MARS SCIENCE LABORATORY: SCIENCE OVERVIEW. J. A. Crisp[1], J. P. Grotzinger[2], A. R. Vasavada[1], J. S. Karcz[3], and the MSL Science Team, [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109 USA, [2]California Institute of Technology, 1200 E. California Blvd., Pasadena, CA 91125, USA, [3]SETI Institute, 515 N. Whisman Rd., Mountain View, CA 94043 USA.

Introduction: The Mars Science Laboratory (MSL) mission is scheduled for launch in the fall of 2009 and operations on Mars beginning the summer of 2010. The high-level scientific goal is to explore and assess quantitatively a local region as a potential habitat for life, past or present. The MSL rover will carry ten scientific instruments and a sample acquisition, processing, and distribution system. The rover instruments and tools will be used to detect and study potential sampling targets with remote and in situ measurements, acquire and deliver samples of rock and soil to the analytical lab instruments for measurement, and observe the environment around the rover. The rover will also have the ability to deposit scooped soil samples containing < 1.5 cm-size rock fragments into a sample cache, providing an option for possible later retrieval by a potential future sample return mission. The primary MSL mission will last one martian year.

Science Objectives: The MSL mission has four primary science objectives. The first is to assess the biological potential of at least one target environment by determining the nature and inventory of organic carbon compounds, searching for the chemical building blocks of life, and identifying features that may record the actions of biologically relevant processes. The second objective is to characterize the geology of the landing region at all appropriate spatial scales by investigating the chemical, isotopic, and mineralogical composition of surface and near-surface materials, and interpreting the processes that have formed rocks and soils. The third objective is to investigate planetary processes of relevance to past habitability (including the role of water) by assessing the long timescale atmospheric evolution and determining the present state, distribution, and cycling of water and CO_2. The fourth objective is to characterize the broad spectrum of surface radiation, including galactic cosmic radiation, solar proton events, and secondary neutrons.

Scientific Investigations: There are ten PI-led scientific investigations on MSL, each related to a single instrument, but the overall scientific goal of assessing present and past habitability will come from using the instruments in an integrated fashion. The instrument investigations have been grouped as follows:

Mast-based remote sensing: Mounted on a mast ~2.2 m above the ground are MastCam, a color wide- and narrow-angle imaging system provided by Malin Space Science Systems (PI: Michael Malin), and ChemCam, a laser-induced breakdown spectrometer and remote micro-imager provided by Los Alamos National Laboratory (PI: Roger Wiens).

Contact science: On the end of the robotic arm are APXS, an alpha-particle X-ray spectrometer provided by the Canadian Space Agency (PI: Ralf Gellert, Univ. Guelph), and MAHLI, a color hand-lens imager provided by Malin Space Science Systems (PI: Kenneth Edgett).

Analytical laboratory measurements: Located within the main body of the rover are CheMin, which analyzes delivered samples with X-ray diffraction, provided by the Jet Propulsion Laboratory, California Institute of Technology (PI: David Blake, NASA Ames Research Center), and the SAM instrument suite, which contains a gas chromatograph, mass spectrometer, and tunable laser spectrometer, provided by NASA Goddard Space Flight Center (PI: Paul Mahaffy).

Environmental measurements: RAD is a radiation detector provided by Southwest Research Institute (PI: Don Hassler). REMS is a meteorology package (temperature, pressure, winds, and humidity) and UV sensor provided by the Spanish Ministry of Science (PI: Javier Gómez-Elvira, Centro de Astrobiología/INTA-CSIC). DAN is an active neutron spectrometer provided by the Federal Space Agency of Russia (PI: Igor Mitrofanov, Space Research Institute). MARDI is a color, high frame rate descent imager provided by Malin Space Science Systems (PI: Michael Malin).

Science Operations in Support of Sample Caching: The MSL Project Science Group (PSG) will maintain a strategic plan for science operations, including the types of materials to be cached. In tactical day-to-day operations planning, the Science Operations Working Group will select the specific materials for caching and prepare detailed rover activity plans consistent with the PSG's strategic plan.

After identifying one or more rock fragments of interest in the soil and analyzing them as desired, a typical caching operations scenario would likely involve imaging before and after scooping and imaging of the cache opening after delivery to the cache. Several rover instruments (MAHLI, MastCam, Hazcam, Navcam, ChemCam, APXS, SAM, CheMin, as appropriate) could be used to make observations of the rock fragments before scooping or of similar material found in nearby larger rocks.