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Named after S. I. Georgievsky

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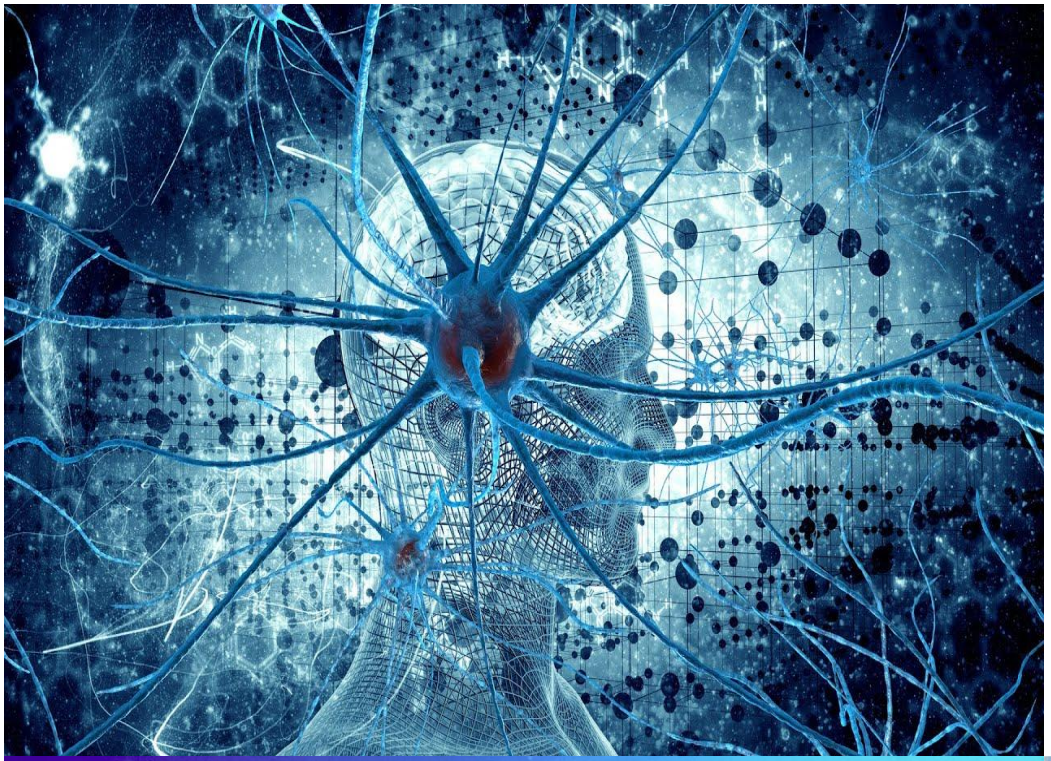
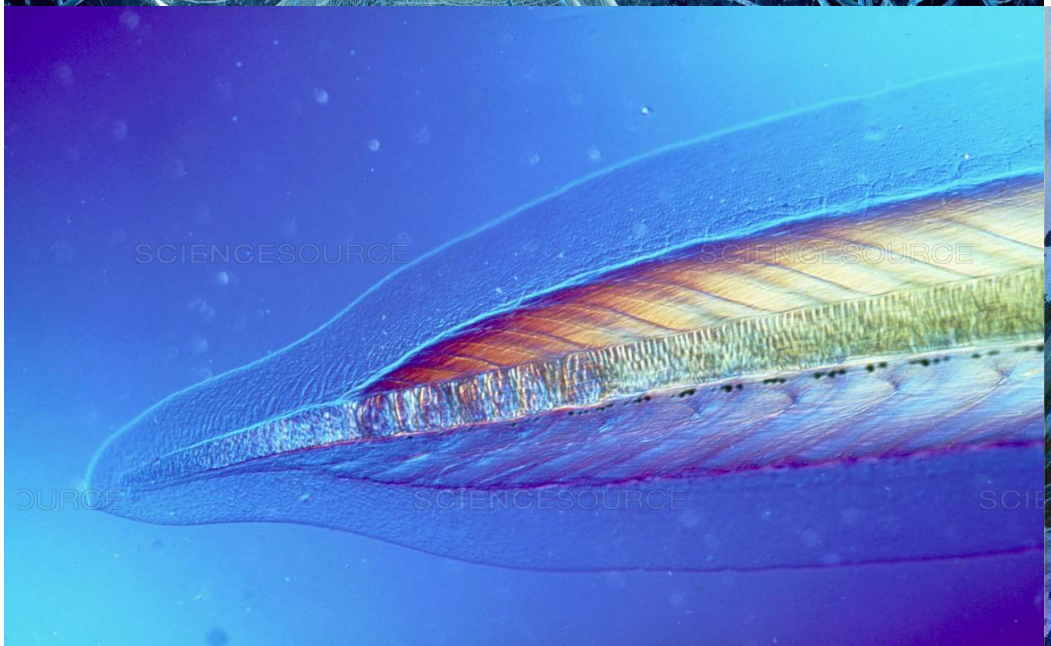
Lancelet- its importance in evolution

