

Bellringer: 4/9/2018

1. What do you know about fish anatomy?
2. What is your favorite fish, and why?
3. STOTD

Updates and Reminders:

Monday: Intro to Marine Fish, start Shark Report
 Tuesday: Shark Anatomy, Shark report
 Wednesday: Bony fish
 Thursday: **QUIZ**
 Friday: Boney Fish continued, **Shark Report DUE**

Non-boney Fishes

Chapter 8 Part 1

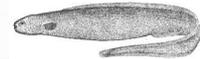
THE FISHES

- All are considered vertebrates
- They make up over 50% of all vertebrate species
- They are found in every area of the ocean and come in a variety of shapes and colors



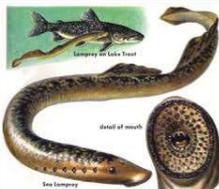
Classes of Fishes

- 3 Classes:
 1. **Agnatha** (jawless fishes)
 - Lampreys and Hagfishes
 2. **Chondrichthyes** (cartilaginous fishes)
 - Sharks, Rays, Skates
 3. **Osteichthyes** (bony fishes)
 - Other fish



CLASS AGNATHA The Jawless fish:

- The most primitive fishes
- **Eel-shaped bodies**
- **no jaws** or paired appendages
- They have **skeletons of cartilage**
- **No scales**
- Examples: **lamprey and the hagfish**

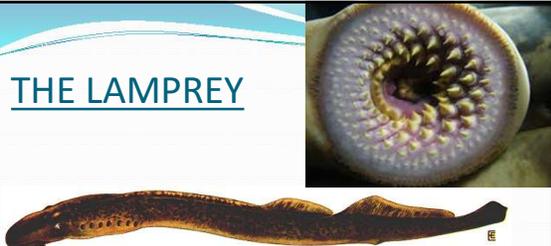


THE HAGFISH

- Are scavengers
- Use their **tongues, which are covered with teeth** to tear into the carcass
- **Hermaphroditic** because they possess male and female parts

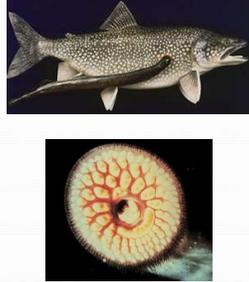


THE LAMPREY



- Are **parasitic**
- Spend their adult life in freshwater but return to ocean to spawn, **catadromous**
- Adults **die after mating**
- Their larva, called **Ammocoetes** spend 3-7 years in ocean
- **Bore into prey and eat them from the inside out!**

DINNERTIME!!!



- Lampreys feed by attaching to their host by an oral sucker disk
- They have teeth that tear into the sides of their prey - they feed off the blood of the host—parasite!

CLASS CHONDRICHTHYES

The cartilaginous fishes

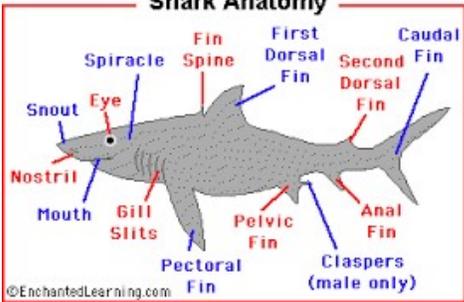
- their skeleton is made of **cartilage**
- Have **jaws**
- This class includes - **sharks, skates, rays**
- These animals have **streamlined bodies (torpedo shaped for fast swimming)**
- Well-developed nervous systems
- Contains the **worlds largest fish - the whale shark**



- Look over the Shark Anatomy Questions

Shark Anatomy

<http://youtu.be/mRkRkBXl-UI?list=PL71eySLINC8ZYEXLfy16YRYJAwaVMKa7N>



Shark Anatomy

Labels: Snout, Eye, Nostril, Mouth, Gill Slits, Pectoral Fin, Spiracle, Spine, Fin, Pelvic Fin, Claspers (male only), First Dorsal Fin, Second Dorsal Fin, Anal Fin, Caudal Fin.

