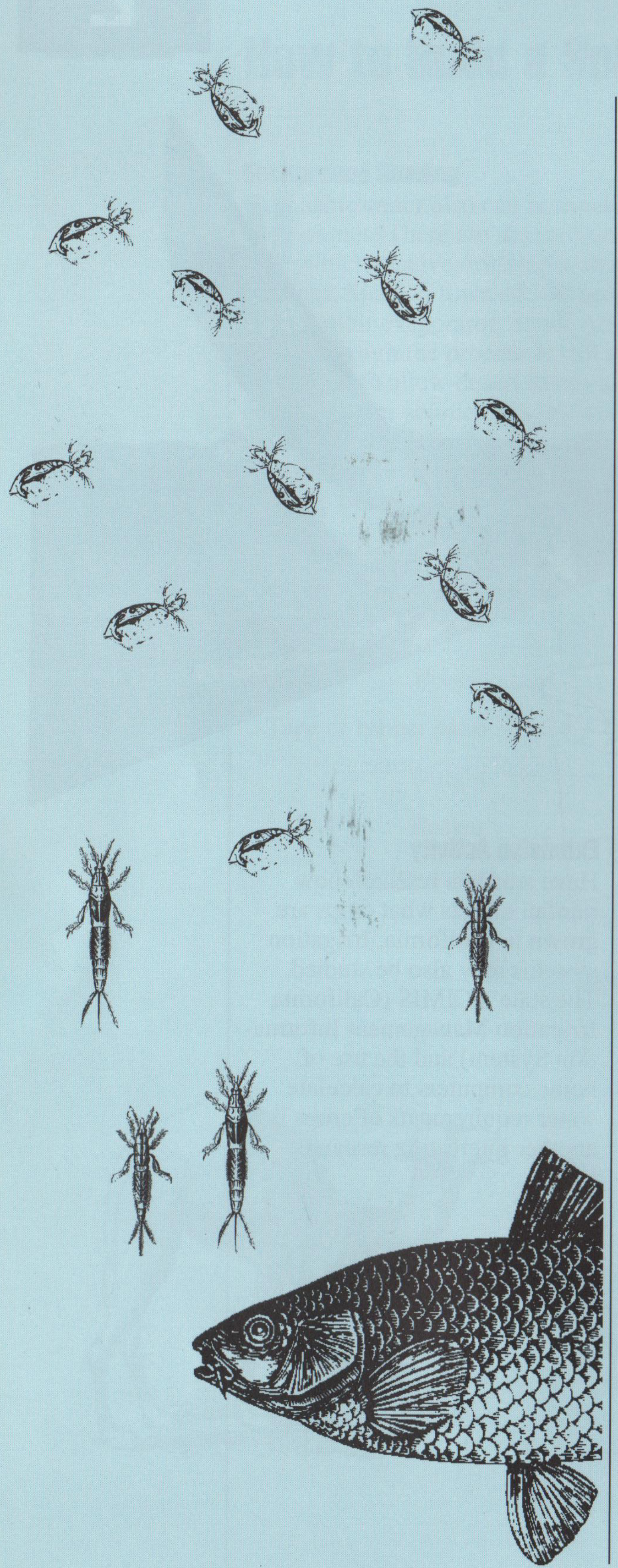
PROJECT WATER SCIENCE

General Science
Secondary Level

Prepared by the
Water Education Foundation



LAB 8
THIS GAME MAY BE HAZARDOUS TO YOUR HEALTH
Accumulation of Toxins in the Foodweb

Objective

Students will understand the concept of an ecosystem, energy transfer through the aquatic food chain, and how toxic materials can enter the food chain. Students will appreciate the delicate balance of nature.

Background Information

Water quantity problems have plagued California since the days of its early settlers. Our state's massive water transportation and storage systems are testimony to the fact that California's water supplies quite often do not occur where and when they are needed most. Our water supply is sometimes a case of glut or famine, flood or drought. But all the water in the world—in the right place, at the right time—won't do a drop of good if it isn't fit to use.

True, our domestic water supplies have come a long way since the days when a glass of water might carry with it the threat of **cholera** or **typhoid**. But almost daily, the news media carry alarming stories of toxic substances threatening our ground water supplies. We've learned that our surface supplies aren't immune from exotic-sounding **contaminants.**

The very chemical used to destroy disease-causing bacteria in drinking water has given rise to a whole new problem—the formation of substances which might possibly cause cancer. The quality of our water supplies, once taken largely for granted, is becoming the focus of increasing concern.

