

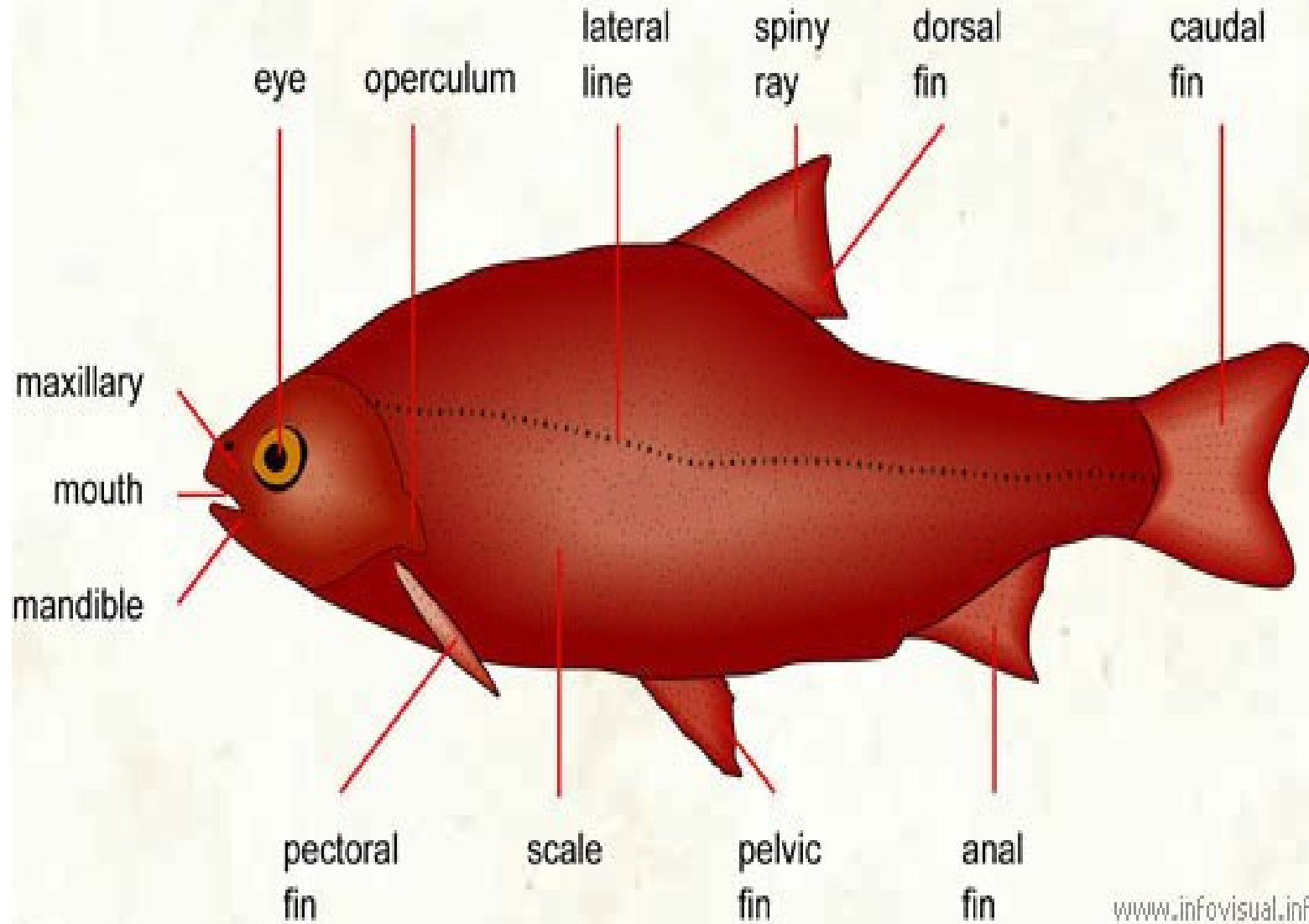
Introduction



To begin this study a student must be equipped with the basic knowledge of fish anatomy.

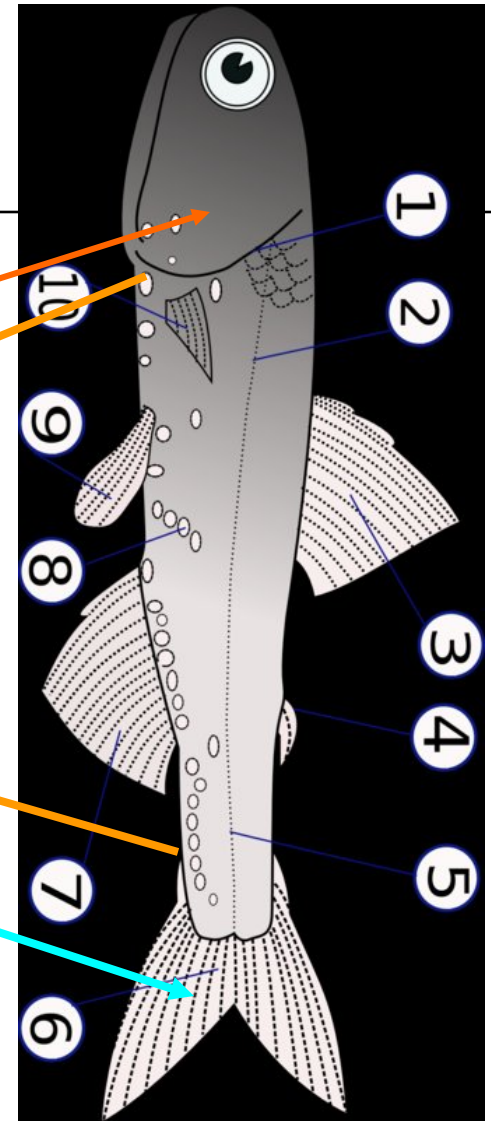
In classifying the fishes, it is better to understand the basic design of the body parts in relation to the environment.

