MERIT BADGE SERIES

EXPLORATION

BOY SCOUTS OF AMERICA®

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"Enhancing our youths' competitive edge through merit badges"

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Note to the Counselor

Thank you for offering your talents as a merit badge counselor. The merit badge program succeeds because of the dedication and generosity of people like you.

A glance down the list of merit badges a Scout may earn reveals that exploration has long been central to Scouting. From Archaeology to Oceanography to Space Exploration and Weather, opportunities abound for Scouts to go exploring and make discoveries to satisfy their natural curiosity. Now the Exploration merit badge provides a framework for grounding the adventures of Scouting in the real-world scientific work of 21st century exploration.

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The requirements for this merit badge are written to accommodate Scouts' various individual interests as well as their different age-appropriate abilities. A candidate for this merit badge is to make a science-based expedition to an area the Scout has not previously explored. The area might be remote, or it may be someplace nearby, as the Scout chooses. The expedition might be a troop activity, or the Scout may undertake a small-scale or individual excursion.

Any troop expedition to a remote location requires a tour and activity plan, submitted for council review, for trips of 500 miles or more; trips outside council borders; or expeditions that involve aquatics (boating, scuba, etc.), climbing and rappelling, or motorized vehicles (snowmobiles, all-terrain vehicles, etc.). No tour plan is necessary, however, for a Scout's individual expedition. For more information about the requirements for a tour plan, please see Tour and Activity Plan FAQs at http://www.scouting.org/healthandsafety/tourplanfaq.aspx.

Remember that at all times, BSA Youth Protection policies apply for all Scouting activities. For more information about the BSA's Youth Protection program, training requirements, and opportunities, see http://www.scouting.org/Training/YouthProtection.aspx.

Whether a Scout undertakes a remote expedition or chooses to explore locally, qualified supervision is a must. Expeditions may be supervised directly by the merit badge counselor or alternatively by a counselor-approved person. Qualified expedition advisors may be drawn from the ranks of school science teachers, museum educators, park rangers, nature instructors, and others with scientific knowledge as well as outdoor skills and expertise. Exploration merit badge counselors may wish to consult the science departments of local community colleges or universities, and get involved with the local chapters of organizations that have exploration interests. These scientists often can serve as mentors and consultants to Scouts' exploration ventures.

Thank you again for your time. Now, let's go exploring!

Requirements

Scouts should go to www.scouting.org/merit-badges/Exploration or check Scoutbook for the latest requirements.

As you work on the Exploration merit badge, remember to always use the buddy system. Whether you are out in the field or meeting with your merit badge counselor, having a buddy will help ensure everyone's safety. You and your buddy can watch out for each other wherever you may be or whatever you may be doing.

Expeditions are widely variable. You do not have to climb Mount Everest or go to a jungle to be an explorer. For this merit badge, an expedition should be viewed like a field trip or science project. While you cannot just hike some place and call it an expedition, you can hike to a location and study an aspect that interests you.

The major difference between an expedition and a field science trip is that you (with your counselor's guidance) have to plan everything. You have to formulate objectives and plan an agenda. As needed, you will need to do things like confirm transportation, arrange communication, plan for food and medical supplies, acquire all food and other supplies, construct safety and possible evacuation procedures, manage any adverse events, and prepare a report after the expedition.

Evaluating the effects of a storm on the local forest or nature preserve, the effects of a drought on a field used by birds and mammals, changes in butterfly populations due to loss of wildflower habitat, incursions by invasive plant or animal species, insect diversity, and presence or absence of amphibians or fish are just some of the examples that can be studied and reported. Your imagination is your only limitation.

Eagle Scout Alex Houston joined this 2014 expedition in Antarctica as part of the National Eagle Scout Association's World Explorer program.

Contents

Since its commissioning in 1964, *Alvin* has taken scientists on more than 4,800 dives to explore the deep sea. This submersible vehicle can carry up to three passengers at depths up to 4,500 meters—nearly 2.8 miles.

Eric Simonson, a certified Alpine and ski guide, uses a ladder to cross crevasses as he ascends Mount Everest.

What Is Exploration?

Have you ever wondered about your surroundings and wanted to learn more about them? Have you thought about the natural world and its interactions? Have you wanted to know why a machine works or how an insect flies, or what triggers some animals to hibernate? Maybe you are intrigued by the invisible world around us: bacteria, viruses, molecules, wind currents, tides, X-rays. Perhaps you have you taken a walk in the woods just to see what is over the next ridge. If so, then you are interested in exploration. Exploration is what you do when you want to discover what is out there in—and beyond—the world.

A balloon flies past a new skyscraper, carrying a camera to help evaluate the energy efficiency of the building.

Exploration: A Key to Discovery

In scientific research, the three guiding principles are discovery, description, and explanation. Exploration (discovery) lies at the heart of research.

Exploration has been defined as the act of searching, with its goal being the discovery of information or resources. Exploration is the engine that drives innovation, whether in science, economics, or business. We need exploration to spur medical discoveries that help people live healthier lives, to seek ways of being more energy efficient, to protect our planet's resources, to better understand Earth's oceans and atmosphere, and to learn about worlds other than our own. The reasons—and the opportunities—for exploration are virtually endless.

Explorer and Distinguished Eagle Scout Michael Manyak uncovers early human footprints in Tanzania.

Exploration is adventurous, but it is much more than an adventure. Many adventures may be quite exhilarating but are not exploration. Exploration is the actual *search* to discover information. Taking a sailing trip in the Caribbean, hiking in the mountains, or joining a guided tour of ancient ruins is exciting, but it is not exploration. However, if you took a sailing trip to the Caribbean to study reef ecology or you hiked in the mountains to survey wildlife, then *that* would be exploration.

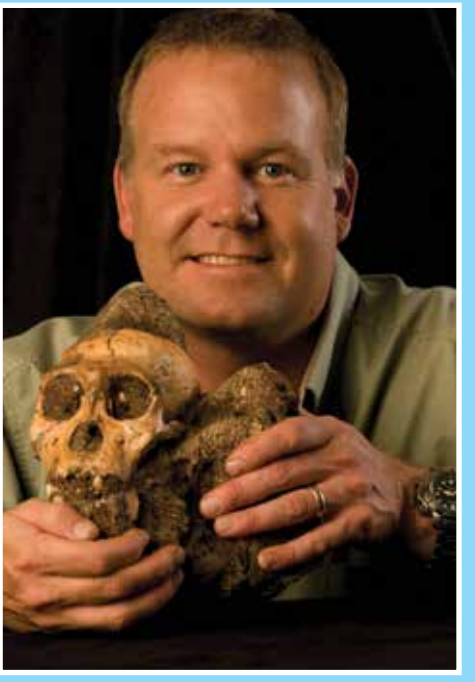
Exploration has a scientific basis, and information is collected and usually shared. The actual trip is secondary to the purpose of discovering information and contributing to scientific knowledge. This distinction is what sets exploration apart from adventure travel, eco-tours, and similarly adventurous activities.

Exploring Our World: Paleoanthropology

"So many young people I meet feel that the great Age of Exploration has passed. That it was the centuries of sailing ships setting off for uncharted shores, or the first ascents of mountains, or the first journeys into uninhabited wilderness that were hallmarks of such an age, and that our world has practically been completely discovered and explored. I hear people say any person entering the fields of exploration or the sciences will only be adding small amounts of information through discovery, effectively contributing only by standing on the shoulders of giants. But I differ strongly with that opinion.

"Living and exploring in Africa over the past 25 years has led me to understand that the rise of technology and the ability to crowdsource skills and expertise from around the world means the greatest Age of Exploration has just begun. Yes, we humans indeed may have walked over every inch of this planet, but we have only just begun to understand what we have found there. We need to inspire a generation of modern explorers willing to combine technology with good old-fashioned exploration on the ground, and I am certain such a combination will make this generation's explorers truly participants in the greatest Age of Exploration the world has ever seen."

—Lee R. Berger, Ph.D., professor and director, Institute for Human Evolution, University of the Witwatersrand, Johannesburg, South Africa; Distinguished Eagle Scout and Fellow, The Explorers Club



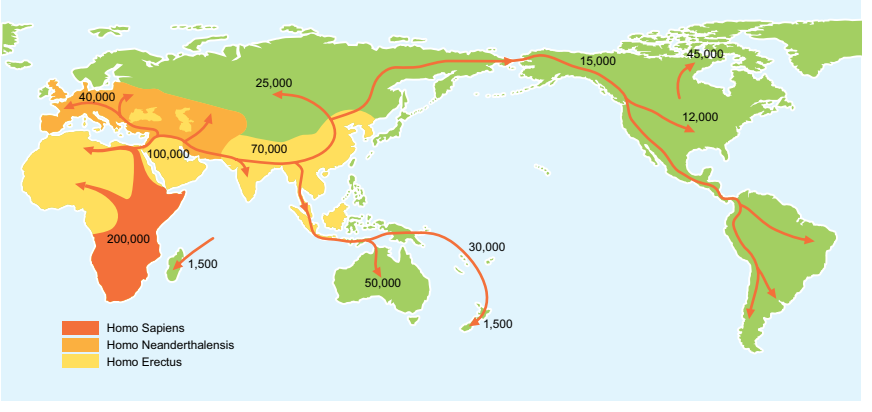
Paleoanthropologist and archaeologist Lee Berger with his discovery of early human Australopithecus sediba.

Cultural anthropologist William Thomas studies the biological diversity of remote areas and then teaches local people such as this resident of Papua New Guinea how to conserve their lands.

History of Exploration

Human beings have a natural tendency to explore. Every generation produces people who crave movement, change, and adventure. To help satisfy their curiosity about the world, these people seek new places, ideas, foods, and other experiences. This innate or instinctive urge to explore is one reason human ancestors left Africa in prehistorical times to eventually populate the rest of the planet.

Also since the beginning of recorded history, various peoples and groups have gone exploring. The ancient Phoenicians, Greeks, and other Mediterranean civilizations explored at least as far as Britain and northern Africa. More than 2,000 years ago, Chinese voyagers explored the eastern parts of the Northern Hemisphere, describing several countries that were then unknown to them, including places in northern India.



Later, the Chinese also made extensive voyages to explore Southeast Asia and the Indian subcontinent, and went as far as the eastern African shore. Around A.D. 1000, Viking explorers roamed throughout the western Northern Hemisphere and likely were the first Europeans to arrive in the New World. Much of the Pacific was explored, with its islands settled by seafaring Polynesian people over a few thousand years. Their explorations lasted into the Middle Ages, about A.D. 1300.

