Exploring Planets: Current Missions

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Class time: Mondays, 2:10-3:00, Rudolph Hall Room 184

Course Objectives

• Learn about current and recent exploration of planets and other objects in our Solar System.
• Who is doing what (and when, why, where, & how)?
• What are the hottest scientific topics?
• Discover fascinating science concepts and technology issues behind the missions.
• Develop an informed perspective on why we explore and why we should explore.
• Have fun!
Mercury to Pluto and Beyond

- Venus – AKATSUKI, Venus Climate Orbiter (JAXA)
- Moon – LRO, Chang'e-4 (& Yutu 2), Queqiao, Chang'e-5 T1; Artemis
- Mars – InSight, MAVEN, Opportunity, Curiosity, MRO, Odyssey, Mars Express, MOM, ExoMars TGO
- Asteroids – DAWN (Ceres, concluded Oct. 31, 2018)
  Hayabusa 2 (asteroid Ryugu, there now)
  OSIRIS-Rex (asteroid Bennu, there now)
  Lucy (mission to Trojans, Oct. 2021)
  Psyche (mission to Iron Asteroid Psyche)
- Jupiter – Juno, orbiting since 2016
- Europa - Europa Clipper (future)
- Titan - Dragonfly (New Frontiers candidate)
- Pluto, Charon, Ultima Thule – New Horizons
- Comets – Rosetta (past) & CAESAR (future)
- Interstellar – Voyager 1 & 2
Class Format

• **Mission Discussions**
  – Faculty & Graduate Students
    • Researchers involved in current missions will describe missions and our involvement in them
  – Students
    • Gather information (web-based) and present to class
  – Address questions such as:
    • What is the purpose of the mission?
    • How does it work?
    • What does it do?
    • What has been discovered and/or what is anticipated?
  – Ultimately, why do we explore?
    • What motivates this grand endeavor?

Presentation and discussion of a mission
  – What, when, where, how, why?
  – Science objectives and how will they be achieved?
  – Interesting facts and cool results or anticipated results
  – Images and graphics!
  – Other interesting information about the mission

Challenges (technical, scientific)

Importance/significance

• Each student will gather information about a current mission of your choosing and do a class presentation (PowerPoint or Keynote)
# Schedule

## Course Schedule: EPSc 106, Exploring the Planets, Tentative

<table>
<thead>
<tr>
<th>week</th>
<th>date</th>
<th>schedule (notional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/14</td>
<td>Introductions, missions</td>
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<tr>
<td>3</td>
<td>2/04</td>
<td>Exploring the Moon (Prof. Jolliff)</td>
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<tr>
<td>4</td>
<td>2/11</td>
<td>Exploring Mars (guest speakers)</td>
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<tr>
<td>5</td>
<td>2/18</td>
<td>Missions 1,2</td>
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<tr>
<td>6</td>
<td>2/25</td>
<td>Missions 3,4,5</td>
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<tr>
<td>7</td>
<td>3/04</td>
<td>Missions 6,7,8</td>
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<tr>
<td>8</td>
<td>3/11</td>
<td>Spring Break</td>
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<tr>
<td>9</td>
<td>3/18</td>
<td>Lunar &amp; Planetary Sci. Conf., Class TBD</td>
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<tr>
<td>10</td>
<td>3/25</td>
<td>Missions 9,10,11</td>
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<tr>
<td>11</td>
<td>4/01</td>
<td>Missions 12,13,14</td>
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<tr>
<td>12</td>
<td>4/08</td>
<td>New Horizons, the Pluto system (Prof. McKinnon)</td>
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<tr>
<td>13</td>
<td>4/15</td>
<td>Mission design teams 1 and 2</td>
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<tr>
<td>14</td>
<td>4/22</td>
<td>Mission design teams 3 and 4</td>
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<td></td>
<td>4/26</td>
<td>Last day of classes</td>
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**Project** *(small group)*
Select a target of interest (a planet or moon) and create a mission concept, focusing on the science objectives and implementation.
What will be your exploration priority for the Solar System and why?

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E-mail presentation materials to Prof. Jolliff ahead of class. Good idea to also bring a copy on a USB memory stick.
Class Discussion

• **Current Events**
  – New & recent items of interest
  – Example: What's in the sky this morning?
  – What is *in the news*?