MORPHOLOGY OF A BONY FISH



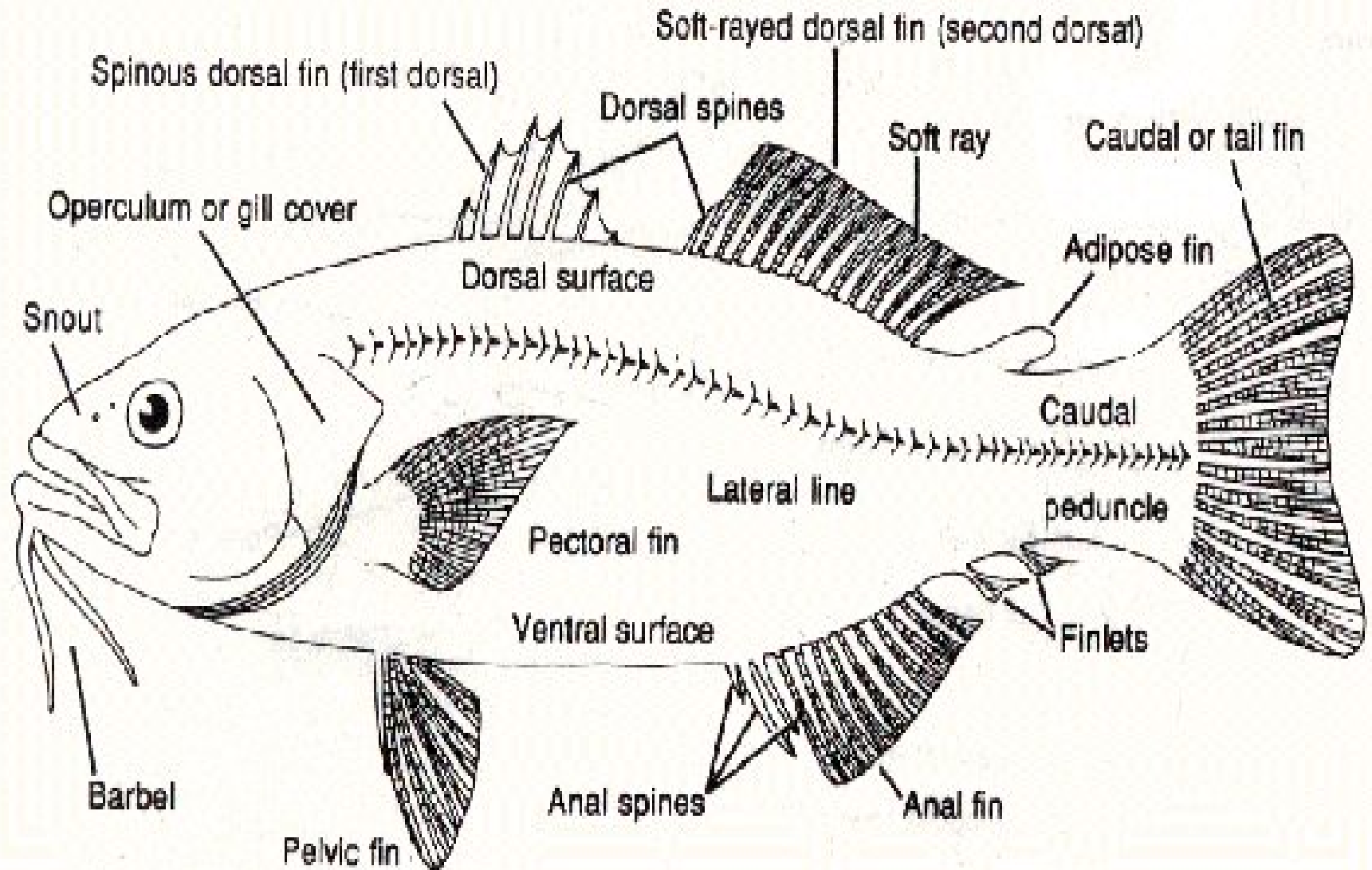
Body Divisions

- Their body is divided into:
 - head
 - trunk
 - and tail
- although the divisions are not always externally visible.

