



## Education and Research: Testing Hypotheses

### Background Information—Observing Deeply

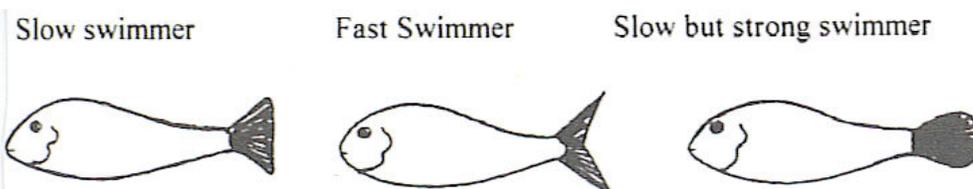
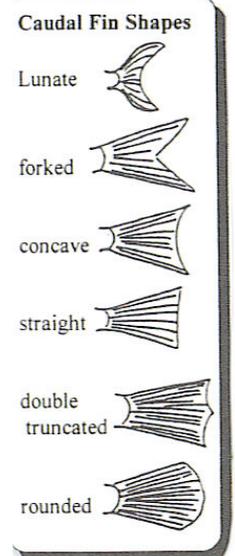
Fish are members of the phylum Chordata and they, like humans, have backbones. There are several major characteristics that all fish have in common. Most have backbones, are aquatic, breathe through gills, and are cold-blooded. Fish also have several features that enable them to survive in their environment. They are all covered with *scales* and a *mucus lining*, which serve as a protective outer covering. *Fins* enable the fish to swim, turn, stop and remain upright in the water. Fish have adapted well to their environment, and this is seen in their body shapes, camouflage, mouth positions and various behaviors. By observing a fish's body shape, behavior, mouth and fin positions, and swimming style, one can describe where the fish probably lives, how it moves, and sometimes, what it eats.

1. **Fins:** Fins give fish mobility, stability and maneuverability. They are used in swimming, turning (steering), stopping (braking), and perching. Each fin is moved by a set of muscles. Some fish have developed special uses for fins. There are two types of fins: paired (one on each side) and unpaired, or median (single) fins.

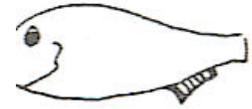
- a. **Dorsal fins** are unpaired median fins that have spiny or soft rays. They act as keels and prevent the fish from spinning or rolling. They keep fish upright in water or stabilized so they can swim straight. Some fish use their dorsal fins to swim. Some fish will have only one dorsal fin while others may have two or three. The front part of the dorsal fin is generally thicker than the rear part, which is thinner and without spiny rays. Some fish, like the triggerfish, undulate the dorsal fins for swimming power. The dorsal fin of remora is modified into a suction disk for attachment to larger fish.



- b. The **Caudal fin**, or tail fin, is also an unpaired median fin. The caudal fin helps to propel and maneuver fish. It is most often used to generate swimming power and to assist in braking, turning, or stopping. Caudal fins appear in a variety of shapes, and the shape determines how fast a fish can swim. Caudal fins with lobes of equal size are *homocercal* and caudal fins with lobes of unequal size are called *heterocercal* and give lift to the fish. The *caudal peduncle* is where the tail is attached to the body. If the caudal peduncle is narrow and the caudal fin is forked, the fish is a fast swimmer.



- c. The **anal fin** is an unpaired median fin that is located near the tail. The anal fin, like the dorsal fin, is a stabilizing fin.



- d. **The pectoral fins** are paired fins. They work like arms and legs and are used for turning and braking. Some fish have unusual adaptations for their pectoral fins: sea robins use them to crawl, skates and rays use them to swim, and flying fish use them for gliding through the air.

