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COMMUNITY RESOURCES FOR SCIENCE

BASIS Lesson Plan

Lesson Name: Clean Oceans for Powerful Communities

Grade Level Connection(s)

NGSS Standards: Grade 5, Earth and Space Science
FOSS CA Edition: Grade 5, Earth and Space Science

[CRS will identify standards connections & communicate with BASIS team about these]

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

Teaser/Overview

Advertise your lesson to teachers with a fun and interesting overview! In 2-3 sentences, what is your lesson about? (This will be sent to teachers when your lesson is advertised to them). Example:

- By learning about the history of environmental justice and people like Cesar Chavez, students will become inspired to be activists in their own communities! In hands-on activities, students will brainstorm sources of pollution and see how it trickles into local bodies of water and even into the food we eat.

Lesson Objectives

*What **meaningful scientific experiences** will students gain from your lesson? If possible, think about what questions students will be figuring out (as opposed to topics they will be "learning about"), and what scientific practices they will use to figure it out. Examples:*

- Students will identify different types of pollution sources (point and nonpoint) and how using nature-based solutions can prevent pollution from entering the ocean.
- Students will model microplastic bioaccumulation within the aquatic food web and how they can take steps to protect themselves from eating unsustainable seafood
- Students will understand the history of environmental justice, encouraging them to be advocates for improving the world around them.

Vocabulary Words

- Environmental Justice
- Wetlands
- Point and nonpoint sources

- Bioaccumulation
- Biomagnification
- Nature-based solution
- Microplastics
- Environmental racism
- Conservation

Include a bulleted list of 3– 6 important (new) words with definitions that will help students gain the most from your lesson. Definitions should be grade level appropriate.

Materials

Scientist Volunteers will bring:

What will you bring with you? (Include a detailed list so that interested teachers can use this lesson plan to teach the lesson on their own, too!)

- Watershed Models (5)

[https://www.enviroscapes.com/product/make-your-own-watershed-kit-single-kit/hands-on-models]

- Shrimp template (b&w and colored) A plain/colored ratio of 3:1 works well. (20) [https://cdn-5cb4e3b3f911cf0dc86f377b.closte.com/wp-content/uploads/2015/01/shrimp-template.pdf]
- Water bottles with punctured tops (5)
- Plastic water bottles (5)
- Bags of cocoa powder (5)
- Spoons (5)
- Cut up sponges (5)
- Pieces of paper labeled shark, octopus, and fish in a 1:3:9 ratio, respectively (count depends on size of class)

Materials teachers should provide:

What basic materials, if any, should students have ready when you arrive (pencils, paper, scissors, etc.)?

Classroom Set-Up

Share anything the teacher should know about how the classroom should be set up prior to this lesson (this info is shared with the teachers in their confirmation email). For example:

- The class should be divided into 5 groups and will sit in these groups for the introduction of the lesson accompanied by a powerpoint presentation.
    - Scientist volunteers need access to a projector oriented to where students can see the screen
- Presentation Link

Classroom Visit

1. Introduction (15 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:
After you introduce yourselves as role models, take some time to introduce the topic of this lesson: Ocean ecosystems and their connection to us and our daily lives. It may be helpful to keep the suggested take-away in the back of your mind throughout the lesson: **Environmental justice is a way to solve environmental problems in our communities in a way that promotes democratic participation and all people feel safe to enjoy the environment around them.**

Your topic introduction should follow the outline below. As much as possible, try to frame this information as questions posed to the class, rather than as a lecture. This helps activate students' prior knowledge and facilitates student-guided discussion.

- We're going to be talking about environmental justice today! What environmental problems affect your community? Can someone give me an example of an environmental problem? [If students do not think of reactions immediately, have them turn to their neighbor to gather thoughts for a moment; Think-Pair-Share]
- Your community can be your neighborhood, school, city, state, and world! What are the impacts? Who is affected the most? Is everyone affected equally? Field answers from students for 1 minute. Promote a general discussion about pressing environmental issues. Show images of different types of environmental issues and how they affect the community.