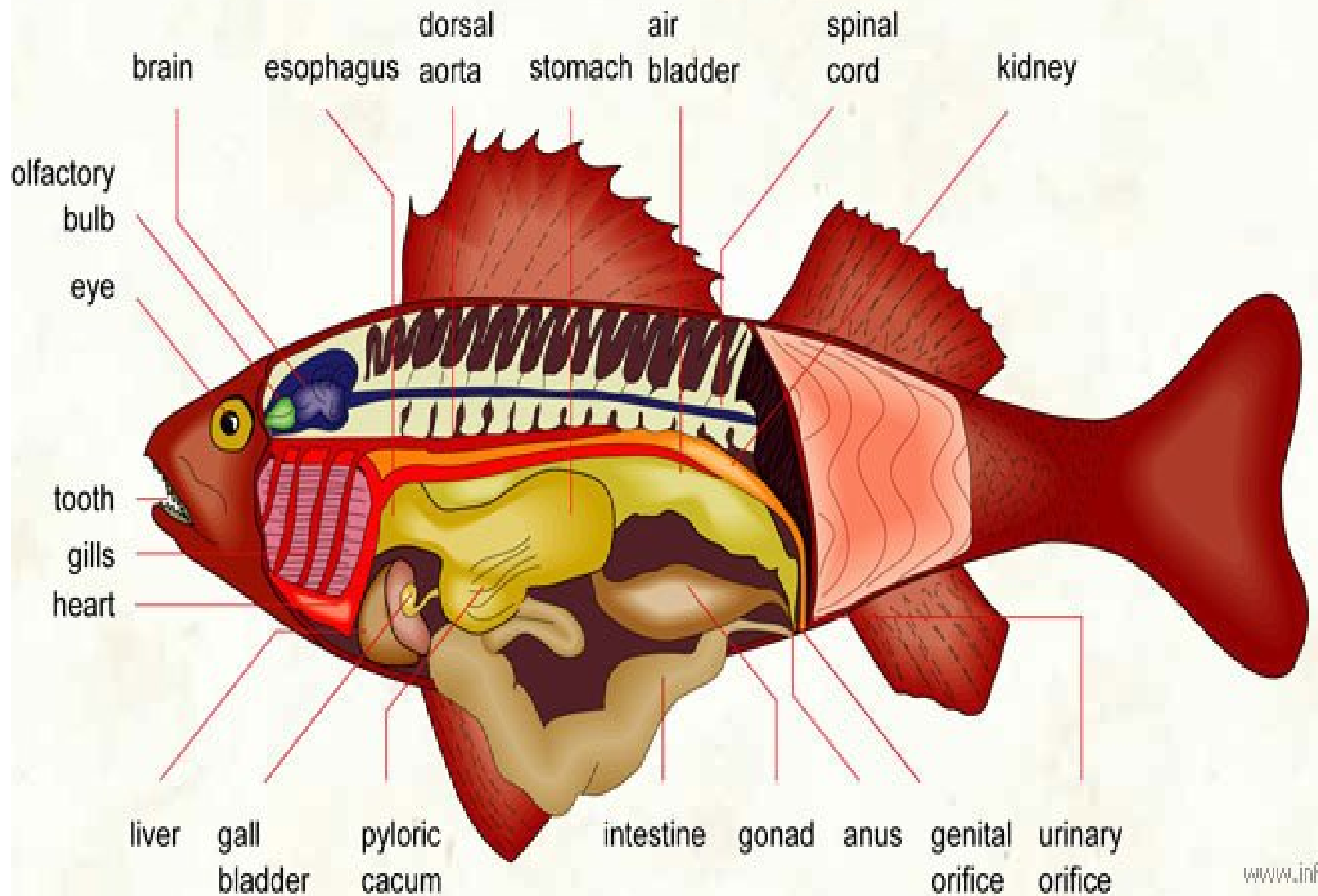


The caudal peduncle

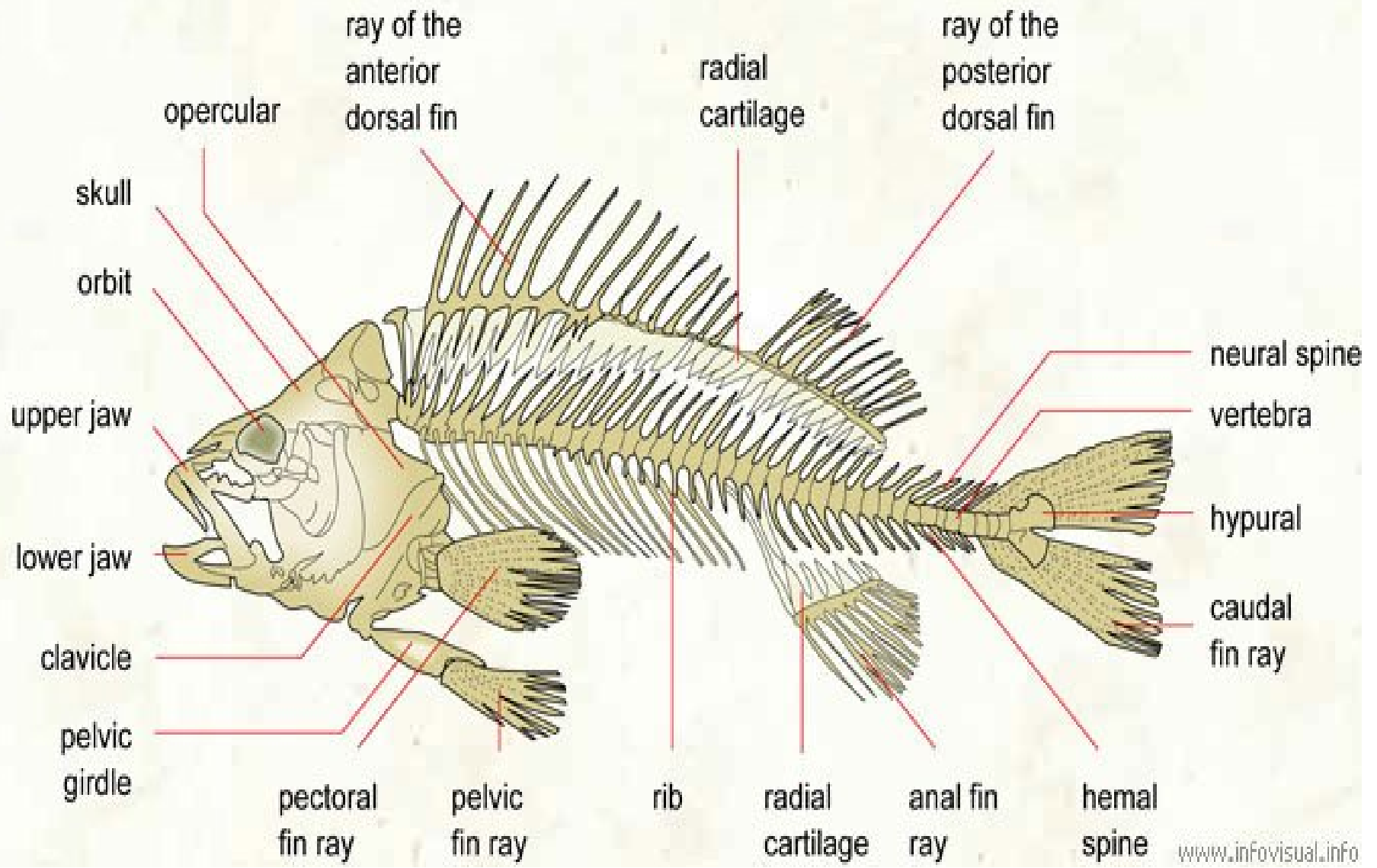
- is the narrow part of the fish's body to which the caudal or tail fin is attached. The **hypural joint** is the joint between the caudal fin and the last of the vertebrae. The hypural is often fan-shaped.



INTERNAL ANATOMY OF A BONY FISH

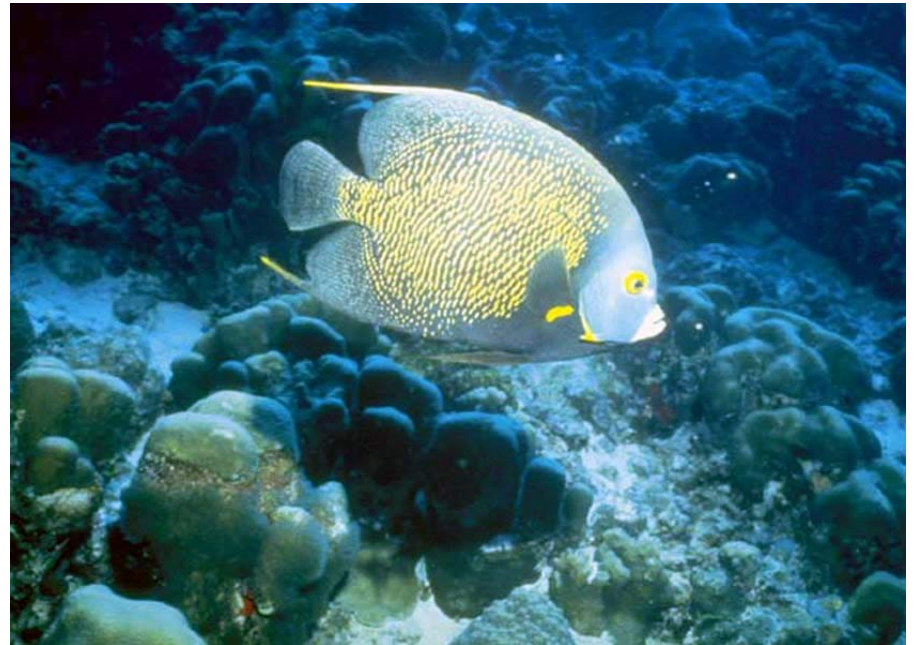


SKELETON OF A FISH



Fishes were described and classified by:

1. Body parts
2. Mouth location and size
3. Tail shape
4. Color
5. Some special adaptations



Body shape

- is a good indicator of how a fish moves and where it lives.

1. flat or depressiform

= They normally live on the bottom of the sea floor

= flap their fins up and down to swim through the water in the same way a bird flaps its wings.

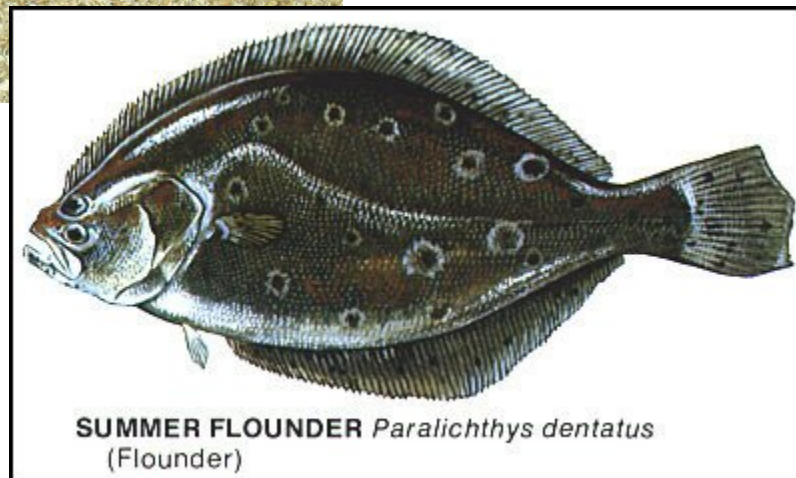
= ex. Skates and flounder



Oban Skates



Stingray



SUMMER FLOUNDER *Paralichthys dentatus*
(Flounder)

