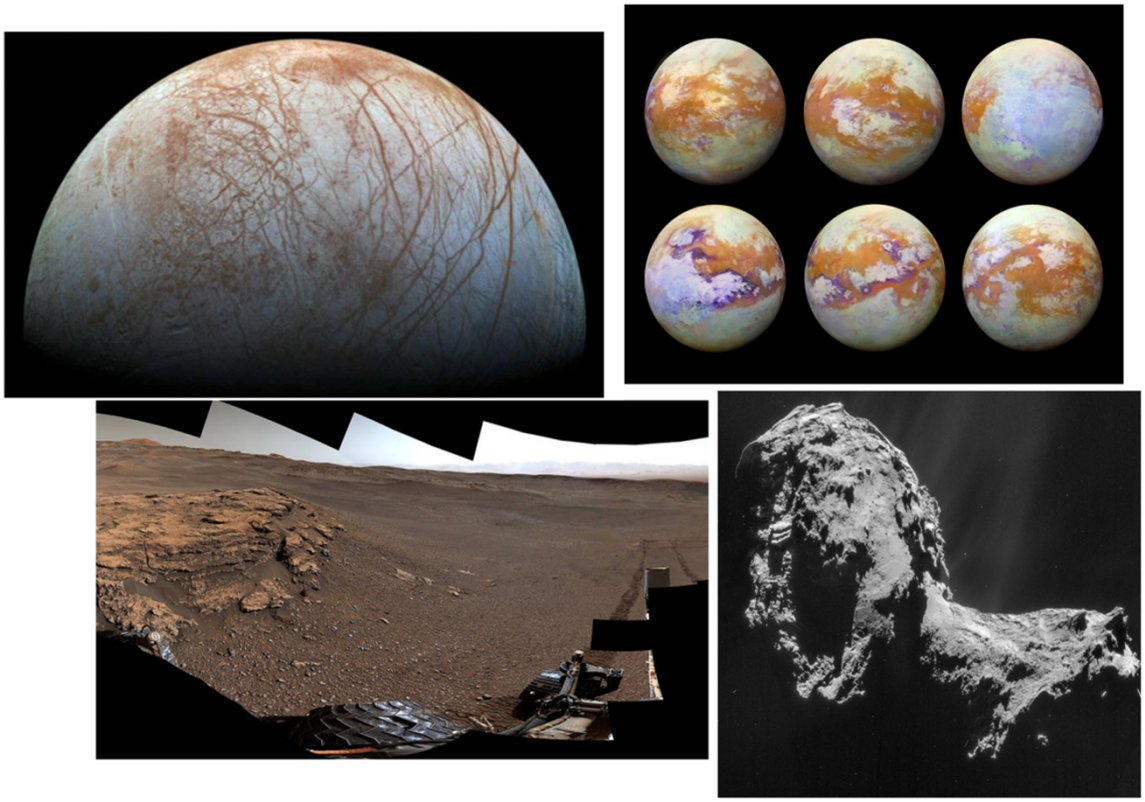
ASTRONOMY LAB PROJECT – SOLAR SYSTEM MISSONS AND SPACECRAFT

Projects and presentations due last week of lab



PROJECT INTRODUCTION

Astronomy gives us glimpses of worlds beyond our own. In your Astronomy lecture, you have learned about different missions and spacecraft that have furthered the field of Astronomy, transporting scientists and the public alike outside of our Earth revealing answers to questions about the Universe in which we reside. In your Astronomy Lab Project, you will study one of these missions or spacecraft in-depth.

SELECTIONS AND PRESENTATION DETAILS

For your final project for Astronomy lab, you will craft both an individual project and also a 10-minute group slideshow presentation on a Solar System mission or spacecraft of your choice selected from a list of options. You will have two decisions to make before preparing this project and presentation: your group must first decide on this **Mission/Spacecraft Selection** to research (examples: New Horizons, Curiosity, or Voyager 1; see pages 8-14 for all selection options), and second you must decide on a project **Format Selection**, the method that you prefer to use to convey the results of your research for your project, also chosen from a list of options (examples: blog, video, or paper; see page 6 for selection option details). You will submit your project to your TA at the beginning of class the last week of lab, and you will also give a 10-minute group slideshow presentation this same week. 5 minutes will also be set aside for questions (not included in the 10 minutes). For this presentation, use an application such as PowerPoint or Prezi. Your slideshow should be created using best presentation formatting (most slides should contain both images and text, you should use bullet points rather than long lengthy paragraphs, you should have introduction and conclusion slides, etc.) Each student in your group should talk for at least 2 minutes. During the lab period, each member of your group is responsible for asking another group a question about their project (3 questions total for your group).

