Undergraduate Research in Quantum Mechanics at the University of Central Arkansas

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The College of Natural Sciences and Mathematics at the University of Central Arkansas was founded in the academic year 1994-1995. The college consists of the departments of Biology, Chemistry, Computer Science, Mathematics, and Physics and Astronomy. The college largely serves undergraduates, though small graduate programs leading to masters degrees in Biology, Applied Computing and Mathematics for teachers are also offered. Since its founding the College has emphasized innovative pedagogies, including active and discovery based learning, and technology enhanced learning. Student research, both in and out of the classroom has played a significant role in the achievement of college goals and in the success of its graduates.

Support of a student Research Program

Student research programs can be supported in a number of ways, we have successfully employed the following measures:

- Annual Student Research Symposium

  Each year since 1995 a student research symposium has been held. An abstract book is produced, and displayed on the college web pages. Faculty from across campus, all students, and members of the local community are invited.

- Regular "Chalk Talks"

  Chalk talks are held monthly and are rotated through each of the college's three buildings. These are informal sessions attended by faculty and students where students describe where they are in their research, and what their plans are.

- University Student Research Fund

  The University budgets $15,000 annually. Students write formal proposals and are required to submit reports. The fund supports supplies and travel.

- College Student Research Fund

  The College also operates its own student research fund. This fund is used to provide matching funds for the University Student Research Fund and also supports some research in association with departments.

- Travel to professional conferences by students

  The College Research Fund provides funding (sometimes as matching funds) to support student travel to professional conferences. Students are funded if they are presenting papers or posters.

- Support for grant proposal development by faculty

  The College provides reassigned time for proposal development. Faculty whose grants provide support for students are provided reassigned time for each semester in which the grant is active. In determining awards, proposals that will support students are given priority.

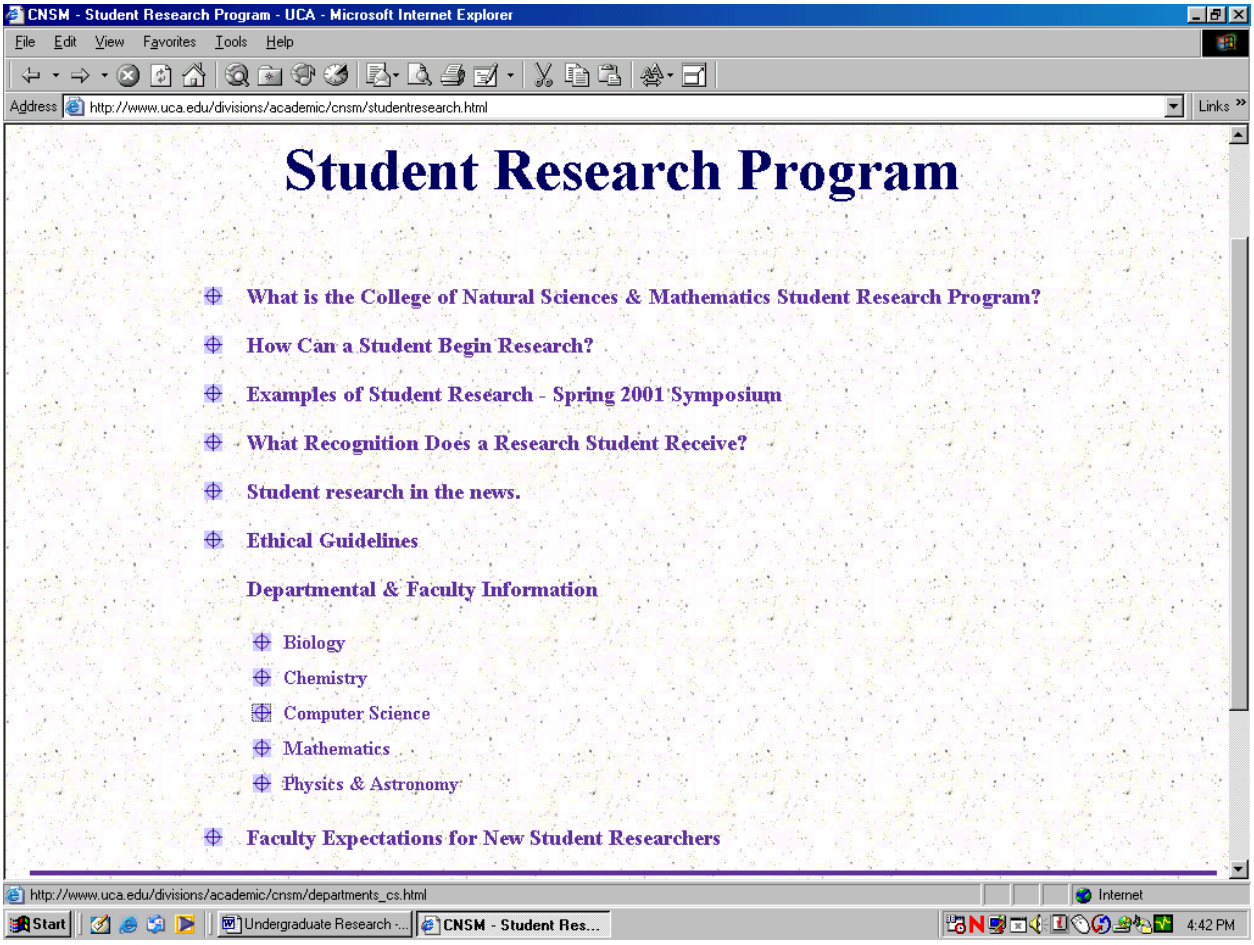
- Support for grant proposal development by students

