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Grade	5+	Word Count	2,005
Lexile	1220L	Multi-level	O Z Z2
Learning A–Z	level Z2		

Refer to the Focus Question on page 2 of this title to guide discussion and support additional learning connected to the text.

Hoover Dam stands as one of the greatest engineering feats in the United States. It helped transform the American Southwest, allowing water from the Colorado River to be used throughout the desert landscape. Students will enjoy learning about how the dam was built and how it operates.

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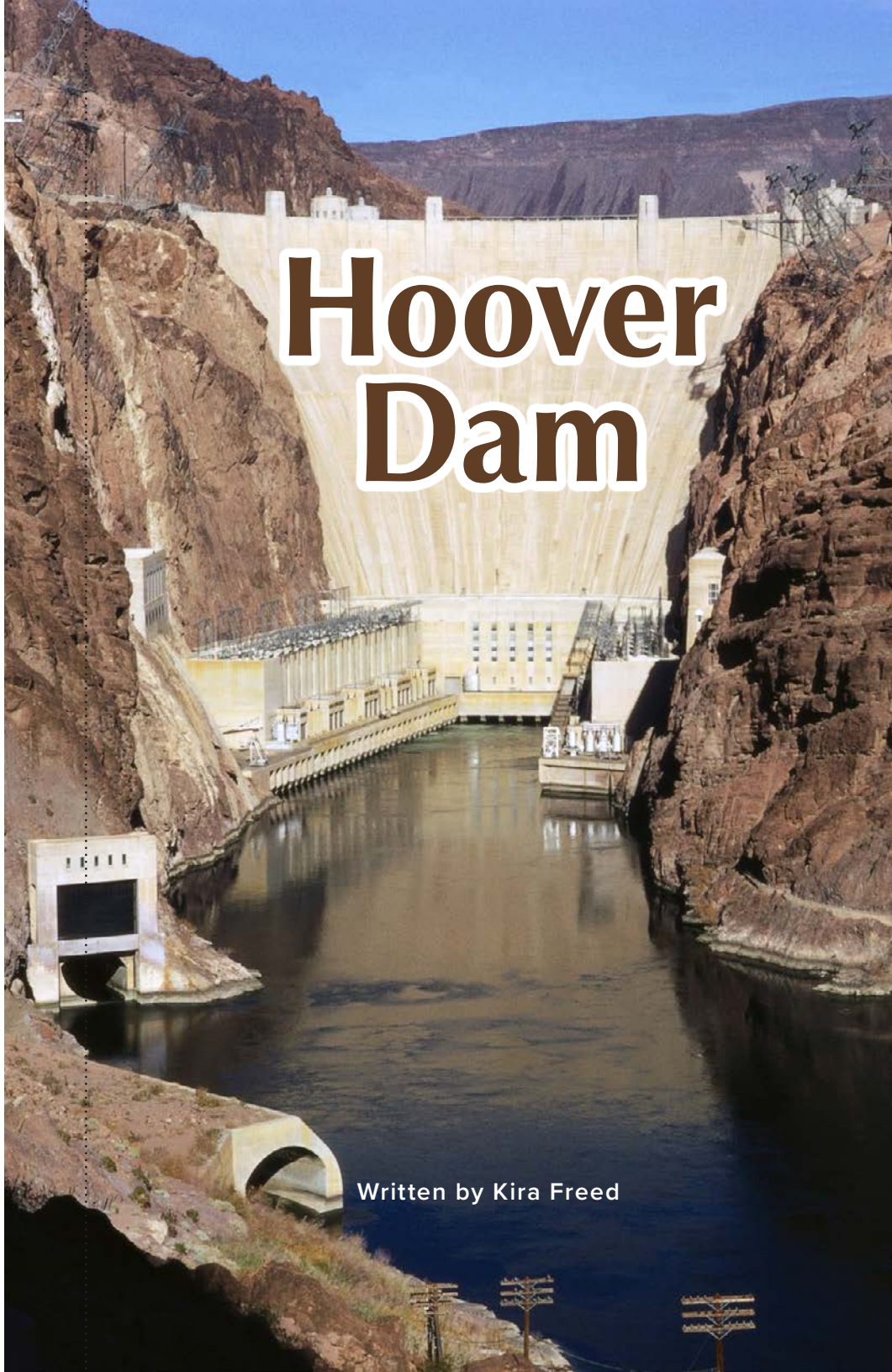


