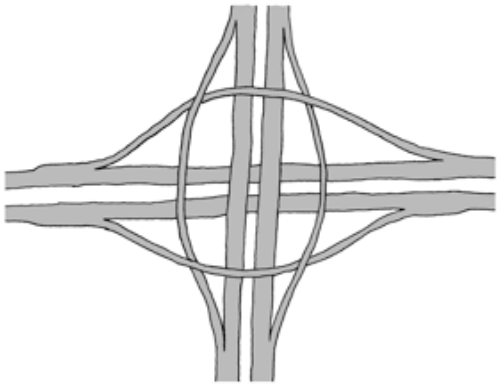
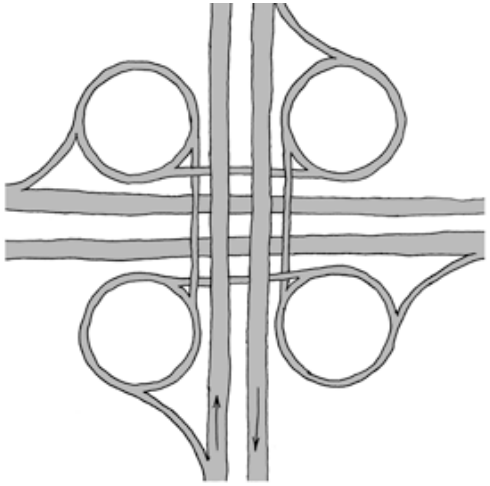
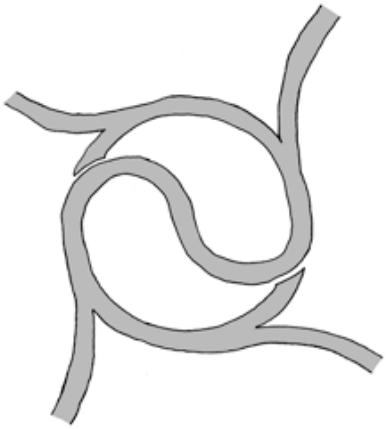
Highway Engineer Pranks



The no-choice interchange



The inescapable clover-leaf



The roundabout supercollider

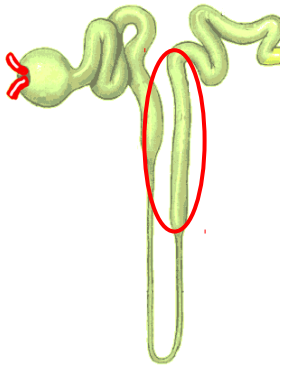
xkcd A WEBCOMIC OF ROMANCE, SARCASM, MATH, AND LANGUAGE.

Lecture 5 – congenital abnormalities and normal development of the urinary system

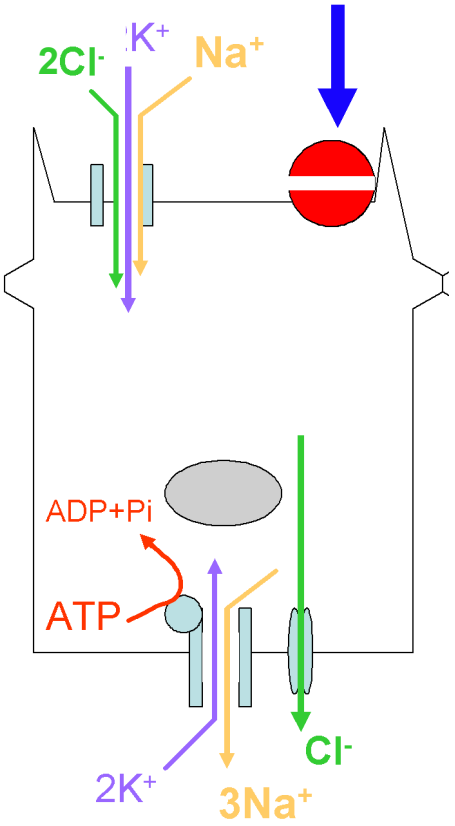
What can go wrong? – Hereditary disorders of tubule function.

Bartter's syndrome (Type 1) – impaired SLC12A2

TAL cells:



SLC12A2



Effects (choose one)

a) Loss of Na^+, K^+, modest H_2O, hypocalcuria

b) Loss of Na^+ K^+, much H_2O; hypercalcuria

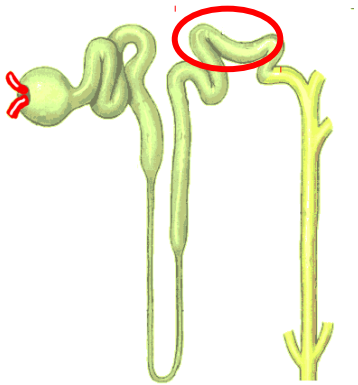
c) Na^+ loss, K^+ retention, high aldosterone

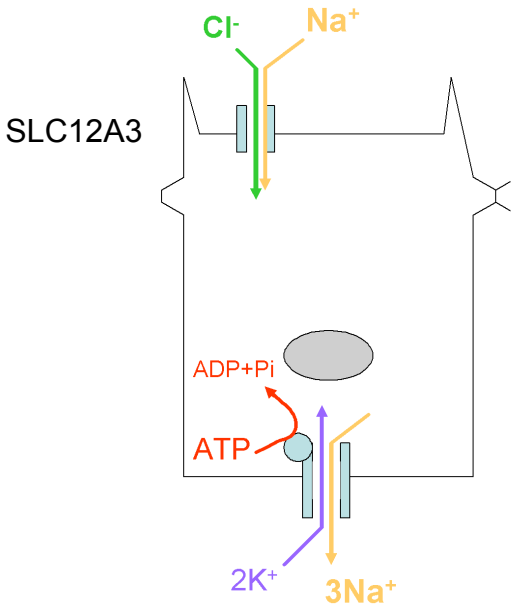
d) Diabetes insipidus (polyuria, polydipsia)

e) Volume expansion (body), hypertension

What can go wrong? – Hereditary disorders of tubule function.

Gitelman's syndrome – impaired SLC12A3





Effects (choose one)

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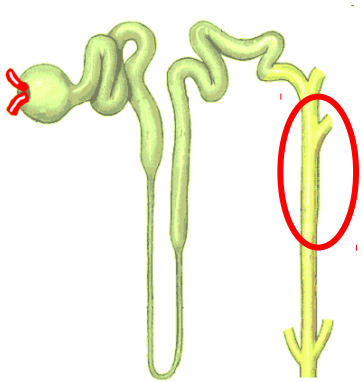
c) Na^+ loss, K^+ retention, high aldosterone

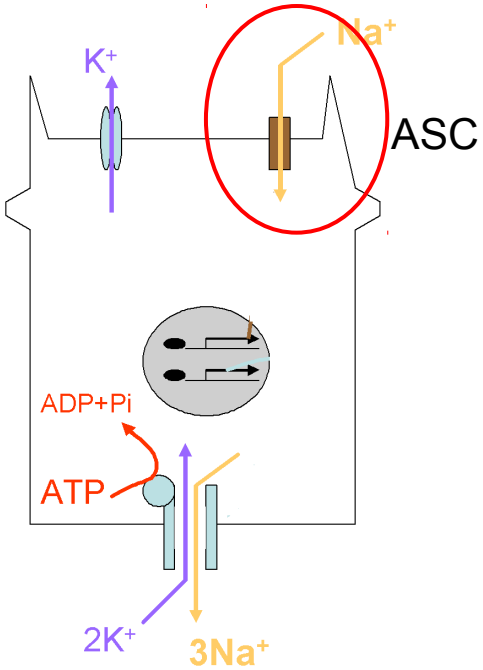
d) Diabetes insipidus (polyuria, polydipsia)

e) Volume expansion (body), hypertension

What can go wrong? – Hereditary disorders of tubule function.

Liddle's syndrome – hyperactive ASC (=ENaC)





Effects (choose one)

a) Loss of Na^+, K^+, hypocalcuria

b) Loss of Na^+ K^+, H_2O; hypercalcuria

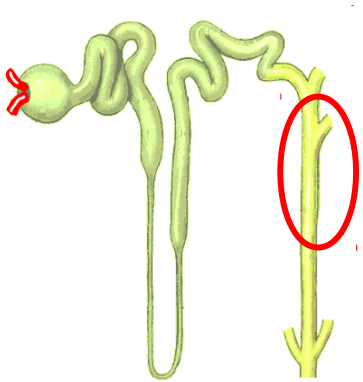
c) Na^+ loss, K^+ retention, high aldosterone

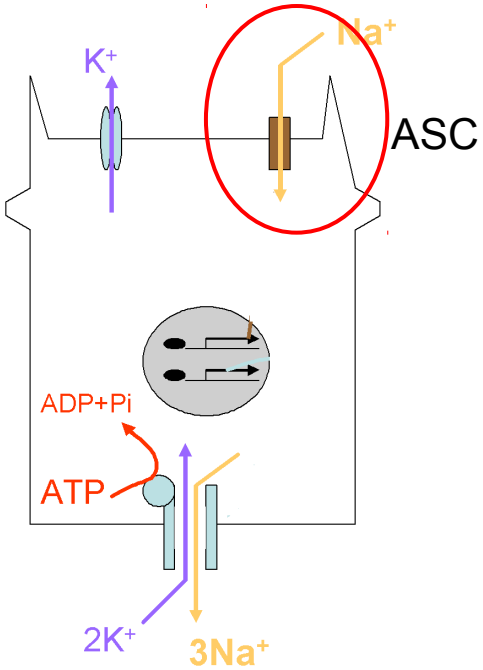
d) Diabetes insipidus (polyuria, polydipsia)

e) Volume expansion (body), hypertension

What can go wrong? – Hereditary disorders of tubule function.

Pseudohypoaldosteronism – inactive ASC (=ENaC)





Effects (choose one)

a) Loss of Na^+, K^+, hypocalcuria

b) Loss of Na^+ K^+, H_2O; hypercalcuria

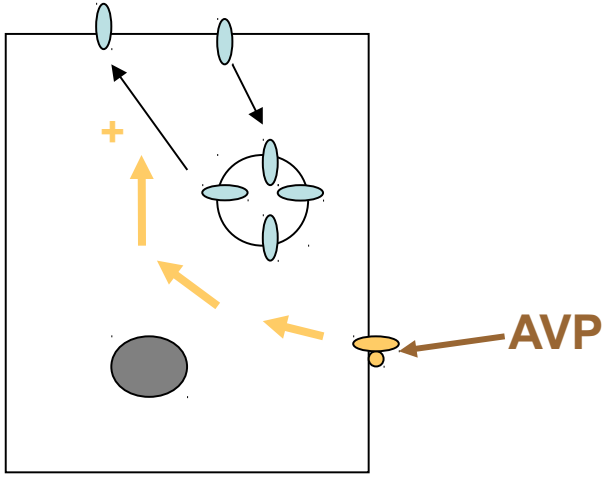
c) Na^+ loss, K^+ retention, high aldosterone

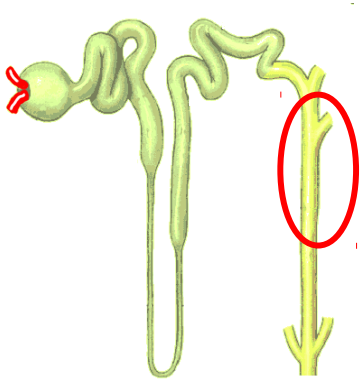
d) Diabetes insipidus (polyuria, polydipsia)

e) Volume expansion (body), hypertension

What can go wrong? – Hereditary disorders of tubule function.

