Welcome to Yellowstone National Park. If you are a newcomer to the Yellowstone Forever Institute, you will be amazed at what awaits you during each day of exploration. We are glad that you are able to join us at Old Faithful, one of the park’s most iconic locations. Our goal is to provide you with an enjoyable, high-quality educational experience and a safe and memorable visit to Yellowstone.

The following information is provided to help you prepare for your program. Please read it thoroughly and call us at 406.848.2400 or email contact@yellowstone.org if you have any questions. We recommend all first-time visitors seek general park information through the National Park Service at 307.344.2107 or www.nps.gov/yell.

**Important Information Included in this Document**
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**From the Instructor**

Welcome to Yellowstone National Park and Yellowstone Forever seminar, "Into the Depths of Yellowstone Lake". Yellowstone National Park is the world’s first national park, site of North America’s largest silicic volcano, and the world’s largest concentration of geothermal features. The Park, rimmed by a crescent of older mountainous terrain, has at its core the Quaternary Yellowstone Plateau, an undulating landscape shaped by forces of late Cenozoic explosive and voluminous volcanism and later glaciation. The 0.63-Ma Yellowstone caldera is the centerpiece of the Yellowstone Plateau and is one of the largest calderas on Earth measuring ~75-km x 45-km in diameter. The floor of the Yellowstone Caldera lies above a large, partially molten, magmatic complex.

Yellowstone Lake, the largest high altitude (defined at above 7000 ft. in elevation) lake in North America, straddles the southeast margin of the Yellowstone Caldera and lies in the heart of Yellowstone. Ferdinand Hayden led the 1871 survey to Yellowstone being interested in watersheds, specifically that of...
the Yellowstone River, and wanted to reach and map Yellowstone Lake. Henry Elliott, a member of the survey party, led the exploration to establish the shape and depths of Yellowstone Lake and, in 1871, produced the first bathymetric map of Yellowstone Lake. Several other mapping efforts have occurred since then, each one a marked improvement of the previous map, due to advances in navigation and technology.

Multi-beam sonar imaging and seismic-reflection surveys of the northern, central, and West Thumb basins of Yellowstone Lake provide insight into post-caldera volcanism and active hydrothermal processes occurring in a large lake environment above a magma chamber. High-resolution mapping of the lake floor reveals an irregular lake bottom covered with dozens of features directly related to hydrothermal, tectonic, volcanic, and sedimentary processes. Newly mapped rhyolitic lava flows that underlie much of the northern, central, and West Thumb basins exert fundamental control on lake geology, basin bathymetry, and localization of hydrothermal vent sites. Imaged and identified features include over 650 hydrothermal vent sites, several very large (>500 m diameter) and many small hydrothermal explosion craters (~1-200 m diameter), elongate fissures cutting post-glacial (<12 ka) sediments, siliceous hydrothermal spires as tall as 8 m, sublacustrine landslide deposits, deformed lacustrine sediments associated with domal structures and hydrothermal vents, submerged former shorelines, and a recently active graben. Sampling and observations with a submersible remotely operated vehicle (ROV) confirm and extend our understanding of many of the identified features.

