# Bio-Prints: Printmaking with Ocean Organisms

**Recommended Grade Level:**
Grades 6th - 12th grades

**NGSS Science & Engineering Practices:**
- Asking questions and defining problems
- Planning and carrying out investigations
- Designing solutions

We will identify how this program can be tailored to meet NGSS standards for specific grade levels.

**Background Information:**
The centuries-old technique of *gyotaku* can be used for an interdisciplinary lesson on fish/squid anatomy and physiology, form and function of different homologous structures, experimentation and the development of an optimal printmaking process.

Gyotaku, the art of Japanese fish printing, was developed by fishermen in Japan as a way of recording the sizes of fish in their catches. This technique was used to accurately record the sizes of fish before cameras were invented. These fishermen were solving their own data recording problem with this technique of spreading sumi ink on the fish, then covering them with rice paper to produce fish prints.
Gyo = fish, taku = impression.

**Teacher Preparation:**
- Time to purchase and gather materials
- 30 minutes to prepare materials before class

**Activity:**
- 15 - 30 minutes for fish and/or squid observation and physiology
- 30 - 45 minutes for printmaking
- 15 minutes for discussion
- 15 minutes for clean up

**Materials Needed:**
- 2-4 whole fish (see References to find out more about purchasing sustainable fish)
- 2 giant squid (Humboldt squid)
- Ice chest for keeping fish fresh until needed
- Newspapers

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- Masking tape (optional)
- Large trays (e.g. cafeteria trays) for materials
- Magnifiers
- Paper towels
- Printing ink
- Paint
- Paint brushes (brushes, foam brushes)
- Rollers (for paints and inks)
- Printing paper (rice paper, newsprint, etc.)
- Plastic bags
- Sand
- Modeling clay
- Pins
- Scissors
- Dissection tray
- 2 heavy duty garbage bags for clean up
- Access to sink

**Preparing for the Activity:**
1. Cover tables with several layers of newspaper. Tape newspaper in place (optional).
2. Arrange materials (paints, inks, brushes, paper towels, etc.) on nearby trays.
3. Wash mucus off of the fish and pat dry with paper towels.

**Procedure:**

**Fish/Squid External Anatomy: An Exploration of Body Parts and Function**
Discuss the habitat where these animals survive. Have students identify external structures and hypothesize functions using the vocabulary below:

Squid external anatomy
- Two tentacles and eight arms – limbs for foraging and mating
- Suckers – serrated structures for grasping prey
- Mantle – main part of the body that contains major organs, torpedo-shaped to give ultimate hydrodynamic shape
- Syphon – tubular structure at the base of the mantle involved in propulsion and excretion
- Fins – steering, changing direction
- Chromatophores – organelles that contain pigment, used for communication and camouflage
- Beak – chitinous structure for tearing and ingesting prey

- Eyes – vision underwater

Salmon external anatomy

- Scales – “armored plating” for protection
- Lateral line – a system of tactile sense organs used to detect water movement and vibration
- Fins – body protrusions webbed with skin that are supported by muscles, not the skeletal system
    - Pectoral – steering and changing direction
    - Dorsal – stability and orientation
    - Caudal – forward motion, propulsion
    - Anal – stability
    - Pelvic – up and down movement, turning and stopping
    - Adipose – improves maneuverability in turbulent waters
- Mouth and sharp teeth – foraging krill and small fish
- Nostrils – smell, salmon are able to smell their way to rivers
- Eyes – underwater vision
- Operculum – body flap to protect the gills
- Gills – extract oxygen from water, “feathered” to provide maximum surface area for oxygen absorption
- Gill rakers – strain plankton from water

Use magnifiers and/or microscopes to explore:

- Fish scales, extracted gills and lateral line
- Squid chromatophores and sucker discs

**Making the Print:**

1. Make sure the fish/squid is completely dry.
2. Lay it flat on the newspaper.
3. Use sand-filled plastic bags, modeling clay and paper to stabilize the fish/squid in a flat position.
4. Use pins to fan the fins/tail of the fish or the fins/arms/tentacles of the squid if desired.
5. Apply ink and/or paint with the implements provided. Experiment to find out what works best. Focus on developing a process that produces the desired results.
6. Ask questions: Does applying paint from tail to head against the scales give better detail? Experiment with different materials and techniques to find answers to questions.
7. Avoid painting the eye for the print (it can be painted in by hand later).
8. Lay the print paper over the fish and carefully smooth the paper over the entire fish.
9. Carefully lift the print from the fish and lay flat or hang to dry.
10. Rinse ink and paint off fish for the next print.

**Wrap Up:**
Review the external structures of the fish/squid and their functions. Discuss how each structure is specially adapted to allow the animal to survive and thrive in the marine/freshwater habitat. Have students identify human-induced threats facing both squid and fish (overfishing, habitat destruction, pollution, etc.) and what people can to remediate these impacts.

**References**
California Academy of Sciences Fish Print Activity:
http://www.calacademy.org/teachers/resources/lessons/fish-prints/

TED ED You Tube video on history of Gyotaku
http://ed.ted.com/lessons/gyotaku-the-ancient-japanese-art-of-printing-fish-k-erica-dodge

Nina Christiane Stokes article on Gyotaku for Alabama Cooperative Extension System:
http://www.aces.edu/dept/fisheries/education/documents/Fishprintactivitiy.pdf

For more information about sustainable seafood:
http://www.seafoodwatch.org