STEM NOVA Supplemental Guide to Completing the NOVAs Started in the Summer Camping Kit

Bolded items were already completed in your Summer Camping Kit.

Uncovering the Past

1. Read or watch anything related to archaeology (about an hour total); write and discuss 2 questions from what you read or watched with your counselor.
   Recommended Video:
   Archeology - exploring the past with modern technology | DW History Documentary
   https://youtu.be/VpK8fpqPJT0
   Discuss the video after watching it with your parent or counselor.

2. **Complete 1 Adventure from the list (separated by rank) OR complete Option A or B (all together)**
   Option A: Preserve a hot dog with baking soda for 14 days, measuring dimensions and tracking changes.
   DO NOT EAT THE HOT DOG
   Options B: Make a plaster of paris rock mold, and carve petroglyphs on it.

3. Explore: learn about what archaeology and archaeologists; discover the differences between physical remains, artifacts, and ecofacts; list 10 artifacts from your home.
   Read "Archeology 101" with a parent or counselor.
   Use the glossary from https://www.archaeological.org/programs/educators/introduction-to-archaeology/glossary/ to help you define the words listed in #3.
   List 10 Artifacts from your home.

   1._____

   2. _____

   3. _____

   4. _____

   5. _____

   6. _____

   7. _____

   8. _____

   9. _____

   10. _____

4. **Look through items in a trash can to learn about the people using it OR collect your own artifacts and place them in layers to show how you live.**

5. Visit a place that has excavated items and talk to someone who works there about the displays. *Can be a virtual tour.

   Visit https://vft.asu.edu/ and choose ONE of the virtual field trips to take. Use the interactive controls to explore your surroundings with your parent or counselor. Be sure to watch the videos that are included.

6. Discuss with your counselor what you have learned about archaeology.

Bolded items were already completed in your Summer Camping Kit.

Down & Dirty

1. Read or watch anything related to Earth, weather, geology, volcanoes, or oceanography (about an hour total); write and discuss 2 questions from what you read or watched with your counselor.

Recommended video:
Weather`s Devastating Forces[Nature Documentary]HD
https://www.youtube.com/watch?v=_puHRrN1fRI
Discuss the video after watching it with your parent or counselor.

2. **Complete 1 Adventure from the list (separated by rank) OR complete Option A or B (all together)**

Option A: Collect mineral samples and discuss geology (similar to Webelos Earth Rocks).
Option B: Make a fossil cast and do a dinosaur dig.

3. **Investigate Earth science: choose from building a volcano, collecting minerals in your state, making weather instrument & weather journaling, or visiting/learning about animal habitats.**

4. Visit a place where Earth science is being done OR explore a career associated with Earth science.

Recommended video:
The Weather Channel: Connect with Weather
https://vimeo.com/101526273
Discuss the video after watching it with your parent or counselor.

Bolded items were already completed in your Summer Camping Kit.

Nova Wild!

1. Read or watch anything related to wildlife, ecosystems, etc. (about an hour total); write and discuss 2 questions from what you read or watched with your counselor.
   Recommended video:
   Wildlife Warriors - The tough fight against the extinction of endangered species
   https://youtu.be/Ii1ExRr4abA
   Discuss the video after watching it with your parent or counselor.

2. Complete 1 Adventure from the list (separated by rank) OR complete Option A or B (all together)

Option A: Make a water cycle poster and record weather.
Option B: Make a food chain poster and learn about endangered species and natural resources.

   Complete the included packet entitled "My Water Cycle Packet"
   Complete the included packet entitled "Weather Log" by looking up and recording the weather each day for a week.

3. **Explore wildlife: discuss wildlife & food chains, draw native plants or animals, discuss with your counselor.**

4. **Act like a naturalist: choose 2 from investigating endangered species, investigating invasive species, visiting an ecosystem near you, investigating one wild animal near you, investigating wild neighbors, or earning the Cub Scout World Conservation Award (each option includes a hands-on activity).**

5. Visit a place to observe wildlife and talk to someone about ecosystems and the person's career path related to wildlife.
   Recommended video:
   The Secret Life of Corals: A Dominican Republic Adventure
   https://youtu.be/VgCpKGb9Als
   Have you parent or counselor use the questions provided in the "The Secret Life of Coral Reefs: A Dominican Republic Adventure TEACHER'S GUIDE" to discuss ecosystems in coral reefs after the video. It also includes additional resources that can be explored if your scout is interested.

6. Discuss why wildlife and biodiversity are important and the problems with invasive species and habitat destruction.
   Recommended video:
   What is biodiversity and why is it important?
   https://youtu.be/7tgNamjTRkk
   After watching the video, discuss with your parent or counselor way that humans have interacted with wildlife and how that has affected biodiversity and the availability of habitats.

Bolded items were already completed in your Summer Camping Kit.

