

Readings and Resources

California Coastal Voices

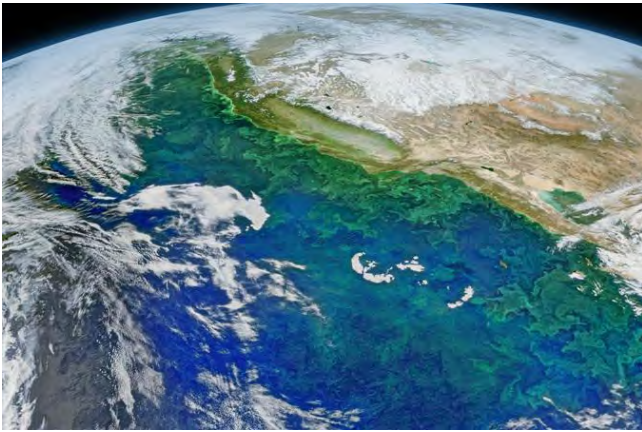


Ocean Beach, San Francisco. Photo: Tom Mikkelsen

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Making Sense of Images



Earth Observatory, NASA

Images can be much more than a snapshot—they are often evidence of choices made, of a culture’s impact on the land, and of the natural systems acting upon a place. Images can dramatically document changes over time: coastal weather hazards can be predicted, slow-moving geological processes can become visible, connections between biological communities can be seen. In a fast changing world of many environmental problems, image analysts provide insight into past choices, current conditions, and possible future scenarios that may be used to make sensible choices. Images do more than document problems—they often point the way to solutions.

Thinking Tools for Image Analysis

Coastal image analysts look for evidence relevant to specific questions they are seeking to answer or for a phenomenon they are seeking to explain. Analysts may start by looking for evidence of the following big ideas:

- Patterns
- Cause and effect mechanisms
- Scale
- Natural systems and boundaries/ intersections with other systems
- Structure and function
- Stability and change
- Energy flows and cycles

Observed **patterns** are the foundation of many scientific questions. Consider, for example, the patterns inscribed in beach sand by human activity or on water by wind.



Cause and effect relationships are often the focus of an image analysis. Once a pattern is noticed, the hunt for an explanation can begin. For example, you may have noticed the impact of a holiday on a beach or park. Overflowing garbage cans, plastic bags pinned in the bushes by wind, and footprints covering the beaches are all evidence of heavy human traffic the day before.

Scale and placement within **natural systems** is vital to image analysis. Before interpreting an image, it’s helpful to know the general location and a reference for the size of the objects in the image. Considerations of scale, place, and their conceptual boundaries inform how an analyst will model a system. For example, the small beach shown above is on Lake Tahoe, a relatively closed system with an alpine climate. This makes the dynamics different from a beach on the temperate and energetic Pacific shore.

The concept of **structure and function** explores how the form or shape of an object or living thing is related to or depends upon its function, and vice versa. For example, coastal armoring structures (such as seawalls) are sometimes built to function as protection for homes that are too close to eroding bluffs and beaches. Natural rates of erosion within a beach system, angles of surf and currents, and the height of projected sea level rise must be understood to make informed choices as to how and whether to build on the coast or to install coastal armoring to protect existing structures.



Determining the degree of **stability and change** within the beach system is how engineers place parameters around these decisions. When looking at the photo on the right, two questions might be: how is the Pacific Ocean's level changing over time at the location, and what other factors (sand starvation, storms, el Niño) might be destabilizing the beach?

Finally, **energy**, energy flows, and the consequences of moving energy are a frequent focus of image analysis investigations of the natural systems in coastal zones. The moon, the atmosphere, the ocean, and adjacent land areas all impart energy to beaches. Energy is conserved, meaning that energy can't be created or destroyed, so typically the task of the image analysis becomes describing how the energy is flowing within a given place or natural system. Have you ever stood on a beach as a powerful wave breaks upon the shore, sending both vibrations into the sand and sound into the atmosphere?



These seven thinking tools may be used independently or woven together to reflect the complicated nature of natural systems. Your choice of tools will be governed by your purpose. For example, engineers planning to build a power plant will want to know if an area is geologically stable. A policy maker working on enhancing access to a beach would seek images that offer insights into transportation routes. Where to locate bathroom facilities or build low impact trails is another question answered using image analysis. Beach users seek shelter from the wind, so a bathroom could logically be sited near

but not in these relatively rare spots. Beach users have historically created damaging informal trails, sometimes visible in aerial photographs. Placing low impact trails and boardwalks along these routes could make access easier and protect vulnerable plant and animal communities. This pathway in Palos Verdes protects sensitive coastal scrub habitat.

Interpretation of Aerial Photographs

The following elaborates on the Guiding Questions for Image Analysis worksheet.

Absolute Location: In what coastal region was this image created?

Use clues like plant communities or size of rivers to place the image in either the North, Central, or South Coast regions. Recognizable human-built landmarks can help. Distinctive types of trees (redwoods for example), or distinctively contoured points of land are the most common starting point for an analysis. For example, if the coast has large, impressive trees on both sides of a coastal point, the location is likely in a northern region; by contrast, if only low scrubby plants are visible then a location further south in the coastal scrub biome may be inferred initially. Be careful in your conclusions, as a location completely exposed to the North Coast's incessant winds will also have only low, ground-hugging plants. Piles of large logs on the beach will, however, be a reasonably definitive clue to North Coast beaches.



Place: What would a person in this place see, hear, and feel?

Determine what direction is north. Subsequently, think about the prevailing wind, direction that hills and cliffs face, evidence of precipitation, and plant community.

Normally, you should begin by looking for a reference object to give you a sense of scale. If buildings are present, find a home, school, or road. This will help you develop a good picture of things combined with your prior knowledge.



Human/Environment Interaction: How do humans depend upon and/or influence (positive or negative) the coastal environment in this place? What ecosystem services can you identify? Examples of some of the many ecosystem services include natural shoreline protection, water filtration, food production, carbon sequestration, and recreation.



Movement and Access: How are people accessing this place and how could access be improved? This may be considered from perspectives inside or outside of the study site but keep your purpose in mind. Increasing and enhancing access is one purpose, protecting and enhancing habitat is another. They might or might not be mutually exclusive.

Bio-Region: How and why is one area in this place similar to another? Can you identify any natural geographic boundaries?

Photos courtesy of the California Coastal Records Project.

Guiding Questions for Image Analysis

Place this handout in your project notebook for repeated reference.

Absolute Location: In what coastal region was this image created? What is your evidence?

Place: What would a person in this place see, hear, and/or feel? What is your evidence?

Human/Environment Interaction: How do humans depend upon and/or influence (positive or negative) the coastal environment in this place? What ecosystem services can you identify? What is your evidence?

Movement and Access: How are people accessing this place and how could access be improved? This should be considered from perspectives inside or outside of the study site, but be sure to use remote sensing tools to build your perspective.

Bio-Region: What natural factors influence the biological community found in this place? Be sure to consider climate, geology, geography, and vegetation distribution.

The Public Trust Doctrine

From the California State Lands Commission

Group 1 The common law Public Trust Doctrine protects sovereign lands, such as tide and submerged lands and the beds of navigable waterways, for the benefit, use and enjoyment of the public. These lands are held in trust by the State of California for the statewide public and for uses that further the purposes of the trust. The hallmark of the Public Trust Doctrine is that trust lands belong to the public and are to be used to promote publicly beneficial uses that connect the public to the water.

The Public Trust Doctrine is steeped in history traceable to Roman law concepts of public rights and common property ownership that the air, the rivers, the sea and the seashore are incapable of private ownership because they are dedicated to public use. English common law refined this principle to state that the sovereign, i.e. the entity exercising authority, holds navigable waterways and the lands underlying them as a trustee for the benefit of the public for water-related uses. After the American Revolution, each of the original thirteen states succeeded to this sovereign role and became a trustee of the navigable and tidal waterways within its boundaries for the common use of the people. When California became a state in 1850, it too succeeded to the same sovereign rights and duties under the Equal-Footing Doctrine.

