Research in a Learning Environment:
Bridging the Gap in the Chemical Sciences!

The School of Education & Professional Studies Seminar Series
"Disciplined Inquiry in Education"

Fadi Bou-Abdallah
SUNY Potsdam
Chemistry Department
September 28, 2011
• Faculty cannot do it on their own...
• Students need to express interest
• Administration needs to invest and support it

“Those who educate children well are more to be honored than parents, for these only gave life, those the art of living well.” – Aristotle
Outline of My Talk

• Briefly Discuss the Benefits of Undgrd. Res.

• Give a Brief Outline of my Research Program

• Highlight Students’ Achievements

• Discuss Recent Awards/Publ./Collab.
Undergraduate research experience is instrumental in ensuring a well-rounded scientific education.

It also provides the necessary critical thinking skills to become a well-informed world citizen.
Undergraduate Research

Who Benefits?

Research at an undergraduate institution:

1- Enhances the educational experience of undergraduates
2- Reduces the rate of attrition (improves students retention)
3- Provides a pathway for exploration (undeclared students!)
4- Opens doors for collaborations between faculty at various institutions

Can be rewarding, frustrating or exhilarating

- publications
  - Conferences
  - Exposure
- If things do not go as planned
- Research outcome
Albert Einstein once reasoned:

“It is not so very important for a person to learn facts. For that he does not really need a college. He can learn them from books. The value of an education in a liberal arts college is not the learning of many facts but the training of the mind to think something that cannot be learned from textbooks”.

Research and education are highly integrated and inquiry-based method is the best way to teach science!
One of the hard things about science is the constant level of abuse:

//......Your grants are rejected......//
//......Your papers are turned down......//
//......Inability to balance personal life with professional life......//
//......Lack of time → There’s only 24 hrs per day......//

In brief .... It’s not an easy business !!!

You have to be **committed**, you have to **believe in** and **absolutely love** what you’re doing in order to:

• put up with all that ...
• keep going ...
• and ultimately be successful !
"Chemistry is a science that appeals to the mind and to the emotions. It is observation, interpretation, logic, mathematics, fascination at what happens in the laboratory or at what simulated molecules do on the computer. More women should join in exploring these aspects and discovering how easily they can enjoy chemistry."
Selling your science to other scientists can be tricky.

Selling it to non-scientists is much harder.
Science is fundamentally a human endeavor driven by the same impulses that motivate much of human activity:

• Curiosity about the unknown
• Thrill of discovery
• Delight in creativity
• Benefits derived from understanding

CURIOSITY, DISCOVERY, CREATIVITY, BENEFITS = Driving Forces
Most People’s View of a Chemist
My friends, as a result of our experimentation, we have just lost a dear and valued colleague...

On the other hand, we have just gained a publication.
CHEMISTRY IS A CENTRAL SCIENCE

Chemistry has a central role among the sciences; it tries to understand and help solve society’s problems.
The Power of Chemistry

Na
A highly reactive metal

Cl
A powerful oxidant

NaCl
Sodium chloride known as “Table salt”

Tasty chemical when sprinkled over popcorn

O₂ (g) + 2 H₂ (g) → 2H₂O (l) + Energy
A strong oxidant
A highly flammable gas
Water
In recent years, there have been many calls from prominent higher education leaders for a strengthening of the links between research and teaching and the incorporation of research and inquiry into the undergraduate curriculum (e.g., Boyer Commission 1999; Brew 2003; Healey and Jenkins 2009; Rowland 2006).

There is strong and growing interest in incorporating undergraduate research and inquiry into the mainstream of undergraduate education. And our campus is not a stranger to this movement (we have been very lucky to have received a Title III Strengthening Institutions Grant (i.e. Dr. Gerald Ratliff) & the excellent work that many faculty are doing in bringing external funding to support their research programs and various projects on our campus.)
Research Program

Dr. Fadi Bou-Abdallah

bouabdf@potsdam.edu

Assistant Professor, SUNY at Potsdam (2007-present)
Research Scientist II, University of New Hampshire (2003-2007)
Pre-doctoral degree, Ecole Normale Superieure de Cachan (ENSC), Paris-France (1997)
M.S. Chemistry, Lebanese University (1996)

Interests and Field of Study
Biolnorganic Chemistry and Physical Chemistry of Biological Processes

To Contact Dr. Bou-Abdallah:

(315) 267-2288
(315) 267-3170
bouabdf@potsdam.edu
Research Program

My research interests are in the general area of iron protein biochemistry. The goal is to elucidate the structure-function relationships and better understand the role of these crucial proteins in the regulation of cellular iron homeostasis. Proteins such as human transferrin, cytoplasmic and mitochondrial ferritins of different origins, human and bacterial frataxins are being investigated. The hope is to generate new knowledge that is essential for the rational development of new treatments for iron overload diseases and other defects in iron metabolism.