If you have questions or need help completing one of these requirements, please reach out to your unit STEM coordinator or district STEM coordinator. Please also feel free to contact Dr. Kevin Tucker at kevtuck@siue.

ARCHAEOLOGY 101

INTRODUCTION

Archaeology is the study of past cultures through the material (physical) remains that people left behind. These can range from small artifacts, such as arrowheads, to large buildings, such as pyramids or temple complexes. Anything that people created, used, or modified, and the places where they did so, is part of the archaeological record.

Archaeologists use these remains to understand and recreate all aspects of past culture, from the daily lives of ordinary people to the grand conquests of emperors. Often, these objects are buried and have to be carefully uncovered or excavated before they can be studied. In many cases, they are the only clues archaeologists have to help them reconstruct the lives of ancient people. These objects are like pieces of a giant jigsaw puzzle that the archaeologist must solve.

Careful excavation of Iron Age pots at Tongobriga, Portugal (photo courtesy of Jason Urbanus).

Archaeology helps us to appreciate and preserve our shared human heritage. It informs us about the past, helps us understand where we came from, and shows us how people lived, overcame challenges, and developed the societies we have today. The focus of archaeology has changed over the years. Today, archaeologists study everything from ancient pots to DNA to 3-dimensional reconstructions of ancient sites. This expanded scope of archaeology has necessitated the creation of many new interpretive approaches and recovery techniques. While the trowel continues to be a primary tool, archaeologists have also added satellite imagery, computers, and robotics to their arsenal. Excavations now often include dozens of experts from varied disciplines, including ceramics, osteology, geology, and botany, as well as research technicians with highly specialized talents.

MATERIAL CULTURE

When we talk about culture, we mean the behavior and beliefs of groups of people. These cannot be excavated directly, although they can be seen to influence the physical remains, material culture, that archaeologists find. These remains range from stone tools to buildings to written records. Features are remains that can-not be moved (large buildings, post holes), while artifacts are smaller, portable objects.

The preservation of material culture depends on the type of materials (organic, which usually decay more quickly, or inorganic) and the environmental conditions to which they have been exposed. Materials deposited in the open are affected by factors such as rain, sun, snow, wind, and other natural phenomena. Buried materials are usually better preserved than those exposed to the elements. Dry conditions generally preserve remains better than wet, although the airlessness of bogs and other underwater conditions can also preserve many objects. In rare circumstances freezing conditions in mountaintop or tundra environments, can likewise preserve sites, artifacts, and even human remains.

An excavator brushes sand away from an elephant bone at Hierakonpolis, Egypt (photo courtesy of Hierakonpolis Expedition).

TYPES OF ARCHAEOLOGY

There are many branches of archaeology, a number of which overlap. Prehistoric archaeologists deal with time periods before the invention of writing. Historical archaeologists have the luxury of examining both physical remains and texts (when they survive). Industrial archaeologists study buildings and remains that date to the period after the Industrial Revolution. Archaeologists generally choose to focus on a particular culture that is often associated with a chronological period: classical archaeology covers the civilizations affected by the Greeks and Romans; Egyptian archaeology deals with Egypt; Mesoamerican archaeology focuses on cultures in Central America and Mexico, and so on.

A fragmentary amphora or storage jar recovered from a thirteenth-century shipwreck (photo courtesy of Black Sea Shipwreck Research Project)

Archaeologists help reconstruct the past in other ways besides excavating sites belonging to a particular culture. Ethnoarchaeologists study people living today and record how they organize and use objects. The study of modern behavior can help reveal how and why people in the past left behind certain types of remains in certain patterns. Environmental archaeologists help us understand the past environmental conditions as well as human activities like ancient agriculture. Experimental archaeologists reconstruct techniques and processes used in the past to create artifacts, art, and architecture. Underwater archaeologists study material remains that survive underwater, including shipwrecks and sites inundated by a rise in sea level. Others, working in the field of cultural resource management, assess archaeological remains at construction sites in order to record critical information and preserve as much as possible before the site is destroyed or covered over.

THE PROCESS OF ARCHAEOLOGY

Archaeology uses scientific principles to guide its practices. Before beginning to excavate, an archaeologist needs a reason to dig, an excavation plan, and permission from the government of the place being excavated.

Although archaeology is usually associated with digging, sometimes the goal is not to excavate, but rather to identify and plot sites across a landscape or region to see the big picture of habitation or activity in an area. These are some of the steps an archaeologist might follow:

Hypothesis Creation

Archaeologists do not dig randomly in search of artifacts. When they do find artifacts, they are much more interested in the information these can provide, rather than if they are visually pleasing. Excavations are conducted to answer specific questions or resolve particular issues. The only exception is in cultural resource management, undertaken when sites are in danger of being destroyed.