Group 2 The foundational principle of the Public Trust Doctrine is that it is an affirmative duty of the state to protect the people's common heritage in navigable waters for their common use. The traditional uses allowed under the Public Trust Doctrine were described as water-related commerce, navigation, and fisheries. As a common law doctrine, the courts have significantly shaped the Public Trust Doctrine in a number of important ways. Courts have found that the public uses to which sovereign lands are subject are sufficiently flexible to encompass changing public needs. The courts have also found that preservation of these lands in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments which provide food and habitat for birds and marine life, are appropriate uses under the Public Trust Doctrine. Courts have also made clear that sovereign lands subject to the Public Trust Doctrine cannot be alienated through sale into private ownership.

Group 3 Another way that the courts have shaped the Public Trust Doctrine is by addressing the roles and responsibilities of the state in managing sovereign lands. In California, the Legislature, as both trustee and trustor of sovereign lands, has enacted provisions involving the uses of sovereign lands found primarily in the Public Resources Code and uncodified statutes involving local governments. These laws are in addition to those contained in the California Constitution.

The State of California has entrusted the State Lands Commission with administering the principles of the Public Trust Doctrine. The Commission manages the state's sovereign public trust lands to promote and enhance the statewide public's enjoyment of the lands and ensure appropriate uses of public trust lands.

An Introduction to the California Coastal Act

Group 1 Alarmed that private development was cutting off public access to the shore, and catalyzed by a huge oil spill off the coast of Santa Barbara, Californians in 1972 rallied to “Save Our Coast” and passed a voter initiative called the Coastal Conservation Initiative (Prop 20).

Prop 20 created the California Coastal Commission to make land use decisions in the Coastal Zone, while additional planning occurred. Then in 1976 the State Legislature passed the Coastal Act, which made the Coastal Commission a permanent agency with broad authority to regulate coastal development.

The Coastal Act guides how the land along the coast of California is developed, or protected from development. It emphasizes the importance of the public being able to access the coast, and the preservation of sensitive coastal and marine habitat and biodiversity. It dictates that development be clustered in areas to preserve open space, and that coastal agricultural lands be preserved. It prioritizes coastal recreation as well as commercial and industrial uses that need a waterfront location. It calls for orderly, balanced development, consistent with these priorities and taking into account the constitutionally protected rights of property owners.

The Coastal Act defines the area of the coast that comes under the jurisdiction of the California Coastal Commission, which is called the “coastal zone.” The Coastal Zone extends seaward to the state’s outer limit of jurisdiction (three miles), including offshore islands. The inland boundary varies according to land uses and habitat values. In general, it extends inland 1,000 yards from the mean high tide line of the sea, but is wider in areas with significant estuarine, habitat, and recreational values, and narrower in developed urban areas. Coastal Zone boundary maps are available on the Coastal Commission website.

The Coastal Zone does not include San Francisco Bay, which is under the jurisdiction of a separate state agency, the San Francisco Bay Conservation and Development Commission.

Annotated Reading of Selected Coastal Act Sections

The following is a selection of excerpts from the Coastal Act, which contains many additional policies and procedures not addressed here. To read the entire Coastal Act, visit www.coastal.ca.gov/coastact.pdf. The quoted sections below are each referenced with their identifying section number in the Coastal Act.

The Coastal Act begins with a section (30001) on the **importance of the California coast and its ecological balance:**

The Legislature hereby finds and declares:

(a) That the California coastal zone is a distinct and valuable natural resource of vital and enduring interest to all the people and exists as a delicately

balanced ecosystem.

(b) That the permanent protection of the state's natural and scenic resources is a paramount concern to present and future residents of the state and nation.

(c) That to promote the public safety, health, and welfare, and to protect public and private property, wildlife, marine fisheries, and other ocean resources, and the natural environment, it is necessary to protect the ecological balance of the coastal zone and prevent its deterioration and destruction.

(d) That existing developed uses, and future developments that are carefully planned and developed consistent with the policies of this division, are essential to the economic and social well-being of the people of this state and especially to working persons employed within the coastal zone.

Thus, the law recognizes the importance of both the **natural** environment and **economic** development that is dependent upon the resources of the coast.

The Coastal Act (30001.5) declares that the basic **goals** of the state for the coastal zone are to:

(a) Protect, maintain, and where feasible, enhance and restore the overall quality of the coastal zone environment and its natural and artificial resources.

(b) Assure orderly, balanced utilization and conservation of coastal zone resources taking into account the social and economic needs of the people of the state.

(c) Maximize public access to and along the coast and maximize public recreational opportunities in the coastal zone consistent with sound resources conservation principles and constitutionally protected rights of private property owners.

(d) Assure priority for coastal-dependent and coastal-related development over other development on the coast.

(e) Encourage state and local initiatives and cooperation in preparing procedures to implement coordinated planning and development for mutually beneficial uses, including educational uses, in the coastal zone.

Chapter 3 of the Coastal Act contains the policies that are to guide coastal resource planning and decisions on individual development proposals. The Coastal Act recognizes that at times there will be conflicts between these policies, and states that "such conflicts be resolved in a manner which on balance is the most protective of significant coastal resources." (30007.5)

Group 2 The Coastal Act prioritizes the **public's right to access the shoreline** (30210 to 30214):

[M]aximum access, which shall be conspicuously posted, and recreational opportunities shall be provided for all the people consistent with public safety needs and the need to protect public rights, rights of private property owners, and natural resource areas from overuse.

Coastal development should not impede existing rights of access:

Development shall not interfere with the public's right of access to the sea where acquired through use or legislative authorization...

The previous statement makes reference to different ways public access rights are established. The government may establish these rights (such as by purchasing land to create a public path to the beach) or they are sometimes established through historic public use.

Acquisition through historic use is explained in the *California Coastal Access Guide*, published by UC Press:

According to court decisions, in order for the public to obtain an easement by way of implied dedication, the essential elements that must be established are that the public has used the land 1) for a continuous period of five years as if it were public land, 2) with the actual or presumed knowledge of the owner, and 3) without significant objection or significant attempts by the owner to prevent or halt such use.

The ultimate determination of prescriptive rights, if they are challenged, takes place in court. However, Section 30211 of the Coastal Act requires the Coastal Commission to make determinations as to the existence of these rights where there is evidence of historic use of a given area.

New public access is encouraged in the Coastal Act:

Public access from the nearest public roadway to the shoreline and along the coast shall be provided in new development projects except where: (1) it is inconsistent with public safety, military security needs, or the protection of fragile coastal resources, (2) adequate access exists nearby, or, (3) agriculture would be adversely affected.

In practice, most new accessways require that an organization (public or private) first accept responsibility for maintenance and liability before being opened to the public.

The Coastal Act (30252) recognizes that it is not sufficient to provide access to the coast; sensible planning for encouraging coastal recreation includes addressing transportation needs and other considerations, such as preventing overcrowding of recreation areas:

The location and amount of new development should maintain and enhance public access to the coast by (1) facilitating the provision or extension of transit service, (2) providing commercial facilities within or adjoining residential development or in other areas that will minimize the use of coastal access roads, (3) providing non automobile circulation within the development, (4) providing adequate parking facilities or providing substitute means of serving the development with public transportation, (5) assuring the potential for public transit for high intensity uses such as

high-rise office buildings, and by (6) assuring that the recreational needs of new residents will not overload nearby coastal recreation areas by correlating the amount of development with local park acquisition and development plans with the provision of onsite recreational facilities to serve the new development.

The Coastal Act (30221) calls for **lower cost visitor and recreational facilities**, addressing the concern that coastal recreational opportunities be available to all Californians regardless of income level. In addition, “Developments providing public recreational opportunities are preferred.” Also:

Oceanfront land suitable for recreational use shall be protected for recreational use and development unless present and foreseeable future demand for public or commercial recreational activities that could be accommodated on the property is already adequately provided for in the area.

Group 3 The Coastal Act (30230) also **prioritizes ecological resources**. Marine resources, such as wetlands, rocky intertidal areas, and the open ocean are addressed as follows:

Marine resources shall be maintained, enhanced, and where feasible, restored. Special protection shall be given to areas and species of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes.

The Coastal Act (30240) includes **special protection for Environmentally Sensitive Habitat Areas**, often referred to as ESHA:

- (a) Environmentally sensitive habitat areas shall be protected against any significant disruption of habitat values, and only uses dependent on those resources shall be allowed within those areas.
- (b) Development in areas adjacent to environmentally sensitive habitat areas and parks and recreation areas shall be sited and designed to prevent impacts which would significantly degrade those areas, and shall be compatible with the continuance of those habitat and recreation areas.

The law recognizes the importance of maintaining adequate **water quality** for coastal zone organisms and human health (30231):

The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment,

controlling runoff, preventing depletion of ground water supplies and substantial interference with surface waterflow, encouraging waste water reclamation, maintaining natural vegetation buffer areas that protect riparian habitats, and minimizing alteration of natural streams.

The Coastal Act **prioritizes certain types of activities and development** over other types in the coastal zone. For instance, visitor-serving commercial recreational facilities designed to enhance public opportunities for coastal recreation are prioritized over private residential, general industrial, or general commercial development, but not over agriculture or coastal-dependent industry (30222). Recreational boating and its related facilities are encouraged in the Coastal Act (30224).

The Coastal Act (30253) dictates that new development be designed and sited to minimize adverse impacts to coastal resources, both natural and visitor-serving, as follows:

New development shall do all of the following: (a) Minimize risks to life and property in areas of high geologic, flood, and fire hazard. (b) Assure stability and structural integrity, and neither create nor contribute significantly to erosion, geologic instability, or destruction of the site or surrounding area or in any way require the construction of protective devices that would substantially alter natural landforms along bluffs and cliffs. (c) Be consistent with requirements imposed by an air pollution control district or the State Air Resources Board as to each particular development. (d) Minimize energy consumption and vehicle miles traveled. (e) Where appropriate, protect special communities and neighborhoods that, because of their unique characteristics, are popular visitor destination points for recreational uses.

Group 4 **Views** and local character are protected by the Coastal Act (30251):

The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and, where feasible, to restore and enhance visual quality in visually degraded areas.

The Coastal Act (30235) calls for **limits on the use of shoreline armoring**:

Revetments, breakwaters, groins, harbor channels, seawalls, cliff retaining walls, and other such construction that alters natural shoreline processes shall be permitted when required to serve coastal-dependent uses or to protect existing structures or public beaches in danger from erosion, and when designed to eliminate or mitigate adverse impacts on local shoreline sand supply.

The issue of whether new shoreline armoring should be allowed will arise with increasing frequency as global warming causes sea level rise. In applying the Coastal Act, the Commission tries to avoid shoreline armoring by locating new development away from hazard areas if feasible.

The Coastal Act (30006) includes a statement on the importance of **public participation** in its implementation...

The Legislature further finds and declares that the public has a right to fully participate in decisions affecting coastal planning, conservation and development; that achievement of sound coastal conservation and development is dependent upon public understanding and support; and that the continuing planning and implementation of programs for coastal conservation and development should include the widest opportunity for public participation.

...as well as **public education** (30012):

The Legislature finds that an educated and informed citizenry is essential to the well-being of a participatory democracy and is necessary to protect California's finite natural resources, including the quality of its environment. The Legislature further finds that through education, individuals can be made aware of and encouraged to accept their share of the responsibility for protecting and improving the natural environment.

The Coastal Commission

There are 15 California Coastal Commissioners. Twelve are voting members and three are non-voting members. The voting members are appointed by the Governor, the Speaker of the Assembly, and the Senate Rules Committee; each appoint four Commissioners, of which two are selected from the public at large and two are locally elected officials. The local officials on the Commission represent six coastal regions in California. The Governor's appointments must include at least one representative who resides in and works directly with communities with diverse racial and ethnic populations and communities with low-income populations burdened disproportionately by high levels of pollution and issues of environmental justice. The non-voting Commissioners are the Secretary of the Resources Agency, the Secretary of the Business and Transportation Agency, and the Chairperson of the State Lands Commission.

The Coastal Commission meets each month to hear from the public and make decisions. The meetings are held in different coastal locations and generally last three days. You can find out about these meetings on the Coastal Commission website at www.coastal.ca.gov. Meetings are open to the public as well as streamed live online, and previous meetings can be viewed in a video archive.

Student Guide to Personalized Learning Plans

A Personalized Learning Plan should include your personal learning goals for the project and the steps you will take to reach the goals. This plan will help you and your teacher track your progress toward mutually agreed upon learning outcomes.

Write **two personal learning goals** for use with the project. These goals can personalize the challenging question, refine the project products, modify the learning process, or connect your project to more than one subject area. Goals 1 and 2 should be:

1. An interest-based goal related to the project topic, your desired new knowledge, and/or how to apply the knowledge.
2. A Habits of Mind goal specifically related to applying knowledge in the real world.

List the steps you will take to reach each goal. How will you attain your goal? Try to phrase these steps as “I will” statements.

Specific:

Journalists ask themselves five questions when attempting to get complete stories: what, who, when, where and why. You can use this approach to write specific goal statements. For instance “What human actions (what) pose a risk to blue whales (who and why) in the Santa Barbara Channel (where) during the busy summer months (when)?”

16 Habits of Mind Goals:

- Persisting
- Managing impulsivity
- Listening with understanding and empathy
- Thinking flexibly
- Thinking about thinking (metacognition)
- Striving for accuracy
- Questioning and posing problems
- Applying past knowledge to new situations
- Thinking and communicating with clarity and precision
- Gathering data through all senses
- Creating, imagining, innovating
- Responding with wonderment and awe
- Taking responsible risks
- Finding humor
- Thinking interdependently
- Remaining open to continuous learning

Arthur L. Costa and Bena Kallick, 2000

Measurable (Observable):

What will your peers and teachers see and hear that demonstrates your success? For example, a choice to focus on developing your ability to persist to completion despite distractions would:

- Look like you continuing to work on your project tasks despite a busy classroom.
- Sound like you asking clarifying questions, considering alternative problem solving strategies, and asking for help when needed.

Consider quantifying your goals. For example, if asking clarifying questions is tough for you, set a goal of speaking twice per class period, even simple restatements or observations. If staying on task is an issue for you, set a goal of sitting where you will not be distracted by others or concentrating for increasing amounts of time.

Attainable:

Ask yourself if this is achievable goal? Removing an obsolete dam in just six weeks is an unrealistic goal. By contrast, bringing public attention to the damage caused by the dam to local watersheds and beaches by writing editorials, creating podcasts, or by taking local officials to the site is both doable and extremely valuable.

Relevant to your own life and education requirements:

Is the goal consistent with your greater needs and desires? Those students preparing for immediate college attendance after high school may want to set goals related to expected majors. A student planning to spend the summer watching their younger siblings might be interested in issues affecting children. Your teacher will lead the co-authoring of the education requirements section of the personal learning plan.

Timely:

Be sure to include realistic target dates for all elements of your plan.

NOTES FOR YOUR PERSONALIZED LEARNING PLAN:

Group Work Contract

Goals of the Group Contract

TEAM MEMBER NAME	TEXT NUMBER	EMAIL ADDRESS

Team Member's Role and Name	Team Member's Responsibilities. Be as specific as possible. Include performance indicators, tasks, and due dates.
Principal Investigator	
Scientist	
Engineer	
Policy Manager	

Option for Team Members: Share a goal from your Personalized Learning Plan

Group Agreements

Consequences for Breaking Agreements

1. Team members will issue one friendly reminder, as needed.
2. Team will issue a written formal joint warning. Teacher must know that warning was issued, but does not need to be involved.
3. Team member will be removed from the group and given an opportunity to re-join the group after make up work is performed. Team must schedule a problem-solving conference.
4. Team member will be removed permanently from the group. Team meets with teacher during office hours prior to permanent removal. If a team member is “fired,” that person is responsible for completing an alternative project of the teacher’s design.

Group Contract Signature Page

We have co-authored this contract, understand its contents, and agree to abide by every word. I am acknowledging my willingness to be held accountable to the group with my signature below.

Printed Name:

Signature:

Printed Name:

Signature:

Printed Name:

Signature:

Printed Name:

Signature:

Teacher Checklist for Student-Driven Projects

Prepare for Projects (3 to 6 weeks prior to entry event)

This is always the busiest time for a project-based teacher. With planning most projects go well, if not exactly where you thought they would. This is normal and expected in student-driven project-based learning environments.