PROJECT CONTENT

Once your group has picked your group Mission/Spacecraft Selection, your job is to study the mission or spacecraft in detail. Your individual project and group project presentation must include enough information to write a 2-page, double-spaced paper (you don't need to write this paper (unless you choose the paper Format Selection), you just need to incorporate this much material into your blog or video, etc.) This information must address the following:

Background

What is your Mission/Spacecraft Selection? What tools (instruments) did/does it use to collect data and perform science? Who built the mission or spacecraft and its instruments? How was it funded? What is the historical timeline for this mission (When was the idea for it conceived? When was it built? When was it launched/when did it fist begin operating? Have there been any other events of note?) What is the current operational status of this mission or spacecraft?

Science of the Mission or Spacecraft

What astronomical objects were/are studied by this mission or spacecraft? What are the scientific goals of this program? What form does the data collected take? What have scientists learned from this data?

Conclusion

Were the program goals achieved? What questions remain unanswered by this mission or spacecraft, at least so far, and what new questions were developed because of the program? What remains to be uncovered by other similar programs? Are their plans for any similar programs on the horizon?

On the Mission/Spacecraft Selection page you choose (pages 8-14), this **selection text may share additional items or questions to address**; if it does, make sure to include information to answer these questions. Finally, in the format of your choice, also include in your project **a list of citations** you used for researching your mission or spacecraft. You must include at least 3 sources. Every Mission/Spacecraft Selection page (pages 8-14) includes one or more suggested resources for getting started. You are welcome to use these resources as part or all of your 3 citations, though this is not required. The members of your group may use the same citations in your individual projects.

PROJECT GRADING AND SCHEDULE

This final project will be worth 60 points of the total points that make up your total lab grade, or the equivalent of 3 individual lab grades. The rubrics that will be used to grade the two parts of your final project, your individual project and your group presentation, can be found on pages 4-5. Your individual project and group presentation are due the last week of lab.

PROJECT RUBRIC

40/60 points of project grade

Category / Score	**3**	**8**	**13**	**Score and Notes**
Mission/Spacecraft Selection Science	• It was not clear which Mission/Spacecraft Selection was made • The group does not addresses the astronomical objects studied by the Mission/Spacecraft, its scientific goals, what was learned from the Mission/Spacecraft, if the program goals were achieved, or what remains to be uncovered by future programs	• The group addresses some but not all of the following: the astronomical objects studied by the Mission/Spacecraft, its scientific goals, what was learned from the Mission/Spacecraft, if the program goals were achieved, and what remains to be uncovered by future programs	• It was clear which Mission/Spacecraft Selection was made • The group addresses the astronomical objects studied by the Mission/Spacecraft, its scientific goals, what was learned from the Mission/Spacecraft, if the program goals were achieved, and what remains to be uncovered by future programs	
Mission/Spacecraft Background, Conclusion, and Other Topics	• Use of scientific language is routinely incorrect • The does not address the Mission/Spacecraft's instruments, who built it/them, launch/first light information and other key dates, or current operational status of the Mission/Spacecraft • If the student's individual Mission/Spacecraft Selection page gives additional items or questions to address, the student does not include this information	• Use of scientific language is usually correct but infrequently incorrect, and sometimes clunky/awkward • The group addresses some but not all of the following: the Mission/Spacecraft's instruments, who built it/them, launch/first light information and other key dates, and current operational status of the Mission/Spacecraft • If the student's individual Mission/Spacecraft Selection page gives additional items or questions to address, the student includes some but not all of this information	• Use of scientific language is appropriate • The group addresses the Mission/Spacecraft's instruments, who built it/them, launch/first light information and other key dates, and current operational status of the Mission/Spacecraft • If the student's individual Mission/Spacecraft Selection page gives additional items or questions to address, the student includes this information	
Format Selection Organization	• It was not clear which Format Selection was made • Includes 1 or no citations supporting information • Spelling & grammar mistakes in every sentence • Very little information is included in the report • The student has put little effort into the creation of their website/video/paper	• Includes only 2 citations supporting information • Average number of spelling & grammar mistakes • The report includes information, but it is not enough information to use to write a 2-page paper • The student has put some effort into making their project engaging and interesting	• It was clear which Format Selection was made • Includes 3 or more citations supporting information • No noticeable spelling & grammar mistakes • The report clearly includes a sufficient amount of information to fill a 2-page, double-spaced paper • The student has put good effort into making their website/video/paper engaging, making creative choices where applicable	
			Initial Score	
			Final Score (Initial Score + 1)	