Inactivating Mutations of Aquaporins





Effects (choose one)

a) Loss of Na^+, K^+, hypocalcuria

b) Loss of Na^+ K^+, H_2O; hypercalcuria

c) Na^+ loss, K^+ retention, high aldosterone

d) Diabetes insipidus (polyuria, polydipsia)

e) Volume expansion (body), hypertension

What can go wrong? – Problems outside the kidney

Addison's disease (destruction of adrenal glands)

(JFK was a sufferer)

Effects (choose one)

a) Loss of Na^+, hyperK^+, hypovolaemia

b) Loss of Na^+ K^+, H_2O; hypercalcuria

c) Whole body hypo-osmolarity

d) Diabetes insipidus (polyuria, polydipsia)

e) Volume expansion (body), hypertension

What can go wrong? – Problems outside the kidney

Psychogenic polydipsia

(this is just a random image of someone drinking, not a patient)

Effects (choose one)

a) Loss of Na^+, K^+, hypovolaemia

b) Loss of Na^+ K^+, H_2O; hypercalcuria

c) Whole body hypo-osmolarity

Final Topic:

Development of the kidney

(important because of congenital abnormalities)

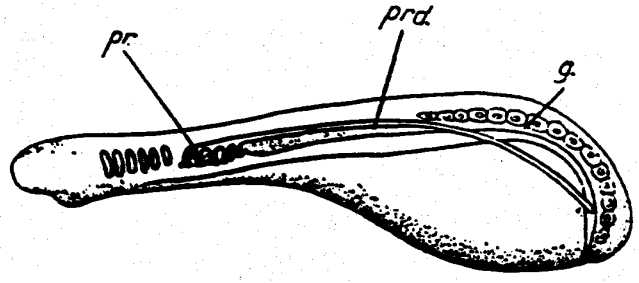
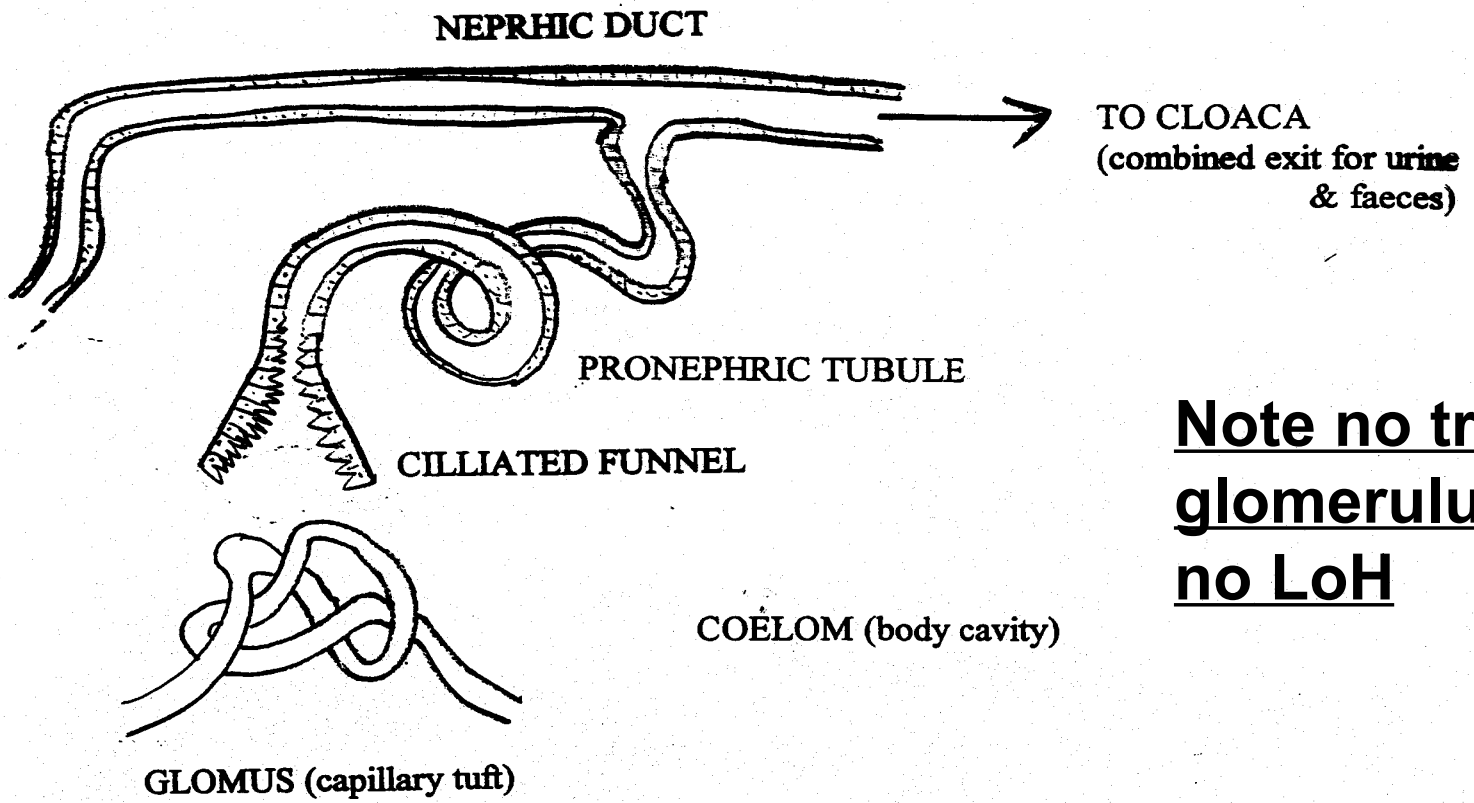


Image source: Life of Vertebrates (Young)

FIG. 58. Diagram to show arrangement of the pronephros in a freshly hatched lamprey.

g. gonad; *pr.* pronephros; *prd.* pronephric duct. (After Wheeler.)

Lamprey embryo:



Note no true glomerulus, no LoH

Adult:

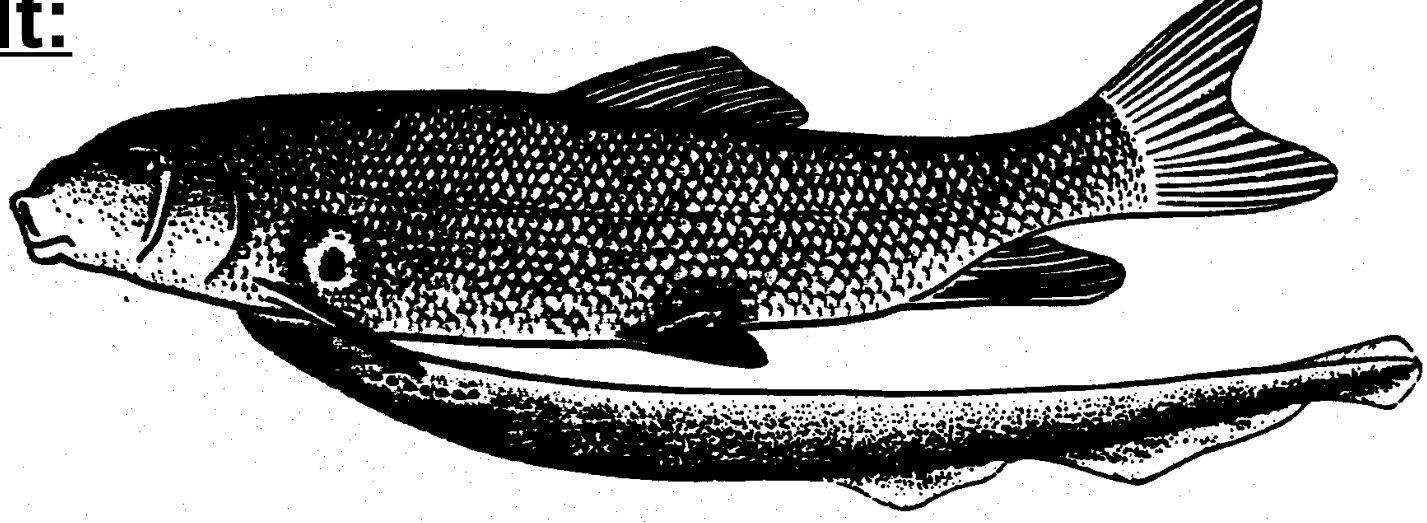


FIG. 55. Lake lamprey attached to a bony fish, which also shows the scars of the attacks of other lampreys. (After Gage.)

Image source: Life of Vertebrates (Young)

pronephros

mesonephros

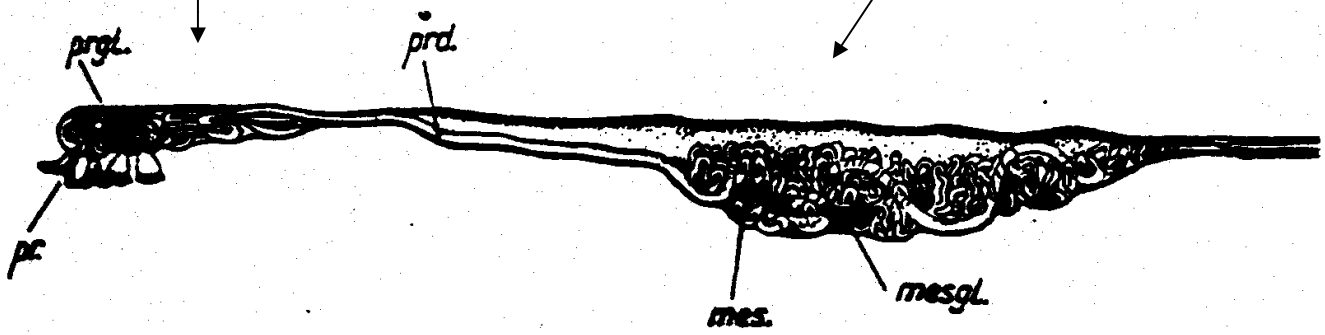
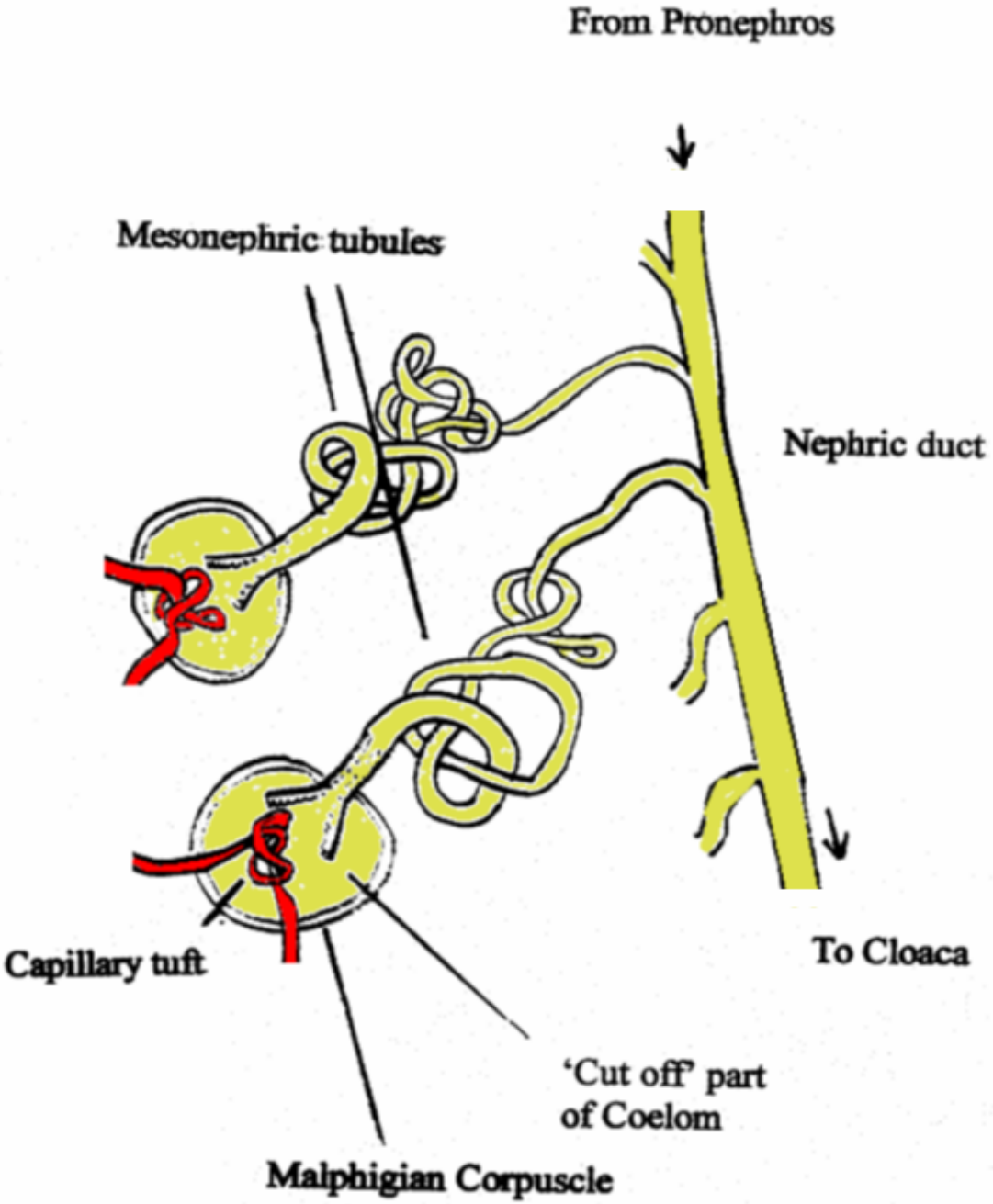
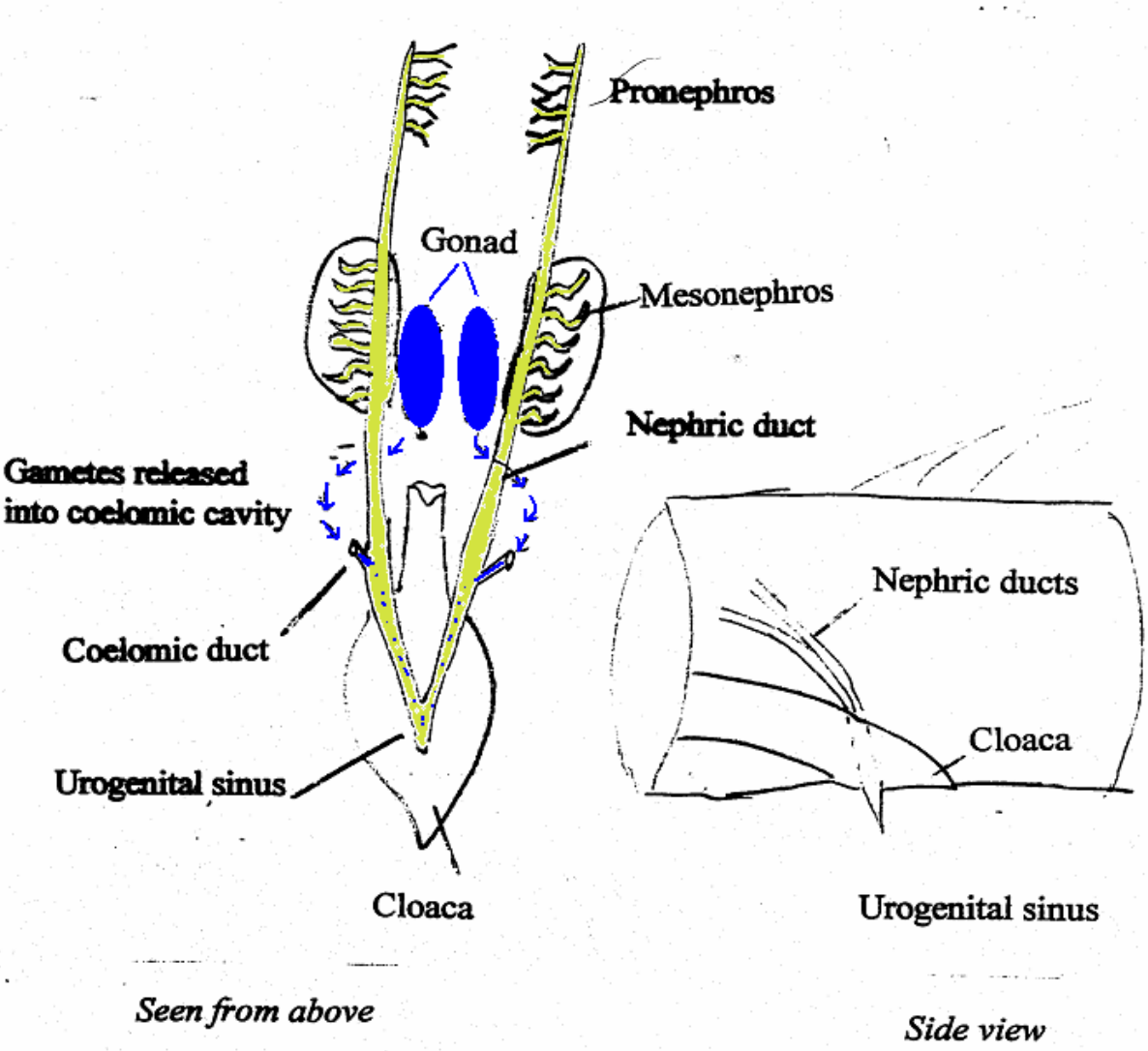


