Galilean Moons of Jupiter

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The planet Jupiter's four largest moons, or satellites, are called the Galilean moons, after Italian astronomer Galileo Galilei, who observed them in 1610. The German astronomer Simon Marius apparently discovered them around the same time. The names Marius proposed for the moons in 1614 (suggested to him by a fellow astronomer, Johannes Kepler) are the ones we use today — Io, Europa, Ganymede, and Callisto.

Io is the most volcanically active body in the solar system. Its surface is covered by sulfur and lava in many colorful forms. As Io travels in its slightly elliptical orbit, Jupiter's immense gravity causes tides in Io's solid surface 100 meters (300 feet) high, generating enough heat to give rise to the volcanic activity and drive off most water. Io's volcanoes are driven by hot silicate magma.

Europa's surface is mostly water ice, and the icy crust is believed to cover a global water ocean. Europa is thought to have twice as much liquid water as Earth. This moon intrigues astrobiologists because of its potential for having a habitable ocean very much like Earth's. Life forms have been found thriving near underwater volcanoes and in other extreme locations on Earth that are possible analogs to what may exist at Europa.

Ganymede is the largest moon in the solar system (larger than the planet Mercury), and is the only moon known to have its own internally generated magnetic field. Callisto's surface is extremely heavily cratered and ancient — a record of events from the early history of the solar system. However, at a small scale, Callisto shows very few craters, suggesting that landslides have happened throughout its history, and probably occur even today.

The interiors of Io, Europa, and Ganymede have a layered structure (as does Earth). Io has a core, and a mantle of partially molten rock, topped by a crust of solid rock coated with sulfur compounds. Both Europa and Ganymede have an iron-rich core, a rock envelope around the core, and an upper layer of water in ice and liquid forms. Like Europa, Ganymede and Callisto have oceans, but they are deeper and less accessible than Europa's. Their seafloors are covered with thick layers of ice — if formed under more pressure, water ice can become denser than ice typically found on Earth, and sink rather than float.

Three of the moons influence each other in an interesting way. Io is in a gravitational tug-of-war with Ganymede and Europa that drives the tides that make these moons so geologically active. Europa's orbital period (time to go around Jupiter once) is twice Io's, and Ganymede's period is twice that of Europa. For every time Ganymede goes around Jupiter, Europa makes two orbits and Io makes four orbits. The moons all keep the same face towards Jupiter as they orbit, meaning that each moon turns once on its axis for every orbit around Jupiter.

FAST FACTS

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Mean Distance from Jupiter</th>
<th>Mean Radius</th>
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<tbody>
<tr>
<td>Io</td>
<td>422,000 km (262,200 mi)</td>
<td>1,833 km</td>
</tr>
<tr>
<td>Europa</td>
<td>671,000 km (417,000 mi)</td>
<td>1,942 km</td>
</tr>
<tr>
<td>Ganymede</td>
<td>1,070,000 km (665,000 mi)</td>
<td>3,551 km</td>
</tr>
<tr>
<td>Callisto</td>
<td>1,883,000 km (1,170,000 mi)</td>
<td>3,528 km</td>
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The prevailing idea of the time was that all heavenly bodies orbit Earth: a planet with its own small orbiting bodies did not conform to this geocentric model. 1979 — Voyager 1 photographs an erupting volcano on Io: the first ever seen anywhere other than Earth. 1979–2000 — Using data from the Voyager and Galileo spacecraft, scientists gather strong evidence of an ocean beneath the icy crust of Europa; Galileo data indicate oceans within Ganymede and Callisto as well.

2003 — The Galileo mission ends with the spacecraft deliberately descending into Jupiter's atmosphere and being vaporized. Mission controllers purposely put Galileo on a collision course with Jupiter to eliminate any chance that the spacecraft would crash into Europa and contaminate that moon with terrestrial microbes.

**FOR MORE INFORMATION**

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**SIGNIFICANT DATES**

1610 — Galileo Galilei and Simon Marius independently discover four moons orbiting Jupiter. This discovery, among others by Galileo, helped change the way people thought about the heavens.

1979 — Voyager 1 photographs an erupting volcano on Io: the first ever seen anywhere other than Earth.

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