

REU Handbook

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INTRODUCTION

Welcome to the 2006 Summer Research Experiences for Undergraduates (REU) Program in the Chemistry Department at the University of Alabama. This "REU" Program is sponsored by the National Science Foundation and The University of Alabama Department of Chemistry.

During the next ten weeks, you will be introduced to the challenging field of chemical research. Each one of you will be involved in your own research project in laboratories of Department of Chemistry. Not only will you be able to gain "hands-on" experience in the operation of research grade instruments and computers in our department, but you will also be able to interact with faculty, staff, graduate students, and postdoctoral fellows, on a personal basis. We hope you will use the next ten weeks to the utmost, so you can learn as much as possible and have fun as well.

John B. Vincent
REU Program Director

REU Program Expectations

This program is designed to stimulate your interest in chemistry through active full-time participation in a meaningful 10-week research project. The NSF-sponsored REU program has been designed so that you will develop a confidence and independence in carrying out meaningful research on a topic of current interest and generate a willingness to accept responsibility to report your results to your peers. NSF believes that in this way more students will plan on attending graduate school in science, especially in chemistry. To prepare for a successful professional career, we expect that you will demonstrate your ability to think independently by summarizing your results at the end of the project in a written report and prepare your results for presentation at your college and at state, regional or national scientific meetings.

List of REU Participants Summer 2006

Name & College	Permanent Address	Advisor & Project Title Room #	Rose Towers
Allison Arrendale Berry College	2354 Camden Lake Circle Acworth, GA 30101 (770) 975-4346 aarendale@students.berry.edu	Dr. Carolyn Cassady "Mass Spectrometry Studies of Peptides."	210
Keith W. Bentley The University of Alabama	7533 Carriage Cove Trussville, AL 35173 (205) 655-9430 Crunner172003@yahoo.com	Dr. Anthony Arduengo "Organophosphorus Valence Confused Systems"	209
Joshua Dolphin The University of Alabama	1200 Camiro Read Roswell, NM 88203 (505) 623-4245 jsdolphin@bama.ua.edu	Dr. Anthony Arduengo "Unusual Bonding Arrangements"	
Michelle Harris Alabama A&M University	45 Pine Lane Eutaw, AL 35462 (205) 372-2961 Michelle.harris@Mailserver.aamu.edu	Dr. Kevin Redding "Purification of a Bacterial Protein via Genetic Modification"	210
Ashley D. Hunter Shelton State Community College	2516 Twin Manor Northport, AL (205) 759-4909 hatladyhunter@yahoo.com	Dr. Anthony Arduengo "Hydrogen Storage With Novel Valence Structures"	

Name & College	Permanent Address	Advisor & Project Title Room #	Rose Towers
Joanna M. Smith University of Alabama	3341 Overton Road Birmingham, AL 35223 (205) 970-0488 jmsmith@bama.ua.edu	Dr. Kevin Shaughnessy “Metal-Catalyzed Modification of Biomolecules”	
Kimberly Smith University of North Alabama	P. O. Box 2671 Muscle Shoals, AL 35662 (256) 381-3686 Kjsmith1@gmail.com	Dr. Shane Street “Dendrimer-Based Nanocomposites”	211
Bryan Wiggins Alabama A&M University	314 Hillside Road Decatur, AL 35601 (256) 584-0245 Bcwig18@aol.com	Dr. Greg Szulczewski “Scanning Tunneling and Atomic Force Microscopic Studies On Organic Molecules.”	209

2006 REU PROGRAM
June 4 - August 12
University of Alabama,
Tuscaloosa, Alabama
Shelby Hall

Schedule of Events in addition to selected projects.

