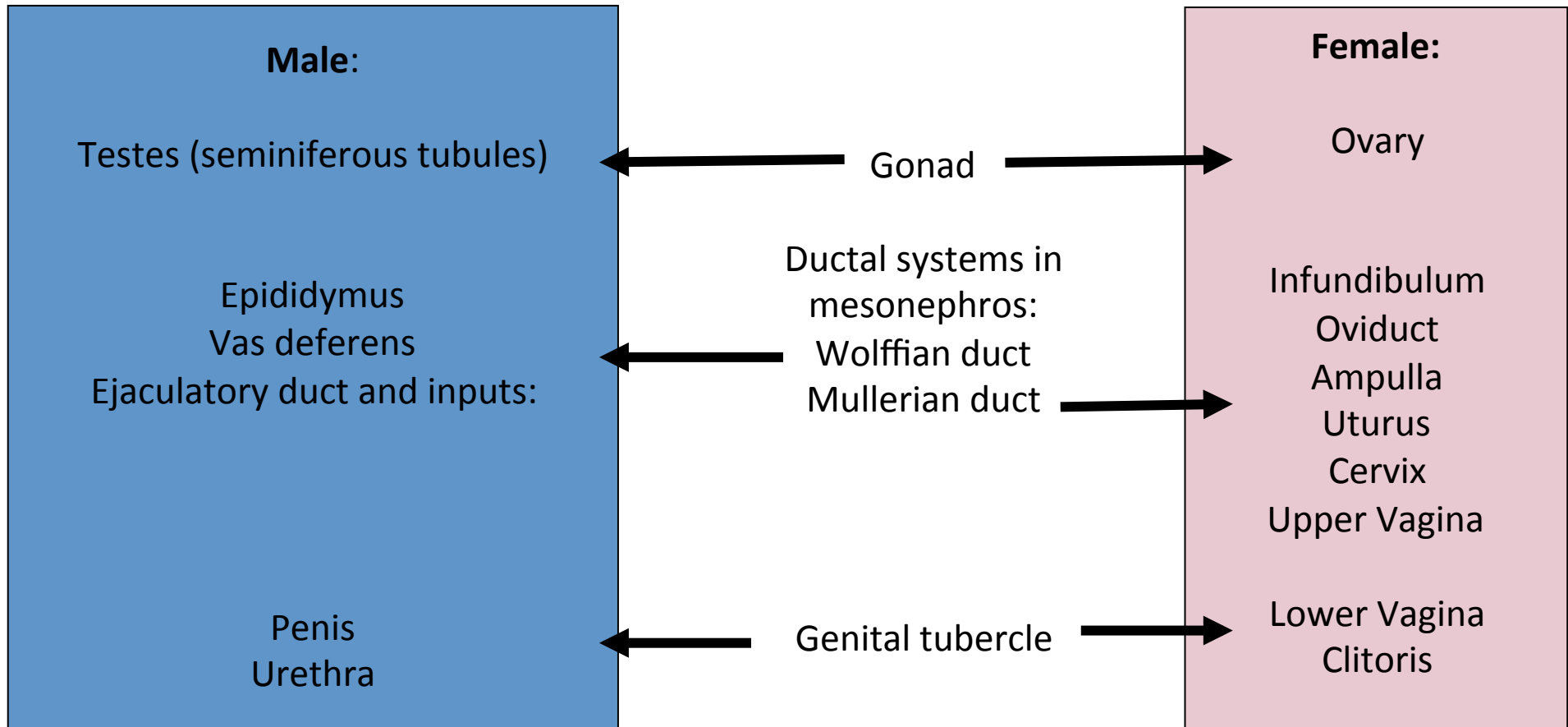
## Bipotential organs



(From: Mouse development, Ch. Sex Determination and differentiation, Swain and Lovell-Badge)