PRESENTATION RUBRIC

20/60 points of project grade

Category / Score	**0**	**2.5**	**5**	***Score and Notes***
Mission/Spacecraft Selection Science	• It was not clear which Mission/Spacecraft Selection was made • The group does not addresses the astronomical objects studied by the Mission/Spacecraft, its scientific goals, what was learned from the Mission/Spacecraft, if the program goals were achieved, or what remains to be uncovered by future programs	• The group addresses some but not all of the following: the astronomical objects studied by the Mission/Spacecraft, its scientific goals, what was learned from the Mission/Spacecraft, if the program goals were achieved, and what remains to be uncovered by future programs	• It was clear which Mission/Spacecraft Selection was made • The group addresses the astronomical objects studied by the Mission/Spacecraft, its scientific goals, what was learned from the Mission/Spacecraft, if the program goals were achieved, and what remains to be uncovered by future programs	
Mission/Spacecraft Background, Conclusion, and Other Topics	• Use of scientific language is routinely incorrect • The does not address the Mission/Spacecraft's instruments, who built it/them, launch/first light information and other key dates, or current operational status of the Mission/Spacecraft • If the group's individual Mission/Spacecraft Selection page gives additional items or questions to address, the group does not include this information	• Use of scientific language is usually correct but infrequently incorrect, and sometimes clunky/awkward • The group addresses some but not all of the following: the Mission/Spacecraft's instruments, who built it/them, launch/first light information and other key dates, and current operational status of the Mission/Spacecraft • If the group's individual Mission/Spacecraft Selection page gives additional items or questions to address, the group includes some but not all of this information	• Use of scientific language is appropriate • The group addresses the Mission/Spacecraft's instruments, who built it/them, launch/first light information and other key dates, and current operational status of the Mission/Spacecraft • If the group's individual Mission/Spacecraft Selection page gives additional items or questions to address, the group includes this information	
Presentation Organization	• Includes 1 or no citations supporting information • Spelling & grammar mistakes in every slide • The group has put little effort into the creation of their presentation • Presentation is noticeably short • Presentation is very difficult to read and has the incorrect amount of text and to the extreme • If asked questions, students did not respond to questions asked	• Includes only 2 citations supporting information • Average number of spelling & grammar mistakes • The group has put some effort into making their presentation engaging and interesting • Slides are mostly easy to read with an appropriate amount of text (not too wordy) • If asked questions, students' responses could benefit from more professionalism	• Includes 3 or more citations supporting information • No noticeable spelling & grammar mistakes • The group has put good effort into making their presentation engaging, making creative choices where applicable • Slides are easy to read with an appropriate amount of text (not too wordy) • Students attempted to answer questions thoughtfully and professionally	
Category / Score	**0**	**1.5**	**2.5**	***Score and Notes***
Questions	• Group poses 1 or no questions, or only 2 or 3 questions all asked by the same student	• 2 group members pose a relevant question during another presentation	• All 3 group members pose a relevant question during a another presentation	
Individual Score	• Little to no fluid delivery, appropriate vocal enthusiasm and audience engagement (gestures, etc.) • Student read directly from the slides, did not speak at all, or was absent	• Some fluid delivery, appropriate vocal enthusiasm and audience engagement (gestures, etc.) • Student spoke for at least 1 minute	• Fluid delivery, appropriate vocal enthusiasm and audience engagement (gestures, etc.) • Student presented 1 image and spoke for at least 2 minutes	
			Final Score	

FORMAT SELECTIONS

Choose one. Regardless of format, include material equivalent to the amount of information in a 2-page, double-spaced paper. Address all questions; don't forget to list 3 resources.

VIDEO

Convey your research through video format. Show visuals highlighting your mission or spacecraft, and dub in or film yourself narrating. This audio-visual format can also be used to showcase a more creative endeavor (though it is not required): You could choose to write and perform a song about your mission or spacecraft, or a poem, etc.

POSTER

Display informational text and visuals for your mission or spacecraft all in a single, visually organized location. Provide your TA with a copy of this digital poster or a high-quality photograph of this physical poster where all words are legible. Transcribe your text if this is not possible.

BLOG/WEBSITE

Showcase your mission or spacecraft providing information and introduction in this visual medium. Provide your TA with the link to the blog or website you create for your project.

PAPER

Write a paper to get your information across. It should be 2-pages, double-spaced, 12-point font, 1-inch margins, etc. Your list of citations do not count toward the page length.

OTHER FORMAT

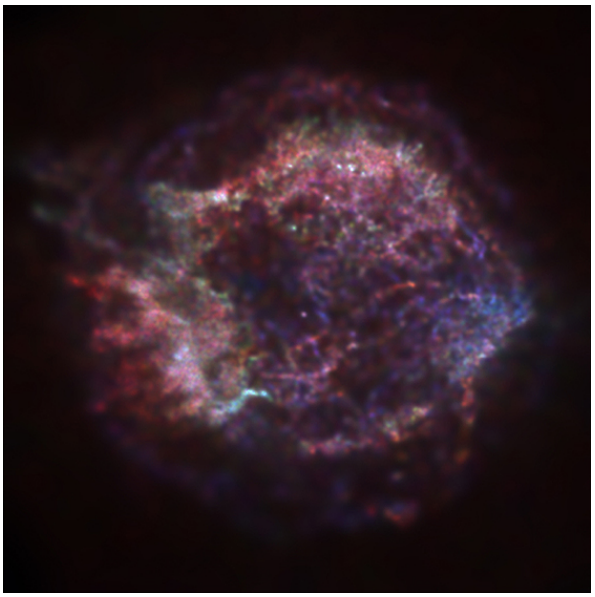
If you have an idea for another format, you must approve it with your TA. It's likely to get approved, but you'll need to formally check on this.

MISSION/TELESCOPE SELECTIONS

Choose one from pages 8-14

CHANDRA SPACE TELESCOPE

Chandra is a flag-ship class X-ray telescope orbiting the Earth. It was launched on July 23, 1999 with an expected lifespan of around five years but has survived much longer and is still taking images and data today. Chandra is one of the Great Observatories, making it one of the best telescopes that astronomers are able to use, especially in regard to looking at high energy objects that are used to probe the structure and evolution of the universe. A Chandra false color image of the supernova remnant Cassiopeia A in the X-ray band is shown at right (https://chandra.harvard.edu/photo/1999/casajph/). Since this course is Solar System Astronomy, at least one of the images you discuss in your project should relate to Solar System Astronomy in some way. For example, you could find 1 image of a nebula/star-forming region, where young stars like our Sun begin their lives (and begin to form their own Solar Systems), or you could find 1 image of a planetary nebula, the likely fate of our own Sun one day, or 1 image of a star similar to our Sun (perhaps a star with possible planets in the habitable zone).



Get started here:

https://www.chandra.si.edu/about/ Contains an overview of information about the Chandra mission and team. Information is broken upon cohesivity and has a wide variety of depth.

https://www.space.com/18669-chandra-x-ray-observatory.html Strong "pop-science" article that details the history and scientific goals of the Chandra telescope.

https://twitter.com/chandraxray?lang=en: Social media that shares what Chandra is currently observing and other interesting facts relating to X-ray astronomy

https://www.instagram.com/nasachandraxray/?hl=en: Social media that shares the best images taking by Chandra

Information to include:

Why is Chandra in orbit around the Earth?

What characterizes X-ray emitting objects? What are some challenges with observing X-rays?

Has Chandra degraded throughout its lifetime? If so, why?

HUBBLE SPACE TELESCOPE

The Hubble Space Telescope is the flagship mission most of you are probably familiar with. It was launched in 1990 by NASA, but even today it can take some truly remarkable images. However, it has mostly taken images of objects in space outside of our own Solar System. Since this course is Solar System Astronomy, at least 1 of the images you discuss in your project should relate to Solar System Astronomy in some way. For example, you could find 1 image of a nebula/star-forming region, where young stars like our Sun begin their lives (and begin to form their own Solar Systems), or you could find 1 image of a planetary nebula, the likely fate of our own Sun one day, or 1 image of a star similar to our Sun (perhaps a star with possible planets in the habitable zone). The Hubble image to the right, known as the Pillars of Creation, is an example of a nebula/star forming region.

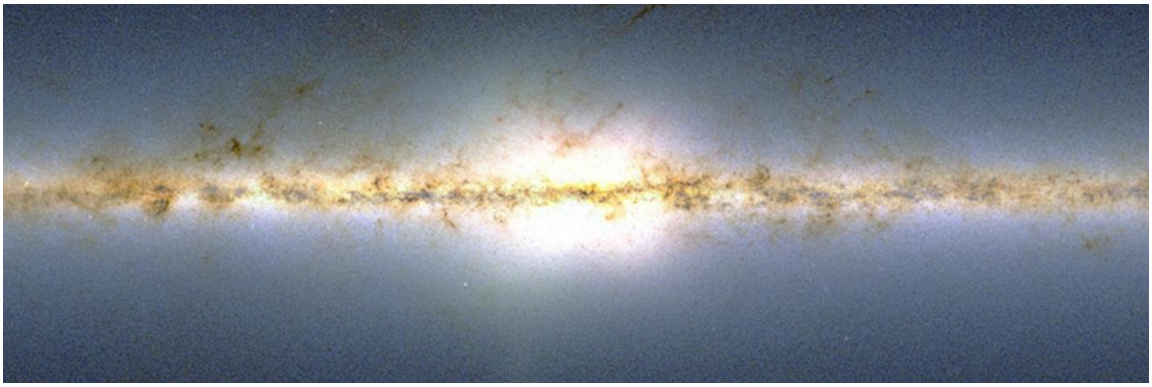
Get started here:

All of NASA's current missions have their own websites that give details about the mission, including images related to them. The following link sends you to a gallery of images on its official website. This is a good starting point because each image is labeled with the name of the object(s) being pictured.
https://hubblesite.org/images/gallery/

An alternative location to look at is NASA's web page on the Hubble mission. The link given below can be used to find photos Hubble has taken, but there is one caveat. Make sure to read the description of any images you are interested in. Some of them are taken as a joint project using multiple telescopes.
https://www.nasa.gov/mission_pages/hubble/multimedia/index.html

SLOAN DIGITAL SKY SURVEY (SDSS) TELESCOPE

The Sloan Digital Sky Survey (SDSS) has created the most detailed three-dimensional maps of the Universe ever made, with deep multi-color images of one third of the sky, and spectra for more than three million astronomical objects. It has been one of the most successful surveys in the history of astronomy. SDSS began regular survey operations in 2000, after a decade of design and construction. It has progressed through several phases, and each of these phases has involved multiple surveys with interlocking science goals. An infrared image of our inner Milky Way galaxy is displayed below that shows the plane and bulge of the Galaxy full of stars and dust



Get started here:

SDSS home page: https://www.sdss.org/

SDSS surveys: https://www.sdss.org/surveys/

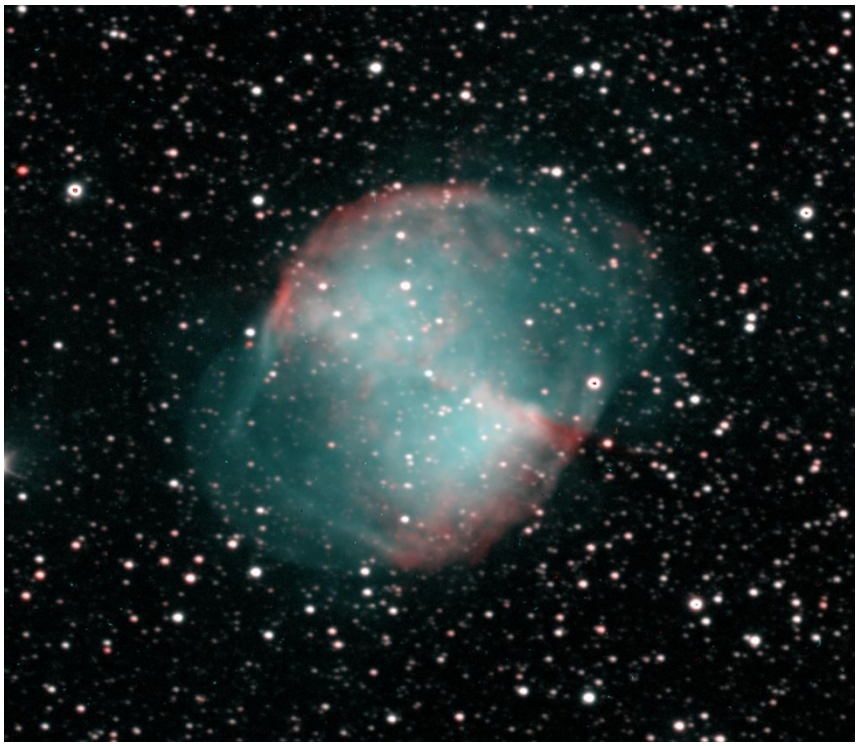
Image navigation: http://skyserver.sdss.org/dr16/en/tools/chart/navi.aspx