The Viking Ship Museum in Oslo, Norway, houses attractions including the Oseberg Ship. The figurehead of the ship dates from around A.D. 800, but archaeologists believe that the ship itself is older.

The Explorer Gene

While not all of us want to jump in a kayak and paddle the length of the Amazon, the evidence suggests that humans move around more than any other mammal. Scientists are researching the human genome (complete set of genes) to see if there is a genetic basis for this urge in our species. This research in itself is exploration, and it is being done in a laboratory.

Anthropologists (who study human beings and their ancestors), neuroscientists (who study the human brain and its relation to behavior and learning), and other researchers have linked a variation of a gene to certain characteristics of explorers. This gene controls a chemical messenger within our brains known as dopamine, which is important for learning. Studies have shown this variation of the dopamine gene to be strongly related to curiosity and restlessness. About 20 percent of all people have this gene variation, which makes them more likely to explore new places, ideas, foods, and other new things. These people tend to seek movement, change, and adventure.

This genetic variation has been strongly linked to human migration, and it occurs frequently in nomads—people who move around a lot and seldom settle in one place. While this variation has sometimes been called the "explorer gene," the urge to explore is likely more complicated. Certainly there are people without this variation who have an interest in exploration. But for some, this gene may be an added influence and a stimulus to go exploring.

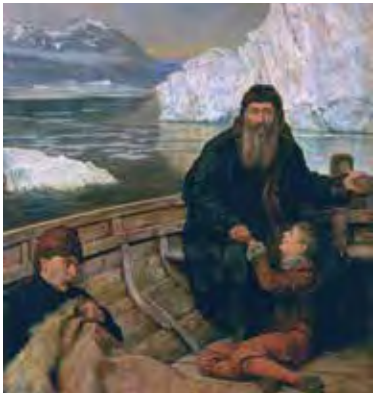
Small bands of people moved over large areas of the European continent during the last ice age.

The Age of Discovery

In European history, a period of long-distance exploration began in the 15th century with the first Portuguese discoveries of scattered islands in the Atlantic Ocean, as well as the 1492 discovery of the Americas by Christopher Columbus, funded by Spain. This "Age of Discovery" (also known as the Age of Exploration) continued into the 17th and 18th centuries, with European naval expeditions crossing the Atlantic and later the Pacific Ocean.

An oil painting by 19th-century artist John Vanderlyn depicts Christopher Columbus landing in the West Indies in 1492.

During this time, Europeans explored large areas of the Americas, Africa, Asia, and the islands of the tropical Pacific. After this age, further explorations brought knowledge of some of the remaining unknown areas of the world, including remote Pacific islands and the regions of the North and South Poles.



The last voyage of English explorer Henry Hudson in the early 1600s is imagined in a painting by John Collier.

A statue of Antarctic explorer Robert Falcon Scott (1868–1912) in Christchurch, New Zealand

Modern Exploration

The history of exploration up until the early 20th century focused largely on geographical description: finding, exploring, mapping, and giving an account of unknown regions of planet Earth. Then came the explorations of the Space Age, which were made possible by the development of rocket-ship technology during World War II and which took humans to the moon (1969–1972).

Today, explorers are expanding on these earlier ventures and are also exploring new frontiers like the deep ocean and molecular biology. New technologies have spurred and are contributing to these 21st century efforts. As you will see in the next section of this pamphlet, there is still much to explore.

Astronaut Buzz Aldrin walks on the surface of the moon in a photo taken by mission commander Neil Armstrong during the historic Apollo 11 mission in 1969.

The Butterfly Nebula, discovered in 1947 by astronomer Rudolph Minkowski, has the peculiar form of two lobes that emanate from a central star, resembling the wings of a butterfly. This image was captured by the Hubble Space Telescope in 2009.

Diversity of Exploration

Exploration happens everywhere on Earth and beyond, in a wide variety of subjects, specialties, environments, and circumstances. Actual exploration might be limited by cost, technology, or the environment, but the concepts are limited only by your imagination and curiosity. Many areas remain to be explored, whether you are interested in subatomic particles or invisible life such as viruses, or you long to discover new planetary systems or travel beyond our solar system and out into the universe.

Space Exploration

Space explorers discover new celestial bodies—including stars, planets, moons, asteroids, and comets—and observe the known ones. New technologies for human spaceflight and robotic probes are constantly expanding the possibilities for the physical exploration of space.

Subterranean Exploration

Below ground, discoveries of new animals and microscopic life-forms are helping us understand the complex interactions of living things underground and how species adapt to lower levels of light and oxygen. Physical exploration is extending our knowledge of large underground cave systems, some of them newly discovered.

In space exploration, amateur observers as well as professional astronomers can make important discoveries. For example, scientists found in 2013 that a rock sample collected by Curiosity, NASA's Mars rover, contained sulfur, nitrogen, hydrogen, oxygen, phosphorus, and carbon—elements that mean ancient Mars could have supported life.

Aerospace Exploration: To Infinity, and Beyond

"We as humans have an innate sense of curiosity and a thirst for taking on great challenges, and this is certainly at the core of America's greatness, past, present, and future. Each time we press the limits of human endurance and technological capability a bit further, remarkable benefits are returned to our society in terms of new knowledge, advanced capabilities, novel industries, and inspiration to press even further.

"The story of America overcoming its underdog status in the early space race with the Soviet Union is well-known, ultimately achieving crewed lunar landings in the late 1960s and early 1970s. What came as a huge surprise to 'second generation astronauts' like myself is that the U.S. and Russian space programs would eventually come together to build and operate the International Space Station, along with partners from Europe, Canada, and Japan.

"What's taking place in space today is no less exciting, with commercial enterprises like SpaceX and Virgin Galactic aiming to make space accessible for more than a select few astronauts. NASA and space agencies around the world are targeting a human presence on Mars in the coming decades.

"I've had to retire and hang up my spacesuit, but they'll be looking for bright, well-rounded, and well-prepared astronauts for these missions in a few years. Will you be onboard?"

—Scott Parazynski, M.D.
Astronaut; Distinguished Eagle Scout; Fellow, The Explorers Club

Astronaut and physician Scott Parazynski aboard the space shuttle

Dr. Parazynski, anchored to a foot restraint, prepares to work on a damaged solar array at the International Space Station.

Cave Exploration

"In 1980 I was co-leader of an expedition which explored the first cave outside of Europe over 1,000 meters deep (3,280 feet). It was the seventh one in the world that deep. Today there are over 100 caves [known to be] that deep. I am still co-leader of the international project exploring that cave in Mexico, the deepest cave in the Western Hemisphere.

"There are an unknown number of more caves to be discovered, explored, and studied. It will take many lifetimes before all of the caves on Earth are explored and mapped. In them live new species of life-forms including organisms that live in low oxygen or other conditions impossible for us to live in. These extremophiles are of great interest to science because of how they have adapted and for the products they produce.

"Caves are not all small and confining. Some are vast in length and dimensions. Some have single rooms larger than giant sports stadiums. Others have underwater passages requiring sophisticated scuba gear and cautious procedures. Some even await new technologies to be able to explore them."

—C. William Steele
Distinguished Eagle Scout; Fellow, National Speleological Society; Fellow Emeritus, The Explorers Club

Cave explorer Bill Steele in a tight spot, *above*, exploring Twinkie's Cave, Comal County, Texas, where he and others have found the remains of prehistoric beasts, such as the skull of a saber-toothed tiger. At *right*, inside Mexico's Sistema Huautla, the Western Hemisphere's deepest cave system, he sketches a map of the cave.

Polar Exploration

Polar exploration of both the Arctic region and Antarctica has a long and exciting history and continues today. Environmental science studies are being done in both polar regions. Permanent international research stations in Antarctica study marine life, environmental changes, the effects of ocean currents, and other topics and sciences including weather, geology, and paleontology (fossils). Antarctica has nearly 400 lakes trapped under its ice, and their unique ecosystems are being explored. Nearly 4,000 new bacterial species have been discovered in just one subglacial (below-the-ice) lake.

Scientists use weather balloon soundings to measure the ozone layer at the South Pole.

Polar Exploration and Dentistry: Understanding the Narwhal Tusk

"Why would a dentist travel 2,000 miles north to a latitude between the North Pole and Arctic Circle to understand the tooth of an arctic whale? First, the knowledge gained about an extraordinary sensory organ system gave insight into all mammalian teeth including our own. [Also], insights from traditional Inuit knowledge and science could be integrated to better understand this whale and its ecosystem.

"The function of the narwhal tusk has eluded scientific discovery for over 500 years. A harsh arctic environment with forbidding weather conditions and ice, the elusive behavior of the narwhal, and the novel methods of conducting scientific experiments in frigid waters on live captured-and-released narwhals provided formidable obstacles. The rewards and lessons are great. Patience and persistence were among the key attributes for success. Innovation, creativity, and interdisciplinary study of the various fields of science needed for such research were essential to a successful outcome.

"[This work showed] how teams of scientists from different disciplines could integrate ideas with the traditional knowledge of Inuit elders and hunters to solve one of nature's most perplexing mysteries. Results have changed the perceptions and understanding for this whale, for other toothed mammals, and sensory organs as well as providing insights into a changing arctic. There is much exploration yet to do."

—Martin T. Nweeia, D.M.D., D.D.S.
Harvard School of Dental Medicine; Fellow, The Explorers Club

Narwhals, a type of arctic whale

Dentist and polar marine biologist Martin Nweeia, *left,* examines a narwhal tusk up close.

Exploration in the Treetops

"Whereas astronomers explore outer space, arbornauts explore the treetops. The exploration of forest canopies is relatively new. Scuba gear to explore coral reefs was developed in the 1950s, rockets to reach the moon were designed in the 1960s, but ropes and harnesses were rigged to explore the treetops as late as 1979. Only in the last 30 years have scientists discovered that almost half of Earth's biodiversity lives in the tops of trees. This makes forest canopies one of the last unexplored regions of the planet. Today, canopy scientists use ropes, hot-air balloons, walkways, ladders, or even construction cranes to explore the tops of trees.

"Anyone can discover something new in a forest canopy, because it is a new frontier. By climbing trees or even by reaching the lower branches, new species of insects, fungi, mosses, orchids, or tardigrades (also known as water bears) inhabit the leaf and bark surfaces. Because the treetops are where sunlight hits Earth, most of the leaves and flowers of trees and vines grow vigorously up there; and thus, many organisms gather up there to eat, or be eaten! By learning single rope techniques, or locating a canopy walkway or tree platform in a state park, you too can become an arbornaut, making observations and sometimes discoveries in the treetops!"

