



# Lecture 1 – Fish classification and the properties of water

# Introduction



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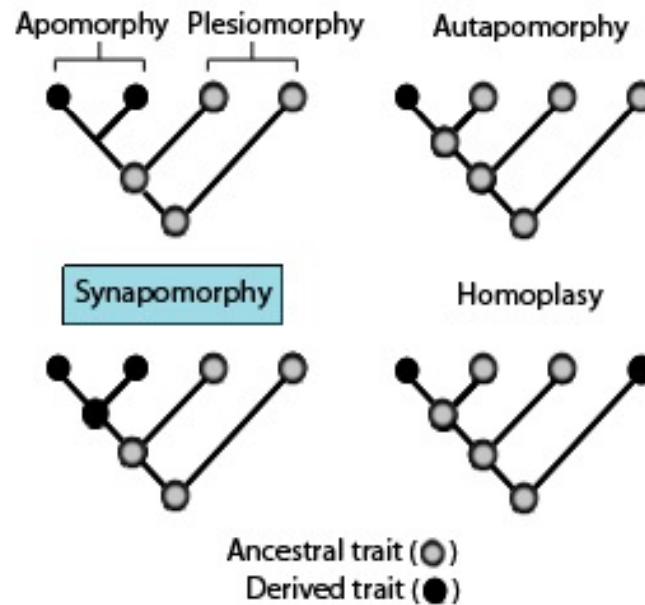
- 'What is a fish'? We all use the term Fish regularly but the term fish is not a natural group of animals in the way the terms Reptiles or Birds are.
- When scientists arrange living things into groups for classification they try to make the classification system they use represent the actual relationships between those living things and not just group things that look similar.
- Simply, all living things are divided up into a series of classifications delineated as:- Kingdom, Phylum, Class, Order, Family, Genus and species (but you get sub and super versions of all these classifications).
- The more categories that two organisms share the more closely they are related.
- The term 'Fish' does not fit into any of these categories. This is because it is a general term not a scientific one.

# Modern Systematics

**Pleisiomorphy** – an ancestral or primitive character

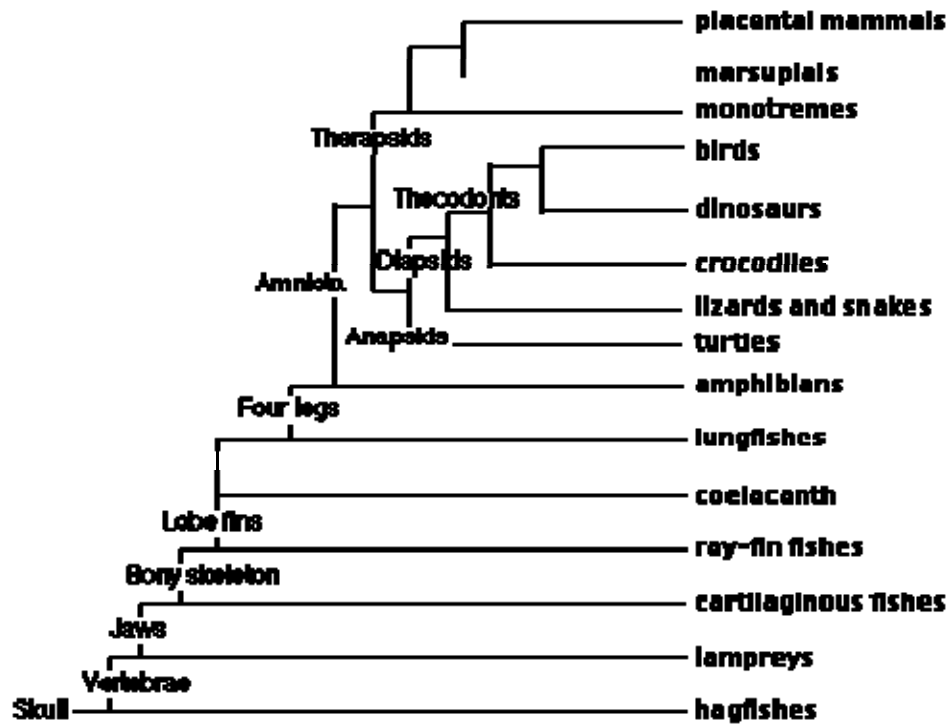
**Apomorphy** – a derived or specialised character.

