



BACK BAY SCIENCE CENTER

Water Quality Module

Activity I – Field Inventory
Activity II – Testing for Toxins Lab

BACKGROUND INFORMATION

Earth is known as the water planet. Our bodies are mostly water and we need to drink water daily to keep from dehydrating. But is the water life-sustaining or dangerous? World-wide, only one in eight people have access to clean water. But what about aquatic plants and animals? It is imperative to determine the quality of our water. By monitoring water quality, we are better able to connect environmental challenges with likely causes. When we determine causes, we can develop personal, industrial and governmental changes in our behaviors and policies.



Humans have chosen to live beside water for a variety of reasons. Early settlements were established close to the trade routes along rivers and oceans. Access to irrigation for crops and drinking water was essential for developing cultures. Milder weather was a bonus for many, but necessary for those with certain health problems.

CALIFORNIA STATE CONTENT STANDARDS

Grades 6 – 8

6th Gr. Science:
Ecology - 5b, e

7th Gr Science:
Physical Principles in Living Systems - 6d
Investigation and Experimentation - 7a

8th Gr Science:
Reactions – 5a, b
History /Social Science: 8.12.5

Grades 9 – 12

Science:
Biology/Life Sciences –
Ecology 6a, b

AP Science - Science Practices SP 1.1,
1.2
Earth Science ES 5.3
Life Science LS 3.1 3.2

History/Social Science –
11th Gr – 11.115
12th Gr – 12.3.2
EEI P and C: Ic; IIa; IIIc: IVb, c
Ocean Literacy Principles: 1g,h; 5d, f;
6e,g; 7c,d
Climate Literacy Principles: 2c, d; 3c; 4f,
g; 6c, d; 7d

As the population density grew, the consequences of human behavior began to accumulate: litter on the streets; pesticides and fertilizers used to maintain non-native gardens; pet wastes; car, cleansers, industrial and air pollutant residues. On land this may be unsightly, have an unpleasant odor, or be unnoticeable, but when washed into our streams by seasonal rains or summer watering it seriously impacts the quality of our water. Every year, there are beach closures because of high coliform bacteria counts. Rivers and streams are visibly and also chemically polluted - endangering the health of those seeking respite. Drinking polluted water is the cause of many diseases. Eating fish caught in these waters is also dangerous because the toxins bioaccumulate (build up).

Aquatic plants and animals have no escape. The chemicals in the water are absorbed into their tissues. The often invisible and toxic chemicals can have life-threatening consequences. Some are changing the pH level and can dissolve the calcium present in mollusk and crustacean shells, killing the animal. Some (hormones) change reproductive ability, while others (neurotoxins) attack an organism's ability to move. Nitrates are considered nutrients for non-native plants, but result in massive "die-offs" downstream. Eutrophication occurs when the proliferating bacteria feeding on the decomposing algal blooms pull oxygen out of the water. One of the challenges is that the longer plants and animals live in polluted waters, the more toxins bioaccumulate in their tissues. Since predatory animals ingest many of these plants and animals, the toxins

within them are biomagnified (intensified).

Scientists have developed a variety of tests that allow us to detect the presence of specific chemicals in water. By monitoring the levels of chemicals present in the water, and also tracking the overall viability of the ecosystem with population counts of local species, we can get a sense of how the levels of chemicals are impacting the biome.

ii

Although we likely will not achieve "zero pollution", we can determine optimum levels, carrying capacity and danger levels for the variety of plant and animal species.

By testing the water, we can connect problems within an ecosystem to the causative agents. When we identify causative agents, we can put our energies into creating solutions. On a Federal level, we have the Clean Water Act. State-wide, we have the California Coastal Commission and the Water Quality Control Board that addresses water quality. Local municipalities, realizing its importance, have established Best Management Practices for industry. The Municipal Water District of Orange County has an active outreach 'Project Pollution Prevention' program.

We have learned that most of the pollutants entering our local waters are from non-point sources. Although the products we use are not intended for aquatic dispersal, this is how they end

up via storm drain run-off. Cigarette butts leech chemicals, as do plastic

bottles, animal waste, fertilizers, pesticides and the cleansers that we regularly use. Because so much of the problem originates in our neighborhoods, individual responsibility and action are critical to solving the problem. Citizen advocacy groups work to increase public awareness and offer steps we can take in our daily lives to ameliorate the severity of the problem. Local stream “watches” and clean-ups are being conducted. Monthly population counts at the Back Bay Science Center and activities with the Newport Bay Conservancy monitor the health of our waters.

RESOURCES:

<http://coastalscience.noaa.gov/stressors/pollution/>

<http://www.usc.edu/org/seagrant/>

[http://www.cacoastkeeper.org/programs/mapping-](http://www.cacoastkeeper.org/programs/mapping-initiative/mmp4west/)

[initiative/mmp4west/](http://www.cacoastkeeper.org/programs/mapping-initiative/mmp4west/)

[http://www.scientificamerican.com/articl](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-)

[e.cfm?id=plastic-not-fantastic-](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-www.thankyouocean.org/threats/water-pollution/)

[www.thankyouocean.org/threats/water-](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-www.thankyouocean.org/threats/water-pollution/)

[pollution/](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-www.thankyouocean.org/threats/water-pollution/)

[http://www.healtheocean.org/](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-www.thankyouocean.org/threats/water-pollution/)

[http://www.healthebay.org/get-](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-www.thankyouocean.org/threats/water-pollution/)

[involved/ways-heal/home](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-www.thankyouocean.org/threats/water-pollution/)

[http://newportbay.org/](http://www.scientificamerican.com/article.cfm?id=plastic-not-fantastic-www.thankyouocean.org/threats/water-pollution/)



TEACHER GUIDE – Water Quality Module

ACTIVITY I: Water Quality Field Inventory

OBJECTIVES:

Students will be able to –

1. Identify at least 3 ways that water quality is related to ecosystem health.
2. Conduct at least 3 water quality assessments.
3. Explain the 'life-friendly' pH zone.
4. Detail at least 5 ways that their personal activities impact water quality.

KEY TERMS:

Algal Bloom Bioaccumulate
Biomagnify Biome Coliform
Carrying Capacity Decomposition
Die-off Ecosystem Estuary
Eutrophication Food-web Micro-habitat Niche Non-native Non-Point Source Pollution Neurotoxin
Nutrient pH Sediment Toxic
Turbidity Upstream Urban Run-Off
Water Column Watershed

MATERIALS:

Water Quality Field Observation Sheets, with Analysis Questions
Pencils
Air and Water Thermometers
Calculators
Secchi disc



TEACHER GUIDE – Water Quality Module

ACTIVITY II: Testing for Toxins Lab

OBJECTIVES:

Students will be able to –.

1. Identify at least 3 ways that water quality is related to ecosystem health.
2. Conduct at least 3 water quality assessments.
3. Explain the 'life-friendly' pH zone.
4. Detail at least 5 ways that their personal activities impact water quality.

KEY TERMS:

Algal Bloom Bioaccumulate
Biomagnify Biome Coliform
Carrying Capacity Decomposition
Die-off Ecosystem Estuary
Eutrophication Food-web Micro-habitat Niche Non-native Non-Point Source Pollution Neurotoxin
Nutrient pH Sediment Toxic
Turbidity Upstream Urban Run-Off
Water Column Watershed

MATERIALS:

Water Quality Lab Observation Sheets, with Analysis Questions

Pencils

Water Samples, taken at various depths in water column, Source Labelled

Water Quality Test Kits:

Dissolved Oxygen

Conductivity?

Nitrates

Phosphates

Ammonia
pH