Several powerful geological processes in Yellowstone National Park have contributed to the unusual shape of Yellowstone Lake, which straddles the southeast margin of the Yellowstone caldera. Volcanic forces contributing to the lake's form include the 2.057±0.005-Ma caldera-forming eruption of the Huckleberry Ridge Tuff followed by eruption of the 0.631-Ma Lava Creek Tuff to form the Yellowstone Caldera. A smaller caldera-forming event about 165,000 years ago, comparable in size to Crater Lake, Oregon, created the West Thumb basin. Large-volume post-caldera rhyolitic lava flows are exposed west and southwest of the lake. Several significant glacial advances and recessions overlapped the volcanic events and helped deepen the fault-bounded South and Southeast Arms. More recent dynamic processes shaping Yellowstone Lake include currently active fault systems, erosion of a series of post-glacial shoreline terraces, and postglacial (<16 ka) hydrothermal-explosion events, which created the Mary Bay crater complex and other craters. Formation of hydrothermal features in Yellowstone Lake is related to convective meteoric hydrothermal fluid circulation above a cooling magma chamber. Hydrothermal explosions result from an accumulation and release of steam generation during fluid ascent, possibly reflecting changes in confining pressure that accompany and may accelerate failure and fragmentation of overlying cap rock. Sealing of surficial discharge conduits due to hydrothermal mineral precipitation also contributes to overpressuring and catastrophic failure. Heat-flow maps show that both the northern and West Thumb basins of Yellowstone Lake have extremely high heat flux compared to other areas in the lake and the park. Earthquake epicenter locations indicate that the areas within the lake and north of the lake are seismically active. Dives on hydrothermally active areas within the lake using a submersible remotely operated vehicles have collected hydrothermal fluids and solids, microbial material, and photographically documented the floor of the lake.

As your instructor, I have been involved in various mapping efforts of Yellowstone Lake, beginning in 1999 (USGS high resolution bathymetric map of entire lake 1999-2003), selected features in the northern basin 2012 with University of Illinois), and now on a NSF-funded grant looking at forcing mechanisms of hydrothermal activity focused on seismic activity and annual lake level changes.

As your instructor in the five-day course, my goals are to show you examples of various geological features that contribute to the geology of the lake floor. We will focus on:

- The physical and morphological characteristics of post-caldera rhyolitic lava flows exposed peripheral to Yellowstone Lake.
• The physical and morphological characteristics of post-glacial hydrothermal explosion craters and their ejected deposits.
• Smaller, more abundant hydrothermal vents and structures surrounding the lake.
• Features of the Yellowstone Caldera.

Most of our time will be spent in the field; however, we will start the class with an overview of the geology of Yellowstone National Park and how Yellowstone Lake fits into this. The class will be based at Old Faithful. We will start early each day after breakfast (7:30 a.m.) so be prepared to take a lunch into the field. We may hike up to 12 miles each day; most days will be less averaging around 8. This class is being held in summer months (August), however, weather on the Yellowstone Plateau can be quite variable. It is important to bring warm clothing, rain gear, extra socks, and good hiking shoes. Participants will also want to bring, in addition to their box lunch, ample water, snacks, and sunscreen and other sun protection. We’ll be lodging at Old Faithful so we have plenty of opportunity to observe Old Faithful and look at thermal features on Geyser Hill and the Upper Geyser Basin. We’ll discuss the behavior of geysers, the different kinds of thermal waters at Yellowstone, and the gases emitted through the ground. We’ll talk about how volcanologists try to use this information to decipher the workings of the magma chamber, and how geyser basins are affected by earthquakes, ground movements, and other geophysical phenomena familiar at Yellowstone.

By the time the seminar is over, you should have a good understanding for how Yellowstone Lake evolved. By examining analogous on-land features identified in the bathymetric map of Yellowstone Lake, I hope this seminar will give participants a better perspective on how Yellowstone Lake formed and how Yellowstone Lake fits into the Yellowstone Caldera. Except for the evening lecture, all class time will be spent, rain or shine, walking around in the outdoors and making observations. Each day will consist of several short 0.5- to 4-mile round-trip hikes on park trails, including easy climbs. Good walking or hiking shoes are required, as we could accumulate up to 12 miles in one day.

Lisa Morgan, USGS
Scientist emeritus, Yellowstone Volcano Observatory

Tentative Agenda
Day One: August 7, 2019

7:00 p.m. Orientation of class and the next five days in the field. I’ll provide an overview of the geology of Yellowstone Lake and how it fits into the Yellowstone Plateau and the 630,000-year-old Yellowstone Caldera.

Lunch and snacks are not provided, so please make sure you bring a lunch, snacks, and adequate water for your needs during each day, schedules may change due to weather.