**Synapomorphy** – trait that is shared by two or more taxa and their most recent ancestor



**Cladistics** uses **synapomorphies** to construct a **cladogram**

Archosauria  
expanded pneumatic  
sinuses in their skulls



It is not about looks

The term **fish** is actually used to describe any animal that is part of the Subphylum Vertebrata but is not a member of the Classes Amphibia, Reptilia, Aves (Birds) or Mammalia.

The Subphylum Vertebrata	
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<b>Class</b>	<b>Common Name</b>
Myxini	Hagfish (Fish)
Cephalaspidomorphi	Lampreys (Fish)
Chondrichthyes	Sharks and Rays etc.(Fish)
Osteichthyes	Trout and Salmon etc.(Fish)
Amphibia	Amphibians
Reptilia	Snakes, Turtles etc.
Aves	Birds
Mammalia	Cats, Cows and People

Three extant (still living and antonym of extinct) groups of fishes:

1. Jawless fishes (only vertebrates without jaws)
2. Jawed cartilagenous fishes (skeleton is predominantly cartilage)
3. Jawed bony fishes (skeleton is predominantly bone)

All classifications have two SUPERCLASSES with the number of CLASSES differing between them.  
Note : SUBCLASS is also known as an ORDER

Classification after Nelson (1994)

*Nelson, J.S. (1994). Fishes of the World (3rd ed.). J. Wiley and Sons, Canada.*

**Bold denotes not found in Africa**

PHYLUM Chordata: possess a notochord (slim and flexible rod that supports the body) at some point in their lives

SUBPHYLUM Vertebrata: possess vertebral column of backbone.

SUPERCLASS Agnatha: Jawless vertebrates (all are fish) .

SUPERCLASS Gnathostomata: Vertebrates with jaws, including fish.

CLASS Chondrichthyes: cartilagenous fish

SUBCLASS Elasmobranchii: slitlike gill openings.

SUBCLASS Holocephali: Chimaera (ratfish).

CLASS Actinopterygii: ray-finned fishes

SUBCLASS Chondrostei: primitive ray-finned fish: sturgeons, paddlefish, bichirs.

SUBCLASS Neopterygii: modern ray-finned fish: gars, bowfins

DIVISION Teleostei: advanced neopterygians.

CLASS Sarcopterygii: fleshy-finned fishes and tetrapods.

