



Cabrillo Marine Aquarium Lesson Plan

Grade Level: Eighth Grade and High School (9th-12th Grades)

Title: Data Exploration Activity: A Lesson on Food Webs and Bioaccumulation

Objective: Students analyze a food web to determine which organisms in the food chain accumulate the greatest concentration of chemicals in their tissues and consider which organisms in a food web might be most affected by the introduction of a toxic chemical to their habitat.

California Science Standards: 8th: 9a, 9b, 9f Investigation & Experiments
9th-12th: Chemistry & Biology/Life Sciences

Time to Complete: 45 minutes

Materials Provided by CMA: *Reading Handout: The Great DDT Debate, Worksheet: The Great DDT Debate, Worksheet: DDT Food Web Diagram*

Materials Provided by Teacher: Photocopies (online access to PDF), Internet access

- ❖ NOTE: All Marine Birds are protected by Federal Law. It is illegal to collect or possess marine birds or any parts of a marine bird (bones, feathers, etc.).

Vocabulary: DDT, DDE, PCB's, biomass, bioaccumulation, biomagnification, primary producer, primary consumer, secondary consumer, tertiary consumer, decomposer

Background Information: Food chains are a part of the web of life. A food chain starts with plants, the **producers**, which use the sun's energy to produce food. The chain of energy next passes on to plant-eating animals, such as mice, known as **primary consumers**. It then proceeds to the animals that eat the primary consumers – for example, weasels – known as **secondary consumers**. If a third animal, such as an owl, were to eat the secondary consumer, it would be known as a **tertiary consumer**. Various organisms break down dead plants and animals into nutrients and energy. These organisms – such as earthworms, bacteria, fungi, and some types of insects – are known as **decomposers**.

Dichlorodiphenyltrichloroethane, also known as "DDT" is a colorless, tasteless and almost odorless insecticide that was banned for use in the United States in 1972. Unfortunately, much of the DDT still remains in the environment. When an animal consumes food having DDT residue, the DDT accumulates in the tissue of the animal by a process called **bioaccumulation**. The higher an animal is on the food chain (e.g., tertiary consumer such as seals), the greater the concentration of DDT in their body, as a result of a process called



biomagnification. DDT has caused eggshell thinning and has thus resulted in severe population declines in multiple bird species. In this activity students will identify the way in which DDT might move through a food chain.

Lesson Outline:

- **Activity 1:** Define Lesson Vocabulary
- **Activity 2:** Read *Reading Handout: The Great DDT Debate*
- **Activity 3:** Discuss and complete the *Worksheet: The Great DDT Debate*
- **Activity 4:** Food Web Relationships using *Worksheet: DDT Food Web Diagram*

Lesson Procedure:

Activity 1 through 4: Be sure to discuss the key concepts with the class and define unfamiliar vocabulary terms and their meanings.

Activity 1: Define Lesson Vocabulary

- Define bioaccumulation and biomagnification
- **Bioaccumulation refers to the accumulation of a toxic chemical in the tissue of a particular organism. Biomagnification refers to the increased concentration of a toxic chemical in tissues the higher an animal is on the food chain**

Activity 2: Read *Reading Handout: The Great DDT Debate*

- Call on different students to read aloud the different sections

Activity 3: Food Web Questions & Calculations *Worksheet: The Great DDT Debate*

- Activity can be done as a class or individually
- Answer key provided below
- You may have students use calculators (if needed)
- Discuss results together as a class

Worksheet: The Great DDT Debate ANSWER KEY

1. What is the difference between bioaccumulation and biomagnification?
Bioaccumulation refers to the accumulation of a toxic chemical in the tissue of a particular organism. Biomagnification refers to the increased concentration of a toxic chemical in tissues the higher an animal is on the food chain
2. Which group of plants and animals is most susceptible to problems from DDT: primary producer, primary consumer, secondary consumer, or tertiary consumer? Why?
Tertiary consumers – Tertiary consumers are more susceptible to problems from DDT because of biomagnification



