NATIONAL GEOGRAPHIC

RESOURCE LIBRARY | LESSON

Blue Holes: Being an Explorer

This series of activities takes students through a process from defining exploration to planning, carrying out, and communicating the outcomes of a micro-expedition.

GRADES

7 - 12, Higher Ed

SUBJECTS

Biology, Ecology, Earth Science, Geology, Oceanography, English Language Arts, Geography, Physical Geography

CONTENTS

5 Activities

ACTIVITY 1: WHY WE EXPLORE | 1 HR 40 MINS

DIRECTIONS

1. Define "exploration."

Ask students how they define "exploration," writing all ideas on the board. Next, ask: *Who do you think of when you hear the word "explorer"?* Explain that although explorers like Marco Polo or Christopher Columbus typically come to mind, there are many present-day explorers and anyone can be an explorer. In this activity students will investigate why people explore and consider places they would like to explore.

2. Brainstorm ideas about exploration.

Use a round robin approach to generate students' ideas about exploration. Group 3-5 students at each table, and have them choose a scribe. Give each group a marker and a sheet of butcher paper with one of these questions on each paper:

- *Why do people explore?*
- *What places have you explored? What did you learn?*
- *What places would you like to explore in or near your city or town? Why?*
- *What places would you like to explore in your home country? Why?*
- *What places would you like to explore outside of your country? Why?*

At the teacher's signal, each group brainstorms while the scribe captures the ideas. After two minutes, have students pass their butcher paper in a clockwise direction to the next table. Each group has one student read aloud the question and the ideas from the previous group, and then the group again brainstorms new ideas to add to the previous groups' ideas, without repeating ideas. Allow each group to add their ideas for each question.

3. Have students mark their favorite ideas.

Give each student ten stickers or markers. Hang the sheets of butcher paper on the walls around the room. Give students five minutes to move around the room to read the questions and ideas on each sheet, marking their two favorite ideas for each question. As a class, discuss students' ideas and favorites for "*Why do people explore?"* and *"What places have you explored?"* Call out the most-favored places they'd like to explore, and save these lists for a later activity.

4. Analyze past vs. present day exploration

Explain that it is now important to discuss how explorations have changed over time because exploration has continually shaped our world (e.g., spice routes and connecting cultures). Ask students: *How might reasons for exploration have changed over time? What ways do you think exploration has shaped our world?* (Hint: think about the voyages of past and present-day explorers, how technology has changed, and how commerce has changed). If students need ideas, allow them to do research online about these questions. Ask them to discuss and

write down their ideas in small groups and then share them with the class. Discuss differences and similarities between groups' ideas. Ask students to save their ideas because they will use them later when they are developing their own "micro-expeditions."

5. Discuss the difference between exploration and expeditions.

Explain that so far we have focused on exploration, but let's consider now how exploration might be different from an expedition. Ask: *What's the difference between exploration and an expedition?* (With exploration, the goal is simply to find out more about a place. With an expedition, scientists or explorers have some background knowledge but seek evidence, or data, to help in answering specific questions. Expeditions also require substantial planning to ensure they are able to achieve this purpose.) Have students share their ideas with the class. Write down the ideas on butcher paper and keep them for use in Activity #2—Plan and Prepare for an Expedition—to help students keep the characteristics of an expedition clear in their minds.

6. Analyze the reasons behind present-day expeditions.

Have students analyze a present-day expedition. Explain to students that there is a place far from people, barely explored, and full of danger, that needs to be explored now because the risk is that it will soon be lost. There are places about 60 miles from Florida, on the islands called the Bahamas that fit this description—places called "blue holes." Have students watch the video clip, **Islands of Bahamas Blue Hole**, to look for reasons why scientists wanted to explore the blue holes there. Have students answer these three questions in a paragraph for each:

- *What is the purpose of this blue holes expedition? What do you think the scientists want to accomplish?*
- *Do you think the explorers/scientists on the Blue Holes Expedition would agree with your reasons for exploring from the brainstorming today? Explain. What additional reasons do they have for why they explore?*
- *How is the Blue Hole Expedition different than historical explorations? (Hint: think about available technology and scientific advancements as well as purpose.)*

Conclude the activity by explaining that students will now focus in the next set of activities on the details of conducting an expedition, culminating in implementing their own micro-expeditions. They should keep their ideas from this activity in mind throughout the process to help them develop their plans.