—Margaret Lowman, Ph.D.
Chief of Science and Sustainability at the California Academy of Sciences; Fellow, The Explorers Club

Tropical canopy biologist Meg Lowman on an afternoon swing

Dr. Lowman on her way to work

Tropical Exploration

Up to two-thirds of all known plants and animals live in the lush rain forests of the tropics. Tropical rain forests are the world's most diverse and interdependent ecosystems. *(Interdependent* means the living things rely on each other for survival.) New discoveries are constantly added to the millions of species that are known to live in rain forests. The rain forest *canopy* (treetops) is an area of tremendous biological activity. Increasing deforestation, or destruction of forests, poses problems that require significant research and exploration to understand the effects of the destruction and to find practical solutions to balance or prevent such loss.

Bioprospecting

Bioprospecting is the search for plant and animal species from which commercially valuable and marketable new products can be obtained. Bioprospecting also includes the search for previously unknown compounds in organisms that have never before been used to make medicinal drugs.

Bioprospecting in the Kamchatka Peninsula

"Diversa (today part of BASF), the company I cofounded, mounted a microbial diversity research expedition to the Kamchatka Peninsula with the Russian Government and the U.S. Department of Energy. The region is a land of extremes best suited for hardy adventurers and scientists and contains unique fauna.

"Our search for unexplored microbes sought novel proteins in the microbes that might reduce the need for chemicals and, thereby, make cheaper and more environmentally friendly products. This expedition targeted the unearthly Geyser Valley, a boiling canyon of hot springs and calderas that belched bacteria and primitive bacteria-like organisms of unimaginable alien designs. The waters there are steaming and can exceed boiling temperatures in the superheated vents. Microbial populations there are referred to as *hyperthermophiles*, [and these organisms] have difficulty growing at [158 degrees Fahrenheit] since it is too cold for them. They grow best at temperatures ranging from [176 to 235 degrees].

"We collected water and mud samples among the geysers with a Russian soldier to protect us from unwanted bear visits. It was exhilarating to work in this most beautiful and pristine environment … and we made breakthrough discoveries that led to products on the market today, likely used in the paper of this book. We have had other expeditions to areas of extreme conditions leading to other exciting discoveries. There is huge potential in this type of exploration."

—Jay M. Short, Ph.D.
Molecular biologist and entrepreneur; Fellow, The Explorers Club

Jay Short bioprospecting in the steaming calderas (volcanic craters) of the Kamchatka Peninsula, Russia

Marine Exploration

Some ocean explorers search beneath the waves to locate and identify historic shipwrecks. Other marine researchers seek sustainable fishing and food sources, track the environmental effects of ocean pollution, study the effects of ocean currents on climate, seek to understand and protect coral reefs, or do geological research on the seafloor. Underwater exploration is also done in freshwater lakes, rivers, and marshes.

Ocean Exploration

"The ocean covers nearly three-quarters of our planet. We rely on the sea for food, medicine, minerals, jobs, and untold hours of wonder and enjoyment, not to mention billions of dollars in economic revenue. The ocean is also part of Earth's life-support system, producing oxygen while absorbing carbon dioxide and heat. Yet less than 10 percent of the ocean has been explored!

"Through ocean exploration we have discovered unimagined ecosystems thriving in habitats devoid of sunlight, new mineral deposits, and features that reflect the inner workings of Earth. It is through this process of discovery that we gain critical information about our planet, the life living on it, and how to better our own lives.

"From a simple net dragged behind a ship to a high-tech remotely operated vehicle or free-swimming robot, we now have a multitude of tools to explore and study the ocean. Computer models, amazing visualizations, and satellite tracking tags are opening up new views of the sea and revealing more than ever before about the behavior of marine organisms. Many mysteries remain in the sea, but the future of ocean exploration is bright and exciting."

—Ellen Prager, Ph.D.
Marine scientist and author; Fellow, The Explorers Club

Ocean scientist and explorer Ellen Prager introducing herself to a grouper

The crewed submersible *Triton*

Marine Research

"Modern science is always on the move. Every day, new tasks that were always done by people in the oceans and seas (and lakes and rivers, and even research tanks) can be done by underwater robots or other equipment. But there will always be that 'special something' that an actual human can bring to the equation that can never be replaced.

"It's critical that we keep developing new equipment and better ways of exploring underwater without putting a person in harm's way. But just as importantly, we need to continue research and development that improves how we can keep [humans] physically in the loop when we need to. Just two examples are improvements in diving techniques using mixed gases that allow people to explore deeper depths without risk, or which keeps divers warmer, longer so they can spend more time underwater to see and do more. Imagine yourself deep on a coral reef finding never-before-seen species of fish in the Northwest Hawaiian Islands. Or way back in a cold, dark cave finding remnants of previously unknown ancient civilizations!

"Our planet is full of new things to find and places to explore; we need smart scientists and engineers to do the research and develop the technology to get there. Why not be one?"

—Karin Lynn
Captain, Civil Engineer Corps, U.S. Navy (retired); Trustee and member, Women Divers Hall of Fame (WDHOF); Fellow, The Explorers Club

Karin Lynn in a bathysphere, a steel diving sphere for deep-sea observation

Ocean Exploration and Conservation

"We know more about the surface of the moon than our own oceans. It is the oceans that our planet depends on to maintain a normal climate and make our life on land possible. We depend on the ocean for food for billions of people. These are just a few of the reasons it is critical for us to explore and discover new knowledge about our ocean planet.

"Four hundred years ago the first explorers sailed their ships to discover new lands and people. Today researchers still go to sea to discover unknown facts and locations. With these discoveries we can understand more about climate change, discover new drugs for use in medicine, discover better ways to fish, and provide food, among many other things. It is our duty to conserve these precious assets, and the health of our reefs and oceans is essential.

"While making these discoveries is our most important goal, to be the person who made the discovery is extremely exciting and rewarding. To be the first person to explore a new reef or discover a new species is something that will always be your achievement—something that no one else has done. This is what being an explorer is all about."

—R. Craig Cook, M.D.
Medical director, *Sport Dive* magazine; Fellow, The Explorers Club

Dive medicine specialist and explorer Craig Cook studying a coral reef

High Altitude Exploration

High-altitude explorers may identify and analyze mineral resources in the mountains, weather patterns and their effects on environment, or better methods for growing crops and livestock in high-altitude climates. Working at great heights is physically challenging. Researchers in this field study the effects of thin air on the human body and brain to discover how physical and mental performance is affected by low levels of oxygen and reduced atmospheric pressure. The knowledge gained from high-altitude research can medically benefit "lowlanders" as well as members of the military.

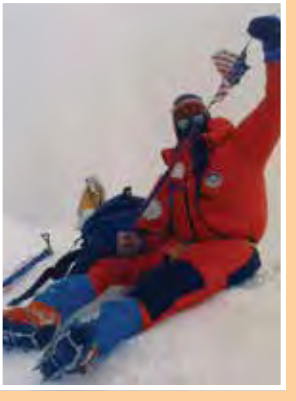
Mountain Exploration

"Do you want to go somewhere unfamiliar, or accomplish a new challenge in the mountains? To be successful, you must prepare well. Learn all you can about where you want to go, and the skills that will be required. Talking to people who have been there before provides valuable information. Reading stories about explorers is a great way to understand the challenges of the mountains and how you must adapt to survive, when everything around you is changing.

"For over 40 years I have explored the world's great mountains, leading over 100 high-altitude expeditions. In 1999 I led the team that found the remains of the famous British climber George Mallory high on Mount Everest. Mallory and his partner Andrew Irvine had disappeared June 8, 1924, on their way to the summit. Did they really reach the top? We now have some clues to explain the events of that fateful day, but the final answer awaits a future explorer.

"The skills you develop close to home are the same skills you will use to accomplish future adventures in faraway places. Practice, practice, practice!"

—Eric Simonson
Distinguished Eagle Scout; American Mountain Guides Association (AMGA) certified Alpine and ski guide; Seven Summits; Fellow, The Explorers Club



Mountaineer and explorer Eric Simonson on the summit of Mount Everest

Atmospheric Exploration

"Since the early days of the 20th century explorers have contributed to our knowledge of how the world's weather and climate work. This work continues today. Scientist-explorers and others who support their atmospheric science studies are in Antarctica, on land and at sea in the Arctic, aboard oceanographic research ships on the oceans, on airplanes flying into and around violent storms, and in trucks equipped with portable radar and other instruments chasing tornadoes across the Great Plains. Their work has provided great improvements in weather forecasts in recent years. But many questions remain.

"Scientist-explorers help answer important questions about how Earth's climate works and how it is changing. While the Arctic and Antarctic and much of the world's oceans are far from where most people live, what happens in these remote places affects both the day-to-day weather and the climate—the long-term average weather—for all of Earth as it changes.

"Explorer-journalists often accompany explorer-scientists to chronicle their work in print and online publications, books, television and film reports and documentaries, and pod casts. As weather editor for *USA Today* and USAToday.com, I was privileged to report about scientific research and daily life from Antarctica, Greenland, and northernmost Alaska, on a research icebreaker in the Arctic Ocean, in airplanes in hurricanes, and with scientific tornado chasers on the U.S. Great Plains."

—Jack Williams
Eagle Scout; Fellow, The American Meteorological Society;
Fellow, The Explorers Club

Jack Williams cooking dinner at a U.S. Antarctic Program survival school

Geological Exploration

Early geological explorers were mostly interested in describing geographic features and searching for riches. The emphasis now, however, is on greater understanding of our world and more efficient, sustainable use of natural resources. Oil and mineral exploration continues to be of vital importance, and more exploration is happening in developing countries. Learning about *plate tectonics* (how Earth's crust moves), searching for groundwater, studying glaciers for environmental clues, and searching for alternative energy sources all fit under the wide umbrella of geological exploration.

Energy Exploration

"Exploration in the most remote parts of the world has been part of the oil and gas industry since its beginning. Intrepid geologists and engineers traveled the world looking for locations of the next great oil or gas discovery to help power the energy needs of the world's economy. Today, exploration takes place from the Arctic sea to the jungles of South America. Wells are drilled in 10,000 feet of water and hydrocarbons are produced utilizing multi-billion-dollar facilities that are among the greatest engineering projects in the world.

"To understand petroleum systems, energy scientists travel to field locations to observe and study rock sequences. They look for rock outcrops in river valleys and on mountain sides, cliffs, and road cuts. They dive into the waters of the oceans to study modern seafloor depositional systems (living reefs and river deltas) using Earth's surface as a natural laboratory to understand what happened millions of years ago."