Image list: http://skyserver.sdss.org/dr16/en/tools/chart/list.aspx

Galaxy Zoo: https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/ original iteration used SDSS data

SOUTHEASTERN ASSOCIATION FOR RESEARCH IN ASTRONOMY (SARA) TELESCOPE

SARA (The Southeastern Association of Research in Astronomy) was commissioned in the interest of helping represent astronomers who needed



smaller telescopes to conduct their research. Not every research project in Astronomy requires a giant telescope, and the SARA 0.9-m telescope at Kitt Peak National Observatory in Arizona is an example of an excellent observatory for small telescope research. It also focuses on undergraduate student involvement, allowing students to get actual experience using a telescope. A false color image taken by SARA is shown above of M27 the Dumbbell Nebula

Get started here:

https://www.noao.edu/aura/stma/abs/toswalt.html - background

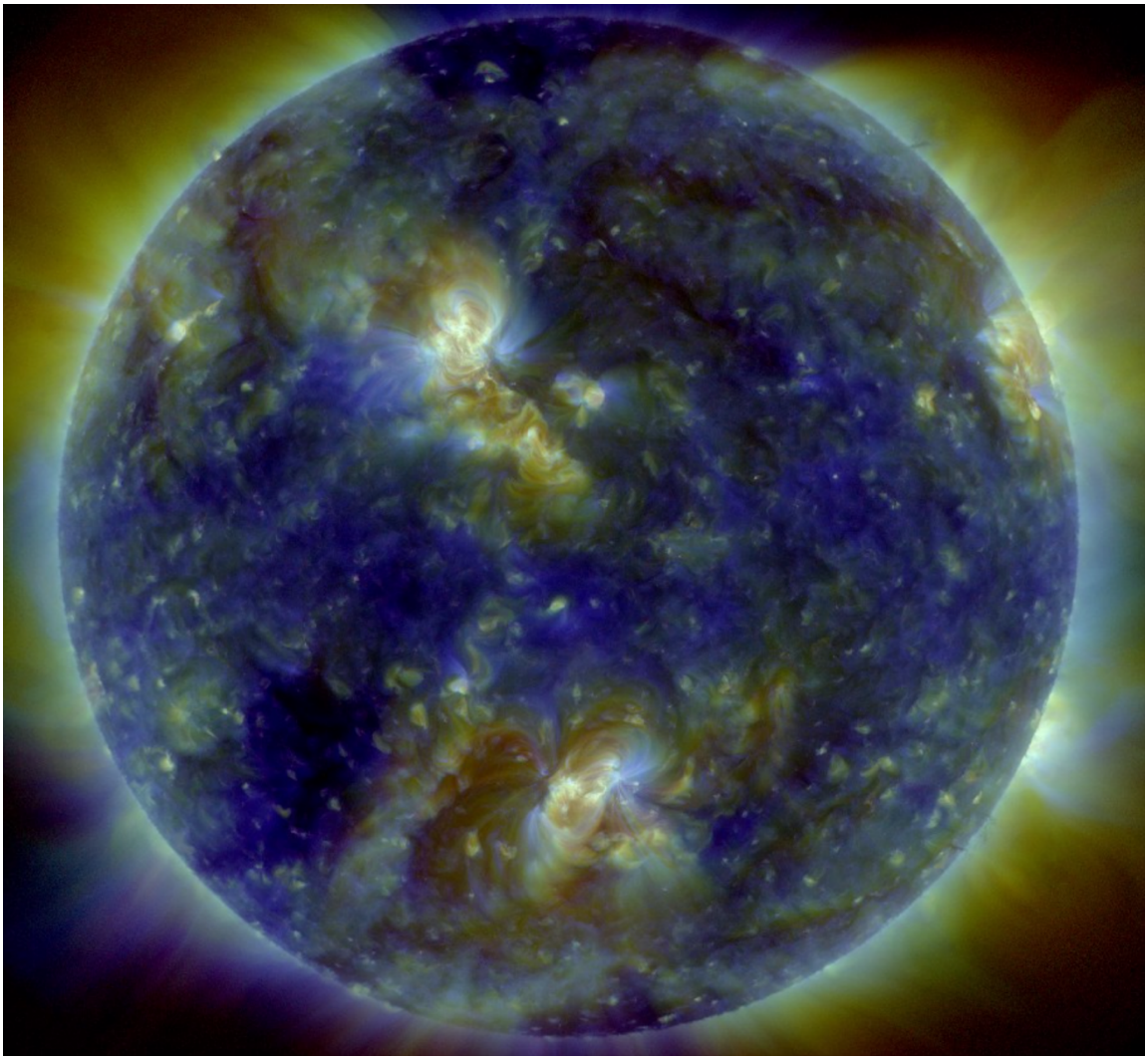
https://daytonabeach.erau.edu/about/labs/sara - background