Hoover Dam

Written by Kira Freed

Glossary

appropriation *(n.)* page 8
money formally set aside for a particular use

bedrock *(n.)* page 9
a layer of solid rock underneath the ground's surface

chemical reaction *(n.)* page 15
a process in which one or more substances are changed to another

divert *(v.)* page 8
to cause something to change direction

excavating *(v.)* page 14
uncovering or digging out

innovative *(adj.)* page 11
creating something new and original

parched *(adj.)* page 4
very dry or lacking moisture

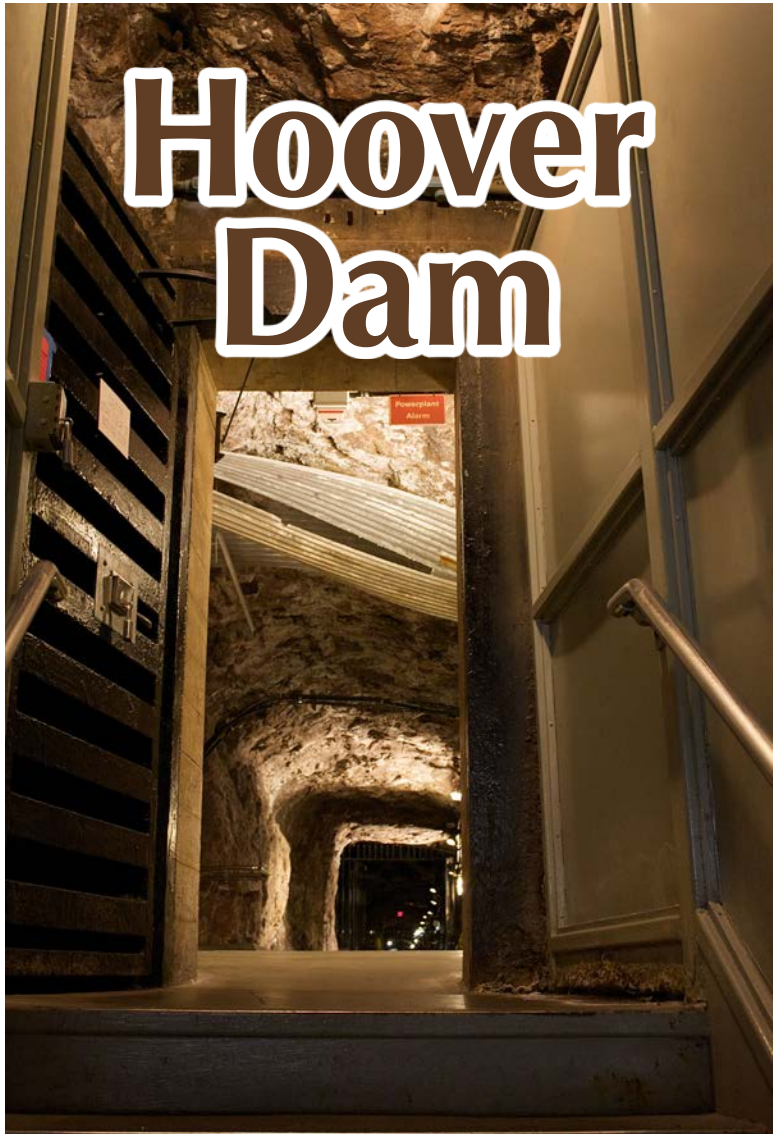
reclamation *(n.)* page 8
the act of recovering or restoring

reservoir *(n.)* page 5
a large tank or lake used for collecting and storing water for human consumption or agricultural use

resourcefulness *(n.)* page 17
the ability to find ways to solve problems or overcome obstacles

spillways *(n.)* page 16
passages for water to flow around obstacles, such as a dam

turbine *(n.)* page 7
a fan-shaped machine that captures the energy of water, wind, or steam



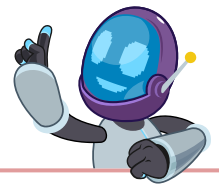
Above: A view from an interior tour of Hoover Dam

Cover: The downstream side of Hoover Dam, showing the power plant

Written by Kira Freed

Focus Question

What has been the impact of Hoover Dam on life in the southwestern United States?