FIG. 60. Kidney system of a 22-millimetre larva of *Lampetra*.

mes. mesonephric tubules; *mesgl.* mesonephric glomeruli; *pr.* pronephric funnels; *prd.* pronephric duct; *prgl.* pronephric glomeruli. (After Wheeler.)

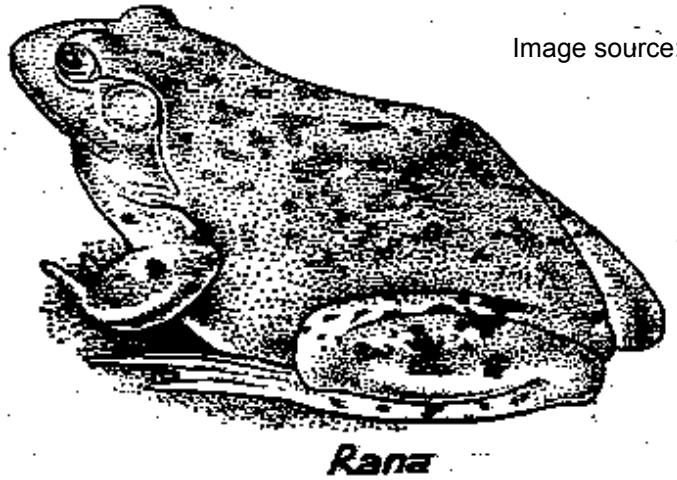

From Pronephros
Mesonephric tubules
Nephric duct
To Cloaca
Capillary tuft
'Cut off' part
of Coelom
Malphigian Corpuscle

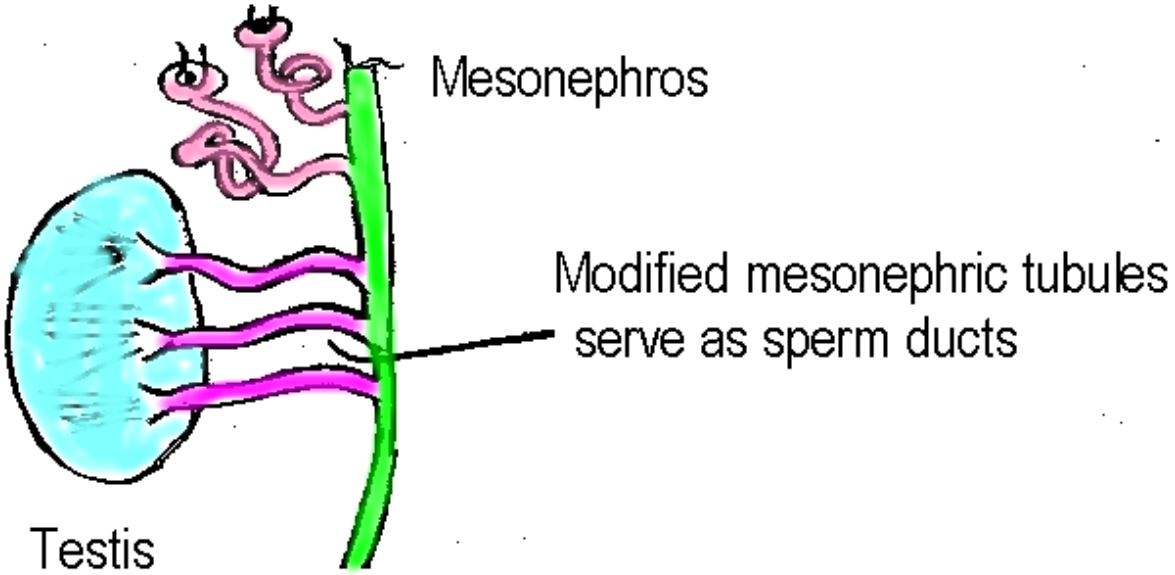
Reproductive system



The above is true for BOTH SEXES

Image source: Life of Vertebrates (Young)



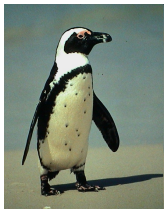


Vertebrate evolution









Chordata (invertebrata)

agnatha

ichthyes

amphibia

reptilia

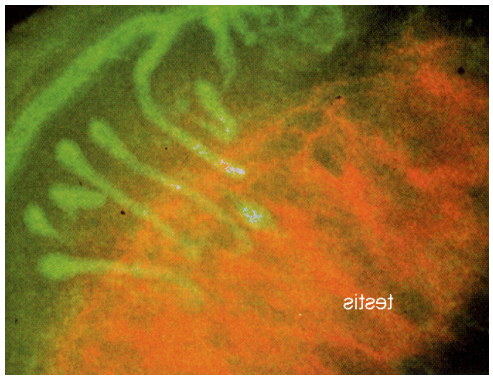
mammalia

aves

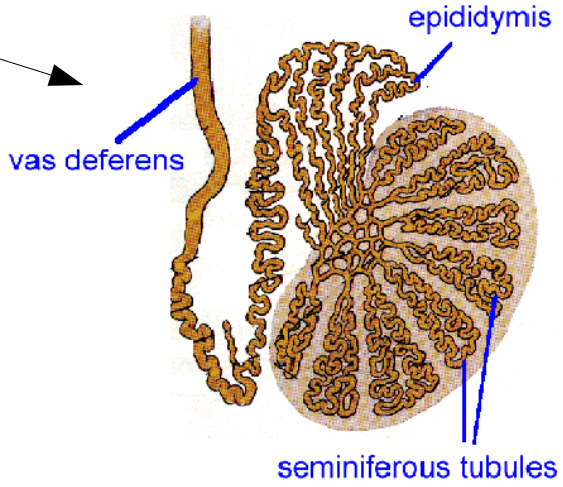
Amniotes

Everything down this way has a very different excretory system (similar genes & proteins but v different anatomy)

Flashback to year 1: Adult testicular anatomy:

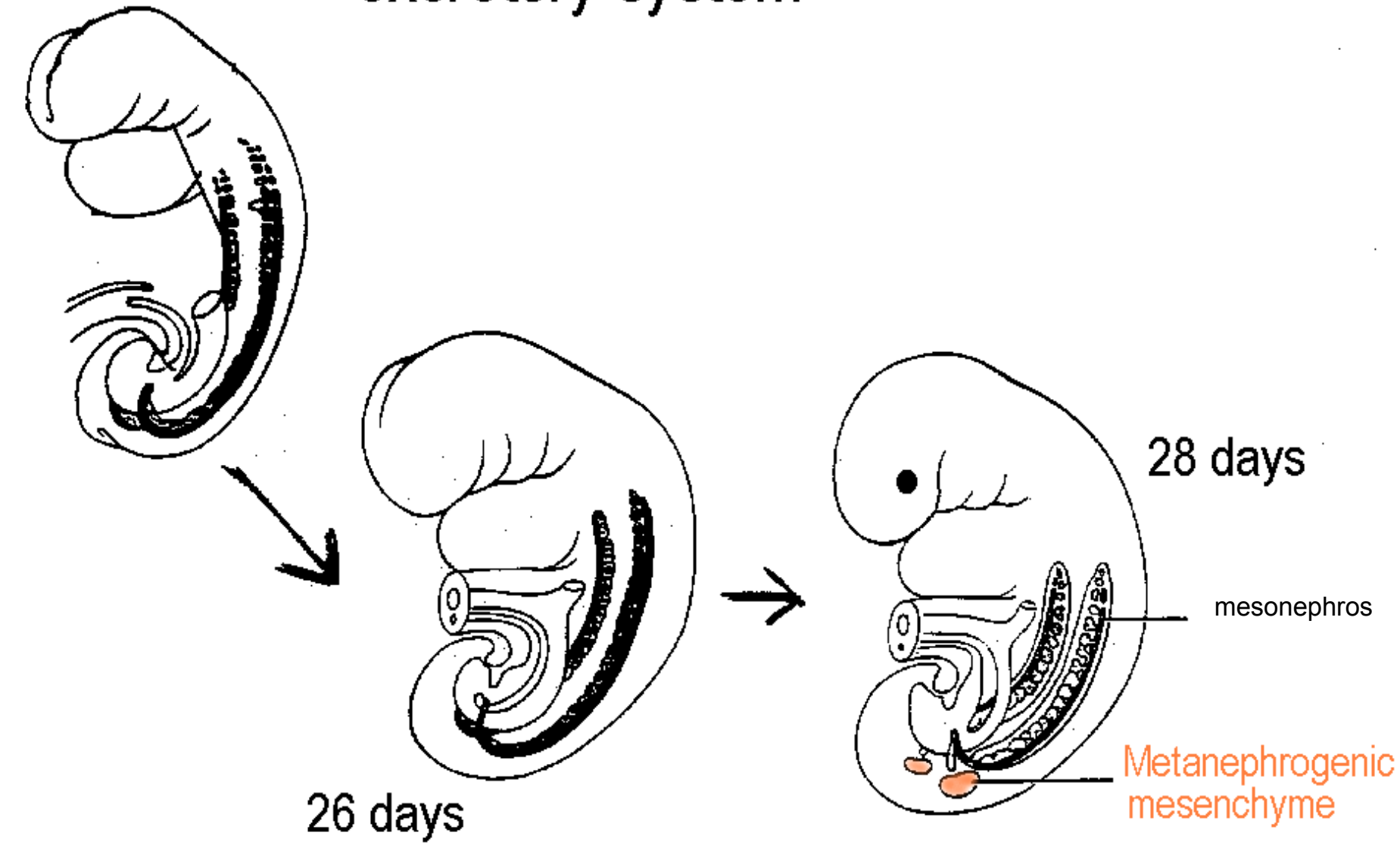


(one of your 1st year slides)

