FISH STATION

- Importance of Malibu Lagoon for fish and other animals
  - Productivity
    - Estuaries are among the most productive ecosystems (coral reefs and tropical rainforests are most productive)
  - Nursery Area
    - Many fishes use lagoons as breeding grounds or as nurseries for small fishes – lagoons are typically warmer and more nutrient rich with lots of food which allows for fast growth, and lagoons typically offer shelter from predators
    - Ex. of fish that use lagoons as a nursery area – Halibut, Mullet, Sardines, Smelt
  - Spawning Sites
  - Migration Routes (steelhead, migratory birds)
  - Filtration
    - Lagoons filter the water and sediment that runs from the top of the watershed before it enters into the ocean, which improves water quality offshore.

- Introduction to Fishes
  - Life cycle – most fish have a planktonic larval stage (zooplankton), but some are livebearers (ex – surfperch)
  - Growth - Fish (and animals in general) generally grow very quickly when young and growth slows with age. Once they reach a max size, they will continue to accumulate body mass (note – BOFF = Big Old Fecund Female = lots of healthy eggs); growth can vary with several parameters such as sea temperature and food availability
  - Gravid – term to describe pregnant fishes
  - Fins – Dorsal, Pectoral, Pelvic, Anal, Caudal – different shapes/sizes for different types of swimmers (ex. maneuvering, anguilliform-eels)
  - Gills – used for gas exchange (breathing)
  - Mouth/Eye position – helps target certain prey (halibut have eyes on both side of head when in the plankton, rotates to one side after settlement – can be righty or lefty! – some species are only right or left-eyed)
  - Scales
    - 4 common types of scales: ctenoid, ganoid, placoid, cycloid
    - Steelhead Trout have cycloid scales
    - Ctenoid and cycloid scales can be used to age a fish because they accumulate concentric rings around a focus which can be classified into annuli
  - Otoliths
    - Hard, calcareous structures located in the cranial bones near the brain of teleosts
    - 3 types – sagittae (largest & most typically used in aging studies), lapilli, astersci
    - made of calcium carbonate crystals embedded in an organic matrix – grow daily
  - Teeth – different shapes and sizes for different predators
    - Piscivores – eat fish (kelp bass,
    - Planktivores – eat plankton (damselfish, gobies, lots!)
    - Herbivores – eat algae/plants (only 3 species off our coast – opaleye, halfmoon, zebra perch; opaleye found in Malibu Lagoon)
    - Coralivores – eat coral (ex-parrotfish)
  - Body shape – varies depending on lifestyle (ex-flattened (depressed)-flounder, halibut; fusiform-tuna, salmon; anguilliform-eels)
  - Type of predator – ex.-sit and wait, ambush, filter feeder

- Camouflage – countershading (ex. sharks), chromatophores (ex-octopus, flatfish – can change color to camouflage)
- Finlets or caudal keel – pelagic fishes have these to help reduce drag when swimming fast for long distances (ex – tuna, marlin)
- Some differences between bony and cartilaginous fishes
  - Bony fishes – Class Osteichthyes or Teleosts (~95% of fish)
    - Have calcareous bones like us!
    - Have Swim bladders – help maintain neutral buoyancy by gas exchange
    - Lack eyelids
  - Cartilaginous fishes – Class Chondrichthyes (sharks, rays)
    - Lack calcareous bone, instead are made of tissues of which cartilage is one – like that found in our ears and noses! Cartilage is only about half as dense as bone, which means less energy needed for swimming
    - Have Dermal Dentacles – tooth-like scales and the reason sharks and rays feel sandpapery
    - Lack Swim bladders – use dynamic lift (hydrodynamic planing) to achieve neutral buoyancy
    - Have Eyelids – some sharks have a nictating membrane (like a penguin) to protect their eye; the great white has muscles that can roll the eye back into the socket!
    - Have relatively large livers which contain low density oils (helps w/buoyancy)

- Endangered species found in the lagoon – steelhead and tidewater goby
  - Steelhead trout (*Oncorhynchus mykiss*)
    - In the Salmonid family
    - Anadromous life cycle: freshwater – saltwater – freshwater
    - What other species can do this?
    - Lagoon very important for the survival of this species because of the time spent in the lagoon as a *smolt* growing and morphologically changing to be able to withstand salt water.
    - Found in Malibu Creek and Topanga Creek – RCD conducts monthly snorkel surveys to monitor their abundance and movement. Mostly small fish in both.
  - Tidewater goby (*Eucyclogobius nicholsii*)
    - Gobies are most speciose family of fishes (Gobiidae)
    - Gobies are bottom-dwelling and have fused pelvic fins (one way to tell if it is a goby)
    - Completely extirpated from Malibu Lagoon by 1970. Successfully reintroduced to the Lagoon in 1991 from Ventura River population.