Tip

Students can research citizen science opportunities that align with their exploration interests. Have them explore CitSci.org, iNaturalist.org, National Geographic Education Citizen Science Projects, or look for other opportunities in their local area.

Tip

To gain better insight into exploration and expeditions today, have students read the article "The New Age of Exploration".

Informal Assessment

Have students summarize in writing their ideas for the questions in Step 4. Check for synthesis of ideas about exploration and a comparison of the class' ideas with the approach to exploration in the video.

Extending the Learning

Show the short videos **A Young Explorer** and **Why Water Exploration?** in which Dr. Kenny Broad talks about why he liked to explore as a kid and where his interest in water exploration came from. Ask: *What do you think is his motivation for exploration, past and present?*

Students can research present-day explorers on the National Geographic Explorers website. Students can choose an explorer and determine the purpose of their explorations. Discuss whether the featured explorers changed students' definitions of what it means to explore.

OBJECTIVES

Subjects & Disciplines

- **Earth Science**

- Oceanography

Geography

- Physical Geography

Learning Objectives

Students will:

- list and assess ideas for why people explore, historically and currently
- brainstorm ideas for their own explorations
- analyze the purpose behind a Bahamas expedition

Teaching Approach

- Learning-for-use

Teaching Methods

- Brainstorming
- Discussions
- Multimedia instruction

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- Geographic Skills
  - Asking Geographic Questions
- Science and Engineering Practices

- Planning and carrying out investigations

National Standards, Principles, and Practices

IRA/NCTE STANDARDS FOR THE ENGLISH LANGUAGE ARTS

• **Standard 12:**
Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).
• **Standard 8:**
Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

NATIONAL COUNCIL FOR SOCIAL STUDIES CURRICULUM STANDARDS

• **Theme 3:**
People, Places, and Environments

NATIONAL GEOGRAPHY STANDARDS

• **Standard 4:**
The physical and human characteristics of places

NATIONAL SCIENCE EDUCATION STANDARDS

• **(5-8) Standard G-1:**
Science as a human endeavor
• **(5-8) Standard G-2:**
Nature of science
• **(5-8) Standard G-3:**
History of science
• **(9-12) Standard G-1:**
Science as a human endeavor
• **(9-12) Standard G-2:**
Nature of scientific knowledge
• **(9-12) Standard G-3:**

Preparation

BACKGROUND & VOCABULARY

Background Information

Exploration has a broad definition but can be considered travel over new territory—undiscovered or new to the explorer—for adventure or discovery, or looking at something in a careful way to learn more about it. An expedition is a journey that requires planning and purpose setting, and is usually undertaken by a group of people, for a specific purpose, such as to explore a distant place or to do research.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
expedition	*noun*	journey with a specific purpose, such as exploration.
exploration	*noun*	study and investigation of unknown places, concepts, or issues.

ACTIVITY 2: PLAN AND PREPARE FOR AN EXPEDITION | 1 HR 40 MINS

DIRECTIONS

1. What is an expedition?

Using students' ideas about exploration and expeditions from Activity 1, Why We Explore, engage in a class discussion to review the differences and similarities between the two. Update the ideas on the butcher paper from Step 5 in Activity #1 if needed and keep posted

at the front of the class for students to reference as they begin to develop their "micro-expeditions" later in the activity.

2. Explore the Blue Holes expedition

Now that students have an understanding of what an expedition is, they can take their understanding further to explore what it actually takes to implement one. Have students imagine they are planning an expedition of a site that people know little about: the Bahamas Blue Holes. First, project photos from the **Deep Dark Secrets** photo gallery to give students a glimpse of this unique site. Discuss students' observations about the characteristics of the place. Ask students to form small groups—the same as in the previous activity—and develop a research question from what they've seen.