June	5	8:00 a.m.	(Room 206 F – Shelby Hall) Welcome, expectation of program, register cars, laboratory safety, tour of Shelby Hall, introduction to Science Library, etc.
June	5	1:00 p.m.	(Room 206 F -Shelby) Faculty advisors present selected projects to group at large. Notification of the room number of the lab for each project.
		2:00 p.m.	Begin projects
June	6	8:00 a.m.	Continue projects (Search out location of library)
June	6	7-10 p.m.	Science and Engineering Library, how to use facility and begin literature search (meet initially in Room 206 F Shelby).
June	7	3-5 p.m.	Sci Finder (meet in Room 318 Shelby)
June	9	1-2 p.m.	Publicity and Photo Session (Room 206 F Shelby)
June	11	10:00 a.m.	Tour of area parks (attendance required) will provide details.
June Aug.	12 to 9	Monday 12-1 p.m.	First Faculty Research Seminar (Room 206 F Shelby, bring your own sack lunch, attendance required every Monday).

June	15	4-9 p.m. Thursday	(Lake Lurleen State Park) PICNIC - students, faculty, and secretaries. All REU students and REU participants please meet in the Shelby Rotunda at 4:00 p.m.
June Aug.	16 to 4	1:00 p.m. Friday	(Room 206 F) - First Weekly meeting (attendance required) from 1-2 p.m. each Friday
June	17	2:30 p.m.	Tour of Westervelt-Warner Museum of Young America. Meet in Shelby Rotunda 2:30 (attendance required).
July	7	8:00 p.m. Friday	Astronomy Show (Physics) Rm 227, Gallalee Meet in Shelby Rotunda. (Attendance required).
July	14	12-1 p.m.	Hand in abstracts in ACS format.
Aug.	12		(Room 206 F - Shelby) Faculty - Student farewell luncheon meeting 11:30—1:00 p.m. 1—>3:30 p.m. - complete reports. Special instruction for college reports, local and national ACS meetings, and applications to professional schools. Attendance required. (ATTENDANCE REQUIRED).

REU PROGRAM
June 4 - August 12, 2006
Faculty Research Seminars
(Monday -Noon)
Room 206 F

June	12	Professor Street	Surface Analytical Techniques
	19	Professor Shaughnessy	Reactions in Environmentally Benign Solvents
	26	Professor Redding	Biological Photochemistry
July	3	Professor Nikles	Materials for Information Technology
	10	Professor Rogers	Green Chemistry
	17	Professor Cassady	Peptide Sequencing by Mass Spectrometry
	24	Professor Woski	Synthesis of Modified Nucleic Acids
	31	Professor Blackstock	Crystal Engineering
Aug.	7	Professor Bakker	Meso, Micro and Nanostructures by Self Assembly

REU PROGRAM 2006
Research Techniques and Final Reports
Friday, 1:00 p.m., Room 206 F

June	9	Publicity & Photo Session	University Relations
	16	NMR Facility	Ken Belmore
	23	Glassblowing Demonstration	Richard Smith
	30	Progress Report 3 minutes each student	Program Committee
July	7	Vac-line Techniques	Prof. Thrasher
	14	X-Ray Crystallography	Scott Griffin
	21	Mass Spectrometry	Prof. Cassady & Mass Spec Manager
	28	Scanning Electron Microscope	Jolanta Nunley
Aug.	4	Surface Analytical Techniques	Prof. Szulczewski
		8 a.m.	1 p.m.
	11	Allison Arrendale Ashley Huner Kimberly Smith	Michelle Harris Joanna Smith Bryan Wiggins



SHELBY HALL
Home to the Chemistry Department

The front of Shelby hall was modeled after the original campus buildings that were later destroyed during the Civil War. The center rotunda is a three story open space that leads out to the interior courtyard. The front wings of the building house teaching and administrative functions.

MINIMUM SAFETY REGULATIONS FOR RESEARCH LABORATORIES

In order to create safer laboratories and also to meet federal and state safety regulations, the safety rules and procedures, as outlined in the booklet, Chemical Laboratory Safety Manual, have been adopted by the Safety Committee of the Chemistry Department. These rules are not attempts to restrict or hamper research. Instead, they are based on common sense and enacted for the benefit and safety of everyone. Your cooperation is essential. Please attempt to bring your laboratories and your laboratory procedures into conformity with these principles and remind others to do so.

