

BASIS Lesson Plan

Lesson Name: Kids Protect the Bay!

Grade Level Connection(s)

NGSS Standards: Grade 2 Life Science, Grade 2 Earth and Space Science

FOSS CA Edition: Grade 4, Aquatic Environments

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

Teaser/Overview

This hands-on lesson guides students to investigate the Bay Area ecosystem. Students will rotate through two fun, inquiry-based activities, exploring different kinds of human impacts on the San Francisco Bay and discovering what we can do to protect it!

Lesson Objectives

- Students will use interactive models and simulations to explore phenomena having to do with water pollution.
- Students will better understand their impacts on the plants and animals whose habitat is the San Francisco Bay, regardless of their proximity to the water's edge.
- Students will appreciate their role in the Bay Area ecosystem.

Vocabulary Words

- **Ecosystem:** living/nonliving things that make up an environment and affect each other
- **Pollution:** human waste that harms the ecosystem
- **Habitat:** the environment where a plant, animal, or other living thing lives
- **Toxic:** poisonous
- **Biodegrade:** break down over time into smaller pieces by bacteria or other living things
- **Model:** simple representation of something that is too large or complex for us to study
- **Simulation:** using a model to figure out what would happen in a certain situation
- **Hypothesis:** guess based on evidence
- **Evidence:** things that we observe (see, hear, notice, etc.) that help us make claims

Materials

Scientist Volunteers will bring:

- Images, demos, specimens, etc. to support intro and stations
- Station 2: Plastic containers, vegetable oil, images of oil spills and cleanup, feathers, saran wrap, cotton balls, pipettes, spoons, paper towels
- Station 3: Rubber bands, trays, popcorn kernels, yellow beads, spoons, clear cups, images of decayed birds

Materials teachers should provide:

- Whiteboard and dry-erase markers (or other large space to write in front of class)

Classroom Set-Up

- Students should begin at a common space (eg carpet) if possible
- Desks/tables/chairs should be arranged so that students can easily be split into two or four groups after the introduction is over (depending on number of volunteers)

Classroom Visit

1. Introduction (5-10 minutes)

Role Model Introduction:

Being a role model is an important part of being a BASIS volunteer! Begin your lesson by explaining who you are and what you do as a scientist. Feel free to tell your “story” as if giving an elevator pitch to elementary school students: Why did you become a scientist? What questions are you trying to figure out? What do you do in your job? Why should students relate to you? Feel free to bring in photos, specimens, and other props. Let your personality shine through!

Topic Introduction:

After you introduce yourselves as role models, take some time to introduce the topic of this lesson: bay conservation. It may be helpful to keep the suggested take-away in the back of your mind throughout the lesson: **our activities can harm the San Francisco Bay ecosystem, but we can also help protect it!**

- Introduce the phenomenon that the class will explore: the San Francisco Bay ecosystem. The following guiding questions may be used:

- Share an image of the SF Bay. Who recognizes this place? Where is it?
- What do we use the bay for?
- Who else lives in or uses the bay? (fish, birds, otters, plants...) What do they use it for?
- Can you think of any way that those plants and animals impact us? How about the other way around – how do we impact those plants and animals?
 - Help students make the connection between the water they use and the bay: water from their taps, from storm drains, from Lake Merritt, etc. ends up in the bay eventually! Trace this relationship using visuals.
- We are all a part of the same **ecosystem** (write on board, define).
- Can anyone think of any ways that we might help keep the marine life in our ecosystem healthy?
- Can anyone think of ways that we might harm the marine life in our ecosystem?
- Introduce the learning experiences: oil spill and plastic pollution investigations
 - Present two visuals (image, props, specimens, videos, etc.), one at a time: one of an oil spill, and one of plastic pollution
 - These are two of the big ways humans harm the bay ecosystem.
 - What's happening? These are types of **pollution** (write on board).
 - What's the problem?
 - What can we do about it?
 - These are important questions – and we brought some fun activities that can help us figure out the answers!

Teaching Tip: Encourage Broad Participation

- Write vocab words, key terms, questions, and brainstorm lists on the board, and refer back to the board frequently. This is especially important to engage visual learners and English language learners!
- Facilitate student-guided conversation by turning your *statements* into *questions*.
- Invite students to respond and add on to one another's ideas.
- Wait 3 seconds before calling on someone to answer a question.
- Bring in images, props, specimens, and demos to add to students' engagement with the phenomenon before they start their investigation.

2. Learning Experience (35 minutes)

For this part of the lesson, students will rotate between two activities. However, ideally students will be split into *four* groups, to make group size more manageable and to give students more time to interact with role models. If four volunteers are not available, the class can simply be split in half.