- Review project materials, standards, and teacher support pieces.
- Organize a local guest speaker, videoconference, or a phenomenon for the project's Entry Event. Arrange space for public presentations of learning products if appropriate, and invite audience. Arrange speakers, adult mentors, and transportation for off-site activities.
- Contact teachers from other departments and propose partnerships.
- Perform a safety survey of any outdoor sites involved with the project.
- Prepare for "just in time teaching" by reading the project's *Teacher Guide*.
- Identify mutually reinforcing activities from existing curriculum guides.

Most importantly, prepare students for collaborative work, self-assessment, and sense-making conversations. See Create a Culture of Inquiry discussion in the Teacher Support reading titled *Organizing for Student Success*.

Launch Projects with an Engaging Entry Event (first week of project)

Your primary task when launching the project is to ensure a truly engaging entry event. Be sure that your speaker is prepped, knows how to connect to teenagers, and has visual aids or activities that prompt need-to-know questions. If quality speakers can't be found consider videos or video conferencing. Students receive the *Invitation to Engage* reading, *Rubrics*, and their *Student Checklist*; followed by the *Asking the Right Questions* reading.

- Help students interact with guest speaker, video, or a natural phenomenon. Introduce the Challenging Question.
- Encourage discussion of science, engineering, and policy viewpoints as students will be assuming these roles.
- Check for prior knowledge and build place-based connections
- Post the Challenging Question and create a calendar with student tasks. Use or revise the *Student Checklist* provided with the project or develop your own. (The *Student Checklist* and selected other documents are available in Word on the *Coastal Voices Website*, www.coastal.ca.gov/coastalvoices.)
- Review the procedures for creating group contracts and personalized learning plans, if you are using them. Assign teams and create contracts. Make students aware of your grading procedure. One option is for groups to agree that they will be the ones responsible for dividing up points based on the level of work each student does on the group project.
- Define the major learning products, which are typically the project notebook and a public presentation.

Manage the (Potentially) Messy Middle of Projects (3 to 4 weeks long)

This period of time is a cycle of questioning, knowledge building, explaining, revising understanding, and reflecting. Rarely is the middle of a project linear or predictable. Students may need all sorts of support ranging from direct instruction in process skills such as evaluating resources for bias, validity, and authority, to structured homework activities to clarify significant science concepts.

- Distribute the readings: *Claims, Evidence, and Reasoning*, followed by the field experience reading, *Tips for Effective Communication in Public Settings*, and any readings specific to the particular project. An additional reading is available titled, *Students Taking Action on Science & Policy and Communicating to Public Audiences*.
- In the second week, have students perform self assessment and write plans of improvement.
- Use a Daily Phenomenon (as described in the Teacher Support piece, Organizing for Student Success) to build shared knowledge as needed.
- Review project notebooks as often as time allows to ensure your ability to provide frequent feedback to students. Use exit tickets to track content knowledge and progress. Evaluate with rubrics.
- Have content resources ready that relate to students' "need-to-knows" and personalized learning plans. Deliver when students ask. Resist the impulse to front load or deliver lectures. Remember, this is "just in time" instruction.
- Perform weekly check-ins with groups using Habits of Mind descriptions. Perform additional team building activities as needed, however students should manage their own groups. In week three, meet with each group for debriefing on group work.
- As you get to week three increase the frequency of formative feedback. Be sure to review drafts of any written products and especially the project notebook.
- Use gallery walks as foundations for self- and peer-review.
- Provide frequent opportunities for students to practice.
- Confirm arrangements for public presentations and further adult mentoring opportunities. Send reminders to invited audiences.

Celebrate Student Work in Public Settings (last week of project)

Your primary role towards the end of the project is to facilitate reflection, support accurate student thinking by formally correcting when needed, and to celebrate the growth that you have noted during your regular formative assessment sessions.

- Perform system checks on any technology that will be used in presentations at least two days prior.
- Review rubrics, personalized learning plans, and performance expectations.
- Review the questions created at the beginning of the project.
- Have students perform self-assessment, lead reflection discussions, and write plans of improvement.
- Meet with each group for debriefing on group work. Have students divide points per original contract agreements, if applicable.

Asking the Right Questions

Projects, in school or out, are driven forward by questions and a sustained pursuit of inventive, evidence-based answers. Creative questioning is the motive force and the fire that will light your path forward as a self-directed learner. A quote attributed to Albert Einstein is, “It is not that I am so smart, it is just that I stay with the questions longer.” An inclination to persistently question, explore alternative explanations, seek answers for oneself, and communicate solutions are key job skills.

If asking the “right question” is a key to achieving meaningful results, what is the right question? One starting point is that the “right question” is one that interests you, connects to your life, and relates to significant real world processes, events, phenomena, or relationships. This is a prime opportunity for exercising your voice and choice to shape your learning and our society.

The next section (adapted from Rothstein and Santana’s *Question Formulation Technique*) provides a strategy your group may use to organize your questioning in order to launch your investigation.

- 1. Design a question focus:** Take this project’s Challenging Question as posed and rewrite it as an assertion or a statement. Then reverse engineer (pick apart) the challenging question as a starting point to develop your own focus question. You will notice that the question as it is stated has implicit assumptions, clear goals, and a target audience. Decide for yourself what part of the question intrigues you and suggests a focus for further questioning. However, you should question the question before adopting it as a guide for your learning.
- 2. Produce questions:** Begin developing “need-to-know” questions to guide your research into the Challenging Question. Use these rules to brainstorm:

Ask as many creative and probing questions as time allows. Feel free to riff off one another to keep things moving. For now, more is better; in a later step you will work to prioritize your questions.

Do not stop to judge, edit, answer, or respond to any question during question generation.

Have one group member write down each question exactly as posed. You may wish to rotate this task as it can inhibit the scribe’s creativity.

Change all assertions or statements into questions.

- 3. Work to refine questions:** Seek to convert closed questions (yes/no) to open ended questions that will require more thought and investigation. Aim for higher-level thinking questions that require analysis, synthesis, and

application of knowledge. Do you notice any patterns to the questions? Is there a way to investigate each question, and if not how can that question be restructured?

4. **Prioritize and classify questions:** You are being asked to investigate a complex issue. First, prioritize and narrow down your list of questions. Next, broadly categorizing the questions, for example, according to the group role (science, engineering, or policy) that will be leading each question's investigation.
5. **Plan how to investigate the questions:** What knowledge will be needed? Find out what is already known so your creative questioning will have the potential to explore new ground. The real skill lies in recognizing what data and information is valid, free of bias, and relevant to the question being asked.

What will you be doing? Think carefully about what science, engineering, and policy practices will lead you to significant answers to the various questions. Observation, research, interviews, fieldwork, experiments, surveys, data mining, or a combination of approaches? Be sure to consider how you will obtain, evaluate, and communicate about these complex subjects.

What will you be thinking about? Big ideas! Patterns, cause and effect relationships, policies that lead to stability or change. Models, of many system types: climate, transportation, communication, ecological, financial, or physical. How do the systems interact and function? What are the boundaries? Where do varied systems intersect? What are the component parts and what limitations exist?

6. **Commit to Next Steps:** This is an ideal time to finalize your learning contract and begin designing your investigation. See Student Checklist.
7. **Student Reflection:** Consider in your project notebook what steps you might take to improve your questioning skills. When does it feel most challenging to ask questions? How might you control circumstances that make you nervous? Consider setting a goal to ask a question every day.

Students of the art and science of questioning are doing far more than setting the learning agenda for themselves; they are training themselves in a new way of thinking that leads to innovation, career success, and mental habits that may be applied across subject areas, lifestyles, and geography. Author and poet Harvey Oxenhorn illustrates the ultimate positive outcome for questioners: "Being mindful...To notice everything, to make that level of awareness so habitual that it became unconscious...To get in the habit of asking questions was to get in the habit of answering them for yourself. What you gain in the process, when allowed to make your own mistakes, is self-reliance, ability, and independence."

Claims, Evidence, and Reasoning Guide

For our individual impacts to be positive, people of every age must practice speaking, arguing, and acting with clarity and precision based on carefully developed evidence. Today’s complex social and environmental issues require nuance in expression, effective listening and speaking skills, and an ability to distinguish between closely related topics. Developing evidence for yourself, analyzing counter arguments, and making well-reasoned claims leads to confidence and assertiveness.

