FRIENDS OF THE LA RIVER

SOURCE TO SEA
Watershed Education Program

THE LOS ANGELES RIVER ROVER
FoLAR's MOBILE VISITOR AND EDUCATION CENTER

Standards Connections & Summary
High School: Grades 9-12
Human Impact on the Los Angeles River: Past, Present, and Future

Lessons Summary: Human Impact
(Varies with grade level)

	Lesson #1 In-class, teacher led	Lesson #2 River Rover Visit, FoLAR led	Lesson #3 In-class, teacher led
Objective	**An Introduction to the LA River** Students understand the history of the River, and that humans and nature are interconnected. By understanding the past, humans have the ability to change the present and future of their environment.	**Past, Present, and Future of the LA Watershed** Students will compare the states of the River in the past and the present, learn about the LA Watershed, and design a future River.	**Biodiversity** Students will be able to explain and illustrate the interconnected relationship between living organisms in the River habitat.

Activities	• Powerpoint presentation which provides visual aids • Introduction to Indigenous people of LA • Discuss why the concrete was covered in concrete	River Rover Stations : Each class will rotate through 3 stations/mini-lessons in small groups in and outside the River Rover. Stations call on prior knowledge from Lesson 1. Each class takes approx. 1 hour to rotate through all three stations. Topics covered: • Historic flooding and channelization of the River • Endangered and threatened animals • Human impact on biodiversity • How the LA River gets water • The LA River watershed -- with interactive 3D model • Future of the River • Art as activism	Powerpoint presentation as visual aid Topics covered: • Native v. non-native plants discussion and game • Biodiversity discussion • Overview of plants and animals found in the River • Overview of food chains and food webs • Discussion of how plants, animals, and humans are all interconnected Optional activity: Web of Life

	LA River Field Trip: Lewis MacAdams Riverfront Park
Objective	Students will be able to apply concepts to real world situations by experiencing investigation of the riparian habitat of the LA River. Students will be offered skills to help them engage with nature and develop wonder and curiosity of their environment in order to help them think like scientists, engineers, and naturalists.

Activities	The goal of the activities is to help promote: • Investigation of the River through touch, sight, and sound • A curious mindset • Thinking like a scientist by making observations, formulating questions, and collecting and analyzing data • Use of language of the discipline to actively engage with the nature around them • Synthesis of material from lessons #1 - 3 Rotate through learning stations: **Nature Walk:** Students will go on a guided walk along the River and learn naturalist skills. As we explore the River, they will make nature observations that will help them identify the various plants and animals we come across and understand their role in the ecosystem. **Water Filtration Station:** Students collaborate to construct filtration systems using permeable and impermeable materials. They will test and evaluate the effectiveness of their design and compare it to the filtration occuring in concrete and natural bottom areas. **Macroinvertebrate Water Quality Lab:** Students will collect water samples and identify the various macroinvertebrates they collect. They will discuss why macroinvertebrates serve as indicator species and how they help determine the water quality of the LA River.

Standards Abbreviations Key

California State Standards Abbreviations
- SS: Social Studies
- LS: Life Sciences
- SM: Scientific Method
- ES: Earth Science

Next Generation Science Standards Abbreviations (NGSS)
- ESS: Earth and Space Sciences
- LS: Life Sciences
- ETS: Engineering and Design
- PE: Performance Expectations
- DCI: Disciplinary Core Ideas
- CC: Crosscutting Concepts

California Common Core State Standards Abbreviations (CCSS)
- L: Language Standards
- RI: Reading Standards for Informational Text
- SL: Speaking and Listening Standards
- W: Writing Standards

NGSS: General Concepts Covered in Lessons (L) #1-3 Students (Ss)

Across grade levels

Possible applications in lessons are italicized.

Science and Engineering Practices	Cross Cutting Concepts (CC)
Constructing Explanations and Designing Solutions Construct an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future. (HS-ESS3-1) Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and trade off considerations. (HS-ESS3-4) **Engaging in Argument from Evidence** Engaging in argument from evidence in 9–12 builds on K–8 experiences and progresses to using appropriate and sufficient evidence and scientific reasoning to defend and critique claims and explanations about natural and designed world(s). Arguments may also come from current scientific or historical episodes in science. **Connections to Nature of Science Scientific Knowledge is Based on Empirical Evidence** Science knowledge is based on empirical evidence. (HS-ESS3-5) Science arguments are strengthened by multiple lines of evidence supporting a single explanation. (HS-ESS3-5)	**Systems and System Models** Models…can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2) **Structure and Function** Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1) **Stability and Change** Feedback (negative or positive) can stabilize or destabilize a system. (HS - LS1-3) Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3- 3),(HS-ESS3-5) Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects. (HS-ESS3-1) **Stability and Change** Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3- 3),(HS-ESS3-5)

Scientific Investigations Use a Variety of Methods Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity , skepticism, replicability of results, and honest and ethical reporting of findings. (HS -LS1-3)	**Connections to Nature of Science Science is a Human Endeavor** Science is a result of human endeavors, imagination, and creativity. (HSESS3-3) **Science Addresses Questions About the Natural and Material World** Science and technology may raise ethical issues for which science, by itself, does not provide answers and solutions. (HS-ESS3-2) - Science knowledge indicates what can happen in natural systems—not what should happen. The latter involves ethics, values, and human decisions about the use of knowledge. (HS-ESS3-2) - Many decisions are not made using science alone, but rely on social and cultural contexts to resolve issues. (HS-ESS3-2)

