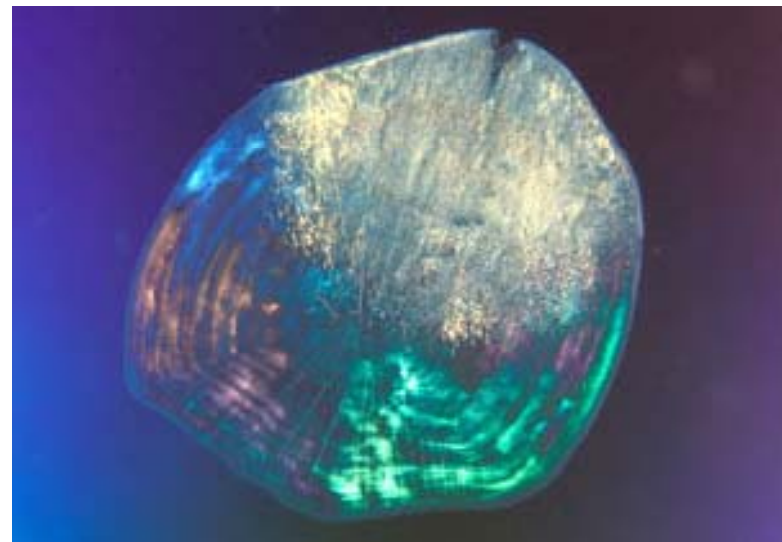


# Lecture 6 – Integument - Scale

- A **scale** is a small rigid plate that grows out of an animal's skin to provide protection.
- Scales are quite common and have evolved multiple times with varying structure and function.
- Scales are generally classified as part of an organism's integumentary system.
- There are various types of scales according to shape and to class of animal.
- Although the meat and organs of some species of fish are edible by humans, the scales are usually not eaten.



# *Scale structure*

- **Fish scales**

Fish scales are dermally derived, specifically in the mesoderm. This fact distinguishes them from reptile scales paleontologically. Genetically, the same genes involved in tooth and hair development in mammals are also involved in scale development.

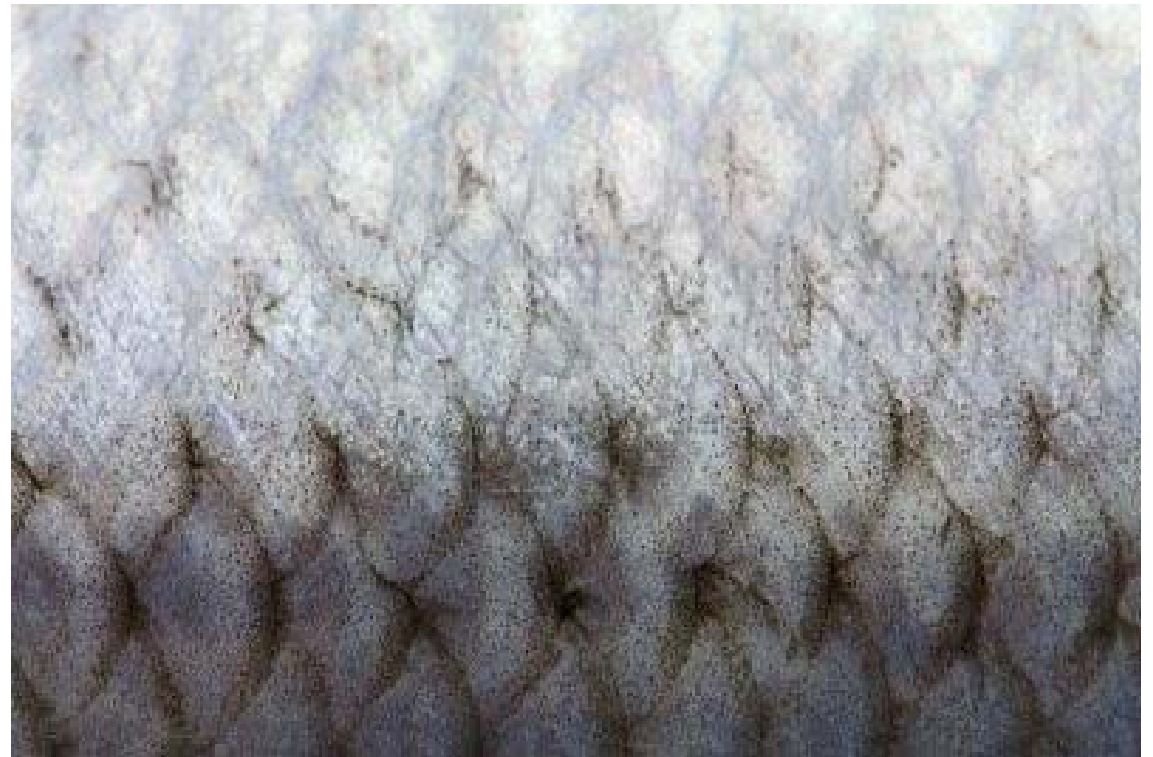
Earliest scales – heavily armoured thought to be like Chondrichthyans