- Today I will discuss ocean conservation and environmental justice. What do you know about “environmental justice"? Have you heard that phrase before?
- Wait for students to raise their hands and receive thoughts from students. If not, have students discuss in pairs for 1 minute to discuss and then field answers from them.
- Define. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, when it comes to the development, implementation, and enforcement of environmental laws, regulations, and policies. This goal will be achieved when everyone enjoys:
    - Equal protection from environmental and health hazards
    - Equal access to the decision-making process to have a healthy environment in which to live, learn, and work.
- Overall, the principles promote secure jobs, quality schools and recreation, housing and healthcare, democratic decision making, and personal empowerment.
- These are examples of environmental racism in which people of color experience more environmental hazards than other groups.
- How do you think pollution affects the world around us? Do you think some people are more affected than others? Let’s do a science activity to figure it out.

2. Learning Experience (35 minutes)

Students will split into 4 groups (there can be more based on classroom size and materials) for activity 1. Every 2 groups will be led by a BASIS volunteer (the more volunteers the better). Then the students will return to their regular seating arrangements for activity 2 and 3. Remember that these activities are designed to address the key take-away: **Environmental justice is a way to solve environmental problems in our communities in a way that promotes democratic participation and all people feel safe to enjoy the environment around them.**

Activity #1: Watershed Activity (10 minutes)

1. Students will be seated/standing around 1 enviroscape watershed model. The materials will be passed out before students get into their groups. If not, pass out materials per group.
2. Scientist volunteers will draw a building legend on the whiteboard for students to use as reference for their models. The volunteer will call attention to the legend and explain its use for the activity.
3. Students will have model buildings (factory, farm, 2 residential buildings, restaurant) that they will place onto the watershed model. There will be different versions of the watershed model that the students will be using. Ask students where they think each building should be located.
4. Students will then brainstorm the layout of their faux city. After placing down the buildings and with scientist volunteer help, students will then brainstorm, with a scientist volunteer, potential sources of pollution. What buildings are where? Are they near water? Farms? Cities?

5. As a class, brainstorm common sources of pollution to put on the map. Explain the difference between point and nonpoint sources and students share what they think are point and nonpoint sources.
6. Students will place [cocoa powder] onto the model to simulate pollution. Things may get messy, so be prepared for some spills or to help students sprinkle the coca powder. Ask and demonstrate to students using the model how the pollution interacts with different forms of the environment; ie absorbs into the water system, absorbs into soil, etc.
7. Scientist volunteers will then use a water funnel to simulate rain onto the watershed model. Students should see the pollution make its way into water sources and eventually into the ocean. Scientists volunteers will emphasize that there is nothing to prevent or capture this pollution. Ask students how can we prevent this from happening in our watershed?
8. Field some responses from students. Scientists will say "We can add wetlands!". The volunteers will have sponges and then explain that the sponges represent wetlands and how this can help prevent some pollution.
9. We will redo the simulation but this time, the students will add sponges to the model along the tidal area. Students should observe how the sponges block some of the pollution from entering the ocean.
10. Volunteers will then clean up the activity materials, leaving the watershed, and transition to discussion and review.

Review and discuss activity #1: (10 minutes)

- Talk about restoring wetlands as a form of nature based solutions. Nature-based solutions mimic and enhance natural systems. Wetlands are good for soaking up runoff and also protecting the coast from storm surges!
- Are there any wetlands in the bay? Unfortunately, in the bay area we have destroyed a lot of our wetlands. Urban development and concrete allows water to run directly from the streets into the ocean. Did you know that Alameda was a wetland before becoming a city?
- On the central coast, there are towns that were built on top of wetlands. Many of these towns are low income agricultural towns. They are more at risk because they are not protected from storm surges.
- Issues of environmental racism like this have occurred throughout history. There have been some influential activists and events that encouraged the movement.
- How does the pollution that we saw go into the water circle back to us? Let's do an activity to see how plastic and other toxins make their way into the food chain.
- At this point, return students back to their seats, if you haven't done so already, and move the watersheds to an area where they will not distract students.

