

- What is the origin of the Great Salt Lake?
 - After the Lake Bonneville flood, the Great Basin gradually became warmer and drier. Lake Bonneville began to shrink due to increased evaporation. Today's Great Salt Lake is a large remnant of Lake Bonneville, and occupies the lowest depression in the Great Basin.

- Who discovered Great Salt Lake?
 - The Spanish missionary explorers Dominguez and Escalante learned of Great Salt Lake from the Native Americans in 1776, but they never actually saw it. The first white person known to have visited the lake was Jim Bridger in 1825. Other fur trappers, such as Etienne Provost, may have beaten Bridger to its shores, but there is no proof of this. The first scientific examination of the lake was undertaken in 1843 by John C. Fremont; this expedition included the legendary Kit Carson. A cross, carved into a rock near the summit of Fremont Island, reportedly by Carson, can still be seen today.

- Why is the Great Salt Lake salty?
 - Much of the salt now contained in the Great Salt Lake was originally in the water of Lake Bonneville. Even though Lake Bonneville was fairly fresh, it contained salt that concentrated as its water evaporated. A small amount of dissolved salts, leached from the soil and rocks, is deposited in Great Salt Lake every year by rivers that flow into the lake. About two million tons of dissolved salts enter the lake each year by this means.

- Where does the Great Salt Lake get its water, and where does the water go?
 - Great Salt Lake receives water from four main rivers and numerous small streams (66 percent), direct precipitation into the lake (31 percent), and from ground water (3 percent). The total average annual inflow to the lake is about 2.9 million acre feet of water.
 - The Great Salt Lake is a terminal lake because it has no surface outlet (rivers flowing from it). Water is lost from the lake mostly through evaporation. Evaporation rates are highest during the hot summer months and lowest during the winter. An average of about 2.9 million acre feet of water evaporates from the lake annually.

- How big and how deep is the lake, and why does it change in size?
 - Great Salt Lake averages approximately 75 miles long by 35 miles wide at a surface elevation of about 4,200 feet. At this elevation, the lake covers an area of 1,034,000 acres, and has a maximum depth of about 33 feet.
 - It is reported to be the 33rd largest lake in the world and the largest fresh or saltwater lake in the United States after the Great Lakes. Its size and depth, however, vary both

seasonally and over the long term. The magnitude of these changes depends on the balance between the total amount of water that enters the lake and that which leaves.

- On average, the lake level fluctuates one to two feet annually, rising to its highest level during May through July (following the melting of the mountain snowpack) and dropping to its lowest point during October through November (after the hot summer months).
 - In historical time (1847 to present), fluctuations of the lake level have varied over a range of 20 feet from a low of 4,191.35 feet in 1963 to a high of 4,211.85 feet in 1986-1987. The historical average elevation of the lake is about 4,200 feet.
 - Because of the very shallow nature of the lake, even modest changes in its elevation result in relatively large changes in the lake's area and volume. The accompanying map shows the high, average, and low elevations of the lake and pertinent information for each of these elevations.
- How many islands are in the Great Salt Lake, where are they, and are they inhabited?
 - The lake contains 11 recognized islands, although this number varies depending on the level of the lake. Seven islands are in the southern portion of the lake and four in the northwestern portion.
 - The large islands in the southern portion are named Antelope, Stansbury, Fremont, and Carrington. The smaller islands are named Badger, Hat (Bird), and Egg. The four small islands in the northwestern portion are Dolphin, Gunnison, Cub, and Strongs Knob.
 - Antelope Island has been inhabited since pioneer times. A ranch house on Antelope Island is said to be the state's oldest Anglo-built structure on its original foundation and the longest continually inhabited building in Utah. Presently, the Utah Division of Parks and Recreation retains ownership of the ranch house which is open periodically during the summer for tours.
 - Fremont Island has also been inhabited, most notably by Judge Wenner, a probate judge for Salt Lake County, and his family, from 1884 to 1891.
 - Both Gunnison and Carrington Islands were unsuccessfully homesteaded for short periods of time.
 - Antelope Island has been owned by the State of Utah since 1980. It is home to a large herd of buffalo which is managed by the Utah Division of Parks and Recreation. Antelope, deer, and many other animals also live on the island.
 - The northern 2,000 acres of the 23,175-acre island are designated as Antelope Island State Park. The Antelope Island/Syracuse causeway is the only public-access road connecting the island to the mainland.
 - When and why was a railroad built across the Great Salt Lake?