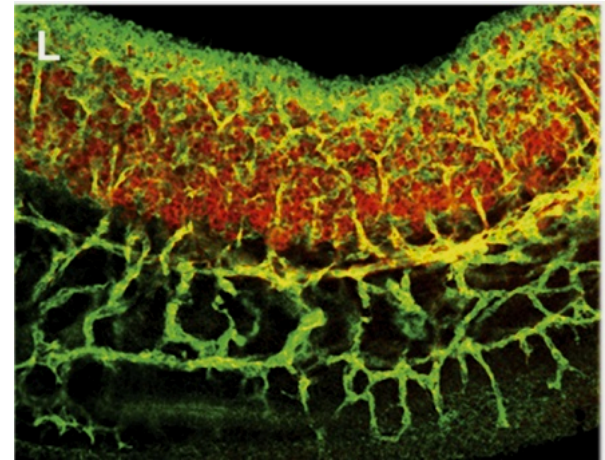
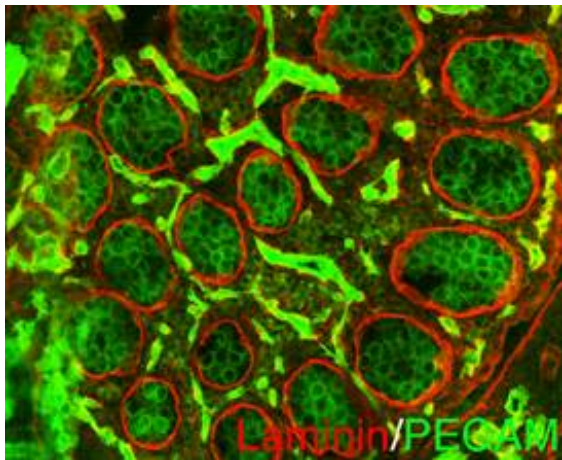
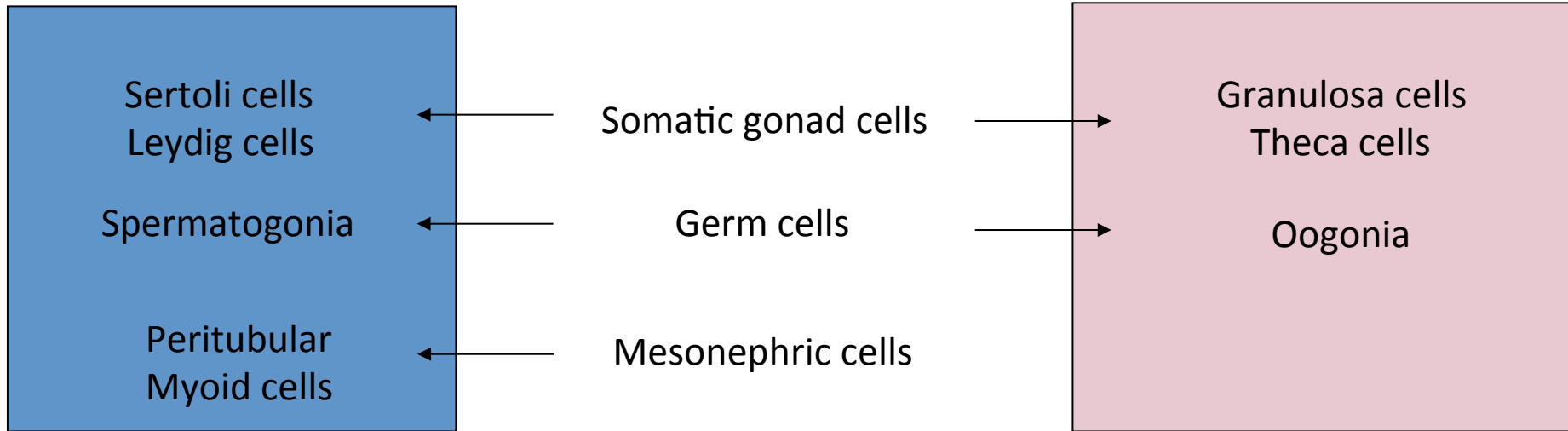
# Gonad Development

