Abstract: Launched in 2004, MESSENGER flew by Mercury three times in 2008-2009 en route to becoming the first spacecraft to orbit the solar system's innermost planet in March 2011. Orbital observations over the subsequent 18 months have provided the first global view of this nearby but heretofore little studied world. MESSENGER's chemical remote sensing measurements of Mercury's surface indicate that the planet's bulk silicate fraction, low in Fe and high in Mg, differs from those of the other inner planets. Moreover, surface materials are richer in the moderately volatile constituents S and K than predicted by most current models for inner planet formation. Global image mosaics and targeted high-resolution images reveal that Mercury experienced globally extensive volcanism, with large expanses of plains emplaced as flood lavas and widespread examples of pyroclastic deposits likely emplaced during explosive eruptions of volatile-bearing magmas. Bright deposits within impact craters host fresh-appearing, rimless depressions or hollows, often with high-reflectance interiors and halos and likely formed through processes involving the geologically recent loss of volatiles. The large-scale deformational history of Mercury, although dominated by near-global contractional deformation as first seen by Mariner 10, is more complex than first appreciated, with numerous examples of extensional deformation that accompanied impact crater and basin modification. Mercury's magnetic field is dominantly dipolar, but the field is axially symmetric and equatorially asymmetric, a geometry that poses challenges to dynamo models for field generation. The interaction between the solar wind and Mercury's magnetosphere, among the most dynamic in the solar system, serves both to replenish the exosphere and space weather the planet's surface. Plasma ions of planetary origin are seen throughout the sampled volume of Mercury's magnetosphere, with maxima in heavy-ion fluxes in the planet's magnetic-cusp regions. Bursts of energetic electrons, seen at most local times, point to an efficient acceleration mechanism operating within Mercury's magnetosphere on a regular basis that produces electrons with energies up to hundreds of keV on timescales of seconds.