2. Long and Skinny or Filiform

= slither through the water like a snake

= examples - like an eel,



Snake eel



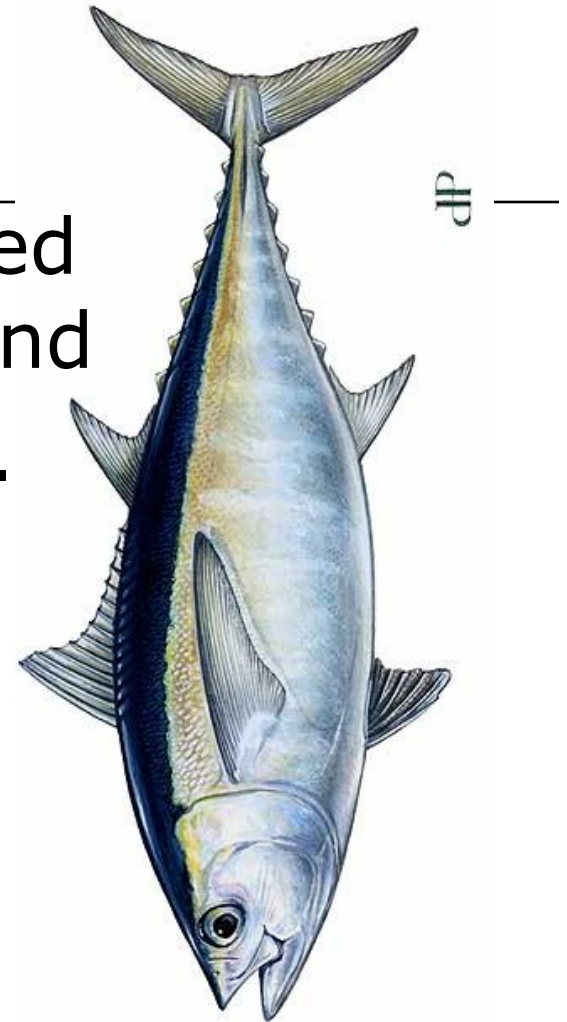
American Eel

3. oval or fusiform

- section like a tuna or striped bass are fast swimmers and
- usually live in open water.



Largemouth bass photo © Brian Jorg



Black fin tuna

4. compressiform

- shape like that of angelfish looks thin when viewed from the front.
- This body shape is well designed for making quick turns and quick bursts of speed over short distances.
- Compressiform fish commonly live where there are many places to take refuge such as ponds, lakes, or coral reefs, or
- They school together in shallow open waters.

5. Compressiform fishes



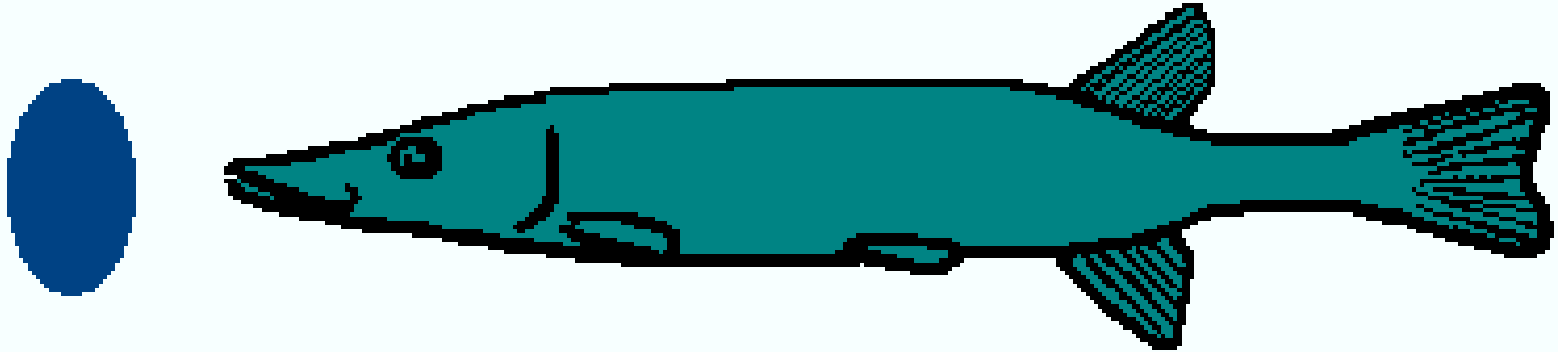
Yellow-faced Angelfish

Angelfish



Holacanthus bermudensis





6. Sagittiform

- These body shapes are good for **rover predators**, which depend on an ability to strike quickly--often from a hiding place.
- "**Arrow-like.**" Example shown is a grass pickerel. Other fish with this body type include **piques, gars, topminnows, killifish**, needlefish, and barracuda.

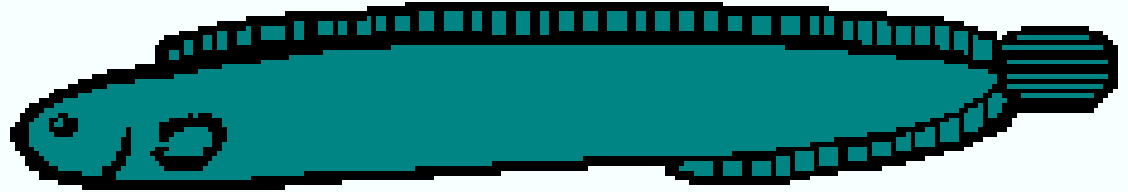


Spotted gar



barracuda

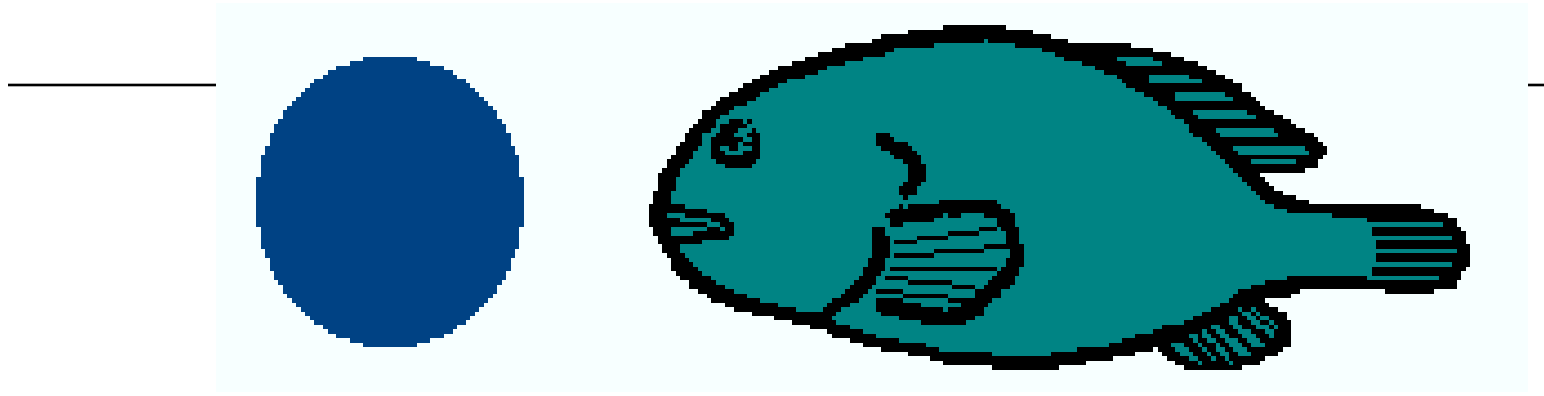
7. Taeniform



- "Ribbon-like." Example shown is a gunnel. This shape is good for hiding in cracks and crevices, but fishes like this do not move very fast.

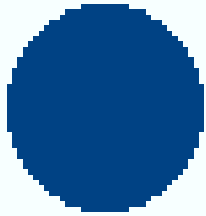


8. Globiform






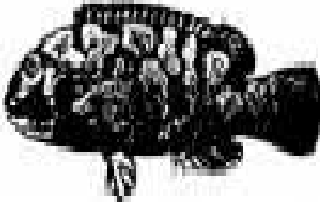

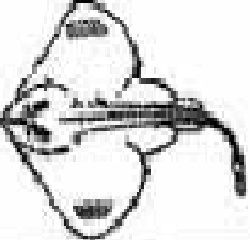


- **"Globe-like."** Shown is a smooth lump sucker. This, too, would be an unusual shape in a freshwater environment, although pupfish come close.

