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BASIS Lesson Plan

Lesson Name: The Ocean Belongs to Everyone!
(A catchy lesson name can help attract teachers to the lesson!)

Grade Level: 2

Presenter(s): Ocean Society of Berkeley

Standards Connection(s):

California Science Standards: Grade 2

- Life Sciences: Plants and animals have predictable life cycles
- Earth Sciences: Earth is made of materials that have distinct properties and provide resources for human activities

NGSS: Grade 2

- Life Sciences: 2-LS2: Ecosystems: Interactions, Energy, and Dynamics
- Earth Sciences: 2-ESS1: Earth's Place in the Universe; 2-ESS2: Earth's Systems

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

Teaser/Overview

Students in the East Bay live less than 20 miles from the Pacific Ocean – but how well do we really understand our relationship with the ocean? In this lesson, students will rotate through three fun interactive activities, asking questions about human impacts on the ocean ecosystem and exploring what we can do to protect it!

Lesson Objectives

Students will use interactive models and games to explore different phenomena having to do with pollution in the oceans, in order to better understand human impacts on the marine ecosystem. They will be able to identify ways that we can better protect the oceans, and how students themselves can help take care of the marine ecosystem in our own backyard.

Vocabulary Words

- **Marine**: having to do with the sea
- **Ecosystem**: the whole group of living and nonliving things that make up an environment and affect each other
- **Organisms**: living things
- **Conservation**: planned management of something (like the ocean) to prevent waste, destruction, damage, or neglect
- **Biodegradable**: something that can be broken down by bacteria and other organisms
- **Pollution**: human waste that spoils something or makes it impure

Materials

Scientist Volunteers will bring:

- Intro: inflatable globe, phytoplankton, Great Pacific Garbage Patch
- Station 1: cardstock; dry erase marker; laminated food chain cards
- Station 2: Plastic containers, vegetable oil, images of oil spills, feathers, saran wrap, cotton balls, pipettes, spoons, paper towels
- Station 3: Rubber bands, trays, popcorn kernels, beads, small spoons, cups

Materials teachers should provide:

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

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 three groups after the introduction is over
- We will need access to a large space on the whiteboard (or similar board) to write

Classroom Visit

1. Introduction (_10__ minutes)

Role Model Introduction:

Being a role model for students is an important part of being a BASIS volunteer. Begin your

lesson by introducing yourselves! Every team member should take a moment to explain who they are and what they study/do as a scientist. A bonus will be to tell your "story," as if giving an elevator pitch to 8-year-olds: Why did you become a scientist? What made you interested in your topic? Why should students relate to you, or be interested in you? Feel free to draft a script of what you will say, here. And remember, you can also weave your story throughout your lesson through examples from your own life, and/or return to it with Q&A at the end.

Topic Introduction:

1. We will begin by introducing the idea that the Earth is a water planet
    - Today, we're going to talk about the oceans, and how we can protect them so all plants and animals – including humans! – can continue to use them to live and stay healthy
    - First, we have a question for you. Do you think there is more water or land on Earth? Do you think the continents and islands take up more space, or the oceans and seas? [give 3 seconds to think]. Raise your hand if you think the land takes up more space. Now raise your hand if you think the water takes up more space. You're right! The oceans take up much more space. In science, we say that the oceans cover more *surface area* [write on the board] – can anyone guess what that means?
    - Here's a tougher question: does anyone have a guess about how much more surface area the oceans take up than land? How much more space does water take up on our planet than land? [answer: 70% - or, roughly, twice as much surface area! The oceans take up almost twice as much space as the land does.]
        - If the classroom has a globe, spin it around so students can see how much more water there is. If not, inflate globe to illustrate the ratio of water:land.
    - And finally: do you think there are more living things, or *organisms* [write on board], on land or in the water? Take a few moments to talk to the person next to you about what you think the right answer is. [answer: estimated 9/10 of organisms on Earth live in the oceans]
    - So the oceans are very important!

2. Next, we will discuss the relationship between humans and the oceans, using a 3-column chart written on the board: why do we need the oceans; how else do we use the oceans; how can we damage the oceans
    - Group brainstorm: The oceans are also very important for human survival! Who can think of some ways?
        - Make sure to emphasize that more than half of the world's population depends on fish as its main protein source!
        - Other things to add if students don't come up with them:
            - Phytoplankton produces more than half of the oxygen we need to breathe (explain phytoplankton and show image)