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Shark Report!

- You will choose a shark from a list of 30 common sharks and write a report.
- The guidelines are shared with you in Google Drive.

Tuesday Bellringer: 4/10/2018

1. What shark have you chosen for your report?
2. What Class are sharks classified?
3. What are the names of the 2 fins on the found on the back of a shark?
4. STOTD

Updates and Reminders:

Tuesday: Shark Anatomy, Shark report

Wednesday: Bony fish

Thursday: **QUIZ & Report cards**

Friday: Boney Fish continued, **Shark Report DUE**

- Add to your vocabulary:
- 34. Spiral Valve

SHARK ANATOMY:

- The **caudal fin (tail fin)** provides the forward thrust **for swimming**
- The **tail is not symmetrical**, the top half is larger than the lower half (called **heterocercal**) - the vertebral column extends into the upper lobe of the caudal fin
- **this motion is balanced by the pectoral fins**
- Sharks also possess **2 dorsal and pelvic fins**

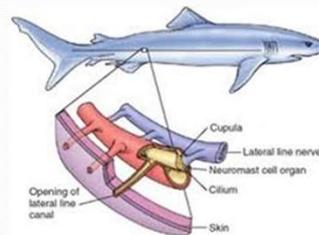
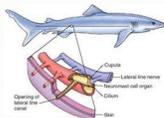
SHARK ANATOMY - cont.

- Sharks have thick skin covered in **placoid scales - much like sandpaper**
- Their jaws contain many rows of **teeth that they shed periodically**
- Sharks negatively buoyant sea water, to compensate some have enlarged livers that contain squalene - an oily substance



SHARK SENSES:

- **Vision** - sharks have **excellent vision**, they often have a nictitating membrane that protects the eyes, they **have color vision** but it is not well developed
- **Smell/Taste** - the rostrum of the shark contains the nose, they have **an incredible sense of smell**
 - **2/3 of their brain is committed to the olfactory sense**
- **Touch - sense vibrations in the water** - the organs that register the vibrations are called **neuromasts**



DIGESTION IN SHARKS:

- They **use sharp teeth to tear** apart their prey
- Once the food is swallowed it passes through the stomach and into the intestine called a **spiral valve** - it is narrow at the beginning and widens at the end
- Sharks tend to have **lower internal salinity than seawater** - they **store their urine inside their bodies** to help regulate salinity



REPRODUCTION IN SHARKS:

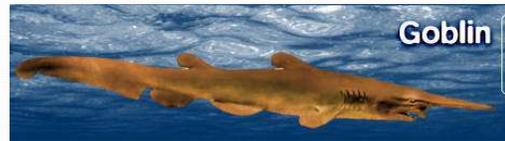
- Reproduction is **internal**
- The pelvic fins of male sharks are modified into structures called **claspers** - during mating the male uses them to deliver sperm to the female
- There are two types of reproduction in cartilaginous fishes -
 1. **ovoviviparous**: eggs develop inside female (majority of sharks)
 2. **oviparous reproduction**: spawning eggs (few shark, majority of fish)



REEF SHARK:



GOBLIN SHARK:



GREAT WHITE:



HORN SHARK:



AN UNUSUAL HEAD!