Survey and Site Location

Once archaeologists have a reason to dig, they must identify where to dig. Sometimes, unexpectedly discovering evidence that a site existed in an area is the impetus to dig—but even then the goal is not just to dig the site, but to answer questions about the ancient people, their culture, and their environment. Evidence for sites can take many forms, including information provided in myths and stories, historical references, old maps, farmers' reports of finds in their fields, satellite photographs, and the results of subsurface detection methods such as ground-penetrating radar. Traditional surface survey often involves hours of walking over miles of terrain to find sites. Sites identified during survey (usually by density patterns of small artifacts, such as broken pieces of pottery) are plotted on a map. If a team decides to excavate a site they have identified by survey, a detailed map is also made before digging begins. The map is the first of a series of records made during an archaeological investigation.

Excavation
This is the best known aspect of archaeology. Archaeologists excavate remains buried under the earth. Soil and other deposits build up naturally above sites over time through slow accumulation and more dramatic climatic events such as flooding or volcanic eruptions. As sites grow, change, are destroyed, and rise again over time, successive layers of soils surround artifacts and features. These layers are called strata, and the recording and analysis of the layers is called stratigraphy (to write or record strata). Archaeology and the earth sciences share the goal of examining the changing layers of the earth, although an archaeologist focuses on human time and human agency.

Trench wall showing various strata at Welqamex, a Native American site in southern British Columbia (photo courtesy of Anthony P. Graesch)

Unlike the image in cartoons and movies of archaeologists as treasure hunters, excavation requires extremely careful work. Like detectives at a crime scene, archaeologists evaluate and record an archaeological site with great precision in order to preserve the context of artifacts and features, and they work in teams with many other specialists. A site is divided into sections to help keep track of the location of each find, and a site plan (a map) is created to keep track of all the features and artifacts.

Since they will continue to develop better techniques and tools for recovering the past, archaeologists usually leave areas unexcavated so that others can examine the site again in the future. The site architect establishes a datum point, an easily identifiable, fixed spot at a known elevation above sea level. Excavators record the vertical as well as horizontal relationships of every object. Within each "square," every artifact is located vertically in relationship to the datum point and horizontally in relationship to the sides of the square and to structures.

Data Collection and Recording
Artifacts must be carefully removed for further analysis and study. However, before they are moved records— including photographs, drawings, and detailed notes— are made of all artifacts and features and their surroundings. Archaeologists are trained to notice changes in soil texture, color, density, and even smell, and to draw and record on a top plan any changes they notice in the soil as they excavate. A photographer photographs every find as it starts to emerge from the ground, again after it has been uncovered, but before it is removed from the square, and then again after it has been removed, cleaned, and recorded. The dirt removed from the square is sieved if it seems likely that small finds, perhaps seeds, small bones, or other evidence, may have been missed. Any sieved finds are recorded as coming from the square or a particular deposit within it.

Students measure the depth of an excavated surface in a 1 by 1 meter trench at Welqamex, British Columbia (photo courtesy of Anthony P. Graesch)

As at a crime scene, if information is missed or lost while excavating because of careless procedures, it may be lost forever. It is very important to excavate properly and record everything (even the unexciting finds and the things that no one was looking for), and then to publish thoroughly, so others can perhaps interpret finds the current excavators do not

yet understand. Archaeological con-text is the association of artifacts and features found within an area or layer, and the relationship of this area or layer to what lies above and below it. The context of archaeological finds is what allows us to interpret them and understand their meaning in ancient peoples' lives.

Laboratory and Conservation
Ancient objects that have been preserved underground or underwater for years have to be cared for appropriately once they are exposed to the air. Conservators are specialists trained to preserve and restore delicate or damaged objects. Conservation is usually done in a lab, but sometimes objects are so fragile that some work to save or stabilize them must be attempted in the field. In the lab, objects are further cleaned, stabilized, and conserved, and thorough records are created for each object: its material, its dimensions, color, function, and more.

Interpretation
Once excavation is completed and the features and objects have been conserved and analyzed, the team is responsible for interpreting the findings and explaining the story of the site and the significance of the finds to the people of the past. The story is one possible version of the site's history.

The evidence archaeologists interpret is incomplete, since many remains have been destroyed and many will never be found. Even when written records survive, they generally provide only a partial account of what really happened. Together the specialists evaluate what survives, consider what seems to be missing, and develop a theory about what may have happened.

Publication
The end result of excavation is the publication of all the finds, plans, and photographs along with an interpretation of the site. Ideally, the publication will be thorough enough that other archaeologists and historians can look at the data for themselves and agree, disagree, or take the interpretation further—or in a different direction.

TECHNIQUES AND TOOLS

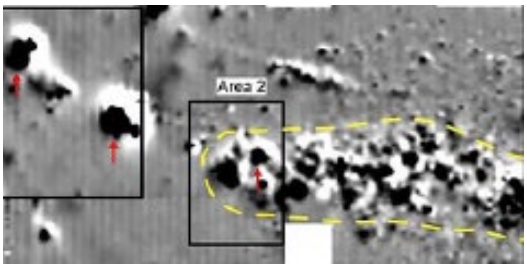
Archaeologists use many tools, some created for them, and others borrowed from other fields.

