# The Albacore Tuna System

For use with Fish Watch at www.fishwatch.gov

## Grade Level
9-12

## Materials
- 1 Fish bowl and all the necessary parts for a fish bowl system (live goldfish, pebbles, fish food, plants, water, etc.)
- Copies of handouts included in lesson
- Chart paper and markers (or projector screen and projector)
- Markers/colored pencils
- Computers with Internet access

## Audio/Visual Materials
- Projector
- Computers (one for each pair of students)

## Teaching Time
Two to Three 45-minute class periods

## Seating Arrangement
Students sitting in pairs

## Key Words
- Sustainability
- System
- Boundaries
- Inputs/Outputs
- Elements

## Focus
- Systems and Sustainability

## Focus Questions
- What is a system?
- What are the elements, boundaries, inputs and outputs of the Albacore tuna system?
- How is sustainability an integral piece of the balance of the Albacore tuna system?

## Learning Objectives
- Explain the concept of systems, specifically the Alaska pollock system.
- Describe the relationship between systems and sustainability.

## Background Information
In this lesson, students will learn about albacore tuna and the system in which it lives.

"Sustainable seafood is a hot topic these days. "Sustainability" is based on a simple principle: meeting today's needs without compromising the ability of future generations to meet their needs; for example, using a resource but leaving some for the future. In terms of seafood, this means catching or farming

## National Science Education Standards

*Grades 9-12*

Content Standard C: Life Science

- Interdependence of organisms/ecosystems
- Matter, energy and organization in living systems

*Content Standard F: Science in Personal and Social Perspectives*

- Environmental Quality

## Ocean Literacy Essential Principles

*Essential Principle 6*

*Fundamental Concept b*

From the ocean we get foods, medicines, and mineral and energy resources. In addition, it provides jobs, supports our nation's economy, serves as a highway for transportation of goods and people, and plays a role in national security.

*Fundamental Concept e*

Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution) and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

*Fundamental Concept g*

Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean.

seafood responsibly, with consideration for the long-term health of the environment and the livelihoods of the people that depend upon the environment. For example, U.S. seafood is wild-caught and farm-raised under strict regulations that work to keep the environment healthy, fish populations thriving, and our seafood industry on the job." (Quote from www.fishwatch.gov)

Currently, Pacific Albacore tuna are considered sustainable while the Atlantic Albacore Tuna are considered overfished internationally. U.S. landings have been within quotas. In fact, the Pacific Albacore tuna are one of the only species of tuna to be considered sustainable. As we further explore the Albacore tuna systems (Pacific and Atlantic) we will better understand the fragile nature of sustainability, and just how easily even a change in one element could alter the balance of the whole system.

## Albacore Tuna

Albacore tuna is a "highly migratory species" – these fish are found around the world and can travel long distances. Albacore are a temperate (cooler water) species but spawn in warmer tropical waters. Unlike non-migratory species that are only found off our coasts, we are not the only ones fishing for albacore. Fisheries for highly migratory species such as albacore require cooperative international management to ensure the resource is abundant and global harvests are sustainable.

There are six stocks of albacore – North Pacific, South Pacific, North Atlantic, South Atlantic, Indian Ocean, and Mediterranean Sea. Most albacore on the market comes from the Pacific, and U.S. fishermen mainly target both North and South Pacific stocks (see Pacific albacore tuna). Albacore hasn't been a main focus of the U.S. commercial tuna fisheries operating in the North Atlantic. U.S. fishermen catch less than 2% of the total international catch of North Atlantic albacore. Nonetheless, the United States actively participates in the conservation and management of this resource and fishery.

Fishermen have been harvesting this "white-meat" tuna off the West Coast for more than 100 years. Because the last of the canneries in California have closed and albacore populations have shifted northward with changing oceanographic conditions, the bulk of the albacore catch now comes from Oregon and Washington. Most commercial fishermen use either troll or pole-and-line (bait boat) gear to harvest albacore and generally fish from mid-June to October, depending on their location. Today, catches of albacore make up the majority of the total commercial tuna harvest off the West Coast. The catch is canned in Oregon and Washington, some is sold locally (some fishermen sell direct to the public), and some is shipped to major canneries in other states for processing.