- Fossil fishes
- ion reservoir
- osmotic control
- protection
- Weighting



# *Scale function*

- Primary function is protection (armor plating)
- Hydrodynamics



***Scales are composed of four basic compounds: (moving from inside to outside in that order)***

- Lamellar bone
- Vascular or spongy bone
- Dentine (dermis) and is always associated with enamel.
- Acellular enamel (epidermis)

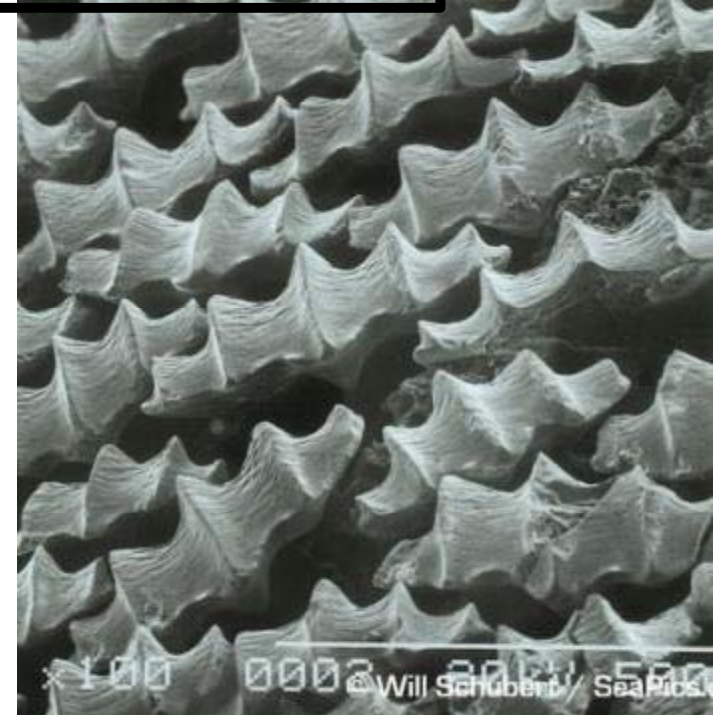
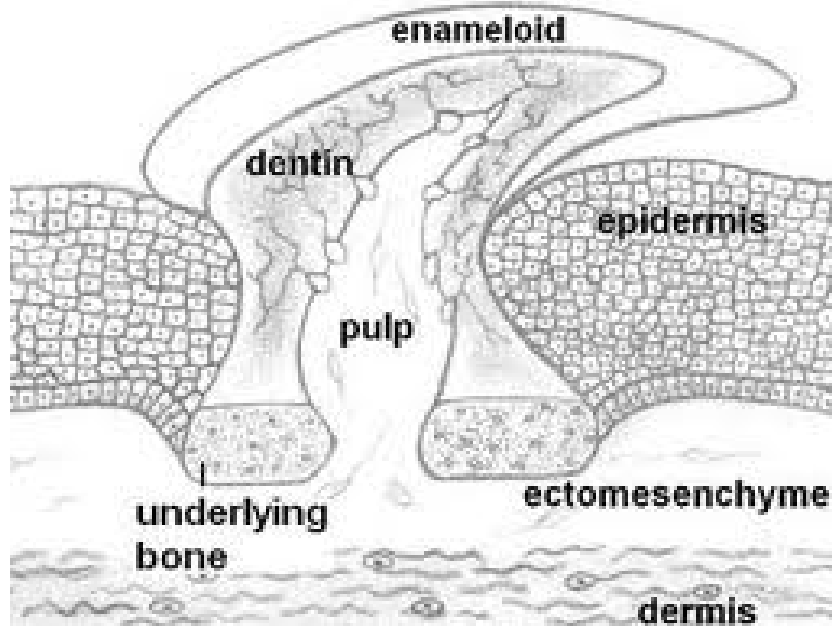
- The scales of fish lie in pockets in the dermis and are embedded in connective tissue.
- Scales do not stick out of a fish but are covered by the Epithelial layer.
- The scales overlap and so form a protective flexible armor capable of withstanding blows and bumping.
- In some catfishes and seahorses, scales are replaced by bony plates.
- In some other species there are no scales at all.