Anguilliform



- **"Eel-like."** Many **eels**, of course have this shape. Shown is a **brook lamprey**. This shape allows a fish to enter and hide in very narrow openings, and also helps the fish resist the force of current.

BODY SHAPE

Crossection	Fish	Shape	Locomotion
	 <p>Tuna</p>	Fusiform	Fast-swimming in open water.
	 <p>Tautog</p>	Compressiform	Quick speed for short distances.
	 <p>Skate</p>	Depressiform	Swims like a flying bird.
	 <p>Pipefish</p>	Filiform	Slithers through the water like a snake.

Another way to classify body types is by their function. In this system:

1. **Rover predators** (fish that more or less constantly swim about searching for prey) include **fusiform body types**, as well as salmon, trout, and bass; **they have pointed heads, terminal mouths, narrowed caudal peduncles, and forked tails.**



Salmon

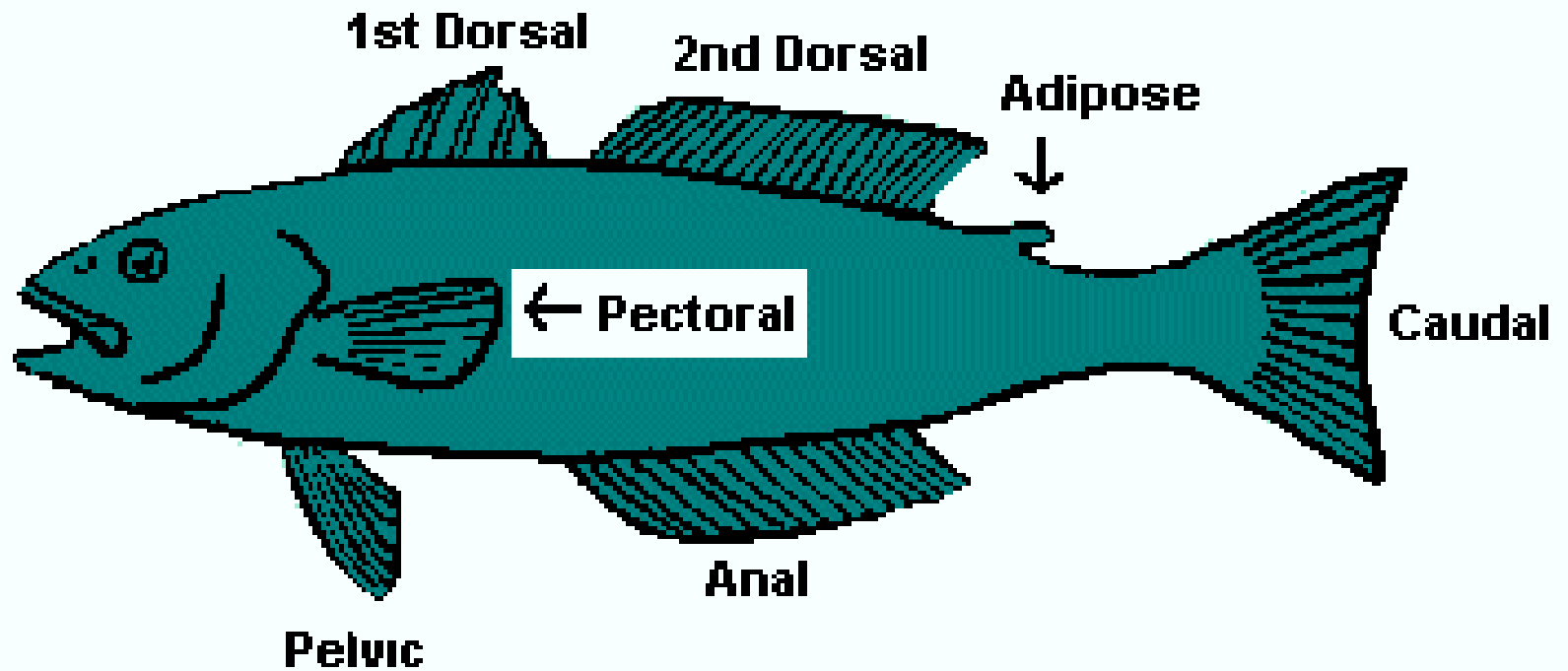
2. **Lie-in-wait predators** (predators that catch their prey by ambush) include **sagittiform body types**; they have dorsal and anal fins placed well back on the body, a **streamlined form**, **flattened heads**, and large, **well-toothed mouths**.

3. **Surface-oriented fishes** are often small, with mouths that are directed upwards toward the surface of the water. These fishes often swim just below the surface, and eat food that is floating on the surface or flying above it. Topminnows, killifish, freshwater hatchetfish, halfbeaks, and flying fish are examples of surface-oriented fishes.

4. **Deep-bodied fish** include all the **compressiform types**, and are found widely in places where the ability to make tight, close turns is of value, such as rock reefs, coral reefs, thickly vegetated areas, and schools.

-
5. **Eel-like fish** include taeniform, anguilliform, and filiform shapes all in one category.
 6. **Bottom fish** is a very broad category that includes **bottom rovers** like catfishes, suckers, and sturgeons, **bottom clingers** like sculpins, **bottom hidiers** like darters and blennies, and **depressiform** body types, like flatfish.

Morphology: Fin type



Pectoral fins:

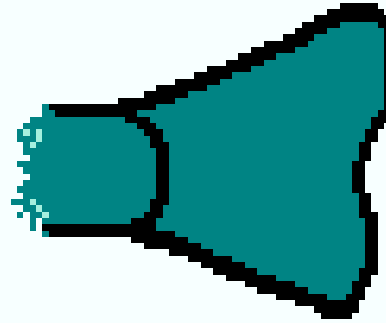
- Pectoral fins may be horizontal and down low, like in a salmon, trout, shark, or sturgeon, and used mainly for gliding.
- These are often are used for swimming, holding position, and changing directions quickly.

Pelvic fin location:

- Pelvic fins are usual *abdominal*, meaning that they are attached midway down the belly.
- When the pelvic fins are below the pectoral fins, such as can be seen in the diagram of the non-existent fish above, they are termed *thoracic*.
- When a *thoracic* pelvic fin is attached under the gills, it may also be called *jugular*, and if under the chin or eye, *mental*.

A.

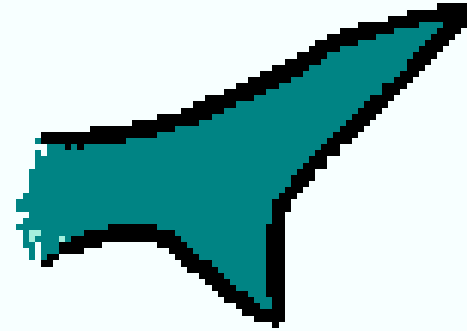
Caudal fin shape:



A. The *homocercal* (homo-SUR-kul) tail is a modern development. It is symmetrical.

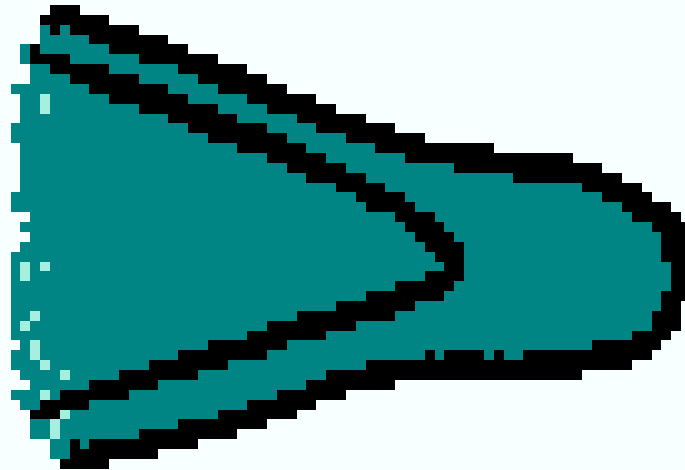
= It includes truncate, square, slightly forked, and deeply forked types. It is by far the most common caudal fin shape, shared by most fishes.