—Glenn A. Adams
Distinguished Eagle Scout and leader in the field of shale gas exploration

Glenn Adams with fellow Eagle Scout Bill Steele, caving in Oklahoma at Jester Cave, the longest gypsum cave system in the Americas

Anthropology and Exploration

Anthropology is the study of humans, both ancient and modern. Anthropology connects to the social and biological sciences and commonly is divided into broad categories of cultural anthropology, biological or physical anthropology, archaeology, and linguistics.

Exploring Human Origins

"Where did we come from? What can we discover about the ancient roots of our species?

"All exploration begins with curiosity. And curiosity leads to all sorts of interesting questions that make us get off our seats, travel, and find out new things about the world. Understanding our own beginnings—the origin of human beings as a species—offers one of the greatest adventures of all time. My own part in it involves travels to the Great Rift Valley of East Africa where my team of scientists and excavators slowly dig up the excitement of fossilized bones and the oldest Stone Age tools made by our ancestors.

"Many different people have a place in this adventure. Geologists study layer upon layer of dirt where the bones of our ancestors became embedded. Physicists measure how old the layers are back through time, and chemists figure out the long-ago changes in vegetation and climate. Digging is a matter of great care and skill, so excavators play a big role. Archaeologists explore how earlier species made tools, while paleontologists have clever ways of studying bones and discovering how our ancestors changed over time.

"Piecing these clues together, a picture of the past comes into view. At that amazing point, traveling the world to remote places becomes a way of traveling back through time to discover the great survival story that led to our own species being here, all over the globe."

—Richard Potts, Ph.D.
Director, Smithsonian Institution Human Origins Program, National History Museum; Fellow, The Explorers Club

Paleoanthropologist Rick Potts examining early human artifacts

Cultural anthropologists examine social patterns and how people live together in particular places, and study differences and similarities of race, class, gender, and nationality. This type of research and exploration often involves living among the group being studied and observing their practices in everyday life.

Cultural Anthropology

"Cultural anthropologists study the customs, traditions, values, and ideas of a particular group of people. Anthropologists gain insights by living within the culture and working with a key informant who helps them interpret what they observe. I am interested in traditional environmental knowledge and its potential for conserving biodiversity. I have had the privilege of living with the Hewa people of New Guinea and traveling in their unexplored lands for over 25 years.

"My principal informant, a man named Tama, was a master naturalist who taught me the workings of the rain forest—information new to science. Tama knew over 300 trees and 200 pollinators/seed dispersal agents, and how human activity affected each of them. My explorations have led to the discovery of 50 new species, as well as a conservation plan for this region based on traditional knowledge."

—William H. Thomas, Ph.D.
Anthropologist, Montclair State University; Fellow, The Explorers Club

Anthropologist Bill Thomas and a native of Papua-New Guinea

Biological (or physical) anthropologists are interested in how humans adapt to various environments, how biological and cultural processes shape human behavior, and what causes disease and early death. They are interested in human biological origins, evolution, and variation. They study other primates (primatology), fossils (paleoanthropology), prehistoric people (bioarchaeology), and the biology and genetics of living populations.

Archaeologists study past peoples and cultures through the artifacts and architecture the people left behind. Pottery, stone tools, animal bones, and remains of structures are evaluated to learn about and understand the cultures of those ancient civilizations. Linguistic anthropologists study how language reflects and influences social life. Language and communication affect a wide variety of cultural behaviors and activities.

Paleolithic Archaeology

"Have you ever stopped to wonder if another person may have once stood in the very same place you are right now? Humanity has a deep and complex past, and the study of this past is called archaeology. Archaeologists unlock the clues to human history and prehistory by exploring the material remains of human behavior. Some archaeologists study artifacts like ancient texts, architecture, coins, or pottery.

"Paleolithic archaeologists study even older forms of technology, when humans used tools made of stone to hunt and fish. In order to study these items, archaeologists first have to find them, and we do that by exploring. Our excavations can take us to the most remote parts of the world, across Africa, Asia, and South America. Exploration is key to understanding our past and where we fit in the world, and it can begin in our own backyard."

—Kathryn Ranhorn, Ph.D.
Paleolithic archaeologist, The George Washington University; Fellow, The Explorers Club

Paleolithic archaeologist Katie Ranhorn excavating artifacts

Exploration in Linguistics

"The ability to use and understand language is one of the few things that makes humans different from every other creature on Earth. Through linguistics (the study of languages), linguists aim to uncover how the human mind works.

"Some languages, like English, French, and Japanese, have huge amounts of recorded materials (including books, songs, and movies) and many thousands of speakers, but many languages do not. In fact, of the 7,000 languages spoken across the world today, more than half remain undocumented, meaning there are no books or recordings for linguists to even begin to understand how these languages work. In many cases, these undocumented languages are spoken in parts of the world that are not commonly visited, or are poorly understood by outsiders.

"Linguists wishing to broaden our understanding of human language must travel to these remote areas, often spending long periods living with people whose cultures are very different from their own, recording, describing, and even learning to speak the local language. Today, our understanding of how the languages of the world work depends heavily on linguists willing to be explorers, and willing to be partners with people from diverse cultures all around the world."

—Andrew Harvey
Linguist; Fellow, The Explorers Club

Linguistic anthropologist and explorer Andrew Harvey *(center, above left)* travels to remote areas around the world to record the languages of isolated peoples.

Imaging in Exploration

"While planes, satellites, and rockets have flown over huge areas of our planet, most of the areas directly above our dense cities remain relatively unexplored. This layer of airspace is found just above the tallest buildings in our cities. It extends up to about 1,000 feet because the Federal Aviation Administration (FAA) does not want pilots to get any lower than that for reasons of safety.

"Though you can easily see this space by looking up from the sidewalk, few people are able to get cameras and other scientific sensors up that high for very long. We explore this aerial layer with a tethered aerostat—a minivan-sized helium balloon tied to a long cable. It can lift a variety of cameras, blinking lights, radios, or antennas to get sophisticated images.

"Lifting various special cameras lets people like city planners and security officials see interesting patterns in the landscape from a really exciting perspective. When the cameras get to about 800 feet above ground level, we need to invent ways to aim and take many pictures while standing on the ground. This requires us to create most of our own equipment from existing technology. First, you draw your ideas and dreams in a sketchbook and then refine them once you understand what your requirements are. Then you have craftsmen help you build your customized equipment. These are actually inventions because they are unique.

"It is important to keep learning each time you make a mistake. Designing these fascinating tools and flying them above sites is a creative form of exploration. It helps you get close to interesting things that are just out of reach in an area not covered by more conventional imaging. This is exploration!"

—Curt Westergard
Digital Design and Engineering;
Explorers Club member

Remotely controlled aerial cameras survey invasive seaweed in the Potomac River.

Exploration Technology

New technologies give explorers state-of-the-art tools to study existing data or to search for fresh information in new ways. For instance, the latest imaging technology may be used remotely and in the field at exploration sites. Laser surface scanning allows sites to be rapidly mapped, and thermal scanning is used to detect animal migration patterns in remote areas.

Lidar (the word combines "light" and "radar") is similar in operation to radar but uses reflected light from a laser with radar to make high-resolution maps. Lidar is used in archaeology to detect sites for exploration. It is also used for geography, geology, seismology, forestry, atmospheric physics, airborne laser swath mapping (ALSM), laser altimetry, and contour mapping. Small lidar units using *optical coherence tomography* (OCT) can map ancient human and primate teeth.

Aviation Exploration

"One important area of aviation exploration involves investigating aircraft accidents. The goal of every accident investigation is to discover why it happened and to prevent another similar tragedy. Aircraft crash investigators analyze the three components of every accident: the human (pilot, mechanic, crew member); the machine (the airplane and its components); and the elements (weather). Information from this type of exploration contributes heavily to making commercial planes the safest form of travel.

"Aviation exploration does not begin at the tip of a massive rocket ship pointed into space. It actually starts with design and building plastic or wooden models. The explorer can discover in his own backyard how to answer questions about how to make something fly straight, turn correctly, reach its destination … and return.

"Besides aircraft design and function, many other aspects of aviation also require exploration such as finding lighter, more efficient fuels and improving communications. Exploration in aviation, like all exploration, is limited only by one's imagination."

—Harry Brooks, Esq.
Aircraft accident investigator;
former United States Marine Corps fighter pilot;
Fellow, The Explorers Club

Aviation explorer Harry Brooks, *top,* searches for clues at airplane and other types of aviation crash sites.

Molecular Exploration

Exploration in molecular sciences is a rapidly growing area of scientific discovery. *Molecular biology* deals with biological interactions at the molecular level; *biochemistry* studies the chemical processes in living organisms. Together they provide the tools to study our molecular living environment.

The continued development and improvement of technology to probe biological and chemical systems has unlocked many mysteries of how cells function and interact and what happens with abnormal function, known as disease. Molecular exploration has led to the production of vaccines, provided ways to rapidly make large amounts of drugs needed to treat illnesses, and allowed the creation of tests to detect diseases. We can now use molecular techniques to identify victims of disasters as well as crime suspects.

Applying the molecular sciences to discoveries in the field is a huge area of exploration that continues to grow. For example, molecular biological techniques are used to evaluate samples from teeth to determine the diet of early humans and to study the blood cells found in the bone marrow of dinosaurs. Remember the story of Jurassic Park, where dinosaurs were created from prehistoric DNA? Though fictional, it may not be as far from the truth as we first believed.

Molecular exploration in a laboratory

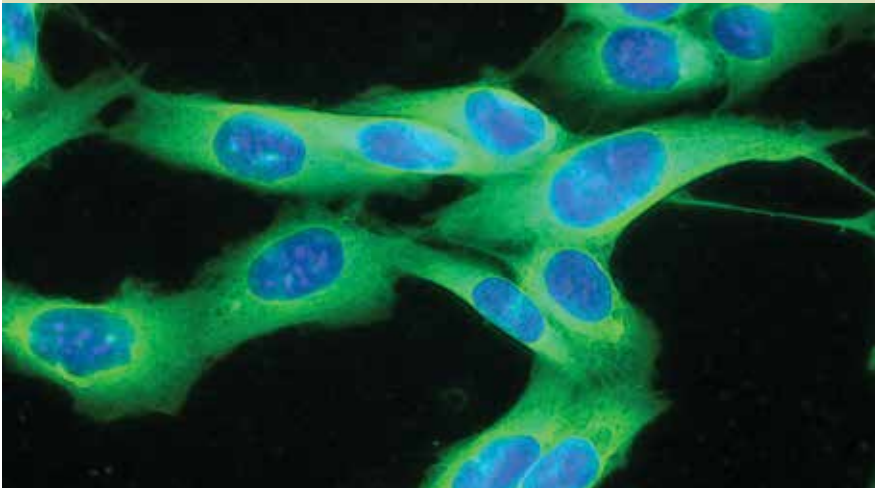
Exploration and Molecular Biology: The Next Frontier

"We normally think of exploration as traveling in or through a geographic area in order to learn about it. Today we can use sophisticated technology to travel into and through the cells of living organisms and even deeper into their molecular inner workings. Molecular biology is the branch of biology that deals with the nature of biological phenomena at the molecular level through the study of DNA, RNA, proteins, and macromolecules involved in genetic information and cell function.