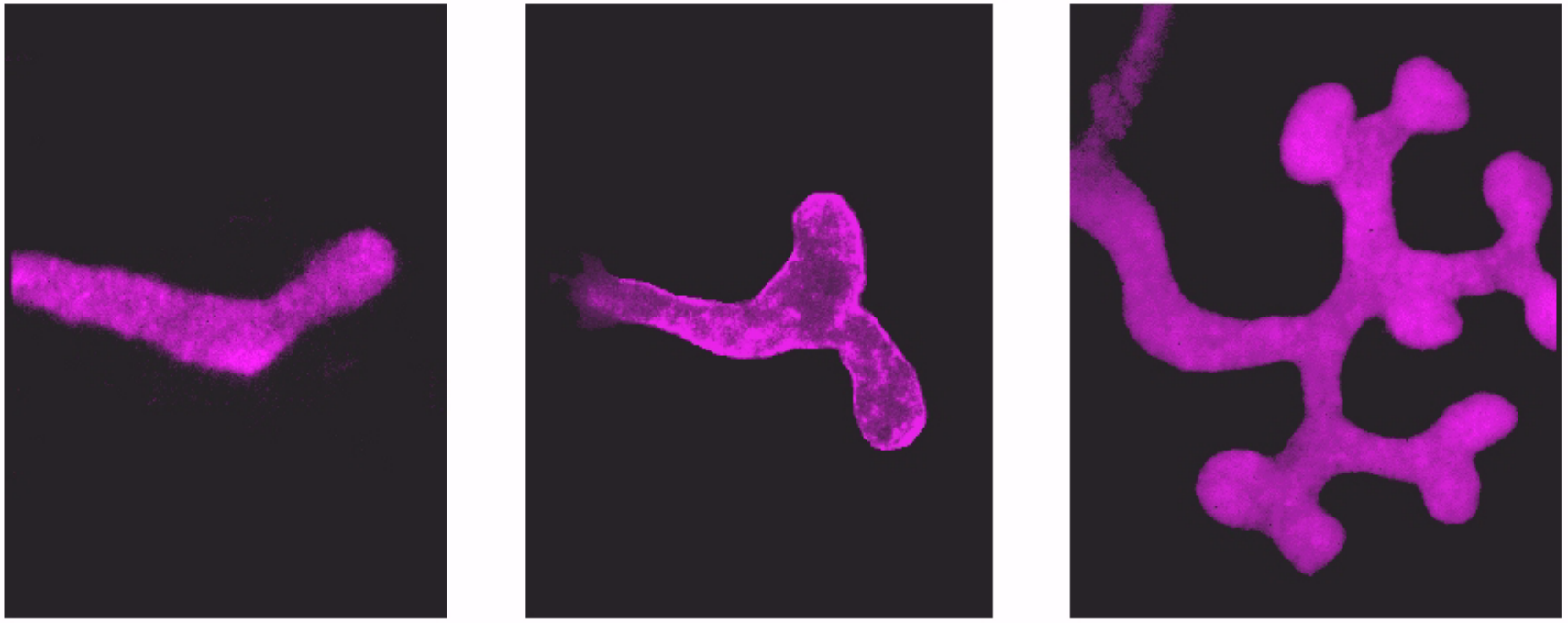


(orientation)

