

I have heard people call Jupiter a "failed star" that just did not get big enough to shine. Does that make our sun a kind of double star? And why didn't Jupiter become a real star?

[Scientific American](#)

"Nearly all scientists who study the formation of planets believe that Jupiter formed in a very different manner than stars form, so that calling Jupiter a 'failed star' is misleading. Stars form directly from the collapse of dense clouds of interstellar gas and dust. Because of rotation, these clouds form flattened disks that surround the central, growing stars. After the star has nearly reached its final mass, by accreting gas from the disk, the leftover matter in the disk is free to form planets.

"Jupiter is generally believed to have formed in a two-step process. First, a vast swarm of ice and rock 'planetesimals' formed. These comet-sized bodies collided and accumulated into ever-larger planetary embryos. Once an embryo became about as massive as ten Earths, its self-gravity became strong enough to pull in gas directly from the disk. During this second step, the proto-Jupiter gained most of its present mass (a total of 318 times the mass of the Earth). Soon thereafter, the disk gas was removed by the intense early solar wind, before Saturn could grow to a similar size."

Boss explains further that brown dwarfs may look like planets but they form like stars--that is, they collapse directly from a gas cloud, rather than building

up in the disk around a star. Brown dwarfs lack sufficient mass to shine, so they might more fairly be described as "failed stars."

Alex Rudolph of the physics department at Harvey Mudd College expands on this important point:

"Jupiter is called a failed star because it is made of the same elements (hydrogen and helium) as is the Sun, but it is not massive enough to have the internal pressure and temperature necessary to cause hydrogen to fuse to helium, the energy source that powers the sun and most other stars.

"However, Jupiter has only about 0.1 percent the mass of the sun, and as it is definitely not a star, we can't really call the solar system a double star. It is interesting to note, however, that more than half of all stars in the sky are part of a binary, triple, or higher multiple star system (binaries being the most common). So the Sun is unusual in being a loner.

"As for why Jupiter failed to become a star--it probably had to do with the accident of the sun grabbing most of the mass early in the formation of the solar system, while in other systems the mass was more equitably distributed; in binary star systems, for example, the masses of the stars are commonly roughly equal. Stellar formation is a hot topic of current research, as astronomers are trying to fathom the still-mysterious details of the birth process.