Activity #2: (7 minutes)

1. In this activity we will replicate bioaccumulation in the food chain.

2. Students will choose roles out of a hat representing either a shark, octopus, or fish. To mimic trophic levels, the roles should be in a 1:3:9 ratio, respectively.
3. Prior to beginning, there will be shrimp, half colored and half not, that will be set in piles of 2-3 shrimp around the classroom. Set a limit for time of play, and agree on an indicator to signal the end of this time limit (lights out works well).
4. Allow the fish to have a head start to collect shrimp. About 30 seconds is sufficient.
5. After this time has passed, allow the other organisms to begin playing. The goal is to consume lower level organisms, or to at least survive in the game (in the case of fish).
6. In order to consume a lower level organism, and thus gain the shrimp that the individual had consumed, the individual must play a game of rock, paper, scissors, and win. If the higher level organism does not win, they move on, and the lower level organism gets to keep their shrimp and continue in the game. If the higher level organism loses, they cannot return back to the same lower level organism for 10 seconds. Emphasize this rule to encourage students playing with others.
7. A lower level organism that is consumed (by losing the challenge of rock, paper, scissors) must return to their desk.
8. Once the agreed time has passed, have students return to their appropriate desks.
9. Ask students to count the number of shrimp they have, being sure to tally colored and plain shrimp separately. This is when to introduce the idea that shrimp printed on coloured paper represent organisms that have eaten plastic.
10. Discuss how the smaller concentrations in lower organisms are sufficient enough to cause death or damage to the organism. As such, in the simulation, any fish that have not been eaten and who hold at least one coloured shrimp are dead. In the case of the octopus, any individuals who have more than half of their shrimp printed on colored paper are also dead. Since higher level organisms are capable of storing higher concentrations of persistent pollutants with less dramatic effect, the sharks who have coloured pieces are no longer able to reproduce and they become an endangered species.
11. If time permits, you may repeat this activity with that idea in play. Students may choose to only go for non-plastic shrimp, but they will eventually have to make a decision on whether to live or to consume a plastic fish.

Review and discuss activity #2: (3 minutes)

- Why do you think plastics cause this much damage to the fish in the ocean? Why do you think small pieces of plastic could be just as or more dangerous than larger pieces?
- Microplastics are pieces of plastic less than 5 millimeters long.
- Bio (life) accumulation (build up) is what happens when toxic chemicals such as microplastics or mercury from pollution build up in an individual animal. Biomagnification occurs when the pollutant makes its way through the food web and animals at higher trophic levels ingest these toxins in high amounts. If we consume animals that have microplastics inside of them, then it enters our bloodstream!

- As we see, there is a connection between environmental health and human health. If there is no ocean pollution, then humans will not consume plastic or other toxic chemicals such as mercury.
- Lack of awareness and education is linked to environmental racism and how communities with fewer educational resources usually do not teach this to students.
- Sustainable seafood is more expensive and less accessible to everyone.
    - Introduce the resource Sustainable seafood watch

3. Wrap Up: Review and Discuss the Learning Experience (____ minutes)

Connections and close: (3 min)

- This can be scary, but knowing about issues like these helps us spread more awareness and gain momentum to fight against pollution and environmental racism.
- What are your thoughts on environmental justice?
- What actions students can take:
    - Attend peaceful protests
    - Call government officials to address EJ and systemic racism→ tell your parents to vote and vote when you can!
    - Join EJ orgs
    - Educate yourself and others → books included in my flier
    - Use the sustainable seafood watch
- Do you have any questions for me?

4. Connections & Close (___ minutes)

Connections to the real world around students:

- Let's see if you have been paying attention:
    - Can someone tell me who Cesar Chavez was?
    - Can someone tell me what the Warren County protest was about?
    - Can someone explain what environmental racism is?

Does anyone have questions?

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

[CRS will identify standards connections & discuss them with your BASIS team]

NGSS:

- Connections by topic
  - Earth and Space Sciences: 5. Earth's Systems
- Connections by disciplinary core ideas
  - Earth and Space Sciences: 5-ETS1B. Developing possible solutions
  - Earth and Space Sciences: 5-ESS3C. Human Impacts on Earth Systems
  - Earth and Space Sciences: 5-ETS1A. Defining and delimiting an engineering problem
- Connections by scientific & engineering practices
  - 2. Developing and using models
  - 3. Planning and carrying out investigations
  - 6. Constructing explanations and designing solutions
- Connections by crosscutting concepts
  - 2. Cause and Effect: Mechanism and explanation
  - 4. System and system models
  - 9. Influence of engineering, technology, and science on society and the natural world
- Connections by performance expectation
  - 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact
    - 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment