



# Best Practices in Discovery-Based Research at Two-Year Undergraduate Colleges

Panel: James Hewlett, Finger Lakes CC
Daisy Zhang, Rob Hatherill, Del Mar CC
Carole Twichell, Collin College
Linnea Fletcher, Austin CC
Facilitator: Bridgette Kirkpatrick, Collin College









## Undergraduate Research at the Community College

### **Professor James A. Hewlett** Executive Director – CCURI President and CEO – STEMsolutions IIc









### Rationale fo



CCURI is funded by

NSF DUE 1524353

REPORT TO THE PRESIDENT ENGAGE TO EXCEL: PRODUCING ONE MILLION ADDITIONAL COLLEGE GRADUATES WITH DEGREES IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

de

Executive Office of the President President's Council of Advisors on Science and Technology

FEBRUARY 2012









## Finding the How: Best Practice Difficult to Capture



### **Apprentice model**

- Low F:S ratio
- Outside coursework
- Summer / Paid

### Spectrum

Spectral structure of the experience limits meta analyses



### **CURE model**

- High F:S ratio
- Course Embedded
- Academic Year / Credit







### CCLI, TUES, IUSE, Helmsley : \$5.95M Total Funding (current IUSE: \$1.5M)



U.S. SCIENCE EDUCATION

Two-Year Colleges Are Jumping Into the U.S. Research Pool January 15, 2012

With NSF Support, Research Moves Into Science Labs of 2-Year Colleges



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Andrea Hook (left) and Jessica Prame work with James A. Hewlett, their biology professor at Finger Lakes Community College, to test their method for extracting and purifying a protein. The college has a grant from the National Science Foundation to foster undergraduate research at two-year colleges.

2016-2017: 259 faculty and 3,815 students participated in a URE



### Co-PIs John VanNiel Darren Mattone

PI

James Hewlett Executive Director

## Heather Bock Project Director

Co-PIs Diana Spencer Virginia Balke



PARTNERS

Anoka Ramsey CC Austin CC Capital CC Central Wyoming College Cochise College Edmonds CC Everett CC Florida Keys CC Gaston College Glendale CC Ivy Tech CC Kapiolani CC Lake Wash Inst. Of Tech. McLennan CC

Mesalands CC Messa CC Midland College Moreno Valley College Muskegon CC North Hennepin CC Piedmont Tech College Portland CC Redlands CC Seminole State College Truckee Meadows CC Tulsa CC Volunteer State CC

ATE supplement

New Partners Del Mar Community College Estrella Mountain Community College Lone Star Community College Los Medanos Community College Mesa Community College Pueblo Community College Trinidad State Citrus College Baton Rouge Community College

Queenborough Community College Broome Community College LaGuardia Community College Broward College

#### COLLABORATORS

Bellvue Community College Mass Bay Community College Montgomery County Community College





# **Barriers Exist**

### Barrier Analysis for CURE; Create New Course

Gain admin support			78% of the CCURI partners
ROW TOTAL	1394	(sum total of barriers)	use modifications to
WEIGHT	4.29		existing courses
WEIGHTED TOTAL	5987.86		
TOP 3 Barriers	Lack of Fu	nding, Lack of help from fac/admin/staff,	Curriculum approval process

Gain department suppo	rt
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ROW TOTAL	1321	(sum total of barriers)
WEIGHT	3.77	
WEIGHTED TOTAL	4983.77	
TOP 3 Barriers	Faculty pushbad	k, Lack of help from fac/admin/staff, Curriculum approval process

#### Recruit students

ROW TOTAL	1286	(sum total of barriers)
WEIGHT	3.84	
WEIGHTED TOTAL	4939.40	
TOP 3 Barriers	Financial Aid res	strictions, Lack of help from fac/admin, staff, credit limit regs







## Barrier: Incompatible Culture

- Lack of training on innovation (faculty and leadership)
- Incompatible promotion, merit and tenure structure
- Risk aversion at the decision making level
- Risk management and command and control response
- Centralized decision-making powers (micromanagers)
- The concept of the "job description"
- The silo effect (ex. Departments, Colleges, Institutions)
- Rigorous applications of policies and procedures