Excavation
Common archaeological tools include shovels and trowels to loosen dirt, brooms and brushes to sweep the loose dirt, buckets to carry the dirt, and sieves to screen it.

In addition to these usual tools, archaeologists use a variety of objects to carefully move soil and uncover objects. For very fine and delicate excavations, archaeologists use dental picks, brushes, spoons, and very fine blades. For larger scale operations, archaeologists may use large earth-movers, such as bulldozers and backhoes, but only to remove topsoil and overgrowth.

The primary tool used by most archaeologists is the mason's pointing trowel with which they slowly scrape away the soil in horizontal motions. Scooped gardening trowels have a tendency to dig holes, which the archaeologist does not want to do. The goal is to work horizontally until all the finds in an area have been exposed and their relationships noted.

Survey and Mapping
Imagery from satellites (photographic, infra-red, and radar), airplanes, kites and drones helps archaeologists identify surface features, while geophysical prospecting tools, such as magnetometers, conductivity meters, and ground-penetrating radar, aid in locating subsurface features.



Magnetometer survey results from Sagalassos, Turkey, show subsurface features including iron kilns (indicated by red arrows) and slag heaps (indicated with yellow), photo courtesy of Sagalassos Archaeological Research Project.

Traditional survey tools used in finding and recording sites are taken from land survey. Archaeological surveyors use compasses, tape measures, stadia, and various other survey tools. Today, most archaeologists also employ electronic devices, such as Total Stations and Global Positioning System (GPS) units, to help them map an area or site. A Total Station is an instrument set on a tripod that shoots a signal at a target (or prism) placed on the feature to be mapped. The signal bounces off the target and returns to the Total Station, which calculates the distance and angle of the object. This information is stored in the instrument's memory and can be downloaded to a computer with software that generates a map. GPS technology uses satellite signals to record a feature or site's location. It is especially useful in survey, as these units are portable and can be accurate to within a few centimeters. This information can also be downloaded and used to create a map.

DESTRUCTION OF CULTURAL HERITAGE

Unfortunately, fascination with the past does not always translate to careful scientific study. Often sites are destroyed by people interested solely in finding objects to collect or sell for profit, with no regard for legal concerns or the loss of knowledge caused by such activity. Sites are also destroyed by development when attention is not paid to what lies beneath the soil. In many cases, cultural heritage is destroyed and information is lost during construction and acts of war and terrorism. Unfortunately, sites can also be badly damaged even by well-meaning tourists who touch or take pieces of objects, art, or architecture. Over time, our very interest in the past can be detrimental to a site when many people visit, breathe on, touch, or take away remains.

Most archaeologists are actively involved in the conservation and preservation of cultural heritage. They try to ensure that there are adequate laws to protect and preserve archaeological remains and devise plans to save sites that are being destroyed. The Archaeological Institute of America, for example, has a Conservation and Site Preservation Program that provides grants to projects that are interested in preserving and protecting sites.

ADDITIONAL RESOURCES

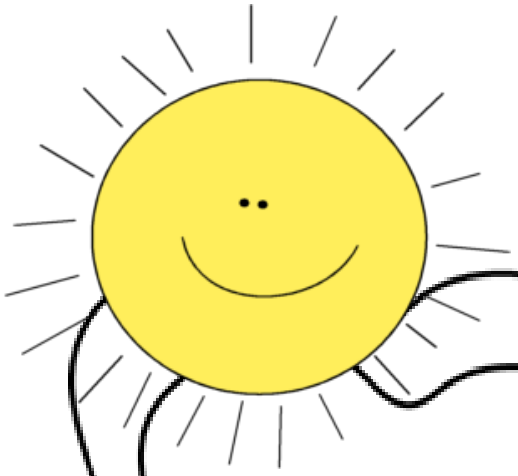
Darvill, Timothy, 2002, *The Concise Oxford Dictionary of Archaeology*. Oxford: Oxford University Press.

Gamble, Clive, 2004, *Archaeology: The Basics*. London: Rutledge.

Loubser, Johannes H., 2003, *Archaeology: The Comic*. New York: Altamira Press.

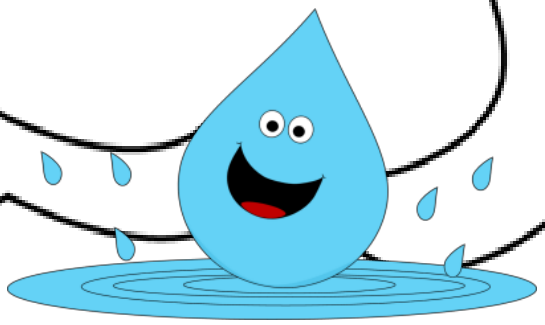
McIntosh, Jane, 2000, *Archaeology*. New York: Dorling Kindersley (Eyewitness Books).