        - Oceans absorb lots of the carbon dioxide we put into the atmosphere (carbon dioxide is pollution and contributes to climate change)
        - Oceans evaporate to form clouds that we need for our own freshwater
- Group brainstorm: what other kinds of things do we use the oceans for?
    - Make sure to include beach use and shipping
- Group brainstorm: We've listed lots of great ways we interact with the oceans. But unfortunately, sometimes the way we use the ocean can be harmful to ocean life. This is very bad for the environment but also bad for humans, because we rely on marine environments for our own survival. Can anyone think of anything we might do that damages the oceans?
    - Things to add if students don't come up with them:
        - Garbage on the beach, which is not *biodegradable* [write on the board and give brief definition]
        - Things falling off boats/ships
        - Oil spills
        - Overfishing
        - Chemical waste
        - In some places, they might dump sewage or garbage into the oceans as well, if they don't have sufficient water treatment or waste disposal systems
    - In fact, there are "dead zones" in the oceans where no fish can survive because the water is so polluted
    - And, humans have been putting so much garbage in the ocean that there's actually something called the Great Pacific Garbage Patch [write that on the board] in the Pacific Ocean, where so much garbage accumulates that you can see the garbage from space! We'll talk more about that soon.
- We can see that it's very important for us to take care of the oceans, which we call *conservation* [write on the board]. We're going to do some fun activities that will help us better understand why it's so important to protect the oceans, and how everyone in this classroom can help take care of them!

2. Learning Experience (__35__minutes)

- *Set-Up: If students' individual desks are already split into three groups, students should return to their chairs to begin the activity (ask the teacher how students normally transition from the carpet to their desks). If not, have students count off by 3 and direct first group 1 to go to station 1; then group 2 to station 2; then group 3 to station 3.

- *Note: To transition students from station to station, make sure each station leader watches the clock – leave 10 minutes from start to finish at a station, with 1 minute transition in between, unless you notice that the intro ran long/short. If there is one additional scientist available, make sure that person confirms with each station leader that they're ready to rotate. If there are only 3 scientists present, make sure to catch the other leaders' eyes before rotating. Then instruct students that when you say go, they will stand up and walk quietly to the next station (pointing out the next station for each group)
- *Note: it's also a good idea to quickly ask the students in your station for their names; or, if you find you have extra time at your station after activities, ask them their name and favorite sea animal etc.

Station 1: Food Chains

- Who here has ever been to the beach, or to the edge of the Bay, or to Lake Merritt, and noticed some trash in the water? It's not very nice, is it? Well, the problem with trash in the water is not only that it doesn't look nice, or that it gets in the way of swimming, but that it can have a much bigger effect on marine ecosystems than we even see – especially if it's made out of plastic.
- This is because plastic is not biodegradable. Can anyone guess what biodegradable means? [try breaking it into bio and degrade to see if they can figure it out]. Something that is biodegradable can be broken down by bacteria or other tiny organisms (living things) so that it doesn't stay in the environment. So if plastic is NOT biodegradable, what does that mean?
- We're going to do two quick activities that will help us figure out why plastic has such a negative effect on the marine ecosystem.
- Activity 1: Biodegradability
    - Each student will receive one piece of cardstock and one pair of safety scissors.
    - Scientists will explain that the piece of cardstock is trash floating in the ocean. What do students think happens to that piece of trash as it gets tossed around by waves, and maybe crashes into things? [eventually it breaks up into smaller pieces – or it gets eaten accidentally, as they'll explore in Station 3]
    - Great. Let's each be the waves, and imagine we're crashing around these little pieces of trash until they break up into the smallest parts we can imagine. Take your scissors and cut the trash in half… now in half again… [repeat several times, until pieces can't be cut anymore].
    - Now, in reality, this trash is made out of what? [paper]. Paper is biodegradable, which means that tiny organisms like bacteria can keep breaking it down until it becomes tiny particles that are so small they aren't even paper anymore.
    - But what if we pretended this trash was actually made out of plastic? Who remembers – is plastic biodegradable? [no]. That's right. That means it might keep getting broken up into smaller and smaller pieces, but it'll never go away. And any *toxins* – poisonous chemical substances – that might be in the plastic stay in the plastic. Those toxins might not harm people and animals if we touch them, but we definitely wouldn't want to eat them.

