Watershed Walk

Field Trip and Classroom Kit Overviews, Plus Supplemental Activities

A hands-on learning experience at

Neary Lagoon

SANTA CRUZ MUSEUM
of natural history

Program Overview

TITLE: Watershed Walk
TOPIC: Students practice being scientists by collecting and analyzing data on the health of the water at Neary Lagoon.

Why is this a relevant and interesting topic? Every city exists within a watershed where rain collects and drains to the ocean via a system of rivers, lakes, and streams. This means that every action we take on land, whether it is building a factory or washing our car in the streets, affects the ocean through this system. Through scientific assessments, this field trip helps students build an understanding about their role in maintaining the integrity of their watershed. Students measure, collect, and synthesize data out in the field, building a baseline from which they can draw conclusions about the many interacting components within our watershed and how they may be affecting organisms (including ourselves). Combining field observations with testing and data analysis gives students the opportunity to not only develop skills but to experience and enjoy a unique habitat, inspiring stewardship of a local natural setting.

Theme Statement: This field trip provides students with an opportunity to develop and practice skills in collecting and interpreting data while inspiring stewardship for the San Lorenzo Watershed. Students follow a guiding question that leads them to draw conclusions about how the dynamics of a watershed correlate to water quality and the survival of organisms.

Guiding Question: How healthy is the water at Neary Lagoon?

Stewardship Goals: Students observe and test the health of an important water body and, through their findings, discover their role in both improving and maintaining the integrity of their watershed. Students will be prepared to:

1. Make choices that demonstrate an understanding that impacts to one part of a watershed affects its entirety, including the ocean
2. Find ways they can help mitigate negative effects on their watershed's water quality
3. Take action to educate and inspire others to have a positive effect on their watershed

Primary Objectives
By the end of the program, students will:

1. Take five measures of water quality and assess each for what it may indicate about the ecosystem
2. Analyze their data to answer a hypothesis and discover the health of Neary Lagoon
3. Make connections between how living organisms are impacted positively or negatively by water and the water cycle
4. Understand how water moves through a watershed as well as its ability via rainfall to collect and deposit man-made pollutants into our water supply

Next Generation Science Standards

Disciplinary Core Ideas Supported	Science and Engineering Practices Supported	Cross-Cutting Concepts Supported
ESS2.A Earth Materials and Systems: Earth's major systems are the geosphere, hydrosphere, atmosphere, and biosphere. These systems interact in multiple ways to affect Earth's surface materials and processes.	***Constructing Explanations and Designing Solutions:*** Use evidence (e.g. measurements, observations, patterns) to construct or support an explanation	***Cause and Effect:*** Cause and effects relationships are routinely identified, tested, and used to explain change
ESS3.C Human Impacts on Earth's Systems: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments	***Analyzing and interpreting data:*** -Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and/or computational thinking. -Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.	***Systems and Systems Models:*** A system can be described in terms of its components and interactions
	Asking Questions and Defining Problems: Ask questions that can be investigated and and predict reasonable outcomes based on patterns such as cause and effect relationships	
Performance Expectations Supported		
Relates to: ***5-ESS2-1.*** Develop a model from an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.		

The Watershed Walk program has been aligned to the current Next Generation Science Standards. We incorporate the three dimensions of the standards throughout the program's activities, which are taught by trained docents and staff along the 5E Teaching Model. This program encourages in-depth understanding of how water connects land to sea through our watershed through active observation and hands-on water testing. Students develop and deepen skills in collecting, analyzing, and interpreting data, as well as using that data to draw conclusions about the health of the San Lorenzo River Watershed.

Watershed Walk Program Outline and Dynamics

Pre-Trip Preparation:

Neary Lagoon is an exciting place to explore located in the heart of downtown Santa Cruz. Note that we meet at the Neary Lagoon Tennis Courts, where there is a small parking lot. Parking can be fairly limited, so it is best to consolidate space as much as possible if your group is carpooling, and arrive 5-10 minutes early. There are bathrooms at the beginning of the trail, but nowhere else along the route, so you may want to have students use the restroom before leaving school or as soon as they arrive. You may also want to go over the nature of the trip with your chaperones, who will be leading small groups of students between education stations.

