HUMAN EXPLORATION OF SPACE: A COLLEGE SURVEY COURSE. Kenneth S. Coles, Geoscience Department, Indiana Univ. of Pennsylvania, 111 Walsh Hall, Indiana, PA 15705, kcoles@iup.edu.

Introduction: The course "Human Exploration of Space" (GEOS 254) at Indiana University of Pennsylvania introduces students to the past and future of robotic spacecraft and human spaceflight. Most of the students are not science majors and take the course to fulfill the university science requirement.

Scope of the Course: The course has been offered twice (Fall 2008 and Spring 2010 semesters) and covers the following.

A. Principles of Flight and Space Science (2 weeks; models and kinematics of the solar system, powered flight, guidance and tracking).

B. History of Space Exploration and the Space Race (5 weeks; Tsiolkovski, Goddard, the VfR, Sputnik and the Race to the Moon; students prepare a timeline poster of key events during the space race).

C. Robotic Missions (2 weeks; 1957 to the present; each student reports on an assigned mission).

D. Humans in Space and Prospects for the Future (5 weeks; living in space, selection of astronauts and cosmonauts, plans of various nations, choosing future directions; each student proposes a new manned or robotic mission).

The emphasis in the course is uncommon among introductory college courses. A survey of courses at other universities in Pennsylvania indicates that most are conventional astronomy courses, or they cover the entire history of astronomy from Ptolemy and Galileo to the present. A focus on the era of spacecraft and human space flight is much less common. This approach has proven to be informative and engaging for non-science majors. It also educates them about the choices, requirements, and benefits of scientific study of the solar system by robotic and human missions. Lectures, assignments, and projects emphasize a mix of history of science, history of technology, and the applications and uses of both.

Text and Learning Materials: Although this course outline is unusual, it is actually well covered by any number of inexpensive trade books on the history and future of space exploration. Examples include recent books by Launius [1] and Furniss [2]. Supplementary readings include works by Sagan, Clarke, von Braun, Ley, Chaikin, Zubrin, Schmitt, Wilhelms, and others. Throughout the semester students submit reading questions [3] on assigned reading prior to class.

Multimedia resources include the many web pages at NASA and the *Basics of Spaceflight* [4] as well as historic video of Goddard's rocket launches, the A-4/V-2, Sputnik, the manned spaceflights of the 1960s, and the Voyager project.

Student Experience: Surveys at the start of the course indicate students commonly know little or nothing about the exploration of space beyond the date of the first American Moon landing and perhaps the development of the heliocentric model of the solar system.

Areas of increased awareness. At the end of the course, student awareness is significantly greater for several topics: 1) The space race and the achievements of the U.S. and U.S.S.R. 2) The complexity of successful spacecraft designs. 3) Issues in choosing future directions in space exploration. 4) Distortions in media depictions of space travel.

Areas needing improvement. 1) Understanding what is realistic and what is fiction in actual space missions. For example, in the first group of Mission Proposals, many included fantasy technologies or impractical strategies (e.g., travel far outside the solar system). Using past missions as models and strict guidelines on the assignment have helped reduce this. Students continue to request fictional movies in class even while admitting they are unrealistic. 2) Experience with artifacts. In Fall 2008, the course included a trip to the National Air and Space Museum. While students reported this was very valuable, it was logistically very difficult. A virtual, web-based trip the second time the course was taught proved considerably easier but less satisfying. 3) Hands-on and class interaction. Students asked for additional group activity and discussion in class as well as evening telescope observing. 4) Balance between 'how-to' and results. The whole of planetary science is beyond the scope and time limit of the course and is covered by other courses at the university. Nevertheless, case studies of mission discoveries illuminate the principles and process of space exploration.

Summary: A course emphasizing the history and challenges of human exploration of space generates interest, enthusiasm, and understanding among non-science students.

References: [1] Launius, R. D. and Johnson, A. K. (2009) *Smithsonian Atlas of Space Exploration*: Harper Collins, 230 p. [2] Furniss, T. (2006) *A History of Space Exploration*: Mercury Books, 192 pp. [3] Henderson, C. and Rosenthal, A. (2006) *J. Coll. Sci. T., 35(7)*, 46-49; Offerdahl, E. et al. (2008) *J. Coll. Sci. T., 37(4)*, 43-47. [4] J.P.L. (2010) http://www2.jpl.nasa.gov/basics/.