## Bipotential tissues

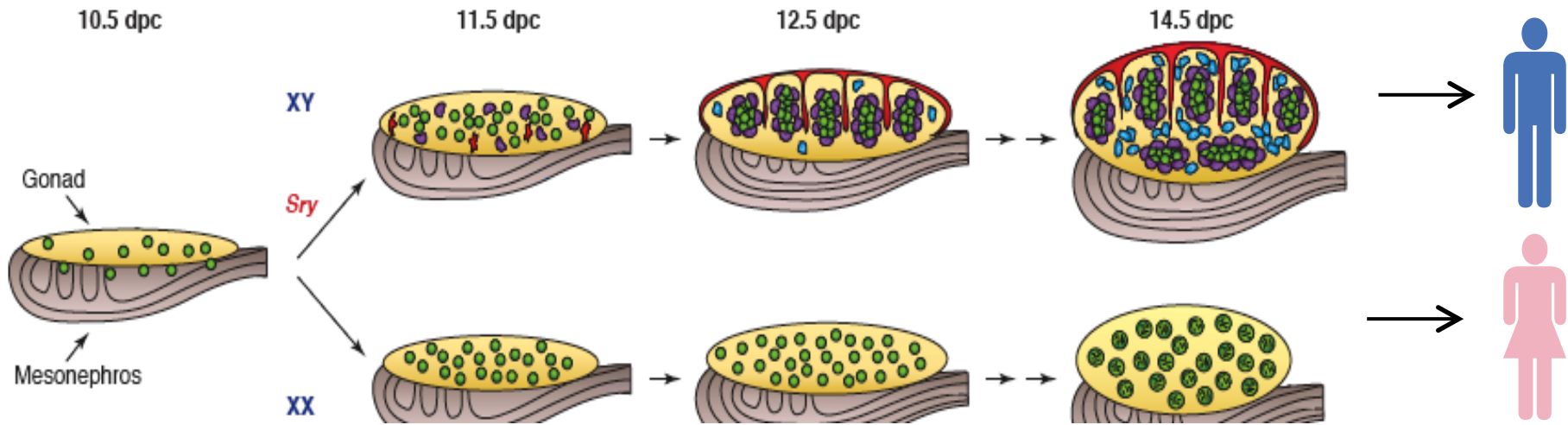


# Gonad Development

## Bipotential cells



# Gonad Development

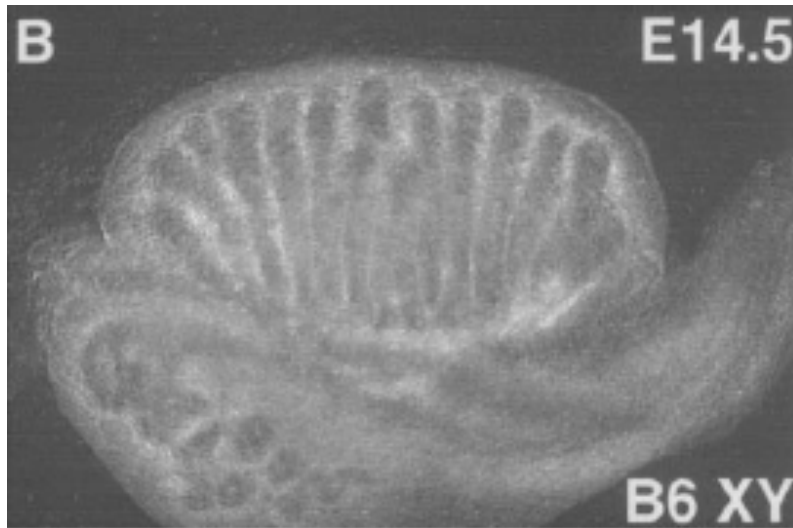


● Sertoli cells   
 ● Germ cells   
 ● Meiotic germ cells   
 ● Leydig cells   
 ↑ Vascular endothelial cells

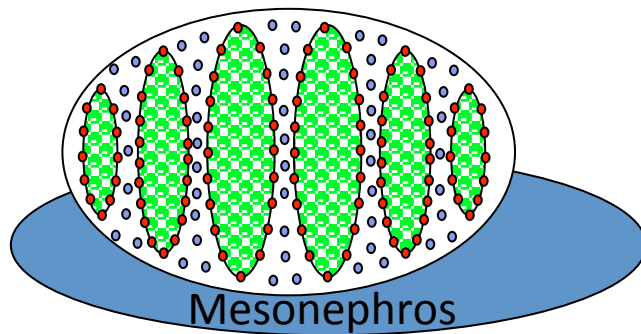
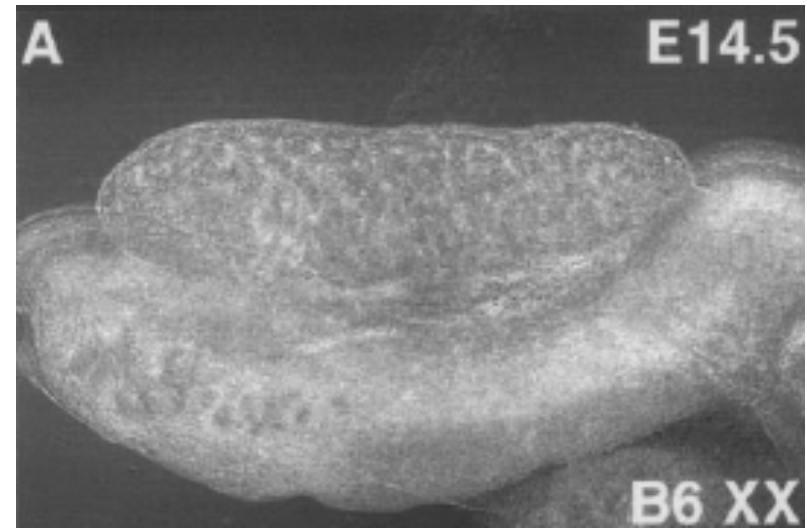
(Adapted from Ross and Capel, 2005)