Words to Know

appropriation	parched
bedrock	reclamation
chemical reaction	reservoir
divert	resourcefulness
excavating	spillways
innovative	turbine

Connections

Writing

What impact has Hoover Dam had on the natural habitats of native plants and animals? What are the benefits of Hoover Dam? Write a paper highlighting the pros and cons of building Hoover Dam.

Social Studies

Create a timeline of the construction of Hoover Dam. Begin with the Alamo Canal in 1901 and end with the renaming of Hoover Dam in 1947. Use the book and outside resources to complete your timeline.

An Engineering Marvel

Hoover Dam is no longer the world's tallest dam—as of 2014, twenty-six were higher—but it's still among the most famous. Constructing the dam involved overcoming nearly impossible challenges, not the least of which was the site's remote location and the need to set up transportation, power, and housing before most of the work could begin. The immensity of the structure was a technical achievement that advanced the field of dam design and construction around the world.

Today, millions of people benefit from the labor of Hoover Dam's builders. The dam transformed the Southwest, providing water and power to California, Arizona, and southern Nevada and allowing the region to flourish. The landmark's construction and impact are an unforgettable chapter in United States history.

A view of Hoover Dam at sunset from the Mike O'Callaghan–Pat Tillman Memorial Bridge

From inside the visitor center, tourists get a bird's-eye view of Hoover Dam. Guided tours give behind-the-scenes details of the dam and power plant.

Visiting the Dam

Each year, millions of people visit Hoover Dam, which has welcomed visitors since 1937. The visitor center has displays about the natural history of the region as well as the history of the dam and the Bureau of Reclamation's efforts to help settle the West and assist with irrigation. Visitors can drive across the top of the dam on Highway 93. They can also enjoy great views at an overlook as well as tours of the dam and power plant. Each year, close to one million people take the tours.

Lake Mead offers recreational opportunities year-round, including fishing, boating, and picnicking. Visitors can also enjoy viewing and photographing the many plants and animals that live in the area.

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Colorado River Watershed

Taming a Wild River

The Colorado River winds through the southwestern United States, bringing water to desert lands that would otherwise be **parched** and lifeless. People have farmed along the banks of the Colorado for centuries and have depended on its waters for irrigation. However, the Colorado proved to be a challenging water source, swelling with snowmelt each spring and often flooding farmlands, then shrinking to a trickle later in the year and causing crops to die.

The changing water supply discouraged early settlers but inspired others to find a way to control the river. Their efforts resulted in the construction of Hoover Dam, an iconic American landmark that continues to inspire awe more than seventy-five years after it was built.

Concerns About Dams

Hoover Dam allowed urban areas to spread and has altered natural habitats. Before 1950, for example, about two hundred desert tortoises could be found in a square mile (2.5 sq km) in the Mohave Desert. Today, there are between five and six tortoises in a square mile. Organizations are working to protect the desert tortoise habitat.

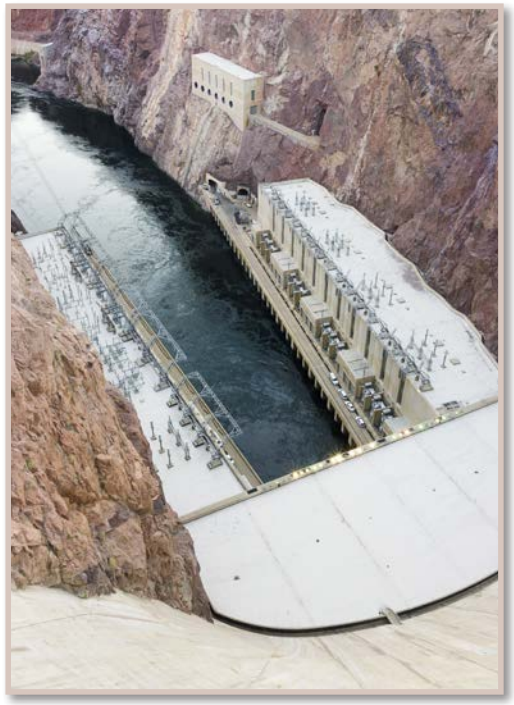
desert tortoise

By February 1, 1935, the work was finally completed. Workers plugged the diversion tunnels that had been allowing the Colorado's waters to bypass the dam site, and water started rising behind the dam, overflowing the cofferdam, and forming Lake Mead. By the time the project was finished, about 21,000 men had worked on it, with an average of 3,500 each day and a maximum of 5,218. The project cost about $165 million—the equivalent of $3 billion or more in today's economy.