Development of the human excretory system



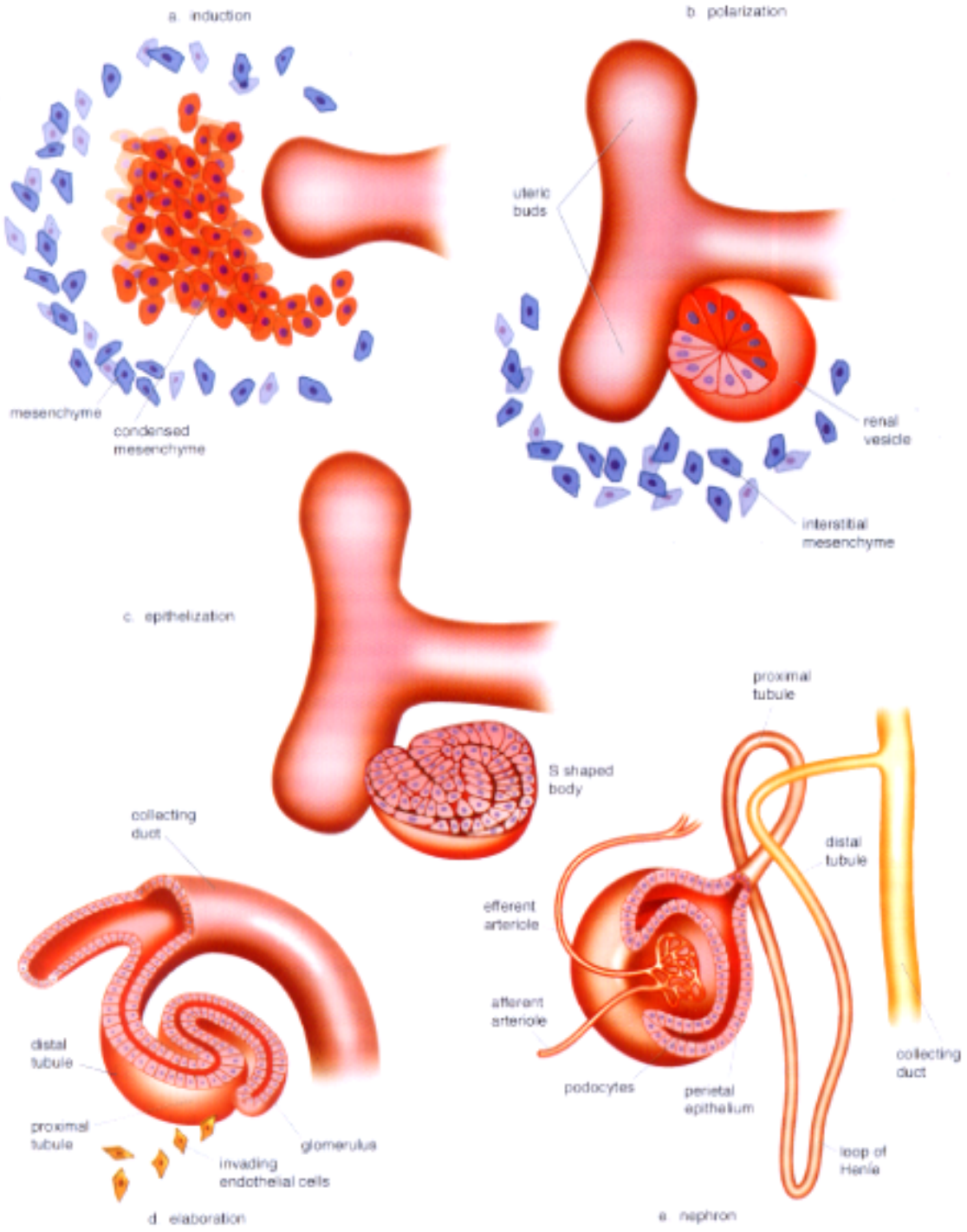
Branching of the ureteric bud



0 days

1 day

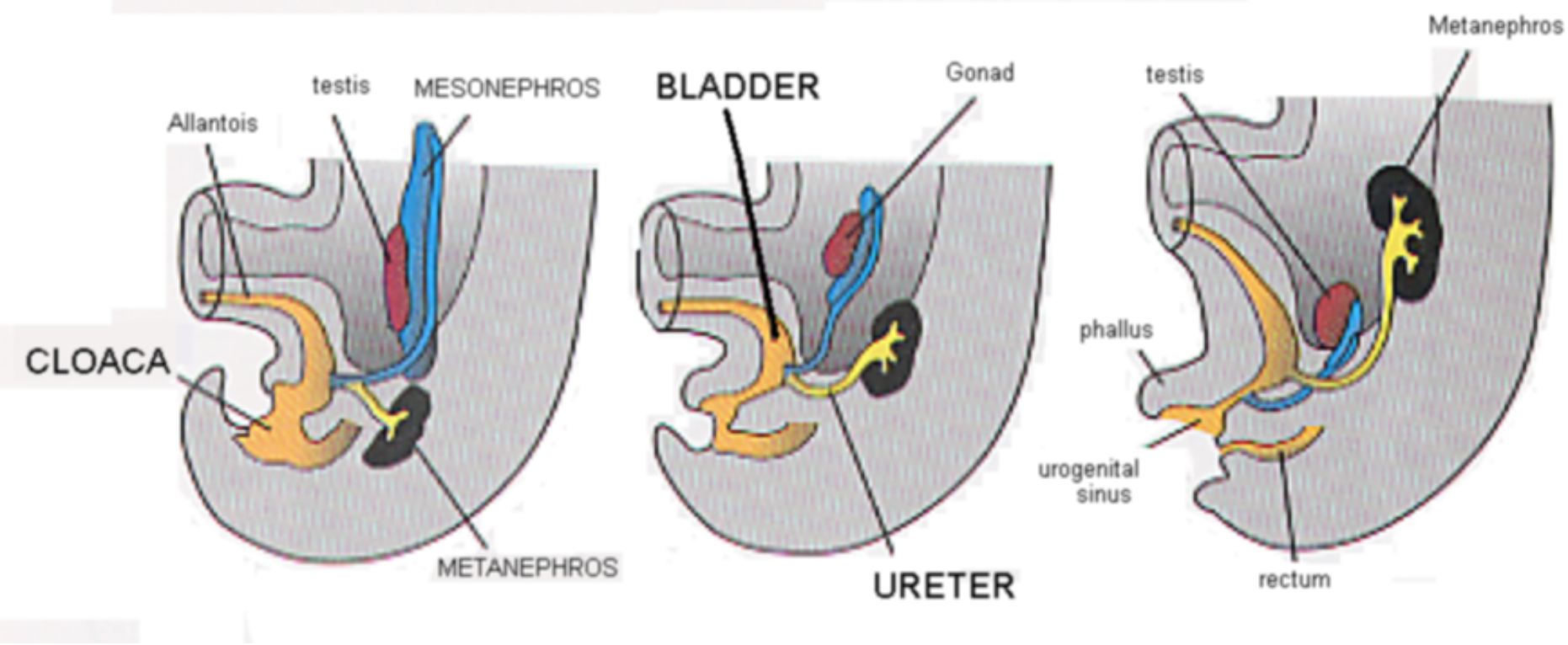
2 days



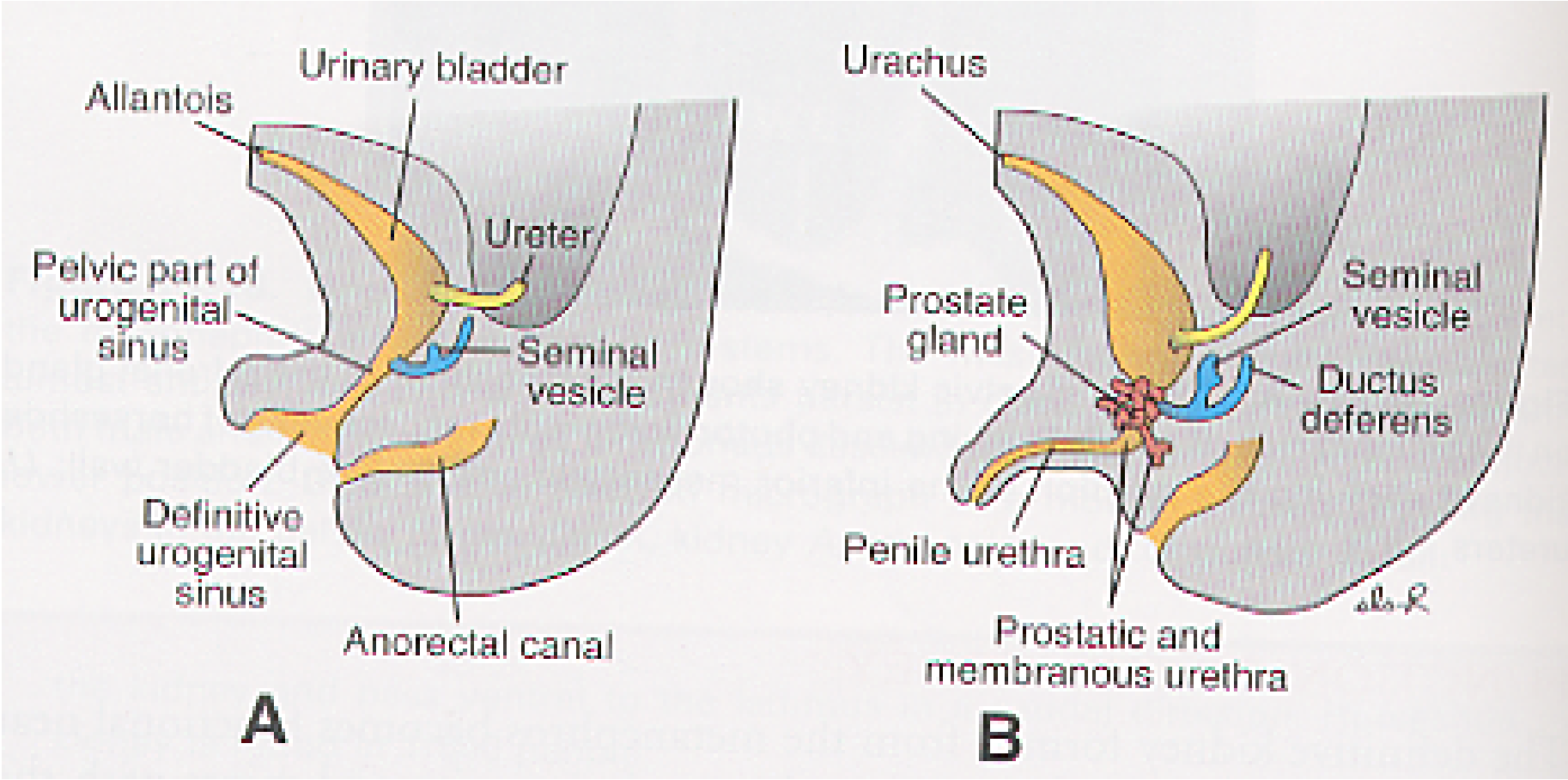
Nephrons form from stem cell populations that cap the branching bud tips

From "The Kidney" (Vize, Bard, Woolf, Academic Press)

Development of the bladder



Development of the prostate



Components of semen

- Testis – sperm
- Prostate – citric acid, enzymes, acidic proteins
- Sem. Ves. – fructose, basic proteins

Timing of release

Prostate

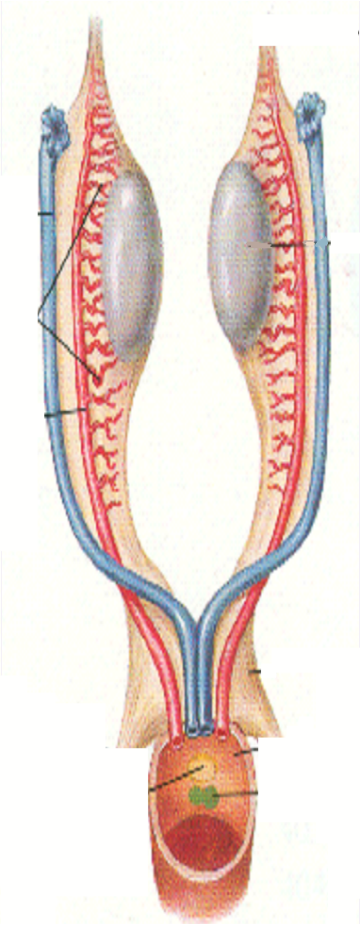
Epididymis

Sem. Ves

Sex-specific development of nephric and Mullerian ducts.

MALE

- Indifferent gonad develops testis cords
- Testis cords connect to som mesonephric tubules (->epididymis)
- Mullerian duct regresses
- Distal neprhic duct sprouts seminal vesicles – the part the nephric duct distal to th is the ejaculatory duct
- Urethra sprouts prostate ar bulbourethral glands.



FEMALE

- Indifferent gonad develops into an ovary
- Upper Mullerian ducts become fallopian tubes
- Mullerian ducts converge & fuse to become the uterovaginal canal
- Neprhic ducts and mesoneprhos degenerates
- Uterovaginal canal forms uterus and upper part of vagina. (Lower part from urogenital sinus)

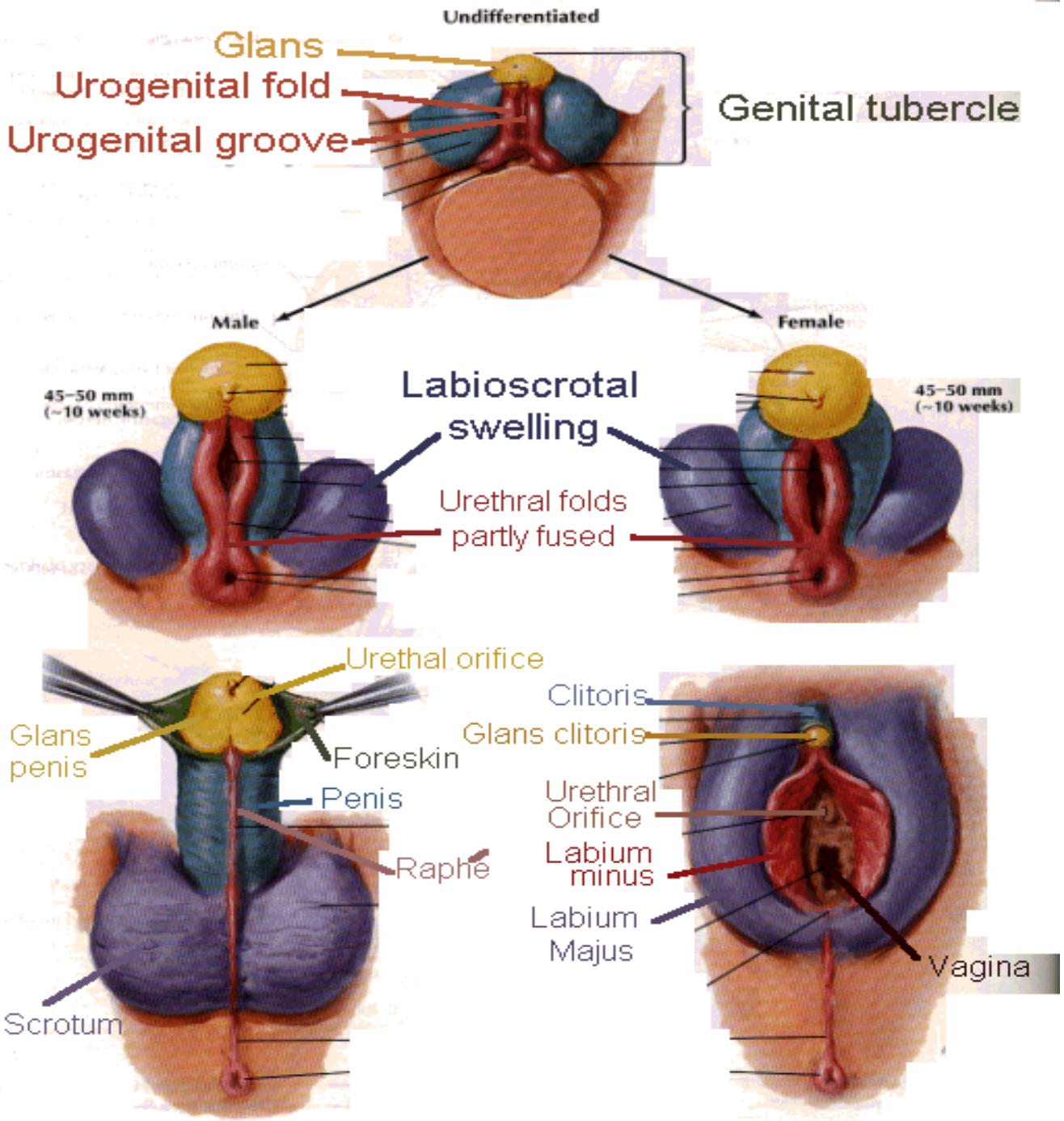
The opening to the world

His:

Urethra runs along penis and opens at its end

Hers:

Urethra ends within vulva and does not run to end of clitoris.



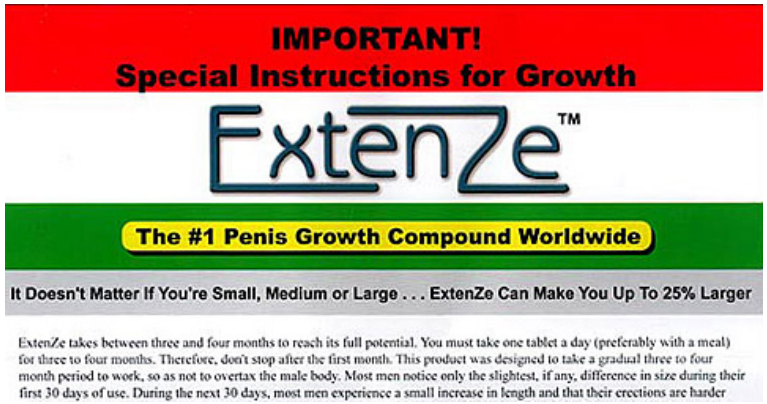
From *Atlas of Human Anatomy* (Netter)

Resultant anatomy is quite variable (in both sexes): this is not a problem.

(RESTART RECORDING)

But this is a problem:

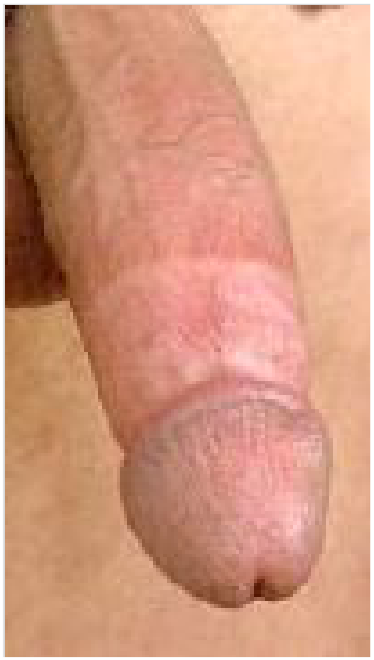
Unscrupulous “doctors” (if they merit that word) are preying on body shame and body insecurity to persuade people to undergo surgical/ medical procedures to conform to some societal ideal.



Your generation of doctors may have to work harder than any other to protect patients from body-shame and its psychological consequences.

One specific variation, prepuce removal, may be surgically-imposed on some people in very early childhood (dependent on cultural identity and national cultural norms).