  Students aided in the development of Sigma Xi, State Undergraduate Research Fellowship, and other similar proposals. The Associate Dean of the College regularly holds grant-writing workshops for students.

- Advertisement of student research opportunities

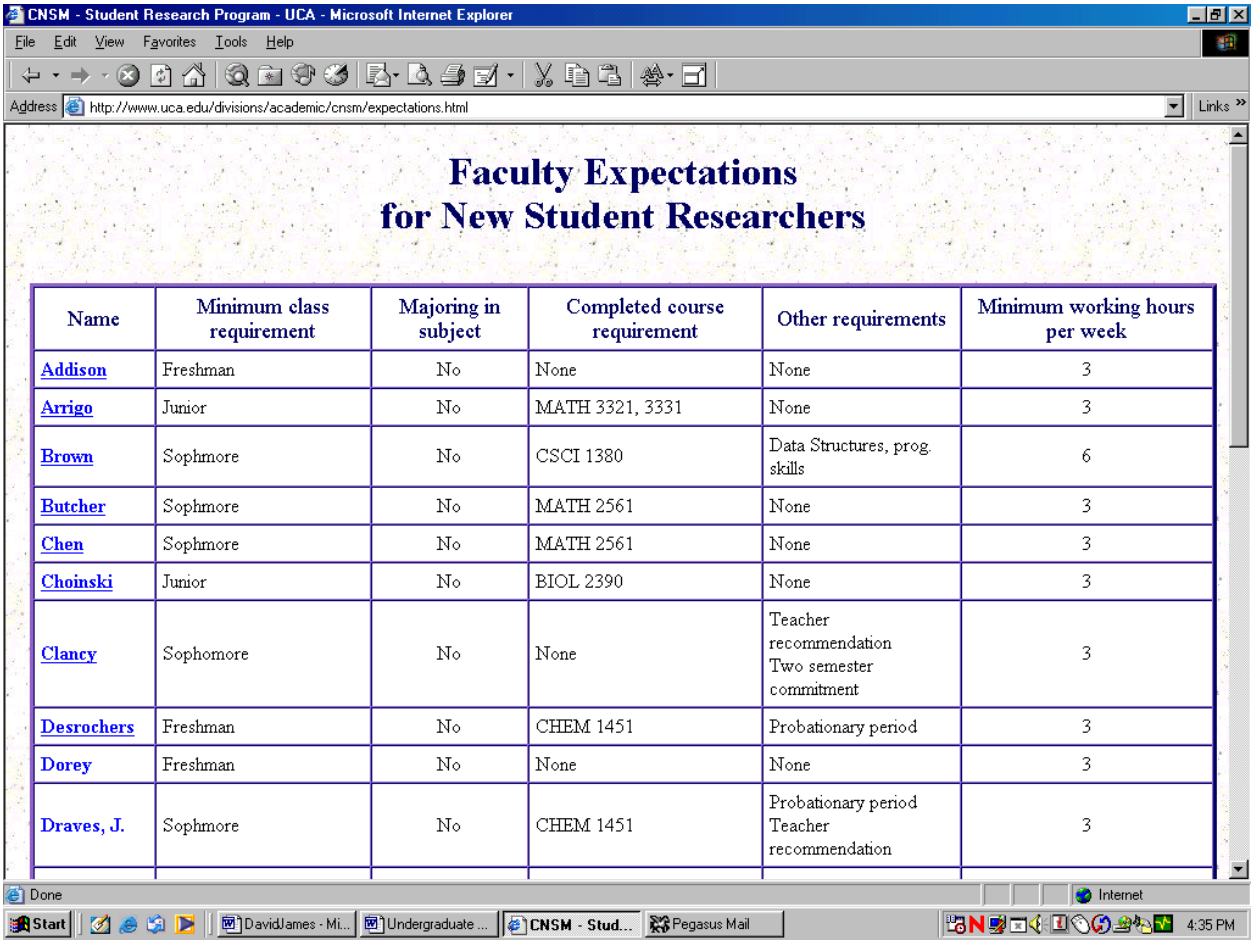
  The College office produces printed material to encourage student participation in research. WWW materials have been extremely successful as dissemination tools. "Business cards" are widely distributed to advertise these pages.

The business cards point to the following page:



Links lead to various pages describing the program and linking to departments and faculty.

Students can quickly learn about faculty expectations through the following page:



Faculty Expectations for New Student Researchers

Name	Minimum class requirement	Majoring in subject	Completed course requirement	Other requirements	Minimum working hours per week
Addison	Freshman	No	None	None	3
Arrigo	Junior	No	MATH 3321, 3331	None	3
Brown	Sophmore	No	CSCI 1380	Data Structures, prog. skills	6
Butcher	Sophmore	No	MATH 2561	None	3
Chen	Sophmore	No	MATH 2561	None	3
Choinski	Junior	No	BIOL 2390	None	3
Clancy	Sophomore	No	None	Teacher recommendation Two semester commitment	3
Desrochers	Freshman	No	CHEM 1451	Probationary period	3