B. The *heterocercal* tail



- is an ancient form,
- possessed by only a few primitive fishes, such as sharks, sturgeon, and paddlefish.
- It was a necessary tail shape when fishes had no swim bladders and were heavy in the front; if the fish tried to use a symmetrical tail, it would have plunged toward the bottom. Instead, it developed a tail with a deliberately downward-driving design and supplemented it with horizontal, plane-like pectoral fins that transformed that downward force into a horizontal, forward-driving force.

C. This tail has a *non-differentiated* caudal fin. This may be found on eels of all sorts, as well as lampreys.



Fish Tail indicates how the fish moves and lives as well.

Types of fish tails:

1. **truncated tail**

= good for maneuverability and short bursts of speed

= not as much drag as the round shape

= Examples: killifish

= This kind of tail is commonly found on fish in coastal embayments.



killifish

Truncate tail

2. Forked Tail

- is good for maneuverability and speed over longer distances.
- Less drag

Northern Pike Minnow

Snout long

Tail fin deeply forked

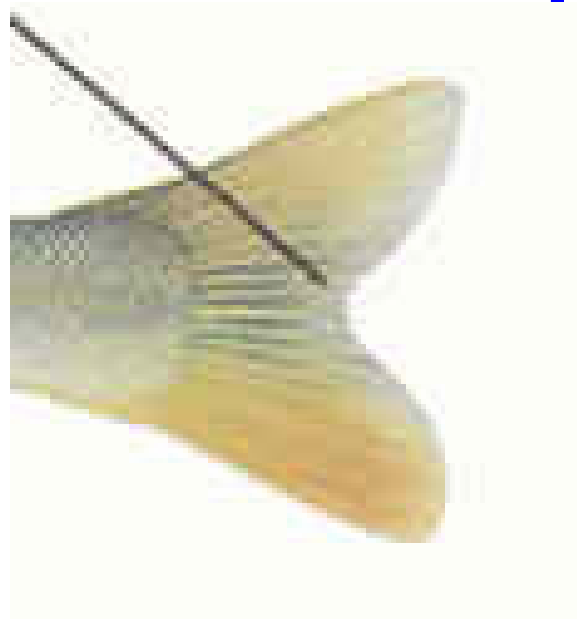


Large, toothless mouth extends behind front of eye (except in small fish)