Uncircumcised



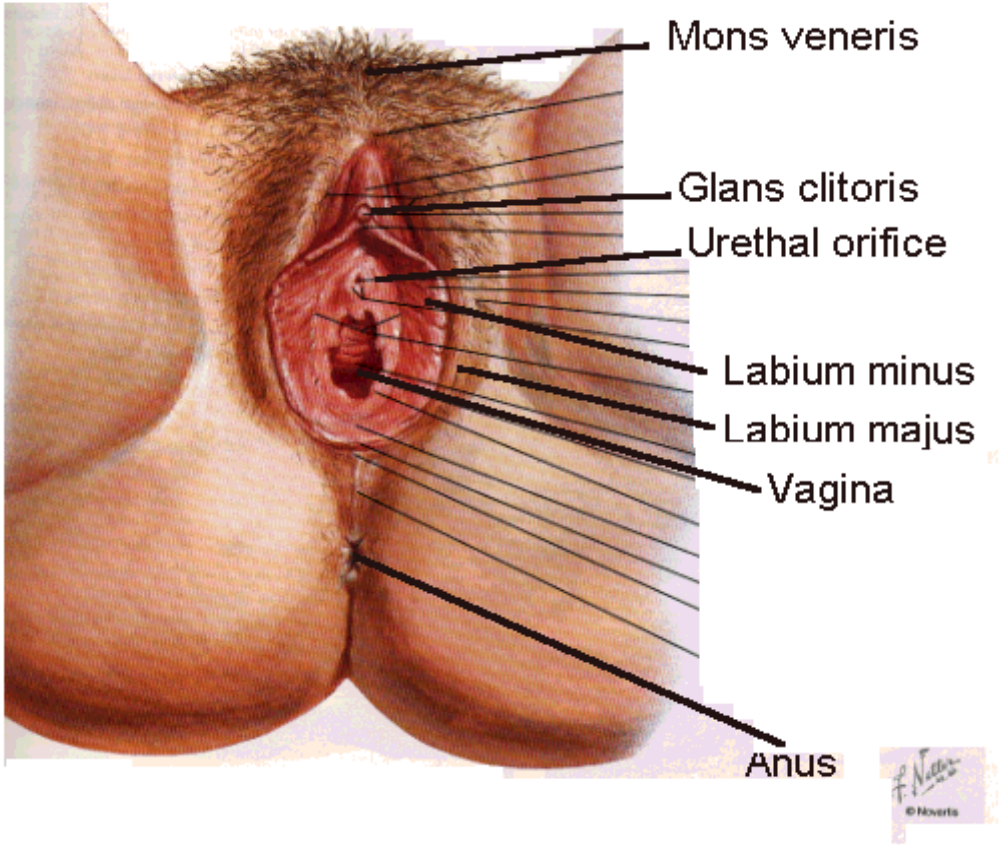
Circumcised

(there are variations in exact appearance here too, depending on precise procedure)

(Female childhood genital mutilation is strictly illegal in the UK and most other countries. The specific type of male childhood manipulation shown above is legal. Wearing your HES hats, you may want to think about how this fits with medical ethics).

Images: Wikimedia commons

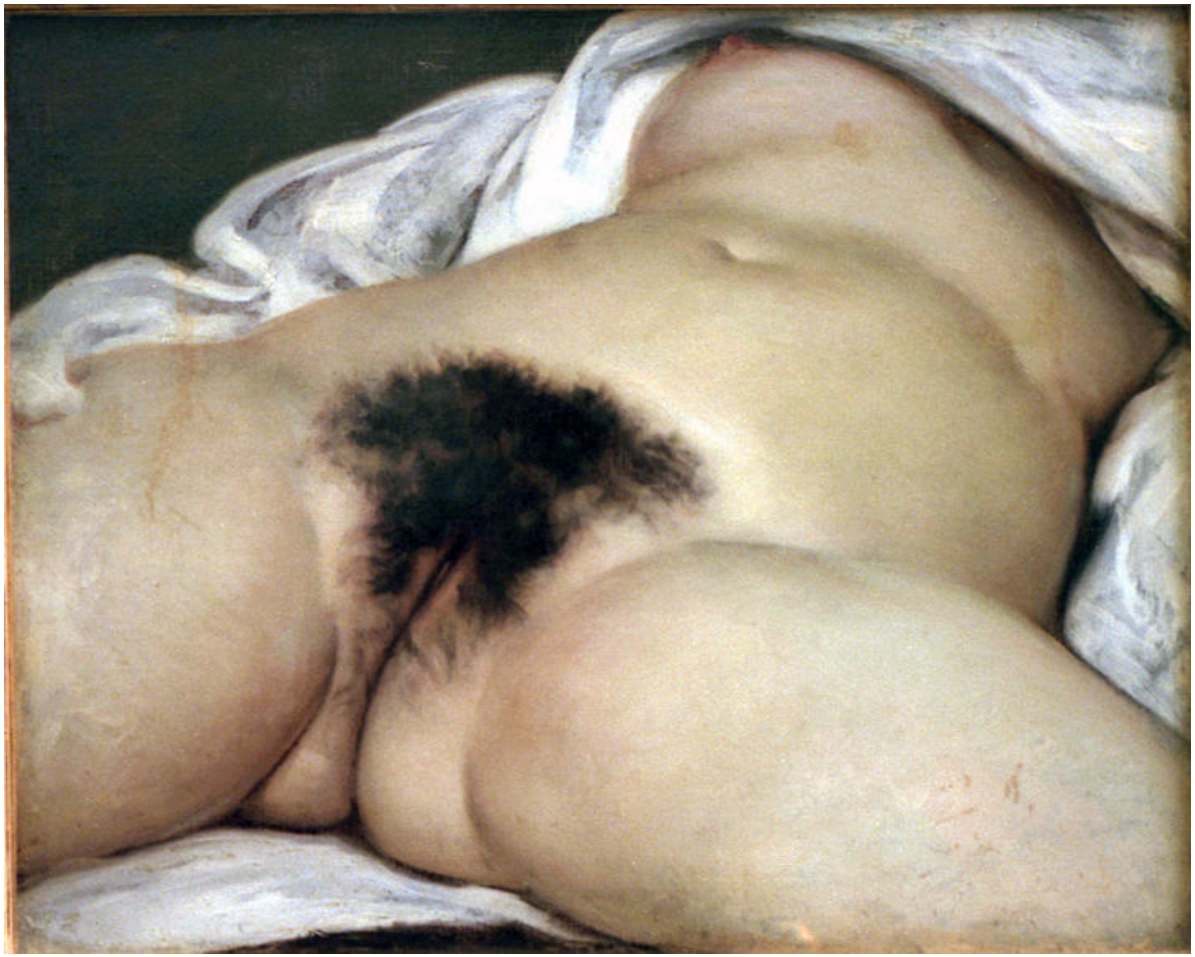
Female anatomy (a typical 'medical drawing' made with labia parted):



More variation:

All are “normal” from a clinician's point of view but can be culturally significant.

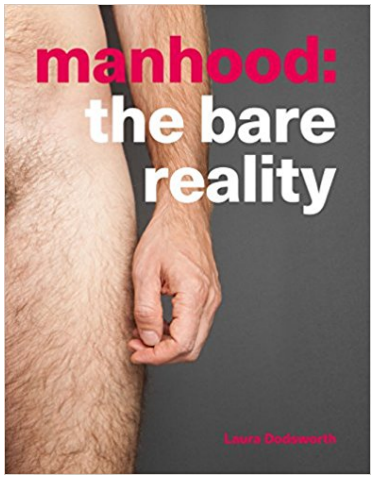
Of course, ‘resting’ female anatomy tends to be more hidden – don’t expect it to be like the textbook drawing I just showed:

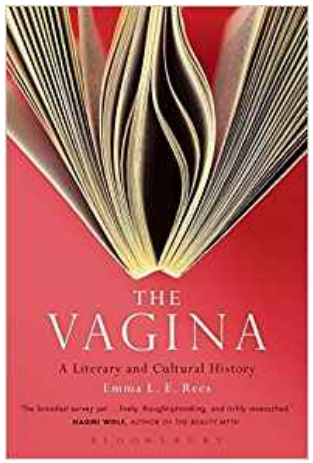


L'Origine du monde, Gustav Courbet 1868.

Image credit: Musée d'Orsay

Tangent (not on year 2 exam syllabus): psychosocial aspects of these organs

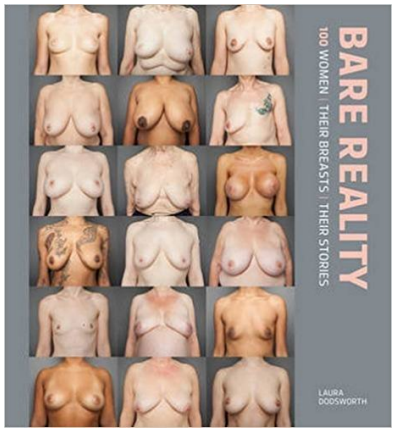




A scholarly study.

c. 100 people photographed (just that part) and interviewed anonymously about their feelings about it.

Not urogenital, but also relevant to psychosocial aspects of parts usually covered. Same author as above, and idea: 100 photos and interviews.



The interviews in the photo books are by no means restricted to sexual aspects; giving birth, feeding babies, surviving cancer, eating disorders, gender reassignment etc all feature a lot.

Congenital Abnormalities

We'll consider the kidney first, then the bladder, then the external genitalia

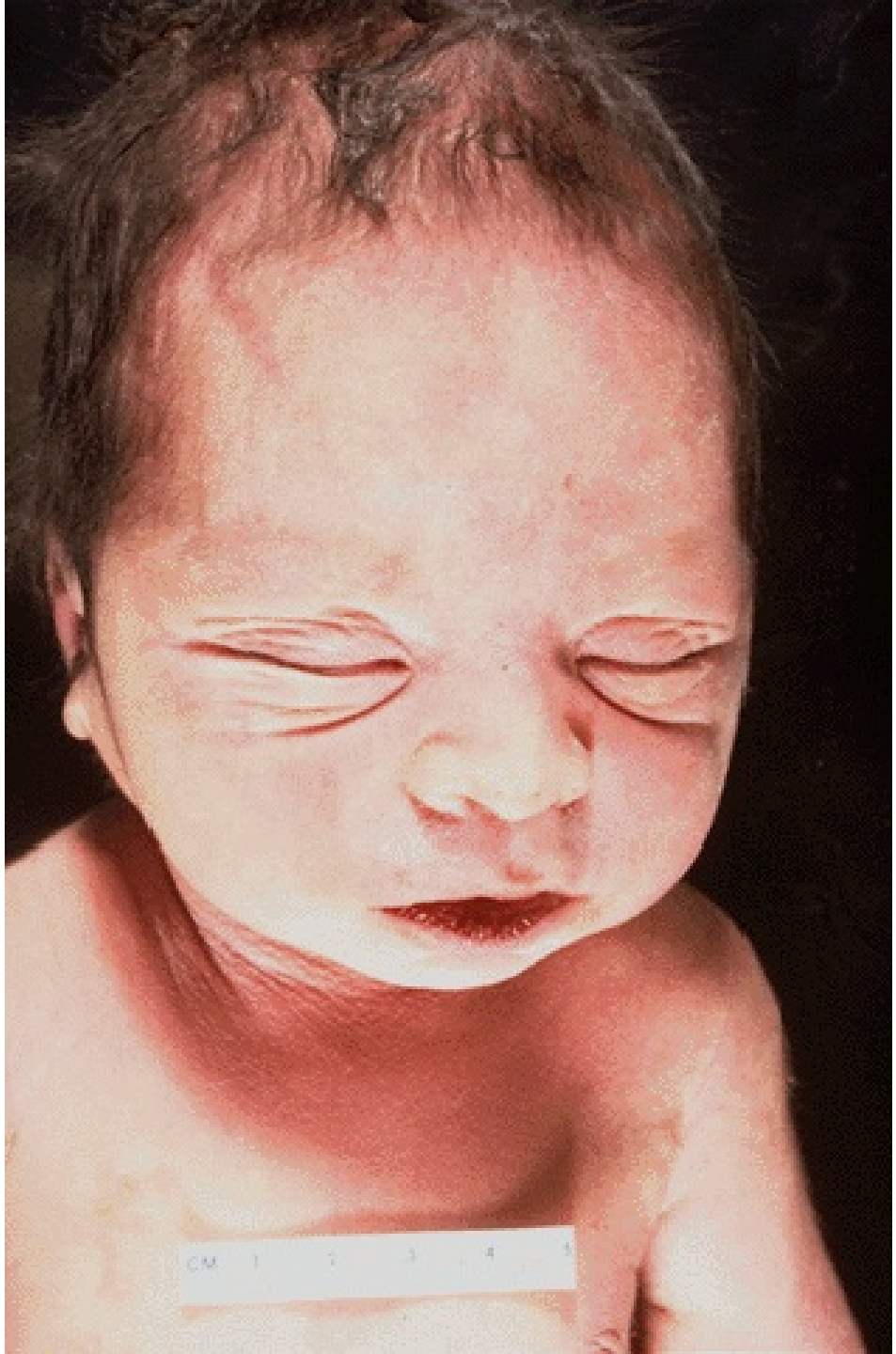
Renal Agenesis

- Bilateral – No kidneys form. Rare; fatal after birth. Lack of amniotic fluid causes Potter's Facies.