Scalloped Hammerhead

Rays and Skates: Generic Characteristics

- Class: **Chondrichthyes**
- **Dorsoventrally flattened** (flat body with gills on bottom).
- **Demersal**: live on bottom
- “True” rays and skates ALWAYS have **5 gill slits on underside of body**
- Pectoral fins flat, fused to head and **look like wings**



Rays and Skates: Feeding

- Feed by **ambushing prey**
 - bury themselves lay on the bottom until something tasty swims by <http://youtu.be/qjivzTzoEJA>
- “**Wing-flapping**”: uses pectoral fins to stir up sediment, or to disable prey
- Opens and closes mouth to **create water flow and suction**
- They eat: **Crustaceans, Bivalves, and Cephalopods**
- <https://www.youtube.com/watch?v=YbOXVIRShoU>



Rays vs Skates

- **Reproduction** is main difference
 - Rays: Viviparous reproduction (live birth)
 - Skates: Oviparous (release eggs in a case)
- **Size**
 - Rays: Larger
- **Tails**
 - Rays: thin and whip-like, some with spines (stingrays)
 - Skates: thicker tail, no spines, serrated (like a bread knife)
- **Teeth**
 - Rays: plate-like teeth for crushing prey
 - Skates: small teeth





Types of Rays

- Stingrays
 - have venomous barbs at end of tail
- Electric rays:
 - can generate and discharge electric current to stun prey and defend itself
 - Rounded wings
- Butterfly rays:
 - have a very short tail
- Manta rays:
 - Largest Ray reaching up to 9 meters
- Guitarfish:
 - tail like a shark, head is triangular/“guitar” shaped
- Sawfish:
 - saw-like snout








Bellringer: 4/11/20108

1. How can you distinguish a ray from a skate?
2. How are sharks and rays similar?
3. How are they different?
4. STOTD

****Keep your Notebook out**

Updates and Reminders:
 Wednesday: Bony fish
 Thursday: **QUIZ**
 Friday: Boney Fish continued, **Shark Report DUE**

Quick Video(s)

1. Why is shark sense of smell is unique?
2. Can sharks hear sound?
3. What are they listening for?
4. What about their eyesight?
5. What about their sense of taste?
6. What about the Ampullae of Lorenzini?
7. What about the lateral line?

1. Skates and rays are in the subdivision known as the: _____
2. How can you tell a ray from a flat shark? (2 ways)
3. What is the sting ray's most feared predator?
4. Where is the sting ray's mouth located?
5. What is the function of spiracles?
6. How does the little skate move primarily?
7. What makes the torpedo ray unique?
8. What makes the eagle ray unique? (2 things)
9. What does the manta ray eat?
10. True or False: rays give live birth
11. True or False: skates give live birth
12. What makes the sawfish a ray and not a shark

Bony Fishes

Chapter 8

The Bony Fishes

- Majority of Fish are "bony" (96 % of all fish)
- Class: **Osteichthyes**
- They are considered one of the most successful vertebrates
- All bony fish have a strong endoskeleton made completely of bone

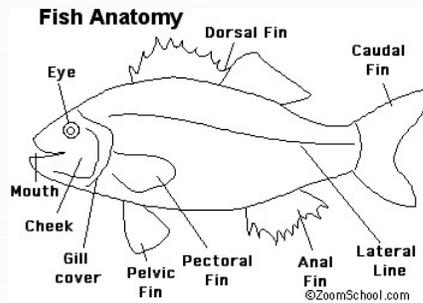
Cartilaginous vs. Bony Fish

- Scales protect the fish and reduce friction while swimming
- Have **cycloid or ctenoid** scales
 - Made of bone
 - Thin, flexible and overlapping
 - Covered by thin layer of skin and mucus
- **Operculum**
 - Gill cover protects gills

Cartilaginous vs. Bony Fish

- **Terminal mouth**
 - Located at anterior end
- **Teeth attached to jawbone**
- **Swim bladder:** gas filled sack
 - Function:
 - Adjusts buoyancy
 - Compensates for the heavy skeleton

Generic Bony Fish Anatomy



Lateral Line

- Bony fish have a fully developed lateral line system
- When water pushes against the fish's side, nerve impulses from sensory cells in the lateral line go to the brain
 - This allows the fish to be aware of its position and rate of movement
 - It also allows a fish to detect an object by movement of water deflected by that object