Forked tail

minnow



3. Round Tail

= Large amounts of surface area for effective maneuvering and acceleration

= but creates drag causing the fish to tire easily



Clown fish

Round tail

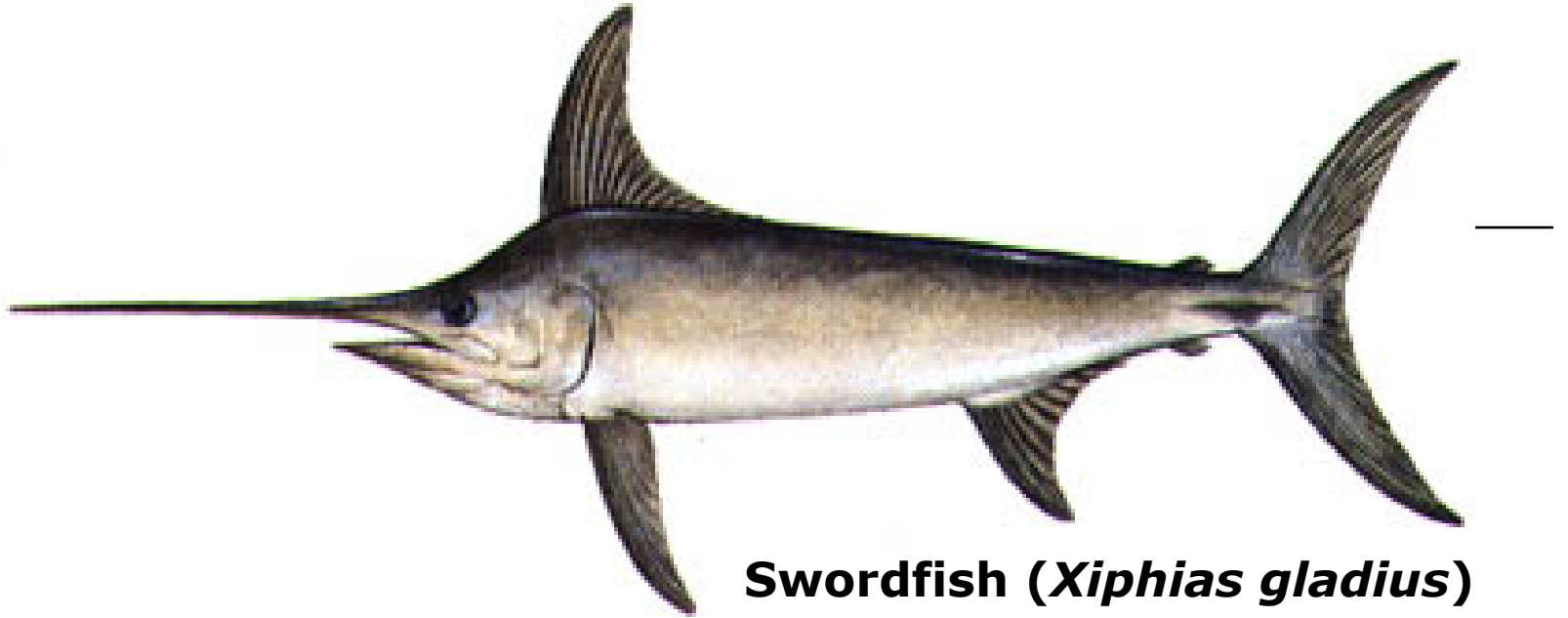
4. Emarginate

= Effective acceleration and maneuvering

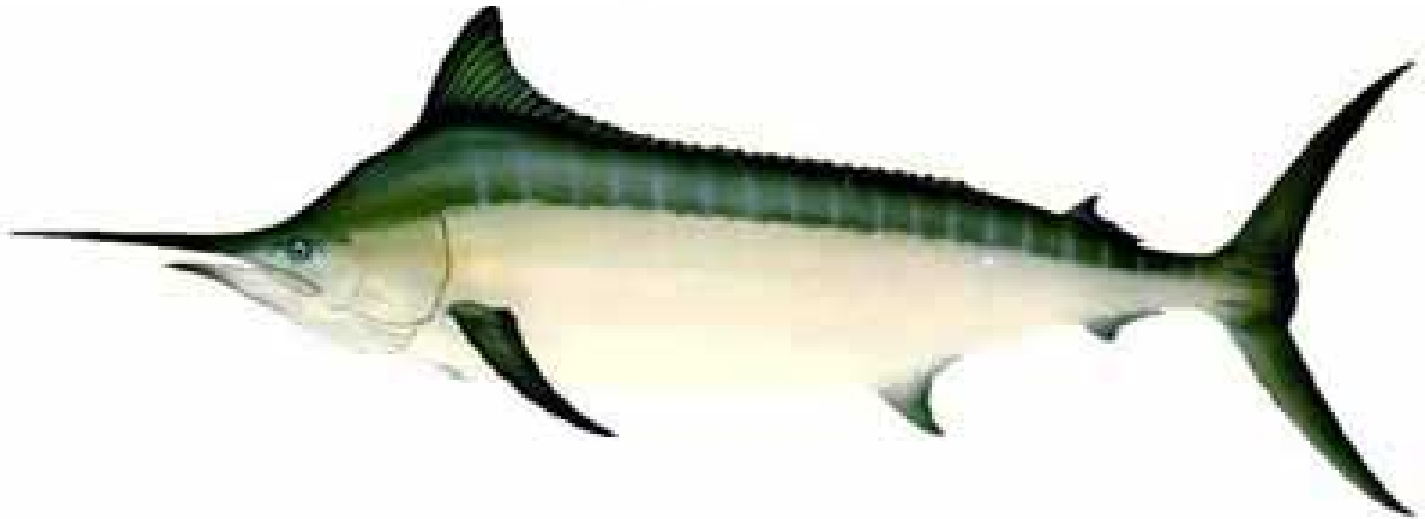
= not as much drag as the round and truncate tail

5. **Lunate** or crescent

- shaped tails like those found on a swordfish
- not good for maneuvering
- but allow for great speed over long distances and
- usually found on fish that live in the open ocean.








Swordfish (*Xiphias gladius*)



Black Marlin (*Makaira indica*)

CAUDAL FIN SHAPE

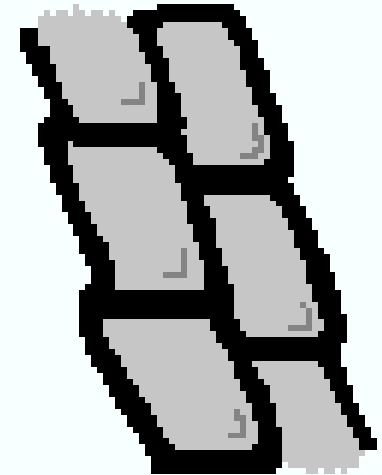
Shape	Function
Rounded 	Large amount of surface area allows for effective acceleration and maneuvering, but creates drag causing fish to tire easily.
Truncate 	Effective acceleration and maneuvering. Not as much drag as a rounded shape.
Emarginate 	Effective acceleration and maneuvering. Not as much drag as a rounded shape or truncate shape.
Forked 	Good acceleration and maneuvering. Less surface area means less drag.
Lunate 	Rigid fin with less surface area means less drag and great acceleration, but decreased maneuvering.

Morphology: Scale type

- Scales have evolved over time and are of major importance in classifying fishes. Most scales are deeply buried in the fish's *epidermis*, or outer skin layer, with only part of them showing. Below the pictures of scales are examples of how the scales would look on the fish's body.

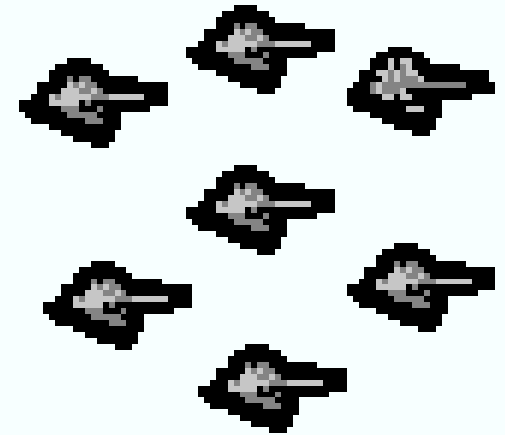
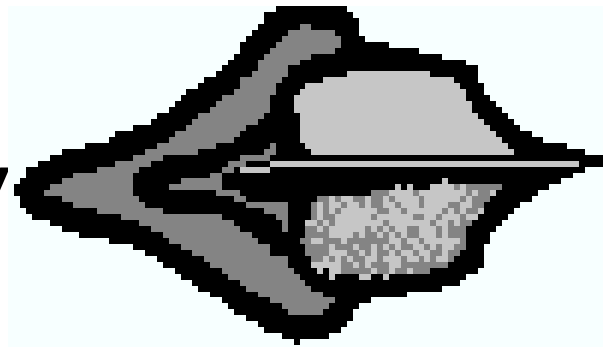
Ganoid

- "primitive" kind of scale
- reminder of the time when fishes used armor plating to protect themselves
- Ganoid scales are hard and smooth, and may take the form of only a few scales



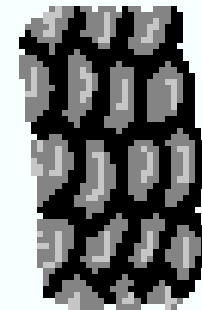
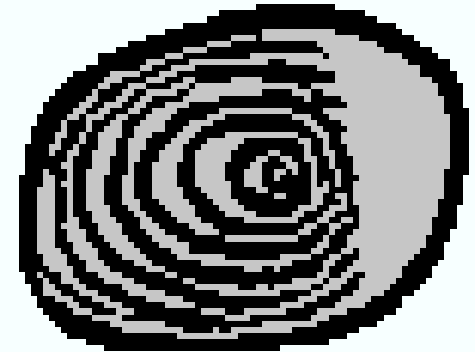
Placoid

- Sharks have placoid (PLAK-oyd) scales: tiny, tooth-like structures that are partially embedded in the skin.
- These tiny, pointed scales, made of the same materials as their (and our) teeth, make their skin feel like sandpaper.



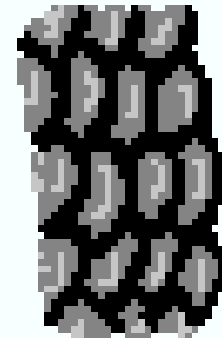
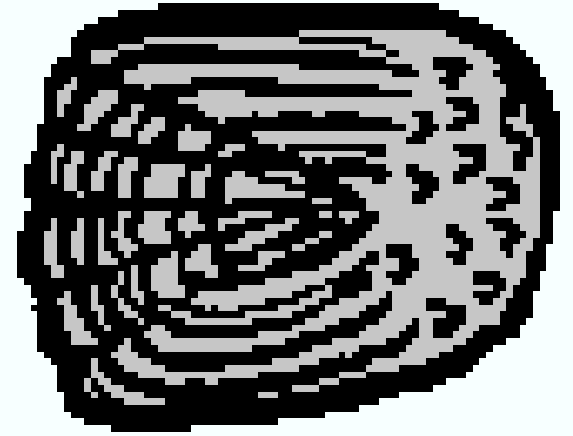
Cycloid

- Many fishes with which we are most familiar have cycloid scales, which are the thin, round, almost transparent scales that we find when we are cleaning **trout, salmon,** or **herring.**
- These scales are mostly buried in the epidermis, allowing only the small posterior margin to show.



Ctenoid

- which are much like cycloid scales except that they have tiny, comb-like projections (*ctenii*) on their posterior edges (the edges that show, and are not buried in skin)
- The colors of brightly colored fishes also show on these posterior edges.



