

# Final Project

## 1 Potential topics

Below is a list of potential project media as well as a non-comprehensive list of suggested topics. You can choose something not listed, so long as it's relevant to the topics we've covered in lab (e.g., exoplanets, stars, galaxies, cosmology, etc.). If you are doing a research project, you should choose a topic that you haven't covered in depth in class or in this lab.

More focused/specific topics often yield more compelling presentations (and are often better suited for short presentations). A sufficiently specific topic would be something like "The Great Red Spot and other storms on Jupiter," while something like "Gas giant atmospheres" would require more specificity.

Example Project Ideas:

- A research project (with an associated PowerPoint and/or whiteboard presentation) on a topic we haven't covered in class (e.g., a new astronomy concept, an astronomer/scientist we haven't discussed in class, an instrument/observatory/technique we haven't discussed in class, etc.)
- A description of a museum exhibit that you'd design to teach the public about a specific concept
- A short performance or dialogue
- A visual, audio, or mixed-media art piece (sculptures, music, *etc.*)
- A creative writing piece (e.g., poetry or a short story)
- Culinary arts (e.g., baked goods representing some astronomy concept, a "cookbook" on how to create stars/planets/galaxies)

Topic Ideas:

- Galaxies (including our own)
  - Galactic dynamics (e.g., birth, growth, rotation of galaxies)
  - Supermassive black holes
  - Different theories of dark matter (or different dark matter candidates)
  - The intergalactic medium (IGM)
  - Dark matter halos and the dark matter content of different galaxies
  - Dwarf galaxy satellites of the Milky Way
  - Ultra-faint dwarf galaxies
  - Dark energy
  - Galaxy clusters

- Stars (including our Sun)
  - Interior structure and chemistry of stars
  - Asteroseismology or helioseismology
  - Stellar atmospheres or magnetospheres
  - Stellar or solar winds
  - The process of star formation (or the properties of star-forming regions in galaxies)
  - Binary star systems
  - Clusters of stars (globular clusters or open clusters)
  - Specific types of star (e.g., T Tauri, RR Lyrae, Population III (the first stars))
- (Exo)Planets
  - Solar system formation and history
  - Planet X
  - Proto-planetary disks
  - Planet and planetesimal formation
  - Brown dwarfs
  - Exoplanet detection methods not discussed in class (e.g., microlensing, astrometry)
  - Exoplanet atmospheres
- Astrobiology
  - The Search for Extraterrestrial Life (SETI)
  - The Drake equation
  - Dyson spheres (or other hypothetical megastructures)
  - Technosignatures vs. Biosignatures
  - Communication and signal detection; candidate SETI signals
  - Breakthrough Listen or Breakthrough Starshot
- Telescopes and spacecrafts
  - Specific missions/projects (e.g., Hubble Space Telescope, James Webb Space Telescope, Kepler, TESS, Nancy Grace Roman Space Telescope, Vera C. Rubin Observatory, Thirty Meter Telescope).
  - Astronomy at specific wavelengths (e.g., Radio astronomy and very-long-baseline interferometry (VLBI), sub-millimeter astronomy, X-ray astronomy, gamma-ray astronomy)
  - NASA budget, missions, proposals (i.e., how funding decisions are made)
  - Space policy (i.e., laws governing space)
- Controversial Astronomy
  - Planet X
  - Extraterrestrial life

- Phosphine on Venus
- Science and Society
  - A biographical presentation on a famous astronomer. If you do this, choose 1-2 scientific contributions to emphasize. Some suggestions for scientists:
    - \* Annie Jump Cannon (spectra of stars)
    - \* Cecilia Payne-Gaposchkin (the composition of stars)
    - \* Vera Rubin (dark matter)
    - \* Jocelyn Bell Burnell (radio pulsars)
    - \* Nancy Grace Roman (stellar classification and motion)
    - \* Jill Tarter (SETI)
    - \* Sara Seager (exoplanets)
    - \* Caroline Herschel (comets)
    - \* Annie Maunder (sunspots, solar corona, eclipses)
    - \* Margaret Kivelson (solar wind, Europa's ocean)
- Miscellaneous
  - The Big Bang and the early Universe (e.g., inflation, nucleosynthesis, the epoch of recombination, the epoch of reionization)
  - The cosmic microwave background (CMB)
  - Gravitational waves and LIGO
  - Compact objects (Black holes, neutron stars, pulsars, magnetars, white dwarfs)
  - High-energy explosions (Fast Radio Bursts or Gamma-Ray Bursts)
- A recent or historically significant astronomy paper (I recommend searching through <https://ui.adsabs.harvard.edu/> or <https://arxiv.org/archive/astro-ph>, or asking me for help finding a paper).