H. Smith

5th Grade - Language Arts and Life Science

**Title**: Bioprospecting in Yellowstone National Park: Beneficial or Harmful

**Description:**

Yellowstone’s hot springs are teaming with microscopic organisms. Only about 1%has been discovered. The business of bioprospecting is a controversial subject for the National Park Service. By learning what bioprospecting is and what affects it may have on the future of the park, medicine, and other areas of science, students will be able to persuade an audience of readers to either support or stand against bioprospecting within the boundaries of Yellowstone National Park.

**Introduction:**

In 1997 Yellowstone National Park signed the nation’s first bioprospecting agreement. The agreement allows scientist to study the microorganisms that live in the hot springs. They are able to apply for a permit which allows them to conduct research within the park. There are strict regulations for the scientist to follow in regards to what can be taken from the park, how it’s to be taken, and what can be done with any samples and data collected.

Research scientists continue to find tiny microscopic organisms that are providing information into life on other planets, evolution, and other medical breakthroughs.

**Prior Knowledge**:

Students will already know certain terms pertaining to microbes. The following terms are prerequisites for this lesson: microbe, thermophile, bacteria, algae, fungi, beneficial, and harmful.

**Time Required**: 1-2 class periods

**Essential Questions**:

* Should researchers be allowed to profit from their findings in a national park?
* Would the scientific research by worth the potential hazards to the environment if large corporations were able to capitalize on any scientific findings (especially energy or medical advancements)?

**Common Core Language Arts Standards:**

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| **ELACC5W1**: Write opinion pieces on topics or texts, supporting a point of view with reasons. |
| * Introduce a topic or text clearly, state an opinion, and create an organizational structure in which ideas   are logically grouped to support the writer’s purpose. |
| * Provide logically ordered reasons that are supported by facts and details. |
| * Link opinion and reasons using words, phrases, and clauses (e.g., consequently, specifically). |
| * Provide a concluding statement or section related to the opinion presented. |
| **ELACC5W4**: Produce clear and coherent writing in which the development and organization are appropriate  to task, purpose, and audience. |
| **ELACC5W5**: With guidance and support from peers and adults, develop and strengthen writing as needed by  planning, revising, and editing.  **ELACC5W6:** With some guidance and support from adults, use technology, including the Internet, to produce  and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of  keyboarding skills to type a minimum of two pages in a single sitting. |
| **ELACC5SL1**: Engage effectively in a range of collaborative discussions (one-on-one, in groups,  and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others’ ideas and  expressing their own clearly. |
| * Come to discussions prepared, having read or studied required material; explicitly draw   on that preparation and other information known about the topic to explore ideas under discussion. |
| * Follow agreed-upon rules for discussions and carry out assigned roles. |
| * Pose and respond to specific questions by making comments that contribute to the   discussion and elaborate on the remarks of others. |
| * Review the key ideas expressed and draw conclusions in light of information and knowledge   gained from the discussions. |
| **ELACC5SL2:** Summarize a written text read aloud or information presented in diverse media and formats,  including visually, quantitatively, and orally. |
| **ELACC5SL3:** Summarize the points a speaker makes and explain how each claim is supported by reasons  and evidence. |

**ELACC5SL4:** Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes

**Georgia Performance Science Standards**:

**S5CS1.** Students will be aware of the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.

**S5CS6.** Students will question scientific claims and arguments effectively.

**S5CS8.** Students will understand important features of the process of scientific inquiry.

**S5L4**. Students will relate how microorganisms benefit or harm larger organisms**.**

**Materials:**

* Handout: “Microbes and Bioprospecting in Yellowstone National Park”
* Paper and pencil
* Highlighters
* Computer

Objectives: Students will be able to analyze the pros and cons of bioprospecting within Yellowstone National Park. They will be able to defend their point of view on bioprospecting in oral and written form.

**Procedures**:

* Pass out handout – “Microbes and Bioprospecting in Yellowstone National Park”
* Read handout to the class as the students follow along. Allow them to ask questions as you read. Encourage students to jot notes in the margin of the handout if necessary.
* Discuss the handout and talk to the students about bioprospecting through time and how it has been both beneficial to humans and harmful to the environment. Talk to them about other areas of the world where this can or has occurred (i.e., rainforests).
* List different occupations or people groups that could benefit or be affected by bioprospecting. (Scientists, doctors, park rangers, tourists, farmers, etc.)
* Break the students into groups. Assign each group an occupation or people group from the list above. The students will then brainstorm ways that their occupation/people group would be affected. The students will perform a skit (like charades) that will show the rest of the class how their group would be affected by bioprospecting.
* After all skits are complete, ask the students to decide what they think is more important to them individually. Ask the students if they would support bioprospecting or not.
* Explain to the class that they will be writing a persuasion essay on bioprospecting in Yellowstone National Park. Review the writing process with the class. Remind students to choose three ideas that will support their choice that will either support having bioprospectors in Yellowstone or will support them being banned from conducting research inside the park.
* Give the students time to brainstorm using a flea-map. As the students are working, walk around to assess for understanding of the writing process.
* When the students are ready, have them begin their rough draft followed by proofreading, editing. Take students to the computer lab to produce their final copy.