Results from a 2016 Sabbatical Project/Study







## **Opportunities Exist**







## **Opportunities Exist**

Metric	Result	
<b>3yr Graduation Rate</b>	Before	24%
(pre/post research program)	After	37%
<b>3yr Graduation Rate</b>	No research	35%
(research vs. non- research students)	Research	47%
	No research	5.3 yrs to
<b>Transfer degree</b>		degree
<b>Completion time</b>	Research	3.9 yrs to
		degree

I enrolled in additional science	
courses because of my research	40.9%
experience	
I plan to transfer to a science	
program at a 4-year college	26 404
because of my research	30.4%
experience	
I am much more confident in my	Q1 Q0/a
laboratory skills	01.070
Research gave me an internship	
or employment opportunity that	36.4%
would not be available without it.	
My research experience helped	22.10/
me obtain scholarship support	22.1%
I have plans to continue my	
education in science beyond a	12 10/
four-year degree because of my	15.170
research experience	





News: Researchers "safer way to treat muscle pain"

## CURE Embedded URE

Introductory Biology/Chemistry case study: "oxidants are no accident"

**Biotechnology techniques coursework: QC Applications, HPLC** 

**BIO 291: The cellular protective effects of nutriceuticals** 







## UGR implemented courses: BIOL 1406, BIOL 1407, BIOL 1414, BIOL 1415

Two tenured faculty member and one adjunct member. One full-time and one part-time lab technician

**Student Profile**: Majority of students are freshman with 2-3 post-baccalaureate and 1-2 HS students per semester





## Small World Initiative

crowdsourcing antibiotic discovery















NSF DUE 1524353









- Shared UG research knowledge and experiences within AC2
- Discussed advantages and barriers to successful implementation
- Discussed Mentor Network for UG Research

Sense of accomplishment for students. Recruit new students into the program. Bring the community together and create academic atmosphere for the college. CCURI is funded by NSF DUE 1524353 WWW.CCURI.org

## **COMMUNITY COLLEGE INNOVATION CHALLENGE**

Home About What You Get How to Enter Enter Now Video Tips How to Win FAQ Rules Results Toolkit



### Third NSF Community College Innovation Challenge rewards top entries

#### Judges recognize projects that slow antibiotic resistance and enhance STEM education

June 16, 2017: Teams from Texas and Colorado received first and second place awards, respectively, in the National Science Foundation's (NSF) Community College Innovation Challenge. The American Association of Community Colleges (AACC) cosponsors the annual event, which fosters students' interest in science, technology, engineering and mathematics (STEM) careers by asking them to offer creative solutions to real-world problems. Read more.

#### First Place 2017



Del Mar College, Texas: Slowing Antibiotic Resistance with EnteroSword

This project advocates the use of tailor-made viruses that target bacteria that are resistant to conventional antibiotics treatment methods.

Photo: Students John Ramirez, Danial Nasr Azadani and Reavelyn Pray with their display at the Finalists' Reception on Capitol Hill. Credit: NSF/Bill Petros

#### Second Place 2017



Red Rocks Community College, Colo.: Cyber Lab Learning Environment

The Red Rocks Community College team uses printed and digital material to demonstrate the power of the Cyber Lab Learning Environment.

Photo: Students Bruno Salvatico, John Sanchez and Isaac Kerley with their display at the Finalists' Reception on Capitol Hill. Credit: NSF/Bill Petros



USDA – ARS, Arid-Land Agricultural Research Center, AZ TAMUCC, Corpus Christi, TX InCell, San Antonio, TX Lawrence Berkeley National Laboratory, CA Corpus Christi Water Department, CC, TX National Natural Toxins Research Center TAMUK, Kingsville, TX Boise State University, Boise, ID Texas A&M Agri-Life Research Service, Corpus Christi, TX University of North Texas, Denton, TX University Hospital Hamburg, Germany MD Anderson Cancer Center, UT-Houston, TX Diagnostic BioSystems, Inc., CA Bioo Scientific, Austin, TX







**BIOO SCIENTIFIC** 



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ERNEST ORLANDO LAWRENCE BERKELEY NATIONAL LABORATORY













#### **Traditional Laboratory Course**



#### Comparison of Figure 2 for a SEA-PHAGES Course and a Traditional Laboratory Course



#### Figure 2: Percentage of students in your class likely to continue or not continue in the sciences by psychological measures on the PITS survey