PHYLOGENESIS OF CHORD AVIAN EXCREATORY SYSTEM

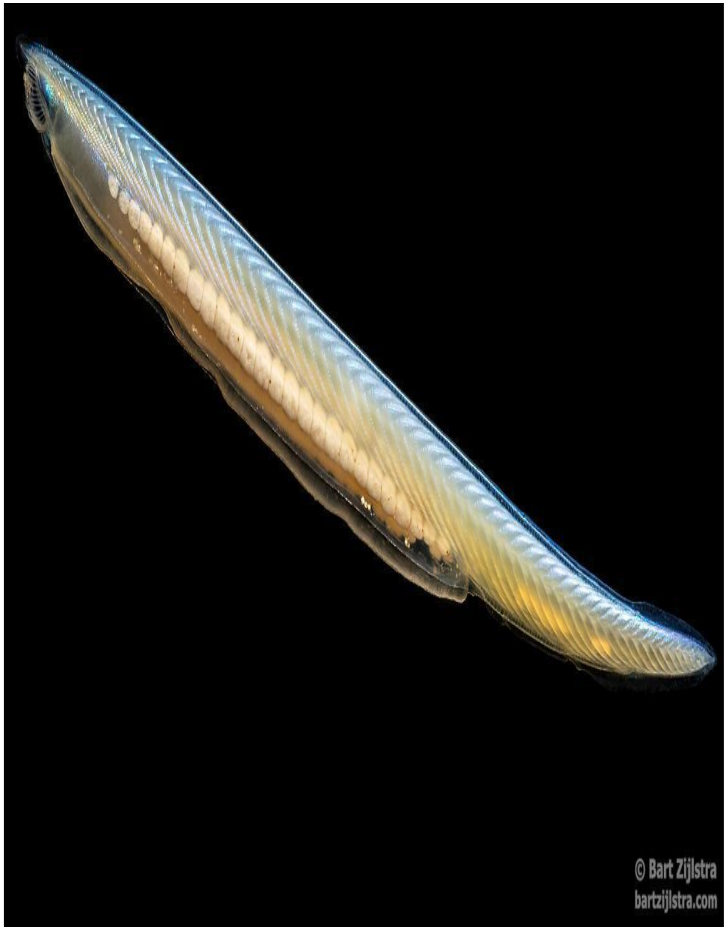
DEVELOPMENTAL DISORDERS OF THE EXCREATORY SYSTEM IN HUMANS





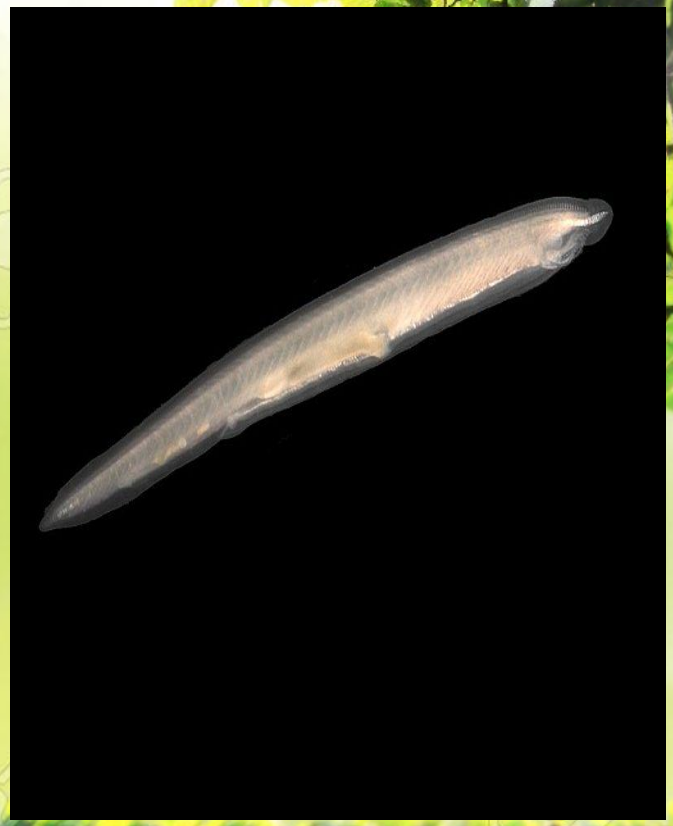
Lancelet

- The **lancelets** also known as **amphioxi** (singular: **amphi xus**), consist of some 30–35 species of "fish-like" benthic filter feeding chordates [n the order **Amphioxiformes**. They are the modern representatives of the subphylum Cephalochordata



SCIENTIFIC CLASSIFICATION

Kingdom:	Animalia
Phylum:	Chordata
Subphylum:	Cephalochordata
Class:	**Leptocardii** Müller, 1845
Order:	**Amphioxiformes** Obscure, 1886
Families	
•Asymmetronidae •Branchiostomidae	
Synonyms	
Branchiostomiformes	



HABITAT

- Lancelets are distributed in shallow subtidal sand flats in temperate (as far north as Norway), subtropical and tropical seas around the world.
- The only exception is *Asymmetron inferum*, a species known from the vicinity of whale falls at a depth of about 225 m (738 ft).
- Although they are able to swim, adult amphioxi are mostly benthic. They live in sandy bottoms whose granulometry depends on the species and the site, and they are usually found half-buried in sand.

Feeding

- *Their habitat preference reflects their feeding method: they only expose the front end to the water and filter-feed on plankton by means of a branchial ciliary current that passes water through a mucous sheet. Branchiostoma floridae is capable of trapping particles from microbial to small phytoplankton size,while B. lanceolatum preferentially traps bigger particles (>4 µm).*

