

**Marine Fish: Part 1 STUDENT NOTES Date:**

Warm up	<p><i>Is fishes a real word? If so, what does it refer to?</i></p>
Animals: Vertebrates	<p>Animals are often divided into two groups:</p> <ul style="list-style-type: none"> <li>• Invertebrate: soft-bodied organisms without backbones</li> <li>• _____: all animals with _____             <ul style="list-style-type: none"> <li>- Vertebrata actually a subphylum of the phylum Chordata</li> </ul> </li> <li>• Chordates are characterized by having a notochord and a dorsal nerve cord at some point in their life cycle             <ul style="list-style-type: none"> <li>• Notochord: _____ along the organism's dorsal side</li> <li>• Dorsal Nerve Cord: _____ just above the notochord</li> </ul> </li> <li>• Vertebrate Characteristics:             <ul style="list-style-type: none"> <li>• Have a dorsal nerve cord (spinal cord) that is protected by _____ (backbone)</li> <li>• Have a head with a brain protected by skull made of cartilage or bone.</li> <li>• _____ Symmetry</li> <li>• Presence of an endoskeleton</li> <li>• Many vertebrates include some of the most _____ organisms on Earth.</li> </ul> </li> </ul>
Typical Fish Characteristics	<p>What is Ichthyology? _____</p> <p>Adapted to live in water; Have gills for breathing; What are fins used for? _____</p> <p>Often covered in _____</p> <p>Cold-blooded (ectothermic)... what does colder temperatures do? Slow the metabolism</p> <p>Internal skeleton</p> <p>All fish possess a _____ → later modified into a backbone with moveable vertebrae that allows the animal to bend and wiggle and serves to protect the _____.</p>
Three main classes: Agnatha	<p><b>Agnatha: "jawless fish"</b></p> <ul style="list-style-type: none"> <li>• _____ fish have a muscular, circular mouth with rows of teeth in rings</li> <li>• What is the general body plan? _____</li> <li>• Suction or filter feed; most primitive and most likely the _____ of bony and cartilaginous fish, fewer in number due to inability to compete with jawed fish</li> <li>• Do they have fins or scales? YES or NO (circle)</li> <li>• Examples: _____ and _____             <ul style="list-style-type: none"> <li>- Hagfish                 <ul style="list-style-type: none"> <li>▪ Feeds mostly on _____ fish</li> <li>▪ Can bore into prey and eat from inside out</li> <li>▪ Live in muddy burrow</li> </ul> </li> <li>- Lamprey                 <ul style="list-style-type: none"> <li>▪ Primarily freshwater fish that breeds in lakes and rivers but move to sea as adults</li> <li>▪ Attach to other fish and _____ on bottom invertebrates</li> </ul> </li> </ul> </li> </ul>

**Chondrichthyes and Osteichthyes (More advanced than Agnatha)**

- General Characteristics:
  - Highly efficient gills
  - \_\_\_\_\_ cover the body; paired \_\_\_\_\_
  - A wide variety of jaw and feeding types
  - Lateral line and other sensory organs; streamlined body

**Chondrichthyes: “cartilaginous fish”**

- Cartilage skeleton; \_\_\_\_\_ mouth
- Many have replaceable razor-sharp teeth; some have small teeth but gigantic mounts
- \_\_\_\_\_ scales, \_\_\_\_\_ gill slits, and paired \_\_\_\_\_
- Live births
- Examples: \_\_\_\_\_
- Energy Efficiency of Sharks
  - Do not have to feed as much as other organisms of the same size
  - Cartilaginous skeletons are \_\_\_\_\_ than bone – less weight = \_\_\_\_\_
  - Store low density organic compounds that minimize the energy they need to expend
  - Buoyant oils in \_\_\_\_\_
  - Shark fins sit at \_\_\_\_\_ and act like wings to provide lift
  - Skin \_\_\_\_\_ helps to transfer energy to the tail for swimming
- Sharks are Successful Predators
  - Good sense of \_\_\_\_\_
  - Sharks have lateral lines and light cartilage skeleton
  - Lateral lines are sensory pores that detect water motion
  - Sharks have electroreception; Electroreception: The ability to sense \_\_\_\_\_ created by muscles nerves
  - \_\_\_\_\_: Organ that detects electrical currents generated by living organisms
  - Visible pits near the snout
- Skates vs Rays
  - Rays \_\_\_\_\_ (viviporous)
  - Skates \_\_\_\_\_ (oviporous)
  - Rays have longer, skinnier tale with spine
  - Have large \_\_\_\_\_ which serve as “wings”
  - Skates have fleshier tale, no spine
  - Rays have plate like teeth while skates have small teeth