# Gonad Development

Embryonic testis



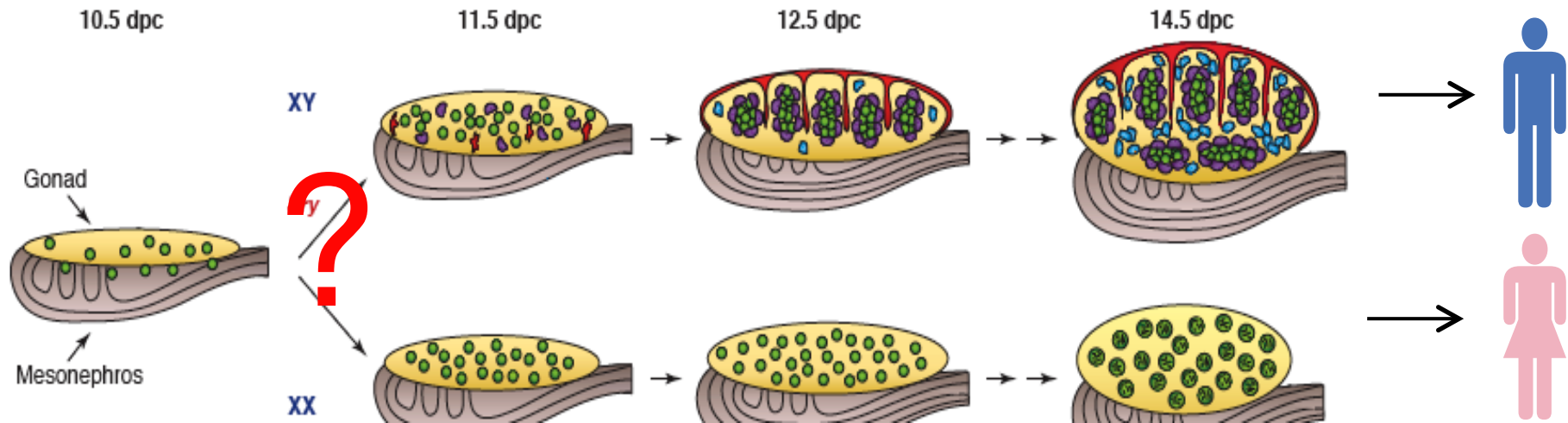
Embryonic ovary



- Leydig cells
- Sertoli cells
- Germ cells

# Gonad Development

## Sex determination



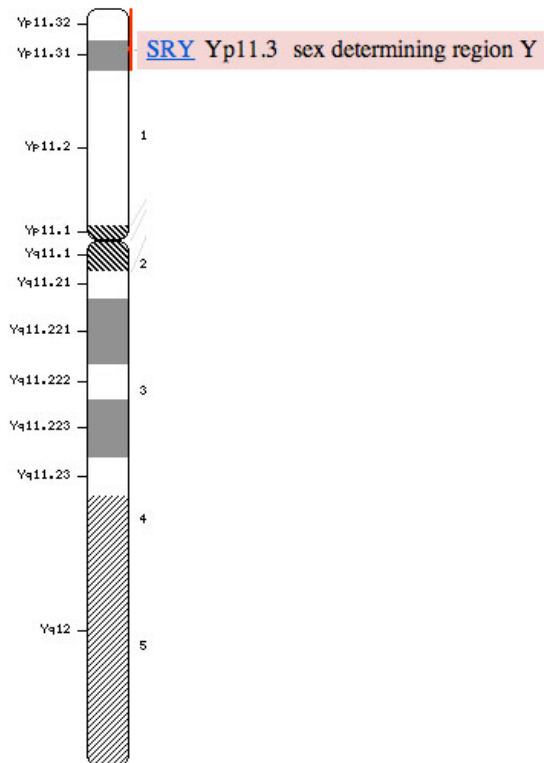
● Sertoli cells   
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(Adapted from Ross and Capel, 2005)

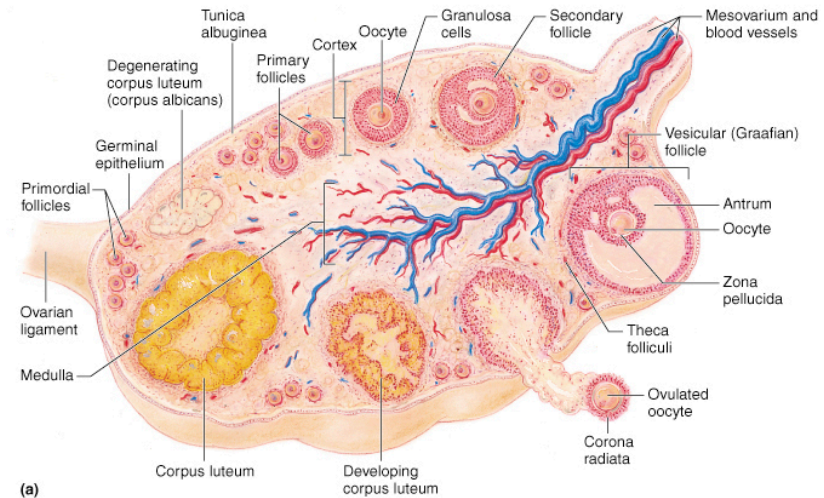
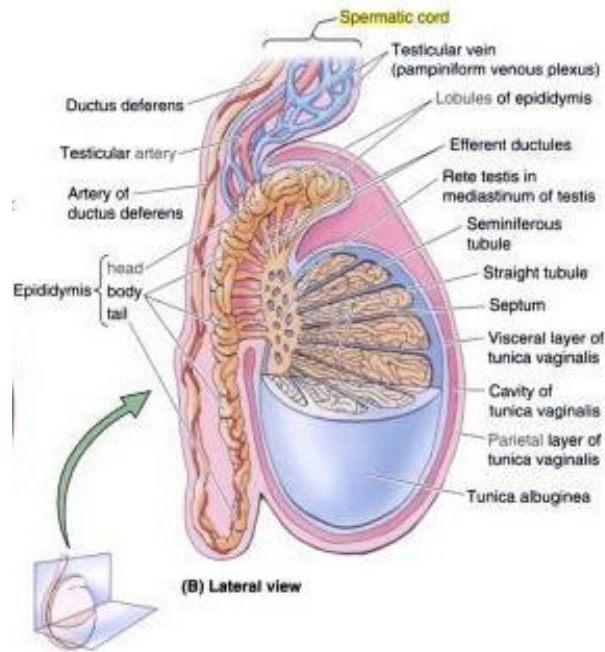