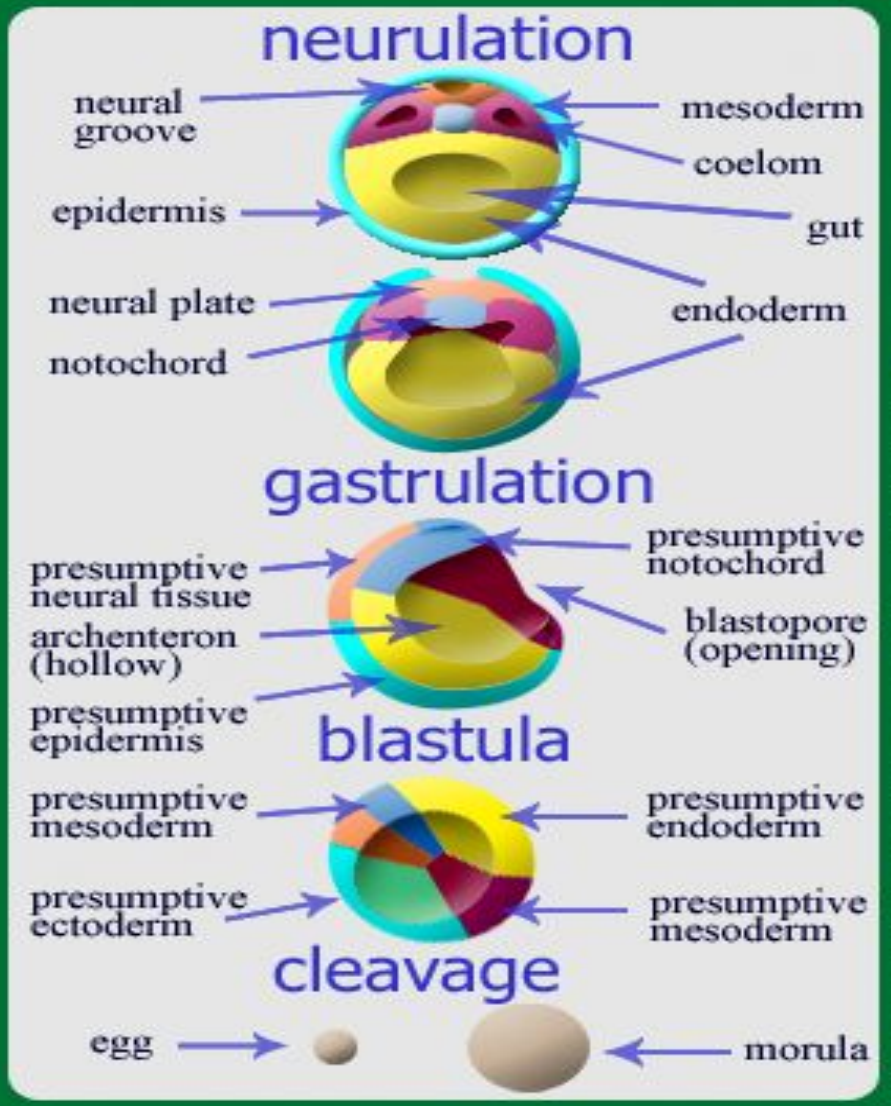
Reproduction and spawning

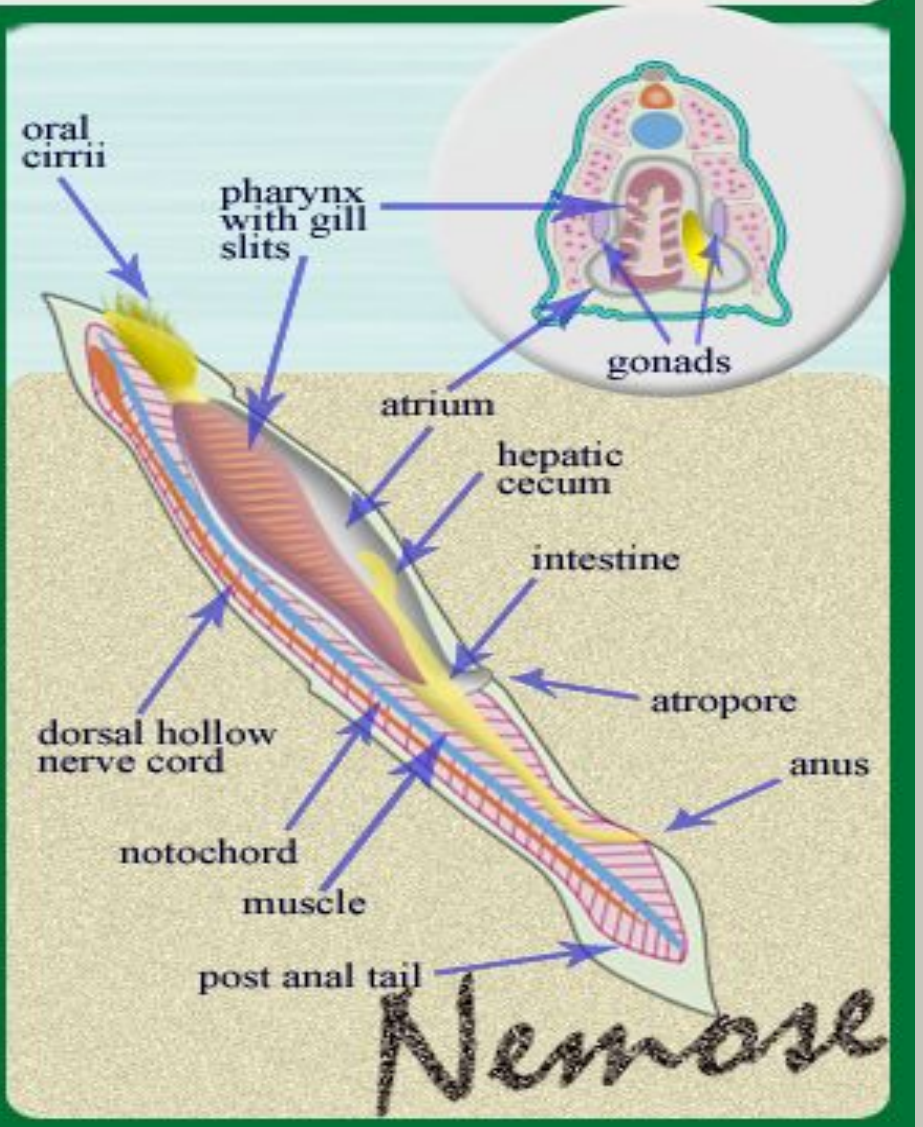
- Lancelets are gonochoric animals, i.e. having two sexes, and reproduce via external fertilization. They only reproduce during their spawning season, which varies slightly between species - usually corresponding to spring and summer months.
- All lancelets species spawn shortly after sunset, either synchronously (e.g. *Branchiostoma floridae*, about once every 2 weeks during spawning season) or asynchronously (*Branchiostoma lanceolatum*, gradual spawning through the season.

Importance in evolution

- Amphioxus or lancelets have been regarded as a key animal in understanding the origin of vertebrates. However, the evolutionary history within this lineage remains unexplored. As the amphioxus lineage has likely been separated from other chordates for a very long time and displays a marked left-right asymmetry, Its evolutionary history is potentially helpful in better understanding chordate and vertebrate origins. We studied the phylogenetic relationships within the extant amphioxus lineage based on mitochondrial genomes incorporating new Asymmetron and Epigonichthys populations, and bosed on previously reported nucléar transcriptomes.