"Molecular science is in the midst of an exciting revolution in computational biology using 'big data' approaches to gain unprecedented insight into biological functions at the most fundamental levels of life, which affect diseases and medical treatments, environmental science, agriculture, and human origins.

"Molecular biological research is sometimes classified as 'basic' or 'translational.' Basic research focuses purely on discovering new knowledge about biological systems. Translational research is focused on applying the newly discovered knowledge for the betterment of the planet and its inhabitants. Whole new worlds await discovery and exploration!"

—Steven Patierno, Ph.D.
Deputy director, Duke Cancer Institute; Eagle Scout



Immunofluorescent image of a human melanoma cell line

Becoming an Explorer

How does someone start to explore? As you have seen, exploration is incredibly diverse with many different areas in which to work and many ways to approach exploration in a given area of study. However, explorers seem to have certain traits in common regardless of what or how they explore. For example, explorers are almost universally inquisitive, and just being observant can stimulate that interest.

Biologist Edward O. Wilson atop a mangrove tree in the Florida Keys, looking for ants in the nest of an osprey, circa 1968

A perfect example comes from the story of famed Harvard biologist Edward O. Wilson, Ph.D., whose expertise is the study of ants. He has spent much of his professional life exploring forests and jungles. However, he claims one of his most exciting discoveries occurred one day while at a meeting in the office of Kathryn Fuller, then president of the World Wildlife Fund.

During this meeting on the environment, Dr. Wilson's idle gaze was drawn to some ants marching down the trunk of a small, bushy, locally purchased potted plant. Something about the ants looked a bit different. He excused himself to examine the ants more closely. Imagine his surprise when he determined they were a previously unknown species, right under his nose. Exploration can happen in your own backyard—even in an office building!

Passion and Persistence

Another characteristic most explorers have is passion. Explorers are often passionate about the subjects of their exploration and are driven by a desire to learn, understand, explain, and share their findings. They are persistent in their quest, driven sometimes to go against conventional thought while standing by their convictions.

A good example is that of Australian doctors Barry Marshall and J. Robin Warren, who first noted and then proved in 1982 that ulcers of the stomach and duodenum (the first part of the intestine) were actually caused by a previously unknown bacterium now known as *Helicobacter pylori*. The formation of ulcers leads to chronic infection, which can cause emergencies from bleeding and the perforation of the stomach or intestine.

***Helicobacter pylori*, a form of bacteria that causes stomach ulcers.**

Most people considered stress and spicy foods to be the major causes of digestive ulcers. When Marshall and Warren suggested such diseases were actually bacterial, many in the medical community scoffed at the idea because they believed no bacteria could survive in stomach acid, which is strong

enough to dissolve some very hard substances. However, Marshall and Warren persisted in their explorations, and now it is firmly established that antibiotics and some medications—instead of extensive surgery—can cure most people who have ulcers. These doctors, one a pathologist and the other a clinical physician, were awarded the Nobel Prize in 2005.

Few explorers will have such major and important results as this example. But discovery is highly rewarding, whether you advance the knowledge of humankind or just fulfill a personal quest.

Access to Resources

Although not everyone will have opportunities to use the latest exploration technologies, you might be surprised by what is available in your local high school science department, community college, or university. Also, you do not have to go to Mount Everest or to the moon to explore. The pond in the woods near your house may produce some extremely interesting findings. Talking with your local science teacher or college professor might provide you with stimulating ideas or expose you to exploration activities that are happening near your home. Most explorers and researchers are delighted to share their passion with an interested person.

NESA World Explorer Program

The Boy Scouts of America's STEM (science, technology, engineering, mathematics) initiative gives Scouts an opportunity for exposure to relevant occupations. These experiences will help them develop skills critical for the competitive world market.

Sending a Scout to a remote location dates back to the first Richard E. Byrd Antarctic expedition in 1928. NESA has now developed the World Explorer program. Selected, highly qualified Eagle Scouts can go on expeditions to remote areas and contribute to a specific scientific project in an area of great interest to the individual. NESA program destinations include the Amazon, Arctic, Galapagos, and South Africa, with expansion to other areas under development.

- In the Amazon, the NESA Eagle Scout Amazon biologist will work in a restricted-access biodiverse science station in the pristine jungle.
- The NESA Eagle Scout Galapagos biologist will join existing scientific conservation and research projects in this unique setting.
- The NESA Eagle Scout arctic marine biologist will study rare marine mammals in the Smithsonian Institution's highly restricted Narwhal Tusk Research program.
- The NESA Eagle Scout paleoanthropologist will participate in evaluation of a spectacular finding of new early human species at a site in a national game preserve in South Africa.

The program continues to grow and is likely to include more equally exciting destinations. For more information, go to www.nesa.org, email nesa@scouting.org, or contact the NESA office by calling 972-580-2000.

Eagle Scout Alex Houston tested the frigid waters of Antarctica during his adventure there.

Eagle Scouts lucky enough to be picked for the NESA World Explorer program have visited faraway places such as the Galapagos Islands, Amazon rain forests, Antarctica, and the Arctic Circle, among other adventurous locations.

Preparing for an Expedition

Every exploration expedition begins with a carefully detailed plan. Before you go on any expedition, use the following steps to plan and prepare.

Develop a Concept

The concept may arise from a longstanding interest or from something that suddenly piques your curiosity. An initial concept needs to be further defined for the explorer to have a realistic view of the goal and whether it can be accomplished. Keep in mind that a successful expedition does not necessarily require that you meet your predetermined goal—you may actually learn more from failure. However, you need a basis for pursuing the exploration, and a concept is required for direction. What is your objective? What are you hoping to learn?

Do Your Research

Do research about your objective to more fully understand what you are trying to achieve and how to go about it. To determine the best timing for an expedition, you must know about the geography and climate of your destination. If you are going to an unfamiliar area, find out about cultural issues in the region and get current information about local controversies or unrest. Check on local laws or restrictions that might limit your access to the area. Determine what resources you will have with you and which you can obtain at the site.

Knowing about your intended destination will help you determine potential partners, sponsors, and advocates for your work who may be able to provide funding or give you on-the-ground support. Gathering as much information as possible about your proposed exploration is highly useful and strongly advised.

Select Your Team

Unless your proposed exploration is to be an individual effort—and you are certain you have every skill necessary to accomplish your goal alone—you will need to put together a smoothly functioning team. This is a key requirement and an important responsibility.

Consider what skills are necessary for your endeavor and determine who can provide the expertise needed. The skills that each individual brings to the team will help you determine how many expedition members you must have. Limit the group size by seeking out people with multiple skills. For example, one team member might have cooking skills or medical knowledge in addition to his or her primary expertise.

Team behavior and chemistry are important considerations. If a brilliant scientist on your team lacks the social skills to get along with others, you might reevaluate that person's role to avoid friction later on. Everyone at some time or another has been on a team that was not functional. Poor behavior might be only an annoyance in your normal environment, but it becomes a critical issue and more difficult to deal with in the field. A team member usually cannot just leave an expedition without creating consequences for the mission.

You must also realize that an expedition can be stressful, and how someone reacts under stress may affect your activities. Although it may be hard to guess their responses ahead of time, you should get to know your companions before setting out so you have an idea of their personalities and can spot any warning signs.

Finally, make sure that everyone will be available at the time proposed for the exploration.

Create the Exploration Agenda

Once you have your team selected and have blocked out dates for the activity, then create an agenda. The agenda serves as a guide during preparation, provides a framework for the activities on-site, and outlines what needs to be done after you return. The agenda will help organize your exploration, identify areas where obstacles may arise, and assist in dealing with unexpected delays.

Be sure to allow enough time for each step in your preparations. Assign tasks, as appropriate, so that all the team members share in this work. Before leaving, give a copy of your agenda to your family or close friends so they can follow your schedule and help if problems arise.

Secure Expedition Financing

Considering the financial requirements—how to pay for an expedition—is an essential part of preparation. Expeditions have become stranded due to inadequate funds. Every exploration activity should have at least a rough budget within which to work, and alternate sources of funding should be lined up in case your primary source falls through or cannot meet your requirements.

Except for major exploration that involves expensive equipment and many people, the cost of a field expedition will generally range from a few hundred to a few thousand dollars, depending on the location and the cost of travel. One strategy to cover expenses is to seek organizations or private individuals who may be interested in your work and will assist financially in the form of a gift or grant. Supporters might also provide equipment or services that can help you stay within your budget.

Gather Equipment and Supplies

The equipment required for your expedition will vary with the location, climate, season, altitude, and number of personnel. Discuss items with the expedition members so that all are in agreement and know about specific gear. Scientific instruments, photographic and video equipment, computers, and portable electric supply need to be carefully chosen and calculated as to weight and volume limitations—how much you can carry.

Consider extra batteries, bulbs, digital camera memory, cords, and other essentials. Plan to "pack it out" to avoid leaving any non-biodegradable supplies at the location. Above all, be practical.