- Great Salt Lake is divided into two parts by the Southern Pacific Transportation Co. (SPTC) causeway. That part north of the causeway and west of Promontory Mountains is called the north arm, and that to the south of the causeway is called the south arm.
 - Bear River Bay, although north of the railroad, is considered part of the south arm of the lake. The south arm and Bear River Bay are connected by an opening in the railroad causeway about four miles east of Promontory Point.
 - In about 1903, the railroad was constructed across the lake as a wooden-trestle structure. The open structure of the trestle allowed for the mixing of water between the north and south arms of the lake. It was built to lessen the distance, degrees of curvature, and time required for trains to travel the previous route around the north end of the lake.
 - By the early 1950s, maintenance costs had become high, and the structure had become unstable under normal operating speeds. Construction of a stable, permanent structure across the lake was needed.
 - By 1953, the SPTC had decided to replace the wooden trestle with a rock-fill causeway to be built parallel to, and about 1,500 feet to the north of, the old trestle. The structure was completed in 1959 at a cost of roughly \$50 million (in 1960 dollars).
 - In 1993, the Trestlewood Division of Cannon Structures, Inc. began to dismantle and salvage the timbers and planking of the old wooden trestle. Salvage operations are still active as of 1995.
- How has the railroad causeway affected the Great Salt Lake?
 - The rock-fill causeway has had two major effects on the Great Salt Lake, both related to restricted circulation of water between the north and south arms: (1) the south arm has maintained a higher water level than the north, and (2), the north arm has become saltier than the south.
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 - The level of the south arm is higher than the north arm because river water enters the south arm at a faster rate than lake water can move northward through the causeway and its openings.
 - Since the construction of the solid-fill causeway, the salt content (salinity) of the north arm has become greater than the south arm. This is due to the following: (1) the south arm receives nearly all of the freshwater tributary inflow to the lake, and (2) the north arm is fed mainly by south arm salty water seeping through the causeway and flowing through the culverts and the breach opening.

- Currently, the north arm of the lake is near its salt-saturation point (24-26 percent) and is about twice as salty as the south arm (12-14 percent).
- What was done about the flooding that occurred around Great Salt Lake during the 1980s?
 - In 1983, the level of Great Salt Lake began to rise, due to above-average annual precipitation. By 1986, the lake rose nearly 12 feet to reach its historic high of 4,211.85 feet. The high lake level caused serious flooding which resulted in millions of dollars in property damage, especially around the south arm of the lake.
 - Flooding disrupted major highway and railroad traffic; inundated mineral-industry solar ponds, roads, beaches, farms, boating facilities and state/federal waterfowl management areas; and threatened water-treatment plants.
 - In 1984, after studying numerous flood-control alternatives, the State of Utah implemented its first flood-control project by breaching the SPTC causeway. The breach consisted of a 300-foot-long bridge-covered opening in the causeway near Lakeside, which allowed the rapid flow of south-arm water into the north arm.
 - Prior to the breach, the elevation of the south arm was over 3.5 feet higher than the north arm. Completed at a cost of about 3.5 million dollars, the project lowered the south arm of the lake by nearly one foot and raised the north arm by about 1.5 feet, within about two months.
 - The lake continued to rise after the causeway breach was completed, forcing the State to implement its second flood-control alternative, pumping water from the lake into the West Desert.
 - Three large pumps installed on the western shore of the lake pumped water via a 4.1-mile-long canal to the West Pond. The pumping project filled the 320,000-acre West Pond with over 800,000 acre-feet of water and greatly increased the net evaporation from the lake. The West Desert Pumping Project was completed at a cost of more than \$60 million.
 - For more than two years, starting in 1987, water was pumped from the north arm of the lake into the West Pond evaporation area in the west desert. During the 26-month life of the project, more than 2.7 million acre-feet of water were pumped, which contained about 695 million tons of salt.
 - The pumps are currently not in use but are maintained in ready condition should the lake rise again.
- How much salt is in Great Salt Lake, and why does the salinity vary?
 - The total amount of salt dissolved in Great Salt Lake is about 4.5 to 4.9 billion tons. As the lake rises, its salinity drops because the same amount of salt is dissolved in more water. The lower the lake level, the saltier the lake becomes. In historical time, the

lake's salinity has ranged from a little less than 5 percent, (just above that of sea water), to nearly 27 percent (beyond which water cannot hold more salt).