3. Design a Blue Holes expedition

Next, still in small groups, have students envision the why (i.e., their research question), what, and how of such an expedition using the **Blue Holes Expedition Planning and Preparation** graphic organizer. Explain that for this exercise they are not expected to have the "right" answers, but instead to think through an open-minded analysis of what such an expedition might enable and require. Also, while creativity is important, so is feasibility. Introduce the concept of feasibility and explain its importance in expedition planning as a necessary counterweight to creative problem solving. For example, using robotics to map an underwater cave might seem feasible, but it could be costly while also dangerous to the cave formations. Give groups 10-15 minutes to discuss and complete the left column of the graphic organizer. Students may want to use plain paper first to list ideas before coming to a consensus and putting those ideas on the graphic organizer

4. Compare ideas with real Blue Holes expeditions

Continuing to use the **Blue Holes Expedition Planning and Preparation** graphic organizer, tell students they are going to watch a few video clips and read an article to gather information to fill out the right side of the graphic organizer. Keep the class in their small groups from previous steps and assign each group 2-3 questions from the graphic organizer to answer as they read and watch.

Have students read the article **Bahamas Caves: Deep Dark Secrets**. Also, show students the following brief video clips from the **Diving the Labyrinth** video set: 1) Islands of the Bahamas blue hole, 2) Blue holes time capsules, 3) SawMill Sink, 4) The lost world, and 5) Building the past.

Students will need some additional information to answer the question on their graphic organizer about cultural considerations. Explain to students that the blue holes may be considered sacred sites by some local cultures and the team must be considerate of these cultural beliefs. To prepare, the expedition team enlists experts from the Bahamas National Museum to guide them in following rules and respecting the culture and artifacts of the Bahamas blue holes.

After completing their graphic organizer, have students consider the thinking they did about such an expedition in Step 3 with what Dr. Broad and his team encountered. Have students discuss in their groups the differences between their expedition design and Dr. Broad and his team's actual expedition.

Next, have each group present their ideas from this comparison to the whole class so each group has information about all nine questions. Ask groups to discuss whether they agree or disagree with each other's comparisons.

5. Analyze team building challenges

Have students watch **Expedition Challenges**, a video of Dr. Kenny Broad's thoughts on what it's really like to work with a team on an expedition. Discuss how the challenges Dr. Broad talks about fit with how the expedition is described in the article and videos.

6. Begin the planning for a "micro-expedition."

Explain that students will now have an opportunity to plan their own expedition—a "micro-expedition." Have students refer back to the ideas generated from Activity 1, "Why we Explore", and brainstorm in small groups research questions about a place where they could potentially conduct the micro-expedition nearby. Have them use the **Micro-Expedition Planning and Preparation** graphic organizer to organize their ideas and to consider all the aspects of their micro-expedition.

7. Create an interactive map for their micro-expeditions and discuss.

Once students have determined the site for their micro-expedition, give each group a few minutes at a shared computer to mark the site of their proposed micro-expedition using the **Mapmaker Interactive**. Once the map is complete, have each group present their micro-expedition idea to the class, including showing the location on the projected map and explaining the what, where, and how of their idea. Decide as a class whether students are drawn to a particular group's idea, or whether the groups should take time to further research and refine their proposed micro-expeditions.

Tip

Students can research citizen science opportunities that align with their exploration interests. Have them explore CitSci.org, iNaturalist.org, National Geographic Education Citizen Science Projects, or look for other opportunities in their local area.

Informal Assessment

Evaluate how thoroughly the groups are considering aspects of their proposed micro-expedition. Assess the clarity of their main aim statement and supporting objectives. Does the expedition seem feasible? Give feedback that helps students to further refine their ideas.

Extending the Learning

Inquire at a university or museum about a guest speaker who has been part of a research expedition. Ask him or her to speak with your students in person or via video conference about the realities of conducting fieldwork. Students can also ask for micro-expedition planning and preparation advice.