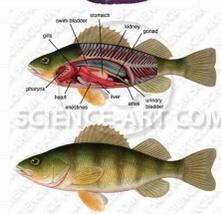
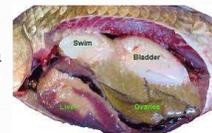
Gill Cover

- Operculum
 - hard plate that covers the gills and is open at the rear
- Movements of the opercula and muscles draw water over the gills, which allows the fish to take in oxygen
 - This allows bony fish to take in oxygen while remaining in place compared to sharks and other fish that have to move forward to take in oxygen
 - The ability to take in oxygen without movement allows bony fish to conserve their energy



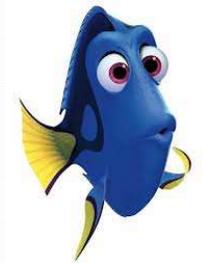
Swim Bladder

- A bony fish would sink without a swim bladder
- Regulates their buoyancy
 - As the swim bladder fills with gas the fish rises
 - As the swim bladder empties the fish sinks



Swim Bladder

- Bony fish do not have to keep swimming to keep from sinking
 - Bony fish also have highly mobile paired fins which enable bony fish to turn sharply and paddle backwards and therefore keep them from sinking



Ray-Finned fishes

- Most bony fishes are **ray-finned fishes**
 - **fins are supported by bony structures** called rays
- Teleosts are the most advanced type of ray-finned fish
 - Teleosts have very mobile fins, thin scales, and completely symmetrical tails



An example of a Teleost is the perch

Ray-Finned Fishes

- 95% of all living fish are Teleosts
- Teleosts are so successful because of their ability to suck food towards their mouth due to its ability to protrude its upper jaw forward in order to grasp food



Bony Fish Characteristics: Overview

1. Class: **Osteichthyes**
2. Cycloid/Ctenoid scales:
 - **Thin, flexible, overlapping, smooth scales made of bone**
3. Operculum/gill cover
 - **to protect gills**
4. Homocercal caudal fin
 - **Top and bottom of tail generally the same size**
5. Fin rays:
 - **fins are supported by bony spines**
6. Swim Bladder:
 - **Buoyancy organ located just above stomach and intestines.**

Shark Research Activity

1. Shark Name
2. Anatomy Unique to this Shark (for example: the shape of the hammerhead's head) Make sure to tell why this is helpful/ hurtful to the shark.
3. Area in the Ocean where this shark can be found.
4. How are their senses helpful to their habitat?
5. What is their main food source?
6. How does this shark reproduce?
7. When is the mating period? (What time of the year do they mate?)
8. Is there an economic benefit gained from this shark?
9. What human activities are affecting this shark the most?
10. How many attacks are reported from this shark each year? Explain why you think there are so many/ so few attacks by this type of shark.

Quiz Info

10 Questions

- 5 Multiple Choice
- 5 True/False, where you have to correct false statements to make them true

Topics:

- Fish Classes: Agnatha, Chondrichthyes, Osteichthyes
- Rays vs Skates
- Chondrichthyes vs Osteichthyes
- External anatomy (fins, gill slits vs operculum, body shape: dorsoventrally flattened vs torpedo shape, scale type: placoid vs cycloid/ctenoid, mouth location: ventral vs terminal)

Bellringer: 4/12/2018

1. Compare and contrast the Chondrichthyes and the Osteichthyes. Have 3 facts for each part of the Venn diagram.
2. STOTD

Our Field Trip as been approved!!!
When: April 25 (all day) Cost: \$15.00

Updates and Reminders:
 Thursday: **QUIZ (now) & REPORT CARDS ISSUED (2:20)**
 Friday: Boney Fish continued, **Shark Report DUE**

Bellringer: 12/1/2017

How would you describe the body shape of

1. a puffer fish?
2. What about an eel?
3. A shark?
4. STOTD

Updates and Reminders:
 Friday: Boney Fish continued, **Shark Report DUE**

THURSDAY, 12/7/2017: BONY FISH & SHARK DISSECTION!!
FRIDAY, 12/8/2017: FIELD TRIP \$\$ & FORMS DUE!