- Can I float in Great Salt Lake?
 - You can easily float in Great Salt Lake if the water is salty enough. At the lake's average elevation of 4,200 feet, the south arm of the lake contains about 13 percent salt, which makes it salty enough for most people to float with little effort. When the lake is higher than 4,200 feet, it is less salty and therefore less buoyant. Swimmers float easily in the north arm because it is twice as salty as the south arm.

- What is the chemical composition of Great Salt Lake?
 - The chemical composition of Great Salt Lake is similar to that of typical ocean water. Sodium and chloride are the major ions in the water, followed by sulfate, magnesium, calcium, and potassium. For comparison, the table below shows the concentration of the six major ions in water of Great Salt Lake, a typical ocean, and the Dead Sea.

Chemical compositions (dry weight percents) of Great Salt Lake, typical ocean, and the Dead Sea waters.						
Source	Sodium	Potassium	Magnesium	Calcium	Chloride	Sulfate
Great Salt Lake	32.8	2.0	3.3	0.2	54.5	7.2
Ocean (typical)	30.8	1.1	3.7	1.2	55.5	7.7
Dead Sea	12.3	2.3	12.8	5.3	67.2	0.1

- What activates/industries exist in and near Great Salt Lake?
 - The Great Salt Lake and its environs have been used by swimmers, boaters, bikers, hikers, and hunters for recreational purposes from the mid-1800s to the present.
 - Long-term water-level fluctuations, both high and low, have adversely affected lake recreation over the years, however. Nearly a dozen resorts have either been flooded or left high and dry.
 - The most famous resort, Saltair, was built in 1893 and destroyed by fire in 1971. The lake and its three state parks, Great Salt Lake Saltair Beach, Antelope Island, and Willard Bay, attracted over a million tourists in 1994.
 - The extraction of common salt from the lake started in the mid-1800s and continues to be an important part of the State's economy. Other products, including magnesium metal, chlorine gas, sodium and potassium sulfate, and magnesium chloride, have been extracted since the early 1960s.
 - Oil occurs in natural seeps on the north shore of the lake, and drilling in the late 1970s disclosed additional oil beneath the bed of the lake.

- The brine-shrimp industry harvests brine-shrimp eggs, for use as fish food, and exports them worldwide.
- Eight state waterfowl management areas and one federal migratory bird refuge dot the southern, northern, and eastern shores of the lake. Established during the early 1900s, these areas serve as important resting, feeding, and nesting areas for millions of ducks, geese, grebes, shorebirds, and other water-dependent birds. Visitors are always welcome, and hunting is generally allowed during the regular waterfowl hunting season.
- What minerals are produced from Great Salt Lake? How and by who are they recovered?
 - In 1995, five mineral-extraction companies operated near the lake. These companies used solar evaporation to concentrate the lake waters to produce either salts or highly concentrated brine (water with high salt content) products. These companies paid a royalty to the State of Utah (owner of the lake), on the salts and other materials produced and sold.
 - Sodium chloride (common salt) is produced by: (1) evaporating the water in shallow ponds that cover many thousands of acres, (2) precipitating the salt, and (3) harvesting it from the bottom of the ponds. The collected salt is rinsed, washed, dried, and screened to produce different product sizes and grades.
 - Food-grade, or table salt is not produced from the lake, because its purity cannot be guaranteed without additional, costly processing. The table salt used in Utah comes from salt-processing facilities in New York, Ohio, Kansas, Louisiana, Texas, or California.
- What lives in and around Great Salt Lake?
 - The tiny brine shrimp (*Artemia salina*) is one of the few animals that live within Great Salt Lake. The brine-shrimp population plays an important part in the lake's ecosystem, especially in keeping the lake waters clean through algae consumption. They are also a major food source for millions of migrating birds.
 - Other forms of life associated with the lake include brine flies, algae, and bacteria. Brine flies congregate by the millions along the lake's beaches, where they feed on bacteria and algae that grow on rocks or wood. The wind commonly blows the remains of dead brine flies into long, black, odoriferous windrows or piles along the beaches. Numerous species of algae and bacteria, which cause the varied colors of the lake waters, provide food for the brine shrimp.
 - Ducks, geese, gulls, pelicans, and hundreds of other types of birds live in the marshes and wetlands surrounding the lake. Great Salt Lake is an important part of the Pacific and Central Flyways for migratory waterfowl and part of the Northern Hemispheric Shorebird Reserve Network.

