

Assessing Authentic Research Learning Experiences

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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

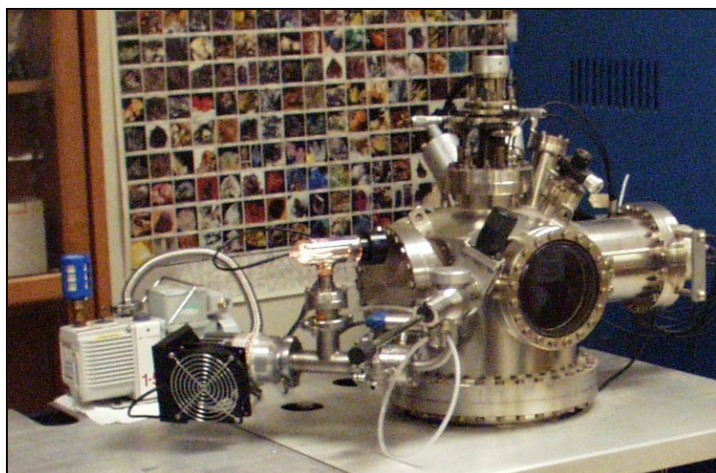
Results: Everyone got "A" grades!

S05 P&A Capstones



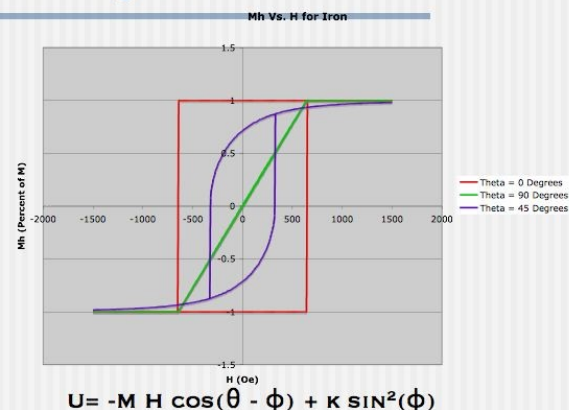
Auger
Spectrometer -
before

after



Installation,
Refurbishment,
and Upgrade of
Thin Film
Deposition
Equipment

Simulating a Simple Ferromagnet



Hysteresis Loops
of Exchange
Coupled Magnetic
Systems

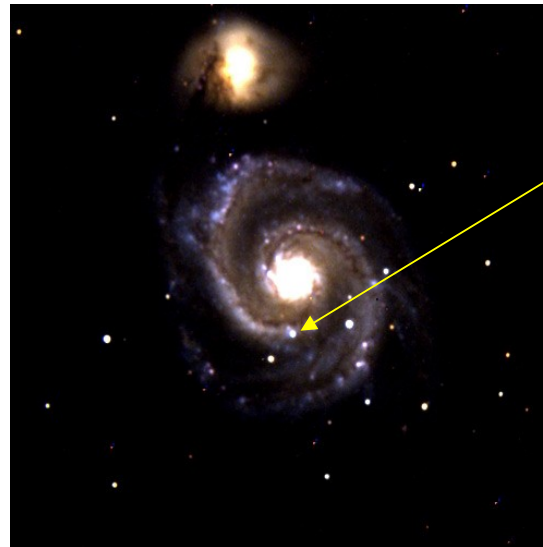
7 total



NASA Research at SSU



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



Supernova in M51

Photometry of magnetic cataclysmic variable system



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?*