President Roosevelt dedicated the dam, then called Boulder Dam, on September 30, 1935. He called it "the greatest dam in the world" and added, "This is an engineering victory of the first order—another great achievement of American **resourcefulness**, American skill and determination."

After the dam's columns were built and grouted, workers built **spillways** to accommodate water in case the Colorado River ever flooded. Water would flow down the spillways before it could reach the top of the dam. If water were to flow over the top of the dam, it would destroy the power plant. Water flowing down the spillways would be carried away through two converted diversion tunnels.

The final step in construction involved building the power plant and four intake towers that would control water flow to the power plant. Workers plugged about one-third of the length of the two inner diversion tunnels and placed steel pipes, called *penstocks,* inside the tunnels. The penstocks control the flow of water from the intake towers to the power plant.

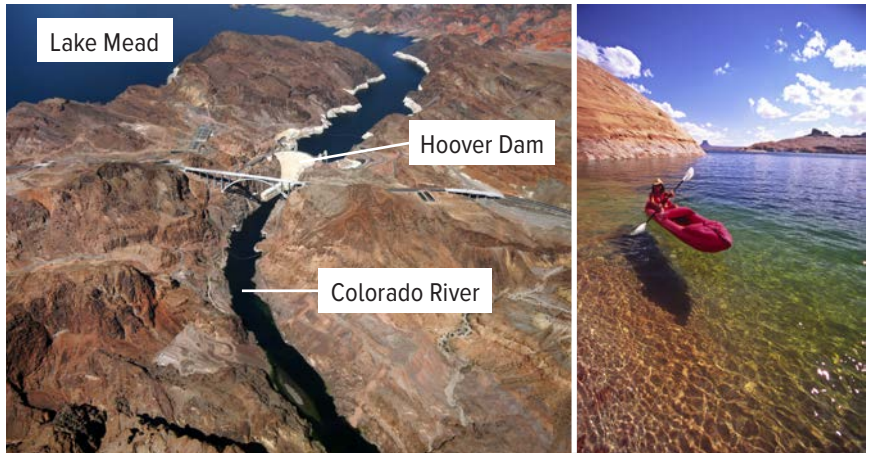


Hydroelectric power plants change the energy of falling water into electrical energy through the use of turbine generators.