Development and anatomy of *Branchiostoma floridae*

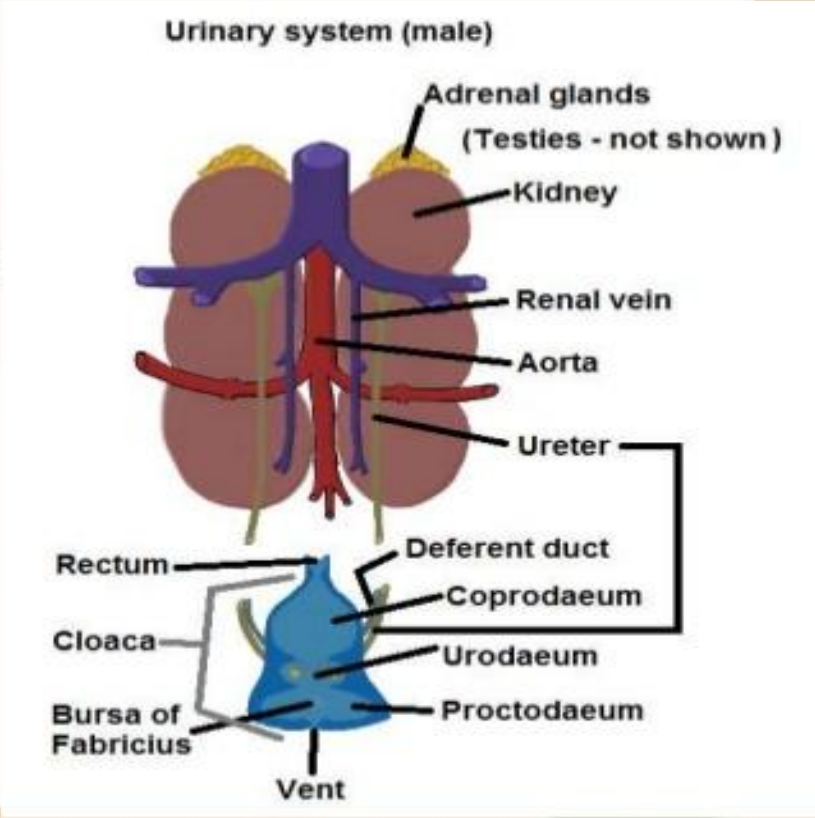




EVOLUTION OF AVIAN EXCREATORY SYSTEM

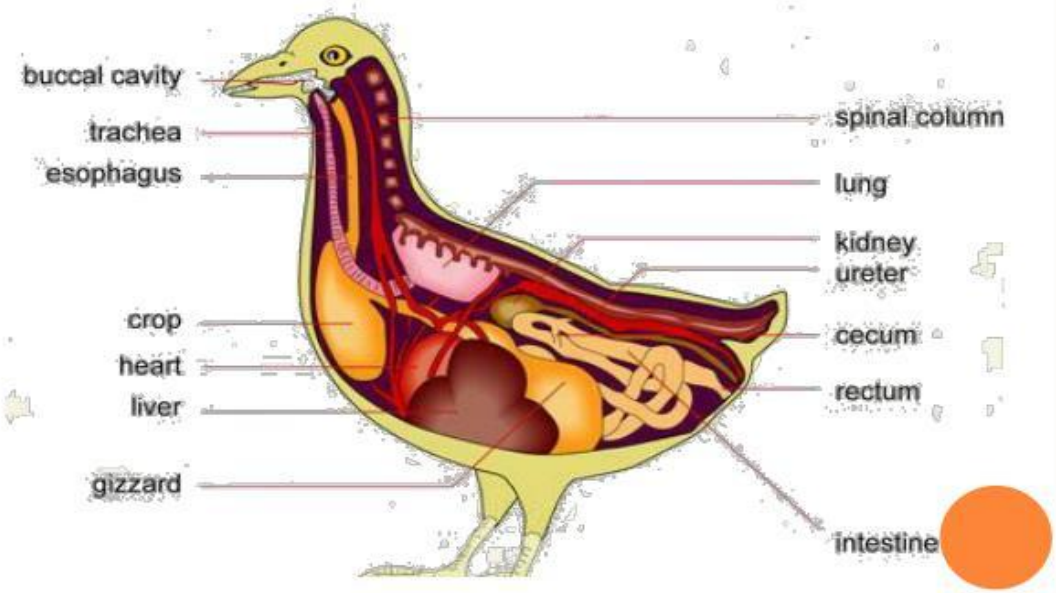
URINARY SYSTEM

- Major organs are the kidneys, the ureter and the cloaca.
- Two kidneys, each with a ureter that carries the urine produced by the kidneys to the cloaca where it leaves the body .
- **No urinary bladder** in bird.



