



## Activity 12 - Waters of Life - A Journey into the Microworld

<b><u>PURPOSE:</u></b>	To introduce students to the diverse and complex world of plankton and other forms of microscopic life that inhabit the estuary and the impacts of various water quality factors.
<b><u>TIME REQUIRED:</u></b>	Two class periods (~45 minutes each)
<b><u>SUBJECTS:</u></b>	Science, English, Math
<b><u>MATERIALS NEEDED:</u></b>	Plankton net, sample collection bottle, small cooler, crushed ice, hand refractometer, eye dropper, armored thermometer, secchi disk, hand lenses, a digital camera, "Impacts" PowerPoint presentation
<b><u>VOCABULARY:</u></b>	Autotrophic, chlorophyll, consumer, dissolved oxygen, food web, larvae, nutrient, photosynthesis, phytoplankton, primary productivity, producer, refraction, salinity, upwelling, zooplankton.

**Outcomes:** 1) Students will be able to differentiate between producers and consumers and associate primary productivity with phytoplankton; 2) Students will be able to identify at least two kinds of phytoplankton and two kinds of zooplankton; 3) Students will be able to describe how some plankton are larval forms and some are adult forms; 4) Students will be able to describe the process of upwelling and various water quality factors that may influence the productivity of plankton; 5) Students will be able to describe the purpose of several anatomical features commonly found in plankton.

### Life Science

- Organism structure & functions
- Traits of an organism passed on
- Population change in the environment

### History and Nature of Science

- How scientists investigate

### Scientific Inquiry

- Ask questions to support scientific inquiry
- Design scientific investigation
- Collect data
- Analyze data

### Science in Personal and Social Perspectives

- Acting on personal and social issues.

**Background:** The basis of much of the aquatic life in an estuary is strongly influenced by the diverse array of plankton, the microscopic plants and animals that inhabit the waters and form the base of the food web. Divided into two broad groups, phytoplankton or plant plankton, and zooplankton or animal plankton, these organisms are by far the most populous group of creatures to be found in the estuary. Phytoplankton and some forms of zooplankton are the producers, capturing the sun's energy through chlorophyll contained within the organism's cells. As the nutrient rich water's of the estuary warm over



shallow tidal flats, the chemical processes that fuel photosynthesis accelerate and chains of single-celled algae grow and reproduce.

Zooplankton, comprised of larval forms of clams, worms, shrimp, barnacles, crabs, and fish and many microscopic animals such as copepods feast on the abundance of food and each other as they compete to survive and grow to maturity. For zooplankton, reproductive success depends on their ability to exploit the rich food source provided by the phytoplankton while maintaining position within the water column favorable to their survival and growth. Large die-off events in the plankton lead to a phenomenon known in the ocean as “marine snow” where the exoskeletons and remains of dead plankton fall to the ocean floor and eventually decompose. This condition can lead to substantial biological oxygen demand and eventually to anoxic conditions detrimental to most if not all marine life.

In this activity, using simple field microscopes and sampling equipment, the students will collect plankton for observation along with water quality information which can then be used to try to understand the basis for the incredible estuary web of life. Students will draw actual and imaginary plankton and then work to explain how these microscopic plants and animals of the estuary live.

**Preparation:** This activity may be conducted as a stand alone field study or incorporated into a full day field trip using other units of the TIDES curriculum. Activities 10, 11, and 13 are recommended for a full day experience depending upon the tide predictions for the day planned for the field work.

Specific tide levels are not critical for this activity, however a dock with sufficient space and adequate safe working space is necessary and an understanding of the current flow direction is essential. For a successful experience, plan for a minimum of 40 minutes to conduct the sampling activities.

Review Activity 8 in the TIDES curriculum with your class prior to the field trip and allow adequate time for the class to identify field study tasks and assign roles. The class should assemble all field equipment necessary prior to the field trip and clearly identify who will be responsible for making sure all items are properly cared for and returned in good shape.

**Activity Description:** Before proceeding to the sampling location on the dock, review safety precautions and behavioral expectations. Pre-assign teams with the following four groupings and rotate the student groups through each station at a specific location along the dock with enough space to ensure safe conduct of the activities.