To help you take only what you need on an extended field expedition, consult the Group Camping Gear Checklist in the *Scouts BSA Handbook for Boys* and *Scouts BSA Handbook for Girls.*

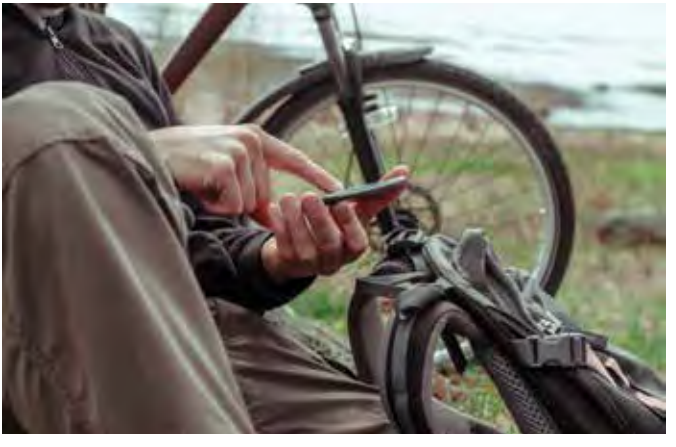
Suggested Personal Items for an Expedition

Each person should bring personal supplies customized for the expedition. Start with the Scout Basic Essentials (from the *Scouts BSA Handbook for Boys* and *Scouts BSA Handbook for Girls*) and also use the following checklist:

- ❑ Adhesive bandages, assorted sizes
- ❑ Liquid soap
- ❑ Lip balm with sunscreen
- ❑ Sunscreen (at least 30 SPF)
- ❑ Sunglasses
- ❑ Hat with brim for shade
- ❑ Insect repellent containing DEET
- ❑ Iodine tablets or ultraviolet light source and portable filters for water purification if bottled water is not available; filtration straws are also good
- ❑ Flashlight
- ❑ Headlamp
- ❑ Binoculars
- ❑ Camera
- ❑ Batteries for all devices
- ❑ Duct tape

Make a Communications Plan

A communications plan is important for even a simple local hike. For exploration in a remote area, communication equipment is essential. Terrain is the major factor to be considered. Common personal communication equipment is designed for urban environments and clear lines of sight but remote places have sparse cellular coverage, and steep terrain can block overhead satellite networks. Satellite phones have advantages but they require triangulation with satellites, which might be obstructed in a canyon or under a rain forest canopy. GPS units are useful but require the same clearance for satellite connection.



No single device is perfect for all conditions, but a mobile phone configured for the local mobile network is the most common and versatile communications tool. Texting may work when connections for calls will not. Mobile phones not only provide communication but also act as a homing beacon, potentially giving search-and-rescue teams a way to find you. However, mobile phones are limited by terrain and atmospheric conditions. New technologies combining both cell and satellite capabilities are emerging.

Another aspect of communications you may need to consider is dealing with the media. If media outlets will want to communicate with your team, make sure to select a spokesperson in advance and determine how messages will be communicated. This can prevent confusion and inaccurate reports, and it will demonstrate your leadership ability.

Establish Safety and First-Aid Procedures

Make safety a priority in preparing for an expedition. One early decision you must make is whether you will have a trained medic on the trip. If so, as the leader you should work with this person to screen participants for medical conditions that could cause trouble later on. These may include asthma, severe allergies particularly to foods or insect stings, recent surgery, and use of medications—especially aspirin, blood thinners, treatments for a heart condition or diabetes, and drugs for anxiety or mental disorders. Require all potential members of the expedition to be open about their medical needs. Remember that if someone is injured or becomes ill on the road, they may need to be evacuated and the trip might be cut short or delayed.

For relatively short trips to an area where medical assistance is easily available, carrying a personal medical kit will likely be sufficient. (See the checklist of recommended medical supplies in this section.)

Regardless of whether a health care professional is going on the trip, all expedition members with conditions requiring physician oversight must provide written medical clearance from their doctor. This clearance should also confirm that the participant has had all appropriate vaccinations. If your activity will be strenuous or stressful, a waiver of liability for each participant is advisable.

Few people have medical evacuation coverage included in their health insurance, so it is vital that each expedition member obtains an insurance policy for medical evacuation. This insurance is relatively inexpensive and, without it, the cost of medical evacuation would be enormous. Such a policy usually provides for trained personnel to coordinate the patient's medical needs as well as evacuation once they are stable.

Do not forget dental care. Travelers to a remote area should have a dental checkup within six months of departure. A tooth abscess is excruciatingly painful and can almost always be avoided with a recent dental visit.

Expedition Medicine

"Everyone who travels to a remote area is concerned about health and safety. Most people are able to get help in the developed world where many resources are readily available, but remote areas have few resources. Safety in a remote area can be quite different than in an urban setting.

"Wilderness medicine is defined as medical care where access to standard resources is difficult or absent. Medical care on a Scouting trip is a good example of wilderness medicine. Search-and-rescue missions and medical missions in underdeveloped countries are other examples.

"Expedition medicine is a subset of wilderness medicine that deals with medical care while on scientific or educational events. Doctors, nurses, and emergency medical technicians all can be involved in expedition medicine. Preparation includes screening expedition members for existing medical conditions that may cause a problem, vaccination recommendations, selecting emergency medical supplies, and arranging for possible medical evacuation and proper insurance. Only minor problems may arise, but you must plan for serious events.

"One great aspect of expedition medicine is that its practitioners are not restricted to one geographical area or environment but may go to jungles, mountains, the ocean, deserts, polar areas, and outer space. The health care professional is an important part of any expedition."

—Michael Manyak, M.D.
Expedition medicine specialist; Distinguished Eagle Scout; Fellow, The Explorers Club

Expedition medicine expert and explorer Michael Manyak *(center, with patient),* treats and arranges evacuation of an injured patient from a remote expedition.

Medical Supplies

Medical supplies for an expedition must be practical, weigh as little as possible, and take up minimal space. To help your team choose wisely, use a checklist of recommended group supplies.

Recommended Supplies for a Team Medical Kit

The following suggestions may be modified depending on the number of expedition members, length of travel, and destination. A health-care professional who is familiar with the remote surroundings can help you customize items for the trip. It's safe to say that the more extensive and remote the expedition, the more elaborate the kit will need to be. If individual team members will be carrying prescribed controlled substances or injectable medications, certain legal requirements apply. Consult with your merit badge counselor, who can help you find out more about those requirements.

Medications

Medication	Supply Unit	Dosage	Total
Aspirin (acetylsalicylic acid)	500 mg, 100 per bottle		2
Antibiotic ointment (bacitracin)	1-ounce tube		2
Allergy medicine (diphenhydramine)	25 mg	1 every 6 hours	60 tablets
Broad spectrum antibiotic (for respiratory or urinary tract infection, bacterial diarrhea, etc.)	Variable	Variable	60 tablets
Ibuprofen	600 mg, 100 per bottle		3
Anti-diarrheal (loperamide hydrochloride)	2 mg, 24 tablets	1–2 tablets	10 bottles
Clove oil (for dental pain)	60 ml		
Acetaminophen (e.g., Tylenol)	100 per bottle		3 bottles

Supplies

Supplies	Unit	Total
Elastic bandages	2-inch and 4-inch	5 of each
Adhesive tape, cloth	2 inches x 10 yards	4 rolls
Sterile cotton balls		
Eye patch		
Gauze pads	2 x 2 inch and 4 x 4 inch	1 box
Triangular bandage for wrapping injuries and making an arm sling		
Adhesive bandages, cloth preferred		Assorted sizes
Sterile gauze pads (2 to 5 per packet)	4 x 4 inch	1 box
Rolled waterproof adhesive tape	2 inches x 10 yards	1 roll
Liquid soap	1 bottle	

Sterile cotton-tipped swabs, or applicators (2 per package)		1 box
Scissors		1
Tweezers		1
Sterile hypoallergenic or latex surgical gloves	Size 7.5	1 box
Non-sterile latex gloves	Large	1 box
Water purification tablets or iodine crystals 3		
Resealable plastic bags	Large and small	1 box of each
Moleskin padding	4⅛ x 3⅜ inch	1 box or 5 rolls
Safety pins		1 package
Throat lozenges		100
Lip balm for sunscreen		10

Personal first-aid kit

Individuals should pack a small medical kit with their personal supplies. Expedition members are responsible for bringing their own personal medicines with enough extra supply to cover travel delays. They should not be dependent on the team medical kit or any health care professionals in the group to meet their specific needs.

Recommended Personal Medical Supplies for an Expedition

- ❑ Personal prescription medications (including the generic names for medications and doses, with a note from the prescribing physician on letterhead stationery for controlled substances and injectable medications)
- ❑ Anti-diarrheal (loperamide hydrochloride)
- ❑ Antibiotic for self-treatment of moderate to severe diarrhea or infections (discuss with your doctor)
- ❑ Antihistamine
- ❑ Decongestant, alone or in combination with antihistamine
- ❑ Motion sickness medication if you are susceptible
- ❑ Acetaminophen or aspirin for fever
- ❑ Ibuprofen for pain
- ❑ Acetaminophen with codeine for strong pain
- ❑ Cough suppressant/expectorant
- ❑ Throat lozenges
- ❑ Antacid
- ❑ 1 percent hydrocortisone cream
- ❑ Bacitracin ointment or similar antibacterial cream
- ❑ Antifungal cream

If the expedition will require traveling by plane, carry medications in their original containers in your carry-on luggage. All liquids and gels must be less than 3 ounces and carried together in a resealable plastic bag.

Any expedition member with a medical condition should carry a medical history including any medications used, even if the condition is under control. This allows for quick reference in case of an emergency. Medical histories can be stored on a computer memory stick. This confidential personal information is not to be shared except with appropriate medical authorities in an emergency. Make sure to get simple written permission from the traveler, in advance, so this information can be shared in an emergency.

The Sweet Sixteen of BSA Safety

The "Sweet Sixteen" of BSA safety procedures for physical activity—16 points that embody good judgment and common sense—are applicable to all activities.

1. **Qualified Supervision.** Every BSA activity should be supervised by a conscientious adult who understands and knowingly accepts responsibility for the well-being and safety of the children and youth in his or her care. The supervisor should be sufficiently trained, experienced, and skilled in the activity to be confident of his/her ability to lead and to teach the necessary skills and to respond effectively in the event of an emergency. Field knowledge of all applicable BSA standards and a commitment to implement and follow BSA policies and procedures are essential parts of the supervisor's qualifications.
2. **Physical Fitness.** For youth participants in any potentially strenuous activity, the supervisor should receive a complete health history from a health-care professional, parent, or guardian. Adult participants and youth involved in higher-risk activity (e.g., scuba) may require professional evaluation in addition to the health history. The supervisor should adjust all supervision, discipline, and protection to anticipate potential risks associated with individual health conditions. Neither youth nor adults should participate in activities for which they are unfit. To do so would place both the individual and others at risk.
3. **Buddy System.** The long history of the buddy system in Scouting has shown that it is always best to have at least one other person with you and aware at all times as to your circumstances and what you are doing in any outdoor or strenuous activity.
4. **Safe Area or Course.** A key part of the supervisor's responsibility is to know the area or course for the activity and to determine that it is well-suited and free of hazards.
5. **Equipment Selection and Maintenance.** Most activity requires some specialized equipment. The equipment should be selected to suit the participant and the activity and to include appropriate safety and program features. The supervisor should also check equipment to determine that it is in good condition for the activity and is properly maintained while in use.
6. **Personal Safety Equipment.** The supervisor must ensure that every participant has and uses the appropriate personal safety equipment. For example, activity afloat requires a life jacket properly worn by each participant; bikers, horseback riders, and whitewater kayakers need helmets for certain activities; skaters may need protective gear; and all need to be dressed for warmth and utility depending on the circumstances.
7. **Safety Procedures and Policies.** For most activities, there are common-sense procedures and standards that can greatly reduce the risk. These should be known and appreciated by all participants, and the supervisor must ensure compliance.

