Chordates: animals WITH a backbone

three classes of fish

Chondrichthyes
Sharks

Osteichthyes
Boney fishes

Agnathids
Jawless fish

Agnatha

-Most primitive
-Lack jaws
-Round row of teeth

Osteichthyes

-Bony fishes
-skeleton made of mostly bones
-96% of fish are the bony fishes
-have plates that cover gills (operculum)
-swim bladder

-Means fish with bony skeletons
-There are over 20,000 species of bony fish
-Seahorses are the only fish that swim upright

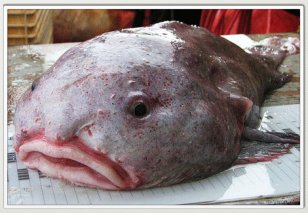
Fish have sleep-like periods where they have lowered response to stimuli, slowed physical activity, and reduced metabolism but they do not share the same changes in brain waves as humans do when they sleep.

On average, flying fish can glide 160 feet (50m), but have been known to glide as far as 660 feet (200 m). And they can reach heights up to 19 feet (6m)

Where do most fish live?

The **epipelagic** (**sunlit zone**)
But fish can be found in any ocean and at any depth

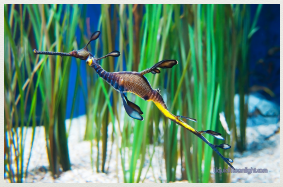
barrel eye



Why do fish move

To increase their chances of survival
To help them reproduce
To find food and shelter
To get oxygen
To migrate
To avoid predators

Fish want to use as little energy as possible to get what they need



How do fish move?

Fish live in water and water is a viscous material. Viscosity is how "thick" a fluid is. Honey is more viscous than water.

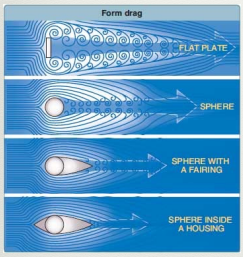
SO Fish are constantly fighting to move through the water. Body shape and ability to move (fins) help a fish adapt to its specific environmental conditions.

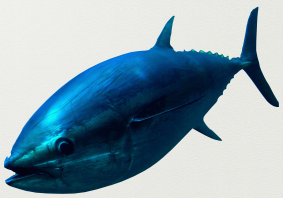
This is why certain fish have different body types, or fin arrangements.

www.youtube.com/watch?v=voxbt1AHxK8&list=PL1AF9FBF586C90DB2&index=100

Fish are subjected to friction of the surrounding water, rubbing against a fishes body. This creates Drag on the fish, slowing the fish down.

Also, body shape/form can also create drag from the surrounding water. A long cylindrical shape fights drag.





Fins

Caudal Fin
Dorsal Fin
Pectoral Fin
Pelvic Fin
Anal Fin

Types of Caudal Fin

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.

Dorsal and Anal fins

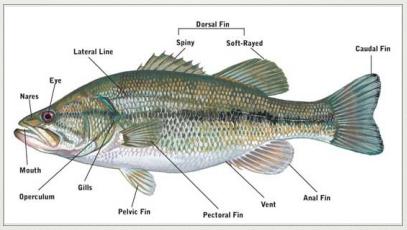
help keep fish stable and upright

Pectoral and Anal fins

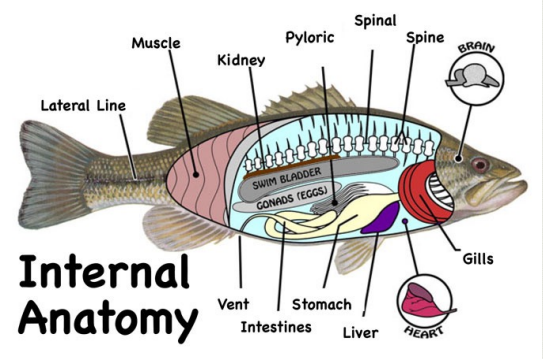
Paired fins help the fish stop and turn

fish swimming

External Anatomy



dissection



Pressure again

Fish can control their float-ability by a special organ called the swim bladder, or air bladder.

Ways animals and plants avoid sinking

- By adjusting body **density** to the same density as that of the water around them (neutral buoyancy).
- Having flattened or bristly shapes that **increase surface area** and reduce sinking.
- Adjust the density of its body by using a SWIM BLADDER
  - They will adjust the density of the components of their insides (they will consume lighter weight ions and leave the heavier ones in the surrounding water)
  - inflated to make the fish rise higher in the water
  - or deflated to make the fish sink lower

No Swim Bladder

Some fish like Tuna do not have a swim bladder and must swim fast to prevent sinking

Some fish like catfish do not have a swim bladder and spend their life on the bottom

The **speed limit** of a fish is determined by the **viscosity or thickness** of the water

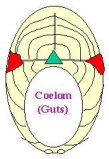
Streamlining of the fastest swimming fish (ex. Tuna) reduces turbulence
Eyes are flattened against the head and male sex organs are usually internal
Barracudas can reach speeds of 40 km/hr
Yellowfin Tuna can reach speeds of 45 km/hr
Larger Tuna can reach 110 km/hr

Cruising speed for fish is about:
1 or 2 body lengths per second (BL/sec.)