# Sry, the male sex determining gene

Y chromosome



# Gonad Development

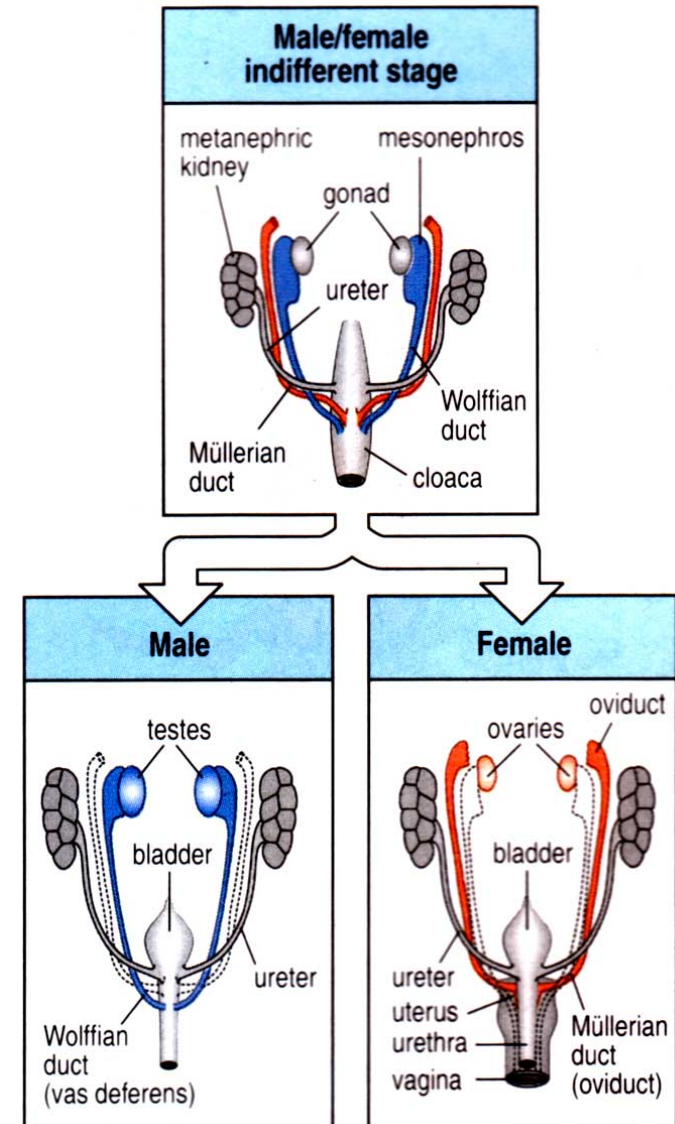


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[http://php.med.unsw.edu.au/embryology/images/7/7f/Testis\\_001.mp4](http://php.med.unsw.edu.au/embryology/images/7/7f/Testis_001.mp4)  
[http://php.med.unsw.edu.au/embryology/images/7/7b/Ovary\\_001.mp4](http://php.med.unsw.edu.au/embryology/images/7/7b/Ovary_001.mp4)

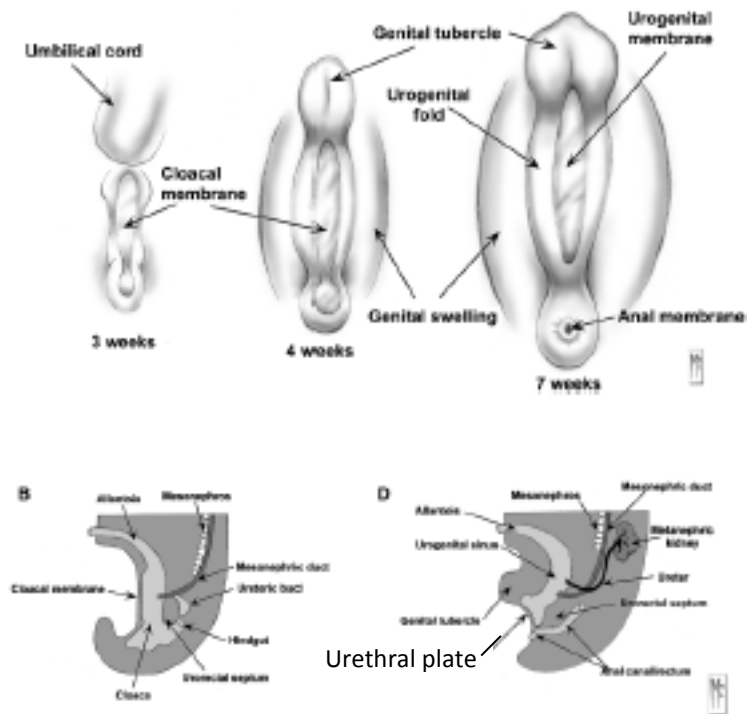
# Development of Reproductive Tract

- Sertoli cells produce anti-Müllerian hormone: Müllerian duct regression
- Leydig cells produce testosterone: Wolffian duct development
- In absence of these hormones: development of female reproductive tract

