

Bringing Research (Inquiry-based Learning) to the Classroom in Introductory & Foundation Courses

- **Goal:** generate three or four new ideas, which can be brought to the larger group.

Background.

- Two recommendations of the Boyer Report.
- In undergraduate education at research universities:
 - Make research based learning the standard.
 - Construct an inquiry-based freshman year.

At Rutgers, we have addressed these recommendations as follows:

- **Impact of Chemistry:** An introductory course for nonscientists
 - Used to satisfy science requirement
 - Features group work, case studies, research experiment: analysis of household dust using x-ray fluorescence.
 - Involves hypothesis, sample collection, preparation, analysis, poster presentation.
 - Students ranged from 1st years to seniors.
- **Related courses in other Science disciplines:** all introductory, all used to satisfy science requirements
 - **Biology:** The Anatomy, Physiology & Energetics of Movement. Group work required.
 - **Impact of Mathematics:** Communication and Cryptography. Writing required.
 - **Impact of Physics:** Great Ideas that Shook Physics and the World. Socratic method used, experimentation stressed.

- **Undergraduate Research Center (URC) –
in progress**

- For beginning students in chemistry & closely allied fields (CCAF).
- Joint with a community college and with a county college.

Outline:

- Create research-oriented project for General Chem lab: household dust analysis.
- Recruit 14 1st-semester students (Center Fellows) for 2nd-semester research project.
- Match Center Fellows with faculty members with near-peer mentors (grad students) in active research groups.
- Create new course for Fellows: Intro to research in CCA F.
- Supervise reports of Center Fellows
- Assist interested Fellows in pursuing research further.
- Assess project

Syllabus – In Progress

Lab (minimum 3 hrs/wk; class meeting 55 min/wk)

Research in CCAF

| Week | Topic/Activity | Speaker | Reading |
|---|---------------------------|---|------------------------------------|
| 1 | Introduction | Potenza/ Herzog | <i>The Two Cultures</i> |
| 2 | Chemistry as a Discipline | Herzog | Beyond the Molecular Frontier |
| 3 | Site Visit 1 | Krenos/corporate partners.* | |
| 4 | Undergraduate Study | Krenos | |
| 5 | Graduate Study | Grad. Stud. Soc. Etkina | |
| 6 | Biomedical Sciences | Ehrenrich/Leibowitz | Science and Engineering Indicators |
| 7 | Site Visit 2 | Herzog/ corporate partners.* | |
| 8 | Pharmaceutics | Colaizzi; Dean, College of Pharmacy. | |
| 9 | Environmental Science | Taghon | |
| 10 | Site Visit 3 | Potenza/ corporate partners.* | |
| 11 | Industry | Speaker TBA | Industrial Applications of Science |
| 12 | Research Results | Students/Herzog | Oral Presentations |
| 13 | Research Results | Students/Herzog | Oral Presentations |
| 14 | Research Results | Students/Herzog | Oral Presentations |
| *Corporate partners: Enzon Pharmaceuticals; Johnson & Johnson; Merck & Co.; Novartis; Schering-Plough; Wyeth. | | | |

Bringing research to the Classroom: In Introductory & Foundation Courses

- How can the thrill of discovery, creation of new knowledge be introduced to beginning students?
 - Guiding principles? Discipline dependent?
 - Interdisciplinary programs?
 - All students?
 - Are cultural changes required?
- Roles of faculty, dep't chairs, deans, central administrators?
 - Who pays? How much?
 - Scale up pilot programs?
 - Effective assessment?

Rutgers' Approach

- **Impact of Chemistry:** An introductory course for nonscientists
 - Used to satisfy science requirement
 - Features group work, case studies, research experiment: analysis of household dust using x-ray fluorescence.
 - Involves hypothesis, sample collection, preparation, analysis, poster presentation.
 - Students ranged from 1st years to seniors (occasional retiree).

- **Undergraduate Research Center (URC) – in progress**
 - For beginning students in chemistry & closely allied fields (CCAF).
 - Joint with a community college and with a county college.
 - Research-oriented project for General Chem lab: household dust analysis.
 - Recruit 14 1st-semester students (Center Fellows) for 2nd-semester research project.
 - Match Center Fellows with near-peer mentors (grad students) in active research groups.
 - New course for Fellows: Intro to research in CCA F.
 - Supervise reports of Center Fellows
 - Assist interested Fellows in pursuing research further.
 - Assess project

Research in CCAF

Lab (minimum 3 hrs/wk; 1 class meeting 55 min/wk)

Two Cultures

Chemistry as a Discipline

Site visits (3)*

Undergraduate Study

Graduate Study

Biomedical Sciences

Pharmaceutics

Environmental Science

Industry

Research Results – Talks (3)

*Corporate partners: Enzon Pharmaceuticals;
Johnson & Johnson; Merck & Co.; Novartis;
Schering-Plough; Wyeth.

Beyond the First Year

Rutgers Undergraduate Research Fellowship Program (all disciplines)

- **PI's write proposals – Students receive stipend**
- **Research results in Thesis/Article**
 - *Rutgers Scholar* – In-house e-Journal publishes Research Results
 - **Mostly Seniors**
- **Banquet & Awards Symposium**