-
- Besides the scale types, there are also **cosmoid** scales, as well as **scaleless** fishes (sculpins, many catfish, some eels, and swordfish), and fishes which have scales so deeply **buried** that they *look* scaleless (many tunas and anguillid eels).



Mouth Shape

- (1) **long, skinny bill** (tweezer like)-poking into crevices
- (2) **large mouth** -swallowing/tearing large prey
- (3) **beaklike mouth** -used to graze on small algae growing on hard surfaces
- (4) **downward**-orientated mouth-useful to suck food up from bottom
- (5) **upward-orientated** – usually feed at the water surface

Morphology: Mouth type



1. Upward orientation
= used to capture prey on the
water surface

2. large mouth

- swallowing/tearing large prey



3. beaklike mouth

-used to graze on small algae growing on hard surfaces



Parrot fish

4. Downward

-orientated mouth-useful to suck food up from bottom



Janitor fish

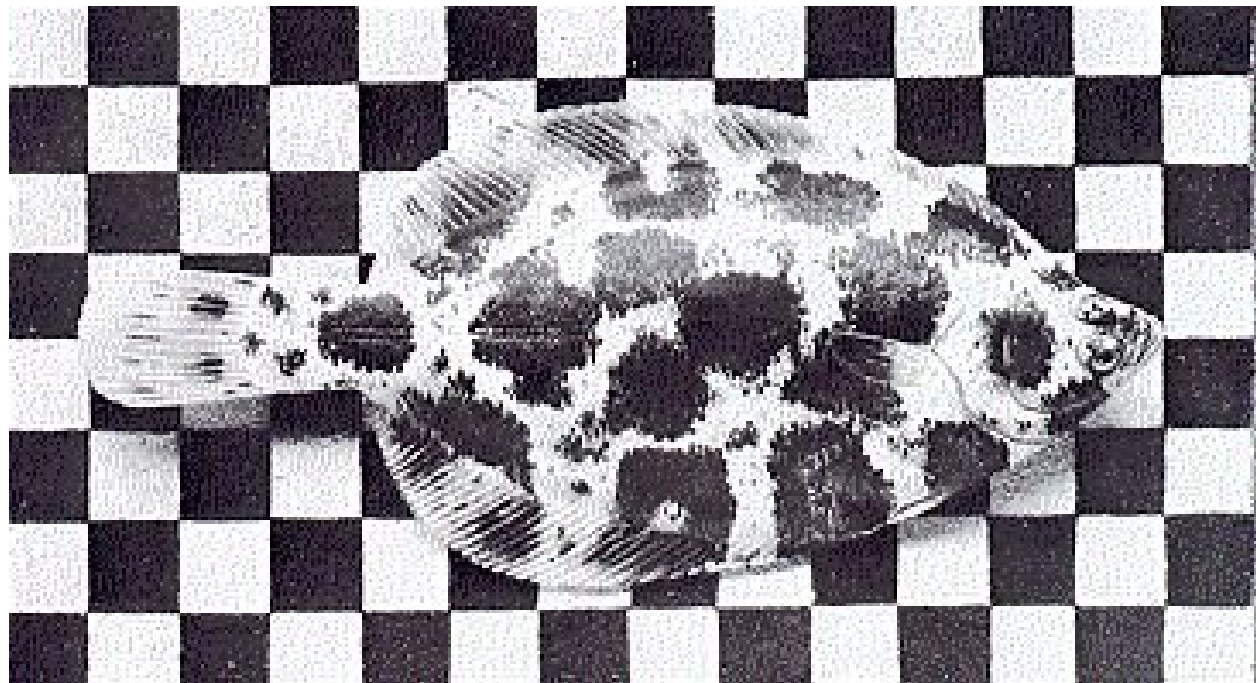
5. long, skinny bill



- (tweezerlike)
- -poking into crevices

Defense Strategies

1. Cryptic Coloration - form of camouflage, colored to match background/surroundings



2. Countershading-dorsally

darkened and ventrally whitened,

dark helps fish to blend in with the dark bottom when viewed from above whereas the white belly helps them to blend with the sky or clearer waters above when viewed from below



3. Disruptive Coloration -another form of camouflage, colors and patterns (i.e.. presence of color stripes or bars) that break up the outline of a fish making it harder to see



Basslet



firefish

4. Eye Spot (false eye)-black spot
located near base of the tail used to
confuse predators



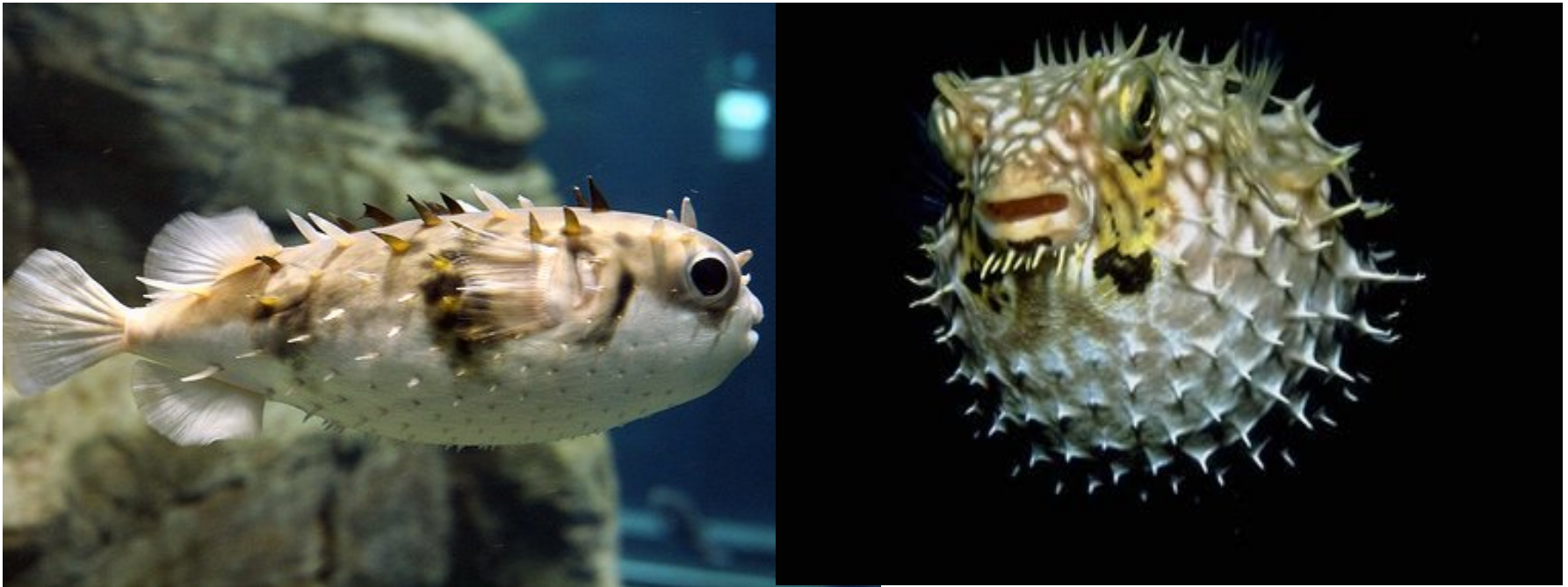
Four Eye Butterfly
Fish.



5. Thickened Scales -protective covering making their hard carpace relatively immune to predation



6. Spines-for defense and protection
from predators, may be venomous



Porcupine fish

7. Schooling-fish

swimming in schools may have a greater chance to survive than if by themselves because an individual fish in a school may be harder to pick out by a predator

