

总决赛：综合组说课文本

China's Chang'e Program: Missions to the Moon

For many space enthusiasts, the Chinese space program's lunar flights have been thrilling to watch. More than a decade ago, China launched the first of its robotic Chang'e missions, and the country has consistently built up ever-greater capabilities as it targets the Earth's natural satellite. In Chinese mythology, Chang'e was a beautiful young girl who took an immortality pill and then flew to the moon, where she became the moon goddess. Chang'e is a fitting name for a series of robots that have gazed down upon our planet from far above.

The Chang'e program began on Oct. 24, 2007, when a Long March 3A rocket launched the Chang'e-1 probe into a polar lunar orbit. The spacecraft circled between 62 and 124 miles (100 and 200 kilometers) high above the lunar surface, bouncing microwave signals off the surface to produce the most high-resolution images ever made up to that point. In addition to mapping features on the moon, Chang'e-1 surveyed the lunar soil for the element Helium-3, which could one day power nuclear reactors, and determined the distribution of other potentially useful resources, according to its mission designers.

A year later, the Chinese space agency sent a follow-up mission named Chang'e-2 to the moon, which produced even more spectacular maps of the lunar surface. The spacecraft's main goal was to scout out locations for China's subsequent lander, but it also accomplished a number of other remarkable feats.

After wrapping up its primary mission, Chang'e-2 departed lunar orbit and flew to the Earth-Sun L2 Lagrange point, where the gravitational pull of the Earth and Sun just about cancels out. In doing so, the Chinese space agency became only the third agency to visit this point, where it demonstrated deep-space communications and tracking for future missions. In April 2012, the spacecraft then ventured off to conduct a flyby of asteroid 4179 Toutatis, getting as close as 2 miles (3.2 kilometers) away, according to China's Xinhua state news service. The probe is expected to return closer to Earth sometime around 2029.

China made history on Dec. 4, 2013, with a successful landing for the Chang'e-3 mission. The touchdown on Mare Imbrium, an ancient volcanic plain, represented the first soft landing on the moon in nearly 40 years — a feat last accomplished by the former Soviet Union in 1976. Chang'e-3 carried the six-wheeled, solar-powered Yutu rover — named for

the pet rabbit of the goddess Chang'e — which rolled out onto the lunar surface and snapped spectacular photos.

China's fourth moon probe, the Chang'e-4 lander, which arrived on the far side of the moon on Jan. 2, 2019, is currently creating a great deal of excitement: It is the first spacecraft to ever land on the moon's space-facing hemisphere. The robot touched down at 177.6 degrees east longitude and 45.5 degrees south within Von Kármán crater, according to an announcement from the China National Space Administration (CNSA). Von Kármán is located inside of the South Pole-Aitken basin, the largest and oldest impact crater on the moon, which has never been explored.

The far side is sometimes erroneously referred to as the "dark side" of the moon, even though it does get sunlight. Traveling to the far side of the moon presents certain technical challenges — namely, it makes communication harder. Whereas Earth-bound scientists can communicate with the near side using direct radio communication, China first had to send a communications relay satellite to orbit above the far side of the moon. That satellite, the Queqiao, was launched in May 2018 and entered orbit around the moon three weeks later.

Chang'e-4 brought with it a successor to the Yutu rover, fittingly named Yutu 2. The 6-wheeled lander also carried a small enclosed experiment with living organisms, including cotton seeds, fruit fly eggs and yeast. The cotton seeds sprouted, the first seeds to germinate on another world. Unfortunately, a day later, the probe entered its first lunar night and, needing to conserve power, did not use its battery to keep the organisms warm. When temperatures inside the canister plunged to minus 62 degrees Fahrenheit (minus 52 degrees Celsius), all of the plants died.

The next in line for China's lunar accomplishments is the Chang'e-5 mission, which will land near Mons Rümker, a mountain overlooking a huge basaltic lunar plain called Oceanus Procellarum. Chang'e-5 will bring back samples from the lunar surface — the first new material from our natural satellite in more than four decades. Scientists are eager to get new samples, which will join material brought back by Apollo astronauts and Soviet robots, and hopefully help answer questions about the formation of both the moon and Earth. Chang'e-5 is expected to launch by the end of 2019.