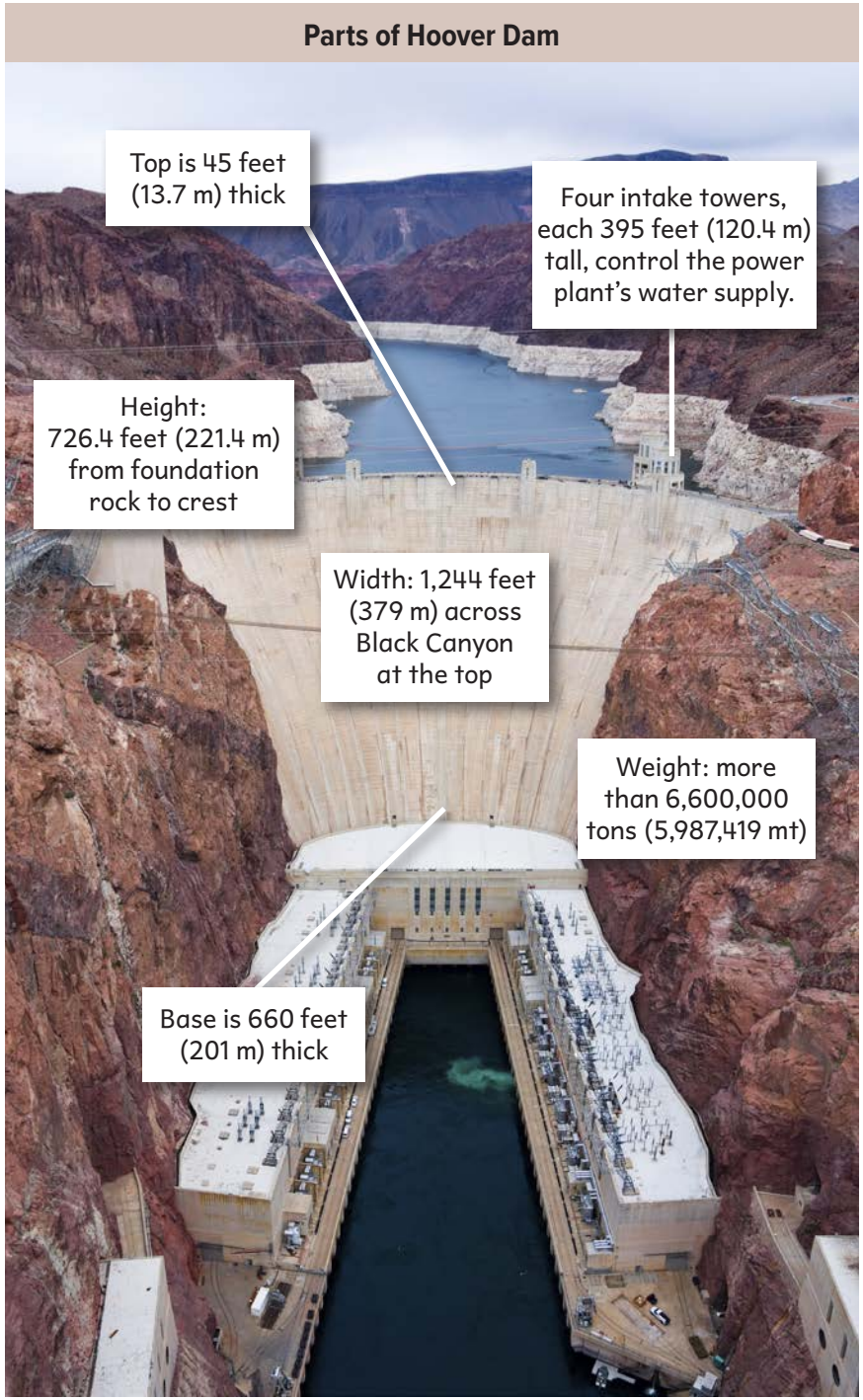
The Arid Southwest

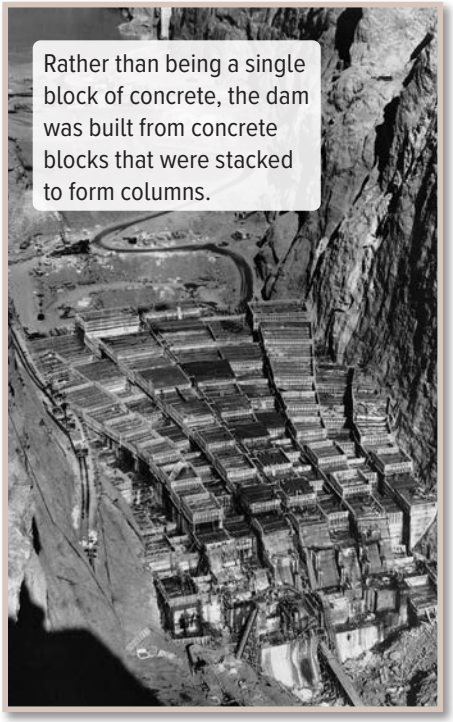
Hoover Dam is located about 30 miles (48 km) southeast of Las Vegas, Nevada, on the border between Arizona and Nevada. The dam spans the Colorado River at Black Canyon. The area around the dam, which is part of the Mojave (moh-HAH-vee) Desert, is hot, dry, and so empty of vegetation that much of it looks like a moonscape.

In sharp contrast to the desert is Lake Mead—Hoover Dam's **reservoir**—which is located to the north of the dam. Construction of the dam created Lake Mead, the largest human-made lake in the United States. The lake, which features 550 miles (885 km) of shoreline, is home to fourteen hundred plant and animal species.



Hoover Dam created Lake Mead (left). Visitors enjoy boating, skiing, and fishing on the lake (right).




Rather than being a single block of concrete, the dam was built from concrete blocks that were stacked to form columns.