The Safety Committee will make unannounced inspections of the laboratories. All hazards will be recorded, and the students working in that laboratory will be given a list of deficiencies and instructions on their improvement. The deficiencies will also be reported to the faculty research advisor responsible for that laboratory. Furthermore, the laboratory will be re-inspected to see that the listed deficiencies have been corrected. A comprehensive listing of all deficiencies found will be compiled so that (a) these problems can be discussed at department-wide safety meetings and (b) so that serious problems or frequently encountered problems may be brought to everyone's attention for immediate resolution.

Each of you can make an important contribution by taking this list and systematically checking and correcting unsafe conditions in your laboratory. Please begin to conduct your laboratory operations in accord with these regulations. Most importantly, please develop a positive attitude about this safety effort. It is each of you who stand to benefit most from these efforts. Later in your career, each of you will probably be responsible for the safety of others working with you. Thus, most of the following regulations are nothing more than procedures which will be with you as long as you are in chemistry. A digest of some of the more common rules and procedures is given in the following pages. For a more complete and authoritative coverage of each of these areas, please consult the Chemical Laboratory Safety Manual.

1. Safety Equipment and Familiarity

- a. Each student must make sure (his, her) laboratory is equipped with a minimum of 1 fire extinguisher per laboratory. They must know the location of and how to use fire extinguishers and fire buckets with sand.
- b. Each student must be aware of the location of and know how to use eyewash fountains, showers, fire-blankets, and emergency kits.

2. Please don't smoke in the laboratories

This is a rather obvious need, particularly since we do not have prescribed smoking areas in the laboratories of Shelby Hall. If you do smoke, you must go outside the building to smoke. (The danger you create for others who work in the labs could be far greater than the danger inherent in your own operations. It is understood this requires changing well-developed habits to accomplish this task, and your cooperation is vital in this respect.)

3. Eye Safety

- a. Eye protection must always be worn in the laboratory, (i.e. safety glasses, goggles, or shields).
- b. If you don't normally wear glasses, consider purchasing a nonprescription, fitted pair.

4. Storage of Solvents

- a. All solvents should be stored in safety cans.
- b. Solvent bottles or cans should not be left or kept on bench tops or left in hallways.

- c. Solvents should not be stored on shelves above benches (serious fire spreading hazard).
- d. Solvents should, if possible, be stored in steel cabinets.
- e. If it is impossible to store solvents in steel cabinets, they must be stored in cabinets behind closed doors. In this way, they won't be accidentally broken when something else happens in the lab.
- f. Don't store large quantities of solvents in the lab.
- g. Transportation of chemicals by elevator must be minimized.
- h. Transportation of chemicals should be performed in rubber safety buckets. These buckets will be provided in the near future. Meanwhile, only a single bottle of a dangerous chemical should be carried at a time.

5. Storage of Chemicals

- a. Avoid storing chemicals near sinks (for example, LiAlH_4 has been found near a sink. This is extremely dangerous).
- b. Don't store flammable chemicals above bench tops.
- c. All chemicals must be clearly labeled.
- d. Old chemicals or excess chemicals should be periodically collected and either discarded, placed in the central storage location of your faculty advisor, or taken to the stockroom.
- e. Chemicals stored in desiccators under vacuum must be kept in closed cabinets, behind shields, or in cages. Never store such desiccators on shelves above bench tops or on lab benches. Label desiccators which are under vacuum.

- f. All gas cylinders must be clamped, and they should be located in areas reserved for gas tanks.
- g. Refrigerators:
 - 1) Refrigerators must be regularly defrosted.
 - 2) Chemicals must be clearly labeled.
 - 3) Chemicals should be stored neatly and carefully – not simply "piled in."
 - 4) Don't store food in refrigerators containing chemicals.

6. Operations Under Vacuum

- a. Vacuum equipment should be shielded (even glass rotary evaporation units.)
- b. Vacuum pumps must have guards. If not, the pumps must be housed in boxes or housings which serve the same purpose.
- c. See 5-e.
- d. Never evacuate flat bottom flasks, bottles etc.
- e. All Dewar flasks and desiccators must be carefully taped.
- f. Vacuum pump exhausts should have a filter. If not, the pump outlet should be exhausted into a hood.
- g. Glass mercury diffusion pumps should be housed in cases which can catch the mercury if the glass is broken.