**Osteichthyes: “bony fish”**

- Skeleton made of true bone
  - They have terminal mouths. What does that mean? \_\_\_\_\_
  - Greater maneuverability
  - Coloration pattern- mainly countershading
  - What controls buoyancy? \_\_\_\_\_
  - What kind of flat bony scales protects the body? \_\_\_\_\_
- Examples: \_\_\_\_\_ and \_\_\_\_\_

Body shape is directly related to lifestyle

### Fusiform

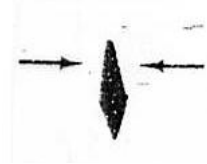
- Streamlined, \_\_\_\_\_ - “swimming machines”
- Designed to rapidly move through the water in pursuit of prey
- Efficiency is higher due to:
  - Ability to fold fins into depressions along body; smooth eyes flush with head
  - Specialized structure known as \_\_\_\_\_ that covers and protects the gills
  - Slim coating
- Examples: \_\_\_\_\_ Diagram of body shape



### Body Forms

### Laterally Compressed/Flattened

- Squished side to side
- Allow for easy movement among plants and narrow spaces- like coral reef
- Examples: \_\_\_\_\_ Diagram of body shape



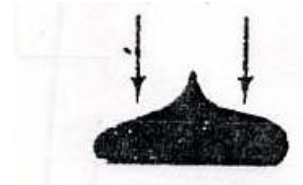
### Attenuated or Elongated

- Tube like; live in narrow spaces—rocks, coral reefs, etc.
- Usually secretes large amount of slime
- Examples: \_\_\_\_\_ Diagram of body shape



### Depressed

- Flattened top to bottom (dorso- ventrally)
- Usually bottom dwellers
- What is there general shape? \_\_\_\_\_
- Examples: \_\_\_\_\_ Diagram of body shape



### Fish: Basic Terms and Parts

### Swimming Pattern

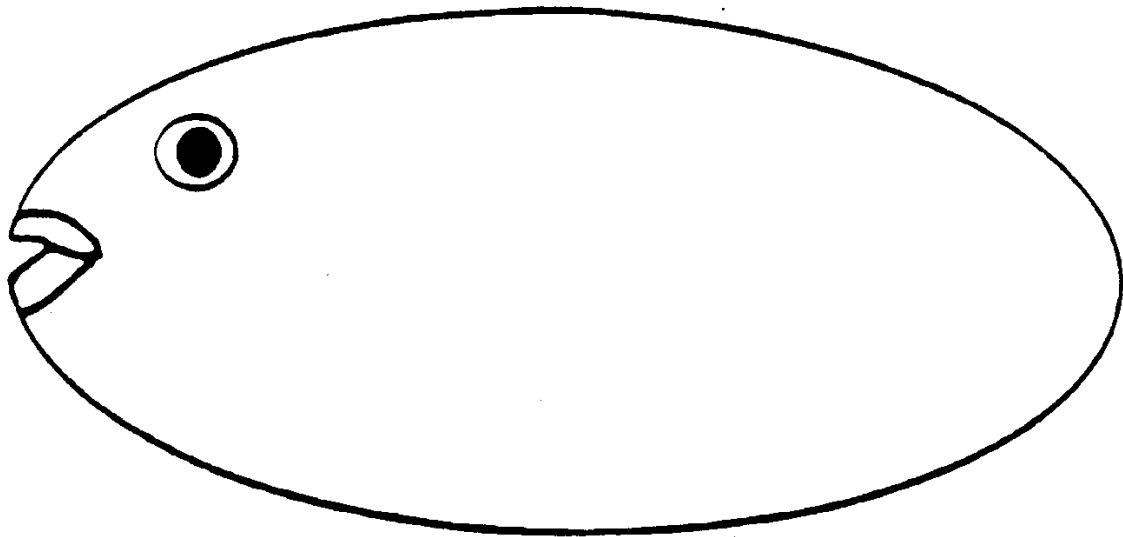
- What swimming pattern do fish exhibit? \_\_\_\_\_
- Depending on the type of fish, different fins may be used primarily for the forward movement