Key Terms and Concepts

Argumentation is the process of supporting claims, assertions, proposed solutions, conclusions, or models with solid reasoning based on valid evidence. This guide uses examples drawn from environmental science and policy; however, it is important to remember that arguing from evidence is an appropriate strategy for working in any career area.

The UC Berkeley Museum of Paleontology defines the word “evidence” as used by scientists and engineers as:

Test results and/or observations that may either help support or help refute a scientific idea. In general, raw data are considered evidence only once they have been interpreted in a way that reflects on the accuracy of a scientific idea.

Notice that science is a conversation, an open process of testing ideas via practices that always converge on the use of evidence to revise knowledge. New evidence, once corroborated through peer review, will be used to revise existing theory. Engineers behave similarly and often use a process known as Evidence-Based Design, a method for everything from the design of buildings to medical studies. The emphasis is on observable, experiential, and testable phenomena.

Evidence is also important for professionals in legal and policy fields. Notice how the underlying principle of a claim being supported by evidence is expressed in the following definition from the California Legal Code:

“Evidence” means testimony, writings, material objects, or other things presented to the senses that are offered to prove the existence or nonexistence of a fact.

For this project, we will define the terms “claim,” “evidence,” and “reasoning” as follows:

Claim:

As used for this project, a claim is a statement that answers the Challenging Question or an essential question developed by student teams. It will always be supported by evidence and scientific reasoning, and be consistent with logic. It is never an opinion, belief, or preference. Your ability to construct viable arguments, claims, and explanations rests upon obtaining, evaluating, and communicating from a foundation of evidence.

Evidence:

For this project we seek evidence in the form of organized data from relevant, reliable sources; direct observation of a phenomenon; experiments; or carefully constructed student surveys. Data must first be organized and interpreted before it is considered evidence supporting a claim.

Reasoning:

This is the link between your claim and the evidence supporting the claim. It is the rationale for why your claim is warranted based on your evidence. We can all recall a situation where a question was met with a dismissive “because it’s in the text book.” In this project we are looking for much more—typically three sources of evidence to support any claim.

Robust reasoning will have four distinct elements: First, you must clearly articulate your claim (your proposed answer to the Challenging Question). Second, describe any patterns or trends in the data cited. A complete description of how the data was obtained, what circumstances prevailed during collection, and any possible weaknesses in the evaluation process are markers of quality. Third, provide a statement of correlation that supports your claim. For example, if the claim is that “high park admission costs are a barrier to access for youth,” a related correlative statement could be, “we expected an inverse correlation between admission price and park visits by young people. We did see this result in park data collected after price increases and in our surveys of 300 students.” Finally, high quality reasoning considers alternative explanations for any claim or explanation: “We considered other explanations related to public transit access and availability of parking. These are factors, however our results strongly suggest that there is a relationship between cost and youth visits to parks.”

Creating a Scientific or Policy Argument

Adapted from NSTA and the California NGSS Roll-Out

Goals: 1. Create an argument consisting of a claim, supporting evidence, and reasoning. 2. Revise the argument based on feedback from peers.

Our first draft of CLAIM-EVIDENCE-REASONING	Comments from peers on improving our work	Our improved draft of CLAIM-EVIDENCE-REASONING
<p>CLAIM: Here is our claim (...we believe that X is caused by...OR we believe that Y has a role in how Z happens...)</p> <p>EVIDENCE: Our evidence comes from (name the type of data and the activity it came from). We saw in the data (name the particular trend or outcome).</p>	<p>Is the claim clear? Does it describe a cause and effect?</p> <p>Is the data relevant to the claim being made? If two kinds of data or observations are being compared, do they make sense to use together? Is the data credible?</p>	<p>Revised CLAIM</p> <p>Revised EVIDENCE</p>
<p>REASONING: We think this evidence supports our claim because if these trends in data are happening, then it means that (state a brief causal chain of events—this chain has to be consistent with known science ideas/facts).</p>	<p>Do you need to make big inferences about what happened or why? Are there big gaps in the causal story here? If you saw this kind of data, does it mean that their claim can be the ONLY one that is true? Should they moderate their claim?</p>	<p>Improved REASONING</p>

Tips for Effective Communication in Public Settings

Public speaking is a fundamental challenge, potentially stressful or frightening for many people, both adults and students. To find your voice, speak intelligently from evidence, and be self-confident when challenged about the questions of the day, is to find your own power and your own chance to change the world. Speaking in 2014, 17 year old Nobel Prize winner Malala Yousafzai said: “We should not wait for someone else to come and raise our voice. We should do it by ourselves.”

Since sharing your work in public through presentations, field experiences, or media is central to this project, to civic participation, and to changing the world, this document describes some techniques of public speaking that with practice will grant anyone the ability to move from academics to action.

- 1. Prepare well.** Georgia State Professor Michael Mescon puts it this way: “The best way to conquer stage fright is to know what you are talking about.” This is a close cousin to the US Navy’s principle of 7Ps. Here is the cleaned up, non-sailor version: Prior Planning, Preparation, and Practice Prevents Poor Performance. Reinforcing this from ancient Greece is Epictetus, who spoke to the importance of listening and learning before speaking with this anatomically apt reminder: “We have two ears and one mouth so we may listen twice as much as we speak.” Listening is preparing. Once you are in command of the facts, the evidence, and the reasoning, it becomes natural to assert your claim.
- 2. Practice, practice, practice, and practice again.** Audiences are forgiving of mistakes, nervousness, and stage fright; however, it is disrespectful to waste their time though lack of preparation.
- 3. Speak only about what you know to be true and don’t fake it.** In his letters home from the Middle East, Malcolm X wrote, “I’m for truth, no matter who tells it. I’m for justice, no matter who it’s for or against.” Speak only about what you know and be happy to offer a professional “I don’t know but I will find out and get back to you.” Once again, audiences expect you to be knowledgeable about your message, prepared to deliver in an effective manner, and honest, but no one expects you to know everything.
- 4. Speak slowly and clearly.** Many people speed up their speech when they are nervous, but that makes you harder to understand and the audience might miss parts of what you are saying. Slow down your speech and take your time.
- 5. Make eye contact with the audience.** This is a tip that will help engage your audience in what you are saying—making it feel more like a conversation than a speech. Don’t just scan the audience—look at individual audience members one at a time. Try to give them an entire sentence or thought before moving on to another person.
- 6. Say thank you.** Your audience’s presence and applause are a gift. At the end of your presentation, always acknowledge your audience by thanking them.

Students Taking Action on Science & Policy and Communicating to Public Audiences



Testifying at a Public Meeting

Tension filled the quiet meeting room, where bodies were tightly held, faces grimly purposeful, and smiles mostly absent. It was clear that the meeting was significant, the participants highly motivated, and the stakes high.

Into this scene came a group of high school-aged students. Dressed in blue shirts emblazoned with “I love MPAs,” they had come to take part in the decision-making. They huddled for a moment with their teacher, gave each other a round of fist bumps, and quietly took seats along the left side of the room. The commissioners filed in, seating themselves on a raised dais in the manner of judges, and began hearing public testimony related to California’s proposed establishment of Marine Protected Areas.

Outbursts were occasionally heard, but the chairperson quickly restored order with a stern look and an admonition. The morning wore on and the audience was growing irritable when the students’ turn to speak arrived.

As Jaime strode to the speaker’s table, pride could be seen in his walk but grumbling could be heard from the audience. Just as he began to speak, a shouted “sit down kid” rose into the atmosphere. With poise and grace, Jaime replied, “Sir, I love this coast and ocean. I am here to speak my mind. No one tells me what to think. My voice matters.” The mood in the room soared as the 16 year old spoke. It was clear that the future is in good hands. It was equally clear that public speaking skills matter enormously.

California King Tides

During a recent “king tide” event when San Francisco Bay rose over Marin’s bike paths, streets, and into the manicured gardens of a nearby hotel, most people continued about their morning tasks. Drivers only rarely slowed to look at the water swelling up out of storm drains and across Tam Junction, an intersection in Mill Valley. One driver, distracted by his cell phone and not expecting flooded streets, hydroplaned across the intersection and lost control of his vehicle. Other drivers made eye contact, communicated their intentions with signals, and collaborated to make safe progress. They were partners with a shared purpose, if only for a moment, in managing the rising tide.