Materials Needed

1. *Layperson's Guide to Drinking Water.* Read pp. 3 and 16.

2. "Food"—white pipe cleaners and colored pipe cleaners, white and colored paper dots (two-thirds of them white, one third colored)—you can get these from the school hole-puncher. For a class of 30 students you should have a paper bag full of 600 of the white food (uncontaminated) and a bag full of 300 of the colored food (contaminated with toxics).

Activity

1. Tell the class that this is an activity about aquatic food chains. Spend some time in establishing a definition. **NOTE:** Do not tell the students what the color of the food represents until after the fish have "fed."

a. Divide the class into three groups. One group will be the water daphnia (a small fresh water animal) group (18 to 20 students). The second group (6 to 8 students) will be the insect larvae who prey on the daphnia (a small fresh water animal) group. The third group (2 or 3 students) will be the fish who prey on the insect larvae.

b. Hand each "daphnia" a small paper or plastic bag or other container. The bag represents its stomach (a container to hold food energy).

c. Scatter the "food" (pipe cleaners or paper dots) in the area where the activity is being conducted. The area can be the classroom if the desks or tables can be moved back, or a grassy area outside. **NOTE:** You will have to establish boundaries.

d. The "daphnia" are now instructed to go looking for food, gathering the "food" and placing it in their container or bag (stomach). At the end of 60 seconds, the "insect larvae" attack the "daphnia" by tagging them and "eat" (collect their "stomachs") as many as possible in 30 seconds. Any daphnia caught must give up its "stomach" to the insect larvae and move to the sidelines.

e. The "fish" are now permitted to "eat" insect larvae for 15 seconds. The same rules apply. At the end of the time period, ask all students to gather together and bring whatever food bags they have with them.

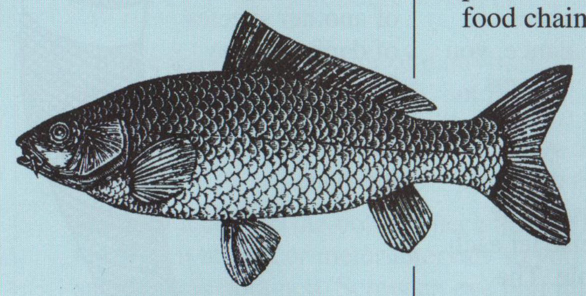
f. Identify which "animals" are still alive. The live animals are to empty their stomach(s) and count the number of white "food" pieces they have and the number of colored pieces. List on the board the species and the number of each kind of "food." Hand out data chart sheets. Have students calculate the percent of colored dots in each animal's stomach by dividing the number of colored dots by the total number of dots in the stomach (white and colored). Record all information on chart.

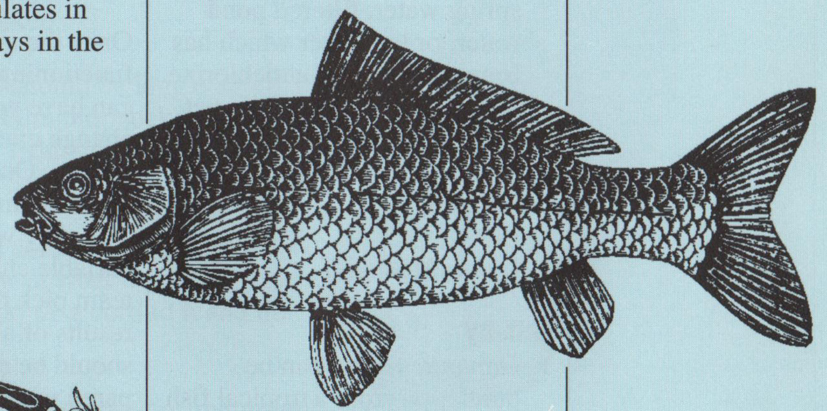
2. Inform the class that there is a toxic chemical loose in the water environment. It is poisonous, accumulates in food chains and stays in the environment for a long time. In this activity, all of the colored pieces of "food" represent the poison. All of the "daphnia" that were not eaten by the "insect larva" may now be considered dead if they have any colored food pieces in their food supply. Any "insect larvae" with a food supply that exceeds 40% of colored food pieces will also be considered dead. Any "fish" with a concentration of 50% or over of toxic substances (colored dots) may be able to survive, but its ability to ward off disease, produce offspring, find and catch food may be limited.