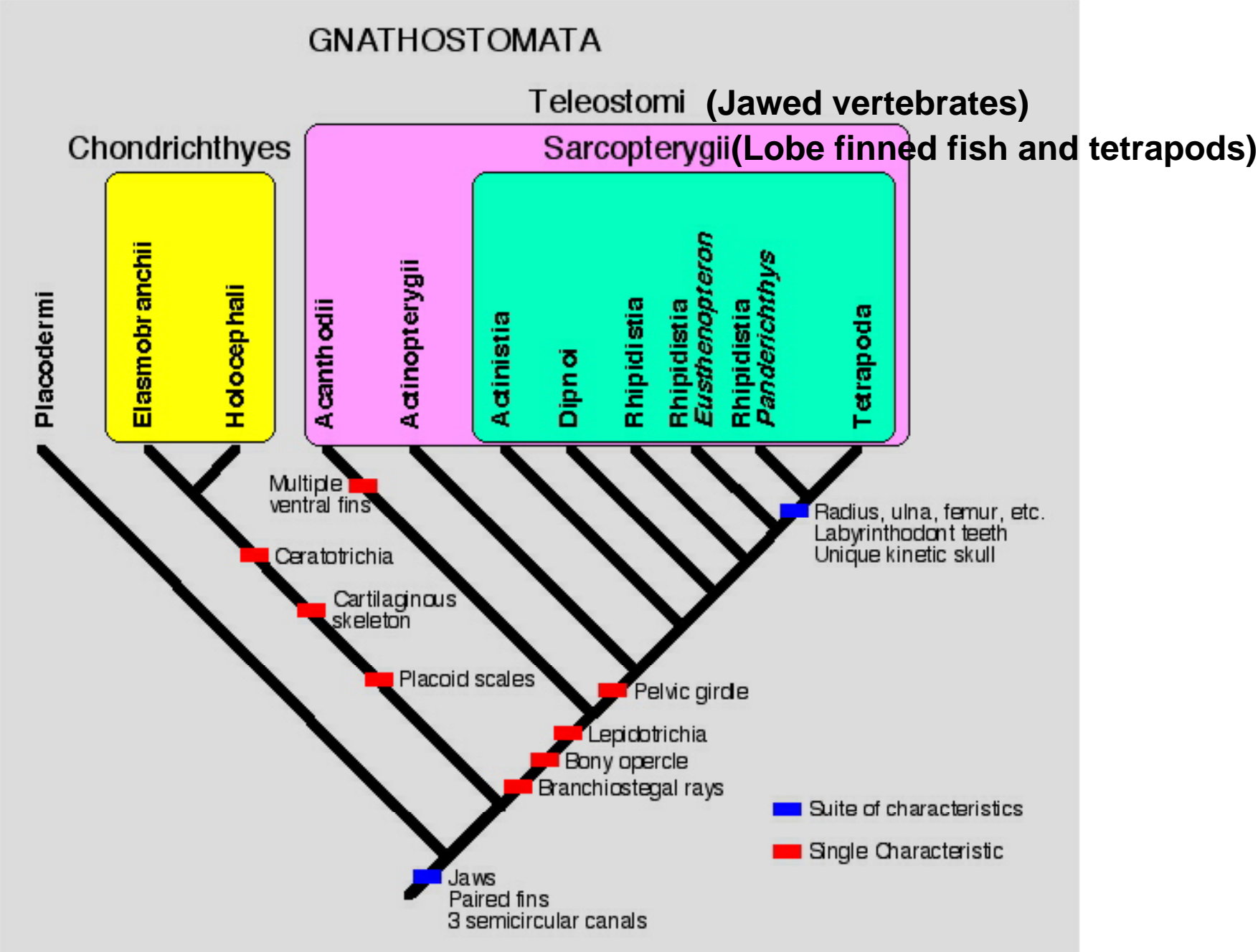
SUBCLASS Coelacanthimorpha: coelacanths

SUBCLASS Dipnoi: lungfishes

SUBCLASS Tetrapoda

**NOTE the absence of the CLASS Osteichthyes – this has been condensed into the Actinopterygii**

# Synapomorphies to construct a cladogram vertebrates including fishes





# Binomial nomenclature

- **Binomial nomenclature:** a two name system for writing scientific names. The **genus** name is written first (always Capitalized).  
The **species** name is written second (never capitalized).  
Both words are italicized or underlined.
- "Formal" scientific names should have a third part, the **authority**. The authority is not italicized or underlined.  
An example is *Argyrosomus coronus* (Griffiths and Heemstra 1995)
- The authority can be written as an abbreviation of the last name of the person responsible for naming the organism.