• **Special topics of interest**
  – role of robotic exploration vs. human exploration
  – issues / risks / costs of exploration
  – What is of interest & important to you?

• **Class Project** (small groups)
  – design and present a mission concept
  – classmates to provide peer review

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Grades based on:

• **Mission Presentations**
  – Preparation (15%)
  – Presentation (15%)

• **Attendance** (25%)

• **Class Participation/Discussion** (30%)

• **Project** (15%)

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Class Resources

• **Internet Resources**
  – Mission websites (like JPL or APL)
  – Education and Outreach websites
  – Popular science websites
  – YouTube
  – TV Clips (Nova, History channel)
  – Google

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*Policy on use of electronic devices in class:*

Making notes for discussion, looking up information – Okay!

Texting, e-mailing, and social media during class – Not okay.
## Missions

<table>
<thead>
<tr>
<th>Object</th>
<th>Mission</th>
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<tbody>
<tr>
<td>Mercury</td>
<td>BepiColombo (ESA-JAXA)</td>
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<td>Venus</td>
<td>Akatsuki (JAXA)</td>
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<td>Moon</td>
<td>Lunar Reconnaissance Orbiter (LRO) (NASA)</td>
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<td>Chang’E 4 &amp; Yutu 2; Chang’e-5-T1 (CNSA)</td>
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<td>Artemis (NASA)</td>
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<td>Mars</td>
<td>Mars Exploration Rover (MER), Opportunity (NASA) (M. Bouchard)</td>
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<tr>
<td></td>
<td>Mars Reconnaissance Orbiter (MRO) (NASA)</td>
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<td></td>
<td>MSL, Curiosity (NASA) (Guests Prof. Arvidson, Madison Hughes)</td>
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<td></td>
<td>Mars Express (orbiter, ESA)</td>
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<td>Mars Odyssey (orbiter, NASA)</td>
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<td></td>
<td>Mars Orbital Mission, MOM (ISRO)</td>
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<td>Mars Atmosphere &amp; Volatile Evolution, MAVEN</td>
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<td>ExoMars, Trace Gas Orbiter</td>
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<td>Insight (NASA)</td>
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<td>Mars 2020 (future)</td>
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<td>Dwarf Planet</td>
<td>Dawn – Ceres (Guest, Xiaochen Mao)</td>
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<td>Asteroids</td>
<td>Hyabusa-2 (Ryugu) (JAXA)</td>
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<td></td>
<td>OSIRIS-Rex (Bennu) (NASA)</td>
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<td></td>
<td>Lucy (Jupiter’s Trojans – future, 2021) (NASA)</td>
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<td></td>
<td>Psyche (Metal Asteroid Psyche – future, 2022) (NASA)</td>
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<tr>
<td>Jupiter</td>
<td>Juno (NASA)</td>
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<td>Europa</td>
<td>Europa Clipper (future – 2022, hopeful)</td>
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<td>Titan and Enceladus</td>
<td>Dragonfly (future) (NASA)</td>
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<td>Pluto-Charon</td>
<td>New Horizons (Prof. McKinnon)</td>
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<tr>
<td>Comets</td>
<td>CAESAR (future) (NASA)</td>
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<tr>
<td>Kuiper Belt Object</td>
<td>(Ultima-Thule) New Horizons (NASA)</td>
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<tr>
<td>Edge of Solar System</td>
<td>Voyager 1 &amp; 2</td>
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<tr>
<td>Extrasolar Planets</td>
<td>TESS (Transiting Exoplanet Survey Satellite)</td>
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</tbody>
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Mission Presentations

Mission Presentations

• Length: 12-15 min
• Essentials of the mission
  – What’s in the name?
  – What does the mission do?
  – Where does it go, where is it now?
  – What are the goals? (in non-technical terms)
  – A little history about the mission if available
  – Spacecraft design
  – Mission design
    (Not too much detail)

• Science Objectives
  – Background information about the object
  – List the objectives
  – How does the mission advance knowledge?