https://www.butler.edu/physics-astronomy/sara - background

https://www.dropbox.com/sh/vz7lus170jnczr1/kvlgLpKFN0/SARA-N - image gallery; most but not all images list target names so you can do research on the target: Abell 78, Arp 102, Comet 209P, etc.

SOLAR DYNAMICS OBSERVATORY

SDO launched in 2010 with the mission to of understanding the interactions between the Sun and the Earth.

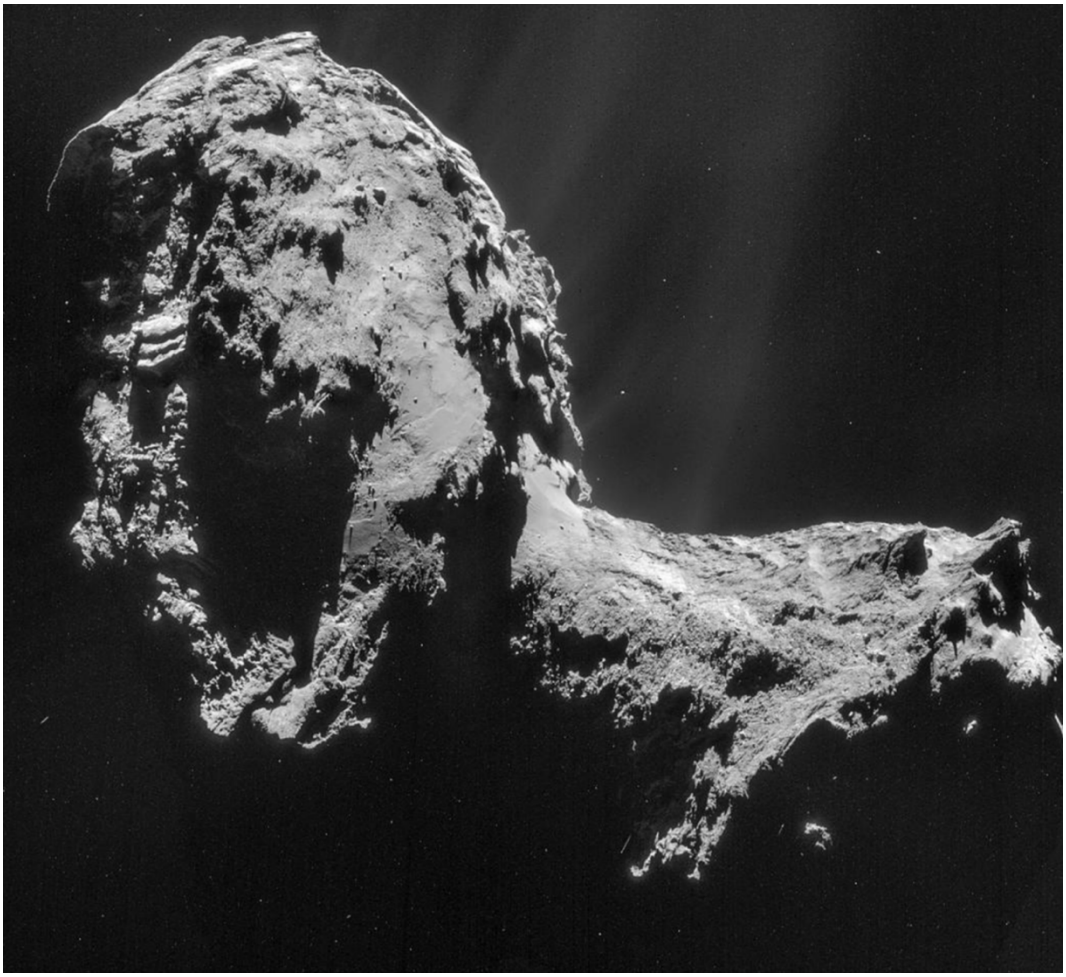


Get started here:

https://sdo.gsfc.nasa.gov

ROSETTA SPACECRAFT AND PHILAE LANDER

Rosetta launched in 2004 with the mission to improve our understanding of the early Solar System. It traveled to study the comet 67P/Churyumov-Gerasimenko (pictured below)