Day 2: August 8, 2019

7:15 a.m. Each day, we will meet in front of the fireplace at the Old Faithful Lodge. not the Inn.
7:30 a.m. Depart for day. Locations that are included in the seminar are subject to change depending on conditions in June.
• Today we will head north and east along the topographic margin of the Yellowstone Caldera.
• Our first stop is at Terrace Hot Springs, along the northwestern margin of the caldera.
• We next will drive to the trail head for Monument Geyser Basin (about 2 miles total, 1000 ft elevation gain) to examine structures very similar in formation to the spires discovered in Yellowstone Lake.
• We next will drive to the Falls of the Yellowstone Canyon where we will see Yellowstone Falls cutting into hydrothermally altered glacial and volcanic rock. We will discuss structures present in the exposures.
We will drive south along the northward-flowing Yellowstone River into the Hayden Valley, site of ancestral Lake Yellowstone, a much larger lake than exists today.
Continue south until LeHardys Rapids where we will look at active deformation associated with the Yellowstone Caldera.
Next stop is the Fishing Bridge Visitors’ Center where we will look at a 3-dimensional bathymetric map of Yellowstone Lake.
Our last stop of the day is at Bridge Bay where we will examine structures associated with the active deformation of Yellowstone Lake.
Return to Old Faithful around 6 pm.

Day 3:  August 9, 2019
7:15 a.m.  Each day, we will meet in front of the fireplace at the Old Faithful Lodge. not the Inn.
7:30 a.m.  Depart for day. These locations are subject to change depending on conditions in June.
We will head east today over Craig Pass passing through several post-caldera rhyolitic lava flows.
Our first stop is on the northern shore of Yellowstone Lake where we will examine several hydrothermal explosion deposits.
Big hike of the day is to Turbid Lake, a 10,300-year-old hydrothermal explosion crater.
We will drive east to Steamboat Point, an active, hydrothermally altered steam system.
We will hike out to Storm Point, a 4,600 year-old hydrothermal dome.
Return to Old Faithful around 6 pm.

Day 4:  August 10, 2019
7:15 a.m.  Each day, we will meet in front of the fireplace at the Old Faithful Lodge. not the Inn.
7:30 a.m.  Depart for day. These locations are subject to change depending on conditions in June.
We will head east again over Craig Pass to West Thumb geyser basin.
We will look at exposures of rhyolite lava impacted by water.
Next stop hike to top of Elephant Back Mountain.
We will visit Duck Lake, a large hydrothermal explosion crater.
Return to Old Faithful around 6 pm.

Day 5:  August 11, 2019
7:15 a.m.  Each day, we will meet in front of the fireplace at the Old Faithful Lodge. not the Inn.
7:30 a.m.  Depart for day. These locations are subject to change depending on conditions in June.
Stop at Midway Geyser Basin. We will walk around Excelsior Crater, which erupted initially as a large hydrothermal explosion crater in 1898, as well as Grand Prismatic hot springs, the third largest hot spring on Earth and the largest one in North America.
We will head north and west from Old Faithful today and drive to Biscuit Basin. Here we will look and discuss recent hydrothermal activity at Black Opal. We will hike west toward Mystic Falls, whose location is controlled by the contact between the Spruce Creek rhyolite to the south and the younger West Yellowstone rhyolite flow to the north.
Next we will drive to Black Sand Geyser Basin and look at another excellent example of rhyolitic lava flows controlling the distribution of hydrothermal systems.
Return to Old Faithful. We will watch an Old Faithful eruption and walk up onto Geyser Hill.
Conclude seminar at 5:00 pm.
If people have time and are interested, we can meet in the Bear Pit Lounge to enjoy cool drinks and wrap up.

What’s Included:
Your tuition includes daily outings and transportation during your program. It does not include transportation to the park, park entrance fees, meals, or lodging. Gratuities are not included in the price of programming. If you would like to recognize exceptional service by an Institute staff member, tips are
appreciated. Donations to support Yellowstone Forever educational programs are also appropriate and will be used to improve and expand opportunities for people to make deep connections to Yellowstone.

