

Olympics on the Moon: A Challenge for Engineering Design

Mr. Cristián Eduardo Vargas Ordóñez P.E., Purdue University at West Lafayette (COE)

Cristián Vargas-Ordóñez is a Colombian graduate student and research assistant in Engineering Education at Purdue University. He is a Master in Education from the University of Los Andes in Colombia, a Master in Science, Technology, and Society from the National University of Quilmes in Argentina, and a B.S. in Chemical Engineering from the University of America in Colombia. As part of his research, he has explored Colombian chemical engineers' social representations about science and technology and the conceptions and attitudes about chemical engineering and their identity as chemical engineers. He belonged to Colombian educational formal and informal ambits like a pedagogic consultant at the Planetarium of Bogotá for the project "Centers of Interest in Astronomy"; innovation, science, and technology instructor and consultant at the science and technology museum Maloka; and school teacher in Chemistry. As part of his research interests, he looks for the integration between the arts and engineering to foster social justice and critical thinking, and the problematization of technology as the core of the engineering identity. He has also worked in primary, secondary, and tertiary sectors in private and public companies across his professional life. He is currently one of the English as Second Language (ESL) and Multiculturality chairs in the Engineering Education Graduate Students Association (ENEGSA) at Purdue University.

Mr. Andrew James Gray, Purdue University at West Lafayette (COE)

Andrew Gray is an undergraduate student and research assistant at Purdue University. He graduated from Purdue Industrial Engineering last year, and plans to study Engineering Education in a graduate program in the United States next year. Andrew's research history has included work with perceptions in engineering and pre-college engineering studies with elementary school-aged children.

Dr. Morgan M. Hynes, Purdue University at West Lafayette (COE)

Dr. Morgan Hynes is an Assistant Professor in the School of Engineering Education at Purdue University and Director of the FACE Lab research group at Purdue. In his research, Hynes explores the use of engineering to integrate academic subjects in K-12 classrooms. Specific research interests include design metacognition among learners of all ages; the knowledge base for teaching K-12 STEM through engineering; the relationships among the attitudes, beliefs, motivation, cognitive skills, and engineering skills of K-16 engineering learners; and teaching engineering.

Olympics on the Moon

Focus grade levels: 6-8 (meets 7th-grade engineering and earth and space science standards)

Time: 3 sessions, 1 hour long each

Abstract

These activities were developed to be implemented fully online as part of an online engineering design summer camp due to the COVID-19 pandemic. Middle school students will discover how sport arenas, rules, and equipment would change if the Olympic Games were conducted on the Moon. During the sessions, students learn about framing an engineering design problem (a step of the engineering design process) in the Lunar Olympics context and are introduced to basic physics concepts. Students also use free online design and coding tools to help improve their engineering conceptions and design skills. The activities can easily be transformed for in-class or hybrid classroom use.

Learning goals

1. Recognize that physical laws will impact sport arenas, rules, and equipment if the Olympic Games are held on the Moon by sketching the change of each element (arena, rules, equipment) for a sport.
2. Understand that engineers use Computer-Aided Design (CAD) and computer coding to simulate physics in real-world problems; understand the use of TinkerCad, basic variable assignment in computer coding, and basic physics concepts such as gravity, friction, velocity, and acceleration.
3. Utilize basic computer coding structure to simulate sports by identifying basic variable assignments and manipulating code to understand the effect of forces in a volleyball game on the Moon.

Materials

- Paper, pencils, pens, markers
- Internet access for YouTube and Octave Online
- Computer and TinkerCAD account
- Social media group or LMS (Google classroom) for posting student work