Have students read Famous Failures, which highlights the difficulties and triumphs of expeditions. Ask students to write down some ideas about how their views of expeditions might have changed after reading this article.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

Earth Science

- Geology
- Oceanography

Geography

- Physical Geography

Learning Objectives

Students will:

- list goals and considerations when planning and preparing for an expedition
- discuss a variety of considerations when planning an expedition
- compare ideas to an actual expedition's characteristics
- apply learning about expedition planning to a micro-expedition

Teaching Approach

- Learning-for-use

Teaching Methods

- Brainstorming
- Discussions
- Information organization
- Multimedia instruction

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Information Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- Geographic Skills
  - Asking Geographic Questions
- Science and Engineering Practices
  - Planning and carrying out investigations

National Standards, Principles, and Practices

IRA/NCTE STANDARDS FOR THE ENGLISH LANGUAGE ARTS

- **Standard 12:**

Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

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NATIONAL COUNCIL FOR SOCIAL STUDIES CURRICULUM STANDARDS

- **Theme 3:**

People, Places, and Environments

NATIONAL GEOGRAPHY STANDARDS

- **Standard 4:**

The physical and human characteristics of places

NATIONAL SCIENCE EDUCATION STANDARDS

- **(5-8) Standard G-1:**

Science as a human endeavor

- **(5-8) Standard G-2:**

Nature of science

- **(5-8) Standard G-3:**

History of science

- **(9-12) Standard G-1:**

Science as a human endeavor

- **(9-12) Standard G-2:**

Nature of scientific knowledge

- **(9-12) Standard G-3:**

Historical perspectives

Preparation

BACKGROUND & VOCABULARY

Background Information

Expeditions, while great examples of human ingenuity and curiosity, are often time-consuming, costly, and full of uncertainty and risk. While not every obstacle can be foreseen, thorough planning is one way to help mitigate expedition risks.

Prior Knowledge

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Recommended Prior Activities

- Why We Explore

Vocabulary

Term	Part of Speech	Definition

Term	Part of Speech	Definition
expedition	*noun*	journey with a specific purpose, such as exploration.

ACTIVITY 3: EXPEDITION ETHICS | 50 MINS

DIRECTIONS

1. Define ethics.

Help students understand the importance of ethics. Put the caver's motto on the board: "Take nothing but pictures. Leave nothing but footprints. Kill nothing but time." Ask: *Why would explorers such as cavers have this motto?* (The motto is a reminder to protect unique and fragile environments such as caves from damage.) Brainstorm as a class about:

1. what could be taken from a cave (examples may include pieces of rock, stalagmites, stalactites, bones, animals, plants),
2. what could be left behind (damaged walls or other formations, garbage, lost equipment), and
3. what could be killed (plants and animals in and around the cave).

Talk about how the caver's motto is an example of environmental ethics, or guidelines for having respect for places and also the people who care about those places. Ask: *What other places need, or benefit from, environmental ethics approaches such as the caver's motto?* (state/national/local parks and forests, beaches, waterways, other public places)

Talk about times when "Take nothing but pictures. Leave nothing but footprints. Kill nothing but time." might be difficult. Students may say that there can be accidental damage in a place, or that doing scientific research in a place may require taking samples of species, bones, rock, water, and more. Even having a campfire can impact the fire site and destroy the firewood. So sometimes there is a "fine line" researchers and others have to walk in making ethical decisions. Where research takes place, scientists have to ask permission to do research and to take samples.

