1.42

WEB-BASED LEARNING MODULE FOR UNDERGRADUATE SCIENCE STUDENTS

Timothy Spangler [1], Tim Killeen[2], Tom Holzer[2], Dolores Kiessling[1], Dwight Owens[1]

[1] UCAR/COMET® Boulder, Colorado, [2]UCAR/NCAR, Boulder, Colorado

1. THE CHALLENGE

Teachers of undergraduate science are often confronted with the difficult challenge of explaining abstract physical concepts in ways that are both comprehensible and enlivening. The overarching goal of drawing talented learners into the atmospheric and space sciences can be thwarted by the rigors of wading through dry theoretical abstractions.

However, undergraduate science education can become lively and engaging when delivered by skilled professors with the support of aesthetically pleasing media and interactive learning tools. Toward these ends, the Cooperative Program for Operational Meteorology, Education and Training (COMET®), and the National Center for Atmospheric Research (NCAR) High Altitude Observatory (HAO) have teamed up to develop a new web-based learning resource titled *Physics of the Aurora: Earth Systems*.

The three primary audiences for this module are undergraduate science students, professors who teach space weather-related classes (astronomy, physics, meteorology, etc.), and space weather forecasters.

2. WEB-BASED LEARNING MODULE AND RESOURCE

This learning resource is designed to support a flexible range of teaching activities, including lecture-support, out-of-class assignments, and independent study projects.

To this end, we've developed an integrated multimedia module, which is composed of numerous stand-alone "learning objects." These self-contained components range from mini-lessons on general physics topics such as "Charged Particle Motions" or "Magnetic Force" to animations, 3D visualizations, simulations, and interactive exercises. These are all built into the main learning module, but can be accessed independently as well.

Another feature of the design is its tri-level presentation. Each main topic is covered by a short narrative presentational overview, written to the level of a general audience. Each overview block also connects to a more detailed and technical level of related elaborative content and interactive exercises, which are written at a higher level for the science majors in our audience. In addition, there is a linked set of *"in-depth"* mini-lessons, which explore some of the theoretical underpinnings of the other sections. These in-depth topics are presented at an even more technical level, including mathematical derivations and physical laws. The intent of this tri-level design is to broaden the module's audience and range of application.

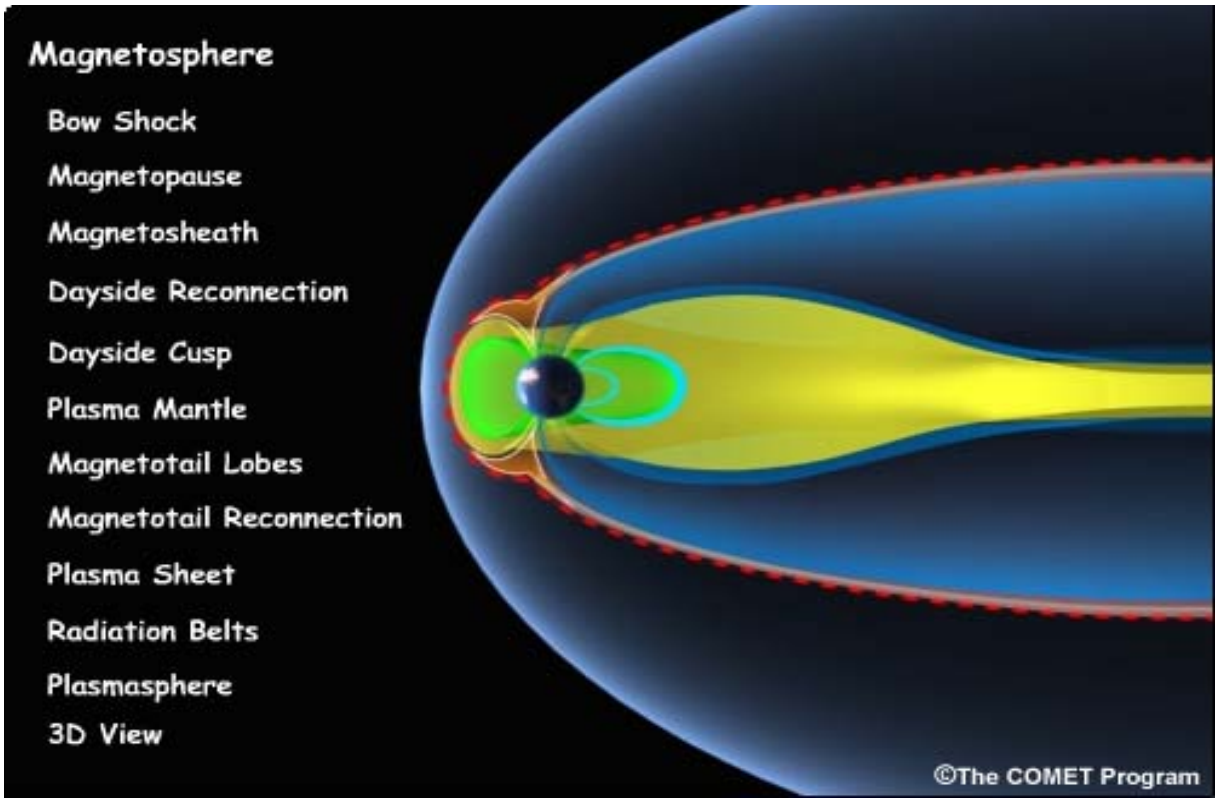
3. SCIENCE CONTENT

Physics of the Aurora: Earth Systems is composed of sections on the Magnetosphere, Thermosphere/Ionosphere, and the Aurora. A team of HAO researchers worked to refine these sections into the following topics appropriate for the undergraduate audience, and came up with the following topics, focused on the Earth part of the Sun-Earth system topics included in each section.

Magnetosphere

- Structure and formation of the magnetosphere
- Reconnection-driven magnetospheric and ionospheric convection
- Magnetospheric regions
- Magnetosphere-Ionosphere current systems
- Magnetospheric particle precipitation and the auroral oval

Corresponding author address: Timothy C. Spangler, UCAR/COMET, P.O. Box 3000, Boulder, CO 80307 USA; email: spangler@comet.ucar.edu.



Thermosphere-Ionosphere

- Formation, structure and variability of the thermosphere
- Formation, structure and variability of the ionosphere
- Thermosphere-ionosphere coupling
- Solar irradiance and its variability
- Thermospheric and ionospheric physical processes

Aurora

- The Aurora oval
- Types of Auroral displays and colors
- Upper atmosphere particle precipitation and its effect on the thermosphere and ionosphere
- Processes associated with high-latitude electric currents
- Atomic processes (ionization, dissociation, excitation, emission)

In-Depth Mini-Lessons

- Charged Particle Motion
- Magnetic Force
- Frozen Field Theorem
- Ionization Spectra
- Static Atmospheres

4. SUMMARY

Physics of the Aurora: Earth Systems is a collaborative effort between the COMET Program and the NCAR High Altitude Observatory. The project will assist faculty and students to better understand the Earth-Sun system, and the importance of this relationship to life on Earth. The module is slated for release in early 2004 and will be freely available via the HAO and COMET websites. It will also be released on CD later in 2004. A related module, focusing on the sun side of the sun-earth system, is also in the planning stages.

5. ACKNOWLEDGEMENTS

This paper is funded by cooperative agreement #NA17WD2383 from the National Oceanic and Atmospheric Administration (NOAA). The views expressed herein are those of the authors and do not necessarily reflect the views of NOAA or any of its sub-agencies. The COMET Program is primarily funded by the NWS, with additional funding from NMOC, AFWA, NESDIS, NPOESS, MSC, and NSF.