Dorey	Freshman	No	None	None	3
Draves, J.	Sophmore	No	CHEM 1451	Probationary period Teacher recommendation	3

The links lead to individual faculty web pages.

Student Research in Quantum Mechanics

Student research has been performed in a wide variety of fields. Our students have presented papers at a variety of conferences and have published their work in a variety of journals. Our students' presentations have been recognized by best paper awards at a variety of conferences. There are active research groups in quantum mechanics involving faculty from the departments of Chemistry, Mathematics, and Physics and Astronomy. Some recent of student efforts in quantum mechanics follow:

Trey Bass – Chemistry Major

Modeling Polymerization

- Annual Student Research Symposium, UCA, May 2002.

Chad W. Fendt – Physics and Mathematics Double Major – Senior in 2002-03

Darboux transformations and α-decay

- MAA Southeast Meeting, Oklahoma Christian University, AR, March 2001,
- Arkansas Academy of Science meeting, UCA, April 2001
- Annual Student Research Symposium, UCA, April 2001,
- Joint Meeting of the AMS-MAA, San Diego, CA, January 2002,
- Annual Physics Meeting, Albuquerque, NM, April 2002,
- Arkansas Academy of Science meeting, UALR, AR, April 2002,
- Annual Student Research Symposium, UCA, May 2002.