Huge buckets of wet concrete were lowered into individual wooden forms, or molds, for the concrete. Then workers known as "puddlers" smoothed the concrete and eliminated air bubbles, which would otherwise weaken the concrete after it hardened. Heat produced by a **chemical reaction** in the concrete could have caused cracking. To prevent this from happening, a 582-mile (937 km) maze of 1-inch (2.54 cm) steel pipes was placed in the forms before the concrete was poured, and cold water was continuously pumped through the pipes. After the concrete cooled, the pipes were filled with grout.

When the concrete in a particular form had hardened, the wooden form was disassembled and reassembled on top of the just-finished section, and concrete was poured into it again, creating a column of cement. Grout filled the spaces between the columns.

Workers broke through the upriver end of the first Nevada diversion tunnel on January 29, 1932, and broke through the other three tunnels soon after. After the tunnels were lined with concrete, they were ready to accommodate water in November 1932. Then workers built the two cofferdams, one above and one below the future dam site. Once the cofferdams were finished, the water was finally diverted—almost a year ahead of schedule. With the water diverted, workers pumped the dam site dry.

The dam had to sit on solid bedrock, which was 135 feet (41 m) below silt and stones that the Colorado River had been depositing over thousands of years. The enormous task of **excavating** that material was completed on June 6, 1933. Then it was finally time to build the dam.

Wowser!

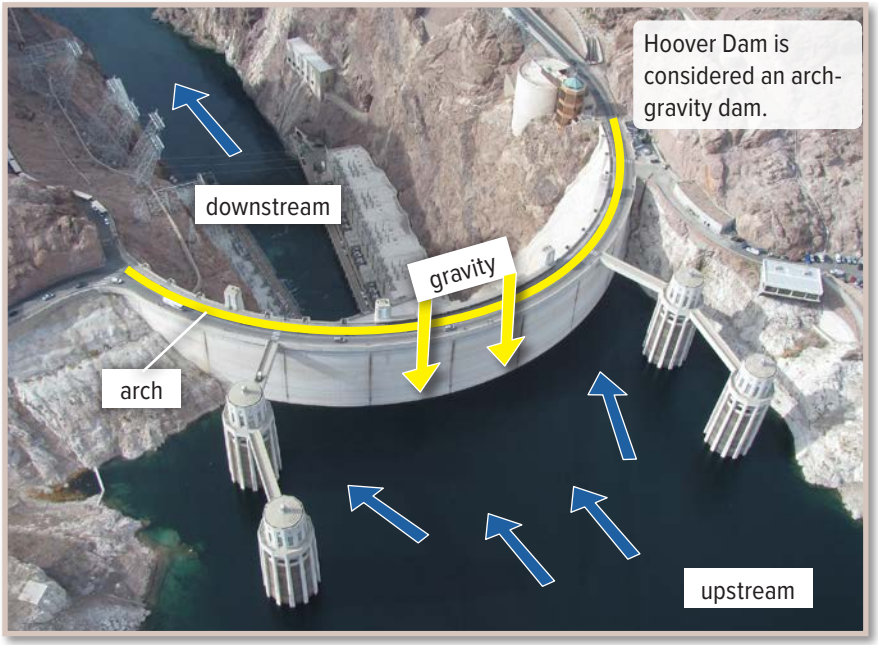
- Hoover Dam, with all its structures, contains 4,360,000 cubic yards (3,333,459 cu m) of concrete. That's enough concrete to pave a highway 16 feet (4.9 m) wide from San Francisco to New York City.
- Workers excavated over 5,500,000 cubic yards (4,205,052 cu m) of rock, earth, and sand during the project. That's enough material to make an even bigger road.

Excavating the foundation of Hoover Dam

A Dam Like No Other

When Hoover Dam was built, it was the tallest dam in the world and was considered a remarkable feat of engineering. Its design combines features of a gravity dam and an arch dam. A gravity dam relies on its own weight to resist the force of stored water, while an arch dam curves upstream, causing most of the water to flow against steep canyon walls and squeeze the arch. As a result, the dam is strengthened and pushed into the ground.

Hoover Dam's power plant, which uses the Colorado River's energy to make electricity, has seventeen **turbine** generators and provides power to roughly 1.3 million people.