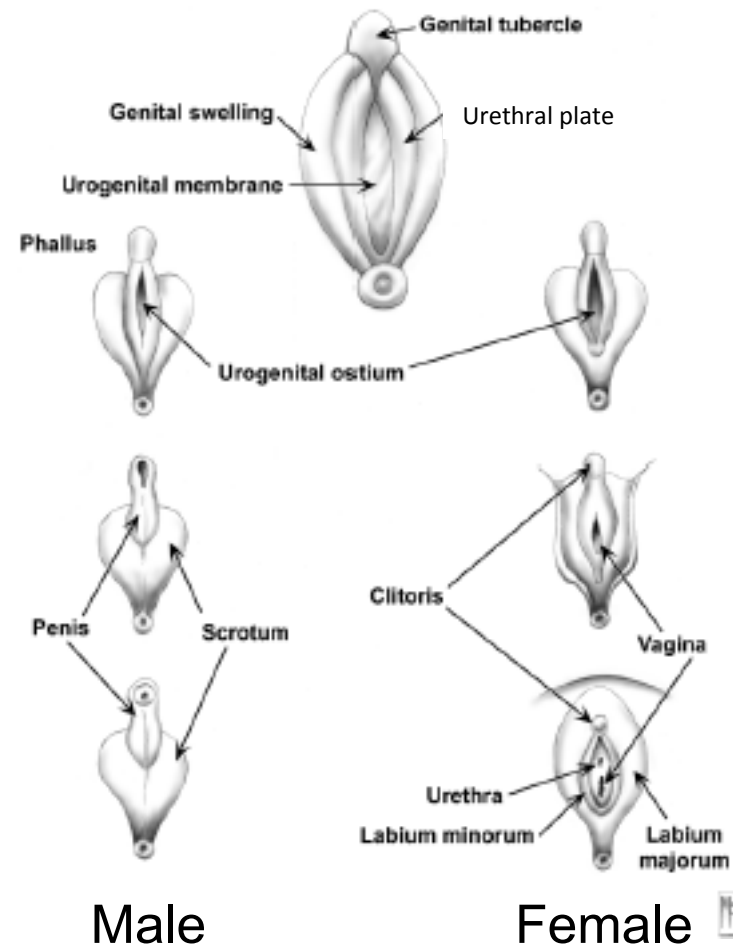


# Development of the external genitalia

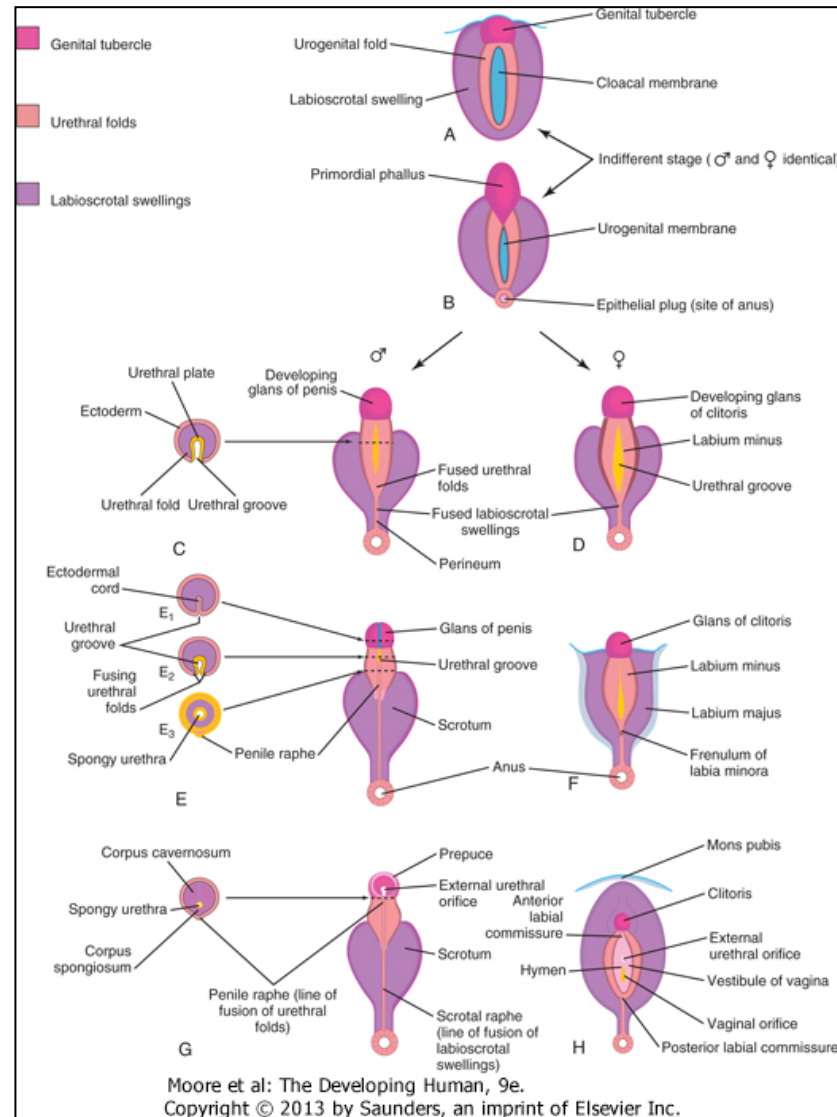
## Indifferent development



## Sex-specific development

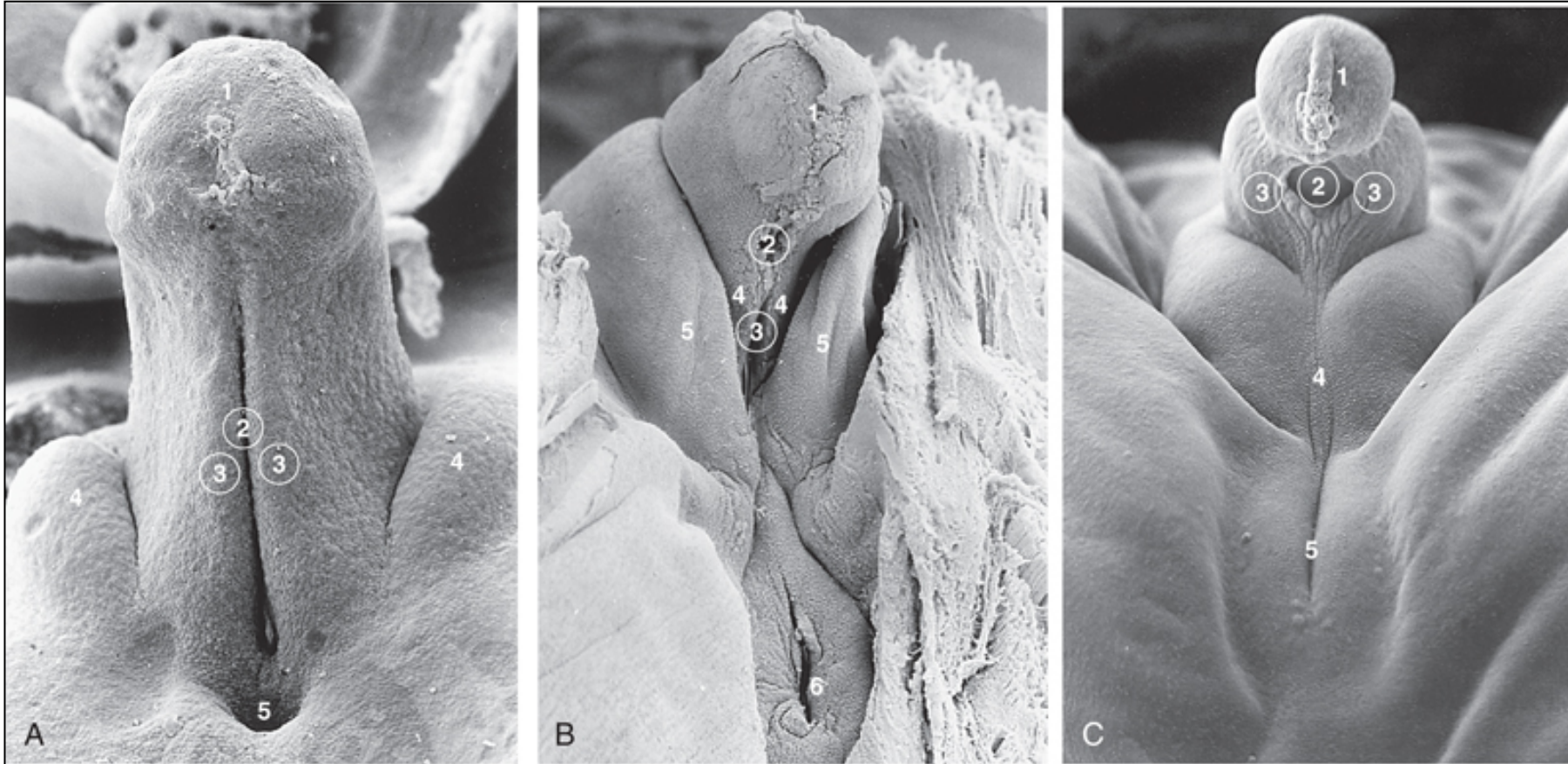


# Development of the external genitalia



[http://php.med.unsw.edu.au/embryology/images/e/e2/Male\\_external\\_001.mp4](http://php.med.unsw.edu.au/embryology/images/e/e2/Male_external_001.mp4)  
[http://php.med.unsw.edu.au/embryology/images/a/a7/Female\\_external\\_001.mp4](http://php.med.unsw.edu.au/embryology/images/a/a7/Female_external_001.mp4)

