

Assessing Authentic Research Learning Experiences

Prof. Lynn Cominsky
Department of Physics & Astronomy
Department of Chemistry
Sonoma State University



Authentic Research Learning Experiences

- Both the departments of P&A and Chemistry have instituted “capstone” courses which attempt to emulate authentic research experiences for graduating seniors
- Both departments also have learning objectives, all of which are to be demonstrated by graduating seniors
- *Big question:* how do we construct meaningful summative assessments for widely differing capstone projects that can be fed back to improve our programs?



P&A Capstone Courses

- **Instructional Design Project (A492 or P492)**
 - A directed project to develop at least one laboratory experiment and/or classroom activity that teaches basic concepts in undergraduate physics.
- **Senior Design Project (P493)**
 - A directed project to develop either a working prototype or a detailed conceptual design for an operational laboratory device.
- **Undergraduate Research (A497 or P497)**
 - Supervised research in an area of physics that is currently under investigation by one or more members of the Physics and Astronomy Department's faculty.



P&A Learning Objectives

1. Knowledge, understanding and use of the principles of physics and/or astronomy
2. Ability to use reasoning and logic to define a problem in terms of principles of physics
3. Ability to use mathematics and computer applications to solve physics and/or astronomy problems
4. Ability to design and/or conduct experiments and/or observations using principles of physics and/or astronomy and physics or astronomical instrumentation
5. Ability to properly analyze and interpret data and experimental uncertainty in order to make meaningful comparisons between experimental measurements or observation and theory



P&A Assessment Results

Student	Capstone course	Learning Outcomes Tested
1	P497	1, 2, 3, 4, 5
2	P493	1, 2, 4
3	P497	1, 2, 3, 4, 5
4	P497	1, 2, 3, 5
5	P497	1, 2, 3, 4, 5
6	A497	1, 2, 3
7	P497	1, 2, 3, 5

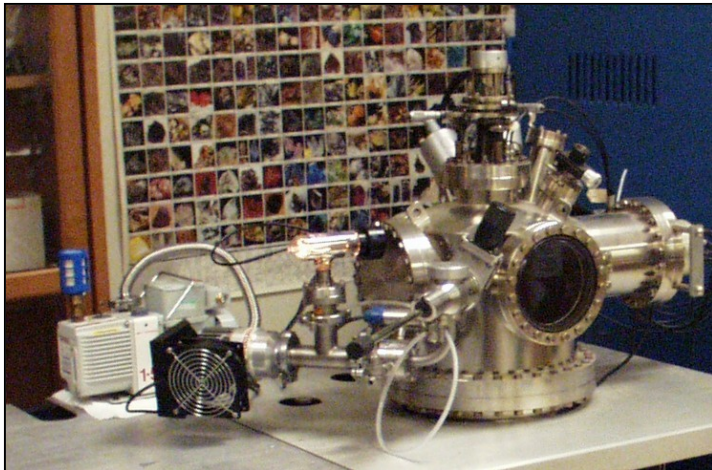
Results: Everyone got "A" grades!