### Relative terms

- \_\_\_\_\_: refers to anything on the back
- \_\_\_\_\_: refers to anything on the underside

Fins: for locomotion and stabilization

**Body parts of Fish**



1. \_\_\_\_\_ : tail fin, used for forward motion and acceleration
2. \_\_\_\_\_ : on the back of the fish
3. \_\_\_\_\_ : rear of ventral side of fish
4. \_\_\_\_\_ : on side of fish
5. \_\_\_\_\_ : toward front of ventral side
6. \_\_\_\_\_ : used for protection—some contain poison sacs
7. \_\_\_\_\_ : covers and protects gills; not found in sharks

Singular fins  
Used to prevent rolling/tipping

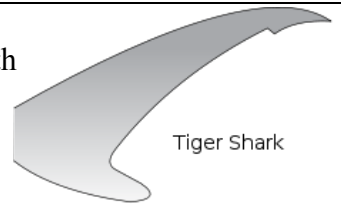
Paired fins (left and right)  
Used to balance, stop and turn

\_\_\_\_\_ : sensory canals used to detect changes in water pressure around the fish (similar to human ear)

**Three major types of caudal fins**

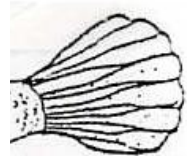
\_\_\_\_\_ : sturgeon or shark—use fins to regulate depth  
(no swim bladder)- also aid in swimming

- Pushes head downward and lifts tail as it beats side to side
- Pectoral fins act as airplane wings
- Example: \_\_\_\_\_



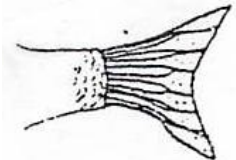
\_\_\_\_\_ : no real lobes

- Example: \_\_\_\_\_



\_\_\_\_\_ : modern bony fish

- Use fins as swimming aids and for turning and stopping—or just moving forward
- Lobe same size
- Example: \_\_\_\_\_



**Marine Fish: Part 2 STUDENT NOTES Date:**

Warm  
up

***What do these fish eat?***

*Barracuda:*

*Butterfly fish:*

*Parrotfish:*

Feeding  
Patterns

Mouth's design tells how fish gets food!  
Forward facing mouth vs. downward facing mouth

- Have specialized teeth for grasping/chewing prey
- Razor sharp teeth to remove bite size chunks. Example: \_\_\_\_\_
- Needle sharp teeth used for grabbing/holding Example: \_\_\_\_\_
- Some allow prey to come to them Example: \_\_\_\_\_
- Some go after it.

- Predatory fish that take small bites of food. Example: \_\_\_\_\_

- What do they do? \_\_\_\_\_
- How? Open their large funnel like mouths and take in large amounts of water
- Food is filtered out by specialized gill rakers as flow past gills
- Example: \_\_\_\_\_

- What are characteristics of these feeders? \_\_\_\_\_
- Create a vacuum with mouth and suck food with considerable amounts of force
- Often equipped with barbels (whiskers) to detect food on the bottom
- Example: \_\_\_\_\_

- Feed on other living creatures
- What are the two types that have rasp like tongues that scrape a hole in side of other fish
  - \_\_\_\_\_: sucks contents out while clinging to the outside
  - \_\_\_\_\_: burrows in and eats from within

Digestive  
System

One way (much like human's!)  
\_\_\_\_\_ → esophagus → \_\_\_\_\_ → intestines → anus

Esophagus may expand to accommodate anything the fish can get into its mouth

Stomach shape varies

Stomach variations

- may contain \_\_\_\_\_
- may take in air/allow the fish to blow up or may be absent all together