Moloney, Norah, 1995, *The Young Oxford Book of Archaeology*. Oxford: Oxford University Press.



My Water Cycle Packet

By _____



Water Cycle Poster Project

You have been learning about the water cycle. The water cycle is continually changing from liquid water to water vapor to ice. One way to think about the water cycle is to follow a drop of water around as it moves on its way through the cycle. You will be creating a poster that shows the water cycle through the eyes of a water molecule. Below is the information that we have learned so far. Use the check off list to help you create your poster.

Water can be stored in different ways. We learned that water can be stored in:
Surface water (lakes, rivers, streams…) - 97% is stored in oceans.
Atmosphere (clouds, fog, humidity, etc.)
Precipitation (rain, snow, sleet, hail, and ice
Glaciers – These giant, slowly moving ice sheets form from snow that compacts
About 75% of the Earth's fresh water is stored as glaciers (most in the north and south poles)
Groundwater
Living organisms – Our body is made up of around 70% water

Water can travel in many different ways. It can:
Evaporate –from surface water into the atmosphere
Condense – from the atmosphere into precipitation
Melt – from precipitation as snow to surface water or from glaciers to surface water
Freeze – from precipitation as snow or sleet
Percolate – from surface water to groundwater cycled over again
Transpire – from living organisms such as plants into the atmosphere
Drink – from surface water or groundwater to living organisms
Excrete – from living organisms to surface or groundwater

What you will need to show on your poster:

- ❑ accumulation
- ❑ Evaporation
- ❑ Condensation
- ❑ Precipitation
- ❑ Run off
- ❑ Ground water
- ❑ Transpiration
- ❑ Illustrations of each vocabulary word
- ❑ Definition/explanation of each word
- ❑ Color. Labels. arrows to show cycle directions. symbols/pictures
- ❑ Title and your name

Science Notebook Vocabulary Sheet: Cut on dotted lines, fold over, add definition and picture

	Accumulation
	Evaporation
	Condensation
	Precipitation
	Run Off
	Ground Water
	Transpiration

Ground Water

Accumulation

Condensation

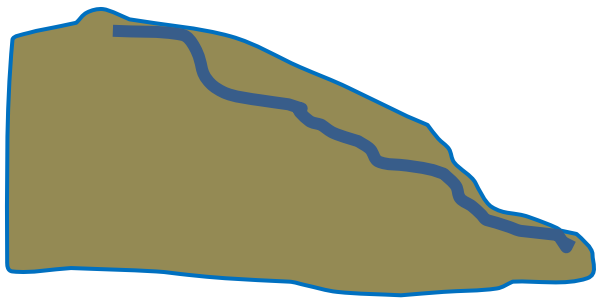
Run Off

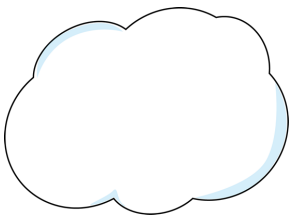
Evaporation

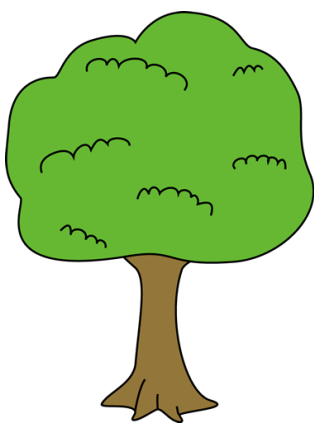
Precipitation

Transpiration

The Water Cycle

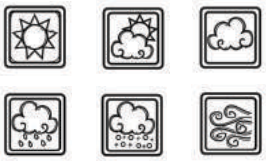
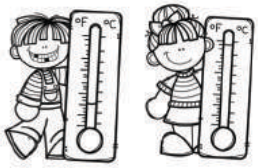




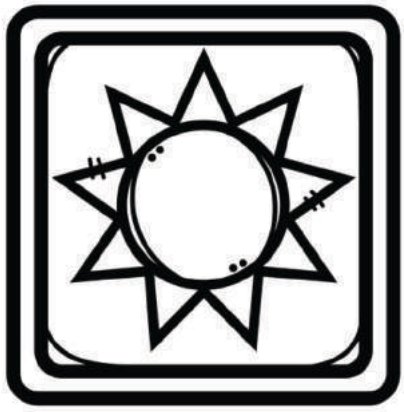


_____'s Weather Log

Weather Log

	Monday ___/___/___	Tuesday ___/___/___	Wednesday ___/___/___	Thursday ___/___/___	Friday ___/___/___
Type of Weather? 					
Temperature? 					
Type of Precipitation? 					
Amount of Precipitation? 					
Windy Conditions? 					
Wind Direction? 					