Bony Fish Body Shapes

1. Streamlined
2. Dorsoventrally flattened
3. Laterally flattened (compressed)
4. Ribbon shaped
5. Elongated
6. Round

Body Shape: Streamlined

- Body shape is directly related to lifestyle
- Here are some examples:
 - Sharks, tunas, marlins are streamlined → fast




Body Shape: Dorsoventrally Flattened

- Flat and adapted to live on bottom
- Lie on one side with both eyes on top
- Begin life with eye on either side
 - Eyes migrate together as they grow older



Flounder



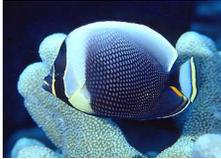
Halibut

Body Shape: Laterally Flattened (Compressed)

- Leisurely swimming around coral reefs, kelp beds, rocky reefs
- Still capable of short bursts of speed



Whitespotted Damselfish



Butterfly Fish



Wrass

Body Shape: Ribbon Shape

- Small
- Elongated
- Brightly colored
- Dorsal fins are spines



Gunnel Fish



Prickleback Fish

Body Shape: Elongated

- Live in narrow spaces in rocks or coral reefs



Trumpet Fish



Fimbriated Moray Eel

Body Shape: Round

- Increases size to intimidate predators
- Ready for inflation
 - Swallow air or water to inflate



Porcupine fish
aka Blowfish

Coloration

- Color comes from cells called: chromatophores
- Use color to advertise they are poisonous
- Some can change colors for these reasons:
 - Camouflage
 - Mood
 - Reproductive condition



Coloration

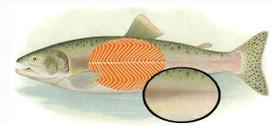
- **Warning coloration:** dangerous, poisonous, or bad tasting fish
- **Cryptic Coloration:** deceives predators and prey
- **Disruptive Coloration:** stripes, bars, spots to help break up the outline of fish
- **Countershading:** disguises fish in open water
- **Color of concealment:** Deep-water fish tend to be black or red, which is hard to see in deep water.



Alisonella
(Pantodon pseudonemurus)

Locomotion

- Swim side to side (S-shape)
- Contractions produced by **myomeres**
 - Bands of muscle running along side of body
 - Large percent of body weight—70% in salmon!



Fish Muscles

- 3 types
 - Red, pink, and white
- Most fish have a combo of 2 or 3 types
- What makes the red muscles red?
 - A lot of capillaries → a lot of blood flow
- Different types of muscles have different jobs.



Tuna

Red vs. Pink vs. White Muscle

- **Red muscle**
 - Slow muscle
 - A lot of oxygen (hemoglobin)
 - steady, constant-effort swimming
 - Open ocean swimmers (tuna, mako)
- **White muscle**
 - Fast muscle
 - Reduced blood → less oxygen
 - anaerobic, works for short periods of time
 - Quick bursts of movement
- **Pink Muscle**
 - Intermediate; continued high speed swimming for 20-30 minutes

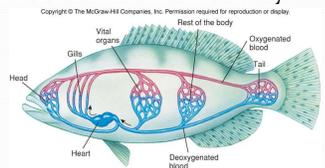
Bellringer: 12/1/2017

1. How do fish body types and coloration related to their lifestyle? Provide an example
2. STOTD

Updates and Reminders:
Tuesday: Fish Behavior, Shark Article, Shark Research Assignment
Wednesday: Fish Dissection Lab Preparation
Thursday: **Boney Fish DISSECTION LAB!!!** PROGRESS REPORTS
Friday: Review, Finish assignments
Monday: Review and **TEST** on Marine Fishes