2. Discuss the ethics of Hiram Bingham and Machu Picchu.

Next, discuss how ethics play out in a real life example. Have students read the articles The Accidental Discovery of Hiram Bingham and The Discovery of Machu Picchu about Hiram Bingham's re-discovery of the site in Peru. Ask students to write any ideas or questions about the material while they read. Afterward, ask: *Which ethical issues came up in this expedition? How does this example relate to the caver's motto?*

Discuss their ideas and explain that Hiram Bingham's "discovery" of Machu Picchu was actually something that local people had known about for a while, and instead he brought awareness of Machu Picchu to the rest of the world. This awareness created a lot of interest in staking claims on Machu Picchu and researching its artifacts. And so, while the Peruvian people were the true keepers of Machu Picchu and its artifacts, ownership of the discovery ended up in contention because of the excitement surrounding Bingham's re-discovery. Further, the increased attention to Machu Picchu brought unprecedented levels of tourism to the area, which has had continual impacts on the physical integrity of the Machu Picchu ruins and the trails around them. Ask students how their initial ideas from Step 1 and discussing the caver's motto might have changed after considering this example.

3. Analyze ethical considerations.

Ask students to bring their thinking about ethics to the specifics of the Blue Holes Expedition. Brainstorm as a class or in small groups the concerns that the team members for the Blue Holes Expedition would have needed to think about ahead of time. Ask students to create a list of their ideas.

Examples may include:

- The need to be well trained for safe and low-impact cave diving.
- The need to take samples from the caves
- The need to make sure they could get to the blue holes in different areas—on both private and public property

Have students watch the **Regulations and Ethics** and **Caver's Motto** videos in which Dr. Kenny Broad discusses the regulatory and ethical considerations for the Blue Holes Expedition. Have them add any new ideas to their lists.

4. Discuss ethical considerations for the micro-expedition.

Using the initial conversation about ethics and their list of considerations for the Blue Holes Expedition as their guide, discuss as a whole class what ethical considerations their group micro-expeditions might have. Ask:

- *Will you be taking, leaving, or harming anything as you explore and collect data?*
- *How can you minimize the impacts on the place?*
- *What impacts might there be, on people and on the environment, and how can you address them?*
- *With whom should you discuss the micro-expedition, including getting permission for exploration, before you go?*

Students can contact park rangers, or others responsible for the site they will explore, to discuss ethics and safety needs.

5. Wrap-up

Ask students to use their ideas and ethical considerations to create a written ethics statement for their micro-expedition. This statement should be a 3-4 sentence long summary of how they will address foreseen and unforeseen ethical issues in their micro-expeditions. Have students work in their small groups to accomplish this, using their lists from the Blue Hole Expedition and the class discussion to help them.

Informal Assessment

Ensure that students' planning for their micro-expedition includes consideration of the impact on the natural environment as well as any impacts on people living nearby. Help to facilitate their reaching out to park leadership or others responsible for the place where they will conduct their micro-expedition. Assess their final ethics statements for cohesiveness and consideration of human and non-human factors.

Extending the Learning

Another set of ethics that suggests how people should treat the outdoors is Leave No Trace. Have students work in groups to determine whether these seven guidelines apply to their micro-expedition and how they should prepare to "leave no trace."

OBJECTIVES

Subjects & Disciplines

Biology
Earth Science

Learning Objectives

Students will:

- define ethics as it relates to exploration and research
- determine the ethical considerations when conducting an expedition
- apply their insights about ethical considerations to their own micro-expedition

Teaching Approach

- Learning-for-use

Teaching Methods

- Brainstorming
- Discussions

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Media Literacy

- Learning and Innovation Skills
  - Communication and Collaboration
  - Critical Thinking and Problem Solving
- Science and Engineering Practices
  - Planning and carrying out investigations

National Standards, Principles, and Practices

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NATIONAL COUNCIL FOR SOCIAL STUDIES CURRICULUM STANDARDS

• **Theme 3:**
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NATIONAL GEOGRAPHY STANDARDS

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NATIONAL SCIENCE EDUCATION STANDARDS

• **(5-8) Standard G-1:**
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• **(5-8) Standard G-2:**
Nature of science
• **(5-8) Standard G-3:**
History of science
• **(9-12) Standard G-1:**