8. **Skill Level Limits.** There is a minimum skill level requirement for every activity, and the supervisor must identify and recognize this minimum skill level and be sure that no participants are put at risk by attempting an activity beyond their ability. A good example of skill levels in Scouting is the venerable swim test, which defines conditions for safe swimming based on individual ability.
9. **Weather Check.** The risk factors in many outdoor activities vary substantially with weather conditions. These variables and the appropriate response should be understood and anticipated.
10. **Planning.** Safe activity follows a plan that has been conscientiously developed by the experienced supervisor or other competent source. Good planning minimizes risks and also anticipates contingencies that may require emergency response or a change of plan.
11. **Communications.** The supervisor needs to be able to communicate effectively with participants as needed during the activity. Emergency communications also need to be considered in advance for any foreseeable contingencies.
12. **Plans and Notices.** BSA tour and activity plans, council office registration, government or landowner authorization, and any similar formalities are the supervisor's responsibility when such are required. Appropriate notification should be directed to parents, enforcement authorities, landowners, and others as needed, before and after the activity.
13. **First-Aid Resources.** The supervisor should determine what first-aid supplies to include among the activity equipment. The level of first-aid training and skill appropriate for the activity should also be considered. An extended trek over remote terrain obviously may require more first-aid resources and capabilities than an afternoon activity in the local community. Whatever is determined to be needed should be available.
14. **Applicable Laws.** BSA safety policies generally run parallel or go beyond legal mandates, but the supervisor should confirm and ensure compliance with all applicable regulations or statutes.
15. **CPR Resource.** Any strenuous activity or remote trek could present a cardiac emergency. Aquatics programs may involve cardiopulmonary emergencies. The BSA strongly recommends that a CPR-trained person (preferably an adult) be part of the leadership for any BSA program. Such a resource should be available for strenuous outdoor activity.
16. **Discipline.** No supervisor is effective if he or she cannot control the activity and the individual participants. Youth must respect their leader and follow his or her direction.

Obtain Necessary Documents

Countries that require vaccination for yellow fever will inspect the traveler's vaccination record before allowing entry and may require vaccination on-site, or else deny the unvaccinated person entry into the country.

All travelers must have valid identification for domestic or international travel. Valid passports are necessary to travel outside the United States. Visas required for most countries are issued at the destination airport, but some countries require a visa ahead of time for U.S. citizens. In some cases, obtaining a visa can take several weeks, so plan ahead.

Before departure, be sure to obtain any necessary permits to enter restricted areas, to do photography or specimen collection, or to bring certain kinds of technical equipment into a country. Getting all the permits ahead of time will prevent delays and ensure you have the necessary permissions. All of this information should be available from the embassy of the destination country.

Make photocopies of passports, visas, and vaccination records in case of loss or theft. One good way to keep copies of documents is to put them on a computer memory stick or thumb drive in addition to having hard copies.

Understand the Legal Considerations

Travel and exploration always pose some risks. Everyone should understand that unplanned events and sudden surprises may trip up even the most prepared individual. All participants must be fully informed of risks. They also must understand that they are voluntarily accepting these risks.

An understanding of basic legal liability and definitions is useful for comprehending documents you may be required to sign. Legal aspects should be discussed with an attorney or legal advisors for the specific circumstances, if necessary.

Be aware that laws and legal issues in foreign countries can be very different from those in the United States. Fines and imprisonment can be severe. If you have a legal problem overseas, immediately contact the American embassy.

Establish Recordkeeping Procedures

Keeping a personal journal is an excellent way to record your experiences on an expedition and will help you later to recall the details. A personal journal serves as a log of your thoughts and impressions, gives a chronological order of events, and is of great use when later preparing a presentation or discussion of your findings.

Documentation is also important for other areas. Supply lists help keep track of inventory and alert you to possible shortages. A list should be kept of medications used from the team medical kit with a log of any individual who was given medication, along with the symptom, date, and time. Also be sure to document any adverse events or problems that arise. Such documentation will help to provide an accurate account of the event, assist in questions involving legal issues, and provide information to resolve any insurance issues.

Besides capturing your personal impressions, you will need to record your data, likely in a separate document or notebook. It is important to back up any data that is logged into a computer. Photos are certainly part of the record.

Follow Outdoor Ethics Guidelines

Much like hikers, cyclists, and kayakers, explorers understand the importance of being responsible stewards of the outdoors. Explorers may be on land, in a cave, below or above water, or in space. Wherever they may be, they share the positive environmental ethic that helps keep our waters, mountains, air, and other locales enjoyable for generations to come.

By practicing the Principles of Leave No Trace and Tread Lightly!, and by following the Boy Scouts of America's Outdoor Code, you can help minimize impacts and enjoy the outdoors responsibly.

The Principles of Leave No Trace*

1. **Plan ahead and prepare.** Consider your group's size, age, and skill level. Gather information (geography, weather, regulations) about the place you will be visiting, and allow enough time to get there.
2. **Travel and camp on durable surfaces.** Follow and use established trails and campsites.
3. **Dispose of waste properly.** Pack it in, pack it out. Pack out all leftover food and trash—this may include human waste, toilet paper, and hygiene products. Keep water sources clean.
4. **Leave what you find.** Examine cultural or historic structures, artifacts, rocks, plants, and other natural objects—but leave them alone.
5. **Minimize campfire impacts.** Use lightweight stoves for cooking and battery-operated lanterns instead of campfires. If fires are permitted, use established fire rings, keep them small, and put them out cold.
6. **Respect wildlife.** Enjoy wildlife during the right time of year, from afar, and never feed them. Store rations and trash securely.
7. **Be considerate of other visitors.** Respect their privacy and property, and allow them to enjoy the outdoors peacefully.

*The member-driven Leave No Trace Center for Outdoor Ethics teaches people how to enjoy the outdoors responsibly. This copyrighted information has been reprinted with permission from the Leave No Trace Center for Outdoor Ethics: www.LNT.org.

As an amateur explorer, consider how exploration activities and their associated scientific goals may affect historical artifacts or pristine environments and ecosystems, which belong to all of humanity and history. Practice the highest level of outdoor ethics possible early on, and those good habits will become exactly that—habits!

Tread Lightly! Principles**

Travel responsibly. Stay on designated roads, trails, and areas. Cross streams and launch your watercraft only in designated areas.

Respect the rights of others. This includes private property owners, all recreational trail users, campers, and others.

Educate yourself. Plan for your trip by obtaining maps, regulations, and other information from public agencies. Know how to operate your equipment safely.

Avoid sensitive areas. Many of these areas, such as historical, archaeological, and paleontological sites, are also protected by law.

Do your part. Be a model user of the outdoors; leave the area better than you found it.

For more information about outdoor ethics, Leave No Trace, and Tread Lightly!, see the *Scouts BSA Handbook for Boys, Scouts BSA Handbook for Girls,* and *Fieldbook.*

The Outdoor Code

The BSA's Outdoor Code reminds Scouts of the importance of caring for the environment. It has special meaning wherever you may be exploring.

Outdoor Code

As an American, I will do my best to—
Be clean in my outdoor manners,
Be careful with fire,
Be considerate in the outdoors, and
Be conservation-minded.

**Tread Lightly! is a powerful campaign to promote responsible recreation through stewardship, communication, and education. This copyrighted information has been reprinted with permission from Tread Lightly!: www.treadlightly.org.

Prepare a Report

After you return, you will share the data and findings of your exploration. It is useful to compile a report about your expedition including objective, preparation activities, findings, and conclusions about your findings.

A conclusion could be very simple. You should note whether the expedition was a success and whether it accomplished its goals. For formal scientific expeditions, leaders may need to summarize findings in formal reports, and individual scientists will document their findings and their interpretation or ideas about what they found, what the discovery means, and its importance.

Hold an After-Action Review

After you return, you will want to conduct a review of your expedition, paying special attention to how well-equipped you were, what actions were successful, and how efficiently your team performed. It is also important to reflect on what did not work well or what could be improved. This review can be recorded if desired, but the important thing is to evaluate the positives and negatives of your expedition. This honest reflection will be of great value the next time you plan an expedition.

In addition to a written report, you might give a talk or make a presentation of your findings. If a problem or dispute arose, you may be required to provide information. These are all reasons why accurate record keeping is important.

Exploration and Documentary Production

"Documentary production plays an important role in exploration because it captures visual testimony of events and discoveries. It supplements written reports of expeditions, documents research in remote areas, and provides real-time environments and circumstances.

"A perfect example of documentary value occurred recently when I was dropped by helicopter atop the isolated mountain range of Cape Melville on Australia's northeastern Cape York Peninsula, along with *National Geographic* photographer Tim Laman and herpetologist Conrad Hoskin. With peaks composed of boulders the size of school buses, Cape Melville's seemingly perilous summits had been largely unexplored for science before the team traveled there in search of unknown species. The upland of Cape Melville is a thoroughly isolated rain forest. … Within just two days the team found five new reptile and amphibian species, including a magnificent leaf-tail gecko living in what headlines around the world subsequently dubbed a 'Lost World'—just miles from human habitation. These rain forest-associated inhabitants have been completely isolated up there for millions of years.

"Verbal reports could not do justice to these discoveries. So go explore … and don't forget your video camera!"

—Nancy Donnelly
National Geographic producer; Fellow, The Explorers Club

Nancy Donnelly at Cape Melville, Australia, "Lost World" camp

A new species of leaf-tail gecko found on an expedition with documentary producer and explorer Nancy Donnelly

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Ilona Titova

Going on an Expedition

In working to earn the Exploration merit badge, you will prepare for an expedition (requirement 7) and then go on the expedition (requirement 8). You are to make an expedition to an area you have not previously explored.