**Continuing Education Credit**

Many of our Field Seminars are recognized by universities across the country. We are happy to provide a letter of completion and supporting documentation that you can submit to the institution of your choice to request approval for university credit or CEUs.

**Lodging Option**

Rooms will be held until 30 days prior to the program in the Old Faithful area for students attending this program for an additional charge. To make your reservation, please call 866.439.7375 and give them the Yellowstone Forever Institute program name.

**How to Prepare for this Program:**

**How fit do you need to be?**

This program is an activity level 4 and students enrolled in this program are expected to be active participants. Be prepared to hike up to 8 miles per day, at a brisk pace, comfortably, with climbs up to 1500 feet on dirt trails. Loose rocks, uneven footing, and off-trail hiking are possible. Good coordination is recommended. We recommend you begin an exercise program right away if you have not already done so. Participants residing at lower elevations may want to arrive a day early to adjust to the altitude. To learn more about how specific medical conditions can be affected by Yellowstone’s environment and our activities, please visit www.Yellowstone.org/experience/health-information/

**General Clothing and Equipment List**

Much of your time will be spent outdoors and all programs are held rain, snow, or shine. You should be prepared for a variety of mountain weather conditions and temperatures. Appropriate clothing, equipment, and footwear are very important. Spring, summer, and fall temperatures can range from below freezing in the mornings to 85 degrees Fahrenheit in the afternoons. The layered use of garments for protection against the wind, sun, and temperature extremes should guide your clothing choices. Loose-fitting layers allow you to maintain a comfortable and dry body as outside temperatures change, and as your own body temperature and moisture output changes with different levels of exertion. Some colder-weather items may not be needed in July or August, but please keep in mind that Yellowstone’s weather is unpredictable.

**Equipment**

Yellowstone Forever field staff assigned to your program will be carrying a first aid kit, bear spray, and emergency communication device.

- □ Daypack, with enough capacity to carry extra clothes, water, lunch, camera, binoculars, field guides, etc.
- □ Water bottle, one-quart is the minimum recommended. Camelback or similar hydration systems work well in summer but can freeze in winter.
- □ Sunglasses
- □ Sunscreen/lip protector, sun at high altitude can burn unprotected skin quickly.
- □ Camera, binoculars
- □ Notebook/pencil
- □ Pocket hand and foot warmers, recommended November through May.
- □ Flashlight/Headlamp, a small light for walking to and from your cabin in the evenings and mornings.
- □ Alarm, so you’re on time for the day’s activities.
**Summer Clothing**

- Insulating underwear, capilene, polypropylene, or similar wicking fabric.
- Midweight insulating layer, light, 200-weight synthetic fleece or wool shirt/pullover.
- Heavyweight insulating layer, wool, down, or heavy-weight fleece jacket, for less-active times.
- Waterproof and windproof outer layer, lightweight and breathable. Jackets and pants are recommended.
- Short sleeved shirt, cotton okay in summer, but synthetic wicking shirts are ideal.
- Pants, synthetic hiking pants, lightweight pile/fleece pants or tights or similar. Jeans are not recommended.
- Hats, both a brimmed sun hat and an insulating hat for cool weather.
- Gloves, lightweight glove liners and a pair of wool/fleece gloves or mittens.
- Socks, light wool or synthetic liner sock with heavier wool or synthetic outer sock. The inner-outer sock combination helps prevent blistering, wicks moisture and reduces friction. Cotton socks do not wick moisture and are not recommended.
- Hiking boots, that provide stability, traction, and comfort. Unless you've consistently hiked in athletic shoes, bring boots that provide ankle support.
- Off-duty shoes, sandals, athletic shoes, or other leisure footwear.