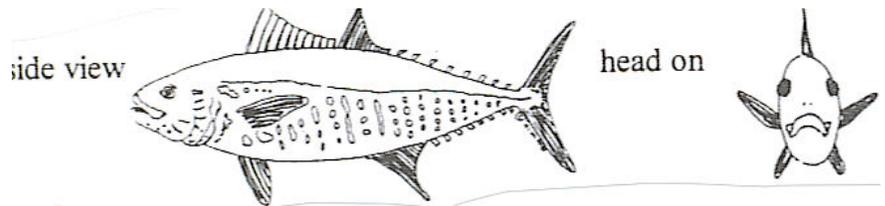


- e. **Pelvic fins** are also paired fins. They are used for stabilizing and braking. Some fish have special adaptations for pelvic fins. Some fish use their pelvic fins for walking or perching. Male skates use their modified pelvic fins for mating. Pelvic fin is absent from some fish, like eels, enabling them to swim through tight places.

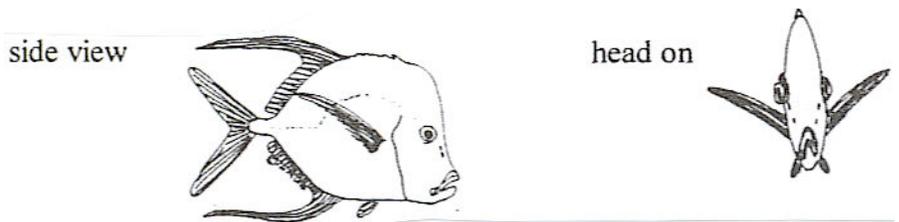


2. **Body Shape:** Fish tend to have body shapes that are most suited for where they live and feed. Each shape is advantageous for a different lifestyle.

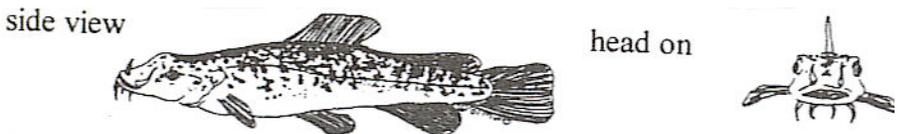
- a. The **fusiform** body shape is rounded or torpedo shaped and streamlined, which is an ideal shape for fast, continual swimming. Fish with this body shape are well adapted for feeding and survival in open water because the fusiform shape creates minimal drag as the fish swims through the water.



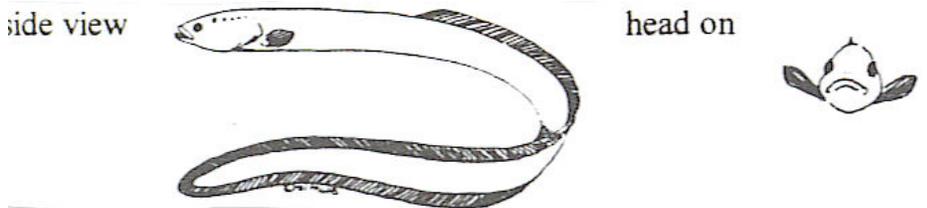
- b. The **compressed** body shape is flattened from side to side, allowing the fish to turn easily and move quickly. Fish with a compressed body shape rely on quickness and agility rather than speed or camouflage to capture prey and avoid predators. This body shape is well suited for schooling, maneuvering around obstacles and coral reefs, and living around wrecks, rocks, or pilings.



- c. Fish with a **depressed** body shape are flattened from top to bottom. This body shape is good for living on the bottom.



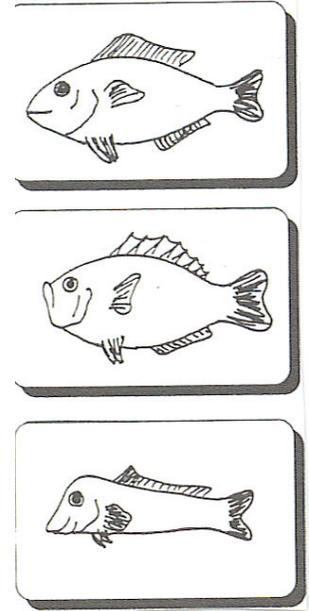
- d. Fish that have an **elongate** or attenuated body shape are long and thin. This body shape allows fish to hide in holes and burrows, in plants and crevasses. Fish with elongate bodies are often quick-action, lie-in-wait predators.