7. General Laboratory Operations

- a. All reactions must be labeled. This includes operations under vacuum. (Write on a card exactly what your reaction is). Tape the card to the reaction vessel or nearby. Then if an accident occurs when you are not in the laboratory, others will be able to deal with it. If the power goes off, others will be able to anticipate problem, etc.

- b. Solvent stills should be labeled.
- c. All reactions should be shielded when not attended. (Have your research advisor provide lab shields if you don't have enough shielding).
- d. All permanent solvent stills should be carefully shielded (again, have your faculty advisor arrange for the necessary shielding).
- e. Cylinders should be moved only with the aid of cylinder carts. Pressure regulating gauges should be removed, and cylinder caps should be on. Return cylinders to stockroom while a positive pressure still exists in the cylinder.
- f. Dewars should not be stored on bench tops.
- g. Dewars in use should be clamped. When not in use, store in closed cabinets.
- h. Water hoses on condensers must be wired or clamped on.
- i. Water hoses draining to sinks or troughs must be securely anchored in place.
- j. Broken glassware should be stored in closed containers and labeled.
- k. Solvents should not be exposed to air for long periods during chromatography operations.
- l. Never throw rags or paper towels which are wet with solvents into the waste cans. Instead, thoroughly soak them with water prior to discarding them.
- m. Never dispose of waste alumina or silica gel (i.e., from column chromatography) by dumping into waste cans. Instead, thoroughly soak with water before discarding.

- n. Solvent and solid waste disposal should be handled carefully and thoughtfully. If any questions arise please contact questions arise please contact a member of the safety committee.
- o. Periodically check the electrical cords on variances, heating mantles, motors, etc. for damage. Have them repaired when not in excellent shape.
- p. Have all electrical cords carefully placed out of the way of jacks, hot plates, solvents, etc. when in use.
- q. Electrical cords should not be strung across aisles or along the floor without being properly protected.
- r. Do not eat in the lab. Areas are provided for such activity.
- s. Bench tops, hoods, passageways, and floors should be kept neat. The single largest cause of accidents is a cluttered and messy work area.
- t. No power cords should be warm to the touch.
- u. Multiple outlets should have fuses or circuit breakers.
- v. Know where the fuses are in each lab.
- w. High voltage circuits (over 600 volts) should be labeled.
- x. Fuse boxes should be three-pronged.
- y. Electrical cords should be three-pronged.
- z. Know what to do for a person who has had a serious electrical shock.
- aa. Emergency phone numbers should be affixed in each laboratory in an easily visible location.

- bb. After fire extinguishers are discharged, contact Environment Health & Safety (8-5905) to have them replaced.
- cc. Clean up mercury spills with Zn powder to form an amalgam. Then clean up and follow by sprinkling sodium polysulfide or powdered sulfur. Never leave a mercury spill without a thorough clean up!
- dd. Mercury should be stored in hoods. A mercury bubbler should be protected with an activated carbon or mineral oil trap.
- ee. Glassware which is chipped, cracked, broken, or star-cracked should immediately be either (a) fixed (annealed or fire polished etc.) or (b) discarded.
- ff. Students should keep in mind that by redistilling and reusing solvents, the volume which must be disposed of is decreased.
- gg. Use of hot oil for heating purposes can be extremely hazardous because of (1) splattering caused by water falling into hot oil, (2) smoking caused by decomposition of the oil or of organic materials in the oil, and (3) fire caused by overheated oil bursting into flame. Operating baths should not be left unattended unless a high temperature cut off is installed. Precautions should be taken to contain any spills of hot oil caused by breakage or of the baths. Adequate ventilation should be available at the place where the bath will be used. No fiberboard, cardboard or other flammable components should be used in the heating apparatus.
- hh. Flammable chemicals should not be dried in an oven. Glassware, washed with acetone, must be air dried first, prior to being placed in an oven.