Carnivore intestine: \_\_\_\_\_ Herbivore intestine: \_\_\_\_\_

<b>Buoyancy Control</b>	<p>What does the swim bladder enable the fish to do? _____</p> <p>Can maintain neutral buoyancy- _____ - just hang there Sharks, skates and rays don't have a swim bladder so they must keep moving or sink to the bottom – they do have a large liver with oil that helps keep them afloat</p> <p>The speed of upward movement is determined by how fast gas can be removed from the swim bladder.</p>
<b>Temperature</b>	<p>Fish are ectothermic so the temperature affects their metabolic rate An increase in temperature = _____ A decrease in temperature = _____</p> <p>Many predatory fish have a countercurrent system for conserving heat which allows their muscles to stay warm → Examples: _____</p>
<b>Circulatory System</b>	<p>Much like human's with gills taking the place of lungs</p> <p>Heart is _____ (yours is 4) –one ventricle and one atrium Have nucleated red blood cells (humans do not) Do have plasma and white blood cells like humans Antarctic icefish lack hemoglobin and red blood cells and therefore have _____ blood!</p>
<b>Respiration</b>	<p>What do gills allow most fish to do? _____</p> <p>Countercurrent system = blood flows opposite water</p> <p>Flow of air: Mouth → gill arches → gill rakers → gill filaments → gill slits ( _____ ) ( _____ )</p> <p>Operculum: What does it do? _____</p> <ul style="list-style-type: none"> <li>• Bony fish possess this structure—cartilagenous fish do not</li> </ul> <p>Some fish may take in air by swimming to the surface and gulping it where it may take several hours to diffuse across gills while lungfish have air-holding sacs</p>
<b>Excretion and Salt Water Balance</b>	<p>Excretion = the disposal of _____ such as carbon dioxide, water, mineral salts, ammonia and urea What are the two main organs involved in excretion? _____</p> <p>The removal of wastes is closely associated with the control of water and salt amounts in body fluids Marine bony fish have a salt content of 1.5%</p> <ul style="list-style-type: none"> <li>• Surrounding water is 3.5%</li> <li>• Diffusion occurs but fish must maintain salt levels of _____</li> </ul> <p>Chloride cells -- _____ -- excrete excess salt</p> <p>Fish must also maintain good osmoregulation –regulating water content—allows fish to maintain salt and water content during extreme salinity changes Remember: salt water fish drink large amounts of water to keep their bodies from _____ through _____ and excess salts are removed by chloride cells</p> <p>Fresh water fish drink very little, release a lot of urine because water is coming in through osmosis—constantly needing to get rid of water</p>

**Marine Fish: Part 3 STUDENT NOTES Date:**

**Skin**

Entire skin of fish is \_\_\_\_\_ (unlike vertebrates)

Covered in scales –grow from pockets in skin

Not covered by a layer of skin, hair or feathers

Covered by \_\_\_\_\_ at all times

Scales covered by a thin layer of living cells. What is this layer called? \_\_\_\_\_

Protection is provided by a thin covering of mucus which reduces friction and lessens the possibility of bacteria and parasites from invading the skin

The common “fish” odor –found in slimy coverings—serves as a means of \_\_\_\_\_.

Scales can also help the fish “\_\_\_\_\_” the water—some fish have taste buds on their \_\_\_\_\_ and \_\_\_\_\_!

**Scales**

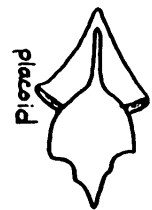
Have about the same number for life—count rings on them for growth.

What are a few fish that do not have scales? \_\_\_\_\_

Eels appear “scaleless” but actually have small scales deeply embedded in the skin

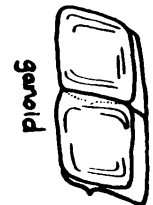
**Placoid Scales**

- Tooth-like
- How do they feel? \_\_\_\_\_
- Examples: \_\_\_\_\_



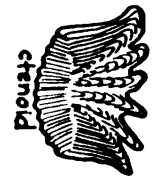
**Ganoid Scales**

- Large and plate-like—made of bone
- Generally fused to form a hard bony covering
- Examples: \_\_\_\_\_



**Ctenoid Scales**

- Describe the scale: \_\_\_\_\_
- Example: Spiny-rayed bone fish like mackerel



**Cycloid Scales**

- Describe the scale: \_\_\_\_\_
- Thin/flexible
- Smooth
- Found in soft-rayed bony fish
- Example: \_\_\_\_\_



Coloration

Fish show a variety of colors with variety of function

- Species recognition during breeding
- \_\_\_\_\_
- \_\_\_\_\_
- Advertisement for willingness to remove parasites from other fish (remora)