- Other species potentially found in the lagoon/creek
  - Seine conducted in 2005
  - See fish guide on website for more information on fishes observed in the lagoon
  - Richard Ambrose and Douglas Meffert studied lagoon fish-assemblage dynamics 1993-1994 – observed 13 species and 16,444 individuals, 80% of which were CA killifish, mosquitofish 9%, topsmelt 7% of total catch.

- Invasive/Introduced species – species that are not native to this area and thrive
  - Carp, catfish, sunfish, mosquitofish, largemouth bass
  - Mosquitofish were introduced to control mosquito populations and are still used today as vector control

- Some animals found swimming in the ocean that are not fish:
  - Marine Mammals
    - Pinnipeds - seals, sea lions
    - Cetaceans - dolphins, porpoises, whales
    - Dolphins found off the SoCal coast: Common, Bottlenose, Risso's, Pacific White Sided
    - Whales found off the SoCal coast: Gray, Blue, Fin, Humpback, Minke, Killer
    - Fun fact - is a whale shark a whale or a shark? – a shark! It eats plankton!
  - Common Seabirds at Malibu Lagoon
    - Cormorants – can dive deep – I saw one at 60 ft once when diving off Catalina!
    - Western Gulls, Brown Pelicans,
    - Cool sea birds that you will not find at Malibu Lagoon:
      - Penguins – 17 species, all live in Southern Hemisphere!
      - Puffins – 3 species, all live far north in Northern Hemisphere!
  - Invertebrates – lack a backbone
    - Invertebrates found in the tide pools near the lagoon and fun facts – sea urchins, sea stars, mussels, limpets, barnacles, ecology-mussels and sea stars (see sandy beach ecology guide)

- Linking water quality with plankton and fishes (see Water Quality and Plankton Guides)
  - Good water quality = lots of plankton = lots of food for fishes and invertebrates

- Plankton is responsible for **60-90%** of O2 we breathe!

- Plastics in the ocean
  - ~90% of all trash floating on ocean's surface is plastic (46,000 pieces of plastic per square mile!)
  - Great Pacific Garbage Patch – world's largest ocean garbage site (twice the size of Texas!), plastic pieces to sea life ratio = 6:1!
  - Balloons in the sea – sea jelly look-a-likes – sea turtles, dolphins, and other marine organisms eat sea jellies!

Teaching Tips:

- Ask lots of questions to make sure the students are engaged
- Use props, anecdotes when possible
- Relate material to something they might know about (spongebob, nemo!)
- Keep your talking to a minimum and have the students teach one another when possible
- Have the students do hands on activities as much as possible

Recommended Reading and Useful Websites:

- Cailliet, G., M. Love, A. Ebeling. 1986. FISHES: A Field and Laboratory Manual on Their Structure, Identification and Natural History. Waveland Press, Inc. Long Grove, IL.
- The Fishes (Stream Biology and Ecology) - http://chamisa.freeshell.org/fish.htm
- The Growth of Fish (Gray and Setna 1930!) - http://jeb.biologists.org/content/8/1/55.full.pdf
- FishBase: A Global Information System on Fishes - http://fishbase.org/

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- Differences between sharks and bony fish & other fun fish facts: http://www.sharksavers.org/en/education/shark-biology-behavior/395-differences-between-sharks-and-bony-fish-more-than-just-the-skeleton.html
- Plastics in the Ocean: http://www.savemyoceans.com/plastics.php
- Great Pacific Garbage Patch: http://www.greatgarbagepatch.org/
- Balloons as Litter: http://www.longwood.edu/cleanva/balloons.htm