Weather Symbols



Sunny

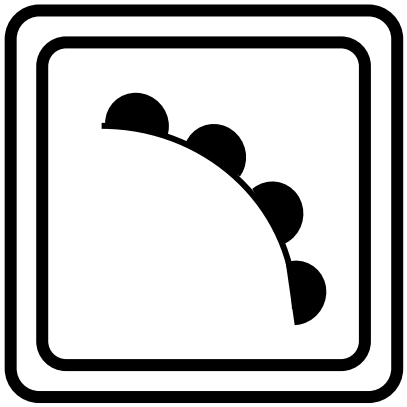
Partly Cloudy

Cloudy

Windy

Rainy

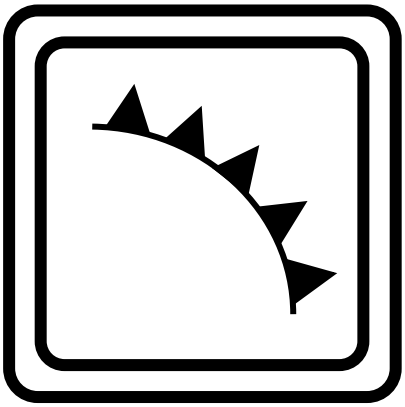
Snowy



Warm Front

High Pressure

Low Pressure



Cold Front

NATURE LAB Educator Resources

The Secret Life of Coral Reefs: A Dominican Republic Adventure

TEACHER'S GUIDE

Grades: All **Subjects**: Science and Geography

Live event date: May 10th, 2019 at 1:00 PM ET

Purpose: This guide contains a set of discussion questions and answers for any grade level, which can be used after the virtual field trip. It also contains links to additional resources and other resources ranging from lessons, activities, videos, demonstrations, experiments, real-time data, and multimedia presentations.

Dr. Joseph Pollock
Coral Strategy Director
Caribbean Division
The Nature Conservancy

Event Description:
Is it a rock? Is it a plant? Or is it something else entirely?

Discover the amazing world of coral reefs with coral scientist Joe Pollock, as he takes us on a virtual field trip to the beautiful coastline of the Dominican Republic. We'll dive into the waters of the Caribbean to see how corals form, the way they grow into reefs, and how they support an incredible array of plants and animals.

Covering less than 1% of the ocean floor, coral reefs are home to an estimated 25% of all marine species. That's why they're often called the rainforests of the sea! Explore this amazing ecosystem and learn how the reefs are more than just a pretty place—they provide habitat for the fish we eat, compounds for the medicines we take, and even coastal protection during severe weather.

Learn how these fragile reefs are being damaged by human activity and climate change, and how scientists from The Nature Conservancy and local organizations are developing ways to restore corals in the areas where they need the most help.

So, come aboard the boat with Joe and our team of experts as we explore one of the most breathtaking, and important, places in the ocean, and learn about the science that's helping bring nature back to life, and how you can help!

Standards:

Next Generation Science Standards Disciplinary Core Ideas

- ESS2.A Earth Materials and Systems
- ESS2.E Biogeology
- ESS3.A Natural Resources
- ESS3.B Natural Hazards
- ESS3.C Human Impacts on Earth Systems
- LS1.C Organization for Matter and Energy Flow in Organisms
- LS2.A Interdependent Relationships in Ecosystems
- LS2.B Cycle of Matter and Energy Transfer in Ecosystems
- LS2.C Ecosystem Dynamics, Functioning, and Resilience
- LS4.C Adaptation
- LS4.D Biodiversity and Humans

National Geography Standards

- 4 - The physical and human characteristics of places
- 8 - The characteristics and spatial distribution of ecosystems and biomes on Earth's surface
- 11 - The patterns and networks of economic interdependence on Earth's surface
- 14 - How human actions modify the physical environment
- 15 - How physical systems affect human systems

Discussion Questions: You can use or adapt these questions for a follow-up discussion with your students after viewing the virtual field trip.

1. Where can you find coral reefs around the world?
   Answer: Coral reefs form in warmer waters near the equator and between the Tropic of Cancer and the Tropic of Capricorn.

2. What is coral?
   Answer: Coral is an animal that has a hard skeleton filled with soft, fleshy parts called polyps. The polyps are like mini jellyfish that live together in a colony.

3. What does symbiosis mean?
   Answer: Symbiosis is when two different organisms live close together and interact in some way. This interaction can be positive or negative. A positive interaction is called "mutualism" because both organisms benefit.