Science as a human endeavor

- **(9-12) Standard G-2:**

Nature of scientific knowledge

- **(9-12) Standard G-3:**

Historical perspectives

Preparation

BACKGROUND & VOCABULARY

Background Information

Hiram Bingham and the exploration of Machu Picchu illustrate expedition ethics and what explorers, researchers, and local stakeholders have learned through past experience. In 1911, Bingham, who was an American historian, started an expedition under the auspices of Yale University to explore Peru in search of a fabled lost capital city of the Incas. During the expedition, a local farmer, Melchor Arteaga, led him to Machu Picchu with the help of a Quechua family that was farming near the ruins. Bingham knew it was an important site, particularly because of the well-preserved stonework. So he returned for additional expeditions, supported by both Yale and National Geographic, for the next few years to clear the ruins of foliage and document and map the site. National Geographic featured Machu Picchu in its April 1913 issue, which sparked substantial global interest and subsequent decades of increased scholarship and tourism.

Prior Knowledge

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Recommended Prior Activities

- Plan and Prepare for an Expedition
- Why We Explore

Vocabulary

Term	Part of Speech	Definition
ethics	*plural noun*	beliefs about what is right and wrong.
expedition	*noun*	journey with a specific purpose, such as exploration.

Term	Part of Speech	Definition
exploration	*noun*	study and investigation of unknown places, concepts, or issues.

ACTIVITY 4: MULTIDISCIPLINARY EXPLORATION | 50 MINS

DIRECTIONS

1. What is multidisciplinary work?

Ask students to imagine working in the Blue Holes Expedition team. Ask: *How do you think people with different scientific expertise contributed to the Blue Holes Expedition?* Explain that when people from different fields, or disciplines, work together, they are taking a multidisciplinary approach. For example, in the Blue Holes Expedition, marine biologists, paleontologists, geologists, and others worked together to answer research questions. In this activity, students will explore the interconnection in the team's work. They will use these ideas to help them later on in creating their own multidisciplinary teams for their micro-expeditions.

2. Have students investigate team contributions to an expedition.

Have students use the National Geographic magazine article **"Bahamas Caves: Deep Dark Secrets"** and the **Blue Holes Project** website to examine the multidisciplinary nature of the expedition. Then show students the **Multidisciplinary Team** video.

Have students use the **Blue Holes: The Importance of the Team** graphic organizer for information about the team. In the second column, have them describe each participant's role with the Blue Holes Project. In the third column, have students write ways that the participants worked together, relied on each other, and benefitted from each other's contributions.

3. Discuss the value of exploration teams.

Have a whole class discussion about the benefits of having a team for the Blue Holes Project. Ask: *In what ways did the work of these experts interconnect? How were they dependent on each other to get data and samples? Could any of them have done this work on their own?*

Project the excerpt below from the end of the "Bahamas Caves: Deep Dark Secrets" article. Have students expand on their ideas for the multidisciplinary nature of the work by adding any new ideas to their graphic organizers (particularly the third column) from Step 2:

"One of the rewards of the expedition's multidisciplinary approach is the constant exchange of ideas and enthusiasm among scientists with wholly different backgrounds. Swart's work on speleothems will shed light on ancient climates, which in turn may explain how and when some Bahamian animal species went extinct—Steadman's and Albury's domain. Pateman's work on human remains may reveal as yet unknown connections between Lucayans and animal bones found in blue holes. Without the unique geologic structure of the inland blue holes—deep, dark, sheltered, with little tidal flow—specialized bacteria studied by Macalady would never have gained a foothold. And if the bacteria hadn't created an anoxic environment, many of life's species wouldn't have flourished in the caves and much of the biological evidence would have vanished."

4. Determine and assess multidisciplinary aspects of your micro-expedition.

Have students work together to determine the areas of expertise that they will need for their micro-expedition. Have them use a two-column chart to list each student as team members in the first column and the different roles and areas of expertise they will be responsible for bringing to the team in the second column. Make sure they include roles of photographer and/or videographer in the list of roles. Last, have them write a list of guidelines for how they envision working together to accomplish their micro-expedition goal, making sure to describe both anticipated successes and difficulties. They will use this preliminary analysis to guide them in their micro-expedition implementation and they can refer back to it when they assess how their micro-expeditions went.