3. Discuss the activity with the class and ask students for their observations about how the food chain works and how the toxic chemicals can affect it.

Extension Activity

Research: point vs. non-point pollution, bioaccumulation of toxins.





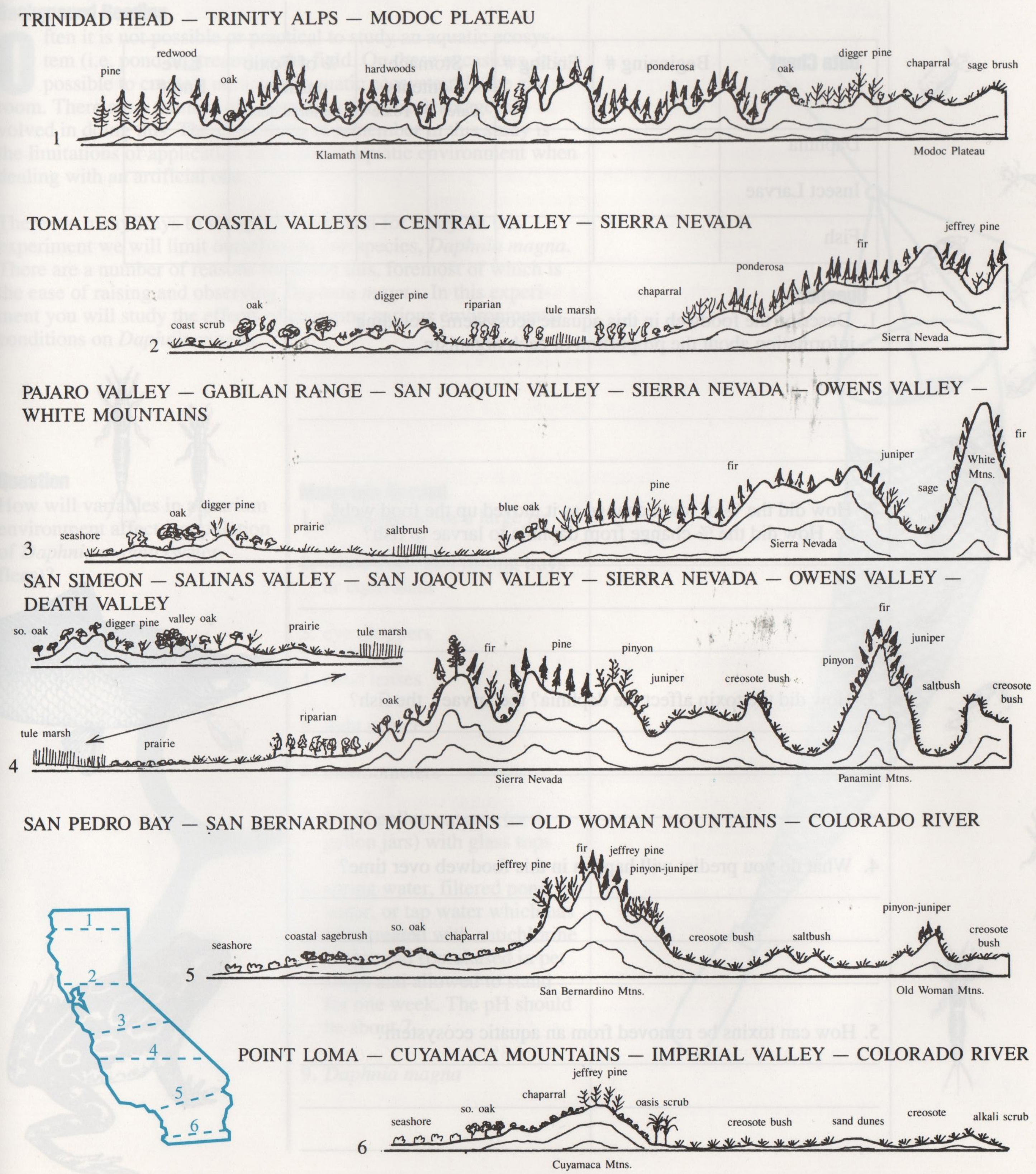
California Precipitation Chart

Average Yearly Precipitation

Station	Annual	Station	Annual
Alpine	16.39	King City	11.25
Altadena	21.19	Lakeport	30.04
Anza	14.41	Lemon Cove	13.47
Auburn	34.46	Long Beach	11.54
Bakersfield	5.72	Los Angeles	14.85
Beaumont	17.00	Modesto	11.70
Berkeley	23.24	Monterey	18.35
Big Sur	40.48	Muir Woods	36.36
Bishop	5.61	Needles	4.39
Blythe	3.75	Oakland	18.03
Borrego Desert	5.85	Oxnard	14.50
Burbank	15.78	Palm Springs	5.20
Chico	25.93	Petaluma	24.02
Chula Vista	8.67	Placerville	36.99
Claremont	17.13	Redding	40.95
Coalinga	7.83	Redlands	12.89
Covina	17.24	Sacramento	17.87
Culver City	14.09	San Diego	9.32
Death Valley	2.03	San Francisco	19.71
Downey	14.38	San Jose	13.86
Downieville	62.70	Santa Barbara	17.70
El Centro	2.35	Stockton	14.40
Escondido	14.53	Torrance	13.13
Fort Bragg	39.30	Turlock	11.39
Fresno	10.52	Twentynine Palms	3.89
Garberville	57.09	Vacaville	24.29
Gasquet Ranger Station	94.22	Van Nuys	15.99
Half Moon Bay	25.22	Visalia	9.86
Helmet	11.51	Whittier	14.51
Idyllwild	25.39	Yosemite	36.06

Source: California Almanac

Geographic Cross-Sections of California with Vegetation Profiles



LAB 8

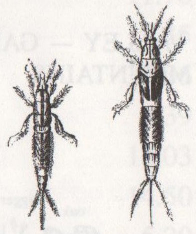
This Game May be Hazardous to Your Health

Accumulation of Toxins in the Foodweb

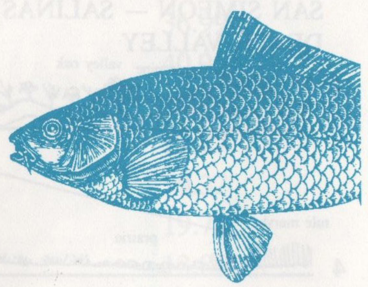
Data Chart	Beginning #	Ending #	Stomach Contents Safe	Stomach Contents Toxic	% of Toxic particles (colored dots)	Live End #
Daphnia						
Insect Larvae						
Fish						

Questions

