Into the Final Frontier :
America's Journey into Space

Course Syllabus

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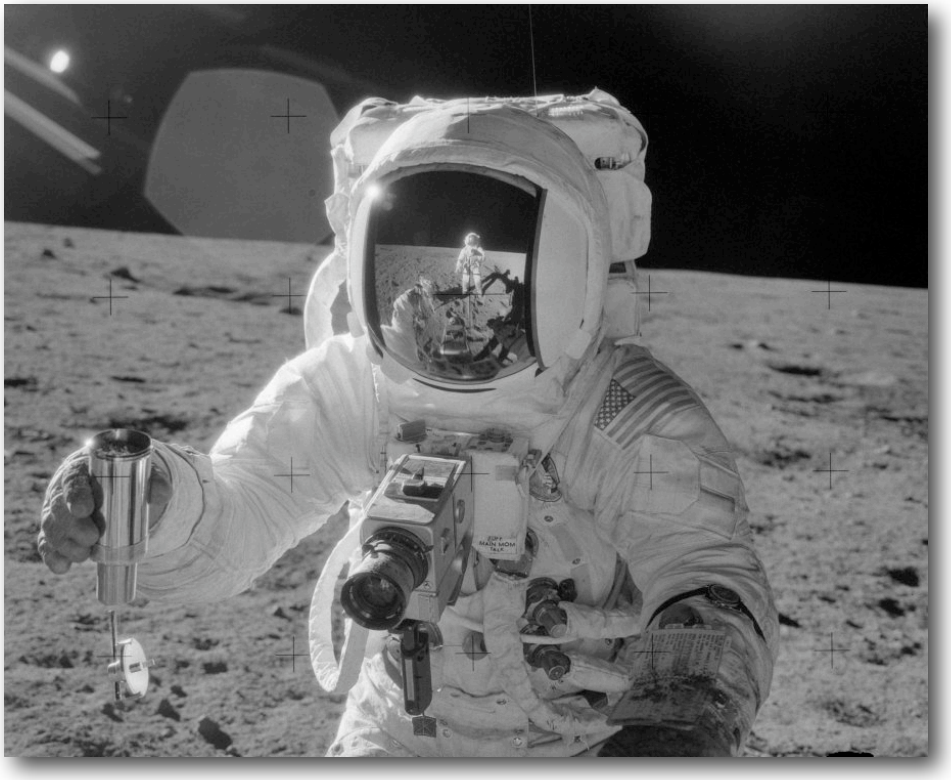

Quote from Alan Bean (Apollo 12 moonwalker):
Why had we gone to the moon at all? Was it worth the cost? I feel that there is no single answer to these questions, and that each person must decide for themselves. The spirit of exploration is either in your heart or it is not. Dave Scott [Apollo 15 moonwalker] spoke eloquently when he said: "As I stand out here in the wonders of the unknown at Hadley [on the surface of the Moon], I try to realize there is a fundamental truth to our nature. Man must explore. And this is exploration at its greatest."

Overview and Objectives :

One of the greatest accomplishments of the twentieth century is the human advance into space. For the first time ever, travel beyond the Earth is more than just the subject of adventurous science fiction tales. It is a reality. The purpose of this course is to trace the development of space flight from the late 1800s to the present time and to discuss the advantages and disadvantages of maintaining a human space flight program. The scientific results of human space flight and the cultural, military, and political environment in which these achievements were made will be examined.

The course will be driven by the following question : "Should the US government be pursuing a human space flight program?" This is a question which has no right or wrong answer. Each student will be asked to develop their own answer to this question, with detailed justifications, during the semester. The final project will be a statement of their position on this issue. The answer will be very personal, but justifying that answer will require input from a variety of fields. In order to facilitate this process, the course material will be carefully designed to address four general questions with regards to the US human space flight program. After taking this course, each student should be able to answer each of these questions and to make their own assessment on the value of the US human space flight program.

1) *What have we done so far in space?*
Here we will cover the history of human space flight, covering all six of the US human space flight programs : Mercury, Gemini, Apollo, Skylab, Space Shuttle and the International Space Station.

2) *How did we do it?*
This question will address the science and technology that got us onto space. The mechanics of space flight, spacecraft design, maintaining a habitable environment, etc. Technology has evolved greatly during the history of the manned space effort. There is probably no better example of technological evolution than to look at how computer technology, as applied to the space program, has evolved over the last 50 years.

3) *Why did we go into space?*
The motivation for the human space flight program was largely political (the "space race"), but there were also scientific reasons for the space effort. In addition, there are less tangible motivations which might be loosely categorized under the heading of "the sprit of exploration".

4) *What have we gained by going into space?*
We have learned a lot about science (e.g., lunar science, human physiology, etc.) We have also gained from the technology developments spurred by the space program.