**SEA-PHAGES** Course

### BIOL 1406 - Biological Concepts I (Biology for Science Majors I) SEA-PHAGE:

Surveys Completed: 21; Class Participation Rate: 84% of total

#### NSF DUE 1524353

Figure 2: Percentage of students in your class likely to continue or not continue in the sciences by psychological measures on the PITS survey



### BIOL 1406 - Biological Concepts I (Biology for Science Majors I) – Traditional.

Surveys Completed: 24; Class Participation Rate: 104.3% of total enrollment, *Fall, 2016* WWW.CCUri.Org





#### **Traditional Laboratory Course**



#### Comparison of Figure 2 for a SEA-PHAGES Course and a Traditional Laboratory Course



**SEA-PHAGES** Course



#### **BIOL 1415 – Biotechnology II (SEA-PHAGE):** Surveys Completed: 7: Class Participation Rate: 47% of total

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#### BIOL 2421 – Microbiology I (PARE): Surveys Completed

23; Class Participation Rate: 96% of total enrollment, Spring,

A Little

Some

A Fair Amount

A Great Deal

ASSOCIAT

#### **CCURI URSSA Spring 2017 All Schools**



#### **CCURI URSSA Spring 2017-DMC**





experience?



1 2 3 4 5 5 7 8 8 5 8

COMMUNITY COLLEGE UNDERGRADUATE **RESEARCH INITIATIVE** 

How much did you GAIN in the following areas as a result of your most recent research





### You don't have to have a grant to start:

- Research Interests of Faculty
- Experienced Interns Working as Teaching Assistants
- Student's Proposed Projects
- Collaborating with Industry
- Extension of SEA-PHAGES or PARE

### Budget wise, UGR courses could be cheaper. Be prepared for more work!

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AC2 BIO-LINK REGIONAL CENTER www.ccuri.org





# AC2 Bio-link Regional Center

Carole Twichell Bridgette Kirkpatrick Ph.D Linnea Fletcher Ph.D











### Embedded Research

- Various course based research projects
  - Arabidopsis
  - C. elegans
  - Microbiology related projects
- They did not have enough structure to extend to a broader student population.











## Previously-Utilized CUREs

- PARE (Prevalence of Antibiotic Resistance in the Environment) Worked for Honors labs
  - Issues: Not enough content for a whole semester
  - Added extension activities to extend content
    - Kirby Bauer
    - Multiplex PCR
    - E-Test
- SEA PHAGES has enough content, but is not scalable for the masses











### How to reach more students

- Restricting research experience to select students is elitist
- We are not reaching all students who are gifted/interested
- We may very well be driving students out of science with our current "cookbook" biology labs
- PARE + extensions is appropriate, but prep-heavy
  - Also ran into biosafety issues (subculturing unknowns)
- Proposed model: analyzing cellulase activity in environmental samples and lab strains (double-blind)







## Going big!

### • Cellulase from environmental samples

- Accessible to all or many
- Real-world applications
- Inexpensive to scale for multiple classes/campuses
- Prep is limited (students take part in setting up experiments)
- Extensions are available for honors sections
- Expandable as our enrollment is continuing to increase
  - Currently ~4500 students per year









### Support



- Administration is supportive of faculty driven curriculum changes
- Faculty wax and wane in support
  - 2 steps forward 1 step back
  - We pilot new models and get initial buy-in
  - We get push back about whether faculty or students can perform advanced skills such as PCR and sequence analysis
  - Varied levels of experience amidst lab instructors is a problem
    - Potential solution: mandatory CE training for adjuncts?









### Things to consider

- When adapting or a new CURE:
  - Prep time, storage and cost-what appears simple on the surface, may not be scalable to more than 1 or 2 classes
    - Going from 1 to 40+ classes can be a game changer
  - Protocols-writing or re-writing in student friendly language
  - Identify allies and opponents-have solid data and an elevator speech
  - Instructors who will be teaching new labs
    - Training involved
    - Resistance to change
    - Technology (techniques and equipment) to be used









## Think Big! ACC Project

- College-wide Annual Poster Session
- Academic Undergraduate Research AND Workforce Internship Posters From High School (Dual Credit) Up through Two Year and Possibly Transfer to 4-Year

Invite Administrators and the Community to View Invite Industry and Academic Partners to Judge Have Students Emcee the Event!







### Questions





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