Station 1: Oil pollution (15 minutes)

At this station, students will figure out why oil pollution is a problem for the SF Bay ecosystem

- Background: How does oil pollution end up in the bay?
 - Has anyone ever seen oil in the bay? In another body of water? On the street?
 - Show students an image of oil in the San Francisco Bay. Point out the oil, and bring in closer-up images of oil on water.
 - Guide students in a discussion about how that oil might have gotten there, and how other oil ends up in the bay.
 - What do we use oil for? (eg cars, boats, BART, heating, electricity, plastic...)
 - How might that oil end up in the bay? (eg oil spills from boats, oil dripping from a car/bus in traffic and going into the ground, where it travels underground or through streams to the bay...)
 - Note: Depending on the background knowledge of the class, the discussion may be more or less student-driven (you may need to provide visuals and information to a greater or lesser degree to explain how oil ends up in the bay).
- Guide students in a group discussion: Why should we keep oil pollution out of the bay?
 - How do animals use the bay? (food, drinking, swimming, living/**habitat**)
 - What would happen if there was oil in an animal's food?
 - What if there was oil in an animal's drinking water?
 - What if an animal swam through, or dove into, oily water?
 - *Note: If students don't come up with it, explain that oil is **toxic** (poisonous). It can poison animals if they eat plants or animals that have oil on them, if they breathe it in, or if it gets on their skin or in their eyes.*
- Present the mini-investigation: oily feathers
 - Each pair of students receives a **model** bay (water in a small plastic container, one for every two students). Explain what the plastic container and water represent, and check for student comprehension.
 - Hand each pair of students two feathers.
 - Have one student from each pair dip their feather into the water: this represents a bird diving into the water for a fish. Have students make observations about the wet feather.
 - Have students shake the feather and/or use paper towel to dry it off. What do they observe now? Was that hard or easy to dry? Almost good as new! Why would that be important for birds? (eg need dry feathers to fly/to keep warm)
 - Create an "oil spill" in each "bay" using vegetable oil. Again check for student comprehension: this represents the oil that runs into the bay from cars on the highway, or from ships that spill oil, etc.
 - Have the other student in each pair (the one who did not dip a feather yet) dip their feather into the oily water. Check for student comprehension: this bird is diving through an oil spill to catch a fish. Have students make observations about the oily feather.
 - Have students try to remove the oil from the feathers. What do they observe now? Is it hard or easy? Why would it be a problem for birds to end up with oil on their feathers that they can't get off? (eg wings are too heavy to fly, can't keep themselves warm)

- Explain that this oil also will affect other plants and animals in the bay, just like you discussed earlier. (eg plants can't get sunlight, fish are poisoned, otters' skin gets oily so they can't keep warm any longer).
- Discuss images of birds/otters affected by oil spills.
- Guide students through the main investigation: oil spill clean-up
 - This means we have to do everything we can to avoid oil spills - but what if there is an oil spill? How can we clean it up, taking away the oil but leaving the water? Will it be easy or difficult?
 - Each pair of students will receive five different materials (saran wrap, netting, cotton balls, pipettes, spoons) that might be used to clean up their oil spills. The scientist will discuss with them which materials students think will work best to clean up the oil while leaving the water (their **hypothesis**).
 - Working in pairs, students will test the materials to see which works best.
- Leave a couple of minutes to guide students in a wrap-up discussion.
 - Was it easy or hard to remove the oil from the bay?
 - Which materials worked best? Why? What **evidence** do they have?
 - Share some images of a real oil spill clean-up, emphasizing what a huge challenge it is, and connecting the real world clean-up techniques to the techniques students tried.
 - How can we avoid this situation? (eg drive less/walk/ride a bike, use green energy, be careful about oil leaks in cars, buy fewer plastics, laws to make oil tankers more reliable, technology to improve clean-up)
- Hopefully, students have figured out that oil spills are a problem for the SF Bay ecosystem because they harm marine life and are very difficult to clean up. Connect this to the lesson take-away: **our activities can harm the San Francisco Bay ecosystem, but we can also help protect it!**

Teaching Tip: Introducing Modeling and Simulation

- Help students understand the point of modeling/simulation:
 - **Model:** simple representation of something too big /complicated for us to study (eg a globe, a model airplane, a plastic skeleton, a star chart)
 - **Simulation:** using a model to test out what would happen in a certain situation
- Make sure students are very clear on what each part of the model/simulation represents
- Refer to components of the model with their real-world name (eg a "beak" not a "spoon")
- Regularly connect the activity to the real-world phenomenon students are investigating
- Bring in plenty of visuals (images, props, demos) to help deepen the connection. This can also help fill time if one station goes more quickly than the other!

Station 2: Plastic Pollution (15 minutes)

At this station, students will figure out why plastic pollution is a problem for the SF Bay ecosystem.

- Background: How does plastic pollution end up in the bay?