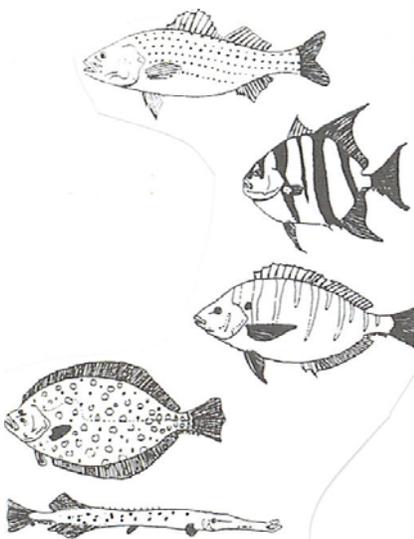
- e. Fish with a square or **truncate** body shape are slow swimmers. They rely on camouflage and other special adaptations to capture prey and avoid predators.
- f. Fish with round bodies have a **globiform** body shape. These fish are also slow swimmers, relying on camouflage and other special adaptations to capture prey and avoid predators.
- g. **Other:** Some fish have body shapes don't fit the above descriptions:

3. **Mouth Position:** How and where a fish eats is determined by the position of the mouth.

- a. Fish with a **terminal** mouth position have a mouth in the middle, at the end of the head. These fish either chase their food or feed on what is ahead of them. They are usually aggressive, fast swimmers. If they are fast swimmers, they may be predators. Those that can maneuver quickly are probably grazers or pickers.
- b. The **superior** mouth position is when the mouth is upturned or near the top of the head. Fish with this mouth position feed on food that is above them and are either a predator or a strainer.
- c. If a fish's mouth is down-turned or on the bottom of the head, it is in the **inferior** position. These fish usually feed off the bottom and are either predators or bottom dwelling scavengers or grazers.



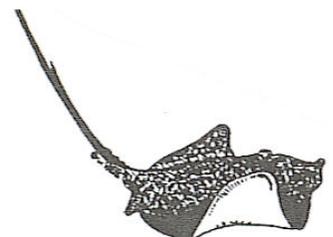
4. **Color and Pattern:** The color and pattern of designs on the fish's body creates camouflage, which provides protection from predators.



- a. **Striped:** lines run from tail to head
- b. **Banded or barred:** colors run around the body
  - i. **banded:** colors run completely around the body from top to bottom
  - ii. **barred:** colors run part way around the body from top to bottom
- c. **Spotted or Speckled:**
  - i. **Spotted:** large spots
  - ii. **Speckled:** small spots
- d. **Marbled:** colors all run together with no particular pattern, but they are not solid.

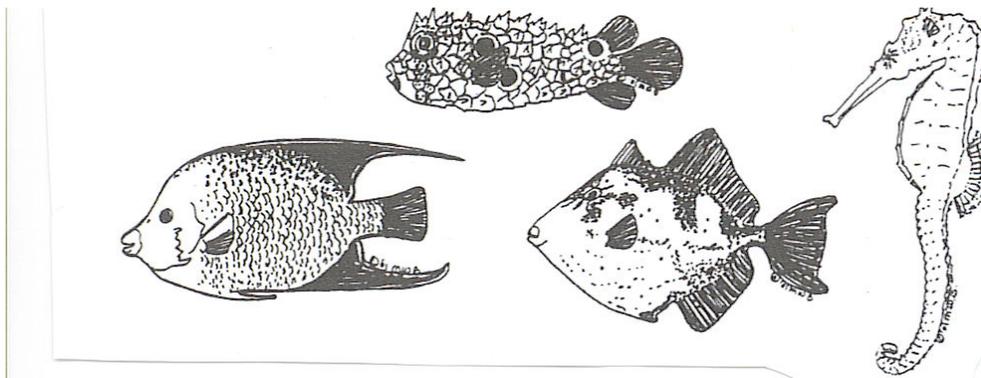
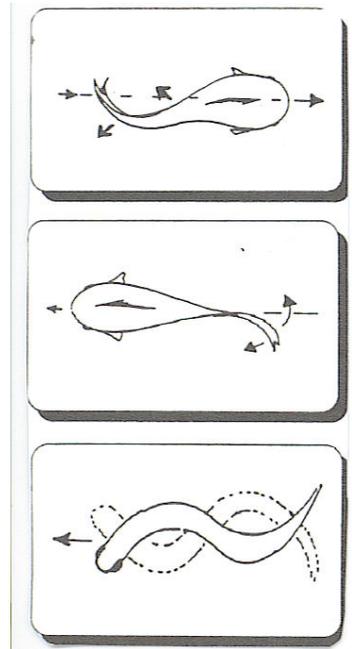