Performance Expectations (PE)	Disciplinary Core Ideas (DCI)
HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [...Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels... **HS-ESS3-2. - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on costbenefit ratios.*** [...Emphasis is on the conservation, recycling, and reuse of resources (such as	**HS-ESS3.A: Natural Resources -** Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. [...Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater)... - Resource availability has guided the development of human society. (HS-ESS3-1) - All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks as well as benefits. New

minerals and metals) where possible, and on minimizing impacts where it is not…Science knowledge indicates what can happen in natural systems—not what should happen.] **HS-ESS3-4. - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*** […Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development…Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources)…	technologies and social regulations can change the balance of these factors. (HS-ESS3-2) **HS-ESS3.B: Natural Hazards/Disasters -** Natural hazards and other geologic events have shaped the course of human history; [they] have significantly altered the sizes of human populations and have driven human migrations. (HSESS3-1) **HS-ESS3.C: Human Impacts on Earth Systems -** The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources. (HS-ESS3-3) **HS-ETS1.B: Developing Possible Solutions -** When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. (secondary to HS-ESS3-2),(secondary HS-ESS3-4)

NGSS Connections by Grade Level

Subject	CA State Standards - Science
Chemistry	**Acids and Bases** : 5.a. Students know the observable properties of acids, bases, and salt solutions. 5.d. Students know how to use the pH scale to characterize acid and base solutions. **Solutions** : 6.a. Students know the definitions of solute and solvent. **Nuclear Processes** : 11.c. Students know some naturally occurring isotopes of elements are radioactive, as are isotopes formed in nuclear reactions. 11.e. Students know alpha, beta, and gamma radiation produce different amounts and kinds of damage in matter and have different penetrations.
Biology/Life science	**Ecology** : Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept: a. Students know biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats. c. Students know how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death. d. Students know how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration. 6.e. Students know a vital part of an ecosystem is the stability of its producers and decomposers. **Evolution** : 8.b. Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment
Earth Sciences	**California Geology** 9.c. Students know the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.

Investigation and Experimentation	1.c. Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions. 1.d Formulate explanations by using logic and evidence. 1.f Distinguish between hypothesis and theory as scientific terms. 1.n. Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken…

California's Environmental Principles and Concepts	
California's Environmental Principles and Concepts California's Environmental Principles and Concepts (EP&C's) examine the interactions and interdependence of human societies and natural systems, and are the foundation of the environmental content taught in the EEI Curriculum. Approved in 2004, these 5 principles and fourteen supporting concepts were developed by more than one hundred scientists and technical experts. By law, the EP&C's must be addressed in all future California textbooks and instructional materials adopted by the state.	
Principle I. People Depend on Natural Systems	The continuation and health of individual human lives and of human communities and societies depend on the health of the natural systems that provide essential goods and ecosystem services. **Concept A.** Students need to know that the goods produced by natural systems are essential to human life and to the functioning of our economies and cultures. **Concept B.** Students need to know that the ecosystem services provided by natural systems are essential to human life and to the functioning of our economies and cultures. **Concept C.** Students need to know that the quality, quantity, and reliability of the goods and ecosystem services provided by natural systems are directly affected by the health of those systems
Principle II. People Influence Natural Systems	The long-term functioning and health of terrestrial, freshwater, coastal, and marine ecosystems are influenced by their relationships with human societies. **Concept A.** Students need to know that direct and indirect changes to natural systems due to the growth of human populations and their consumption rates influence the geographic extent, composition, biological diversity, and viability of natural systems.

	Concept B. Students need to know that methods used to extract, harvest, transport, and consume natural resources influence the geographic extent, composition, biological diversity, and viability of natural systems. **Concept C.** Students need to know that the expansion and operation of human communities influences the geographic extent, composition, biological diversity, and viability of natural systems. **Concept D.** Students need to know that the legal, economic, and political systems that govern the use and management of natural systems directly influence the geographic extent, composition, biological diversity, and viability of natural systems.
Principle III. Natural Systems Change in Ways that People Benefit from and can Influence	Natural systems proceed through cycles that humans depend upon, benefit from, and can alter. **Concept A.** Students need to know that natural systems proceed through cycles and processes that are required for their functioning. **Concept B.** Students need to know that human practices depend upon and benefit from the cycles and processes that operate within natural systems. **Concept C.** Students need to know that human practices can alter the cycles and processes that operate within natural systems.
Principle IV. There are no Permanent or Impermeable Boundaries that Prevent Matter from Flowing Between Systems	The exchange of matter between natural systems and human societies affects the long-term functioning of both. **Concept A.** Students need to know that the effects of human activities on natural systems are directly related to the quantities of resources consumed and to the quantity and characteristics of the resulting byproducts. **Concept B.** Students need to know that the byproducts of human activity are not readily prevented from entering natural systems and may be beneficial, neutral, or detrimental in their effect. **Concept C.** Students need to know that the capacity of natural systems to adjust to human-caused alterations depends on the nature of the system as well as the scope, scale, and duration of the activity and the nature of its byproducts.
Principle V. Decisions Affecting Resources and Natural Systems are Complex and	Decisions affecting resources and natural systems are based on a wide range of considerations and decision-making processes. **Concept A.** Students need to know the spectrum of what is considered in making decisions about resources and natural systems and how those factors influence decisions.

Involve Many Factors	**Concept B.** Students need to know the process of making decisions about resources and natural systems, and how the assessment of social, economic, political, and environmental factors has changed over time.