INSTRUCTIONS FOR KEEPING A RESEARCH NOTEBOOK

GENERAL GUIDELINES

Your research laboratory notebook is a permanent record of the research you perform at the University of Alabama. Careful recording of all pertinent information and data will save you much time when writing manuscripts, as well as your final REU report. Another person should be able to follow your notebook and sufficiently reproduce your experiments.

Always use permanent ink (waterproof, or ball-point) in your notebook recording. If you have spectra and/or graphs recorded on thermal paper, photocopy them, as thermal paper is usually light-sensitive, and important data will fade with time. It is helpful to reduce spectra and graphs and tape them for reference into your notebook.

Leave space in the beginning of your notebook for a TABLE OF CONTENTS. Number pages, if they are not numbered. Also, date each page and experiment. Include yields, weights, etc. in your notebook. Don't use scratch paper to record weighing; this usually gets lost.

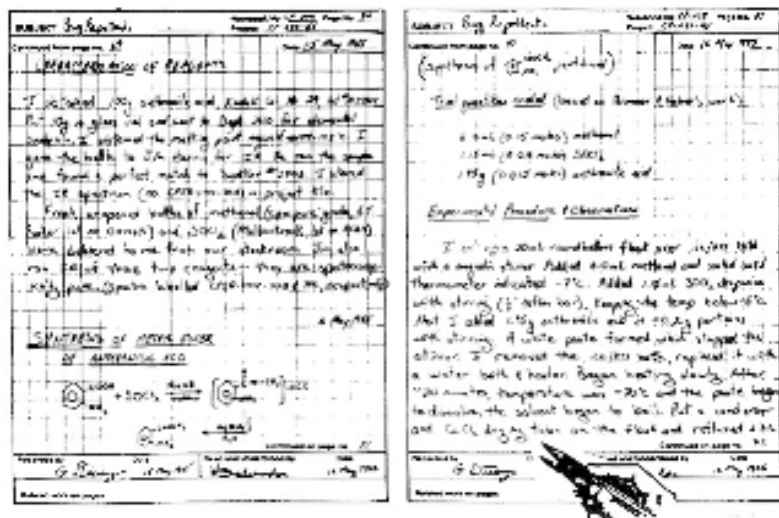
Each person has their own style to keeping a notebook; it's important, though, that you include enough information in your notebook so that other people can reproduce your work, based upon only following your notebook.

An example of how notebooks are kept follows. You can also consult the ACS Guide to Laboratory Notebooks or your REU Advisor for more examples.

Please keep your notebook on your desk when you leave - do not lock it up. In case of an emergency, it may be necessary to consult your notebook for the properties of chemicals used in a specific reaction.

Record the results of conversations with visiting scientists concerning your research in your notebook, as well as any important literature references that may pertain to your research.

KEEPING A RESEARCH NOTEBOOK



Rodgers Library for Science and Engineering

The Eric and Sarah Rodgers Library for Science and Engineering is located within a short walk of Shelby Hall and includes a 200,000 volume collection of monographs and over 1,700 current periodicals. The Science and Engineering Library is the first library at the University built with the intent of taking maximum advantage of computer-based information systems for research. The facility includes a scientific communications laboratory containing projection video screens which allow instructors to teach students how to use online data base searching equipment and to operate stand-alone electronic research systems. The Chemistry Department also maintains accounts with Scifinder for hands-on searching of the chemical literature.

All REU students will learn more about the Science Library at a Library Orientation during the first week of the REU program.

RESEARCH FACILITIES AVAILABLE

The University of Alabama Department of Chemistry has 150,000 square feet dedicated to research. The following research facilities and equipment are available for use:

X-Ray Facilities: Siemens smart CCD area detector system with low temperature device, that permits structural solution of approximately 400 crystal structures per year is available.

NMR Facilities: 360 and 500 MHz FT multi-nuclear NMR spectrometer, can be operated by the REU students. In addition, a 600 MHz FT NMR spectrometer is available for special applications.