# Describing species

- Excerpt from Burchell's work describing *Clarias gariepinus*
- Modern systematics is more complicated
- You need to compare the “new species” with the “types” of its closest relative (museums).
- diagnose differences (morphological or molecular), develop a key for identification.
- Name the new species (etymology)
- Describe occurrence and ecology
- Describe the material examined

# ANATOMY OF FISHES

- There are roughly 28 000 known species of fish today but many more are being described every year.
- Within those 28 000 species there is huge variation in morphology



## But which factors control the shape that a fish takes?

Many factors are involved but perhaps the most important is where the fish lives – WATER



Any understanding of fishes and their anatomy requires some understanding of this medium

Water imposes or relaxes constraints on basic physiological, morphological and ecological developments. – what do I mean when I say that? Give me some examples.

# Water is the common medium

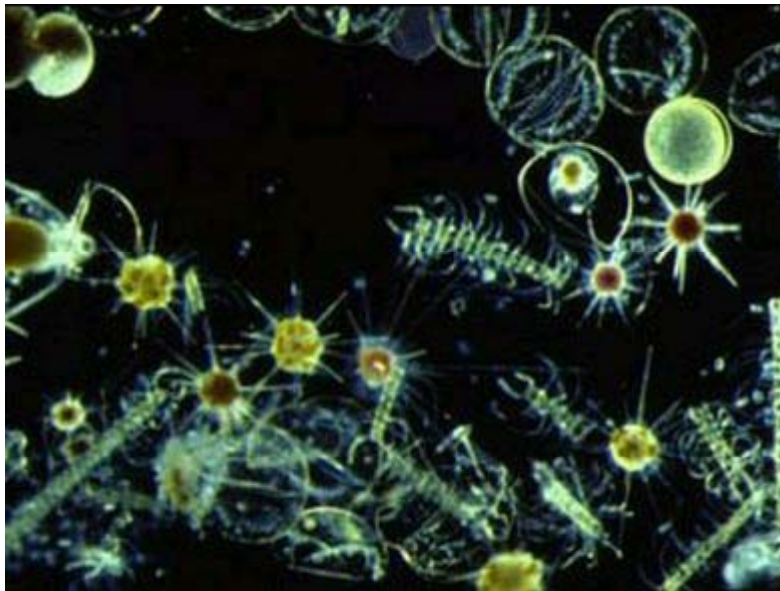
- Fish eat, live and reproduce in H<sub>2</sub>O
- These habitats are often interconnected –  
sea ↔ estuary ↔ freshwater

They can become isolated – can lead to high diversity



# It provides stability and predictability

- Stable and constant (but depends on size and SA:VR)
- Temperature is buffered
- Supports food
- Allows external fertilization



[www.reefresilience.org](http://www.reefresilience.org)

# Universal solvent

- Complex mix of gases, salts and minerals
- Absorbed through gills and even through skin
- Water has low O<sub>2</sub> saturation-gills have to be efficient to extracting it.
- There is passive diffusion across membranes in and out of fish from freshwater and saltwater - therefore places constraints – fish need to osmoregulate.

# Density

- It is 800 X denser than air! (caused development of streamlining) most are a torpedo shape
- Highly viscous to objects with High SA:VR
- Provides bouyancy support (if there is additional air or oil in the body) – fish don't need large heavy bones to counteract gravity





# Incompressibility

- Air is a liquid as is  $H_2O$ . Movement of a fluid therefore can create lift
- $H_2O$  is almost non-compressible -> drag and turbulence
- Sensory systems can detect immediate pressure changes -> lateral line
- Lateral line highly developed in fishes inhabiting turbid water



# Incompressibility

- NB for feeding and breathing
- Suction (extension of mouth and operculum) can be created using a pipette effect (SEA HORSES)
- Breathing in terms of ramming water across gills
- Incompressibility allows for hearing -> otoliths in middle ear and Weberian apparatus
- Each 10m in depth = 1 atm therefore at greater depths high pressure requires less calcification in skeleton and reduced need for bouyancy



# Productivity and diversity

- Low light penetrability
  - >1000m there is no light
  - productivity is restricted to euphotic zone
  - Strong horizontal distribution of fishes
  - Continental shelf has high diversity BUT low abundance



END lecture 1