Avian Excretory System

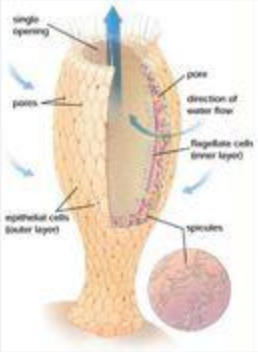
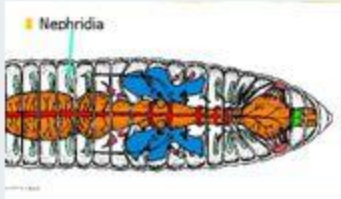
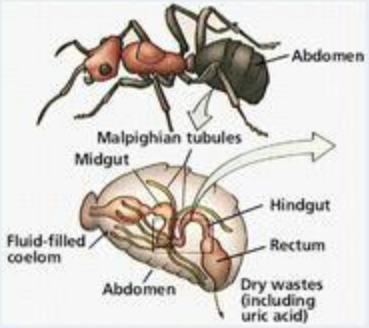
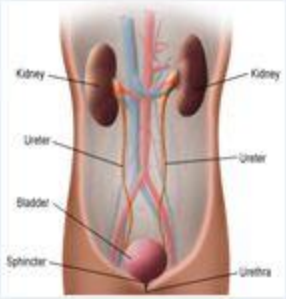
- The excretory system is efficient and lightweight.
- It does not store waste liquids in a bladder.
- Instead, birds convert nitrogenous waste to **uric acid**, which is concentrated into a harmless white paste.
- The uric acid travels to the **cloaca** and is eliminated.



Excretory System

Evolutionary Trends in Excretion

Simple → Complex

Animal Taxon	Aquatic Invertebrates	Worms and Mollusks	Insects	Vertebrates
Release Wastes By…	*diffusion* to remove waste across their cell membranes directly into the water	Use of nephridia- tiny pores along the body excrete wasste	Using malpighian tubules to collect and excrete wastes	Use of kidneys, ureters, and a bladder to collect and excrete waste
Picture of system				
Examples	Sponges, jellyfish, planaria	Earthworm, clam, octopus	Grasshopper, ants, bees	mammals, birds, reptiles, fish, amphibians

HISTORY

- Studies of the embryonic development of primitive vertebrates, such as the dogfish shark, clearly show that the excretory system arises from a series of tubules, one pair in every segment of the body between the heart and the tail. This continuous series of tubules constitutes the archinephros, the name implying that the kidney of the ancestral vertebrate had some such form as this. Each tubule opens internally to the body cavity and may, in the remote past, have opened separately to the exterior; but in all living vertebrates the tubules open on each side into a longitudinal duct, the archinephric duct

- . At the posterior end of the body cavity the two archinephric ducts unite before opening to the exterior. Later in development, Bowman’s capsule arises as a diverticulum of each tubule, subsequently becoming indented by the glomerulus. Eventually, the tubules usually lose their internal openings to the body cavity. The most anterior tubules of the archinephros (pronephros) usually degenerate in the adult.
- In the reptiles, birds, and mammals there is greater separation of function, the mesonephros being exclusively genital and the metanephros being exclusively urinary.

DIFFERENCE BETWEEN AVIAN AND MAMMALIAN KIDNEY

- Two types of nephron (mammalian nephron and reptilian nephron)
- Renal portal system
- Uric acid (in mammals urine is made up of urea while in case of birds it is composed of crystals of uric acid)
- Post renal urine modification