Circulatory System

- 2 chambered heart
- Deoxygenated blood enters 1st chamber of heart from body
- 2nd chamber pumps this blood into gills
- Gas exchange takes place
- Oxygenated blood carried to rest of body



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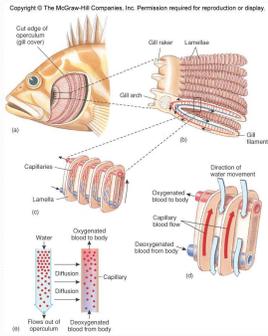
Respiratory System

- What is the percentage of oxygen in our atmosphere?
 - 200,000 parts per million, or 21%
- What is the percentage of dissolved oxygen in water?
 - 4-8 parts per million, less than 1%
- Takes a lot of work for fish to pull oxygen out of the water



Respiratory System

- Must keep gills ventilated
 - Swimming, opening & closing of mouth
- Each gill has rows of filaments with lamellae (increases surface area)
- Oxygen diffuses from sea water to blood
- Water and blood flow in opposite directions → boosting diffusion rate



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Marine Fishes

Chapter 8 Part III: Behavior

Behavior

- Ethology- the study of behavior
- Fish Ethology- the study of the behavior of fish
- Behavior- the sum of all the motor responses to external and internal stimuli



Photo by T. Quinn

The Essentials....

- Behavior is due to : genes, motivation or development
- Can't understand behavior without understanding:
 - genetics
 - development
 - ecology
 - physiology
 - biochemistry



Basically....

- Behavior is:
 - Getting food
 - Avoiding becoming food
 - Mating
 - Adapting to Light





Responses

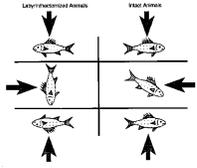
- Fish respond to stimuli using their senses:
 - Visual
 - Olfactory (smell)
 - Auditory (Vibrational)
 - Pressure (Lateral line)
 - Touch
 - Taste
 - Electoreceptors (Ampullae of Lorenzini)



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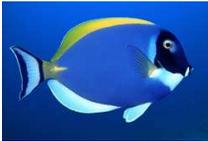
Responses

- Locomotor responses:
 - Kinesis (undirected, random)
 - Taxes (directed, nonrandom)
 - Phototaxis (light)
 - Geotaxis (gravity)
 - Magnetotaxis (electromagnetic field)
 - Electrotaxis (electricity)
 - Rheotaxis (current)
 - Chemotaxis (chemicals)




Homing

- Homing
 - Fish orient to a home range
 - Based upon energy requirements
 - Varies seasonally
 - Requires memory/recognition and taxes




Migrating

- Mass movement from one region to another
 - Once a year, once a lifetime
- Response to a genetic, motivational, or developmental stimulus
- Usually in conjunction with environmental stimuli




Migrations



- Factors that affect migration:
 1. Food (main reason for open water fish)
 - Moving onshore or offshore to feed
 - Tuna, sailfish, marlin...
 2. Reproduction
 - Anadromous: marine fish that spawn in freshwater
 - Salmon
 - Catadromous: Freshwater fish that spawn in saltwater
 - Only 16 known species do this, including Freshwater eels



Behavior: Territories

- Territory: Home area fish defend from predators
- Temporary
 - During reproduction
- Permanent
 - Areas used for food, shelter, or resting
- Aggressive behavior
 - Raised fins, open mouth, darting, grinding teeth
 - Fights are rare



damselfish



Beta fish

Behavior: Schooling

- Schools are groups of fish
 - Protection in numbers
 - Swimming efficiency
- Part time
 - Juveniles
 - Feeding
- Full time
- Migrating schools
- Stationary schools
 - Coral reefs, kelp bed, shipwrecks...