Computer Facilities: An IBM-3090-400 with vector processor and a C94A/264 supercomputer (available via ASN Supercomputer Network). In addition, there are many personal computers available in the department with Scifinder capability.

EPR Facilities: A Varian E-12 EPR spectrometer with 9 GHz and 35 GHz microwave bridges, a 100 MHz Transient Recorder for in situ photolysis experiments, an E-800 Varian ELDOR Accessory, and an ENDOR attachment; a Bruker-ESP 300-10/7 with a ESP 350- ENDOR/TRIPLE accessory; a Varian century series 9 GHz EPR spectrometer; and a newly acquired E-600 Bruker W-band (95 GHz) EPR Spectrometer.

UV-visible equipment: OLIS-upgraded Cary 14 UV-vis-near-IR spectrophotometer, Fluoro-max fluorescence spectrometer, diode array spectrophotometers including Hewlett-Packard 8453, Shimadzu UV-160 A with temperature control available and, an Edinburgh Instruments LP900 Laser Flash-Photolysis UV/Vis Spectrophotometer with 10-ns time resolution.

Electrochemical Equipment: A-BAS-100, two BAS CV-27 potentiostats with Hewlett-Packard X-Y recorders and PAR-273 with model 96 potentiostat/galvanostats are available in the department. Equipment is also available for inert atmosphere electrochemistry.

Inert Atmosphere Equipment: Numerous Vacuum Atmosphere glove boxes are housed in the department for inert atmosphere manipulations.

Photochemical Reactor Equipment: Rayonet Photochemical Reactor is available for photolysis around 325-350 nm. Several mercury immersion lamps, both low and high pressure (Hanovia and Heraeus), are also available.

Gas Chromatography/Mass Spectrometer Facilities: Hewlett-Packard 5985-A and a VG AUTOSPEC double focusing mass spectrometer with GC and FAB inlets.

IR Equipment: Several IR spectrophotometers as well as two FT-IR and a model V-1000 laser Raman spectrophotometer are available.

Support Services: Full-time-machine-shop staff person, one electronics shop technician, as well as one scientific glassblower are all available for use. In addition, a Research Associate is available for consultation and technical expertise in FT-NMR and FT-IR spectroscopy.

Laser Lab: Quartel brilliant Nd:YAG laser, a OPOTEK Magic Cube OPO tunable laser, a Questek model 5200 B dye laser, and a molecular pulsed nitrogen laser are available for transient photolysis studies.

Secretarial/Office Facilities: Three departmental secretaries, 2 photocopying machines, word processing and laser-printer facilities are available.

CHEMISTRY DEPARTMENT DIRECTORY

FACULTY

Faculty

Person	Shelby Room Number
Dr. A. Arduengo	338
Dr. M. G. Bakker	118
Dr. S. Blackstock	224
Dr. C. Cassady	243 E
Dr. D. A. Dixon	113 B
Dr. A. Gupta (133 Bevill)	243 B
Dr. M. P. Jennings	238
Dr. L. D. Kispert	113 D
Dr. R. M. Metzger	143 B
Dr. D. E. Nikles (Bevill, Room 229)	343 D
Dr. K. Redding	343 B
Dr. R. D. Rogers (202 AIME)	313 D
Dr. K. Shaughnessy	232
Dr. T. Snowden	218
Dr. S. Street	143 A
Dr. G. Szulczewski	143 D
Dr. J. S. Thrasher	206 J/332
Dr. R. Timkovich	313 B
Dr. J. B. Vincent	324
Dr. S. Woski	318