Iron is a vital element for almost all living organisms due to its essential role in numerous metabolic processes. However, excess free iron has been implicated in neurodegenerative diseases, apoptosis, and also in the generation of harmful free radicals that cause damage to membranes, proteins and nucleic acids. The low solubility of iron at physiological conditions (~10^{-14} M) has compelled living organisms to adapt efficient iron transport and storage mechanisms, one of which is transferrin, a plasma transport protein which carries iron in the circulation from the gut to the bone marrow and other tissues for the synthesis of hemoglobin and other iron-containing proteins.

The iron-transport protein "Transferrin"

Transferrin is a naturally occurring metal chelating protein that is responsible for the transport and donation of Fe to cells and tissues where it is utilized by many iron-containing enzymes. It is an alpha-globulin (C, and M class) with two high affinity Fe-binding sites. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state. The transferrin molecule is a dimer of two iron complexed subunits. The iron in transferrin is reversibly bound by two histidine ligands on each subunit, and the iron is tightly bound in a ferric state.

The following research projects are being currently studied:

- The thermodynamic investigation of recombinant human serum transferrin binding
Young student researchers are like diamonds in the rough; they can be damaged if mistreated or gems if handled properly. Thus, the care and nurturing of young, talented and prospective science students starts here (U. I.) & is crucial for developing the next generation of scientists.

Three-Interdependent Ways of Teaching & Communicating Knowledge

1. Teaching in a Classroom Setting
2. One-on-One Interaction
3. Undergraduate Research

Instrumental to receiving a well-rounded education “Thinking +Communication” skills
Iron is an element where you “Can’t live without it but you can’t live with too much of it”.

My research interests are in the general area of iron-protein biochemistry and are part of a major international effort to understand the role of iron in health and disease.

Our research is contributing to the understanding of important structure-function relationships in these crucial iron transport and storage proteins and is generating new knowledge that is essential for the rational development of new treatments for iron overload diseases and other defects in iron metabolism.

Interested students should contact Dr. Bou-Abdallah at bouabdf@postam.edu
Undergraduate Research in the Chemical Sciences
- Achievements and Opportunities -

**External Funding:**


- **National Science Foundation** - Major Research Instrumentation Program (NSF-MRI), “Acquisition of an Isothermal Titration Calorimeter”, Award period 2009-2012 - ($126,525).

- **National Science Foundation – Early Faculty CAREER Award** - ($481,193) – **Under Review**

- **American Chemical Society** Innovative Projects Grant Program. Spring 2010. ($1500)
**Internal Support:**

1. Faculty-Undergraduate Summer Research Program Award
2. Kilmer Undergraduate Research Apprenticeships
3. Student-Faculty Travel Awards
4. Individual Development Grant Award
5. United University Professions (UUP) Individual Development Award
6. Mini-Grant Award
7. Research and Creative Endeavors Program Award
8. Grant Development Program Award
9. Faculty Professional Development Program Award (Title III)
10. Faculty Curriculum Development Award (Title III)
Students’ Awards:

- Faculty-Undergraduate Summer Research Program Award

- Kilmer Undergraduate Research Apprenticeships

- Student-Faculty Travel Awards

- Advanced Honors Independent-Study Program Award

- Presidential Scholars
Publications:


Undergraduate Research in the Chemical Sciences - Achievements and Opportunities -

Students’ Presentations:

Oral Talks by Students

Poster Presentations

http://www2.potsdam.edu/bouabdf/List%20of%20publications.html
Undergraduate Research in the Chemical Sciences
- Achievements and Opportunities -

Snapshots From Various Meetings

Gustavo Gonzales
Hiba Iqteit
Adcole Awomolo
Huidong Yang
Banu Kandemir
Justin McNally
Brenna Cooper
Tyson Tepstra
Sean Atkinson