1. Describe the foodweb in this aquatic ecosystem, including information about the proportion of each organism.



2. How did the % of toxin change as it moved up the food web? i.e. How did the % change from daphnia to larvae to fish?



3. How did the toxin affect the daphnia? the larvae? the fish?

4. What do you predict will happen in this foodweb over time?

5. How can toxins be removed from an aquatic ecosystem?

It's a Small World After All

A Water Mini-Ecosystem

LAB 9

Background Reading

Often it is not possible or practical to study an aquatic ecosystem (i.e. pond or stream) in the field. On these occasions, it is possible to create a miniature, aquatic ecosystem in the classroom. There are a number of advantages and disadvantages involved in doing this. The main thing to remember in this study is the limitations of application to an actual aquatic environment when dealing with an artificial one.

There are many ways to set up an ecosystem for study. In this experiment we will limit ourselves to one species, *Daphnia magna*. There are a number of reasons for doing this, foremost of which is the ease of raising and observing *Daphnia magna*. In this experiment you will study the effects of changing various environmental conditions on *Daphnia magna*.

Question

How will variables in aquarium environment affect a population of *Daphnia magna* (water fleas)?

Materials Needed

1. **plankton** net or a large jar
2. white porcelain sorting trays or equivalent
3. eye droppers
4. hand lenses
5. light source
6. thermometers
7. 1 to 2 gallon aquaria (or 1 gallon jars) with glass tops
8. spring water, filtered pond water, or tap water which has been treated with antichlorine compound (purchased in pet shop) and allowed to stand for one week. The pH should be about 7.
9. *Daphnia magna*