S05 P&A Capstones



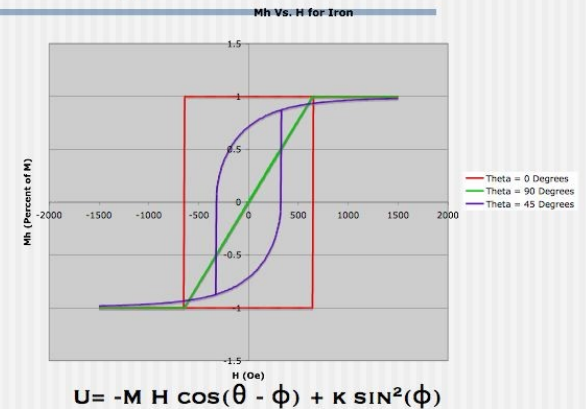
Auger Spectrometer - before

after



Installation, Refurbishment, and Upgrade of Thin Film Deposition Equipment

Simulating a Simple Ferromagnet



Hysteresis Loops of Exchange Coupled Magnetic Systems

7 total

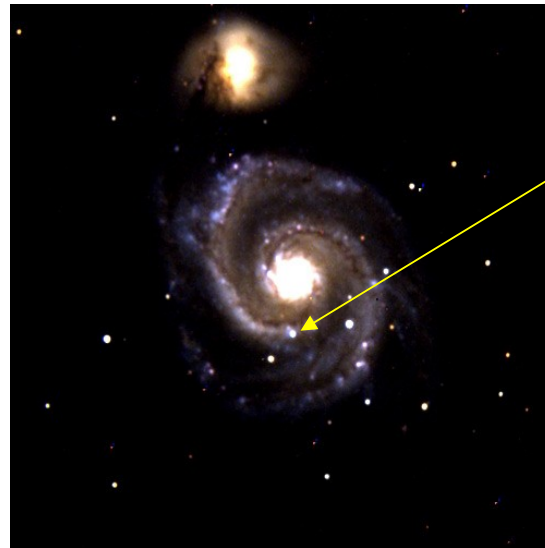


NASA Research at SSU



GLAST Optical Robotic Telescope at the California Academy of Science's Pepperwood Natural Preserve

May 19, 2006



Supernova in M51

Photometry of magnetic cataclysmic variable system

Cor



Chemistry Capstone Courses

- All courses have 1 hour lecture & 6 hours of lab/week
- Chem 401 – BA in Chemistry
 - **Instrumental Analysis and Chemical Synthesis**
 - The projects will cover the synthesis of organic, and inorganic molecules and characterization of student-prepared molecules.
- Chem 402 – BS in Chemistry
 - **Advanced Synthesis and Instrumental Analysis**
 - Project-based synthesis, purification, and characterization of inorganic, organic and organometallic molecules.
- Chem 441 – BS in Biochemistry
 - **Biochemical Methods**
 - Project-based laboratory course involving isolation, purification and characterization of proteins from natural sources.



Chemistry Learning Objectives

1. **Develop conceptual understanding and problem-solving abilities in the fundamental chemical subfields of analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry;**
2. **Gain a foundation of physics and mathematics and integrate these areas with chemical principles;**
3. **Learn the relevance of chemistry and its interdisciplinary ties to other fields and society, in order to become a scientifically literate and ethical citizen**
4. **Perform accurate and precise quantitative measurements;**
5. **Synthesize and characterize inorganic and organic compounds;**
6. **Learn proper and ethical laboratory practices, including safety, waste management, and record keeping;**
7. **Use and understand modern instruments, including NMR, IR, UV-vis, and mass spectrometers, and chromatographic and electrochemical instruments;**
8. **Interpret experimental results and draw reasonable conclusions;**
9. **Develop proficiency with computers for data acquisition and analysis, simulation, theoretical prediction, access to information, and report preparation;**
10. **Plan, design, and execute experiments based on chemical literature;**
11. **Communicate effectively through written and oral reports.**



Chemistry Assessment Goals

- Conduct assessment of one learning objective (or all) using an indirect or direct approach
 - **Indirect: Review of capstone projects and authentic research learning experience courses**
- Provide evidence of assessment
 - **We will discuss the capstone projects and authentic research learning results with respect to at least one learning objective, and use our rubrics to ensure summative standardization.**



S06 Chemistry Capstone posters



Isolation
and
purification
of
Lysozyme



Synthesis and
Characterization
of μ -oxo-bridged
acetates of
chromium, iron
and ruthenium

May 19, 2006



10 total

Partial purification of
pectinesterase from
pineapple



Current vs. best practices

- Chemistry has rubrics for assessing posters, lab partners and group presentations.. but not tied to learning outcomes
- P&A has learning outcomes but no rubrics or consistency – each student is graded individually by faculty advisor
- *What do you think we should be doing?*