In American Samoa and Hawaii-based fisheries, nearly all albacore is harvested with longline gear. Longline vessels in American Samoa almost exclusively target albacore, which is canned locally. Longline vessels from Hawaii harvest albacore while targeting swordfish and other tunas. The Hawaii longline fisheries do not freeze their catch, which is instead sold in the fresh fish

markets in Hawaii, Japan, and the U.S. mainland. (Source: www.fishwatch.gov )

## Learning Procedure

1. Pre-Assessment: What is a system? Ask students to complete the pre-assessment handout. Allow 10-15 minutes for completion. When finished, allow students to share their thoughts and ideas on systems.

2. Use the goldfish bowl as a model of a system. Examine the concept of systems and introduce the essential understandings about systems.

"A System is a collection of things and processes that interact with each other and together constitute a meaningful whole. Examples from the realm of science include atoms, chemical reaction systems, individual cells, organs, organ systems, organisms, ecosystems, solar systems, the banking system, transportation systems, and so on. All systems share certain properties.

**Systems Generalizations:**

- Systems have identifiable elements
- Systems have definable boundaries
- Most systems receive input in the form of material or information from outside their boundaries and generate output to the world outside their boundaries.
- The interactions of a system's elements with each other and their response to input from outside the system combine to determine the overall nature and behavior of the system."

**William and Mary Center for Gifted Education Chesapeake Bay Unit -** www.amazon.com/The-Chesapeake-Bay-Problem-Based-Unit/dp/0787225185

3. Looking at an empty fishbowl, describe a boundary and ask what the boundary would be for some fish living together in the bowl.

4. Have a student pour some water into the fishbowl and ask if the boundary for where the fish might live has changed.

5. Add more water until the bowl is full and ask again about the changing boundary. Is any part of the fishbowl constant?

6. Add fish and discuss the elements in a system of fish living together in the fishbowl.

7. Describe input (e.g. light, food) and output (e.g., dirty water) of a fishbowl system.

8. Talk about interactions (e.g., fish and plants, light and plants, fish and food) within a fishbowl system.

9. Provide situations that would put stress on the system: if there were six goldfish in the bowl, or if insufficient food were added to the system or if a pregnant guppy were added, but no additional food. What would happen to the system elements, input, output and interactions in those cases? Introduce the idea of natural regulation in the system (that the amount of oxygen regulates the number of fish).

10. As you are discussing the Goldfish Bowl system, students can make notes about systems and the examples given about the goldfish system on *The Goldfish Bowl* handout.

11. Once they have completed the Goldfish Bowl system activity, ask students in small groups to come up with several examples of a system. Then have them categorize their examples and discuss.

12. Ask students to think of examples of non-systems – (ie: a pencil, a shoe, noodle.)

13. Revisit the generalizations about systems outlined above.

14. Have students work in pairs and provide them access the Internet. Students should go to www.fishwatch.gov to learn about sustainability. Refer them to the *Glossary* for the definition of "sustainable." They can also visit "Choosing Sustainable" from the *Buying Seafood* tab. Encourage students to continue to explore the FishWatch site to learn as much about sustainability as possible.

15. Students will now begin to learn about the albacore tuna and its system. Depending on your location, you may choose to learn about the Atlantic Albacore Tuna or the Pacific Albacore Tuna or as an extension you might have some groups research the Atlantic Albacore and some research the Pacific Albacore and then compare the two tuna systems using a Venn Diagram.

16. Students should visit NOAA's FishWatch website: www.fishwatch.gov and other NOAA Fisheries Service site to find information about the two types of Albacore tuna.