**Suggested Reading:**


Park Stores
Our Park Stores feature more than 900 books, maps, and videos to help you plan your visit, along with a wide selection of shirts, hats, and other logo items to remind you of your visit to Yellowstone. Yellowstone Forever supporters receive a 15 percent discount on merchandise online or at any of our 11 locations in and around Yellowstone. Proceeds directly support Yellowstone. Visit: Shop.Yellowstone.org

Supporter Program
Yellowstone Forever Supporters directly fund priority park programs and projects. Supporters also provide scholarships for teachers and help expand programming for underserved youth. Benefits include a subscription to our magazine Yellowstone Quarterly, early registration and discounts for Yellowstone Forever Institute programs, and discounts on retail purchases throughout Yellowstone (exclusions apply). If you are not yet a supporter of Yellowstone Forever, an introductory subscription (one year) to our magazine Yellowstone Quarterly is included with your tuition. For more information, visit: Yellowstone.org/donate

Code of Ethics
The Yellowstone Forever Institute is committed to demonstrating a high standard of appropriate and ethical behavior in Yellowstone. As a participant in a Yellowstone Forever Institute program, we ask you to adhere to the following Code of Ethics. In addition to the ethics highlighted below, the Yellowstone Forever Institute abides by all National Park Service rules and regulations. We also practice Leave No Trace guidelines for traveling responsibly in the wilderness.

- Observing wildlife: We will do our best to have as little impact on wildlife as possible. Animals will be observed from a distance, using high-powered spotting scopes to help keep our presence from affecting their behavior. Participants should not expect to get close-up photographs of wildlife. The Yellowstone Forever Institute will adhere to National Park Service regulations by keeping a minimum distance of 25 yards from bison, elk, bighorn sheep, deer, moose, coyotes and nesting birds and 100 yards from bears and wolves. We will not entice wildlife with food, animal calls or any actions that change their behavior.

- Leave what you find: It is illegal to remove natural or cultural artifacts (plants, animals, bones, rocks, etc.) from Yellowstone. Yellowstone Forever Institute instructors have permission from the National Park Service to manipulate plants, rocks, bones, etc. for educational purposes and will return them to their natural positions and locations.

- General etiquette: Yellowstone Forever Institute groups will be considerate of other visitors and respect the quality of their experience. Voices and vehicle sounds carry great distances and affect both wildlife and people—remaining silent or very quiet while watching wildlife lets the sounds of Yellowstone (including wolf howls) prevail.

- Roads and vehicles: Expect wildlife on the road, and drive at or below the posted park speed limits. When stopping to observe wildlife or other park features, the Yellowstone Forever Institute will move vehicles entirely off the road. If there is no safe pullout available, we will drive to the next safe place and walk back to observe the wildlife. We will not stop in the middle of the road, and should a traffic jam develop as a result of our activities, we will cease the activity.
Properly dispose of waste: We will pack out all trash, leftover food and litter. Your instructor will discuss techniques for properly disposing of human waste in the field.

Traveling lightly: When hiking or walking in Yellowstone, we will use existing trails and boardwalks. We will follow appropriate techniques when walking off-trail. Walking around muddy or wet places in the trail increases erosion and negatively affects the resource; proper equipment is essential to hiking ethically. Participants should come adequately prepared with the equipment listed for their program and should expect to walk through mud, snow or puddles in the trail.

Field Seminar Cancellation and Refund Policy
If you cancel within seven calendar days of your registration date, your payment is refundable less a $50 per person per course processing fee. Under most circumstances, if you cancel on the eighth calendar day or after, from the date of registration, 100% of registration payments will be forfeited. If lodging is cancelled after the eighth calendar day from the date of registration, 100% of lodging payments will be forfeited. Applicable taxes will be refunded in the event of program or lodging cancellations. We reserve the right to cancel a course up to 30 days before the first class day. If we cancel, you will receive a full refund of your payment. We urge you to take out accident, baggage, and trip cancellation insurance through a travel agent or website such as TravelGuard.com. Travel insurance can help protect you against financial loss if you must cancel or interrupt your trip.