2020

Agenda

Shubha Tewari

Jan 25, 2020. Arduino microcontrollers in the classroom: teaching how to phrase effective science questions and how to answer them with original data. Prof. Tony Dinsmore, UMass Physics
This workshop will develop course modules that address a challenge in the science curriculum: how do we teach basic problem-solving and curiosity-based research skills in a classroom setting? The standard science curriculum teaches concepts and theory quite well but leaves rather little opportunity for students to take the lead in designing and implementing their own investigations. The workshop will use the Arduino, an inexpensive microcontroller that is simple to set up. A huge range of student-led projects are possible, taking advantage of the recent explosion of inexpensive, small-scale sensors that are available on-line for costs ranging from about $1-20. As part of the workshop, we will work with Arduinos and a few basic sensors. The workshop will focus on developing an iterative process by which students define their own science question, set up a device (controlled by the Arduino) to collect data, and then answer the question. We will go through these steps during the workshop. I will also share my approach, based on a new course for first-year physics majors at UMass that takes students through these steps. For many students, such a course provides a first experience working with the hardware-software interface, designing algorithms, and programming. For workshop attendees -- and for the students that we are planning for -- no prior experience with computing or hardware is needed. Attendees are encouraged to bring a laptop computer. If time permits, you might wish to install the "Arduino IDE" controlling software, located at https://www.arduino.cc/en/main/software. If you cannot bring a laptop computer, you will have access to one at the workshop.

Feb 1, 2020 STEP UP Workshop (Free to attendees)
Michael Wadness, Medford High School, Step Up Ambassador
Savannah Lodge-Scharff, Madison Park Technical Vocational High School, Step Up Ambassador
Did you know that teachers are the reason that most undergraduate women in physics chose that degree? That's right. You are key to encouraging women to pursue prosperous careers in physics! The STEP UP project provides access to downloadable research-based lessons about physics and a nationwide community of teachers engaged in changing the future of physics.This insightful and interactive workshop invites participants to join a national movement designed to empower teachers with resources specifically focused on leveraging high school physics teachers' pivotal role in influencing the career choices of women and contributing to the culture change needed to inspire more women to pursue physics as undergraduates. Workshop physics materials are online at STEPUPphysics.org .

Feb 8, 2020 ENERGY - What is it? How can we teach it? Prof. Karl Martini, Western New England University
All the sciences (from Physics, Chemistry, Biology, Geology, and Meteorology… to Ecology) and many other fields (from Economy to Psychology) use energy as a central concept. Phenomena span an incredible 120 orders of magnitude (now that is crazy!). It is also one of the more difficult topics to teach and for the students to understand, especially as the different fields have different ways of defining the concept. It doesn't help that we humans have no direct energy sensors, thus do not develop an intuition naturally. Energy is one of the central topics of the STEM curriculum, but is often presented as an abstract idea. In this workshop we will start with some simple, hands-on thermal experiments to define energy, energy conservation and energy transformations and to get a personal feel that directly relates to energy in the human body. In subsequent experiments and demonstrations we will use these ideas and tools to broaden the concept to other fields. In the process we will try to disentangle the different energy approaches and energy units that are conventionally encountered.

March 7, 2020. From Soap Bubbles to Cell Membranes. Asst. Prof. Peter Beltramo, UMass Chemical Engineering
Have you ever blown a soap bubble and wondered - what causes the bubble to be so stable and produces those colorful reflections of light? The answer lies in a class of molecules known as

surfactants, and they have remarkable similarities with the molecules that comprise the cell membrane of all living organisms. In this workshop, we will use the analogy of a soap bubble to describe cellular membrane properties such as chemistry, structure, membrane transport, and ion channel formation. The goals of this workshop are to 1) link initially intractable concepts in biology like intracellular transport to the intuitive soap bubble to spur student interest and inquiry, 2) impart critical thinking and group collaboration skills through hands-on activities designed to reinforce and extend student comprehension and 3) establish lesson plans for learning activities that can be adapted to a wide range of classes (physics, biology, chemistry) and educational levels (K-12). By demonstrating membrane processes using the tangible and familiar soap film, this workshop is highly accessible and has the added advantage that all materials can be purchased from a grocery store. In addition, new developments in cutting-edge experimental techniques for studying membrane processes and fabricating biomimetic materials will be discussed to link fundamental concepts to current research at UMass and elsewhere.

March 28, 2020. Plant, Pipettes and PCR. Prof. Elizabeth Vierling, UMass Biochemistry and Molecular Biology, with Elliott Kelly, Amherst Regional Middle School
Plants are amazing organisms that provide us with food, building materials, the pleasure of gardens, as well as providing the foundation of critical world ecosystems. Although they may look like they are just stuck in one place and doing not more than growing, they have many, many complex ways in which they respond to the environment. The goal of this STEM Ed session will be to discuss ways that plants can respond to the environment with hands on exercises and exploration of possible classroom activities. Participants will engage in state-of-the art methods of testing plant DNA composition using the polymerase chain reaction (PCR), as well as learn and "scheme" how these and other experiments on plant responses to the environment that have been integrated into both middle school and high school curricula can work for you. Please see https://sites.biochem.umass.edu/vierlinglab/ for some of the resources that can be discussed in this workshop.

April 4, 2020 Bits, Knits, and Knots: Using Knitting as a Tool for Teaching STEM Concepts. Mary Elizabeth Lee, Daria Atkinson, Michelle Berry, UMass Physics
Knitting is an ancient technology as well as an enjoyable pastime that is often overlooked as an object of scientific study. However, knitting can be used as an accessible, low tech tool to teach coding fundamentals, higher level mathematics, and even concepts in physics. In this seminar we will do all three, as well as teach you to knit. We will divide this into 5 modules:
1. Overview of knitting as technology
2. Learning to knit (and teaching it too!)
3. Knitting as coding
4. Tangles, knits, and knots: the knot theory of knitting
5. Recent developments in the physics of knitting
Accompanying each of these models we will provide brief sketches for lesson plans and discuss the challenges and opportunities associated with their implementation in a classroom setting