Field Trip Structure:

Upon arrival, our experienced staff and docents will greet your class at the Pogonip parking lot and escort them up to the beginning of our trail. We will give an introduction that outlines the theme, our expectations for maintaining student safety, and our guiding question. Your class will then split into three groups to form their hypothesis and visit three stations set up across the lagoon's floating bridges. Docents lead students at each sampling station (listed below) and keep time, alerting chaperones when and where to take their small group next. We culminate back at the entrance with a full-group wrap-up and a watershed model game. In total, the tour is 2.5 hours long with a 10 minute introduction and a 20 minute conclusion.

Watershed Walk Stations:

1. **Hypothesis Formation** -- Students spend time observing the lagoon and use their observations as evidence to formulate a hypothesis about the health of the water
2. **Dissolved Oxygen and Turbidity** -- Students use tools to measure dissolved oxygen and turbidity, then document and compare their results to their hypothesis
3. **pH and Temperature** -- Students use tools to measure pH and temperature, then document and compare their results to their hypothesis
4. **Plankton Biodiversity** -- Students use nets and microscopes to capture and identify plankton in the water. They compare the number of individuals and the number of species to draw conclusions about biodiversity
5. **Watershed Relay** -- In a wrap-up game, students move as water droplets through a model of the San Lorenzo watershed. They use this model and its results to determine ways to help keep the water clean at Neary Lagoon.

Watershed Walk Classroom Kit Outline and Supplemental Activities

Why do we provide the Classroom Kit?

This activity kit is designed to familiarize your students with topics presented in the "Watershed Walk" field trip, and to provide a depth of experience and opportunity to apply knowledge after the trip. The activities within this kit will give your students a better understanding of such topics as **watersheds, ecosystem connectivity, human influences,** and **data collection** using unique artifacts and hands-on exploration. They are designed to build a strong background for the field trip itself, thereby enhancing your students' outdoor experience.

How does it work?

We recommend that these activities are done in the order that they are presented, for a more comprehensive understanding of relevant concepts. These activities can be adjusted to different age or learning groups; you can omit the included worksheets and focus purely on observational activities, and extensional writing prompts help to further understanding and scientific observational skills.

Classroom Kit Contents

1. Supplemental Activity Curriculum Descriptions
2. Materials to support curriculum
3. Visual Aids to support curriculum, including habitat photos, diagrams, and worksheets
4. Artifacts to let students get up close and personal with wetland plants and animals

List of Activities and Key Concepts Covered

1. **Water the Incredible Journey** - ***Water Cycle, watersheds, data collection and connectivity***
   Students race to complete their journey in this active game that takes them through the water cycle as a water droplet.
2. **Water Cycle in a Bag** - ***water cycle, data collection, human influences***
   This multi-day activity explores the water cycle through a classroom model as students observe the process and record their observations.
3. **San Lorenzo River Watershed History*** - ***watersheds and human influences***
   Students use a timeline and maps to identify their watershed at home and school and explore the history of the area from first peoples through modern time.

4. **Water Sources and Sinks** - ***data collection, human influences, water use***
   Students look at and analyze their own water usage by examining their water bill(or sample one given) and explore ways to conserve water.
5. **Mock Town Hall Meeting** - ***water use, human influence, watersheds***
   Students act out stakeholders in an urban development and explore how their assumed roles interest affects water health.
6. **Conservation Commotion** - ***human influence and watersheds***
   Students play a game to test their knowledge of the sources of pollution and how they can make a positive impact on water quality.
7. **The Egg and Acidification*** - ***data collection, connectivity, water quality***
   Students get a look at the effects of pH on the environment through application and testing.
8. **Watershed Student Journal** - the kit includes one master copy of the Student journal that connects all the activities together and ties in the field trip data collection.

* These activities are described below. The Classroom Kit includes the visual aids and materials for all activities, but many can be recreated with materials in most classrooms.