17. Students should complete the *Systems Parts Chart* with their partner while they are researching. Discuss the responses as a whole class upon completion of the research.

18. Students should re-visit their Pre-Assessment and write a response about what they have learned about systems and the Albacore tuna species.

19. Conduct a class discussion about the importance of sustainability and why it's an integral part of the balance of a system.

## The Bridge Connection

www.vims.edu/bridge
Under Ocean Science Topics, click on Human Activities, then Environmental Issues, then Policy, Sustainability, or Conservation.

## The "Me" Connection

Ask students to identify systems of which they are a part. Have them also discuss what they can do to promote seafood sustainability, as well as with other aspects of their community.

## Connections to Other Subjects

English/Language Arts/Social Studies

## Evaluation

The *Systems Parts Chart* can serve as an assessment piece. Additionally, students' reflections on their pre-assessment can be the post-assessment for this lesson.

## Extensions

Students can investigate another seafood species on Fish Watch and other NOAA Fisheries Service website, diagram and describe its system, discuss in class, and make adjustments to their diagrams.

## Additional Resources

NOAA Fisheries FishWatch
www.fishwatch.gov

National Geographic – Ocean Education
education.nationalgeographic.com/education/program/oceans-education/?ar_a=1

NOAA Fisheries Service
www.nmfs.noaa.gov

NOAA Fisheries – Office of Sustainable Fisheries
www.nmfs.noaa.gov/sfa/sfweb

NOAA Fisheries Office of Science and Technology Stock Assessments
www.st.nmfs.noaa.gov/StockAssessment/StockAssessment.html

# *Pre-Assessment: What is a System?*

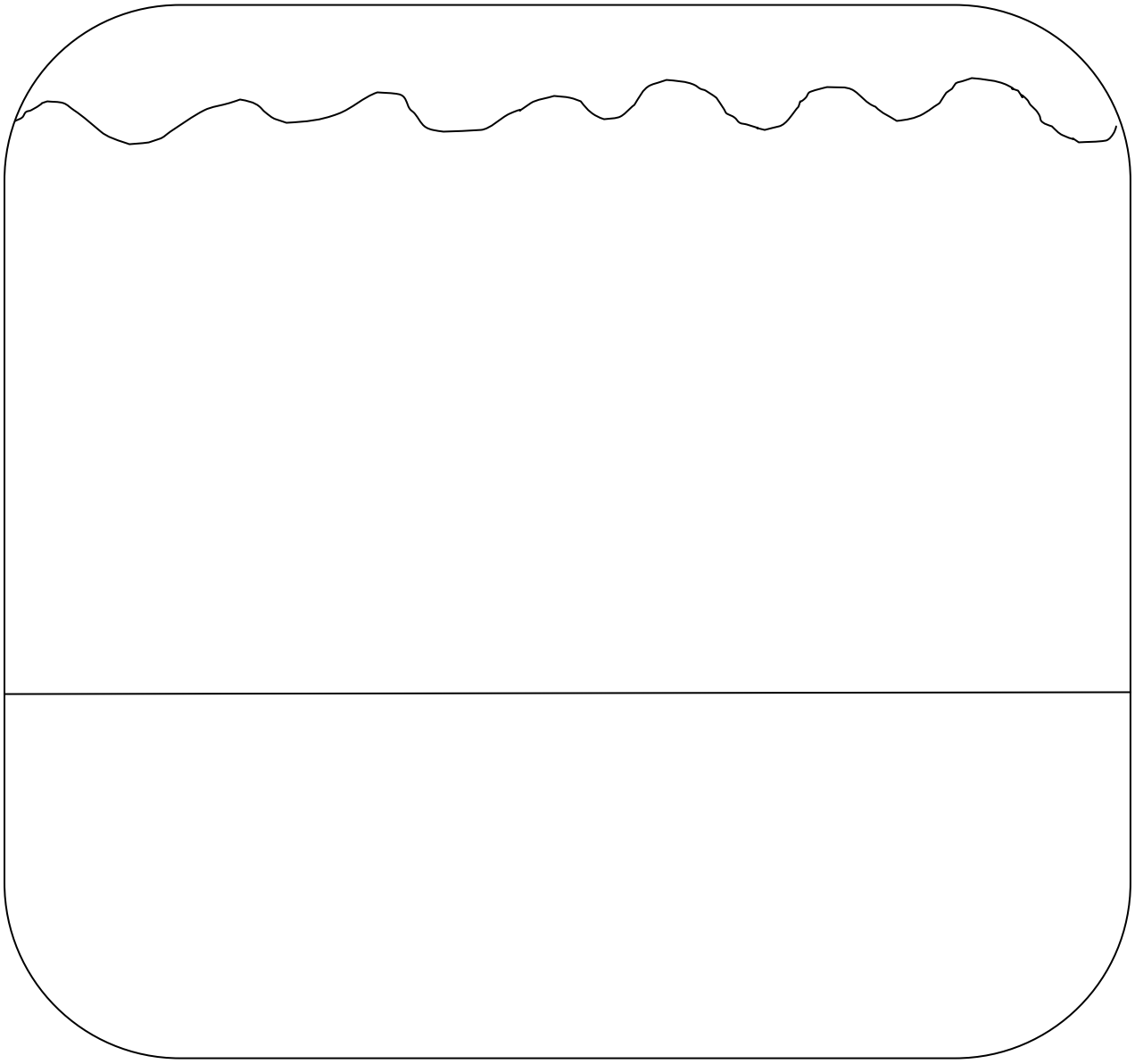
| What is a system? | Examples of systems… |
|---|---|
| What is not a system? | How is the albacore tuna a part of a system? |