• Importance of the Mission
  – As you might explain it to a friend, neighbor, or Congressional representative

• Discoveries or anticipated discoveries
  – Show pictures and images
  – Keep it simple ("high level")

*For graphics: Mac users: “Grab” tool  PC users: “Snipping” tool
Resources

Class Materials
http://epsc106.wustl.edu
login: epsc106     password: planets

Other Useful Websites

Snapshots from Space
http://www.planetary.org/blogs/emily-lakdawalla/

Planetary Photojournal (JPL)
http://photojournal.jpl.nasa.gov/

Smithsonian National Air & Space Museum
http://airandspace.si.edu/research/resources/rpif/

National Space Science Data Center (Planetary Missions)
http://nssdc.gsfc.nasa.gov/planetary/projects.html

Planetary Society (Advocacy Group)
http://planetary.org/home/
Other Information

**Course Description:** Presentation & discussion of currently active space exploration missions investigating planets in our Solar System and beyond. Each week, a different mission (or two) will be discussed, including science context and objectives, and new discoveries. We will discuss as a class why and how we explore other planets and Solar System objects. Each student will be responsible for collecting background information and leading discussion for one (or two) mission(s). Several class periods will include presentations by EPSc faculty or researchers who are active participants in a planetary mission (for example, MER, MSL, MRO, LRO, New Horizons).

**Grading:** Final Grades will be according to the following scheme:

- Mission Presentation(s)
  - Preparation (15%)
  - Presentation (15%)
- Attendance (25%)
- Class Participation (30%)
- Project (15%)

A: 90-100%  C: 70-80%
B: 80-90%  D: 60-70%

“+/-” grades will be assigned within two percentage points of the division between grades.

**Attendance:** Class attendance is mandatory. Notify Prof. Jolliff and Prof. McKinnon if you know you will be absent or if you miss class because you are ill.

**Academic Integrity:** Students are expected to adhere to high standards of academic integrity as outlined in the University’s policy:
http://wustl.edu/policies/undergraduate-academic-integrity.html

**Electronic devices in class (computers, tablets, smart phones):** You may use an electronic device in class for the purpose of note-taking or looking up information relevant to a class discussion. Engaging in e-mail, social media, web surfing, or other activities not related to class are not allowed.
Bias Reporting: The University has a process through which students, faculty, staff and community members who have experienced or witnessed incidents of bias, prejudice or discrimination against a student can report their experiences to the University’s Bias Report and Support System (BRSS) team. See: brss.wustl.edu

Mental Health Services: Professional staff members are available to work with students to resolve personal and interpersonal difficulties, many of which can affect the academic experience. These include conflicts with or worry about friends or family, concerns about eating or drinking patterns, and feelings of anxiety and depression. See: shs.wustl.edu/MentalHealth

Accommodations based upon sexual assault: The University is committed to offering reasonable academic accommodations to students who are victims of sexual assault. Students are eligible for accommodation regardless of whether they seek criminal or disciplinary action. Depending on the specific nature of the allegation, such measures may include but are not limited to: implementation of a no-contact order, course/classroom assignment changes, and other academic support services and accommodations. If you need to request such accommodations, please direct your request to Kim Webb (kim_webb@wustl.edu), Director of the Relationship and Sexual Violence Prevention Center. Ms. Webb is a confidential resource; however, requests for accommodations will be shared with the appropriate University administration and faculty. The University will maintain as confidential any accommodations or protective measures provided to an individual student so long as it does not impair the ability to provide such measures.

If a student comes to me to discuss or disclose an instance of sexual assault, sex discrimination, sexual harassment, dating violence, domestic violence, or stalking, or if I otherwise observe or become aware of such an allegation, I will keep the information as private as I can, but as a faculty member of Washington University, I am required to immediately report it to my Department Chair or Dean, or directly to Ms. Jessica Kennedy, the University’s Title IX Coordinator.

If you would like to speak with the Title IX Coordinator directly, Ms. Kennedy can be reached at (314) 935-3118, jwkennedy@wustl.edu, or by visiting her office in the Women’s Building. Additionally, you can report incidents or complaints to Tamara King, Associate Dean for Students and Director of Student Conduct, or by contacting WUPD at (314) 935-5555 or your local law enforcement agency.

You can also speak confidentially and learn more about available resources at the Relationship and Sexual Violence Prevention Center by calling (314) 935-8761 or visiting the 4th floor of Seigle Hall.