San Lorenzo Watershed History

Learning Objectives

Through this activity, students will:

- Learn about the watersheds of Santa Cruz County
- Find their place within the watershed and understand human impacts on it
- Use storytelling to trace the history of Santa Cruz as it relates to humans interactions with the watershed

Background Information

The history of our county is intricately linked to its water. Learning about the historical use of our watersheds provides a remarkable look into the ingenuity of mankind, and the resiliency of natural systems when left alone to heal.

Before the arrival of Spaniard Gaspar de Portola's expedition in 1769, Santa Cruz County watersheds had provided inhabitants means for a living for over ten thousand years. In 1700, two local Ohlone groups (defined by their languages, each with many small tribes), the Awaswas (600 individuals between Davenport and Aptos) and the Mutsuns (2700 in the Pajaro River drainage) thrived on the living resources the area supported.

Later populations of American pioneers and European immigrants brought their own plants and animals, and found ways of harnessing the country's abundant natural resources to support industries that relied on water, rocks and trees. Migrant Chinese were responsible for, among other accomplishments, building railroads that transported this commerce out of the county to support a rapidly developing state. By the time Big Basin State Park was inaugurated in 1903, much of the forest had been clearcut to support the industries, railroads, and construction that was booming in this area.

Materials:

- Laminated event cards (the underlined parts of the script)
- Timeline History script (included below)
- Felt board or whiteboard to create a timeline
- Santa Cruz watershed map

Directions:

1. Direct students to look around the map and find the watershed that their school is located in (take turns if necessary). Help orient them.
    a. Ask them to go one step further and guess which watershed their home is in (it may be different than the one their school is located in).
2. Have students take note, either in a journal or out loud, of the watershed of your school and their home.
3. Divide students into 6 groups.
4. Tell students: “Now we're going to learn about the history of ONE watershed in our county: the ***San Lorenzo River Watershed***. I'm going to pass out 6 event cards. Each card is one event in the San Lorenzo River's history. When your group receives a card, take a minute to read it and discuss what it means.”
5. Give students some time to discuss, then tell them: “You're now going to hear the story of the San Lorenzo River, and it's your group's job to listen for your event. When you hear the part of the story that sounds like your event card, raise your hand. I'll call on someone in your group to come up and attach the event card to the timeline.”
6. Read the story. If a group misses their event, prompt them by reading that part of the story again and asking students to look at their event cards.
7. When all the event cards are on the timeline, have them give themselves a round of applause. Review the events by having the class read aloud the bolded titles of each card.
8. Lead a short discussion about the sequence of events.

Discussion Questions:

1. List three ways the San Lorenzo River changed after the Spanish came to Santa Cruz?
2. Name one industry developed in the San Lorenzo River watershed. What effects did this industry have on the river?
3. What is being done today to help take care of the San Lorenzo River watershed?

San Lorenzo River Watershed Timeline

"Imagine what it might have been like to live along the San Lorenzo River 250 years ago. When the Spaniards arrived in Santa Cruz in 1769. Two local Ohlone groups lived in villages near the San Lorenzo River and depended on the abundant resources provided by the river. At the time, the San Lorenzo River supported the largest salmon and steelhead fishery south of San Francisco Bay.

In 1791 the Spaniards established Mission Santa Cruz near the San Lorenzo River. They introduced agriculture to the San Lorenzo watershed and eventually overgrazing caused the replacement of valuable native grasses by new foreign plants. As the population of Santa Cruz grew, more houses and commercial buildings were built on the bluffs to the east and west of the river. Development and agriculture both altered the ecology of the river.

During the late 18 and early 1900's resources such as timber, lime, and stone were extracted from the watershed to support the growth of neighboring cities and towns. Clear cutting trees caused landslides and the erosion disturbed plant and animal life in and around the river. In areas where mining and lime production occurred, vegetation, wildlife, underground aquifers, soils and drainage channels were permanently altered or eliminated.

The most severe flood in the history of Santa Cruz occurred on Dec. 22, 1955. The river overflowed on both sides and flowed down Pacific Avenue at a depth of three to four feet. In 1957, in response to the flood, the US Army Corps of Engineers channeled the lower three miles of the river into a levee flood control structure. In 1959, the Jessie Street Marsh filled during construction of levee project and Branciforte Creek was channeled into a cement culvert.