# The Goldfish Bowl

Name: _____

Using the goldfish bowl diagram below, draw and label the elements, inputs, and outputs of the goldfish bowl system. Be sure to place them in the correct location in the system. Then label the boundaries of the goldfish bowl.

What are some interactions that happen in this system?



# Systems Parts Chart

1. What are the boundaries of the Pacific/Atlantic (circle one) Albacore tuna system?

2. List some important elements of the system.

3. Describe inputs into the system.  Where do they come from?

4. Describe outputs from the system.  What part(s) of the system produce them?

5. Describe two important interactions:
    a. Among system elements

    b. Between system elements and inputs into the system.

6. What would happen to the system if the interactions in 5a could not take place?  In 5b?

# Systems Parts Chart
# POSSIBLE ANSWERS

1. What are the boundaries of the Pacific/Atlantic (circle one) Albacore tuna system?

- PACIFIC: *Pacific Ocean from Washington to California, Hawaii and the Samoan Islands, and the high seas of the Pacific,* or in International Waters: *from Japan to California*
- ATLANTIC: *Massachusetts to Louisiana* or in International Waters: *Nova Scotia to Northern Argentina and from Ireland to South Africa*

2. List some important elements of the system.

- Ocean water, sardines, anchovies, squid, other tuna species, billfish, shark, seabirds, sea turtles

3. Describe inputs into the system. Where do they come from?
   - Fishing vessels
   - Purse seines
   - Longlines
   - Bait fish
   - Sunshine

4. Describe outputs from the system. What part(s) of the system produce them?
   - Albacore Tuna (canned tuna)
   - Other fish

5. Describe some important interactions:
   a. Among system elements
      - Albacore eat anchovies, sardines, and squid
      - Sharks, larger tuna species and billfish eat Albacore

   b. Between system elements and inputs into the system.
      - Fishermen fish albacore and remove them from the system.
      - Longlines enter the system and inadvertently remove seabirds, sea turtles and other fish from the system.

6. What would happen to the system if the interactions in 5a could not take place? In 5b?
   - Sustainability of Albacore tuna would be in danger. Overfishing or overfished populations would occur. Other fish populations might be too abundant.