- The shores and nearby wetlands of the lake are also home to a variety of reptiles and mammals. Eight amphibian, two turtle, nine lizard, and eight snake species, as well as total of 64 species or subspecies of mammals have been identified in the Great Salt Lake area.
- How does the lake affect the weather?
 - Due to its large size, Great Salt Lake has a significant effect on the weather of nearby cities. During the winter, the lake is warmer than the air above it. This increases the moisture content of the air, creates thermal instability, and causes natural seeding of salt crystals. These factors are believed to cause the fall and winter "lake effect," in which areas adjacent to and usually downwind from the lake receive greater snowfall than those more distant.
- What makes the lake stink?
 - The unpleasant odor (resembling rotten eggs) that comes from the lake is a common complaint from those who live near the lake. The odor results from the decay of plant and animal remains in the shallow waters around its shores, especially in Farmington Bay. This odor is especially noticeable when northwest winds blow across the lake, stir up the shallow waters, and carry the odor landward to populated regions.
- Is the Great Salt Lake polluted?
 - The quantities of harmful contaminants in the lake, such as industrial organic wastes, copper, arsenic, mercury, cadmium, and lead are very low. This is contrary to what one might expect since rivers, waste-water treatment plants, and industrial facilities discharge into the lake.
 - The lake ecosystem appears to cleanse itself of certain types of contaminants through chemical and biological processes. More study is needed to understand these cleansing processes, however.
- Where are the Bonneville Salt Flats and how did they form?
 - The Bonneville Salt Flats are located west of Great Salt Lake near the town of Wendover on the Utah-Nevada border, about 115 miles west of Salt Lake City. The flats are a broad, salt-covered lake bed, and one of the flattest areas on earth. They were formed during the final evaporative stages of Lake Bonneville.
- What is the tall smoke stack at the south end of the Great Salt Lake?
 - The 1,200-foot-tall smoke stack at the southern end of the lake is part of the Kennecott Copper Company's copper ore-smelting operation. Ore for this smelter comes from the

Bingham Canyon copper mine, which is the largest open-pit excavation on earth. The Bingham Canyon mine, started in 1906, is located approximately 15 miles to the south of the lake on the eastern side of the Oquirrh Mountains.

- What are the round, white sand grains that make up the beaches?
 - The round, brown-to-white grains that make up many of the beaches around the lake are called oolites. Oolites are small spherical to elongated grains composed of concentric layers of calcium carbonate built up around a central core, much like a pearl. The core material is usually a small mineral grain, or a brine shrimp fecal pellet.
 - Some of the most beautiful beaches around the lake are composed of oolitic sand.

- Do fish live in the Great Salt Lake?
 - Yes, but the fish only live near stream inlets where the salinity is low enough for them to survive. Outside of the inlets, fish do not and cannot survive

- What are the most common birds seen on the Great Salt Lake?
 - Wilson's phalarope
 - Red-Necked Phalarope
 - American Avocet
 - Black-Necked Atilt
 - Marbled Godwit
 - Snowy Plover
 - Western Sandpiper
 - Long-billed Dowitcher
 - Tundra Swan
 - American White Pelican
 - White-Faced Ibis
 - California Gull
 - Eared Grebe
 - Peregrine Falcon
 - Bald Eagle
 - Plus large populations of various ducks and geese
 - Over 7.5 million birds of 257 species visit the Great Salt Lake every year
 - Over 2.5 million eared grebes, at times over half the North American population
 - Up to 20,000 breeding adult pelicans on Gunnison Island
 - About 500,000 phalaropes, largest staging concentration in the world, representing 1/3 of world population

- What is the foam that forms on the Great Salt Lake?
 - Deep piles of white, pillowed foam are a common sight along the shores of Great Salt Lake, especially during and after windstorms that cause waves to crash against its shores. The question is often asked, “What causes the foam, and does this mean that the lake is polluted?”
 - The bubbles are formed as the lake moves, but the bubbles in other lakes pop as they reach the surface. On the Great Salt Lake, the bubbles don’t pop due to the presence of *Surfactants*, similar to what you would find in soap. The surfactants are not pollution; rather they are excrement of phytoplankton in the lake.