

<b>An estuary can be a valuable food source for people and other organisms</b>			
Big Ideas	An Estuary is a System that provides a rich source of food energy to many organisms including humans.		
Essential Questions	What foods do humans get from estuaries? Who else eats in an estuary?		
GLE Ties	CH08 1.3.8 Life Processes and the Flow of Matter and Energy CH10 1.3.10 Interdependence of Life IN01 through IN05		
Vocabulary	estuary	invertebrates	detritus
	plankton	food web	consumers
	zooplankton	Salish Sea	producers
	phytoplankton	Puget Sound	eelgrass
	primary productivity	filter feeders	sediment
Possible Misconceptions	Estuaries are unpleasant, useless places.		
Instructional Strategies	Notebooking, Food tasting, discussion		
Assessments	Student reflection written in notebook.		
System Description	<p>This lesson focuses on estuary trophic systems.</p> <p>The important structures are :</p> <ul style="list-style-type: none"> <li>• Salt water and fresh water</li> <li>• Sediment</li> <li>• Producers</li> <li>• Plankton</li> <li>• Estuary animals including but not limited to worms,</li> </ul>		

	<p>snails, bivalves, crustaceans, fish, birds, mammals</p> <p>Energy Transfers:</p> <ul style="list-style-type: none"> <li>• Producers transfer light from the sun into food energy (chemical).</li> <li>• When plants and animals die, they decompose. Small bits of decomposing organic matter (detritus) provide chemical food energy to many estuary animals.</li> <li>• Detritus is also a source of nutrients for plants.</li> <li>• Detritus, carried by water, collects in estuaries where there is reduced kinetic energy (backwaters protected from wind, waves and tides).</li> <li>• Wind, waves and tidal currents carry detritus and also restrict the plants and animals.</li> </ul> <p>Forces acting on the system:</p> <ul style="list-style-type: none"> <li>• Gravity and Centrifugal forces act on water to create tidal currents.</li> <li>• Wind acts on the water to cause waves.</li> <li>• Moving water (waves and tides) suspends and moves solids (erosion)</li> <li>• Gravity acts on solids suspended in water to cause sedimentation.</li> <li>• Moving water and sediments act on plants and animals limiting where they can live.</li> </ul>
<p>Lesson Description</p>	<p>Materials:</p> <ul style="list-style-type: none"> <li>• Copies of poem: "When the Tide Goes Out the Table is Set." <a href="http://www.padillabay.gov/lessons/poem.pdf">http://www.padillabay.gov/lessons/poem.pdf</a></li> <li>• A selection of seafood such as shrimp, canned smoked oysters, smoked salmon, sushi. Oriental markets have a great selection of snacks such as crackers containing fish, squid or algae. Many dairy products contain algin or carrageenan made from seaweed (e.g. ice-cream, yogurt, sour cream). You might want to include some regular crackers to go with your selection.</li> <li>• Paper and art supplies</li> </ul> <p>Note: precede this lesson by getting written parent</p>

permission for students to eat shellfish (some students may have food allergies.)

1. Hook: Begin by reading poem "When the Tide is Out the Table is Set"
2. Students respond to the poem by writing their reflections in their science notebooks.
3. Discuss interpretations.
4. Define estuary as the place partly surrounded by land where fresh and salt waters mix. Examples include the lower portions of rivers, river mouths, Puget Sound and the Salish Sea.
5. Ask students to make a list of estuary animals in their science notebooks. Then students draw a "line of learning" under what they have written so far.
6. Make a list on the board of animals that students know live in estuaries. Students add to their list of estuary animals under their line of learning.
7. Students eat estuary foods.
8. Discuss estuary as a food source for humans. Many plants and animals find food in estuaries, including young salmon, migratory waterfowl and whales.
9. Discuss traditional food gathering by the first peoples. Compare that with present day recreational and commercial fishing as well as oyster, mussel and clam harvesting and farming. This may be an opportunity for students to draw a box and T-chart to display similarities and differences. <http://www.sciencenotebooks.org/>
10. Ask students what it takes to grow these foods. Trace the transfers of matter and energy in both plants and animals (refer to Energy Transfers above). Note that the sun provides energy for primary productivity and that chemical nutrients are provided to producers from detritus transported and deposited by water.
11. Refer to shellfish as filter feeders who remove bacteria and detritus from the water. Lightly introduce the interconnectedness of primary and secondary consumers working up from plankton through small invertebrates, small fish, large fish and birds. We are also consumers. Consider supplementing this lesson with an estuary food web lesson.

12. Note that system outputs include biomass (in the form of tasty animals and plants), oxygen, carbon dioxide (from primary productivity), and hydrogen sulfide  
[http://www.armofthesea.info/flora\\_fauna/ff\\_kingdomspp/monera.htm](http://www.armofthesea.info/flora_fauna/ff_kingdomspp/monera.htm)
13. This is an opportunity for students to draw input-output diagrams for the estuary system.
14. Ask students to share their experiences with gathering shellfish or with fishing in the rivers or bays of Puget Sound. Many ocean fish also depend on estuaries during their juvenile stages. Not everybody likes to eat things that come from estuaries so encourage the expression of other forms of appreciation of estuaries.
15. Optional art activity: students sketch recreational activities in an estuary, or create a collage of estuary animals, foods or activities.
16. Conclude by having students add a summary statement to their notebook which highlights the value of estuaries as well as reasons to protect estuaries for their economic, aesthetic, and recreational values.