Modification

If there are time restrictions, assign one or two researchers to each team. Have students complete the chart and report their findings to the class.

Informal Assessment

Check students' plans and ideas for the feasibility of their micro-expedition and presence of multidisciplinary aspects. Check their guidelines for working together for cohesion and authenticity.

Extending the Learning

This activity includes a long list of scientific fields—most ending in "ology." Have students determine what this root word means and have them make a list of all of the fields or disciplines this expedition includes. Ask: Which ones have you never heard of before?

Have students contact the park or other site where they will conduct their micro-expedition. Have them ask about work that researchers or scientists do at the site. Arrange a video conference with people in the park or the researchers to discuss how they work with teams to accomplish their goals.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

Earth Science

- Geology
- Oceanography

Learning Objectives

Students will:

- analyze the contributions that different team members make to a research project
- determine ways to divide responsibility for different aspects of their micro-expedition

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Multimedia instruction
- Research

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- Geographic Skills
  - Asking Geographic Questions
- Science and Engineering Practices
  - Planning and carrying out investigations

National Standards, Principles, and Practices

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- **(9-12) Standard G-2:**

Nature of scientific knowledge

- **(9-12) Standard G-3:**

Historical perspectives

Preparation

BACKGROUND & VOCABULARY

Background Information

Multidisciplinary works involves a team of people, each with a different skill set and/or area of expertise, that work together, building on each other's strengths, to accomplish a goal. Expedition planning and execution can be complex, so having multiple backgrounds and skillsets involved can contribute to richer findings and deeper understandings.

Prior Knowledge

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Recommended Prior Activities

- Expedition Ethics
- Plan and Prepare for an Expedition
- Why We Explore

Vocabulary

Term	Part of Speech	Definition
anoxic	*adjective*	no oxygen in the environment.
anthropology	*noun*	science of the origin, development, and culture of human beings.
discipline	*noun*	field of study.
ecology	*noun*	branch of biology that studies the relationship between living organisms and their environment.
exploration	*noun*	study and investigation of unknown places, concepts, or issues.
interdisciplinary	*adjective*	having to do with more than one academic subject, or discipline.
multidisciplinary	*adjective*	involving more than one field of knowledge or expertise.
speleothem	*noun*	rock or mineral formations, such as stalactites and stalagmites, created in a cave environment. Also called a cave formation.

ACTIVITY 5: CONDUCT A MICRO-EXPEDITION | 3 HRS 20 MINS

DIRECTIONS

1. Make final preparations for the micro-expeditions.

Have students revisit their expedition planning document, their chart listing team roles and media collection, and the ethics considerations. Have them determine if changes are needed. You can have them create a final checklist of what they need to do. If students are overly ambitious with their goals, remind them that in exploring a place for the first time they should plan to make simple observations, and that this type of exploration takes focus, concentration, and sensory awareness. Have them build into the planning some time for silent

observations during which they describe what they see, hear, and smell. Also explain that a key element of exploration and expeditions is coming away with new questions; it will not be possible to answer all of their questions at once.

2. Plan ahead for communicating their findings.

Have students plan how to share their findings with a larger audience. Ask: *Who will write about different aspects, create the maps, develop the videos, and/or write captions for photos?* Talk about how having these roles in mind during the expedition will help in the communicating afterward. Students might want to use a GPS unit to collect lat/long coordinates for where they collect certain information or data, or use a camera that automatically geo-references images, so that they can plot this on a map, such as MapMaker Interactive, afterward.

3. Conduct the micro-expedition.

Have students conduct their field-based "micro-expedition" as planned, using skills of observation, recording notes, sketching, and use of cameras for both images and video.