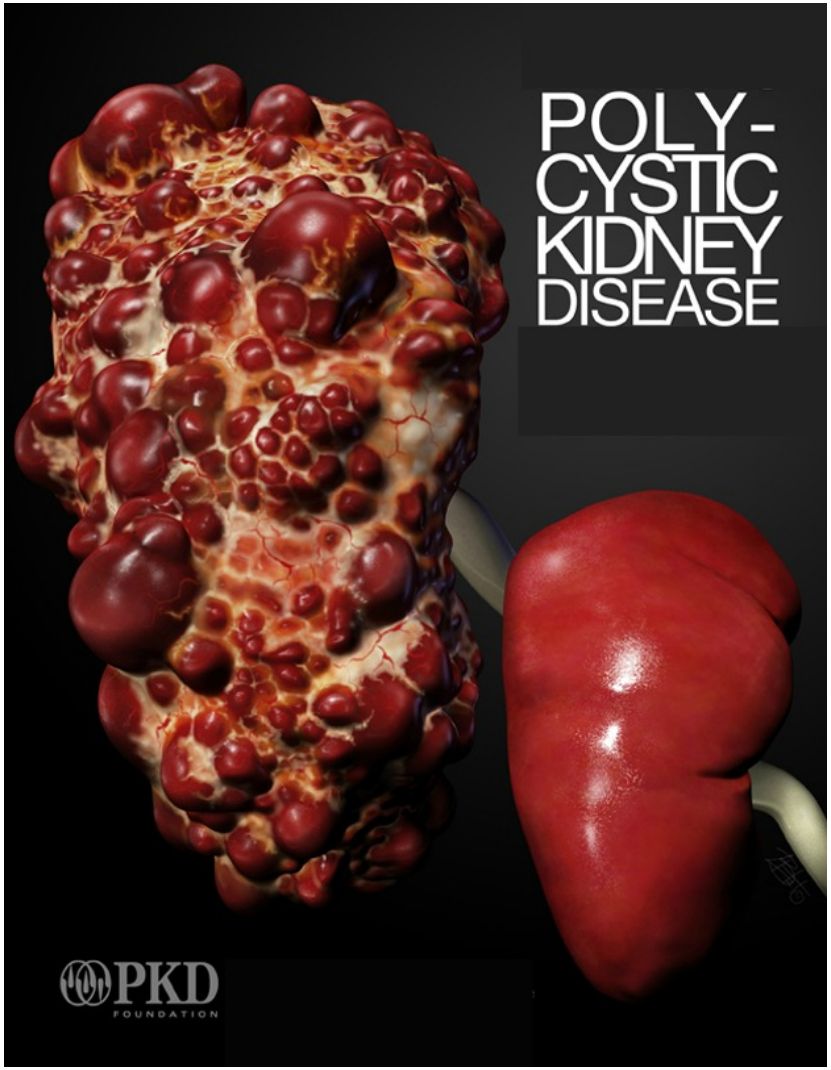
- Unilateral – One kidney missing. Common (1/500). Often no clinical implications unless some bright surgeon removes the working one.

Potter's Facies

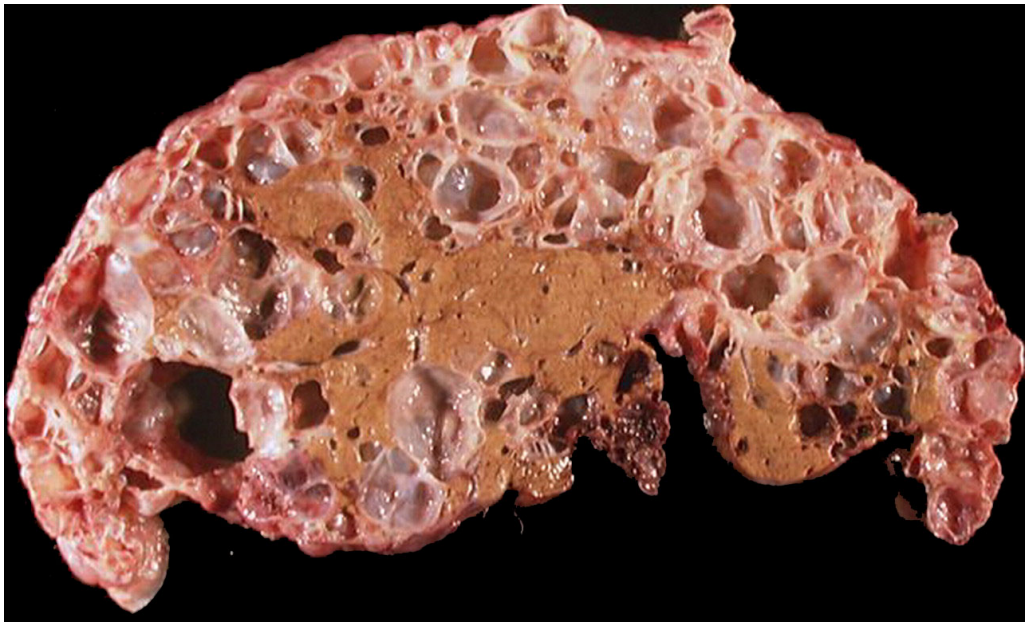
- Flat nose
- Flat chin
- Ears against head



Congenital Cystic Disease



(Same scale)



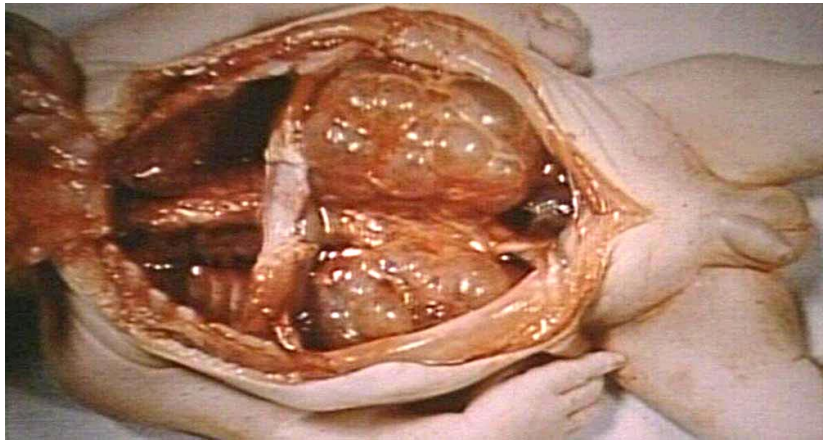
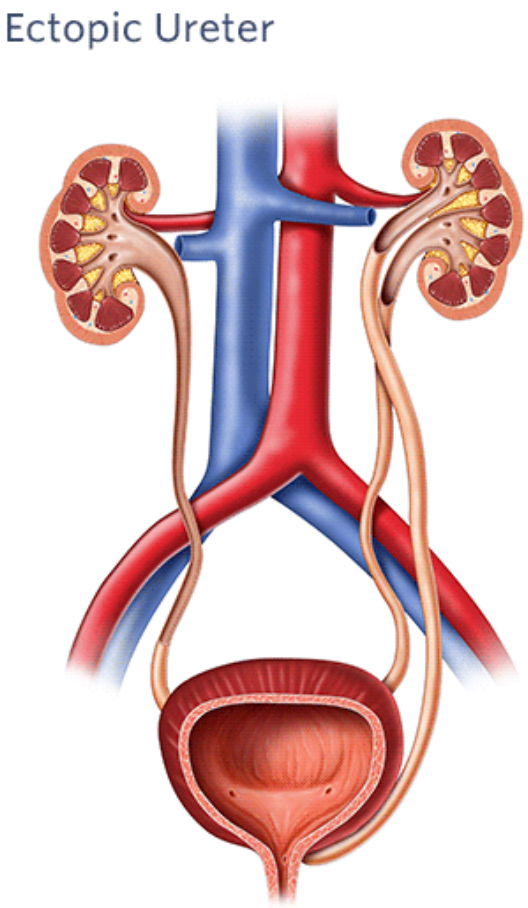


Photo credit: E-medicine centre

Supernumerary ureter



Pelvic kidney

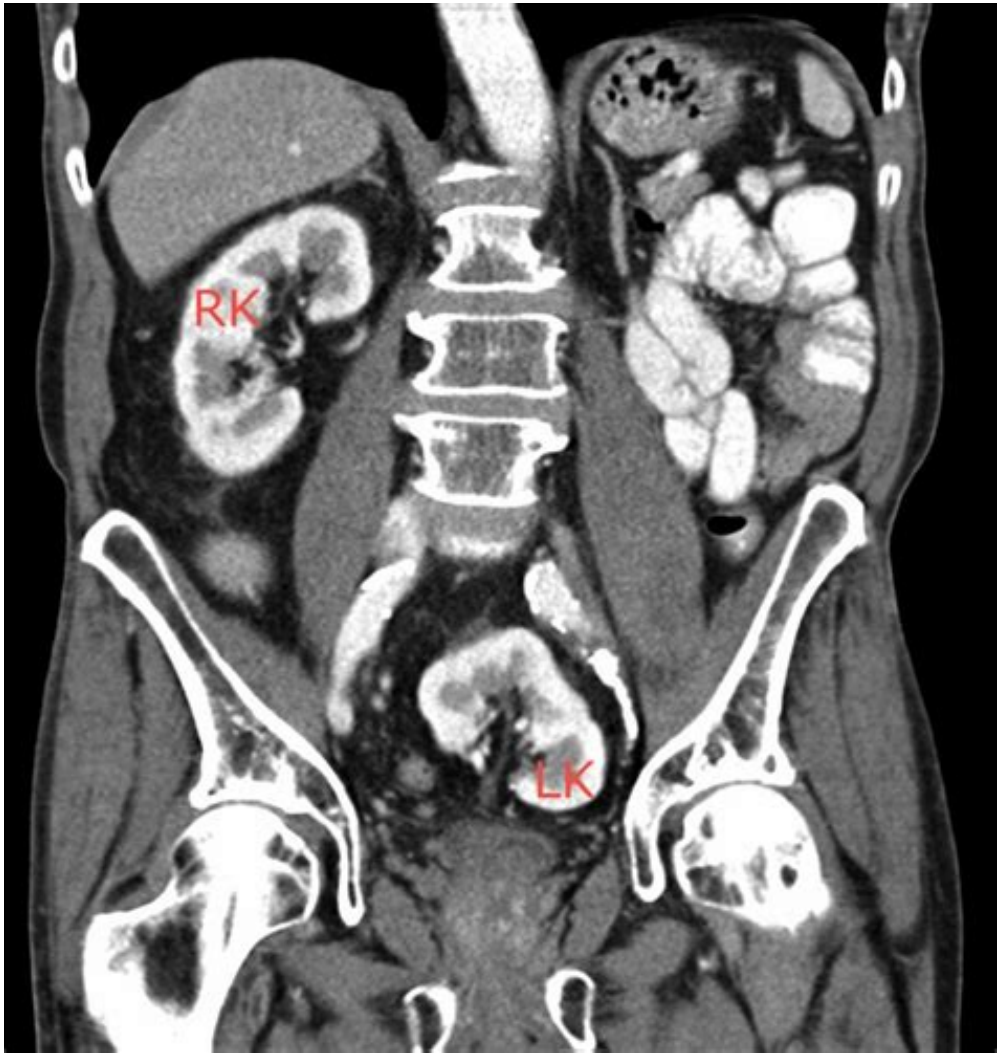
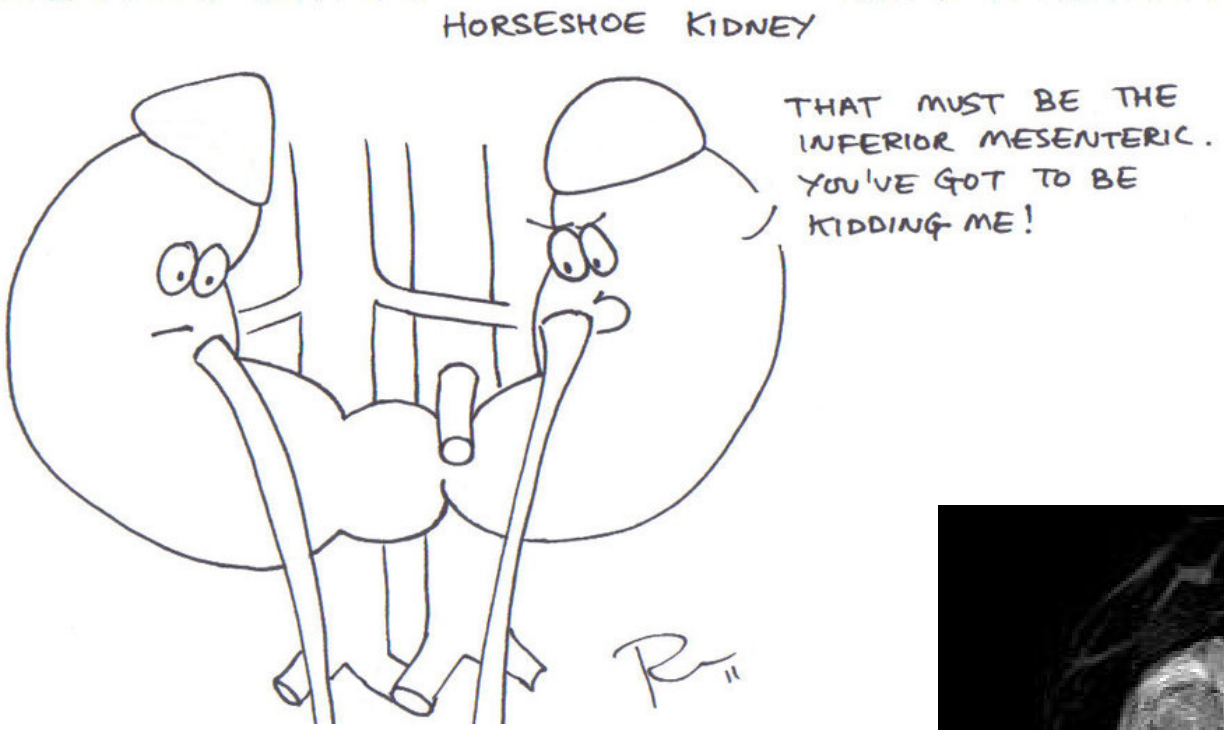
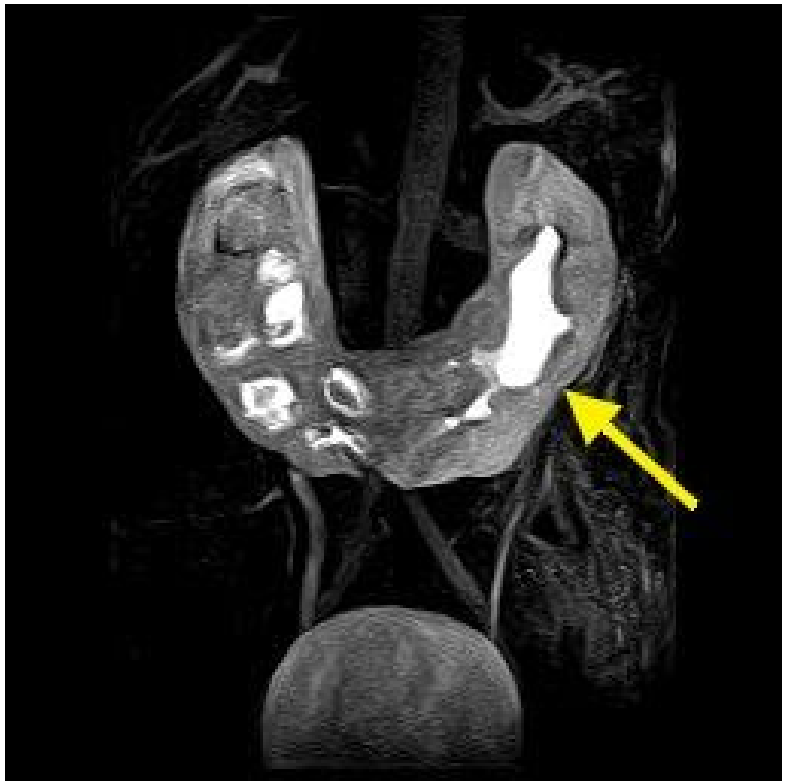