Like the distracted driver, many California coastal residents are not paying attention to climate change. This century will see increased coastal flooding, loss of road access to communities, and damage to homes and wastewater treatment systems. Accelerated beach erosion will harm habitats and buildings unless steps are taken to protect, accommodate, or move development inland.

Fortunately, students at Terra Linda High paid attention as they worked to gather scientific data in the field, interview stakeholders, gather visual evidence, and communicate their findings to public audiences. Teacher Jesse Madsen and his students sought out a partnership with Youth Exploring Sea Level Rise Science (YESS), an initiative focused on supporting students as they seek public audiences for science communications products. YESS and Mr. Madsen’s class then worked with the County of Marin and USC-Sea Grant to move from concepts to civic communication. After collecting and analyzing data on sea level rise, the students created multiple communications products including a Spanish language video about coastal vulnerability in San Rafael, an environmental justice briefing for nearby San Mateo County, and posters for community events.

Watch the video students produced in partnership with the County of Marin and the Community Media Center of Marin in English at <https://youtu.be/LxPefmccFq4> and Spanish at https://youtu.be/cpHo-3_VSuE

CREATIVITY & INNOVATION RUBRIC

Courtesy of the Buck Institute for Education

PROCESS:

	Below Standard	Approaching Standard	At Standard	Above Standard
Creativity & Innovation Opportunity at Phases of a Project <i>Launching the Project:</i> Define the Creative Challenge	<ul style="list-style-type: none"> • may just “follow directions” without understanding the purpose for innovation or considering the needs and interests of the target audience 	<ul style="list-style-type: none"> • understands the basic purpose for innovation but does not thoroughly consider the needs and interests of the target audience 	<ul style="list-style-type: none"> • understands the purpose driving the process of innovation (Who needs this? Why?) • develops insight about the particular needs and interests of the target audience 	
<i>Building Knowledge, Understanding, and Skills:</i> Identify Sources of Information	<ul style="list-style-type: none"> • uses only typical sources of information (website, book, article) • does not offer new ideas during discussions 	<ul style="list-style-type: none"> • finds one or two sources of information that are not typical • offers new ideas during discussions, but stays within narrow perspectives 	<ul style="list-style-type: none"> • in addition to typical sources, finds unusual ways or places to get information (adult expert, community member, business or organization, literature) • promotes divergent and creative perspectives during discussions (CC 11-12.SL.1c) 	
<i>Developing and Revising Ideas and Products:</i> Generate and Select Ideas	<ul style="list-style-type: none"> • stays within existing frameworks; does not use idea-generating techniques to develop new ideas for product(s) • selects one idea without evaluating the quality of ideas • does not ask new questions or elaborate on the selected idea • reproduces existing ideas; does not imagine new ones • does not consider or use feedback and critique to revise product 	<ul style="list-style-type: none"> • develops some original ideas for product(s), but could develop more with better use of idea-generating techniques • evaluates ideas, but not thoroughly before selecting one • asks a few new questions but may make only minor changes to the selected idea • shows some imagination when shaping ideas into a product, but may stay within conventional boundaries • considers and may use some feedback and critique to revise a product, but does not seek it out 	<ul style="list-style-type: none"> • uses idea-generating techniques to develop several original ideas for product(s) • carefully evaluates the quality of ideas and selects the best one to shape into a product • asks new questions, takes different perspectives to elaborate and improve on the selected idea • uses ingenuity and imagination, going outside conventional boundaries, when shaping ideas into a product • seeks out and uses feedback and critique to revise product to better meet the needs of the intended audience (CC 6-12.W.5) 	

CREATIVITY & INNOVATION RUBRIC, PROCESS, continued

	Below Standard	Approaching Standard	At Standard	Above Standard
Creativity & Innovation Opportunity at Phases of a Project				
<i>Presenting Products and Answers to Driving Question: Present Work to Users/Target Audience</i>	<ul style="list-style-type: none"> • presents ideas and products in typical ways (text-heavy slides, recitation of notes, no interactive features) 	<ul style="list-style-type: none"> • adds some interesting touches to presentation media • attempts to include elements in presentation that make it more lively and engaging 	<ul style="list-style-type: none"> • creates visually exciting presentation media • includes elements in presentation that are especially fun, lively, engaging, or powerful to the particular audience 	

PRODUCT:

	Below Standard	Approaching Standard	At Standard	Above Standard
Originality	<ul style="list-style-type: none"> • relies on existing models, ideas, or directions; it is not new or unique • follows rules and conventions; uses materials and ideas in typical ways 	<ul style="list-style-type: none"> • has some new ideas or improvements, but some ideas are predictable or conventional • may show a tentative attempt to step outside rules and conventions, or find new uses for common materials or ideas 	<ul style="list-style-type: none"> • is new, unique, surprising; shows a personal touch • may successfully break rules and conventions, or use common materials or ideas in new, clever and surprising ways 	
Value	<ul style="list-style-type: none"> • is not useful or valuable to the intended audience/user • would not work in the real world; impractical or unfeasible 	<ul style="list-style-type: none"> • is useful and valuable to some extent; it may not solve certain aspects of the defined problem or exactly meet the identified need • unclear if product would be practical or feasible 	<ul style="list-style-type: none"> • is seen as useful and valuable; it solves the defined problem or meets the identified need • is practical, feasible 	
Style	<ul style="list-style-type: none"> • is safe, ordinary, made in a conventional style • has several elements that do not fit together; it is a mish-mash 	<ul style="list-style-type: none"> • has some interesting touches, but lacks a distinct style • has some elements that may be excessive or do not fit together well 	<ul style="list-style-type: none"> • is well-crafted, striking, designed with a distinct style but still appropriate for the purpose • combines different elements into a coherent whole 	

Note: The term "product" is used in this rubric as an umbrella term for the result of the process of innovation during a project. A product may be a constructed object, proposal, presentation, solution to a problem, service, system, work of art or piece of writing, an invention, event, an improvement to an existing product, etc.

PRESENTATION RUBRIC

Courtesy of the Buck Institute for Education

	Below Standard	Approaching Standard	At Standard	Above Standard
Explanation of Ideas & Information	<ul style="list-style-type: none"> • does not present information, arguments, ideas, or findings clearly, concisely, and logically; argument lacks supporting evidence; audience cannot follow the line of reasoning • selects information, develops ideas and uses a style inappropriate to the purpose, task, and audience (may be too much or too little information, or the wrong approach) • does not address alternative or opposing perspectives 	<ul style="list-style-type: none"> • presents information, findings, arguments and supporting evidence in a way that is not always clear, concise, and logical; line of reasoning is sometimes hard to follow • attempts to select information, develop ideas and use a style appropriate to the purpose, task, and audience but does not fully succeed • attempts to address alternative or opposing perspectives, but not clearly or completely 	<ul style="list-style-type: none"> • presents information, findings, arguments and supporting evidence clearly, concisely, and logically; audience can easily follow the line of reasoning (CC 9-12.SL.4) • selects information, develops ideas and uses a style appropriate to the purpose, task, and audience (CC 9-12.SL.4) • clearly and completely addresses alternative or opposing perspectives (CC 11-12.SL.4) 	
Organization	<ul style="list-style-type: none"> • does not meet requirements for what should be included in the presentation • does not have an introduction and/or conclusion • uses time poorly; the whole presentation, or a part of it, is too short or too long 	<ul style="list-style-type: none"> • meets most requirements for what should be included in the presentation • has an introduction and conclusion, but they are not clear or interesting • generally times presentation well, but may spend too much or too little time on a topic, a/v aid, or idea 	<ul style="list-style-type: none"> • meets all requirements for what should be included in the presentation • has a clear and interesting introduction and conclusion • organizes time well; no part of the presentation is too short or too long 	
Eyes & Body	<ul style="list-style-type: none"> • does not look at audience; reads notes or slides • does not use gestures or movements • lacks poise and confidence (fidgets, slouches, appears nervous) • wears clothing inappropriate for the occasion 	<ul style="list-style-type: none"> • makes infrequent eye contact; reads notes or slides most of the time • uses a few gestures or movements but they do not look natural • shows some poise and confidence, (only a little fidgeting or nervous movement) • makes some attempt to wear clothing appropriate for the occasion 	<ul style="list-style-type: none"> • keeps eye contact with audience most of the time; only glances at notes or slides • uses natural gestures and movements • looks poised and confident • wears clothing appropriate for the occasion 	

