State of California - The Resources Agency
DEPARTMENT OF FISH AND GAME
Post Office Box 47
Yountville, California 94599
(707) 944-5500

ARNOLD SCHWARZENEGGER, *Governor*

Watershed Education Guide for "Fishing in the City"

Watershed education in the classroom creates young stewards of natural resources. For this reason, it is key for schools to participate in opportunities offered through the S.F. Bay Area Fishing in the City. A grade-level specific course of study has been compiled for use with grades 3-6 that is easy for teachers to access and will engage their students. *Each suggested program correlates directly to California's 1998 science standards [Physical Science (PS), Earth Science (ES), Life Science (LS), or Investigation (Inv)]*.

Grade 5

A. **Matter makes sense** in the context of the natural study lab of a local creek or aquatic resource.

1. Most things around us (from gases to liquids and solids) are composed of molecules of different kinds of atoms combined together. These compounds make up many basic things. The **rock and sand** of Earth's crust is largely SiO_2 (silicon dioxide). *[PS 1d]*
    a. An abundance of the compound H_2O, better known as **water**, distinguishes our *[PS 1j]* blue planet!
    b. Freshwater supplies are limited.97% of Earth's water is undrinkable for us due to *[ES 3a]* too much of the compound NaCl (**sodium chloride**) and other salts dissolved in it.
    c. Use unique physical properties (i.e. boiling point) to separate a saltwater mixture.
2. The presence of one important common element O_2 (**oxygen**) dissolved in water may be *[PS 1c]* tested by student teams using simple **chemical sampling** tools [i.e. Lamotte "Green" Kit]. Readings of 6 parts per million or greater show a healthy creek level. Have the students try an activity making serial dilutions of food coloring and producing samples to show 1 ppm and 1 ppb (parts per million / billion).
3. The Lamotte kit also has a test for **nitrates** (nitrogen based molecules) whose presence in great amounts such as from the runoff of fertilized fields can indicate a pollutant in the aquatic ecosystem. Other "**non-point source pollutants**" such as oil, paints, and pesticides may flow from a yard or street to a storm drain and into the creek. Evaluate alterative solutions to using chemical technologies in the environment. Have students consider their personal responsibilities. Arrange for a Saturday "Creek Clean Up Day" with students & families to inspire community involvement.
4. **Water quality monitoring** of your aquatic site should include use of a pH indicator *[Inv 5f]* (included in kit / available in litmus strips also) to **test the acidity-alkalinity** of *[PS 1j]* the water. Neutral readings for your local water resource, generally best for wildlife, will run around pH of 7. If the readings are substantially lower it indicates an acidic condition, higher than 7 indicates alkaline water chemistry. Atoms play a role here, too, with single **hydrogen** atoms or an oxygen-hydrogen compound *[PS 1b]* called **hydroxide** (OH) altering the water chemistry.

B. A watershed is all the land surface in a given area which captures precipitating rain or snow and where the surface runoff and groundwater drainage runs into a specific creek or river.

1. **Consider the boundaries** of your school's watershed. Identify any neighboring ridge lines that form its edges. Locate aquatic features at bottom of valley basis. Students can make and color a **local relief map** of salt and flour. Show concentrations of trees (i.e. riparian) with specific colors. Display location of urban features with a different pattern. Try doing a hike and getting **a view of your valley** from a nearby *[ES 3b, 3e]* ridge trail, different plant types, or more growth on one side of a hill than the other?

2. Relate the <u>water cycle</u> to state and local geographical features. High and low air pressure systems over California determine our <u>weather</u> patterns.
3. Close **proximity to the Pacific Ocean** allows <u>convection currents</u> of warm, moist *[ES 4a, 4b]* air to be drawn over the land area, rising and condensing to clouds, often releasing moisture. (Water vapor dissolves into a sea of air as oxygen dissolves in water, each can also "come out of solution." Colder water can hold more oxygen - trout need this! Warmer air can hold more water.)
4. **Set up a rain gauge** and <u>chart a record</u> of rainfall. Can students <u>infer a relationship</u> *[Inv 5g]* between storm activity and general volume of surface runoff?
5. Contrast the open storm drain system to the filtration that happens to waste water piped to a waste treatment plant. **Investigate the ecology of a salt marsh**. Here, the biological activity taking place in the mud flats acts as a natural filter to clean water. Emphasize the value of conserving water resources.

C. Thriving life in aquatic and other habitats depends upon the physical structures and systems of the living inhabitants and interactions between living things and the non-living resources.

1. **Classify plants** by appearance of a <u>vascular</u> (system of tubes/channels) or <u>non-vascular</u> structures for moving water, sugar and minerals from one part to another. *[Inv 5a]*
   a. Moss and green algae don't have tubes or grow very large outside of water either! Ferns and horsetails are good examples of primitive vascular plants. They developed the tubes to transport water up stems, but they still make spores just like the tiny moss plant.
   b. **Consider how a redwood tree** gets water up 260 feet from roots to leaves! *[LS 2a, 2e]* Common riparian trees such as willow, alder, bay, redwood and buckeye, as well as grasses and flowering herbaceous plants are vascular.
2. **The carbon-oxygen cycle** is a good example of the connection of living things to each other and to non-living things. Plants get the essential **carbon** (C) building block when they are performing <u>photosynthesis</u>. Have students **design a poster** of the carbon-oxygen cycle showing a submerged water plant taking in some carbon *[LS 2f, 2g]* dioxide dissolved in the water and giving off oxygen as a waste product. A fish could be depicted as taking in this oxygen and letting out a greater percentage of carbon dioxide as <u>respiration</u> occurs. Respiration may be viewed as the reverse of photosynthesis in that large sugars are broken down into simpler molecules, and O_2 is used up in the process of releasing energy stored in food.
3. Students benefit by **comparing** our **anatomy** to that of an aquatic organism such as a fish.
4. Consider the comparison of a human **lung to the gill** structure of a fish. In a fish, the operculum opens and closes to move water across the gills. [Locate actual fish, model or graphic depiction.] The initial sites of <u>gas exchange</u> (oxygen exchanged for carbon dioxide) in humans and fish are quite different structures yet with *[LS 2b]* similar purposes. Both lungs and gills are crowded with many tiny capillaries of the <u>circulatory system</u>. Red blood cells converge at these points where they come in close contact with the outer environment (lake water / atmosphere). When there is more oxygen available in the environment than in the bloodstream then oxygen moves in or diffuses into the blood of the fish or person.
5. **Share with students the concept** that a <u>chemical reaction</u> takes place when a red blood cell (of fish or human) bonds with a molecule of O_2. The iron atoms in the cell *[PS 1e]* form a chemical bond with oxygen which allows them to be transported by the cell. A new substance (<u>atoms have been rearranged</u>), **iron oxide**, results which has the property of a reddish coloration and so gives oxygenated blood a red appearance. The same reaction occurs when an iron object rusts!
6. Try a **fish dissection**. Perch are easily purchased from a scientific supply service. View **external aquatic adaptations** such as gills, scales, fins for locomotion, and unique sensory apparatus such as the lateral line. An **examination of internal organs** will render a good view of the digestive tract with the stomach, liver and intestine. The heart and the kidney can be easily observed as well. *[LS 2c]*

For more information please contact California Dept. Fish and Game
Fishing in the City program at (415) 892-0460 or erotman@dfg.ca.gov