Covering these four questions will provide students with a mix of material drawn from history, politics, science, technology and what might be called the human spirit. Collectively, these topics will help each student to develop their own position paper.

Readings :

The primary textbook chosen for this course ("Into the Final Frontier: The Human Exploration of Space," by Bernard McNamara) was developed (in part with NSF funding) for a course at New Mexico State University. Additional materials would be added to cover more recent developments since the publication of the text (in 2001). Most importantly, this would include the loss of the Space Shuttle Columbia and its aftermath and the recent directive for NASA to redirect its efforts towards manned exploration of the Moon and Mars. Two additional books have been chosen to provide insight into the human side of space flight. One of these ("A Man on the Moon") covers the Apollo era. The other ("Dragonfly") covers the more recent efforts to develop an international space station.

McNamara, Bernard. 2000. *Into the Final Frontier: The Human Exploration of Space.* (Brooks Cole Publishing.) This text provides an historical account of the space program and will form the basis of our historical survey of the US space program.

Chaikin, Andrew. 1998. *A Man on the Moon.* (Penguin Publishing.) This book is an excellent account of the Apollo moon landings that provides not only an historical overview, but also personal insights from the astronauts themselves. It also formed the basis for the excellent HBO mini-series "From the Earth to the Moon."

Burrough, Brian. 2000. *Dragonfly.* This book chronicles the US participation in the Russian Mir space station program. It provides some insight into US-Russian space activities.

Course Requirements :

Class Participation (20%) :
Active participation is an integral part of an inquiry course. For example, the classroom must provide a forum for students to develop and share their own thoughts on the various issues that we will encounter during the course of the semester. In addition, there will be a variety of group activities designed to develop an understanding of the various concepts (technological, scientific, etc.) that we will explore. Students will be expected to participate actively in all of these activities. Because of the importance of this aspect of the course, attendance will be mandatory (with some allowance made for excused absences).

Response Papers (30%) :
There will be a series of three response papers to be completed during the course of the semester. Each paper will count 10% of the course grade. The first paper will be submitted early in the semester and will provide a baseline for assessing each student's initial view of the US space program. A second paper will cover a topic chosen by each student (with the instructor's approval). This topic will be a critical assessment of some aspect of the US space program (e.g., the role of women in space, manned vs. unmanned exploration, etc.). The topic should be one that is chosen to aid in the development of the position paper. The third paper will be drawn from one of the in-class focus topics listed below. Drafts of each written assignment will be critiqued by in-class peer review and/or by the instructor. Students will then have an opportunity to incorporate the critical input into their final draft.

Final Position Paper (30%) :
This term project will represent the student's own personal assessment of whether or not the US should be supporting a human space flight program. It is meant to reflect their own personal views, but it needs to be supported by fact-based arguments, drawn from the material that will be covered in the course. Drafts of each written assignment will be critiqued either by in-class peer review or by the instructor. Students will then have an opportunity to incorporate the critical input into their final draft. Each student will be asked to make a brief presentation to the class based on the content of their paper.

Exams (20%) :
There will be two exams during the semester, which will focus on the material covered by the assigned readings and the in-class activities. Each exam will count as 10% of the grade.

Course Outline :

McNamara's text will provide the basic structure of the course. We will cover most of that text during the semester, concentrating on those topics that are directly related to the US space program. The outline below is taken directly from McNamara's Table of Contents.

Part I: The Early Pioneers of Space Travel.
1. Kostantin Tsiolkovsky.
2. Robert Goddard.
3. Hermann Oberth.

Part II: Beyond the Space Pioneers.
4. World-Wide Interest in Rockets.
5. Wernher Von Braun.
6. Sputnik and the American Response.
7. The Space Age Begins in Earnest.
8. The Early Stages of Project Mercury.
9. Yuri Gagarin: The First Man in Space.

Part III: America Plans To Place a Man on the Moon.
10. Project Mercury's Suborbital Flights.
11. Project Mercury's Manned Orbital Flights.
12. Unmanned Lunar Reconnaissance Missions Part 1.
13. Unmanned Lunar Reconnaissance Missions Part 2.
14. The Mercury 13 and the Selection of Women Astronauts.
15. Project Gemini: Part I.
16. Project Gemini: Part II.
17. The Flying Machines of Apollo.
18. Apollo 1:The High Cost of Bravery.
19. Apollo Missions 4-10:From the Earth to Lunar Orbit.
20. Apollo 11: The First Manned Lunar Landing.
21. Apollo Missions 12 and 13: A Rough Start to Lunar Explorations.
22. Apollo 14: Alan Shepard Returns to Space.
23. Apollo 15-17: Lunar Exploration Takes Priority - The J Missions.

