

# **Bringing Research into the Classroom**

## **Physical Sciences and Mathematics**

# Barriers and Challenges

to providing research experience to all\*  
undergraduates

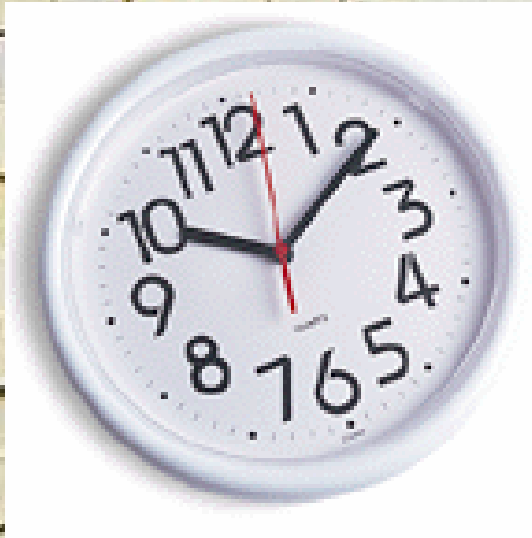
- Too many students to accommodate
- Limited research lab space
- Limited research budgets
- Faculty overcommitted (reluctant to mentor undergraduates)
- Students unprepared to engage in creating new knowledge
- Need for willing and able day-to-day mentors (more senior undergraduates, graduate students, post-docs)

*\*or most, or many.....*

# How can we *use the classroom:*

1. **To make more students research-ready, early in their undergraduate careers**
  - Decreasing the training burden on faculty and lab mentors
  - Enabling students to transition to discovery mode more quickly
2. **To engage a broader group of students in research**
  - Providing non-passive exposure to the **process**, **substance** and **impact** of research
3. **As the research site for individual and group projects?**

# Plan for today's discussion



## 1. Student preparation (e.g.+disc.)

- 20 min (to ~10:35)

## 2. Broaden exposure (e.g.+disc.)

- 20 min (to ~10:55)

## 3. Research in the classroom(e.g.+disc.)

- 20 min (to ~11:15)

## 4. Other topics & approaches

- 15 min (to ~11:30)



## Cement 2-3 ideas to bring forward

- 15 minutes (to 11:45)

# 1. Increasing preparedness:

*E.g.: Research Skills Class (~sophomore level)*

## General skills

- Reading a research paper
- Writing an abstract
- Searching the literature (e.g., SciFinder)
- Using books in the library
- Citing the literature
- Research ethics/responsible conduct
- Keeping a lab notebook
- Lab safety
- Powerpoint (slides, posters)
- Writing a research progress report

## Discipline-specific skills

- Error analysis
- Basis statistics
- ChemDraw
- Mathematica, MathCad
- Common lab techniques (sample handling, instrumentation)
- Sterile techniques
- Field notebooks
- Map reading
- Survival skills

# **Research Skills Class – more....**

## How to find, get and keep a lab spot

- **Finding faculty**
- **Presenting yourself**
  - Resume: what faculty look for
  - The cold call (or e-mail)
  - Preparing for interviewing prospective mentors
  - The interview
- **Responsible conduct in the lab**
  - Ethics
  - Responsibility
  - Accountability
  - Commitment
  - Initiative

**PRODUCT: *Pre-certified students who are research-ready***

# *What do you think?*

1. **How can we make more students research-ready, early in their undergraduate careers?**

## 2. Engaging a broader group of students in research

### *E.g.: Using the research literature*

#### 1. Assign introductory/review articles (at any level)

- Applications not in the textbook: e.g., organic materials or molecular recognition in O-chem
  - Large class: Assign readings and directed study questions
  - Small class: Have students identify aspects they don't understand; each student prepares a tutorial presentation or mini-review
- Modern literature that builds on core course material (e.g., reaction mechanisms, new reactions), so that students see first-hand that field is not static

#### 2. Assign journal article critiques (junior/senior level)

- In large or small classes: Suggest articles for students to summarize, critique, and propose "what's next"
- In discussion or small Honors sections for lg courses:
  - *Add student presentations of critiques*
  - *Skills: critical reading, independent learning, technical writing, and possibly peer review of critiques*

#### 3. Utilize examples from research in the department

***What do you think?***

**2. How can we use the classroom to engage a broader group of students in research?**

### 3. The classroom as research site:

#### **E.g.: Senior-level Materials Chemistry Lab \***

*A spin-off of the NSF-IGERT Materials Creation Training Program at UCla*

#### **First half:**

**Applications-focused lab experiments that train students on instrumentation**

- *Making and characterizing superconductive materials*
- *Thermal analysis as a probe of phase segregation in co-polymers*
- *Making and characterizing luminescent films*

#### **Second half:**

- **Team of students repeats experiments from a journal article (e.g., making an organic LED)**
- **Using those results to develop a new lab protocol for the next generation of students taking the course**
- **Journal article-style lab report**

#### ***Students gain experience:***

- Reading literature
- Reproducing experiments and results
- Trouble-shooting experiments; reading literature to rationalize results
- Writing in the style of professional journals
- *Segue to senior research projects*

# *What do you think?*

**3. How can we use the classroom as the research site for individual and group projects?**

# *Other topics and approaches*