- e. **Countershading:** Many fish are dark on the top and light on the bottom. This serves as a good camouflage. When looking down on the fish it blends with the darker deeper water, and when looking up, the fish blends with the light from above.
- f. **Brightly colored** reef fish blend in with the coral.



5. **Swimming Style:** Fish have developed a variety of swimming styles to aid them in feeding, escaping from predators and in moving around in their habitats.

- a. **Carangiform** is the most common swimming style and is used by fast, strong swimmers in open pelagic water. The tail makes wide sweeps through water. Most fish with the carangiform swimming style are active predators.
- b. Fish that swim with the **ostraciform** swimming style keep their body rigid while vibrating the tail. They are usually slow swimmers, relying on camouflage or spines for protection.
- c. A fish that uses the **anguilliform** swimming style moves like a snake through the water. This swimming style is typical of elongated fish and fish with small fins.
- d. Some fish do not fit into the above categories of swimming styles. Some fish use fins other than the caudal fin for swimming. These fish use precise maneuvers and usually feed on stationary food. Burrfish row with their pectoral fins. Triggerfish and angelfish undulate their dorsal and anal fins to swim. Seahorses vibrate their dorsal and pectoral fins.



6. **Habitats:** Fish in a particular habitat will not all look or act alike. However, they will exhibit the body structures, swimming styles and behaviors that are advantageous to living in their particular habitat. When attempting to determine where a fish lives, one must consider the combination of body shape, mouth position, and swimming style, as well as fin shape and placement.

- a. In the **pelagic zone** or open water, fish must rely on speed to capture prey and escape predators. They must be capable of swimming continuously and producing high speed with quick acceleration. The typical body shape of the pelagic zone is fusiform. Schooling fish typically possess a somewhat compressed body. Pelagic zone fish usually have a forked or lunate tail and swim in carangiform style. The mouth position of predators is usually terminal and upturned if the fish is a plankton eater.
- b. Fish that live around **underwater structures** such as wrecks, rock, reefs, or pilings must be able to maneuver around obstacles. Maneuverability is much more important to these fish than speed. The most common body shape is compressed, and the swimming style is either ostraciform or with fins other than the tail. The mouth is usually in middle of head because these fish are mostly grazers and pick food off of underwater structures.

- c. Bottom- or **benthic**-dwelling fish either rest on or swim close to the bottom. If they rest on bottom, their body shape is usually depressed and they rely on shape, coloration, and camouflage to escape predators and capture food. Bottom-feeding fish typically have a mouth in the down-turned position. If a benthic fish feeds on animals swimming above it, its mouth will probably be upturned. There are, of course, exceptions; drums have compressed bodies that may be slightly flattened on the ventral side with mouths set low on the head, usually in a down-turned position. Flounders have a compressed body and mouths in the center of their head (they lay on their sides on the bottom).

**Source:** Adapted from an original activity, "*How to Read a Fish*," by Margaret Olsen for the Ocean Society Fish Curriculum. The fish drawings are provided by Marsha Ward.