

**MULTI-MEDIA RESOURCES AND 5E PEDAGOGY FOR A COUPLED EARTH AND MARS SCIENCE HIGHER EDUCATION CURRICULUM.** M. A. Chan<sup>1</sup> and J. A. Kahmann-Robinson<sup>1</sup>, <sup>1</sup>University of Utah, Department of Geology & Geophysics, 115 S. 1460 E. Rm 383 FASB, Salt Lake City, UT 84112; [Marjorie.Chan@utah.edu](mailto:Marjorie.Chan@utah.edu), [Julia.K.Robinson@utah.edu](mailto:Julia.K.Robinson@utah.edu).

**Introduction:** An Earth-analog approach to teaching introductory higher education Mars curriculum creates a tangible understanding of the planets Mars and Earth, while also encouraging inquiry-based learning. We developed Earth-analog teaching curriculum for a pilot class Mars For Earthlings (MFE) offered to non-major undergraduates. Weekly class activities involved multi-media resources. We created new, short *Meet the Scientists* clips and utilized existing NASA and YouTube videos to keep students both engaged and current with Mars research and missions, particularly MSL Curiosity. Each in-class or hands-on activity also incorporated the 5E pedagogical approach [1] of learning: Engage, Explore, Explain, Enhance, and Evaluate. This 5E philosophy helps students apply and expand their knowledge. The connections utilize scientific reasoning, prior knowledge, and new ideas that emerge to reinforce Earth-Mars concepts and increase science literacy.

**Earth Analog Curriculum:** The undergraduate course covers topics such as: Mars missions and data collection, planetary make up, surface processes, extra-terrestrial life, and hot topics/societal issues. Students learn to observe Mars processes through two main software packages: Google Earth/Mars, and JMARS (Arizona State University). Mars content is presented with both an Earth-science backbone for context and Earth-analog environments to critically assess Mars interpretations and student-derived hypotheses.

**Mars Resources:** Topical-based MFE resources and curriculum are available via our SERC-hosted website (Science Education Resource Center): <http://serc.carleton.edu/marsforearthlings/index.html>.

Resources are for both students and instructors.

**Lesson Modules.** Topical lesson modules, in-class activities, and homework sets can be read online and downloaded via pdf. Public domain images referred to in activities and/or homework are available in PowerPoint files. For each module, students typically view short YouTube videos on scientific content or entertaining clips to pique their interest such as a rap video on astrobiology.

For the 5E learning [1], students are initially engaged in the Mars topic by inquiry questions or through media content. This is followed by exploration, typically of Mars imagery or Earth analog processes that formulate a knowledge basis. Students often work in groups to discuss the concepts and generate ideas for preliminary investigation. In the explan-

tion stage, the instructor guides students through a deeper understanding of the concepts by having students discuss where Earth analogs may fall short of explaining features on Mars, and where parameters and/or boundary conditions may differ. We enhance or elaborate on additional Mars examples by discussing what features or future research would help refine our interpretations. In evaluation, we relate the activity back to course objectives and goals, and assess the effectiveness of the activity. A 5E example module is on the idea of a Mars ocean- did it exist and why or why not? How would an ocean on Mars be different than Earth's ocean? The flexible activities can be run between 15 to 30 min segments.

*Meet the Scientists.* MFE's website hosts 15 short (1-2 minute) videos of scientists actively engaged in Mars research. Scientists interviewed range from graduate students just beginning their research journey to experienced researchers from a variety of government and academic institutions. The scientists are a diverse group, with representatives from countries beyond the United States. Interview questions include: *How did they become interested in Mars?, What is their current research?, and Why do they enjoy their research?* Some scientists are shown in field or laboratory settings. Researchers work on a variety of projects including modeling impacts, creating geologic maps of Mars, studying Earth analogs to Mars, exploring astrobiology, and more. Several scientists are members of NASA teams. These profiles allow students to see different dimensions of scientists as real people with diverse backgrounds and strengths. As scientists share their excitement about their work, students are intrigued and inclined to learn more. To encourage viewing, students are assigned to answer questions about the videos. As an effective vehicle to draw students into STEM-related disciplines, *Meet the Scientists* provides role models to encourage and motivate aspiring young people.

**References:** [1] Bybee R. W. et al. (2006) BSCS 5E Instructional Model.

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