Part IV: The Early Russian Manned Space Program.
24. Sergei Pavlovich Korolev.
25. The Soviet Launch Facilities and Vehicles.
26. Vostok and Voskhod: The Soviet Union's Early Manned Missions.
27. The End of the Moon Race: A Dash to the Finish.
28. The Early Soviet Salyut Space Stations.
29. The Flight of Soyuz II and Its Aftermath.
30. The Soviet Space Station Program Regains Its Momentum.

Part V: The Era of International Cooperation in Space.
31. Skylab: America's Space Station and Its Early Problems.
32. The Conduct of Long-Duration Missions: Lessons from Skylab.
33. The Apollo/Soyuz Test Program.
34. The Space Shuttle.
35. The Second Generation Soviet Space Stations: Salytus 6 and 7.
36. The Soviet Super Station: The Mir Space Station.
37. Mir Perseveres Through Troubling Times.
38. Flights of the Space Shuttle.
39. The Shuttle/Mir Era.
40. The Shuttle/Mir Program Reveals Unsettling Problems.
41. The American Space Station Freedom Becomes the International Space Station.
42. Moon Base: An Important Step into the Future.
43. Mission to Mars.

Focus Topics :

Throughout the semester, we will investigate several more focused topics in greater detail. These topics will be chosen to provide an opportunity to investigate a variety of space-related issues and to focus the in-class activities. Some of these activities will be derived from NASA educational materials. There are a variety of NASA-developed classroom activities available for many of these topics, including how one maintains a livable environment (spacesuits), space weather, lunar science and the future plans for the US space program (the Constellation program). We will spend typically about one week on each of these focus topics :

1. *Evolution of Computer Technology*
   It is a remarkable fact that at the time we went to the Moon, the pocket calculator had yet to be developed. Not only does this underscore the remarkable nature of the achievements of Apollo, it also underscores how far we have come since that time in the evolution of computer technology.

2. *Maintaining a Habitable Environment in Space.*
   The real challenge of human space flight is that of keeping the human travelers safe during their voyage and providing the necessary tools for them to function in this extremely inhospitable and unforgiving environment. How do we supply astronauts with breathable oxygen, water and food? How do astronauts deal with the ill-effects of prolonged weightlessness?

3. *Space Weather*
   The Sun has a great influence on the space environment. For the most part, we are protected by the Earth's magnetic field. But not always. Large solar storms can cause havoc with communications systems here on Earth and have even resulted in the loss of operational satellites. Astronauts who venture outside of the Earth's protective magnetic shield must deal directly with the dangers of solar activity. Cosmic radiation may even represent a fundamental limitation in our efforts to travel to Mars.

4. *The Human Side of Space Flight*
   One of the most important differences between human space flight and robotic missions is that humans get to experience space. What is that experience like? What is it like to spend months inside the International Space Station? What is it like to walk on the Moon?

5. *What Apollo told us about the Moon*
   The lunar landing missions of Apollo not only demonstrated our technological capabilities, but they also offered an opportunity to study the geology of the Moon in great detail. This focus topic will look at what we learned about the Moon from Apollo. What did we learn about the geologic history of the Moon? Where did it come from? How was our understanding of the Moon changed by Apollo? As part of this study, we will participate in a NASA program that brings real lunar samples into the classroom.

6. *The Human Cost - Disasters in Space*
   Unfortunately the space program has taken its toll in terms of human lives. We will discuss the three major US space tragedies (the Apollo 1 fire and the loss of

Space Shuttles Challenger and Columbia) to see how these have affected our space program. At the same time, we will also look at some close calls, including Gemini 8, Apollo 13 and the fire on board the Mir space station. What lessons can we learn from these incidents?

7. *The impact of the Cold War on the Space Race*
   The early US space program was driven not by the scientific goals, but by the desire to demonstrate our technical superiority over our Cold War adversaries, the Soviets. Here we will review the nature of the Cold War and how it impacted the space program. What prompted Kennedy's 1961 commitment to land a man on the Moon by "the end of the decade"? What were the major milestones of the space race? Who won? How close was it?

8. *The Earthbound Experience*
   For the first time in history, mankind was able to experience the historical event of man's first steps on the Moon. Although such an achievement, by today's standards, seems almost trivial, it was a major technical feat in 1969. How was this accomplished? How has the technology of broadcasting space images evolved since Apollo? How has coverage by news networks changed over the years? How and why was the Apollo experience so special?

9. *Was the Moon Landing a Hoax? - An Exercise in Critical Thinking*
   In recent years, the media has paid a lot of attention to the idea that the Apollo moon landings were faked. None of the claims of the proponents of the Moon landing hoax have withstood critical scrutiny. We will use this issue as an exercise in critical thinking, looking in detail at some of the issues that have been raised by the hoax advocates.