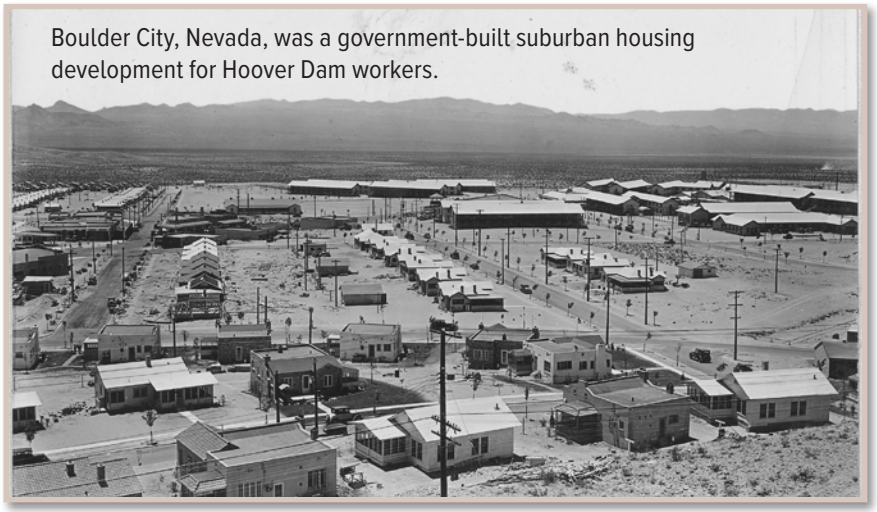
Laying the Groundwork

The desire to tame the Colorado grew at the turn of the twentieth century. The river used to flow into the Gulf of California, but in 1901 a private company built the Alamo Canal to **divert** the river's flow and provide irrigation to California's Imperial Valley. The dry valley was transformed, and crops and livestock flourished, but severe flooding in 1905 destroyed the canal's control gates and devastated Imperial Valley.

Residents wanted a larger, government-maintained canal to tame the Colorado so farmers could once again use its water for irrigation. Arthur Powell Davis thought that constructing a dam along the river would help more people. Davis was chief engineer and later the first director of the U.S. Department of the Interior's **Reclamation** Service (later renamed the Bureau of Reclamation). The agency is best known for building dams and canals in the western states. Davis studied the Colorado River and reported to Congress in 1918. Congress passed the Boulder Canyon Project Act ten years later, approving construction of Hoover Dam as well as the All-American Canal to provide water to Imperial Valley. In 1930, President Hoover signed an **appropriation** bill to begin construction.

Several other projects were taking place at the same time. The U.S. government built a town—Boulder City—for the five thousand or so construction workers and their families. Homes and a hospital were built, along with plumbing and sewage systems. When finished, Boulder City greatly improved conditions for the workers, who could recover each night from the hard labor and receive medical care for injuries and heat exhaustion.

Other projects included laying railroad tracks so supplies could be delivered and building a road between Boulder City and the dam site. In addition, workers installed a power line 222 miles (357 km) long from San Bernardino, California, to Black Canyon to supply power for construction of the dam.



Boulder City, Nevada, was a government-built suburban housing development for Hoover Dam workers.

The workers who dug the diversion tunnels labored seven days a week in extreme heat.

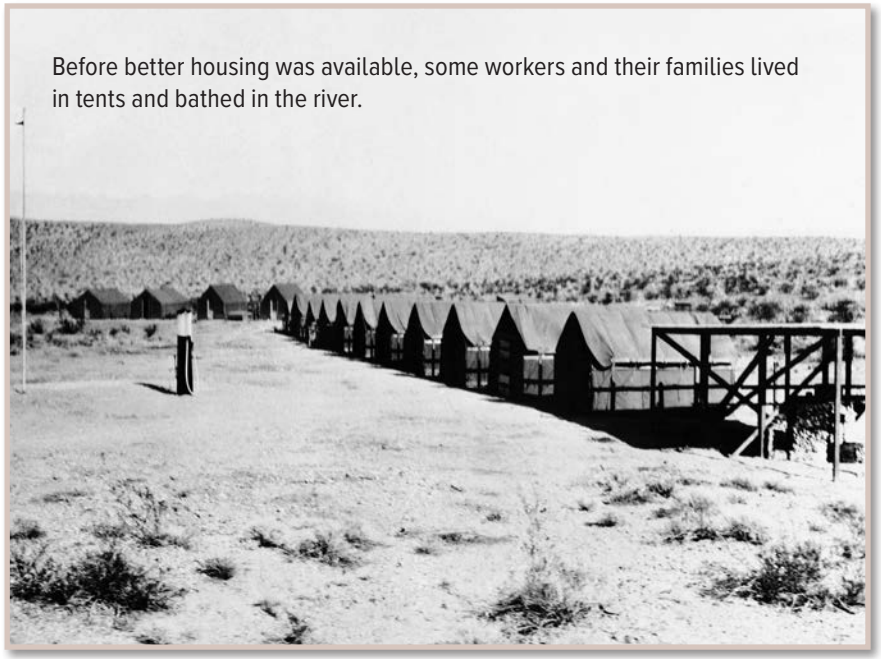
The monumental task of diverting the water began in May 1931. The job was hard, with workers exposed daily to falling rocks, blasting, and fumes from diesel trucks. This part of the project was fast-paced because work on the dam itself couldn't begin until the diversion tunnels were in place.