**Assessment**:

Use the students’ final copy of their piece of writing as assessment.

**Additional Information:**

<http://nature.nps.gov/benefitssharing/whatis.cfm>

<http://www.organicconsumers.org/articles/article_8615.cfm>

<http://www.youtube.com/watch?v=K7i0Y6Ai-P8>

<https://litigation-essentials.lexisnexis.com/webcd/app?action=DocumentDisplay&crawlid=1&srctype=smi&srcid=3B15&doctype=cite&docid=26+Ecology+L.Q.+401&key=2ad21f35842492a3f28e7fe9f1d33e57>

(HANDOUT BELOW)

**Microbes and Bioprospecting in Yellowstone National Park**

**What is a microbe?** A microbe is a microscopic organism. They are located everywhere on the earth, even in the boiling waters of the hotsprings and other thermal features at Yellowstone National Park (YNP). The microorganisms at YNP are often referred to as thermophiles (heat loving bacteria).

**What is Bioprospecting?** Scientific research and use of products in nature is Bioprospecting. Most of the time, it is a search for useful microorganisms that grow or thrive in extreme environments. Ancient civilizations have been using plants and other organisms found in nature as medicines for many centuries. Today, scientists use microscopes to analyze how things in nature are made so that can perform experiments that may lead them closer to understanding why certain microorganisms can live in extreme conditions or how they can help people as medicines.

Sometimes, the only way scientists can examine these microorganisms is to take samples from places where they are protected by law, such as YNP. Thankfully, scientists have discovered a way to copy these organisms in a laboratory setting so they don’t have to take many from their natural habitat to study them.

**Who are bioprospectors?** Any person (mostly scientists) who is curious about things in nature and what/how they can help us could be considered a bioprospectors. Sometimes scientists want to study these organisms for academic reasons while other scientists may want to research them for the purpose of trying to find a cure for a disease. Most bioprospecting in YNP is related to the study of microorganisms. Scientists expect that studying these tiny organisms could lead to many new discoveries in the future.

**How do you get started studying microbes in a national park?** Any scientist who wants to study microorganisms inside a national park must request a permit to conduct research. Only scientists can apply for this permit and they must show proof that they will not harm the park in any way. No natural products are able to be harvested from the park, but samples of the microorganisms can be taken. These samples cannot be sold. If a useful discover is made, the scientist’s data and information can be sold, but not the sample from the park.

**Bioprospecting in the National Parks:** The mission of the National Park Service is to, “preserve natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations.” This also means that parks should be centers for broad scientific inspiration and inquiry. Any research within a national park should be done without harming anything. All researchers should work with universities or other science organizations.

Scientific permits to conduct research in Yellowstone are allowed if there will be ***no harm*** on:

* Public safety and health
* Environmental or scenic views
* Natural or cultural resources
* Scientific research
* Visitors using the park at that time

Plants, Wildlife, Rocks, and Minerals can be collected if:

* The goals of your scientific research needs you to collect them
* There is a written research proposal to a university or science organization.

**Discoveries and future discoveries from bioprospecting:**

* Some of the microorganisms found are added to food for chickens to help them digest their foods and absorb nutrients easier. This allows the chickens to eat less food but have the same amount of energy. This keeps the barn cleaner because the chicken waste is drier and not as messy. Eggs that the chickens lay are cleaner because the barn is cleaner.
* Adding an enzyme from a microorganism to bread makes it last longer and makes the bread fluffier.
* These organisms help improve the breaking down of agricultural and organic waste in landfill sites.
* DNA copying was made possible by an enzyme from a microorganism. This allows us to match DNA in criminal investigations as well as medical diagnoses or cures. (This is a $300 million per year discovery.)
* Scientists have discovered that a unique grass can thrive around hotsprings because its root system has help from a heat-tolerant microscopic fungus. They hope that they can make copies of those microbes to help crops survive extreme drought and harsh winters.
* Bioremediation – these microorganisms from YNP can help to clean up oil spills in high temperature situations. They can also clean the inside of factories smoke stacks.

Remember, the actual items studied or collected in Yellowstone **cannot be sold for money**. However, all the research and information about the microbes studied can be sold. Only about 1% of Yellowstone’s microscopic life forms have been discovered and studied.

***Things to think about…***

* ***Should we continue looking into the benefits of the smallest organisms in this park?***
* ***Would a lot of scientists studying microorganisms hurt the hot springs?***
* ***If a cure for cancer or another disease is found from research done in Yellowstone’s thermal features, should we allow larger companies in to take samples of the microorganisms?***
* ***Will this type of research hurt the environment or animals of the park?***