Fish Diversity, Adaptations & Physiology

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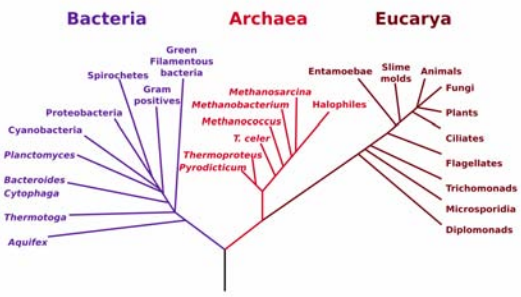
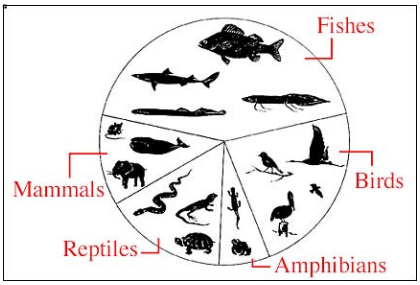
Phylogenetic Tree of Life



Animal Diversity



Fish Diversity

- **Class Agnatha (jawless fishes)**
- **Class Chondrichthyes (sharks, skates, rays)**
- **Class Osteichthyes ("boney fish")**

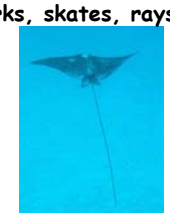
Fishes are the most diverse group of vertebrates

Fish Diversity

Class Agnatha (jawless fishes):
Lamprey, hagfish

Fish Diversity

Class Chondrichthyes (sharks, skates, rays)
- Subclass Elasmobrachii
- Subclass Holocephali



Fish Diversity

Class Osteichthyes ("boney fish")

- Subclass Sarcoptyergii (fleshy-fin fishes)

Crossopterygians (*Latimera*)

Dipnoi (lungfish)

Fish Diversity

Class Osteichthyes ("boney fish")

- Subclass Actinopterygii (spiney-fin fishes)
- Infraclass Chondrostei (reedfish, sturgeon, paddlefish)

Fish Diversity

Class Osteichthyes ("boney fish")

- Subclass Actinopterygii (spiney-fin fishes)
- Infraclass Holostei (gars and bowfin)

Fish Diversity

Class Osteichthyes ("boney fish")

- Subclass Actinopterygii (spiney-fin fishes)
- Infraclass Telostei (most other boney fish)

Viva la difference

- Renal, pancreatic, rectal
- Bouyancy (swim bladder vs liver)
- Sensory (LL, tastebuds, barbels, weberian ossicles, pseudobranch, smell)
- Teeth (max, premax, vomer, palatine, hyoglossal)
- Skin (mucus, taste, alarm, absorption)
- Gills (respiration, ionic balance, absorption)
- Communication (alarm, sound, color)
- Gut (+/- stomach, length, pyloric caecae, pneumatic duct)
- Electric (reception and production)
- Light production
- Reproduction

Sex in Fishes

Hermaphroditism

- **Functional / non-functional**
- **Sequential**
  - **protandrous**
  - **protogynous**

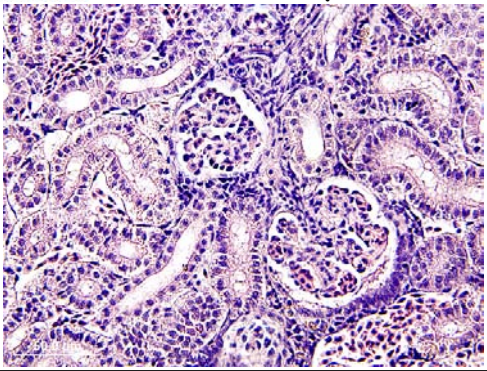
Midnight parrotfish

Internal Anatomy

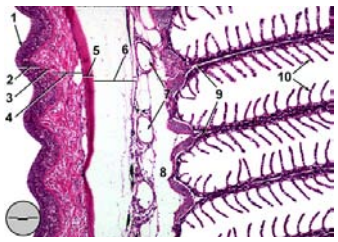
Fish Renal System

- anterior / posterior kidneys
- structure differences
- glomerular / aglomerular
- hematopoeisis
- ion regulation / gills

Fish Renal System

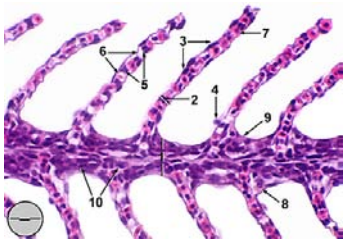


Gills



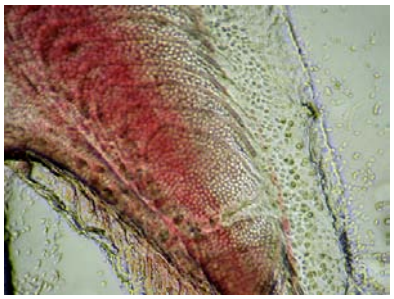
Gill arch: sagittal section (Bouins, H&E, Bar = 90.2 μm). 1. gill raker; 2. mucosal epithelium; 3. basement membrane; 4. submucosa; 5. bone; 6. adipose tissue; 7. sinous venules; 8. afferent branchial artery; 9. primary lamellae; 10. secondary lamellae.

Gills

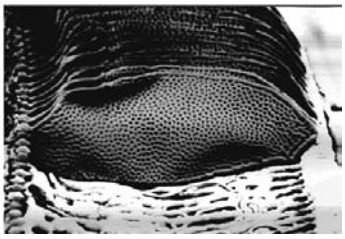


Gill filament, sagittal section (Formalin, H&E, Bar = 16.7 μm). 1. primary lamella; 2. secondary lamella; 3. epithelial cell; 4. mucous cell; 5. pillar cell; 6. lacuna (capillary lumen); 7. erythrocyte within capillary lumen; 8. chloride cell; 9. rodlet cell; 10. undifferentiated basal cell.

Gills

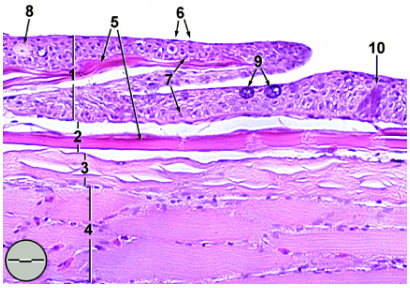


Gills



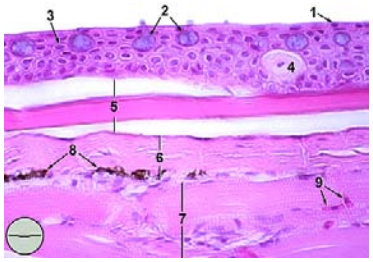
Gills

Skin



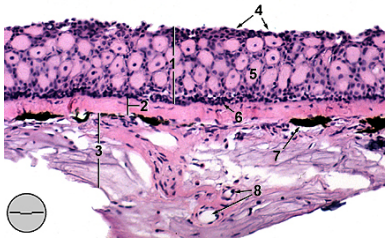
1. epidemis; **2.** scale pocket; **3.** dermis (stratum compactum); **4.** muscle; **5.** scales; **6.** squamous epithelial cells; 7. undifferentiated basal cells; **8.** alarm cell; **9.** mucous cells; **10.** taste bud.

Skin



1. squamous epithelial cells; **2.** mucous cells (expelling mucus);
3. cuboidal epithelial cells; **4.** alarm cell; **5.** scale pocket w/ scale;
6. dermis (stratum compactum); **7.** skeletal muscle;
8. chromatophores (melanocytes); **9.** red blood cells.

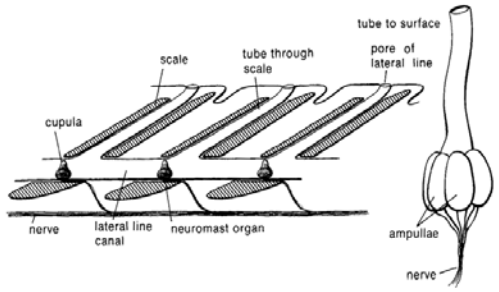
Skin



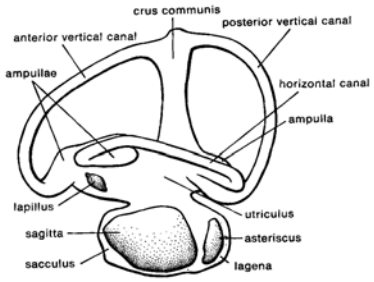
Alarm cells

1. epidermis; **2.** dermis (stratum compactum);
3. hypodermis (areolar connective tissue); **4.** epithelial cells;
5. alarm cells; **6.** wandering leukocytes; **7.** chromatophores (melanocytes);
8. arteriole and venule.