Get started here:

https://www.nasa.gov/rosetta

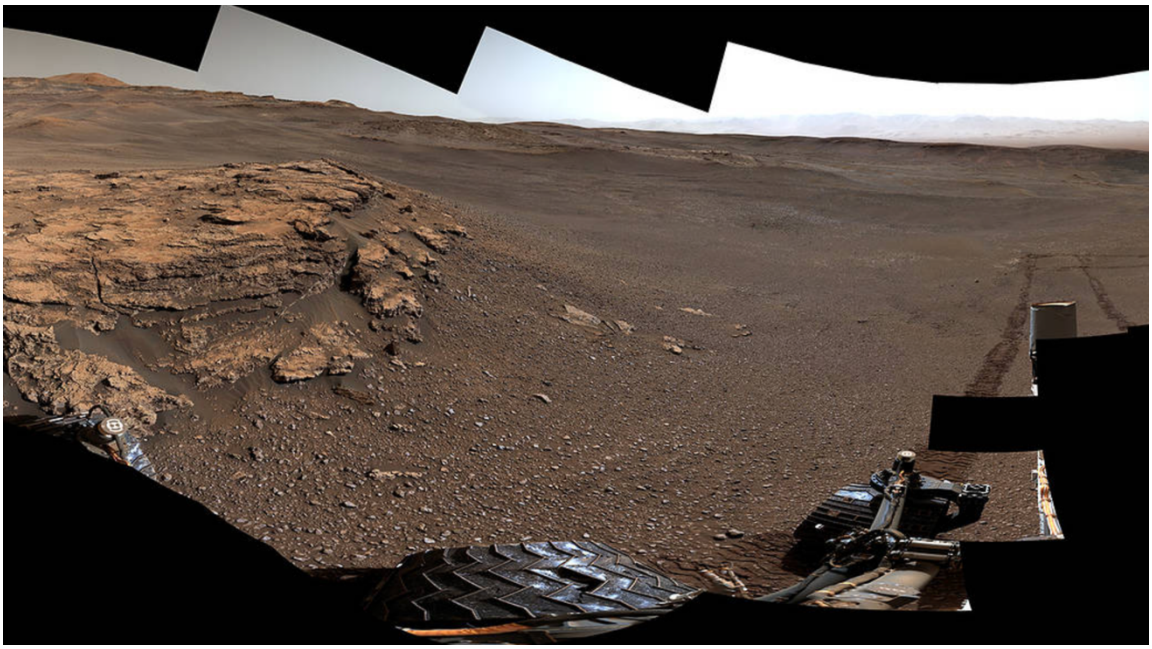
Information to include:

Tell the story of this mission, from conception to inception to completion

How did the spacecraft reach its destination, and how did it operate?

CURIOSITY ROVER

Curiosity launched in 2011 with the mission of investigating conditions for life on Mars (pictured below), both past and present



Get started here:

https://www.nasa.gov/mission_pages/msl/index.html

Information to include:

Tell the story of this mission, from conception to inception to completion

How did the spacecraft reach its destination, and how did it operate?