    - The trouble is, look at how tiny those bits of trash you made are. If you were a very small animal looking for very small food, it is possible you would mistake those tiny bits of trash for food? What if they were even *tinier* bits of plastic – microscopic, even – do you think they might be mistaken for other tiny foods? I think so. Let's explore that further.
- Activity 2: Food chains
    - Scientist will present image of a shark; have students identify it as a shark and guess what it eats
    - Scientist will present image of a tuna; have students identify it as a tuna and guess what it eats
    - Repeat with mackerel
    - Repeat with herring
    - Repeat with zooplankton (and describe what they are)
    - Repeat with phytoplankton (and describe what they are)
    - Explain that phytoplankton are so small that microscopic toxins that come from plastic can be consume with phytoplankton. Point out that bigger pieces of plastic might be consumed with zooplankton (along with those plastic toxins)
    - Now, let's look at it the other way, from smallest organisms to biggest organisms, and try to keep track of how much plastic might be finding its way into the food chain
        - First, put the phytoplankton down on the table – that's the basis of the food chain. With dry-erase marker, make 1 dot on the card, representing a toxin floating nearby. [The scientist can judge whether this can be done by amassing the tiny bits of paper "trash" the students have created instead]
        - Place the zooplankton card on top. It "eats" the phytoplankton, as well as the toxin. Make one dot on the card, representing the toxin now in its body.
        - Place the herring card on top. It "eats" the zooplankton. BUT, the herring is bigger than the zooplankton, and let's say that right now it eats five zooplankton. So how many bits of toxin has it eaten, if every zooplankton has one toxin in it? [five; make 5 dots on the card]
        - Repeat with mackerel, which "eats" 4 herring (20 dots)
        - Repeat with tuna, which "eats" 2 mackerel (40 dots)
        - So, do you see what's happening? That's a lot of toxins inside that poor tuna, which can make it sick. That would be bad for the shark, who needs to eat the tuna! And what happens if a human eats that tuna??
- If there's time left over at this station, have students brainstorm what kinds of materials are biodegradable, and what are not [it's helpful to write down a list for everyone to see]

Station 2: Spill Containment

- Oil spills are a problem for the Earth's ecosystems. At this station, we're going to explore why humans need to be careful about oil spills, and what we can do to contain oil spills.
    - Students at this station will be presented with model "oceans" (water in small plastic containers) – one container for every two students, who will work in pairs.
    - The scientist will explain that there are lots of boats and ships on the ocean, doing lots of different things; and they will invite students to brainstorm what kinds of things boats might be doing on the ocean.
    - The scientist will explain that boats are carrying oil for different reasons: for fuel; for transport to be used in cars; etc. But what if the ship runs aground and a hole appears; or if the pipe carrying oil from the ground bursts? What happens if there's an oil spill??
    - The scientist will then create an "oil spill" (vegetable oil) in the model oceans by pouring a small amount of oil into each container.
    - The scientist will then discuss how the oil spill might harm the ecosystem showing images of oil spills and the affected ecosystems. For a quick demo, the scientist will take two feathers, and dip one in regular water, and one in oily water, then pass them around – and explain that the oil can't be completely washed out of the oily feather, which can no longer help the bird fly. A bird that gets caught in an oil spill can't fly at all anymore!
    - The scientist will share a few photographs of organisms affected by oil spills
    - 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 they think will work best to clean up the oil while leaving the water, and explain that this is their *hypothesis*.
    - Working in pairs, students will test the four materials to see which works best.
- Conclusions: Finally, the scientist will guide students to discuss which materials worked best, and why. They also will discuss why it's important to be careful with how we use the oceans.

Station 3: Plastic Pollution

- Background: We talked earlier about how there might be garbage at the beach that people have left behind; and that sometimes, garbage and other plastic things might be dumped from boats or ships, or even fall overboard accidentally. But what about us here in [town]? Is there anything we can do to keep plastic out of the ocean? Think about this: when we throw plastic garbage into the street, sometimes it disappears after a few days. What happens to that plastic? Has anyone ever seen garbage in the street? How about in a storm drain? [show image]. And where do we think that garbage goes? Right! To the ocean! Plastic is very bad for the ocean (remember the Great Pacific Garbage Patch?). We're going to do two quick activities to figure out why plastic is harmful to marine environments.