Whether you choose a remote area or someplace nearby, plan and prepare carefully and thoroughly, using the steps and the skills you have learned in completing requirements 6 and 7. Your expedition must be supervised by your merit badge counselor or by a counselor-approved person. Qualified expedition advisors might be recruited from the ranks of school science teachers, museum educators, park rangers, nature instructors, and others with scientific knowledge as well as outdoor skills and expertise.

Packing an Animal?

Any expedition traveling into a remote and rugged area where the use of pack animals (horses, mules, llamas, etc.) might be required calls for appropriate planning to include attention to the health and welfare of these animals. This includes food, water, medical supplies, vaccinations, health certificates, and so on. Similarly, if one's expedition included only a companion pet, that animal's needs must be planned for, as well (water, food, leashes, etc.).

Exploration Organizations

Several organizations make exploration a key part of their function and membership. Studying their websites and perhaps contacting the organization may give you insights for your expedition and also connect you with people who can serve as resources for information.

A good way to begin your efforts in exploration is to volunteer with one of these organizations or to get to know scientists within your community. Become acquainted with museums, local high school science teachers, the science departments of community colleges or universities, and the local chapters of organizations that have exploration interests. These scientists often can serve as mentors and consultants to an exploration project.

Some of the best known exploration-related organizations are

- National Geographic Society
- The Explorers Club
- Alpine Club
- Smithsonian Institution
- World Wildlife Fund
- National Science Foundation
- National Aeronautics and Space Administration (NASA)
- National Oceanic and Atmospheric Administration (NOAA)

Getting Started: Join The Explorers Club

If you are 16 years old or have earned the Exploration merit badge, you are eligible for student membership in The Explorers Club, where you can network with explorers from all over the world and many areas of interest. With your parent's permission, download the application from www.explorers.org; contact the National Eagle Scout Association to find an Explorers Club sponsor for the required letter of recommendation. No exploration experience is necessary to become a student member.

Become an Explorer!

"Each of us can be an explorer, every day of our lives. Exploration is investigating the world around us—wherever it is. We may think of Meriwether Lewis and William Clark, who mapped and documented the American West; or Ernest Shackleton in search of the South Pole. However, exploration doesn't require a trip halfway around the world. We can each be an explorer in our own neighborhood—investigating the animals, plants, soils, weather, stars, and other parts of the environment. We can be an explorer in the city—learning about the people—perhaps doing a service project in a school or senior facility.

"Exploration is learning something new by doing. Along with curiosity and some creativity, exploration requires a careful plan, implementation, documentation, and an after-action review. Learn about the world around you. Become an explorer!"

—Rear Admiral (retired) Joyce Johnson, D.O., U.S. Public Health Service Former chief medical officer and surgeon general, U.S. Coast Guard; Fellow, The Explorers Club

Physician and explorer Dr. Joyce Johnson undergoing polar survival training with the U.S. Coast Guard

Glossary

aerospace. Space including Earth's atmosphere and the space beyond.

alpine. Mountainous or high; relating to or resembling lofty mountains.

anthropology. The study of human beings, past and present.

archaeology. The study of the human past using material remains such as structures, artifacts, and monuments.

biochemistry. Chemistry that deals with the chemical compounds and processes occurring in living things.

biodiversity. The biological diversity (variety) in an environment as indicated by the numbers of different species of plants and animals that live in that ecosystem.

bioprospecting. The search for plant and animal species from which medicinal drugs and other commercially valuable products can be obtained.

canopy. The uppermost spreading branch layer of a forest; the treetops.

concept. A general idea or understanding of something; or a plan or intention.

cultural anthropology. The study of human culture, especially social structure, language, law, politics, religion, art, and technology.

deforestation. The clearing or destruction of forests.

dopamine. A chemical that is responsible for transmitting signals between the nerve cells of the brain.

ecosystem. A community of living organisms (plants, animals, and microbes) interacting with the nonliving parts of their environment (things like air, water, and soil).

extremophile. An organism that lives under extreme environmental conditions (as in a hot spring or an ice cap).

fauna. Animal life.

findings. The results of an investigation.

gene. A unit of heredity that is passed from parent to offspring.

genome. The complete set of genes or genetic material of an organism.

hyperthermophile. An organism that lives in extremely hot environments.

interdependent. Mutually dependent; depending on each other.

interdisciplinary. Involving two or more scientific or artistic disciplines (fields of study).

interpretation. Explanation, analysis, clarification, or understanding.

latitude. Distance north or south from Earth's equator measured through 90 degrees.

linguistics. The study of human speech and language.

logistics. The handling of the details of an operation.

macromolecule. A very large molecule (as of a protein).

mammalian. Of a class of warm-blooded backboned animals that have hair, nourish their young with milk produced by mammary glands, and include humans.

microbe. An organism of microscopic size; microorganism.

migration. Moving from one place to another; roaming (often at set times) from one region or climate to another for feeding or breeding.

molecular biology. The branch of biology that deals with the structure and functions of the proteins and other molecules essential to life.

molecule. The smallest particle of a substance that retains all the properties of the substance and is composed of one or more atoms.

neuroscientist. One who studies the function of the nervous system.

oceanography. The science dealing with Earth's oceans, marine biology, marine resources, and the physics and chemistry of seawater.

paleoanthropology. The study of extinct and prehistoric human ancestors, mainly through examining their fossils and artifacts.

Paleolithic. A prehistoric period when human ancestors first made and used primitive stone tools.

paleontology. The study of the fossil remains of animals and plants.

physical anthropology. The study of human evolution and physical variation.

plate tectonics. The theory that Earth's outer shell or crust is divided into several plates that glide over the mantle, the rocky inner layer above the central core.

species. A group of animals, plants, or other living things that all share common characteristics; are of a distinct kind or sort and are classified alike; and usually interbreed only among themselves.

speleology. The study or exploration of caves.

subatomic. Smaller than an atom.

subglacial. Beneath a glacier (a large body of ice).

subterranean. Underground.

terrain. The physical features of an area of land.

Exploration Resources

Scouting Literature

Scouts BSA Handbook for Boys; and *Scouts BSA Handbook for Girls; Fieldbook; Archaeology, Astronomy, Aviation, Bird Study, Chemistry, Environmental Science, First Aid, Fish and Wildlife Management, Forestry, Geology, Insect Study, Inventing, Mammal Study, Medicine, Mining in Society, Nature, Nuclear Science, Oceanography, Photography, Plant Science, Reptile and Amphibian Study, Robotics, Scuba Diving, Signs, Signals, and Codes, Soil and Water Conservation, Space Exploration, Veterinary Medicine, Weather,* and *Wilderness Survival* merit badge pamphlets

With your parent's permission, visit the Boy Scouts of America's official retail website, www.scoutshop.org, for a complete listing of all merit badge pamphlets and other helpful Scouting materials and supplies.

Books

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Ross, Stewart. *Into the Unknown: How Great Explorers Found Their Way by Land, Sea, and Air*. Candlewick, 2014.

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Burns, Ken. *Lewis & Clark: The Journey of the Corps of Discovery* (DVD). PBS, 1997.

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National Geographic Live! *The Explorers: Paul Sereno & Phillip Manning* (DVD), National Geographic, 2008.

Nautilus Live (live streaming). Ocean Exploration Trust, http://www.nautiluslive.org

NOVA: The Vikings (DVD). PBS, 2006.

The Polar Explorer (DVD). PBS Home Video, 2012.

Organizations and Websites

American Alpine Club
710 10th St., Suite 100
Golden, CO 80401
Telephone: 303-384-0110
Website:
http://www.americanalpineclub.org

American Museum of Natural History
Central Park West at 79th Street
New York, NY 10024-5192
Toll-free telephone: 800-462-8687
Website: http://www.amnh.org

The Explorers Club
46 E. 70th Street
New York, NY 10021
Telephone: 212-628-8383
Website: http://explorers.org

National Aeronautics and Space Administration
NASA Headquarters
300 E. Street SW, Suite 5R30
Washington, DC 20546
Telephone: 202-358-0001
Website: http://www.nasa.gov

National Eagle Scout Association (NESA)
Boy Scouts of America
1325 West Walnut Hill Lane
P.O. Box 152079
Irving, TX 75015-2079
Telephone: 972-580-2000
Website: http://www.nesa.org

Visit the NESA website to learn more about its exciting **World Explorers Program** for Eagle Scouts.

National Geographic Society
1145 17th Street NW
Washington, DC 20036-4688
Toll-free telephone: 800-647-5463
Website:
http://www.nationalgeographic.com/explorers

This web address does not appear on the Nat Geo website. There is an Explorer Academy page with a different address. Should the listing be revised in any way?

National Oceanic and Atmospheric Administration
1401 Constitution Avenue, NW
Room 5128
Washington, DC 20230
Telephone: 301-713-1208
Website: http://www.noaa.gov

National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230
Telephone: 703-292-5111
Website: http://www.nsf.gov

Smithsonian Institution
P.O. Box 37012
SI Building, Room 153, MRC 010
Washington, DC 20013-7012
Telephone: 202-633-1000
Website: http://www.si.edu

World Wildlife Fund
P.O. Box 97180
Washington, DC 20090-7180
Telephone: 202-293-4800
Website: http://www.worldwildlife.org

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Paleoanthropology: Lee R. Berger, Ph.D., Exploration merit badge co-developer; Distinguished Eagle Scout; professor and director, Institute for Human Evolution, University of the Witwatersrand, Johannesburg, South Africa; National Geographic Explorer-in-Residence; Fellow, The Explorers Club

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Diving technology: D. Karin Lynn, captain, Civil Engineer Corps, U.S. Navy (retired); trustee and member, Women Divers Hall of Fame; Fellow, The Explorers Club

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Marine biology: Ellen Prager, Ph.D., chief scientist, undersea research station Aquarius Reef Base program, Key Largo, Florida; marine scientist consultant for "Good Morning America"; author and frequent media guest; Fellow, The Explorers Club

Marine mammal biology: Martin T. Nweeia, D.M.D., D.D.S., Harvard School of Dental Medicine; scientist, National Science Foundation; Fellow, The Explorers Club

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Meteorology: Jack Williams, Eagle Scout; founding weather editor of *USA Today* and author of several books on climate and weather; Fellow, The American Meteorological Society; Fellow, The Explorers Club

Microbiology: Jay Short, Ph.D., molecular biologist and entrepreneur; founder, BioAtla and Diversa (now BATF); widely published with more than 100 patents; a pioneer in extremophile discovery; Fellow, The Explorers Club

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