10. *The Future of the US Human Space Flight Program*
    NASA currently plans to retire the Space Shuttles in 2012 and embark on a program of lunar and perhaps Martian exploration. What will become of the US human space flight program? What will become of the International Space Station? What are the current plans for NASA's Constellation, which is expected to return men to the Moon by 2020.

Achieving the Characteristics of an Inquiry 444 Course

The primary goal of the course will be to develop a position paper that addresses each student's own personal view on the value of the US human space flight program. This is a very personal question, which will motivate each student to develop their own set of criteria by which to judge the value of the space program. The research and the application of critical thinking to this task represent a significant aspect of the inquiry concept. A final presentation by each student will also provide them with the opportunity to develop their presentation skills. Below are some comments regarding how this will specifically address each of the defined characteristics of an inquiry course.

- *Encouraging the development of multiple perspectives and involving students in a number of different approaches to the question, problem, or subject of the course.*

  This course will provide background information regarding the space program that is drawn from a variety of fields. This includes history, politics, technology, and various fields of science (astronomy, physics and biology, among others). This material will be addressed in different including independent readings, in-class activities and in-class discussions. All of this information will be incorporated into the students final position paper.

- *Drawing students into the process of scholarly investigation; the communication of information is not necessarily the primary objective.*

  The nature of the course, focused on the development of each student's position paper, will require each student to collect and evaluate information from a variety of different subject areas. This information will have to be collected and evaluated in the context of a number of criteria (as defined by each student) in a way that will facilitate the formulation of their position paper.

- *Structuring the course and course assignments in ways that guide and facilitate the process of increasingly informed inquiry.*

  The course material will cover a variety of different subject areas and provide a sufficiently broad basis for their research. The material foundation will come from their assigned readings, which will be reviewed and discussed in class. In addition, we will be focusing our in-class activities (demonstrations, discussions, group activities, etc.) on selected topics which will broaden their research base even further. Collectively, the course material will provide the necessary background to facilitate the development of their position paper.

- *Working individually with students to foster the student's development as an active learner and competent communicator.*

  The position paper will be developed throughout the semester, starting with an outlines and proceeding with drafts, revisions, etc. These various steps will receive one-on-one reviews with the instructor and may also be the subject of in-class (small group) peer reviews. Other written assignments will also receive similar feedback. Active participation in the class (i.e., discussions) will be an important requirement for success in the course.

- *Encouraging students to formulate and evaluate questions and methods.*

The development of a position paper will require each student to develop their own set of criteria in which to evaluate information from various topical areas. This would likely include such areas as the political and scientific value of the space program. Each student will therefore be obligated to define, in concrete terms, their own definition of value in each area. Their research will require that they formulate key questions that need to be addressed.

- *Students learning to identify, critically evaluate and collect evidence; present results systematically and formulate sound conclusions.*

  The development of a position paper will require the assimilation of information from a variety of fields. This information then must be evaluated in the context of a variety of student-defined criteria. An important component of the course will be to develop critical thinking skills (in the context of the "Moon Landing Hoax") that will enable each student to properly evaluate the collected material. The final paper will be presented both in written form and in oral form (through an in-class class presentation). Along the way, feedback from both the insructor and fellow students will help to guide the research.

Achieving the Student Learning Outcomes of an Inquiry 444 Course

Below are some comments regarding how this will specifically address each of the required learning outcomes of an inquiry course.

- Inspire curiosity:
  An Inquiry Student will compose open-ended questions that lead to further investigation into increasingly focused problems and issues.

  Starting with a broad understanding of the history, politics, technology and science behind our space program, each student will have to assimilate that information in his/her own way so that they can determine, in their own mind, the value of a human space flight program. The course content (reading materials, in-class activities, etc.) will help to guide them through this process.

- Develop understanding and perspective taking:
  An Inquiry Student will explain a central issue or question of the course using at least two unique perspectives.

  This course will provide background information regarding the space program that is drawn from a variety of fields. This includes history, politics, technology, and various fields of science (astronomy, physics and biology, among others). This material will be addressed in different including independent readings, in-class activities and in-class discussions. All of this information will be incorporated into the students final position paper.

- Clarify standards of thinking:
  An Inquiry Student will be able to identify, compare, and evaluate different interpretations (hypotheses, explanations,) of a given phenomenon.

  An important component of the course will be to develop critical thinking skills (in the context of the "Moon Landing Hoax") that will enable each student to properly evaluate the collected material. We will also look at the application of critical thinking skills in the context of the Scientific Method.

- Create effective communicators:
  An Inquiry Student will present in clearly organized form, the results of their investigation into questions or problems they have posed.

  Through a series of writing exercises (consistent with the writing intensive nature of the course) each student will have the opportunity to develop their writing skills. At the end of the semester, each student will also be asked not only to submit their final written position paper, but also to present their position paper to the class, complete with powerpoint slides.