# Development of the external genitalia



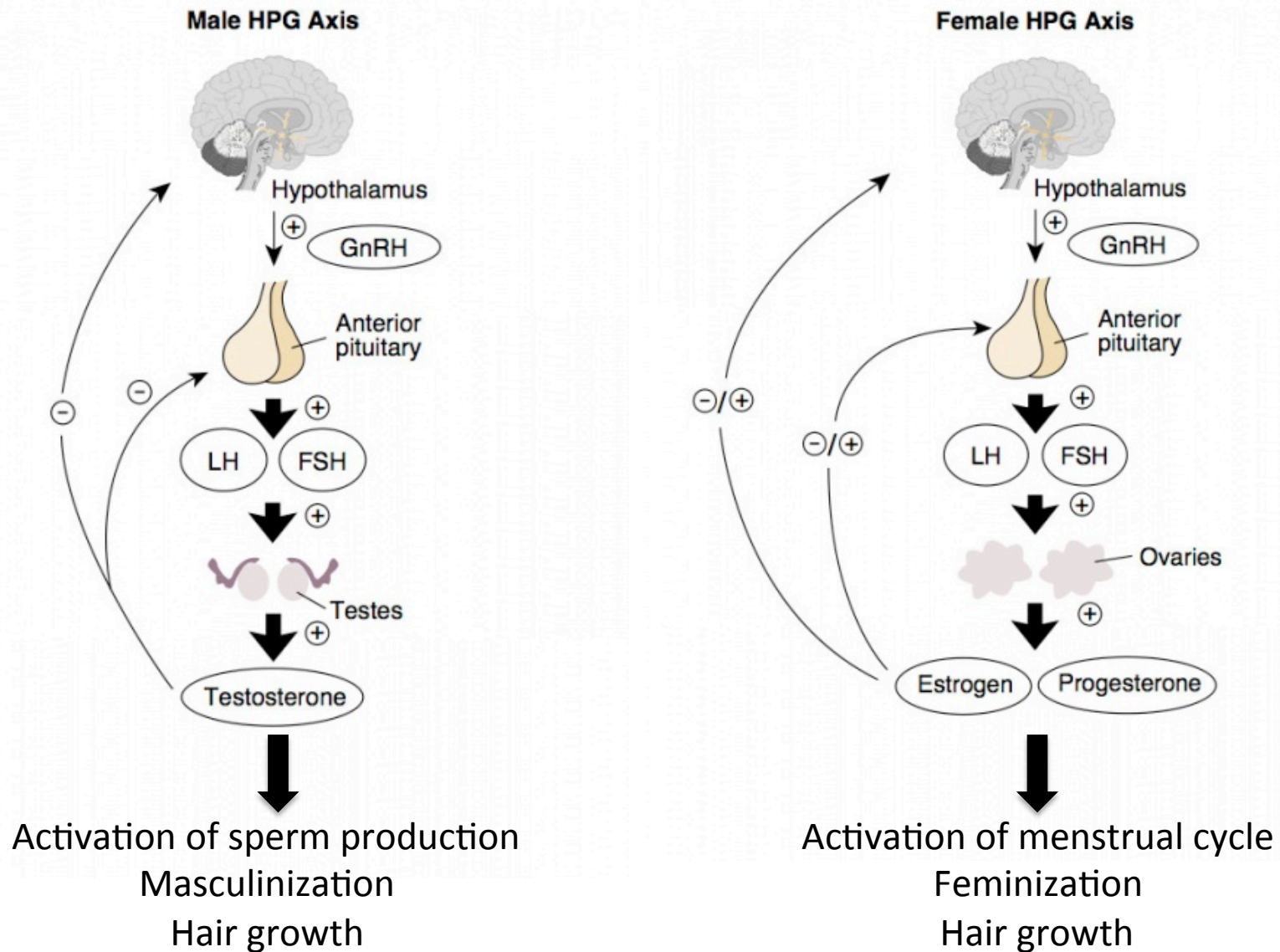
Moore et al: The Developing Human, 9e.  
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# Development of the external genitalia



# Development of secondary sex characteristics

## Puberty





# Sex Determination

Three factors determine sex phenotype:

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- determined at conception

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- Development of testes or ovaries
- Defined during embryonic development

3. Development of secondary sex characteristics

- Hormone dependent
- Defined during puberty

# Disorders of sexual development

## **Sex reversal**

### **Hermaphroditism**

ambiguous external genitalia

True hermaphrodite - both ovarian and testicular tissues

Generally 46,XX (crossing over, X with short arm of Y)

Ovotestes formation - medulla and cortex development

### **Male pseudohermaphroditism - 46,XY**

External genitalia and ducts are intersex

Inadequate testosterone or abnormal AMH production

### **Female pseudohermaphroditism - 46,XX**

Overproduction of androgens

Masculinization of genitalia - clitoral hypertrophy

### **Androgen insensitivity syndrome**

(Testicular feminization syndrome) - 46,XY

female in all ways but with testis

results from androgen receptor defects

### **Hypospadias and cryptorchidism**

[http://php.med.unsw.edu.au/embryology/index.php?title=Development\\_Animation\\_-\\_Testis\\_Descent](http://php.med.unsw.edu.au/embryology/index.php?title=Development_Animation_-_Testis_Descent)

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Embryonic origins of the reproductive system

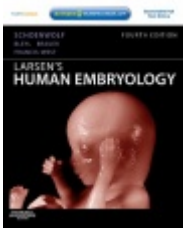
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