Bryan Gipson – Mathematics Major

Darboux transformations of the Variable Wave Equation

- MAA Southeast Meeting, Oklahoma Christian University, March 2001,
- Arkansas Academy of Science meeting, UCA, April 2001
- Annual Student Research Symposium, UCA, April 2001,
- NASA Space grant Consortium, Harding University, AR, April 2001,
- Joint Meeting of the AMS-MAA, San Diego, CA, January 2002,
- MAA Southeast Meeting, HSU, AR, March 2002,
- Annual Student Research Symposium, UCA, May 2002.

Mary Bratton-Housley – Mathematics Major

Approximating Schrödinger Potentials using Darboux Transformations,

- Arkansas Academy of Science meeting, UCA, April 2001
- Annual Student Research Symposium, UCA, April 2001.

Sarah Jacobs – Mathematics Major

Darboux Transformations and Wave Equation Systems,

- MAA Southeast Meeting, Oklahoma Christian University, March 2001,
- Arkansas Academy of Science meeting, UCA, April 2001
- Annual Student Research Symposium, UCA, April 2001,

David James – Physics Major – Accepted into graduate program at the University of Colorado

Stepping on TOEs: Why a Theory of Everything Can Never be Scientific

- Honors College Honors Thesis, 2002

Garth Johnson - Mathematics Major – will grad school at UC Santa Barbara
Darboux transformations of the Variable speed Wave Equation.

- MAA Southeast Meeting, Oklahoma Christian University, March 2001,
- Arkansas Academy of Science meeting, UCA, April 2001
- Annual Student Research Symposium, UCA, April 2001,
- NASA Space grant Consortium, Harding University, AR, April 2001,
- Joint Meeting of the AMS-MAA, San Diego, CA, January 2002,
- Arkansas Academy of Science meeting, UALR, April 2002
- Annual Student Research Symposium, UCA, May 2002.

Brian Lemon – Physics Major – Completing Masters GA Tech
Quantum Interpretations

- Honors College Honors Thesis, 2000

Casey Milford – Computer Science Major – Employed by Acxiom Corporation
Exact Solutions to Approximate Equations,

- Joint Meeting of the AMS-MAA, San Diego, CA, January 2002,
- Arkansas Academy of Science meeting, UALR, AR, April 2002,
- Annual Student Research Symposium, UCA, May 2002.

Luke Walker – Physics Major – Will attend graduate school at the University of Wisconsin, Madison
Identity and Distinguishability

- Departmental Honors Thesis, 2002

Identity and Distinguishability: Paradoxes and Resolutions

- Honors College Honors Thesis, 2002

Brandon Willis – Computer Science Major – Senior in 2002-2003
Exact Solutions to Approximate Equations,

- Joint Meeting of the AMS-MAA, San Diego, CA, January 2002,
- Arkansas Academy of Science meeting, UALR, AR, April 2002,
- Annual Student Research Symposium, UCA, May 2002.

Recent Recognition

Computer Science majors Brandon Wills and Casey Milford are pictured with their poster and computers at the joint meeting of the American Mathematical Society and the Mathematical Association of America at the San Diego Convention Center in January 2002.

The poster was selected as a first prize poster at that meeting's student poster session.

Summary and Conclusions

A vibrant, and growing student research program can be operated at a primarily undergraduate institution. Undergraduates can participate and contribute to research in advanced theoretical areas often believed inaccessible to them.

Benefits include:

- Enhanced student recruiting, both in numbers and quality
- Substantial aid in recruiting research active faculty to an undergraduate institution
- Increased visibility
- Improved success rate in gaining research and equipment grants
- Graduates attend and are recruited by elite graduate programs