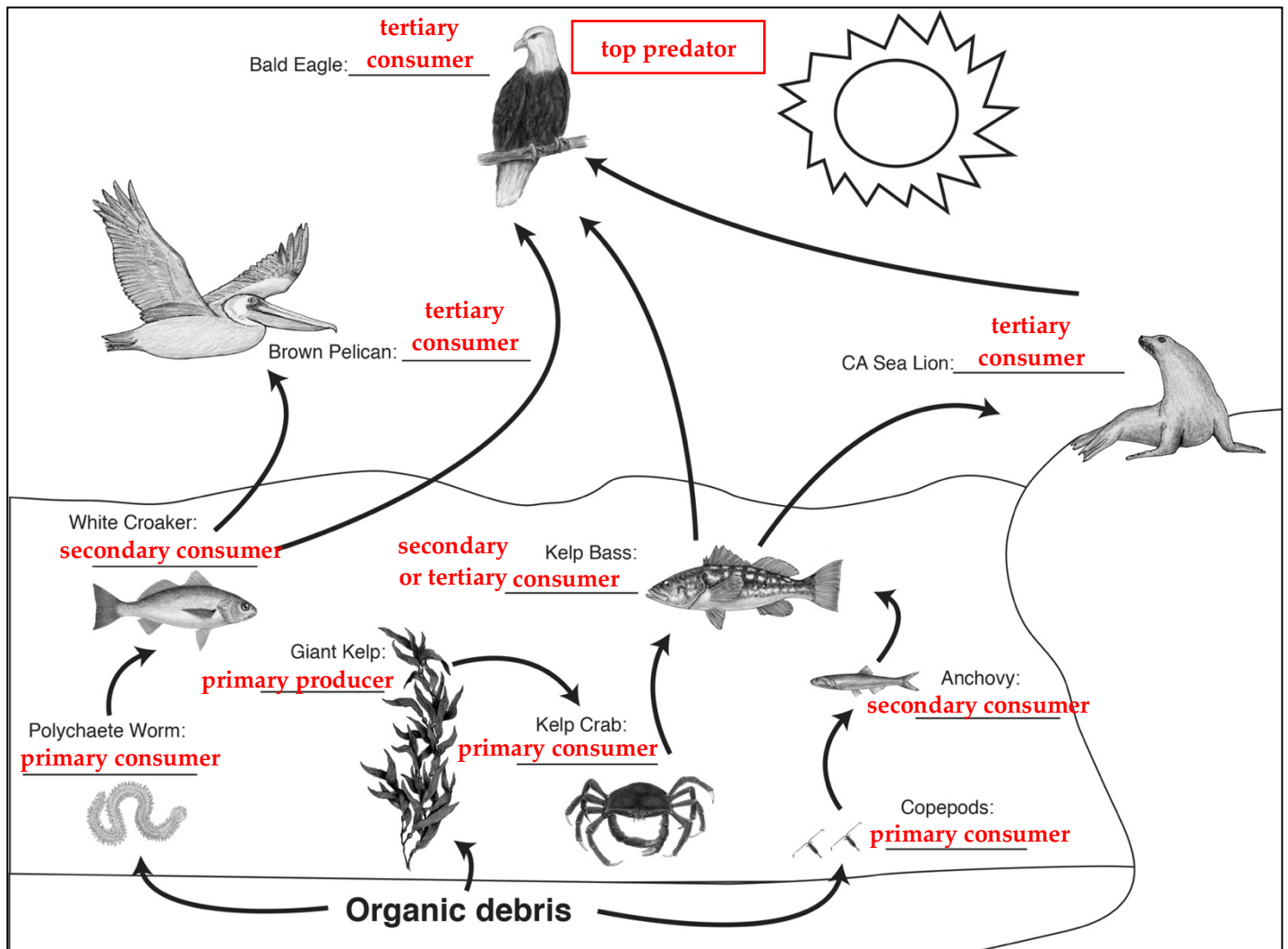
3. Suppose a Brown Pelican eats 300 g of fish per day. The fish tissue consumed by the pelican has an average DDT concentration of 0.1µg/g. How much DDT is the pelican consuming in one day?
 $(300\text{g fish/day})(0.1 \mu\text{g DDT/g fish}) = 30 \mu\text{g DDT/day}$
4. Now suppose a Bald Eagle also eats 300 g of food per day. But, the Bald Eagle also eats California Sea Lion carcasses that have washed up on the beach. The Sea Lion had eaten fish-eating fish (a Kelp Bass) with 1.0 µg/g DDT in their tissue. Much of the Sea Lion's body is made of blubber (a fatty substance) and the DDT bioaccumulates in the Sea Lion. So, the Sea Lion has 2.0 µg/g DDT in its tissue. If the Bald Eagle eats 300 g of Sea Lion, how much DDT does the Bald Eagle consume in one day?
 $(300\text{g Sea Lion/day})(2.0 \mu\text{g DDT/g Sea Lion}) = 600 \mu\text{g DDT/day}$
5. Taking all factors into account, rank the following for likelihood of bioaccumulation: Bald Eagle, Brown Pelican, California Sea Lion, and Kelp Bass.
1 – Sea Lion, 2 - Bald Eagle (eat fish and scavenge on dead mammals and birds)
3 – Brown Pelican, 4 – Kelp Bass

Activity 4: Food web Relationships Worksheet: DDT Food Web Diagram

Based on the food web relationships denoted by the arrows, label each organism with one of the following labels (Answer key, next page):

- primary producer
- primary consumer
- secondary consumer
- tertiary consumer

Worksheet: DDT Food Web Diagram ANSWER KEY



Lesson Extensions:

- **What's the Catch: Video Clip (2 min.)** This short animation film talks about how DDT and PCBs have moved up in the food chain and have contaminated some of the fish caught in Southern California.
- **Bald Eagles Return to the Channel Islands: Video Clip (13 min)**
Short film about Bald Eagle restoration on the Channel Islands that is being funded by the Montrose Settlements Restoration Program
<http://www.montroserestoration.gov/multimedia/videos>
- **Montrose Settlements Restoration Program: Periodical Fact Sheets**
Fishing Restoration/Fish Habitat/Bald Eagle Restoration/Seabird Restoration
<http://www.montroserestoration.gov/>

References:

- Modified Lesson from: USGS Data Exploration Unit
www.pwrc.usgs.gov/
- Montrose Settlements Restoration Program
<http://www.montroserestoration.gov/>

