

**INTEGRATING SPACE SCIENCE****● Ion Propulsion in *Deep Space 1***

On October 24, 1998, NASA launched *Deep Space 1* from Cape Canaveral, Florida. *Deep Space 1* is testing twelve new technologies that will be used in future space-exploration missions.

*Deep Space 1* is accelerated through ion propulsion. An ion drive accelerates ions of xenon gas in one direction, propelling the spacecraft in the opposite direction. Over time, ion propulsion will increase the speed of *Deep Space 1* by more than 12,000 km/h! With chemical propulsion, it would take ten times as much fuel to produce this same increase in speed.

**How an Ion Drive Works**

How does the ion drive in *Deep Space 1* work? First, electrons and xenon atoms are released into the drive's engine chamber. The electrons hit the xenon atoms, knocking an electron off each atom. As a result, the xenon atoms become positively charged ions.

At the end of the engine chamber, there are two electrically charged grids. As the ions pass through these charged grids, the electric field between the grids accelerates the ions to a speed of 100,000 km/h. As the ions leave, the spacecraft is propelled in the opposite direction. Electrons are then added back to the remaining xenon ions so that the spacecraft does not accumulate a negative charge over time.

**Your Turn to Think**

1. What happens when an electron collides with a xenon atom inside the engine?
2. What is the relationship between the direction of the ion beam and the direction of the spacecraft? Explain.
3. Would the ion drive in *Deep Space 1* work if the xenon atoms were not changed into ions by the loss of an electron? Why or why not?