Next Generation Science

Standards (NGSS)

associated

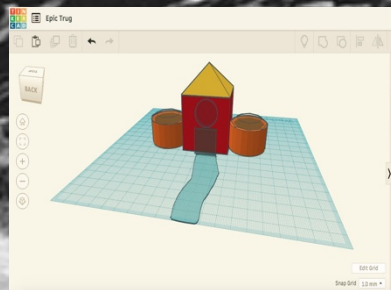
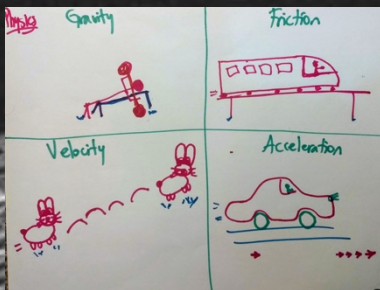
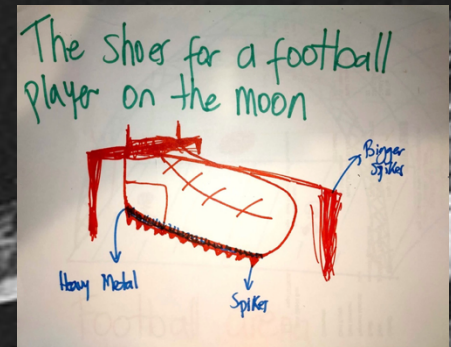
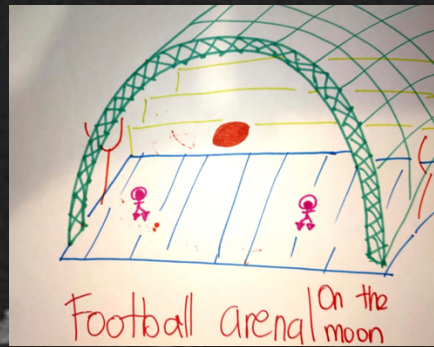
- NGSS, physical science, 2017, middle school, ID#MS-PS2-4
- NGSS, engineering design, 2017, middle school, ID#MS-ETS1-1
- Indiana, engineering, 2016, eight grade, ID#6-8.E.1



Olympics on the Moon

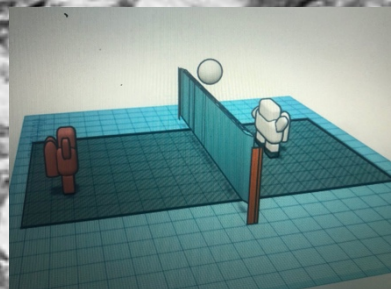
Day 1 / Session 1

Students individually choose a sport, write down the rules of that sport on the Moon, and sketch a new arena/court and the gear/clothing for that sport on the Moon



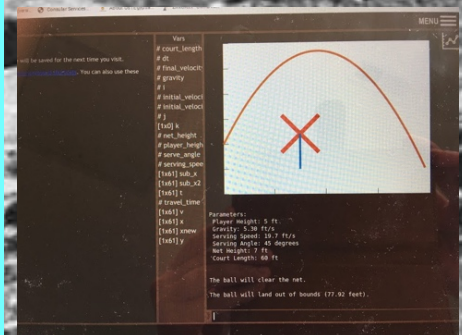
Day 2 / Session 2

Instructor performs a demonstration of TinkerCAD, following student suggestions, as a tool for modeling and exploring ideas. Next, there is a review of the concepts of gravity, velocity, acceleration, and friction through sketches. Finally, the students sketch a volleyball arena and the trajectory of the ball if it is served in different environmental conditions related to the previously reviewed concepts.



Day 3 / Session 3

Instructor performs a step-by-step demonstration about coding. It starts with identifying what a variable is and how to use it in an equation related to the sports and the concepts reviewed in the last session, followed by a simulation on MATLAB. Finally, the students modify a section of a MATLAB file to produce a representation of a parabolic equation using Octave Online (a free online MATLAB compiler) to model the trajectory of a projectile. The kids are exposed to syntactic coding by changing the magnitude of variables and the equations as they consider the varying conditions on the moon.



Contact: Cristián Vargas-Ordóñez, cvargaso@purdue.edu

Project Team: Andrew Gray, Undergraduate student; Cristián Vargas-Ordóñez, Graduate student; Dr. Morgan Hynes, Supervisor.

Link to full curriculum and support resources: Please, follow the QR code

This curriculum was based upon work supported by the National Science Foundation under RET grant no. EEC 1454152—CAREER: Broadening Contexts to Motivate Participation in Engineering through the **Purdue University-CISLUNAR Initiative**