- Activity 1: “Getting out of a bind”
    - Each student gets one rubber band. The scientist will put the rubber band around the student’s hand, hooking around the thumb and pinky finger only. Students will try to remove the rubber band without using the other hand or teeth or rubbing it against something. Give students 20 seconds only.
    - Next, have students remove the rubber band and place it around their wrists like a bracelet. Pinch the fingers together the way you would to make a bird “shadow puppet” with a beak, and have kids pretend to be gulls trying to remove a plastic ring from around their necks without using their teeth or other hand.
    - Explain that just like the students’ hands, many animals aren’t able to get free. Those animals might encounter a rubber band, or something like fishing line, plastic six-pack rings, fishing net, etc. The animal might starve, strangle, or suffocate. This is one of the reasons we need to be careful about not letting garbage get into the oceans!
    - One thing we can do is make sure that when we do put any kind of plastic ring into the garbage (eg from soda can packs), we cut the rings open before throwing them out.
- Activity 2: All full!
    - In this activity, students will understand what happens to plastics in the ocean, and why they are harmful to birds.
    - The object of the activity is to collect as much “food” as possible in the time allotted. Because of the collection method and the short time allowed, some plastic will be gathered also.
    - Students will share trays that have popcorn kernels (“food”) and beads (“plastic debris”) mixed in it. Students will “feed” at each tray for 5 seconds, trying to get as much food as possible using small spoons *without spilling any*. Each student should place the spoonfuls of food into their bowl (“stomach”). When time is up, students examine their cups to see how much real food vs plastic they “ate.”
    - Next, students return all the plastic pieces to their bowls (the rest were released as excrement), and repeat the feeding exercise. After 5 seconds, students will see that there is even more plastic than food in the birds’ stomachs.
    - Repeat the activity one or two more times.
    - Discuss what will happen to animals who encounter plastic alongside their food, and show image. (Plastic can be hard to differentiate from food. Since plastic is difficult to digest, it can build up in the birds stomachs taking the place of real food. The birds feel full, gradually stop eating, and slowly starve.) ***Make sure to leave time for discussion***
- Finally, leave time for kids to discuss what they can do to keep plastic out of the ocean. Examples: 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 lunchbags; 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)
- And remember – plastic is not the ONLY kind of trash that ends up in the ocean and can harm the environment!

3. Wrap Up: Review and Discuss the Learning Experience (_3-5___ minutes)

- Students will regroup (at the carpet if possible) to review and discuss their learning experiences.
- Scientists will ask students what they learned at each of the three stations, giving a moment for students to think each time, and making an effort to call on a variety of students (including those who may not have spoken yet).

4. Connections & Close (_5-7__ minutes)

Connections to the real world around students:

- Scientists will add one more column to the 3-column chart, titled "conservation!" Scientists will ask students what we can all do to help protect the oceans, based on what we learned today and anything else they might know.

Close:

- Does anyone have any questions about the ocean, conservation, or anything else we discussed?
- Does anyone have any questions about becoming a scientist, or what it's like to be a scientist?
- Then, thanks and goodbye!

Follow Up: After the Presentation

- If the teacher is comfortable, students can search the playground looking for trash. Students can put on gloves and pick up trash to throw it away, and help keep it out of our storm drains and water systems.
- Students can go around the room with lab notebooks and make a list of things they see that are biodegradable, and things they see that are not biodegradable. Then they can come together as a group and brainstorm how the classroom (or their own homes) might be able to become more eco-friendly.
- Have students discuss how long it takes for different items to decompose in the oceans, using the attached visual from NOAA (for more info, visit

- The class can try a biodegradability experiment like this one: http://sciencelearn.org.nz/Contexts/Enviro-imprints/Teaching-and-Learning-Approaches/Biodegradability-experiment
- Check out the Smithsonian's Ocean Portal Educators Corner: http://ocean.si.edu/for-educators
- Check out National Geographic's Ocean Education resources: http://education.nationalgeographic.org/programs/oceans-education/

Standards Connections

California Science Standards:

- Life Sciences: Plants and animals have predictable life cycles. As a basis for understanding this concept:
  - Students know light, gravity, touch, or environmental stress can affect the germination, growth, and development of plants
- Earth Sciences: Earth is made of materials that have distinct properties and provide resources for human activities. As a basis for understanding this concept:
  - Students know rock, water, plants, and soil provide many resources, including food, fuel, and building materials, that humans use

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
  5. Mathematics and computational thinking
  6. Constructing explanations and designing solutions
  7. Engaging in argument from evidence
- Connections by crosscutting concepts
  2. Cause and effect: mechanism and explanation
  3. Scale, proportion, and quantity
  4. Systems and system models
  7. Stability and change


HOW LONG UNTIL IT'S GONE?
Estimated decomposition rates of common marine debris items
Apple Core 2 months
Waxed Carton 3 months
Cardboard Box 2 months
Newspaper 6 weeks
Paper Towel 2 – 4 weeks
Wool Socks 1 – 5 years
Foamed Buoy 50 years
Plastic Grocery Bag 10 – 20 years
Plywood 1 – 3 years
Cigarette Butt 1 – 5 years
Styrofoam Cup 50 years
Fishing Line 600 years
Plastic Bottle 450 years
Photo-degradable Beverage Holder 6 months
Disposable Diaper 450 years
Tin Can 50 years
Plastic Beverage Holder 400 years
Glass Bottle undetermined
Aluminium Can 200 years
Cotton Shirt 2 – 5 months
Estimated individual item timelines depend on product composition and environmental conditions.
Source: NOAA, National Oceanic and Atmospheric Administration, US / Woods Hole Sea Grant, US
Graphics: Oliver Lade / Museum für Gestaltung Zürich, ZHdK