Knowledge Expectations for METR 4643
Physics of Planetary Atmospheres

Purpose: This document describes the principal concepts, technical skills, and fundamental understanding that all students are expected to possess upon completing METR 4643, Physics of Planetary Atmospheres. Individual instructors may deviate somewhat from the specific topics and order listed here.

Pre-requisites: Grade of C or better in PHYS 2524, MATH 3113, METR 3113, METR 3213, or permission of instructor.

Students should have a basic understanding of the structure, physics, and dynamics of Earth's atmosphere prior to starting this course

Goal of the Course: This course will provide an integrated overview of planetary sciences, emphasizing planetary formation and evolution, the atmospheres of the planets, and atmosphere/surface interactions. The interrelationships among different systems will be emphasized. The goal is to provide insight on how we decipher details of distant planets, and the differences and similarities among the planets of our solar system.

Topical Knowledge Expectations

I. Solar System Formation
- Understand the general nebular theory of solar system formation
- Be able to describe the theory of stellar formation and the stages of stellar evolution
- Discuss differences in the composition and formation of terrestrial planets versus giant gaseous planets
- Understand the factors that affect planetary obliquity and rotation rates

II. Atmospheric Evolution
- For each planet in the solar system, be able to describe the present day composition, thermal structure, and general dynamics of the atmosphere
- Be able to compare present-day compositions of planetary atmospheres with their composition shortly after planet formation
- Understand the main factors that affect the evolution of planetary atmospheres, including photochemistry, volcanism, and surface-atmosphere interactions
- Be able to describe and calculate the significance of the various methods of atmospheric loss, including Jean's escape, hydrodynamic blowoff, non-thermal escape, and impact erosion
- Understand the effects of solar evolution on the evolution of planetary atmospheres

III. Planetary Atmospheres
- Be able to describe the various methods by which we study planetary atmospheres, including spectroscopy, *in situ* measurements, and modeling
- For each planet in the solar system, be able to calculate the effective temperature, and compare this to measured surface temperatures and actual radiating temperatures
- Be able to calculate atmospheric lapse rates for planetary atmospheres, and apply this to understanding cloud composition on the various planets
- Understand the role of photochemistry in cloud formation on some planets
- For each planet in the solar system, be able to describe and explain the large-scale dynamics of the atmosphere
- Be able to compare and contrast atmosphere and climate evolution on Venus, Earth, and Mars