4. Give an example of mutualism in a coral ecosystem and explain how the symbiotic relationship works.
   Answer:
   a. *Zooxanthellae (microalgae) and Corals: Zooxanthellae help corals by providing food for the corals and corals help zooxanthellae by giving them a place to live. Corals also provide zooxanthellae with carbon dioxide that they can use during photosynthesis.*
   b. *Herbivores and Corals: Some fish that are herbivores eat macroalgae that is growing in competition with the coral. Parrot fish are a great example of a fish that helps corals in this way.*

5. List and describe some of the things that coral reefs do for people.
   Answer:
   a. *Coastal Protection: Reefs act as a barrier and help to calm or buffer waves that could be destructive to property on the coasts. They help prevent the coastline from eroding and keep waves from surging onto land and flooding property.*
   b. *Habitat for Fish: Reefs provide a home for a wide variety of organisms, including fish that people eat and sell to make a living.*
   c. *Tourism: Reefs provide natural beauty to support a tourist-based economy that benefits when people come to dive and snorkel.*

6. In what ways are coral reefs sensitive?
   Answer: Coral reefs are sensitive to temperature change. Reef-forming corals live in waters that are not too hot and not too cold. Slight increases in temperature can cause the corals to expel their zooxanthellae. This is called coral bleaching because the zooxanthellae give corals their color. When the zooxanthellae leave, the corals appear white or bleached. If the water temperature cools, the zooxanthellae will come back, however, if the zooxanthellae leave for too long, the corals can die. Corals are also sensitive to pollution and overfishing. Lastly, ocean acidification, caused by the increased uptake of carbon dioxide in the ocean, can greatly diminish the ability of corals to build new structures and can even cause coral skeletons to weaken or dissolve.

7. What are some ways that people in the Dominican Republic have worked to save their reefs and protect ocean habitats?
   Answer: Fishing for Parrot Fish has been banned so that these fish can continue helping coral by eating the macroalgae that competes with the corals. Fragmentation and microfragmentation techniques are helping to increase and strengthen coral populations in vulnerable or degraded areas.

8. What are some things that you can do to help coral reefs stay healthy and strong?
   Answer: You can be mindful of the fish that you eat and make sure to eat fish that are sustainably harvested by using websites like NOAA's Fishwatch (www.fishwatch.gov) to learn which species are okay to eat. Don't purchase jewelry made with coral pieces. If you go snorkeling or diving near reefs, don't touch the corals and be careful not to step on them or hit them with your feet. Don't litter – it might eventually end up in our oceans. Conserve water – the less wastewater you generate, the less likely that wastewater will end up in the ocean. Teach other people what you have learned about corals.

Related Resources: The following lesson plans and videos can be used to supplement the virtual field trip.

The Need is Mutual: The Importance of Biological Interactions
Grade Levels: 6-8

Organisms have a variety of relationships. In this lesson, students learn to categorize relationships, like symbiosis, between organisms. To reinforce the lesson, examples from coral reefs are presented. There are several extensions for this lesson plan.

The Coral Reefs of Palau: Nature's Amazing Underwater Cities
Grade Levels: 3-8

Join scientist Stephanie Wear on a virtual field trip to the coral reefs of Palau where you'll explore amazing underwater cities found near a remote network of islands in the Pacific Ocean. Our journey to the coral reefs will open your eyes to an amazing, interconnected ecosystem built on symbiosis, where diverse organisms are designed to protect, clean, nourish, and even camouflage one another. In this natural factory, the coral supports its many "workers" and they, in turn, keep the coral healthy.

Other Related Resources

Classroom Resources (All Grades)

- Students Rebuild Ocean Challenge – Create ocean-related artwork and support ocean conservation and coral restoration
  https://www.studentsrebuild.org/challenges/ocean
- NOAA Education Coral Ecosystems Collection – Background information, lessons and activities, multimedia
  https://www.noaa.gov/education/resource-collections/marine-life-education-resources/coral-reef-ecosystems
- NOAA Education Ocean Acidification Collection – Background information, lessons and activities, multimedia
  https://www.noaa.gov/education/resource-collections/ocean-coasts-education-resources/ocean-acidification
- NOAA Coral Reef – 3D Printed Coral Polyp Model
  https://coralreef.noaa.gov/education/polypmodel.html
- Google Earth Great Barrier Reef Street View – Explore coral reefs using Google
  https://www.google.com/maps/about/behind-the-scenes/streetview/treks/oceans/
- Google Earth Underwater Street View for World Oceans Day 2015
  http://google-latlong.blogspot.com/2015/06/explore-life-beneath-waves-in-honor-of.html

Videos (Middle School to High School Level)

- Science Bulletins – Coral Reefs in Hot Water
  https://www.youtube.com/watch?v=RTcBFME4_bU&list=PL03468DEB0456E448&index=21
- NOAA's Ocean Today Every Full Moon Coral Under Threat Video Series
  https://oceantoday.noaa.gov/fullmoon-coralsunderthreat/

Real-time Data (Middle School to High School Level)

- Data in the Classroom – Ocean Acidification and Coral Bleaching Modules
  http://dataintheclassroom.noaa.gov/
- NOAA View Data Exploration Tool – Find data sets on ocean temperature, coral locations, coral bleaching
  https://www.nnvl.noaa.gov/view/globaldata.html

Ocean Acidification Activities and Experiments

Below is a summary of a few demonstrations or simple experiments you can do with students. The URLs provided come from lesson plans with more detailed information.