Lateral line & ampullae of Lorenzini



Fish Have Ears



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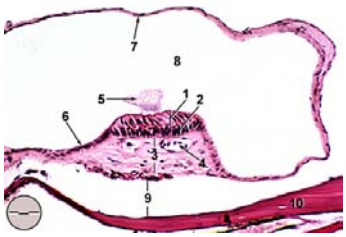
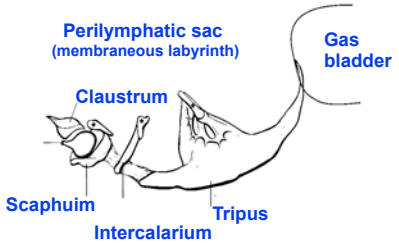


Crista in the ampulla of a semicircular canal (a) (Bouins, H&E, Bar = 31.6 μm).
1. ciliated sensory cells; 2. sustenticular supporting cells; 3. connective tissue;
4. blood vessel; 5. cupula (gelatinous matrix);
6. sensory cells of the ampullar epithelium; 7. squamous epithelium;
8. lumen of the ampulla; 9. areolar connective tissue; 10. cranium.

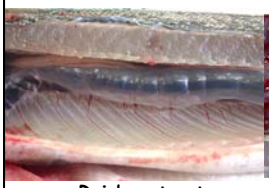
Weberian ossicles



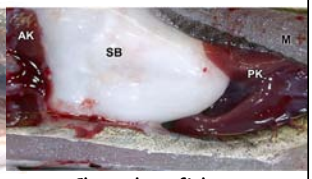
horned dace (*Semotilus atromaculatus*)

Swim bladder

- sound (2-way), bouyancy
- physostomous / physoclistis
- active secretion / rete mirable
- passive secretion / pneumatic duct, oval gland



Rainbow trout



Channel catfish

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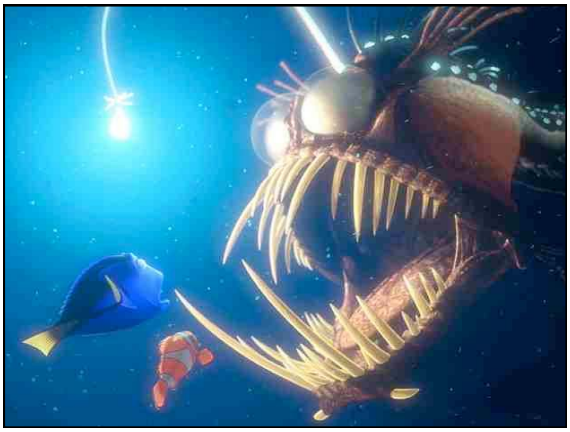
Sex in Fishes



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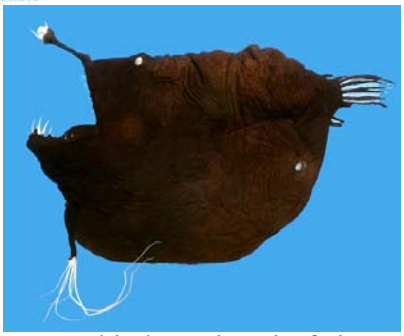
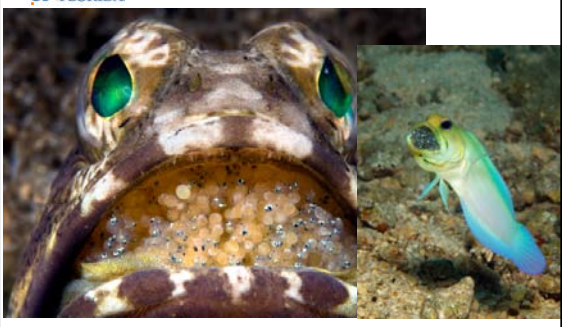
Sex in Fishes