PRESENTATION RUBRIC, continued

	Below Standard	Approaching Standard	At Standard	Above Standard
Voice	<ul style="list-style-type: none"> • mumbles or speaks too quickly or slowly • speaks too softly to be understood • frequently uses “filler” words (“uh, um, so, and, like, etc.”) • does not adapt speech for the context and task 	<ul style="list-style-type: none"> • speaks clearly most of the time • speaks loudly enough for the audience to hear most of the time, but may speak in a monotone • occasionally uses filler words • attempts to adapt speech for the context and task but is unsuccessful or inconsistent 	<ul style="list-style-type: none"> • speaks clearly; not too quickly or slowly • speaks loudly enough for everyone to hear; changes tone and pace to maintain interest • rarely uses filler words • adapts speech for the context and task, demonstrating command of formal English when appropriate (CC 9-12.SL.6) 	
Presentation Aids	<ul style="list-style-type: none"> • does not use audio/visual aids or media • attempts to use one or a few audio/visual aids or media, but they do not add to or may distract from the presentation 	<ul style="list-style-type: none"> • uses audio/visual aids or media, but they may sometimes distract from or not add to the presentation • sometimes has trouble bringing audio/visual aids or media smoothly into the presentation 	<ul style="list-style-type: none"> • uses well-produced audio/visual aids or media to enhance understanding of findings, reasoning, and evidence, and to add interest (CC 9-12.SL.5) • smoothly brings audio/visual aids or media into the presentation 	
Response to Audience Questions	<ul style="list-style-type: none"> • does not address audience questions (goes off topic or misunderstands without seeking clarification) 	<ul style="list-style-type: none"> • answers audience questions, but not always clearly or completely 	<ul style="list-style-type: none"> • answers audience questions clearly and completely • seeks clarification, admits “I don’t know” or explains how the answer might be found when unable to answer a question 	
Participation in Team Presentations	<ul style="list-style-type: none"> • Not all team members participate; only one or two speak 	<ul style="list-style-type: none"> • All team members participate, but not equally 	<ul style="list-style-type: none"> • All team members participate for about the same length of time • All team members are able to answer questions about the topic as a whole, not just their part of it 	

COLLABORATION RUBRIC

Courtesy of the Buck Institute for Education

	Below Standard	Approaching Standard	At Standard	Above Standard
<p><i>Individual Performance</i></p> <p>Takes Responsibility for Oneself</p>	<ul style="list-style-type: none"> • is not prepared, informed, and ready to work with the team • does not use technology tools as agreed upon by the team to communicate and manage project tasks • does not do project tasks • does not complete tasks on time • does not use feedback from others to improve work 	<ul style="list-style-type: none"> • is usually prepared, informed, and ready to work with the team • uses technology tools as agreed upon by the team to communicate and manage project tasks, but not consistently • does some project tasks, but needs to be reminded • completes most tasks on time • sometimes uses feedback from others to improve work 	<ul style="list-style-type: none"> • is prepared and ready to work; is well informed on the project topic and cites evidence to probe and reflect on ideas with the team (CC 6-12.SL.1a) • consistently uses technology tools as agreed upon by the team to communicate and manage project tasks • does tasks without having to be reminded • completes tasks on time • uses feedback from others to improve work 	
<p>Helps the Team</p>	<ul style="list-style-type: none"> • does not help the team solve problems; may cause problems • does not ask probing questions, express ideas, or elaborate in response to questions in discussions • does not give useful feedback to others • does not offer to help others if they need it 	<ul style="list-style-type: none"> • cooperates with the team but may not actively help it solve problems • sometimes expresses ideas clearly, asks probing questions, and elaborates in response to questions in discussions • gives feedback to others, but it may not always be useful • sometimes offers to help others if they need it 	<ul style="list-style-type: none"> • helps the team solve problems and manage conflicts • makes discussions effective by clearly expressing ideas, asking probing questions, making sure everyone is heard, responding thoughtfully to new information and perspectives (CC 6-12.SL.1c) • gives useful feedback (specific, feasible, supportive) to others so they can improve their work • offers to help others do their work if needed 	
<p>Respects Others</p>	<ul style="list-style-type: none"> • is impolite or unkind to teammates (may interrupt, ignore ideas, hurt feelings) • does not acknowledge or respect other perspectives 	<ul style="list-style-type: none"> • is usually polite and kind to teammates • usually acknowledges and respects other perspectives and disagrees diplomatically 	<ul style="list-style-type: none"> • is polite and kind to teammates • acknowledges and respects other perspectives; disagrees diplomatically 	

COLLABORATION RUBRIC, continued

<i>Team Performance</i>	Below Standard	Approaching Standard	At Standard	Above Standard
<p>Makes and Follows Agreements</p>	<ul style="list-style-type: none"> • does not discuss how the team will work together • does not follow rules for collegial discussions, decision-making and conflict resolution • does not discuss how well agreements are being followed • allows breakdowns in teamwork to happen; needs teacher to intervene 	<ul style="list-style-type: none"> • discusses how the team will work together, but not in detail; may just “go through the motions” when creating an agreement • usually follows rules for collegial discussions, decision-making, and conflict resolution • discusses how well agreements are being followed, but not in depth; may ignore subtle issues • notices when norms are not being followed but asks the teacher for help to resolve issues 	<ul style="list-style-type: none"> • makes detailed agreements about how the team will work together, including the use of technology tools • follows rules for collegial discussions (CC 6-12.SL.1b), decision-making, and conflict resolution • honestly and accurately discusses how well agreements are being followed • takes appropriate action when norms are not being followed; attempts to resolve issues without asking the teacher for help 	
<p>Organizes Work</p>	<ul style="list-style-type: none"> • does project work without creating a task list • does not set a schedule and track progress toward goals and deadlines • does not assign roles or share leadership; one person may do too much, or all members may do random tasks • wastes time and does not run meetings well; materials, drafts, notes are not organized (may be misplaced or inaccessible) 	<ul style="list-style-type: none"> • creates a task list that divides project work among the team, but it may not be in detail or followed closely • sets a schedule for doing tasks but does not follow it closely • assigns roles but does not follow them, or selects only one “leader” who makes most decisions • usually uses time and runs meetings well, but may occasionally waste time; keeps materials, drafts, notes, but not always organized 	<ul style="list-style-type: none"> • creates a detailed task list that divides project work reasonably among the team (CC 6-12.SL.1b) • sets a schedule and tracks progress toward goals and deadlines (CC 6-12.SL.1b) • assigns roles if and as needed, based on team members’ strengths (CC 6-12.SL.1b) • uses time and runs meetings efficiently; keeps materials, drafts, notes organized 	
<p>Works as a Whole Team</p>	<ul style="list-style-type: none"> • does not recognize or use special talents of team members • does project tasks separately and does not put them together; it is a collection of individual work 	<ul style="list-style-type: none"> • makes some attempt to use special talents of team members • does most project tasks separately and puts them together at the end 	<ul style="list-style-type: none"> • recognizes and uses special talents of each team member • develops ideas and creates products with involvement of all team members; tasks done separately are brought to the team for critique and revision 	