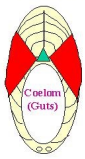
Body Muscle

-75% of the total body mass of fast swimming fish like tuna is muscle
-There is a greater percentage of red muscle than white muscle
-Red muscle contains myoglobin, a pigment that uses oxygen.
-Red muscle is for long term action (long distance swimming)
-white muscle is for quick reactions. (anaerobic)

Red Muscle and Behavior



Catfish: Slow cruising



Swordfish: Fast Cruising

Fish Senses

Sight – some fish can see color and can see in very dim light
Smell – fish have nostrils used for smelling chemical scents in the water
Touch – fish can feel objects against their skin
Lateral line- A system of canals on the sides of fishes that helps fish detect changes in pressure, vibrations and currents

Anableps: can see above and below water at the same time

-Fish "hear" via their **lateral lines**, a line of pressure sensors running along each side of the fish that pick up pressure waves (= sound) in water.
-When someone taps on an aquarium, that creates waves of pressure in the water that the fish can detect.

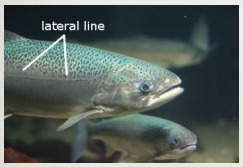
videos.howstuffworks.com/discovery/28100-perfect-predators-the-bull-sharks-lateral-line-video.htm

videos.howstuffworks.com/discovery/28100-perfect-predators-the-bull-sharks-lateral-line-video.htm

http://videos.howstuffworks.com/discovery/30418-perfect-predators-mako-shark-speed-video.htm

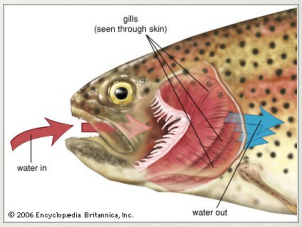
Lateral Line

Detect changes in pressure and vibrations and currents
Detect Prey
Swim together in a school
Detect predators on the sides or behind
Pickup vibrations from the swimming together of other animals

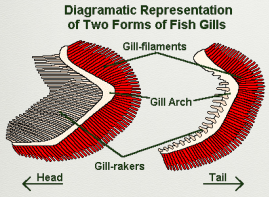


Respiration

Fish use gills to absorb oxygen from the surrounding water
Dissolved gases vary in water with temperature and salinity
Cold fresh water can hold more dissolved gas than warm saltwater



Parts of a Gill
- Gill Arch - stiff structure that supports the gill filaments and the gill rakers
- Gill Rakers – prevent food from clogging up the gill filaments
- Gill Filaments – fingerlike projections where oxygen is absorbed and carbon dioxide is removed
  - Gas is exchanged in gills because water and blood move along side each other in opposite directions

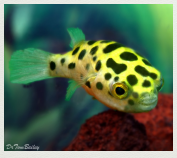


Body Temperature

Endothermic (**homeothermic**) maintain a constant internal body temperature (ex. Humans 98.6^{0}F). White shark, makos, salmon shark, porbeagle have some endothermic abilities. the pic on the right is the cutest .

opah

Ectothermic or Poikilothermic - have a temperature similar to their surroundings (ex. If the water is 56^{0}F F then the fish will have a body temperature around 56^{0}F

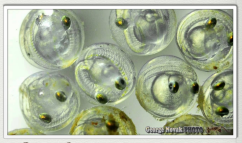


Reproduction

Spawning- release of egg and sperm

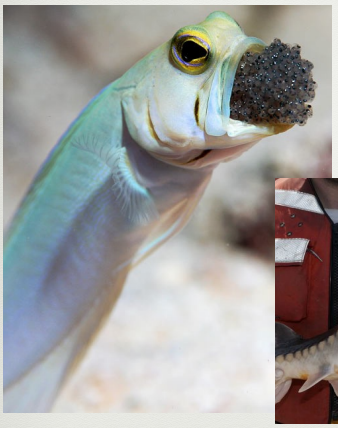
http://video.nationalgeographic.com/video/trout_spawning

http://video.nationalgeographic.com/video/news/us-grunion-spawning-vin

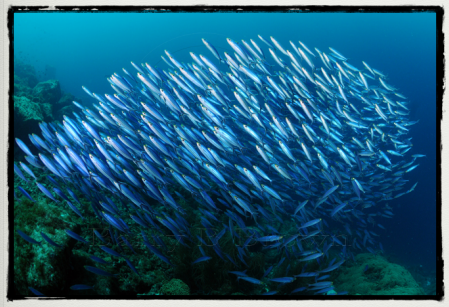


Copulation-direct transfer of sperm into a female

http://www.arkive.org/leafy-seadragon/phycodurus-eques/video-09.html



Schooling and shoaling



Shoaling: fish hanging out together

Schooling: fish swimming together

https://vimeo.com/55506438

wild oceans

http://www.discovery.com/tv-shows/other-shows/videos/superswarm-fish-vortex/

Benefits to shoaling and schooling

Predator evading
Foraging for food
Increased reproduction