Double baited anglerfish

Sex in Fishes



Banded jawfish, male

Sex in Fishes

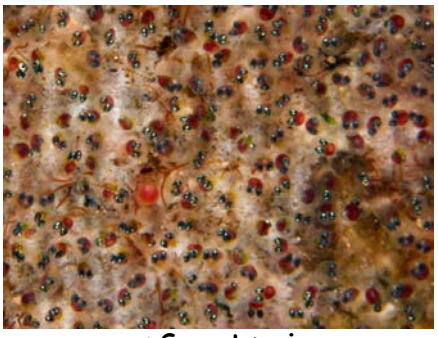
Paternal care:

Seahorses

Sex in Fishes

Mouth brooding in tilapia

Sex in Fishes



anSeargt major eggs

Dentition

Sanddiver

Dentition

Midnight parrotfish

Sex in Fishes

Reef scorpionfish

Sex in Fishes

Peacock flounder, male

Fin adaptations

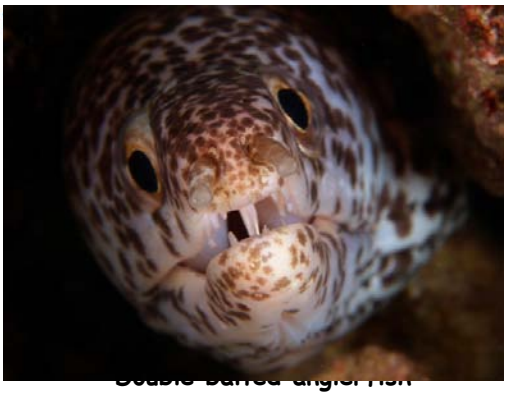
Flying gunaurd

Camouflage

Countershading

Camouflage

Symmetry



Double baited anglerfish

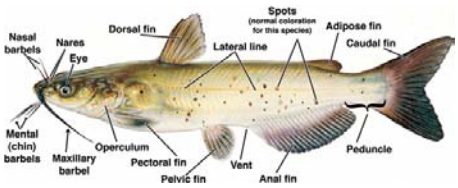
Sex in Fishes

Lesser electric ray

Sex in Fishes

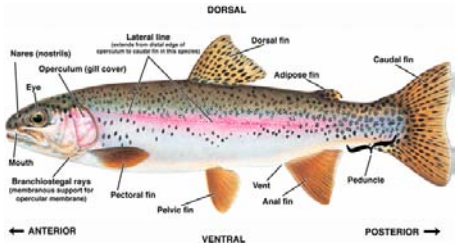
Double baited anglerfish

Sex in Fishes



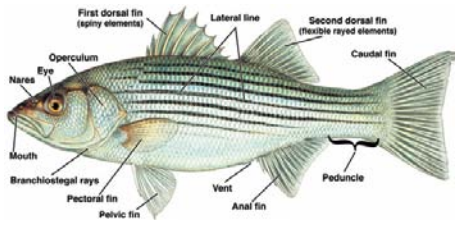
Double baited anglerfish

Sex in Fishes



Double baited anglerfish

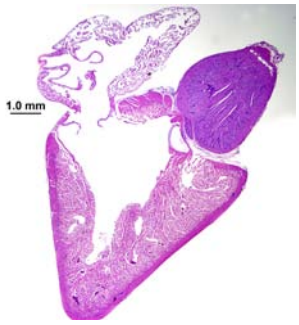
Sex in Fishes



Double baited anglerfish

Bluegill internal anatomy

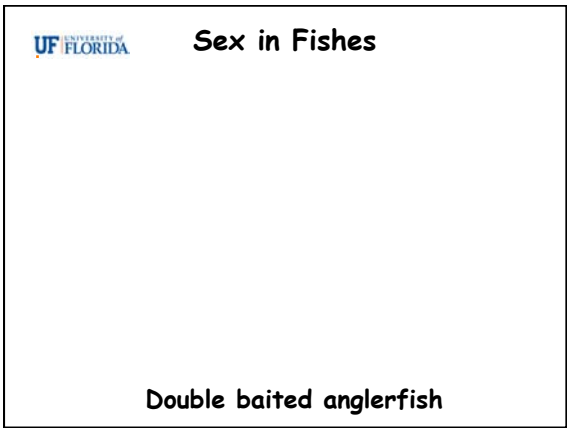
Sex in Fishes



Sex in Fishes

Double baited anglerfish

Sex in Fishes



Double baited anglerfish