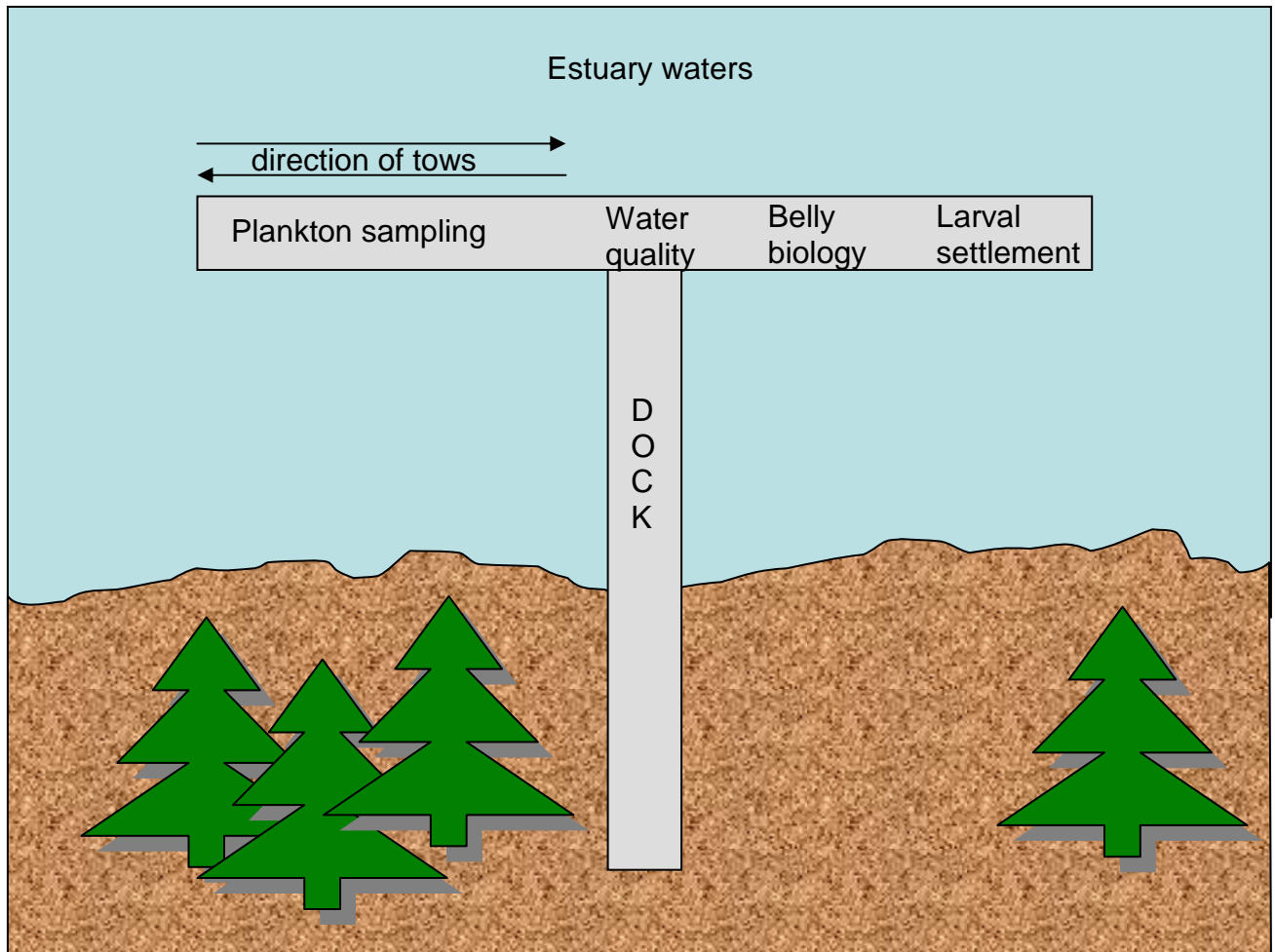
Team 1 – Plankton tow

Team 2 – Water Quality (*temperature, salinity, and turbidity*)

Team 3 – Belly biology

Team 4 – Larval settlement and marine fouling

Review the instructions for each activity with all the students before reaching the sampling location and be sure that the students fully understand what is expected of them. Once all equipment has been assigned, assemble students on the dock in the vicinity of the sampling locations and begin sampling.



**Fig. 1** Typical dock layout for field trip – students rotate through all four stations

### **Team 1 – Plankton tow**

Using the plankton net attached to a 10m tow rope the students will lower the cod end of the net into the water and immerse it until all air is cleared from the cod end and the net. Once submerged, the net is then gently towed through the water maintaining a constant speed below the surface at the desired depth, preferably .5m or so for a distance of at least 5m in one direction. The first student conducting the tow then hands the tow rope to the next student waiting at the end of the first tow and the second student returns the net along the same length of dock and passes the net to a third student and so forth. This is done with the net submerged the entire time and preferably under constant forward movement to keep a head of pressure applied to the contents. This sampling method is not intended to be quantitative, since the same area of water is being repeatedly sampled and the measurements required for quantitative results require additional calculations such as flow rate and volume. However, qualitative data can be acquired using a simple plankton guide (included) or more advanced identification materials.

When the last team has concluded the tow, wash down the net with a rinsing of ambient water to concentrate the plankton in the cod end. Once all the flow has left the net, remove the cod end and



place the contents in a separate, labeled bottle with date, time, and location information and place the sealed sample in the cooler amidst the crushed ice.

As an alternative approach, allow each team to collect and label the sample of plankton they have collected. In order to expand the comparison, have each team sample at a different location along the length of the dock. Remember to label each sample separately.