At least a dozen of 1st year freshman students have expressed interest in undergraduate research . . .
NorthEast Regional Undergraduate and Graduate Student Sigma Xi Conference

Ithaca, NY
April 19, 2008
Presenting at the Sigma Xi meeting -April 2008- Cornell Univ.
Having Fun?
236th National ACS Meeting
Philadelphia, PA
August, 2008
American Chemical Society- Northern New York Research Symposium, SUNY Potsdam, April 04-2009
Banu Kandemir was awarded "The Kilmer Undergraduate Research Poster Excellence Award" April 16, 2009
Learning and Research Fair - SUNY Potsdam, April 21, 2010
For the Kilmer Awards, Justin McNally earned first place for his project “.......” overseen by faculty mentor Dr. Fadi Bou-Abdallah.

American Chemical Society- Northern New York Research Symposium, SUNY Potsdam, April 16-2011
While at Ithaca College, we noticed the existence of a very tough parking policy!
Students involved in Undergraduate Research in my Lab

Gustavo Gonzales  Hiba Iqteit  Adeola Awomolo  Huidong Yang
Banu Kandemir  Justin McNally  Brenna Cooper  Tyson Tepstra
Sean Atkinson

At least a dozen of 1st year freshman students have expressed interest in undergraduate research . . .
Hiba Iqteit,
Health profession
John Hopkins Univ.

Gustavo Gonzales
Medical degree
Univ. of Health Sciences
Antigua, San Juan, PR

Adeola Awomolo
Medical degree
SUNY Upstate Medical Univ.

Huidong Yang
PhD in Neuroscience
Univ. of Illinois at Urbana-Champaign

Banu Kandemir
PhD in Physical Chemistry
Rochester Univ.

Where are they now?
Current Students

Justin McNally
MD-PhD program?
Dartmouth Medical School, MA

Tyson Terpestra
PhD/Research?
or
Medical School?

Brenna Cooper
Nursing School?

Sean Atkinson
Medical School?

At least a dozen of 1st year freshman students have expressed interest in undergraduate research . . .
From left, Chelsea Richard, Justin McNally and Gregory Razzano pose with State Sen. Darrel J. Aubertine, D-Cape Vincent, in the Legislative Office Building in Albany.
Collaborators:

**US**

**Professor N. Dennis Chasteen**
University of New Hampshire
Durham, NH

**Professor Paolo Arosio**
Faculty of Medicine,
University of Brescia,
Brescia, Italy

**Professor Anne Mason**
The University of Vermont
College of Medicine

**Professor Sonia Levi**
Vita-Salute San Raffaele University
Milano, Italy

**Professor Simon C. Andrews**
University of Reading, UK
School of Biological Sciences

**US**

**Professor Artem Melman**
Department of Chemistry & Biomolecular Science
Clarkson University

**France**

**Professor Christina Nielsen-LeRoux**
Institut Micalis
Paris, France
To summarize:

Science is fundamentally a human endeavor driven by the same impulses that motivate much of human activity:

- Curiosity about the unknown
- Thrill of discovery
- Delight in creativity
- Benefits derived from understanding

For me, the desire to know, teach, and share the beauty of science can be expressed in three ways:

1- Excellence in the classroom
2- Excitement of Undergraduate Research
3- Chemical Demonstrations (Magic Shows !)
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Share the Beauty/Benefits of Science
My Message to Students:

Get Involved in “Undergraduate Research”

Think of Becoming the “Producer of Knowledge”
Not Just the “Consumer of Technology”!

There’s nothing to loose... You’re always a winner!
Every chemical substance is a key to the gates of heaven and hell.

Ultimately we are the ones who decide what gate it will open.

We hope to choose wisely.
The Council for Undergraduate Research (CUR) definition of UR:

An inquiry or investigation conducted by an undergraduate student that makes an original intellectual or creative contribution to the discipline.

People have challenged this definition and explored a range of meanings of UR.

Four main ways in which students could experience undergraduate research and inquiry have been suggested:

• Research-led: learning about current research in the discipline
• Research-oriented: developing research skills and techniques
  • Research-based: undertaking research and inquiry
  • Research-tutored: engaging in research discussions

“There is no one correct definition .... One size does not fit all”.
It is discipline- and institution-dependent!