DEVELOPMENTAL DISORDERS OF EXCREATORY SYSTEM IN HUMANS

- AUTOSOMAL DOMINANT POLYCYSTIC KIDNEY DISEASE
- ALPORT SYNDROME
- FABRY DISEASE

Autosomal dominant polycystic kidney disease

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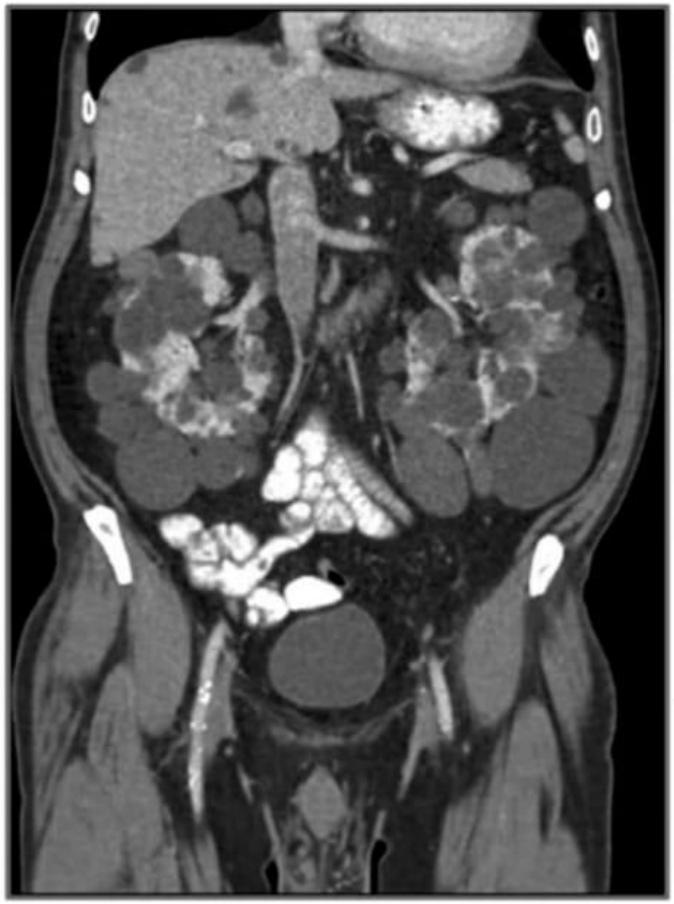
- **Most common** inherited kidney disease (prevalence of 1/500)
- Mutations in genes *PKD1* or *PKD2*, **defective ciliary proteins**; Polycystin1 or Polycystin2; *PKD1* mutation is worse
- Symptoms: Renal failure, hypertension, intermittent hematuria, pain, nephrolithiasis (stones), infections (and pyelonephritis)
- Extrarenal: **cysts** (liver, pancreas, ovaries); aneurysms (coronary, thoracic, intracranial); MV prolapse; male infertility
- Prognosis: larger kidney = worse; no treatments



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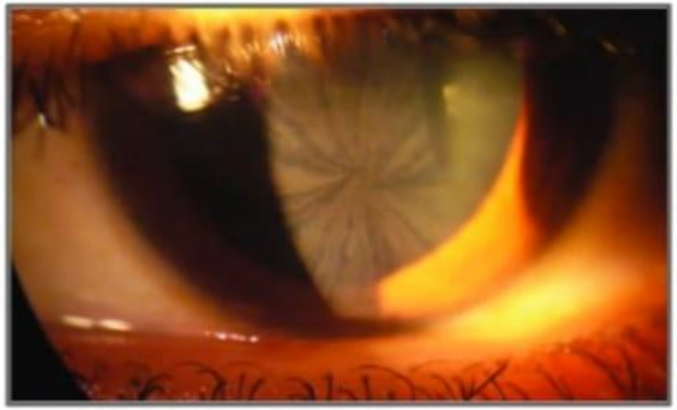
Alport syndrome

- **X-linked**, dominant or recessive (prevalence of 1/4000)
- Mutations affecting **GBM collagen type 4** (α5 chain most common, α3 and α4 less common, not x-linked)
- Symptoms: **blood in urine** (carriers have microscopic hematuria), protein in urine; hearing loss; visual loss (lenticonus); benign smooth muscle tumors (leiomyomas)
- Electron microscopy: **splitting of basement membrane** (lamellation) and **alternating thickening and thinning** of BM
- Biopsy isn't always reliable; diagnose with genetic testing

Fabry disease

X-linked, recessive (prevalence of 1/3100)
Mutations affecting **enzyme α-galactosidase A**; glycosphingolipids accumulate in cells
Renal: proteinuria; decreased eGFR; 50% get ESRD by 50 y/o
Multisystemic symptoms: angiokeratomas on skin of trunk and groin; corneal whorl in the eye; diarrhea; early artherosclerotic disease and heart failure; pain/numbness/tingling in fingers/toes (acroparesthesias)
Diagnose: α-galactosidase levels in men; genetic testing in women



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waving
GREEN
GOODBYE
What Causes Mildew And How To Get Rid Of It