(insert labeled photo of plankton net)

### **Team 2 – Water Quality** (*temperature, salinity, and turbidity*)

Using the armored thermometer, have the students place take a temperature reading at a depth of approximately 25 centimeters below the surface after submerging the instrument for at least one minute. While this is occurring, the team should immerse the secchi disk below the surface and lower it to a depth where it is no longer visible, counting the .25 meter markings on the line secured to the secchi disk. Once the disk has disappeared, the team should hoist the disk until it comes into view and again note the location on the line. This information should be recorded in the worksheet for this activity.

Salinity will be recorded using the hand refractometer. This simple instrument uses the physical properties of salts dissolved in water and the relationship to which light is bent or refracted as it passes through the water to identify the density or salinity on an adjacent scale visible through a monocular eyepiece. Scales of refractometers must be selected carefully so that parts per thousand of dissolved salts is included, as some of these instruments are only designed to identify density. Density is an interesting physical property of the salt water, however, parts per thousand abbreviated ppt or 0/00 is a more useful number when attempting to compare salinity levels in the estuary.

A member of the team should rinse the stage of the hand refractometer with distilled water and then dry it with a clean cloth. The eye dropper being used to collect the sample should also be rinsed and the excess water expelled. Once the instruments are prepped, a small sample of estuary water should be collected from the site with the eye dropper and 2-3 drops placed carefully on the stage of the refractometer. The stage cover should then be closed and a thin sheet of water will completely cover the stage of the instrument.

A reading is then taken by viewing through the eyepiece and identifying the point on the scale at which the light and dark horizons meet. The number of the reading will typically be between 35 ppt (full strength seawater) and 0 ppt (pure water). The team should record this reading in their data table and carefully pass the instrument to each student so that everyone gets an opportunity to observe the reading.

Finally, the thermometer should be retrieved and the water temperature recorded in degrees Celsius at the appropriate location in the worksheet.

### **Team 3 – Belly Biology**

Laying on the dock, students should carefully lean their head only over the edge of the dock to observe the rich and diverse life on the underside along the edges. Many kinds of organisms encrust the dock and observations should be recorded in the students Field Study Journal. Observations may include simple notes on the shape, size, color, and apparent structures of the organisms using descriptive language to log key features. A minimum of 3 individual or colonies of organisms should be observed



and recorded by each student. While a field guide may be tempting to include at this station, use of sharp and careful observation and meticulous recording will yield more results than simply pointing to glossy photos in a book and missing the opportunity to see these organisms in their natural surroundings.

Some students may prefer to make sketches of the animals and plants. This is appropriate and useful, particularly if the drawing can be labeled and later referenced for positive identification.

### **Team 4 – Larval settlement and marine fouling**

If possible, placement of suspended marine fouling plates (10cm x 10 cm plastic plates with holes drilled) several weeks in advance of the field trip will lead to the most interesting results for this activity. If this is not possible, then observations and collections from any hanging tires or floats being used as boat bumpers will be satisfactory.

Students should remove the fouling plates or bumpers from the water carefully while observing any non-sedentary organisms clinging to the plates. If any animals come free, they may be collected temporarily for observation on the dock and then released into the water.

The fouling surface should then be carefully observed for signs of larval forms of estuarine invertebrates and plants. Often the forms will be difficult to differentiate without submerging the surface in a shallow pan of clear water to observe structures which collapse when held out of the water. The students should use hand lenses to make careful observations and attempt to note any specific features that may help with later identification. A digital camera may be employed to document the growth and to provide images for later observation and analysis.

Again, observations may include simple notes on the shape, size, color, and apparent structures of the organisms using descriptive language to log key features. A minimum of 3 individual or colonies of organisms should be observed and recorded by each student. While a field guide may be tempting to include at this station, use of sharp and careful observation and meticulous recording will yield more results than simply pointing to glossy photos in a book and missing the opportunity to see these organisms in their natural surroundings.

The teams should rotate through each of the four stations and have ample time to complete all tasks assigned. Once all teams have participated at all stations, use the class data sheet to record all data for the trip from the water quality station. Care should be taken to return all observed organisms to their native habitat unless proper collecting permits have been obtained and preparations made to transfer specimens for further study.

**Post activity analysis:** Classroom observation of plankton samples using microscopes and good slide preparation techniques will add significantly to student appreciation of the diversity and richness of the plankton. Additionally, a discussion of the water quality data collected and the possible relationship to the richness of the plankton sample is a useful way to increase student understanding of the estuarine ecosystem. The PowerPoint presentation “Impacts of Land Development on Oregon’s Waters” is a useful lecture to be given either before or after the field trip and may be used to introduce the discussion and activity identified in Follow up ideas.

**Follow up ideas:** Students may be encouraged to study news and media accounts pertaining to ocean, estuary and watershed conditions that might impact or relate to plankton abundance and diversity. Ask

## TIDES Field & Lab activity



students to give a brief report of their findings in class and relate what they read to the health of plankton in the estuary.