- Has anyone ever seen plastic in the bay? In another body of water? A lake, pond, or puddle? How about in the street?
- How do you think it got there?
- Where do you think the plastic garbage on the street and in puddles ends up?
- Some garbage pollution ends up in the bay because people put it there: they throw it out a car window, or it might be dumped from a boat. But even garbage we see on the street might end up in the bay, if it ends up in a stream or a storm drain. Where do streams and storm drains around here end up?
- Plastic pollution is especially harmful because it's not **biodegradable**, meaning it stays around for a long, long time instead of being broken down by bacteria.
- Guide a group discussion: Why should we keep plastic pollution out of the bay?
 - Show the group a tray of "garbage" that might be found in the ocean (incl. yellow beads, fishing line, 6-pack rings, enough rubber bands for each student)
 - How might animals encounter this garbage? What might they be doing when they encounter it?
 - What would happen if there was plastic in an animal's food or drinking water?
 - What if the animal thought the plastic *was* food?
 - What if plastic got in the way of an animal's movement?
- Present the mini-investigation: rubber band bind
 - What if an animal, like a bird, encountered something that could get stuck around its neck?
 - Show an image of an animal with plastic around its neck.
 - Each student is going to pretend that their hand is a duck. Practice making hands like ducks: pinch the fingers together the way you would to make a bird "shadow puppet," and say hello to your neighbor!
 - Place a rubber band around each student's wrist, like a bracelet. Have the "ducks" try to remove the rubber band from around their "necks," without using their other hand/mouth/teeth (ducks wouldn't be able to do that!).
 - Explain that just like the students' hands, many animals like ducks aren't able to get free. What might happen to those animals?
- Guide students through the main investigation: full bellies
 - Can we think of any other ways plastic garbage might be harmful to marine life?
 - What if an animal accidentally thought the plastic was food? Let's figure out what would happen with a **simulation** (define)!
 - Students will share trays that have popcorn kernels ("food") and yellow beads ("plastic debris") mixed in it.
 - Students will act as birds diving for food in the bay. Students will "feed" at each tray in several rounds.
 - In the first round, they should take their "beak" (spoon) and collect a mouthful of food. Place the food in the bird's "stomach" (cup). Remember, the bird is diving from high up, so it can't be too choosy about what ends up in its beak!
 - Guide students to examine their cups. What do they observe? How much food did they eat? How much plastic did they eat?

- What happens to the real food? The bird digests all the food, just like humans, and it comes out as excrement (poop!). Have students remove all the popcorn kernels from their cup.
- What happens to the plastic? Nothing! The bird's stomach can't digest it, so it stays there. Leave all the plastic beads in the belly.
- It's time to eat again! Repeat with another dive for food. What do students observe? Remove popcorn and leave beads again.
- Repeat enough times that it starts to become obvious that the plastic is building up in the birds' stomachs.
- Leave a couple of minutes to guide students in a wrap-up discussion.
 - What will happen to the bird if its stomach becomes full of plastic? Will it still get hungry? Will it want to eat any real food, or will it think it's full? What will happen to it? It can be hard for birds to tell what's food from what's plastic!
 - If the class seems sufficiently mature, you can show an image of a bird that has died from eating too much plastic.
 - Also share images of the Great Pacific Garbage Patch, and discuss how plastic from the bay ends up in the ocean, and how it can accumulate (pretty crazy!).
 - How can we avoid this situation?
 - Make sure to always put garbage in a garbage can (no litter!)
 - Recycle! Use a reusable water bottle; use tissue paper instead of packing peanuts; cut up plastic can holders; use a glass or plate instead of disposable cups and plates; buy products packaged with recycled materials; reuse lunch bags
 - Be creative about using plastic you're done with! (eg a plastic tub from the fridge can be used to hold crayons or game pieces)
- Hopefully, students have figured out that plastic pollution is a problem for the SF Bay ecosystem because it can harm or even kill animals. Connect this to the lesson take-away: **our activities can harm the San Francisco Bay ecosystem, but we can also help protect it!**

3. Wrap Up: Review and Discuss the Learning Experience (5-10 minutes)

- Students will regroup at the carpet to review and discuss the learning experience. You may wish to use a chart on the board: pollutant/problems/solutions.
- What did students learn at the oil station?
 - How does oil end up in the bay?
 - Why is it harmful?
 - How can we prevent oil pollution?
- What did students learn at the plastic pollution station?
 - How does oil end up in the bay?
 - Why is it harmful?
 - How can we prevent plastic pollution?

4. Connections & Close (5 minutes)

Does anyone have any questions about what we explored? Does anyone have any questions about becoming a scientist, or what it's like to be a scientist? Thanks and goodbye!

Follow Up: After the Presentation

Teachers who wish to extend the impact of this lesson may find the following CRS web pages useful:

- <http://www.crscience.org/educators/helpfulreports>
- <http://www.crscience.org/educators/treasuretrove>

Standards Connections

NGSS:

- Connections by topic
 - Life Science: 2. Interdependent Relationships in Ecosystems
 - Earth & Space Science: 2. Earth's Systems: Processes that shape the Earth
- Connections by disciplinary core ideas:
 - Life Science: 2-LS2 Ecosystems: Interactions, Energy, and Dynamics
 - Earth & Space Science: 2-ESS2 Earth's Systems
- Connections by scientific & engineering principles
 - 1. Asking questions and defining problems
 - 2. Developing and using models
 - 6. Constructing explanations and designing solutions
- Connections by crosscutting concepts
 - 2. Cause and effect: mechanism and explanation
 - 4. Systems and system models
- Connections by Performance Expectations
 - 2-LS4-1. Make observations of plants and animals to compare the diversity of life in different habitats.
 - 2-ESS2-2. Develop a model to represent the shapes and kinds of land and bodies of water in an area.
 - 2-ESS2-3. Obtain information to identify where water is found on Earth and that it can be a solid or a liquid.