

Important Vocab For the Editorial

1. **objective** (noun) – aim, intention, purpose.
2. **tantalizingly** (adverb) – excitingly, interestingly, fascinatingly.
3. **lander** (noun) – a spacecraft designed to land on the surface of a planet/moon. A lander is immobile, and maintains its fixed position once it has landed.
4. **descent** (noun) – an act of moving downwards; going down, coming down.
5. **trajectory** (noun) – course, route, path.
6. **lunar** (adjective) – it refers to the Moon.
7. **touchdown** (noun) – the moment at which a part of a spacecraft make contact with the ground during landing; arrival, coming in.
8. **put something in perspective** (phrase) – to compare something with a similar thing to give a clearer, more accurate idea.
9. **rover** (noun) – a space exploration vehicle designed to move and explore the surface of a planet or moon. A rover is mobile, and has wheels with which it can move.
10. **touch down** (phrasal verb) – (of an aircraft) land, alight, come down.
11. **deploy** (verb) – use, utilize, employ.
12. **velocity** (noun) – speed (in general use).
13. **altitude** (noun) – height, elevation, distance above the ground/sea.
14. **snap** (verb) – break, separate, split.
15. **exploration** (noun) – investigation, search, inspection (of an area for natural resources).
16. **rover** (noun) – a space exploration vehicle designed to move and explore the surface of a planet or moon. A rover is mobile, and has wheels with which it can move.
17. **on the contrary** (phrase) – in contrast, just the opposite, conversely.
18. **accomplish** (verb) – achieve, complete, fulfil.
19. **orbiter** (noun) – a spacecraft designed to go into orbit of a planet or other celestial body without landing on its surface.
20. **span** (noun) – period, time, duration.
21. **payload** (noun) – it can be a satellite, space probe, or spacecraft carrying instruments and others which are (not fuels) used for a rocket's operation.
22. **evolution** (noun) – development, advancement, growth/rise.
23. **look for** (phrasal verb) – search for, try to find, look around for.
24. **crater** (noun) – cavity, hole, hollow.
25. **candidate** (adjective) – prospect, hopeful, expectant.
26. **harbour** (verb) – shield, protect; accommodate, lodge, take in.
27. **keen on** (phrasal verb) – interested in, passionate about, attracted/fascinated by.
28. **mineralogy** (noun) – the scientific study of minerals.

So close, yet so far: On Chandrayaan 2 lander failure

Chandrayaan 2 might have failed in an objective, but the mission itself is not a failure

The Indian Space Research Organisation (ISRO) came tantalisingly close to creating history in the early hours of September 7 when the robotic lander Vikram followed the predetermined descent trajectory and came just within 2 km of the lunar surface before contact was lost. While it is unfortunate that the lander failed to safely touchdown, it is apt to remember that ISRO was attempting powered landing for the first time. To put it in perspective, there have been 38 attempts so far by other countries to land a rover on the moon and have succeeded only a little more than half the time. This April, Israel's Beresheet lunar lander crashed to the lunar surface. But early January this year, China's Chang'e-4 touched down on the lunar far side and deployed the Yutu-2 rover to explore the South Pole-Aitken basin. In Vikram, the velocity was successfully reduced from about 6,000 km per hour at the start of the descent at 35 km altitude to a few metres per second before communication snapped. That strongly indicates that powered landing went as per plan till about 2 km altitude from the lunar surface.

While the powered landing of Vikram and exploration of the moon's surface for 14 earth days by the Pragyan rover were one of the main objectives of Chandrayaan 2, it is wrong to think that the mission itself has failed. On the contrary, 90-95% of the mission objectives have already been "accomplished". The orbiter is safe in the intended orbit around the moon. And with the "precise launch and mission management", its life span will extend to almost seven years. Carrying eight of the 13 payloads, the orbiter will spend the next nearly seven years making high-resolution maps of the lunar surface, mapping the minerals, understanding the moon's evolution, and most importantly looking for water molecules in the polar regions. Some of the impact craters in the South Pole are permanently shadowed from sunlight and could be ideal candidate sites to harbour water. Water on the moon would, in principle, be used for life support and manufacturing rocket fuel. With the U.S. wanting to send astronauts to the South Pole by 2024, the National Aeronautics and Space Administration (NASA), in particular, will be keen on data from the Chandrayaan 2 orbiter. The ISRO's Moon Impact Probe and NASA's Moon Mineralogy Mapper on board Chandrayaan 1 had already provided evidence of the presence of water in the thin atmosphere of the moon, on the surface and below. A NASA study last year found regions, within 20° of each pole in general and within 10° in particular, showed signs of water. The Chandrayaan 2 orbiter will now possibly reconfirm the presence of water on the moon.