Photo credit: St Vincent's University Hospital





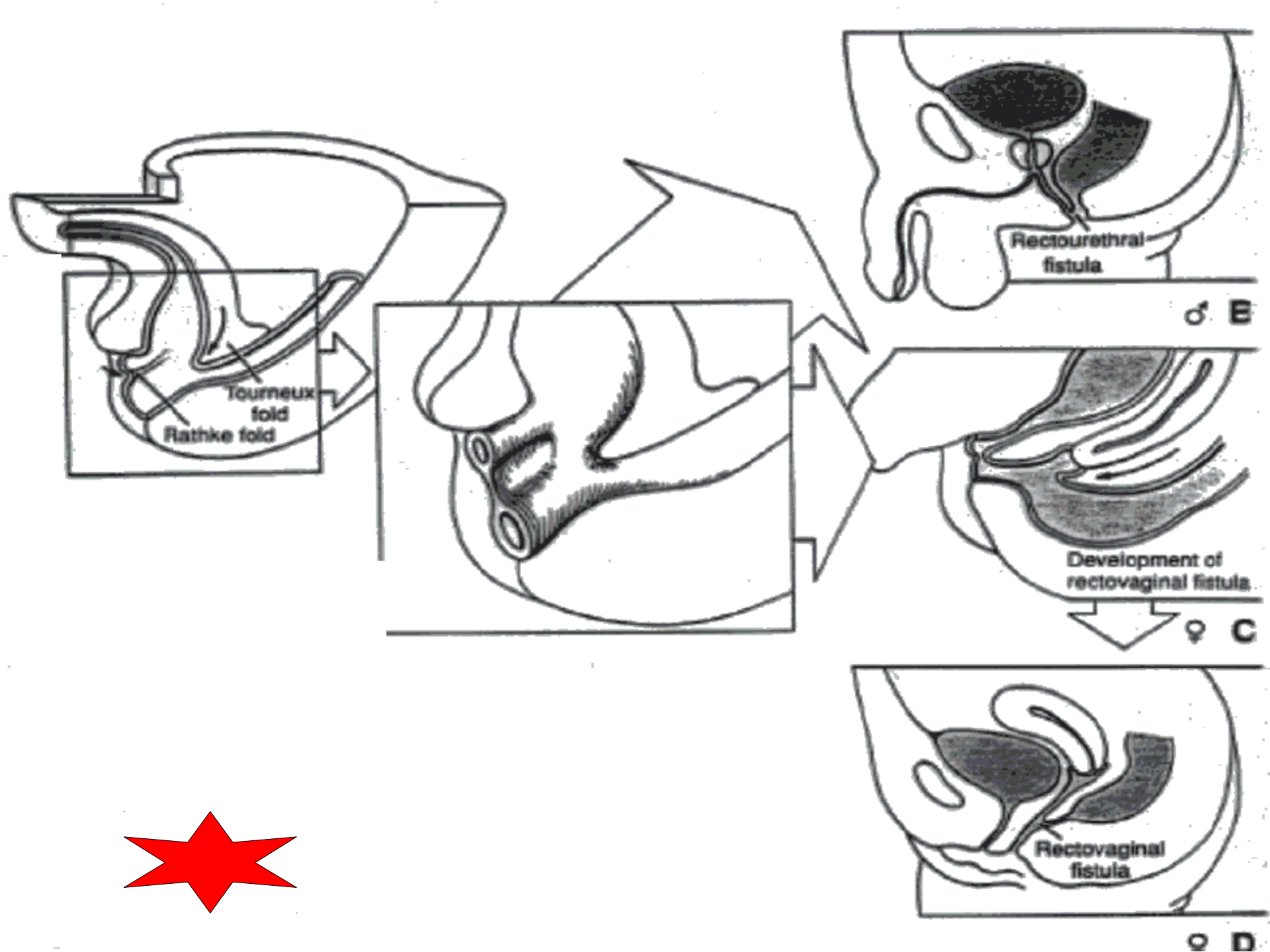
Cartoon: Moraxella, DeviantArt:

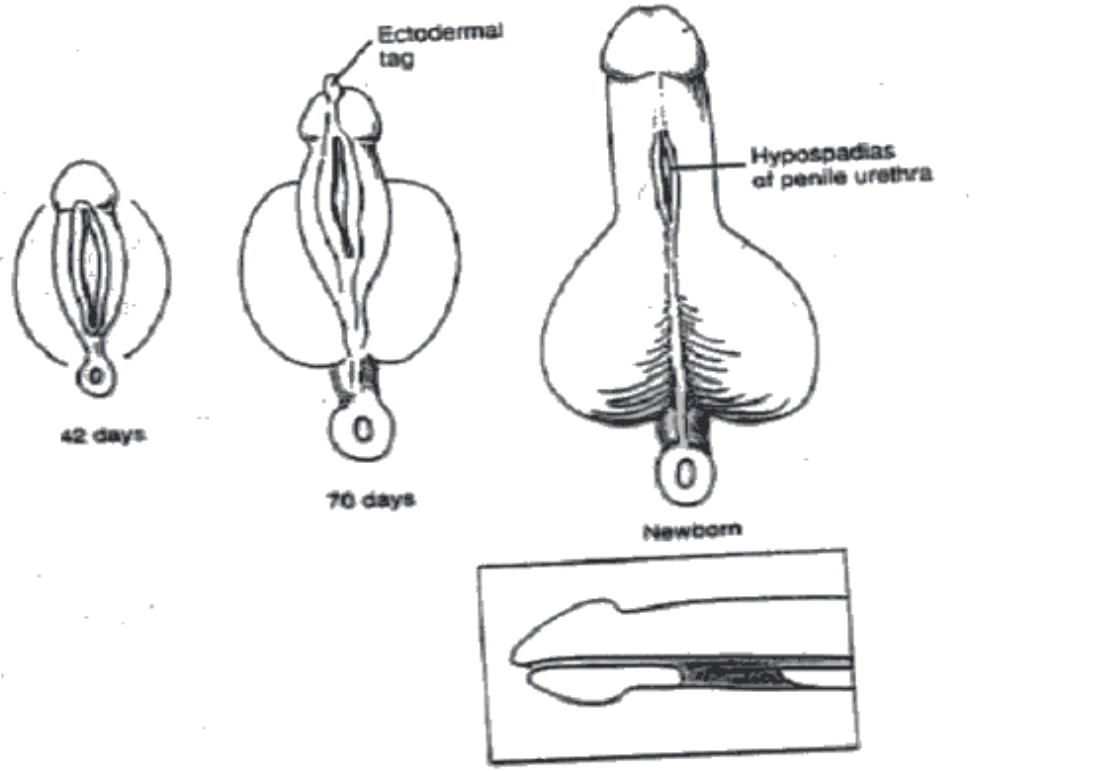
Congenital Abnormalities of Cloacal Development

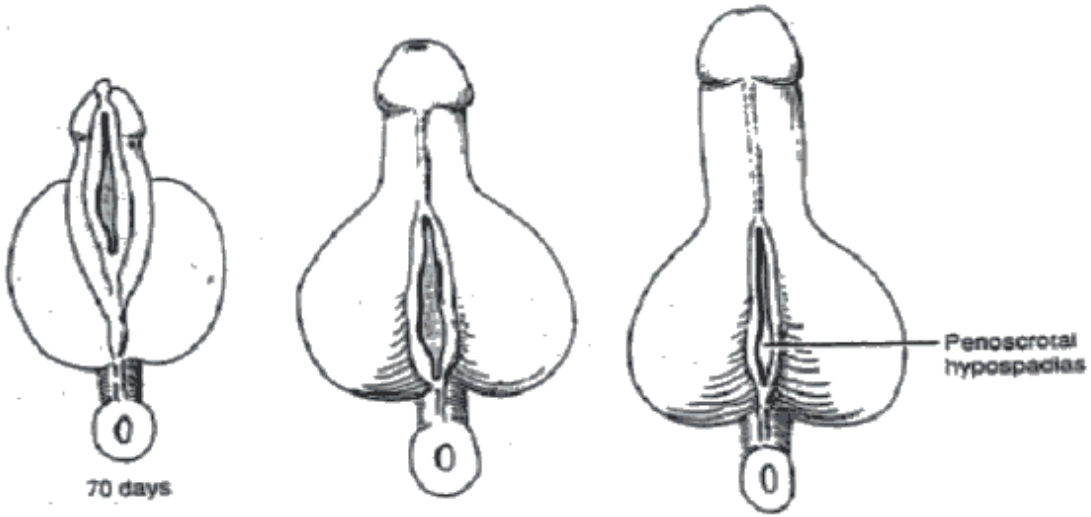
Failure of correct positioning of Rathke and Tourneaux folds results in;

- Rectovaginal fistula
- Rectoprostatic fistula
- Rectoclocal canal (rectum, vagina and urethra unite inside body).

In males, incomplete migration of the urethral groove from the base of the penis to its tip results in hypospadias.


Tourneux fold
Rathke fold
Rectourethral fistula
♂ B
Development of rectovaginal fistula
♀ C
Rectovaginal fistula
♀ D


Ectodermal tag
Hypospadias of penile urethra
42 days
70 days
Newborn


Penoscrotal hypospadias
70 days