Types

- Cryptic: Fish coloration that \_\_\_\_\_ to deceive predators or prey
  - Ex. Flatfishes, some bennies, sculpins, and rockfishes can change color to match their surroundings
- Disruptive: The presence of colored \_\_\_\_\_ that help break up the outline of a fish – difficult to see them as an individual animal
  - Ex. Four-eye butterfly fish, angle fish
- Countershading: Type of coloration commonly found in animals and means that the animal's back (dorsal side) is \_\_\_\_\_ while its underside (ventral side) is \_\_\_\_\_.
  - This shading helps an animal blend in with its surroundings.
  - In the ocean, countershading camouflages an animal from predators or prey and is typically found in organisms that live in the \_\_\_\_\_ (open ocean)
    - When viewed from below, an animal's lighter belly would blend in with the lighter \_\_\_\_\_ above.
    - When viewed from above, its darker back would blend in with the \_\_\_\_\_ underneath.

Two types of cells are located in fish skin

- \_\_\_\_\_: star shaped pigment cells
  - How can fish change colors? \_\_\_\_\_
- \_\_\_\_\_: contain reflecting granules that work like \_\_\_\_\_

Defensive Strategy

Other than feeding

- Modified scales -> \_\_\_\_\_
- Prehensile tails. Example: \_\_\_\_\_
- Sudden expansion. Example: \_\_\_\_\_
- Coloration (see above)
- Secretions such as \_\_\_\_\_
- Schooling-- \_\_\_\_\_ -- some part time and some do this their whole life
- Intimidating behavior—bluffing, raised fins, open mouth, rapid darting, grinding teeth, rubbing spines



Migrations

Two underlying needs are directing seasonal migrations:

- \_\_\_\_\_
- \_\_\_\_\_

How are migratory fish grouped?

- Adult life in ocean—return to \_\_\_\_\_ to breed
  - Examples: \_\_\_\_\_
  - Salmon live several years in the sea and mature sexually then return to rivers. They don't feed once in freshwater—rely on stored fat. Eventually they reach the exact stream where they were born. Females dig a shallow nest where she lays her eggs. The males fertilize and then both die.
  - How do salmon find the exact place to breed? \_\_\_\_\_
- 
- Adult life in freshwater—return to sea to breed
  - Examples: \_\_\_\_\_
  - Some fish remain in the ocean and move on definite pathways between feeding areas and spawning areas—example: herring and tuna

Reproduction

How do fish reproduce? \_\_\_\_\_

Most do it externally. Explain. \_\_\_\_\_  
- Sharks are internal

Terms to know:

- \_\_\_\_\_: fish sperm produced in testes
- \_\_\_\_\_: fish eggs produced in ovaries

Some are dioecious (most) but some hermaphroditic (they are able to produce sperm and egg in combination—have ovotestes—example lancelfish, tripod fish, top minnow (may self-fertilize)

Sex reversal—\_\_\_\_\_—maintains an even number of males and females.

Examples: grouper, sheepshead, and wrasse

For some the urge to breed is controlled by hormones -> timing is controlled by:

- \_\_\_\_\_ Day light length
- Salinity \_\_\_\_\_

Courtship rituals (provide for species identification)

- Bright color display \_\_\_\_\_
- Aggression \_\_\_\_\_
- Specific sounds \_\_\_\_\_

Reproduction Types

- Oviparous: \_\_\_\_\_ that mature and hatch outside of body
- Viviparous: \_\_\_\_\_; mostly mammals
- Ovoviviparous: Produce eggs that mature and hatch inside the female's body and \_\_\_\_\_

## Comparison of Cartilaginous and Bony Fishes

Trait	Cartilaginous	Bony
Examples	_____	_____
Skeleton	Cartilage	Bone
Swim Bladder	_____ - oily liver provides buoyancy	_____ - air filled for buoyancy
Fertilization	_____ - have few large young in life time	_____ - lay millions of small eggs
Scales	_____ - spiny embedded in skin	_____ - platelike _____ and _____ are flat, flexible, overlap
Gills	No _____ have gill slits	_____ operculum cover and protect gills
Feeding Behavior	All predators (four exceptions)	Great variation in food sources
Fins	Rigid and unsegmented	Flexible and segmented
Teeth	_____ to jaw-- replaceable	_____ to jaw-irreplaceable