Activity 3 – A Journey through Time

PURPOSE:	To provide students with an understanding of the scale and type of change which has occurred over the past 10,000 years in estuaries along the Pacific Northwest coast through the actions of nature and humans.
TIME REQUIRED:	One to two class periods (~45 minutes each)
SUBJECTS:	Science, English, Math
MATERIALS NEEDED:	Overhead projector, 2x3 foot sheet of white paper or a projection screen, bulletin board or chalk board, push pins or masking tape, chalk or white board markers
VOCABULARY:	earthquake, tsunami, upwelling, glaciation, subsidence, desalinization, float house, native, fish weir, dredging, toxic

Outcomes: 1) Students will understand and be able to describe at least two naturally occurring conditions that have caused estuaries to change before the arrival of humans. 2) Students will be understand and be able to describe at least three changes that have occurred in estuaries since the arrival of human beings. 3) Students will be able to describe and interpret the impacts of a particular action, event, or change in the estuary.

Physical Science:
- Force & matter interactions
- Forms & behaviors of energy
- Energy transfer & transformations

Earth and Space Science:
- Water cycle

Science & Technology:
- Interconnections among science, technology, and society

Background: Changes in the estuary over time have been greatly accelerated by the recent actions of humans. Particularly in the past 150 years, human activity has dramatically altered the estuarine environment in most places along the Northwest coast both directly and indirectly. In recent times, we have learned a great deal about these complex and productive environments. However, we still have a great deal to learn and the decisions that we make during the next decades will profoundly influence the way in which we relate to estuaries and the productivity that they offer.

This activity will help students to understand the scale and kinds of change which have occurred over the past 12,000 years and that continue to occur. They will discover the role which humans can

play in the care and stewardship of our valuable natural resources and the relationship which we have to the land and water.

Preparation: Photocopy and cut apart activity cards. Prepare a large wall map of the watershed and estuary with streams, shorelines, and the ocean represented. Preferably the watershed would be shaded light brown, streams marked in dark blue, the estuary in light green, and the ocean in dark blue or some similar color scheme to distinguish the areas of watershed (with creeks and rivers), estuary, and ocean (See Activity 1). Alternatively, you may choose to project the included color overhead on a screen and have students tape their cards with masking tape to the screen.

Activity Description: Students will be dealt cards for 3 rounds (10-12 minutes each) in which they are to read the cards and attach them to the watershed map at the front of the room. Additionally, each card has 3 point values assigned to it under the categories – Social, Environmental, and Economic. A classroom tally is kept for each card plays and the points in each category are added up at the end of the round. As the student places their card, they must also briefly describe and relate how they think this action will affect the estuary. Alternatively, they may choose to ask a relevant question pertaining to the topic, which is then written on the board. They may also want to make brief notes or shadings on the base map that help to define the changes (i.e. shading a section of the river brown to show a landslide/dam that occurred in the "Time Before We Arrived".)

If you choose to use the student scoring sheet included with this activity, make the students aware in advance of the criteria you will be using for the scoring. The suggested categories are Accuracy, Detail of Description, and Creativity. Suggested weightings are included with the score sheet.

Note: you may adjust the timing of this activity by reducing the number of cards played in each round (no less than ten) to ensure that all three rounds are played.

The three rounds are described as follows:

Round 1 – The Time Before We Arrived – This period represents actions that occurred to create the natural attributes of a watershed, estuary, and ocean environment before the arrival of humans to the Pacific Northwest coast (~12,000 to 10,000 years ago).

Round 2 – The Time When We Arrived – This period represents actions taken by human settlers along the Pacific Northwest coast (~10,000 years ago to 50 years ago).

Round 3 – The Time is Now! – This period represents actions taken by modern inhabitants of the Pacific Northwest coast (50 years ago to present day).

Chaos cards may only be chosen during the third round and may be selected in place of the card the student was given. In other words, they made trade in a card in the third round for a Chaos card. If a "Doubling Effect" Chaos card is chosen, the student must read their original card and then interpret the "doubling" of whatever action was on the original card (i.e. if a Lumber Mill closes, then doubling would mean two mills have closed.) Doubling effects are based on the idea that in situations where we do not have much experience or science to base decisions upon, we may grossly underestimate the impacts of the situation. Conversely, "Halving Effect" Chaos cards work in the opposite way, reducing the impact by one half with based upon a similar rationale of difficult in accurate estimation. Note: Doubling or Halving has a corresponding effect on the number of points in each category for the card previously chosen by the student.

Class Tally Sheet by Round and Category

The point range for each card is: -2 -1 0 +1 +2

	Social	Environmental	Economic
Round 1 (This round only includes an environmental point value for each card since social and economic consequences are based on human conditions.)			
Round 1 sub-total			
Round 2			
Round 2 sub-total			
Round 3			
Round 3 sub-total			
Total			

Criteria for point values

+2	Impact of the condition is substantial resulting in major positive changes to the Social, Environmental, or Economic state of the community.
+1	Impact of the condition is noticeable resulting in moderate positive changes to the Social, Environmental, or Economic state of the community.
0	Impact of the condition is negligible resulting in no apparent changes to the Social, Environmental, or Economic state of the community. This value may also represent the offsetting effects of opposing consequences or impacts during a specified period of time. (i.e. several successful years of crab harvest are followed by several poor years. Therefore, the net impact during that period of time is zero.)
- 1	Impact of the condition is noticeable resulting in moderate negative changes to the Social, Environmental, or Economic state of the community.
- 2	Impact of the condition is substantial resulting in major negative changes to the Social, Environmental, or Economic state of the community.

Definitions for categories

A social impact is one that affects how people live and behave in a community.

An environmental impact is one that has consequences for the natural conditions of the ecosystem.

An economic impact is one that affects how people make a living or obtain wealth in a community.

Post activity analysis:
Did the students participate more than simply reading the card and placing it correctly on the map? What kinds of questions did the students generate, if any?

Ask the students to analyze the overall scores for each of the three rounds and discuss whether or not they think the scores are an accurate representation of the social, environmental, and economic impacts that occurred during that time period. Discuss how the Chaos cards played or did not play a role in changing the outcomes of the Round 3 cards.

One method possible for evaluating student's achievement in this activity is to score each student based on their participation and how they play their cards during the rounds.

Students may be graded using the following scoring sheet.

Scoring Sheet

Student's name(s):
_____

Characteristic	Quality	Points assigned
Accuracy	Very accurate Fairly accurate Accurate Somewhat inaccurate Very inaccurate	+3 +2 +1 -1 -2
Detailed Description	Very detailed Somewhat detailed Average detail Somewhat lacking detail Lacking necessary detail	+3 +2 +1 -1 -2
Creativity	Very creative Somewhat creative Acceptable Not acceptable	+3 +2 +1 0

Final Score: _____

Follow up ideas:

A discussion with the students about the rate of change in recent times as compared to pre-settlement times will stimulate more thought about what effects humans can have on the estuary. In particular, be sure to include discussion of scientific research as an effort to understand, in objective terms, the way in which ecosystems function and have functioned, with and without human intervention. This might be followed by a discussion of other factors which influence the decision-making process and the ways in which decisions are ultimately implemented.

You may want to ask your students to survey newspapers, television, radio, or the internet for news and information related to estuaries both directly and indirectly. An assignment might consist of asking them to collect 5 articles each (half page write ups for non-print media) and critique the decision made or the news reported as to the potential impacts to the estuary. You might also ask them to comment on whether or not they agree with the decision and why or why not. This exercise can be used to develop critical thinking skills.