# *Evolution of scales*

Placoid scale – (Chondrichthyes – cartilaginous fishes) develop in dermis but protrude through epidermis. Enamel and then dentine with a pulp cavity.

Lamellar bone  
Vascular or spongy bone  
Dentine (dermis) and is always associated with enamel.  
Acellular enamel (epidermis)





# *Evolution of scales cont.*

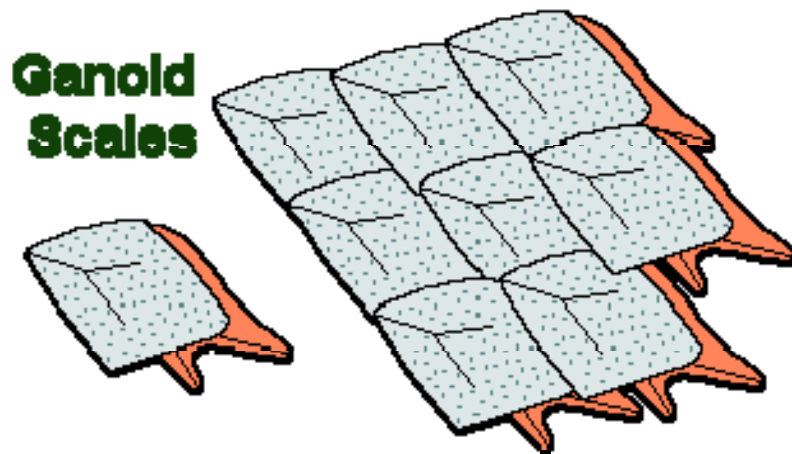
- Cosmoid scale – ancestral form and found in Sarcopterygii (fleshy finned fish)
- They consist of a layer of both bone types, a layer of dentine-like cosmine, and an outer layer of vitrodentine.
- Found in lungfish and prehistoric fishes

Lamellar bone  
Vascular or spongy bone  
Dentine (dermis) and is always associated with enamel.  
Acellular enamel (epidermis)



# *Evolution of scales cont.*

- Ganoid scale – found in Polypteriforms (birchirs) and gars.
- Made of enamel (ganoine = form of enamel found in fish) overlying vascular bone



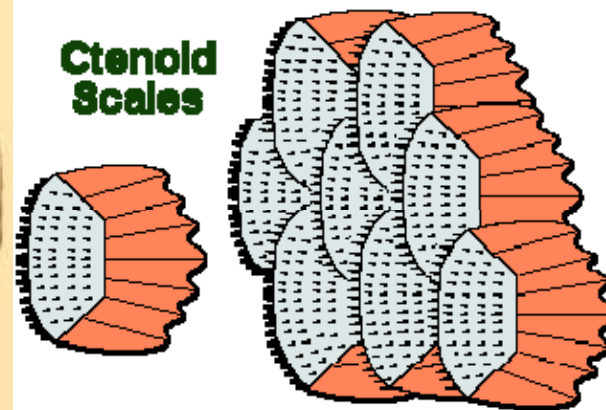
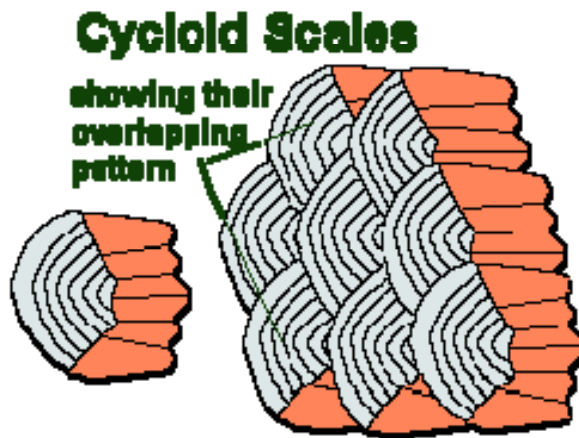
Mottled Birchir *Polypterus weeksii*