Symbiotic Relationships

1. Mutualism: 2 species “work together”, both benefit
 - Clown fish and anemone
2. Commensalism: 1 organism benefits from other
 - Barnacles and whales
3. Parasitism: 1 organism is harmed from relationship
 - Lampreys on fish, nudibranchs on sponges
4. Competition: ≥ 2 species use same limited resource




Label the Type of Symbiotic Relationship



1. Nudibranch on sponge



2. Shark and remora fish



3. Dolphins and mackerels



4. Clown fish on anemone

Bellringer: 5/10/2017

- What two factors effect fish migration the most?
- What bodily products will attract sharks?
- What interesting fact did you discover about your shark?
- STOTD
- **TURN IN HW

Updates and Reminders:
 Wednesday : Fish Dissection Lab Preparation
 Thursday: **Boney Fish DISSECTION LAB!!!!** PROGRESS REPORTS
 Friday: Review, Finish assignments
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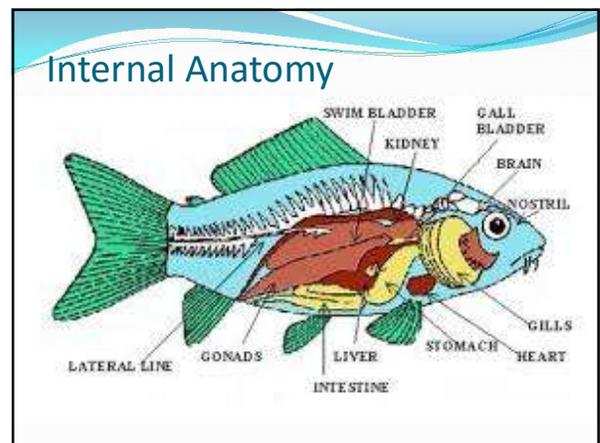
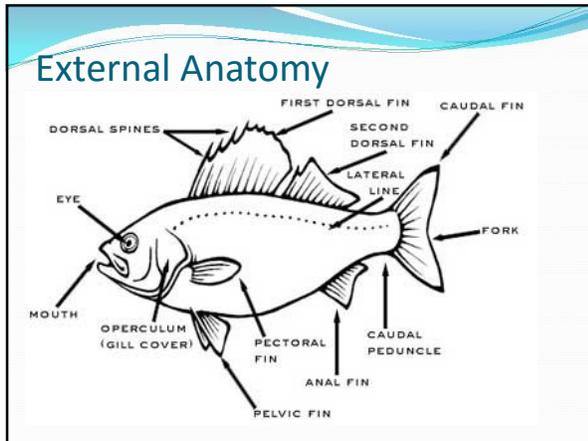
Bellringer: 12/6/2017

What do you expect the fish dissection to be like tomorrow?

STOTD
 **FIELD TRIP FORM AND \$\$ DUE on FRIDAY

Updates and Reminders:
 Wednesday : Fish Dissection Lab Preparation
 Thursday: Shark & Bony Fish DISSECTION LAB!!! PROGRESS REPORTS
 Friday: Review and TEST on Marine Fishes
 Monday: Extra Credit Presentations
 TUESDAY: AQUARIUM FIELD TRIP

White Grunt Dissection



Making the cut: start at vent (anus)



Make cut straight along belly



Cut between pelvic fins



Cut all the way to operculum



Open the body cavity



Internal

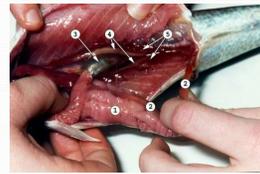


1. Heart
2. Liver
3. Pyloric Caecae
4. Adipose, Fatty Tissue

Definitions

- Heart
 - **Helps transport blood**
 - The heart of slow moving fish are small, active fish have large hearts
- Liver
 - **The liver has many digestive and storage functions:**
 - Produce bile
 - Stores: Fats, blood sugar, Vitamin A, Vitamin D
- Pyloric Caecae
 - **Finger-like pouches attached to gut**
 - **Protein Digestion**