- Use beakers with differing concentrations of acid (in this case – vinegar). Put calcium tablets, old-style chalk, egg shells, etc. in the beakers and watch the change over time. The pH of the solution can be measured, and the items can be weighed as time passes. This demonstrates how organisms with calcium carbonate shells can dissolve in the presence of increased acidity.
  - http://www.cisanctuary.org/ocean-acidification/PDFs-WorkshopPage/Hands_on_acivities/Marine_Osteoporosis/marineos.pdf
  - http://www.cisanctuary.org/ocean-acidification/PDFs-WorkshopPage/Hands_on_acivities/OA_Shells.pdf

- Put red cabbage juice or bromothymol blue indicators in a beaker and blow into them with straw (adding CO_2). The indicator will change color as CO_2 increases. This demonstrates how the ocean takes up carbon dioxide.
  - http://monitor.noaa.gov/education/pdfs/rov_ocean_acidification.pdf

- Put dry ice in a beaker with bromothymol blue. As the dry ice sublimates, the carbon dioxide gas will change the color of the indicator from blue to green to yellow. This illustrates how carbon dioxide can be taken up by seawater.

NATURE SPY
ESPÍA DE LA NATURALEZA

YOU'RE INVITED TO PLAY NATURE SPY!

The goal is simple—spot as many animals and plants from the list below during the virtual field trip and check the boxes as you see them. Be sure to watch closely as some could be hard to spot. Good luck, nature spies!

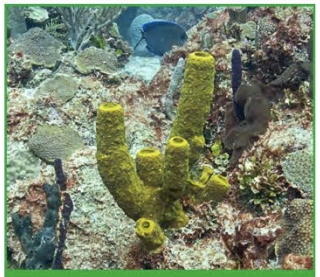
¡ESTÁS INVITADO A JUGAR ESPÍA DE LA NATURALEZA!

El objetivo de este es simple—encuentra los tantos animales y plantas de la siguiente lista durante el viaje virtual y marca las casillas cuando logres verlos. Las fotos son para inspiración; los objetos pueden verse ligeramente diferentes durante el evento. ¡Buena suerte!

☐ FAN CORAL
CORAL ABANICO

☐ PARROT FISH
PEZ LORO

☐ PILLAR CORAL
CORAL PILAR



☐ YELLOW TUBE SPONGE
ESPONJA TUBULAR AMARILLA

☐ FOUR-EYE BUTTERFLY FISH
PEZ MARIPOSA CUATRO OJOS

☐ SERGEANT MAJOR FISH
PEZ SARGENTO MAYOR

☐ SOFT CORAL
CORAL BLANDO

☐ STAGHORN CORAL
CORAL CUERNO DE CIERVO

☐ FRENCH GRUNT FISH
PEZ RONCADOR

☐ MONTASTRAEA CORAL
CORAL MONTASTREA

The Secret Life of Corals Virtual Field Trip Log

BEFORE

I know that..._____

_____

I wonder if..._____

_____

I hope that..._____

AFTER

I want to know more about..._____

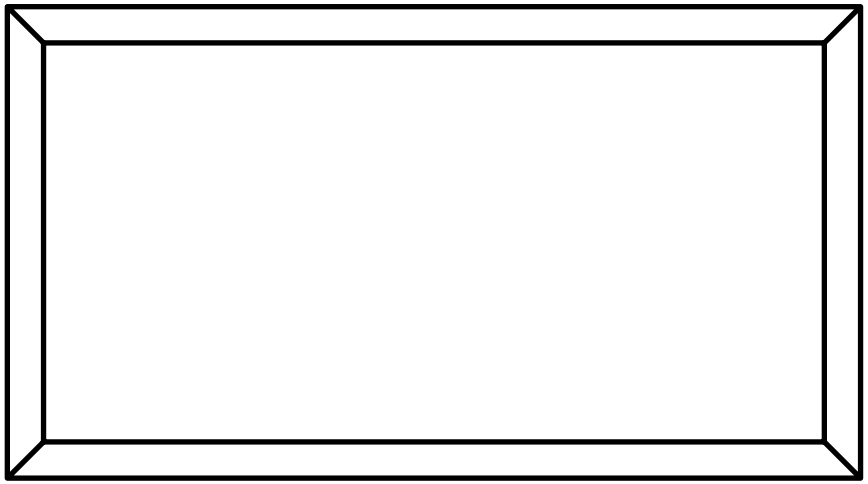
_____

My favorite part was ..._____

_____

I learned that..._____

_____



Imagine you are in the Dominican Republic – what would you be doing? Are you on a boat, snorkeling, diving, or relaxing on the beach? On the left, draw a "selfie" of yourself on your trip.

Rate this virtual field trip by coloring in the number of stars you would give it!