Dr. Joseph Thrasher
Chair, Department of Chemistry



Dr. Anthony Arduengo



Dr. Silas Blackstock



Dr. Martin Bakker



Dr. Carolyn Cassady



Dr. David A. Dixon



Dr. Arunava Gupta



Dr. Michael Jennings



Dr. Lowell Kispert



Dr. David Nikles



Dr. Robert Metzger



Dr. Kevin Redding



Dr. Robin Rogers



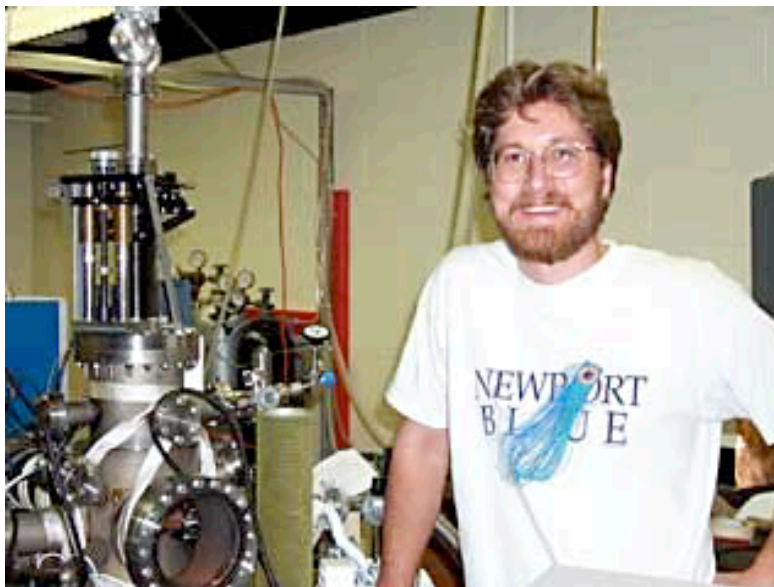
Dr. Kevin Shaughnessy



Dr. Timothy Snowden



Dr. Shane Street



Dr. Gregory Szulczewski



Dr. Stephen Woski



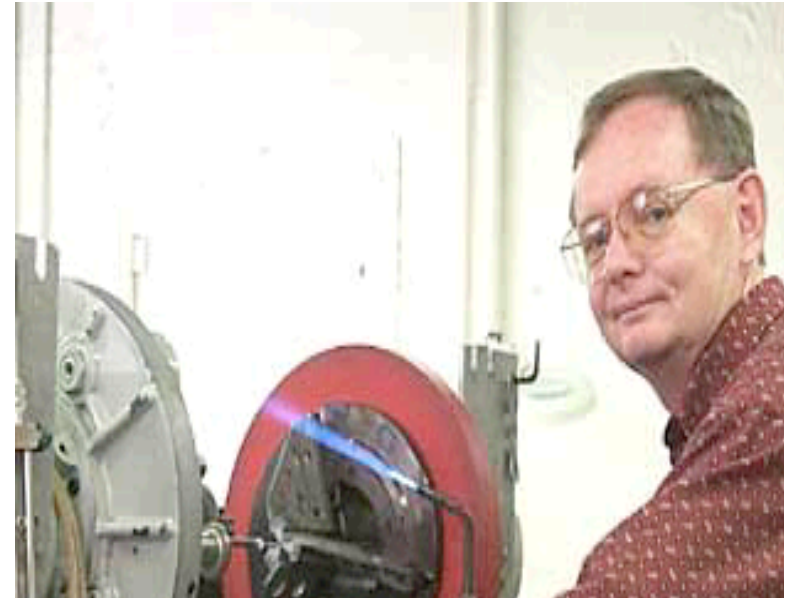
Dr. Russell Timkovich



Dr. John Vincent



Jackie McPherson
Secretary to the Chairman



Richard Smith, Departmental Glassblower



Carolyn Walker
Budget Specialist

Marlene Jones
Accounting Clerk



Michael McLemore
Electronics Technician Senior



Ken Belmore
NMR Lab Manager



David Key
Senior Mechanician



April
MacIntosh

Evelyn
Jackson

Janice
Voss

SURVEY: YOUR COMMENTS ABOUT THE PROGRAM

At the end of your stay at The University of Alabama, we would like for you to make a list of things your likes/dislikes about the program and ways to make it a better program.

In doing so you can help evaluate what works better in helping students to obtain more knowledge about research and chemistry.

Your comments may be anonymous.

Thank you.