Europa Mission Science Overview

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Science Goal & Notional Objectives

- **Goal:** Explore Europa to investigate its habitability

- **Objectives:**
  - **Ice Shell & Ocean:** Characterize the ice shell and any subsurface water, including their heterogeneity, ocean properties, and the nature of surface-ice-ocean exchange
  - **Composition:** Understand the habitability of Europa’s ocean through composition and chemistry
  - **Geology:** Understand the formation of surface features, including sites of recent or current activity, and characterize high science interest localities
  - **Reconnaissance:** Characterize scientifically compelling sites, and hazards, for a potential future landed mission to Europa
NASA-Selected Europa Payload

Europa-UVS
UV Spectrograph
surface & plume/atmosphere composition

MASPEX
Mass Spectrometer
sniffing the atmosphere

SUDA
Dust Analyzer
surface & plume composition

ICEMAG
Magnetometer
sensing ocean properties

PIMS
Faraday Cups
sampling the plasma environment

E-THEMIS
Thermal Imager
searching for hot spots & preparing for future landing

EIS
Narrow-Angle Camera
surface mapping & preparing for future landing

EIS
Wide-Angle Camera
alien landscape in 3D & color

MISE
IR Spectrometer
surface chemical fingerprints

REASON
Ice-Penetrating Radar
plumbing the ice shell

Gravity Science
confirming an ocean

Composition
Geology
Ice & Ocean
Reconnaissance
### Europa Explorer 2007: Instrument Mapping to Investigations

<table>
<thead>
<tr>
<th>Science Objective</th>
<th>Science Investigation</th>
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<tbody>
<tr>
<td>A. Ocean</td>
<td>A1. Determine the amplitude and phase of the gravitational tides.</td>
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<td>A2. Determine the induction response from the ocean over multiple frequencies.</td>
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<td>A3. Characterize surface motion over the tidal cycle.</td>
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<td>A4. Determine the satellite's dynamical rotation state.</td>
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<td>A5. Investigate the core and rocky mantle.</td>
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<td>B. Ice</td>
<td>B1. Characterize the distribution of any shallow subsurface water.</td>
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<td>B2. Search for an ice-ocean interface.</td>
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<td>B3. Correlate surface features and subsurface structure to investigate processes governing communication among the surface, ice shell, and ocean.</td>
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<td>C. Chemistry</td>
<td>C1. Characterize surface organic and inorganic chemistry, including abundances and distributions of materials, with emphasis on indicators of habitability.</td>
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<td>C2. Relate compositions to geological processes, especially communication with the interior.</td>
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<td>C3. Assess the effects of radiation on surface composition, albedo, sputtering, and redox chemistry.</td>
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<td>C4. Characterize the nature of exogenic materials.</td>
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<td>D. Geology</td>
<td>D1. Characterize magmatic, tectonic, and impact features.</td>
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<td>D2. Search for areas of recent or current geological activity.</td>
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<td>D3. Investigate global and local heat flow.</td>
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<td>D4. Assess relative surface ages.</td>
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<td>D5. Characterize the physical properties of the regolith, and assess processes of erosion and deposition.</td>
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<td>E. External</td>
<td>E1. Characterize the magnetic environment.</td>
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<td>E2. Characterize the ionosphere and neutral atmosphere and their dynamics, with implications for surface interactions.</td>
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<td>E3. Characterize relationships between the magnetic field and plasma.</td>
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<td>E4. Characterize the global radiation environment.</td>
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<td>F. Neighbors</td>
<td>F1. Determine the nature and history of the geological activity and interior evolution of the Galilean satellites.</td>
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<td>F2. Understand the processes that determine the composition, structure and dynamics of the Jovian atmosphere as a type example of a gas giant planet.</td>
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<td>F3. Study the interactions between Jupiter's magnetosphere and its satellites.</td>
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**Objective's #1**

**Investigation's #1**

**Jovian System**

- Telecom
- Laser Alt
- IPR
- WAC
- MAC
- IR Spect
- INMS
- UV Spect
- NAC
- Thermal
- MAG
- Plasma

H - 4
Simultaneous Synergistic Observations

remote sensing of electromagnetic radiation

in situ measurement of fields & particles
Thematic Working Group (TWG) Structure

Habitability

Composition
including: exosphere, composition

Geology
including: geology, recon

Interior
including: ice shell, ocean

including: conditions for life, geochemical gradients, signs of life

Composition
including: exosphere, plume deposits, thermal anomalies, ocean properties, surface irradiation, recon composition

Geology
including: recon hazards, ocean properties

Interior
including: ice shell, plume sources
NASA-Appointed Working Groups

- **Gravity Working Group**
  - Focus on whether the existing mission concept and instrument payload can successfully confirm the presence of an ocean, and if not, how that can be corrected

- **Radiation Working Group**
  - Consider the scientific applications of the data set to be produced by the spacecraft's planned radiation monitoring system

8/4–5/2015
Three Europa Data Types

• **Archival data products**
  - Delivered to the Planetary Data System (PDS)
  - Calibrated and documented, with necessary algorithms (i.e. “usable”)

• **Collaborative data products**
  - Delivered to the Europa PSG
  - “Quick-look” products for internal PSG and Project use within ≈3 days of ground receipt

• **Public Data Products**
  - Delivered to Science Communications for public dissemination
  - Documented highlights of high public appeal, within ≈1 week of data receipt or production
“Global-Regional” Surface Coverage

- Utilize multiple satellite gravity assists to enable “global-regional” coverage of Europa while in orbit around Jupiter

- Current mission design consists of 45 low-altitude flybys of Europa from Jupiter orbit over 3.5 yr
Europa: The Adventure Begins!

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