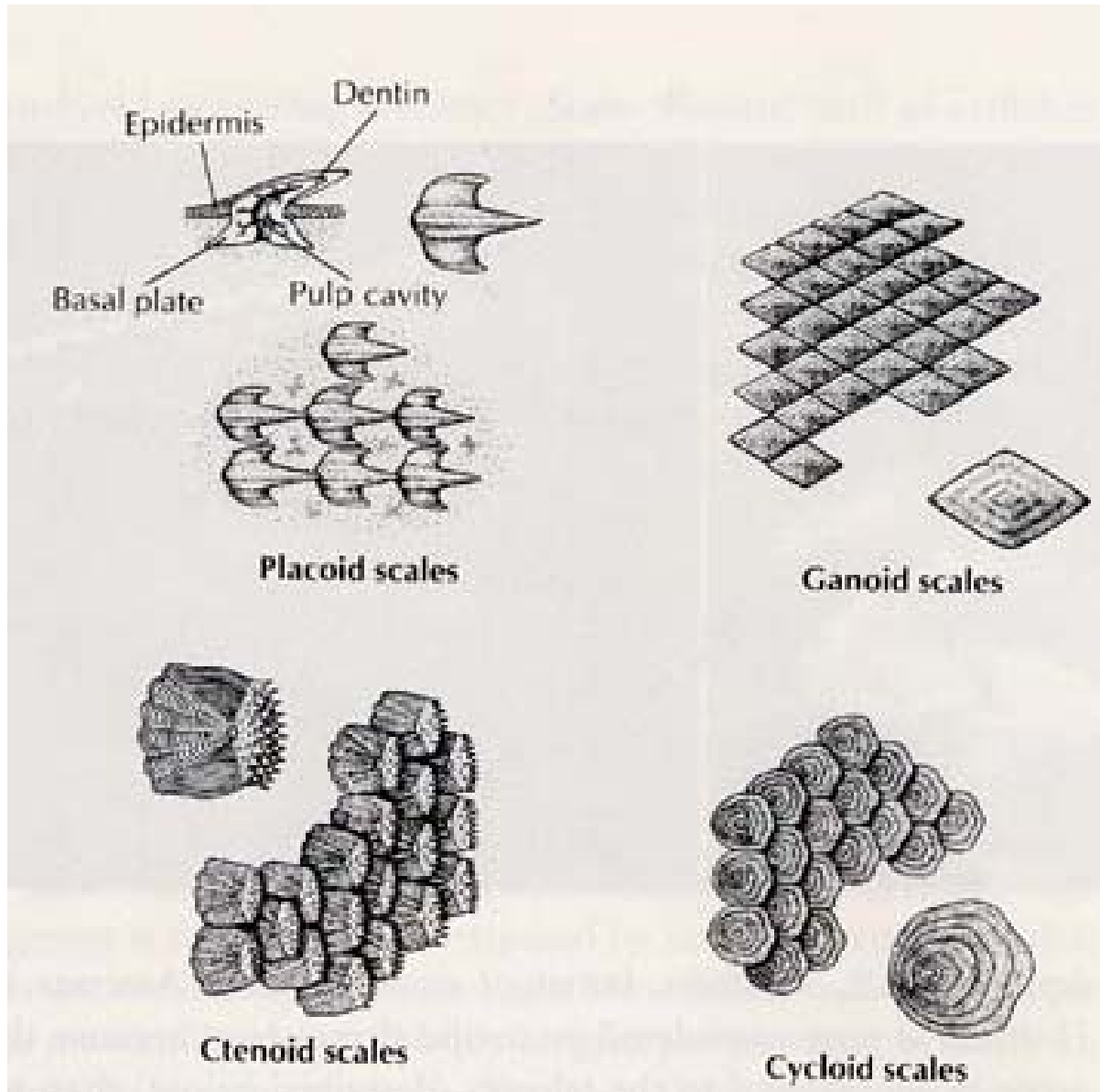


## *Evolution of scales cont.*

- Elasmoid – (Teleostei – infraclass of the ray finned fishes) lack enamel, dentine and vascular bone layer. Their scales are formed of lamellar bone, which is acellular and noncalcified. Cycloid is the more primitive of the two types of Elasmoid scales and gives rise to the Ctenoid form with teeth on margin called ctenii.



# Overhead summary



# *Scale derivatives*

## **Chondrichthyans (cartilagenous fishes)**

- Fused placoid scales give rise to spines – Squalids, Holocephalans and stingrays



## Rostrum of sawfishes



## Teeth



# *Scale derivatives*

## **Osteichthyes (bony fishes)**

- Bristles and spikes in porcupine fishes
- Fins rays -> lepidotrichia (bony, bilaterally-paired, segmented fin rays)
- Scalpels in surgeon fishes
- Scutes (kingfish and tunas)
- Plates in seahorses and boxfishes
- Teeth