CRITICAL THINKING RUBRIC

Courtesy of the Buck Institute for Education

	Below Standard	Approaching Standard	At Standard	Above Standard
<p><i>Critical Thinking Opportunity at Phases of a Project</i></p> <p><i>Launching the Project:</i> Analyze Challenging Question and Begin Inquiry</p>	<ul style="list-style-type: none"> sees only superficial aspects of, or one point of view on, the Challenging Question 	<ul style="list-style-type: none"> identifies some central aspects of the Challenging Question, but may not see complexities or consider various points of view asks some follow-up questions about the topic or the wants and needs of the audience or users of a product, but does not dig deep 	<ul style="list-style-type: none"> shows understanding of central aspects of the Challenging Question by identifying in detail what needs to be known to answer it and considering various possible points of view on it asks follow-up questions that focus or broaden inquiry, as appropriate (CC 6-12.W.7) asks follow-up questions to gain understanding of the wants and needs of audience or product users 	
<p><i>Building Knowledge, Understanding, and Skills:</i> Gather and Evaluate Information</p>	<ul style="list-style-type: none"> is unable to integrate information to address the Challenging Question; gathers too little, too much, or irrelevant information, or from too few sources accepts information at face value (does not evaluate its quality) 	<ul style="list-style-type: none"> attempts to integrate information to address the Challenging Question, but it may be too little, too much, or gathered from too few sources; some of it may not be relevant understands that the quality of information should be considered, but does not do so thoroughly 	<ul style="list-style-type: none"> integrates relevant and sufficient information to address the Challenging Question, gathered from multiple and varied sources (CC 6,11-12.RI.7) thoroughly assesses the quality of information (considers usefulness, accuracy and credibility; distinguishes fact vs. opinion; recognizes bias) (CC 6-12.W.8) 	
<p><i>Developing and Revising Ideas and Products:</i> Use Evidence and Criteria</p>	<ul style="list-style-type: none"> accepts arguments for possible answers to the Challenging Question without questioning whether reasoning is valid uses evidence without considering how strong it is relies on “gut feeling” to evaluate and revise ideas, product prototypes or problem solutions (does not use criteria) 	<ul style="list-style-type: none"> recognizes the need for valid reasoning and strong evidence, but does not evaluate it carefully when developing answers to the Challenging Question evaluates and revises ideas, product prototypes or problem solutions based on incomplete or invalid criteria 	<ul style="list-style-type: none"> evaluates arguments for possible answers to the Challenging Question by assessing whether reasoning is valid and evidence is relevant and sufficient (CC 6-12.SL.3, RI.8) justifies choice of criteria used to evaluate ideas, product prototypes or problem solutions revises inadequate drafts, designs or solutions and explains why they will better meet evaluation criteria (CC 6-12.W.5) 	

CRITICAL THINKING RUBRIC, continued

	Below Standard	Approaching Standard	At Standard	Above Standard
<p><i>Critical Thinking Opportunity at Phases of a Project</i></p> <p><i>Presenting Products and Answers to Driving Question: Justify Choices, Consider Alternatives & Implications</i></p>	<ul style="list-style-type: none"> chooses one presentation medium without considering advantages and disadvantages of using other mediums to present a particular topic or idea cannot give valid reasons or supporting evidence to defend choices made when answering the Challenging Question or creating products does not consider alternative answers to the Challenging Question, designs for products, or points of view is not able to explain important new understanding gained in the project 	<ul style="list-style-type: none"> considers the advantages and disadvantages of using different mediums to present a particular topic or idea, but not thoroughly explains choices made when answering the Challenging Question or creating products, but some reasons are not valid or lack supporting evidence understands that there may be alternative answers to the Challenging Question or designs for products, but does not consider them carefully can explain some things learned in the project, but is not entirely clear about new understanding 	<ul style="list-style-type: none"> evaluates the advantages and disadvantages of using different mediums to present a particular topic or idea (CC 8.RI.7) justifies choices made when answering the Challenging Question or creating products, by giving valid reasons with supporting evidence (CC 6-12.SL.4) recognizes the limitations of an answer to the Challenging Question or a product design (how it might not be complete, certain, or perfect) and considers alternative perspectives (CC 11-12.SL.4) can clearly explain new understanding gained in the project and how it might transfer to other situations or contexts 	

APPLICATION OF CONTENT KNOWLEDGE: FORMAL WRITTEN REPORTS AND PUBLIC PRESENTATIONS RUBRIC

Indicators of Achievement Adapted from Costa and Kallick, NCTE, and NGSS

<i>Habit of Mind</i>	Unsatisfactory	Growing to Competency	Competent (State Standard)	Distinguished
Striving for Accuracy	Sloppy or incomplete work with no evidence of revision or editing process. Feedback from peer reviewers and adult collaborators is not incorporated into work.	Student occasionally reviews checklists, rubrics, and peer feedback to enhance written communications. Care is taken to convey significant science concepts with examples and data.	Student understands and can apply two to three relevant science concepts in a written sequence of claims, evidence, and reasoning. Student works with peers as instructional resources.	Without sacrificing scientific accuracy, student constructs a coherent storyline referencing California places, issues, and connections to his or her own life. Student demonstrates a command of writing mechanics, organization, and ability to revise and edit.
Creative Questioning	Student does not initiate questioning in any written or verbal form. When questions are asked, they focus on meeting minimum requirements as articulated by adults.	Student initiates science-based questioning with support from peers or teachers. The value of questioning is understood, but the habit is still being cultivated.	Student independently produces original questions, considers questions from multiple perspectives, and produces original answers. Student brainstorms with others during the questioning process and listens carefully to arguments made by peers.	Student uses science and engineering practices to develop personalized place-based driving questions with connections to science concepts and to the ideas of classmates. Student considers alternative perspectives and nurtures an inclination to question daily.
Applying Past Knowledge to New Situations	Science notebooks, feedback from peers, and previous experience does not inform actions or writing.	When reminded and supported, prior knowledge is accessed and used to improve speaking and written communications.	Student consistently uses prior knowledge to investigate new phenomena. Reference to previous experience or careful use of analogies may be seen.	Student consistently uses prior knowledge to investigate new phenomena. Reference to previous experience or careful use of analogies may be seen.
Thinking and Communicating with Clarity and Precision	Use of vague and imprecise language leads to confusion about meaning. Science vocabulary is missing or used incorrectly.	Science concepts and ideas are communicated using analogies from everyday life, but subtle distinctions are lost due to a lack of vocabulary or incomplete grasp of scientific concepts.	Student avoids generalizations and distortions of fact while clearly defining science terms, concepts, and ideas. Student can distinguish between closely related science topics (e.g. weather and climate, or heat and temperature).	Students use exact language to convey science concepts and emerging ideas. Claims are supported with evidence and reasoning that is grounded in place, personal experience, and relevant science concepts. Writing is concise, descriptive, and coherent.

SCIENCE NOTEBOOK AND EXIT TICKET RUBRIC

<i>NGSS Element</i>	Unsatisfactory	Growing to Competency	Competent (State Standard)	Distinguished
Crosscutting Concepts	Student does not show connections across content area boundaries. Most learning activity is limited to memorizing facts without context.	Student identifies patterns and classifies relationships as causal or correlational. Student understands that events that occur closely in time may or may not be related.	Student places significant knowledge in context using systems, models, and causal analysis. Student evaluates questions and models for testability, arguments for validity, and solutions for practicality.	Explanatory power of crosscutting concepts is fully utilized to think and write as scientists do while addressing real world environmental problems. Alternative explanations are routinely considered, as is instrument error.
Science and Engineering Practices	Student identifies testable questions and performs simple qualitative investigations, but fails to recognize the many ways that scientists perform their work.	Student specifies relationships, between variables and clarifies arguments, but rarely evaluates or proposes solutions.	Student uses evidence and computational thinking to analyze geoscience data, construct arguments, develop conceptual models, plan investigations, and propose science-based actions.	Science and engineering practices are habitually referenced in writing. System level thinking is demonstrated in reference to boundaries, interactions, and constraints posed by methods, society, or environmental concerns.
Disciplinary Core Ideas	Student does not demonstrate understanding of science content; science vocabulary is wholly absent.	Student can identify components, yet understandings about relationships between components are elusive. Placing knowledge in context, using thinking tools like the crosscutting concepts is rare, but increasing.	Student presents Earth systems that are dynamic, interactive, and composed of both living and non-living features, with feedback effects that may be altered by human activity. Science vocabulary is wielded with precision and clarity.	Writing is precise and clear with no composition or style errors leading to elegant place-based expression of science concepts. Student makes a personal connection to the information and acts upon valid science information.
Conceptual Models	Work is inaccurate, lacking most needed components; messy craftsmanship detracts from overall presentation and obscures meaning.	Poor craftsmanship obscures meaning. Model is missing an element needed to completely understand science concepts or make predictions.	Model is neat; all depictions are accurate, legible, and scientifically defensible. Models have components, relationships, and connections labeled. Predictions about future conditions may be made.	Models can be used to evaluate the merits and disadvantages of various actions, generate predictions, and quantify relationships between components or variables.