Above the ground, "high scalers" removed loose rock from canyon walls and cut grooves where the two sides of the dam would be attached. High scalers used jackhammers and dynamite while dangling 800 feet (244 m) above the river on wooden swings in up to 120°F (49°C) heat. Falling rocks and tools claimed the lives of dozens of workers. A total of ninety-six workers died from construction-related causes while the dam was being built.

Even though the dam would be built in Black Canyon (shown here before construction began), it kept the name Boulder Dam until 1947, when it was renamed to honor Herbert Hoover, the thirty-first U.S. president.

The first step was to find a good site for the dam—one that would require the least effort and expense to safely store the greatest quantity of water. A search was launched to find a suitable canyon. The two best options were Boulder Canyon and Black Canyon, which were located 20 miles (32 km) apart along the Arizona-Nevada border.

The Bureau of Reclamation sent surveyors and mapmakers to check out both sites. Because its canyon walls were granite, they settled on Boulder Canyon until workers discovered faults, or cracks, in the granite, so they switched the location to Black Canyon, whose **bedrock** and canyon walls were andesite breccia, a type of rock without cracks.

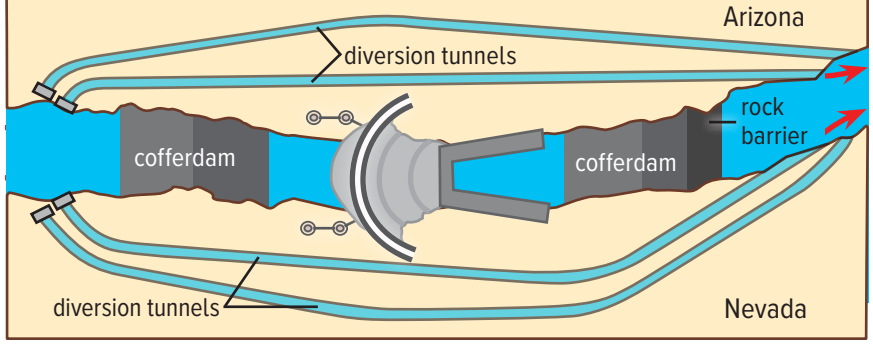


Before better housing was available, some workers and their families lived in tents and bathed in the river.

Construction of Hoover Dam began on March 11, 1931, during the Great Depression, a time of staggering economic hardship in the United States. In total, 21,000 unemployed men flocked to southern Nevada from around the country for the construction jobs. Many came as early as the summer of 1930, long before actual construction began. President Hoover, who was widely blamed for the Great Depression and wanted to put as many people to work as possible, ordered surveying and other early work to begin before lodging, drinking water, or a hospital were in place. Workers lived in camps that lacked electricity and running water. The conditions were rough, but the men desperately needed work.

Building the Dam

The construction project was awarded to Six Companies, a group of six construction companies with a great deal of experience building dams, bridges, tunnels, and roads. Frank Crowe, the engineer in charge, was known to have used **innovative** construction techniques while building many dams in the west.

The first phase of the project involved diverting the Colorado's water around the dam site. Workers blasted four tunnels, two on the Arizona side and two on the Nevada side, and then built a watertight barrier, called a *cofferdam*, upstream of the future dam site to divert the water into the tunnels. Another cofferdam at the bottom, along with a rock barrier, would keep water below the construction site from flowing back upriver so the construction site would stay dry.

Hoover Dam Diversion Map