Internal



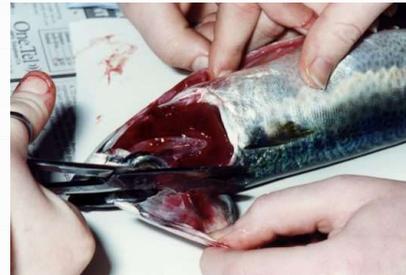
- Pull the adipose tissue (1) and gut (2) aside to expose the swim bladder (3), gonads (4) and kidneys (5).
- As a general rule, carnivorous fishes have relatively short guts. Herbivorous fishes have much longer guts.
- The gonads and kidneys are paired. One of each can be seen on both sides of the swim bladder.

Definitions

- Gonads
 - **Gonads are sex organs; ovaries in females and testes in males.**
 - In most cases, fertilization of eggs is performed externally, called spawning.
 - Often these organs are found separate in fish, male and female. However, some fish are hermaphroditic, meaning they carry both types of gonads.
- Kidneys
 - Kidneys are paired organs located ventral to the spinal column. **They are involved in excretion and regulation of water in fish.**

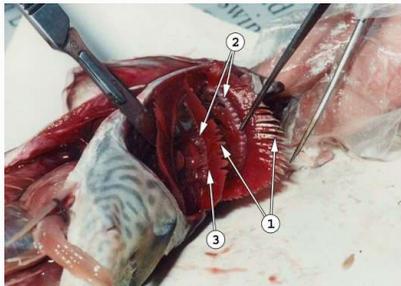
Internal

- Remove the right gill cover (operculum) to expose the gills.
- Bony fish have a single opening behind each operculum.



Internal

1. Gill Filaments
2. Gill Rakers
3. Gill Arches



Definitions

- Gill arch
 - **provides support for the gills.**
- Gills
 - **organs used for breathing.**
 - Water enters the mouth, and passes between the gills.
- Gill filaments
 - **absorb the oxygen from the water**
 - **release carbon dioxide.**
- Gill rakers
 - appendages along the front edge of the gill arch.
 - **aid in feeding processes**

Internal Systems

- **Digestive System:** breaks down and processes proteins, carbohydrates, and fats.
- **Excretory System:** the system that removes wastes.
- **Nervous System:** organs receiving and interpreting stimuli
- **Reproductive System:** organs and tissues involved in reproductions, including gonads, eggs, and sperm.
- **Respiratory system:** organs and tissues involved in the oxygen and carbon dioxide gas exchange.
- **Urinary System:** organs that remove nitrogen from the blood and regulate water balance

Brief Overview

- <https://www.youtube.com/watch?v=pNZQEmGpuk>

Bellringer: 5/10/2017

1. How will you make the incision to view the internal anatomy of your fish today? Use anatomically correct terms.
2. True or False: Human lungs are more efficient than fish gills.
3. If a fish has a lower jaw that sticks out further than the top jaw, what does that mean?
4. The dorsal and anal fins aid in _____ the fish in the water and prevent it from _____.
5. STOTD

Updates and Reminders:
 Thursday: **Boney Fish DISSECTION LAB!!!** PROGRESS REPORTS
 Friday: Review, Finish assignments
 Monday: Review and **TEST** on Marine Fishes

Bellringer: 5/12/2017

1. Why would a fish be territorial?
2. What type of relationship do Tuna and Spanish Mackerel have?
3. The study of behavior is called _____.
4. STOTD
 - Keep your Bellringers out
 - *****Packet Due on Monday!!**
 - *****Monday: Review & TEST on Marine Fish**

Post Lab in Bellringer Notebook

1. With your partner/group from yesterday make a Plus/Delta T-chart about lab.
2. Then, discuss with your group new things that you learned about fish and/or fish anatomy.
3. Also discuss that if you had the opportunity to do a dissection again, what would you do differently?
4. Were there any benefits to doing the fish dissection?
5. If yes, what are the benefits?