4. Reflect and evaluate.

As soon as possible after the expedition, give students time to free-write about their reflections on the micro-expedition. Ask:

- *What are the key findings?*
- *What observations were made?*
- *What did you observe that you expected to see?*
- *What did you not expect to see?*
- *What new questions do you have about this place?*

Next have students reflect on their expedition in small groups, using the materials they developed in the planning stage (i.e., planning sheet, ethics statement, multidisciplinary work statement) to evaluate how well they think the micro-expedition was carried out. Ask: *Did we adhere to our plan? Why or why not? What obstacles came up? How did your group work together?* Have a whole group discussion of the outcomes of their expedition.

5. Create a product to communicate findings to a new audience.

Have students use their notes, reflections, sketches, images, and video to create a presentation, blog post, slideshow, bulletin board, GeoTour (using the MapMaker Interactive), or other display to educate new audiences about their findings. Consider having students present to park rangers, community leaders, or other stakeholders about their expedition process and their observations.

Modification

Another option is to have students work in small groups to plan and conduct micro-expeditions on school grounds.

Tip

Make sure each student has a small field notebook and pen or pencil for writing notes and making sketches.

Modification

Modify this activity based on available class time. You can have students conduct their expeditions in small groups outside of school with parent help, or do it as a class as part of a field trip.

Tip

Request maps of the micro-expedition ahead of time for students to use in their preparation, or have students make their own maps using MapMaker Interactive.

Informal Assessment

Evaluate students' reflections and their final product communicating their micro-expedition process and findings. Consider having students develop a list of micro-expedition planning tips for the next class undertaking a similar project.

Extending the Learning

Have students take their new questions and choose one to further explore. What scientific disciplines or fields would an expedition to address this question involve? Have students do further research on the question to find out current knowledge about this topic.

OBJECTIVES

Subjects & Disciplines

Biology

- Ecology

Earth Science

- English Language Arts

Learning Objectives

Students will:

- evaluate plan for a micro-expedition and determine changes needed
- execute their plan while making observations and collecting data and media
- evaluate implementation of micro-expedition
- create a presentation or other display to share with new audiences

Teaching Approach

- Learning-for-use

Teaching Methods

- Discussions
- Experiential learning
- Reflection

- Writing

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
  - Information, Media, and Technology Skills
    - Media Literacy
  - Learning and Innovation Skills
    - Communication and Collaboration
    - Critical Thinking and Problem Solving
- Geographic Skills
  - Acquiring Geographic Information
  - Asking Geographic Questions
  - Organizing Geographic Information
- Science and Engineering Practices
  - Planning and carrying out investigations

National Standards, Principles, and Practices

IRA/NCTE STANDARDS FOR THE ENGLISH LANGUAGE ARTS

- **Standard 12:**

Students use spoken, written, and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

- **Standard 8:**

Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

NATIONAL COUNCIL FOR SOCIAL STUDIES CURRICULUM STANDARDS

- **Theme 3:**

People, Places, and Environments

NATIONAL GEOGRAPHY STANDARDS

- **Standard 4:**

The physical and human characteristics of places

NATIONAL SCIENCE EDUCATION STANDARDS

- **(5-8) Standard G-1:**

Science as a human endeavor

- **(5-8) Standard G-2:**

Nature of science

- **(5-8) Standard G-3:**

History of science

- **(9-12) Standard G-1:**

Science as a human endeavor

- **(9-12) Standard G-2:**

Nature of scientific knowledge

- **(9-12) Standard G-3:**

Historical perspectives

Preparation

BACKGROUND & VOCABULARY

Background Information

For this final activity, it is important to encourage students in their exploration and explain that things may not go completely according to plan and they won't be able to answer everything they want to, but that is part of the discovery process. Encourage students to use this as a learning opportunity to understand more about what it takes to engage in expeditions and about their own abilities to work as part of a team and think like an explorer.

Prior Knowledge

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Recommended Prior Activities

- Expedition Ethics
- Multidisciplinary Exploration
- Plan and Prepare for an Expedition
- Why We Explore

Vocabulary

Term	Part of Speech	Definition
expedition	*noun*	journey with a specific purpose, such as exploration.
exploration	*noun*	study and investigation of unknown places, concepts, or issues.