In 1976, the San Lorenzo River was made part of the State Protected Waterways Program, which provided funding to develop a management plan to help take care of the San Lorenzo River.

The City's San Lorenzo River Committee was founded in 2004 to help restore wildlife habitat and create opportunity for human enjoyment in and along the River. The committee is currently working on a plan to restore and promote the river as a recreation feature, an alternative transportation corridor, a fish and wildlife habitat and valuable natural resource worthy of community support and involvement."

Wrap up: You can learn more about what's happening along the San Lorenzo River by visiting the River Committee's website and by attending city council meetings.

The Egg and Acidification

Learning Objectives

Through this activity, students will:

- See how acidity affects a calcium carbonate eggshell.
- Consider how changes in pH might affect living things.
- Understand the role of pH in accessing habitat health.

Background Information

This is a simple experiment, with little setup time. It examines how acidic solutions can break down materials with calcium carbonate in them (in this case, an eggshell). After placing the egg in the jar, the work is done for the day. When students return the next day, they will notice the calcium carbonate shell has disintegrated, leaving a thin membrane and the inner contents of the egg. This visual will help spark a class discussion, where students will work in smaller groups to answer some key questions.

The ocean acts as a large sink for carbon dioxide (CO_2), and in recent decades the rapid increase of CO_2 in the atmosphere has increased the quantity that gets absorbed into our oceans and freshwater rivers. When CO_2 mixes with water, it changes rapidly through chemical reactions that result in an increase in the water's pH (a measure of the acidity of a solution). Simultaneously, it decreases the availability of calcium carbonate, a molecule vital to animals who build shells (snails, crabs, and many forms of plankton).

As the amount of carbon dioxide in our water systems rise, they threaten the health of the ecosystems within them. Animals who build a calcium carbonate shell to live in, disintegrate, or do not survive to maturity. This entails the disintegration of coral reefs, as the coral's structure is depending on calcium carbonate, as well as a decrease in available phytoplankton, some of which also build their shells out of the molecule. This decreases habitat as well as food availability, which affects other organisms -- some of which we harvest for food! It also directly affects shellfish aquaculture, as once again these animals rely on calcium carbonate to build their shells.

Materials:

- 2 Eggs (uncooked is ok) OR 1 egg per partner, plus 1 egg for the water control
- Glass Jar
- Vinegar (enough to fully submerge the egg in the jar)
- Water (enough to fully submerge an egg in a jar)

- PH testing strips

Directions:

Teacher Preparation: Gather materials, but do not assemble. If students will be conducting this demonstration, it is good practice to model safe handling of solutions: they may wear gloves and goggles, and work on a surface that can tolerate spills.. Prepare to facilitate pre- and post-discussion.

Pre-Discussion:

1. Describe the materials and procedure to the class: They will be submerging an egg (in its shell) into vinegar. Their control test will be to submerge an egg in water. The question: What will happen to the egg in vinegar?
2. Before making an educated guess, students should make observations and measurements of the egg, water, and vinegar: allow students to make notes about the materials. Instruct them to measure the pH of the vinegar and compare it to a glass of water.
3. With a partner, have students write down a hypothesis about what will happen to the egg in vinegar. They should consider the following questions:
    - What will be the effect of vinegar on the egg? What will be the effect of water on the egg? What is the point of putting the egg in water??

Procedure:

1. Fill a jar partially with white vinegar.
2. Place egg into jar of vinegar and adjust the amount of liquid so that the egg is fully submerged. Repeat with a jar of water.
3. Allow time for students to make observations.
4. Set aside (out of sight) for approximately 24 hours.
5. After 24 hours, make observations of both jars. Students should take notes about both eggs and record similarities and differences between the two.

Post-Discussion:

Within their groups, have students discuss and answer the following questions:

1. Describe what happened to the egg in water.
2. Describe what happened to the egg in vinegar.
3. Why do you think the egg was affected in this way?
4. What does this experiment tell us about the properties of vinegar?
5. Are there other forms of life in nature that would be affected by acidification? (anything with shells or bones)

6. As humans, how do our actions affect the pH of water (in the ocean and in fresh water)?
7. Do you believe those actions are positive or negative for our water source?