DEPARTMENT OF
PHYSICS &
ASTRONOMY

Physics & Astronomy
Colloquium

Prof. Michele McColgan

(host: Prof. Beth Thacker)

Siena University

3:30 - 4:30 p.m. | Tuesday, Sept. 23

ESB I Building 120

Title: Making the Invisible Visible: Using Augmented Reality to Teach Abstract Physics Concepts

Abstract: A persistent challenge in physics education is helping students construct three-dimensional mental models of abstract concepts. These concepts may be introduced verbally by an instructor, represented in two-dimensional textbook diagrams or whiteboard sketches, or illustrated through analogy. Students must then connect such representations to specific perspectives of a 3D model and to the variables in equations that capture its components.

The MARVLS Augmented Reality (AR) Apps were developed to address this gap by linking equations, 2D diagrams, and interactive 3D visualizations. Using handheld devices and a Merge Cube, students can manipulate AR models of concepts that are traditionally difficult to visualize, such as magnetic fields, wave interference, and quantum phenomena. Five apps are currently available—covering introductory physics, plasma physics, quantum computing, and chemistry—with an engineering-focused app in development. Accompanying lessons support integration into classroom practice.

Ongoing NSF-funded research evaluates the effectiveness of the magnetism modules using a mathematical sensemaking framework, providing insights into how students connect symbolic equations with physical intuition. This talk will highlight the design of the MARVLS apps, share findings on their educational impact, and discuss opportunities for incorporating AR into broader STEM instruction and the teaching of abstract concepts more generally.

Refreshments at 3:00 p.m. | ESB I 120

Biography

Michele McColgan is a Professor in the Department of Physics & Astronomy at Siena College in upstate New York. She teaches courses in general physics, optics, electronics, and laboratory methods, and actively mentors undergraduate research. Her scholarship focuses on the use of augmented reality manipulable visualizations to support student understanding of abstract and three-dimensional physics concepts. This work, currently supported by the National Science Foundation, aims to advance physics education through the integration of innovative technologies.