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Highlights of the NSF Sponsored Introductory Biology Project (IBP) Conference

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Abstract for DBER Group Discussion on 2013-02-14

Presenter, Department(s):

William Glider
Professor of Practice
School of Biological Sciences

Title:

Highlights of the NSF Sponsored Introductory Biology Project (IBP) Conference

Abstract:

I was invited to attend the Introductory Biology Project (IBP) conference in Washington, DC this past summer. The conference was funded by an NSF grant to Gordon Uno, University of Oklahoma and hosted by AAAS. I presented a poster dealing with aspects of my collaborative research with colleagues in the UNL Center for Instructional Innovation (CII) and also acted as a representative from ABLE (Association for Biology Laboratory Education). The conference was organized around three themes: Promoting Vision and Change, Implementing Vision and Change, and Evaluating Vision and Change. An overview of the content areas discussed at the conference will be presented and the following presentations will be discussed: *Are Academic Boot Camps Effective?* presented by Bill & Sheri Wischusen, LSU and *The Use of Peer-led Workshops Improves Student Learning* presented by Ralph Prezler, NMSU.



VISION AND CHANGE

IN UNDERGRADUATE BIOLOGY EDUCATION
A CALL TO ACTION

www.visionandchange.org



ADVANCING SCIENCE. SERVING SOCIETY

In 2007, the **American Association for the Advancement of Science (AAAS)** and the **National Science Foundation (NSF)** initiated a series of conversations with more than 200 faculty members, administrators, and other stakeholders from around the country, **seeking input on how to improve undergraduate biology education to better prepare all students for the biology-related challenges of the 21st century.** V&C report published 2011.

July 15-17, 2009,

- 500+ biology faculty from **two- and four-year** colleges and universities, researchers, **administrators, students** and other stakeholders in the future of undergraduate biology education met in Washington, DC for the Vision and Change Conference. Hosted by the AAAS, with support from the NSF and input from representatives of the Howard Hughes Medical Institute (HHMI) and National Institutes of Health (NIH),
- **the meeting set out to mobilize the nation's educators to ensure that the undergraduate biology they teach in their classrooms reflects the biology they practice in their labs and in the field.**
- The conference also developed recommendations to ensure that all students – **biology majors and those majoring in other fields – gain a better understanding of the nature of science and the natural world.**

Vision and Change Action Items

- Life sciences education must become a much more **active process** than is currently the case for too many students.
- Undergraduate biology education must become more **concept oriented** and concentrate more on **integrating factual knowledge within those concepts**. It is important not to consider factual content as the **sole basis** for undergraduate biology, **especially at the introductory level**.
- Similarly, we must reexamine the notion that the content and processes of science are separate, independent goals for student learning.

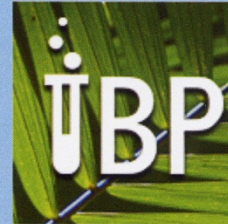
Future of the Vision and Change Initiative

I. What is **PULSE** (Partnership for Undergraduate Life Sciences Education)? www.aibs.org/education/pulseproject.html

- Spring 2012: NSF, NIH, and HHMI partnered to launch the PULSE program. Supporting the effort are Knowinnovation and the American Institute of Biological Sciences.
- The PULSE initiative will facilitate the systemic change that was identified as a national priority in the V&C report.

- Fall 2012: 40 Vision and Change Leadership Fellows were selected via peer review. Included are individuals **experienced in catalyzing undergraduate biology education reform at institutional, departmental, or divisional levels in the nation's colleges and universities.** The Fellows represent **research universities, regional or comprehensive universities, liberal arts colleges, and community colleges.**
- II. Second V&C Conference (*Chronicling the Changes*. will be held Fall 2013 – invitation only via peer reviewed abstracts

*Introductory Biology
Project Summer
Conference:*



Implementing Vision and Change at
the Introductory Biology Level

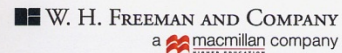
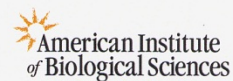
June 28th – July 1st, 2012

A conference held at the
American Association for the Advancement of Science
Washington, DC



NSF #0840911 RCN-UBE

Preparing to Prepare the 21st Century Biology Student:
Using Scientific Societies as Change Agents for the Introductory Biology Experience





Content no longer is king. The “march through chapters” of a textbook to glean and *memorize facts will no longer be measured by the AP test nor should it be taught in introductory biology courses*, said principal meeting organizer **Gordon Uno**, the David Ross Boyd Professor of plant reproductive biology and science education at the University of Oklahoma.

The new education paradigm focuses on **processes of scientific reasoning**. **Laboratory work will assume a new prominence** and, he said, it will shift from a teacher-directed orientation “**to students being more independent investigators**.”

Too much of what currently passes for **student involvement in research** uses them only to gather or input data. Uno called that “**misuse and abuse of student researchers**.” He believes they should also be involved in formulating hypotheses, analyzing the data, and every other facet of the research process.

IBP Conference

Two and one-half day major conference on the **Introductory Biology Experience** at the undergraduate level. In terms of teaching and *helping our students learn biology, what works, what doesn't, and how do we know?*

Meeting was organized around 3 themes

Promoting Vision and Change: what are new, or well-tested and effective, methods, materials, and practices for teaching Introductory Biology and helping students learn biology (identifying best practices, informative resources, useful professional development practices, and relevant research).

Implementing Vision and Change: how do we recognize and overcome the barriers to change and make use of the best practices that have been identified (widely-applicable resources, useful professional development, opportunities for funding, places for networking, relevant research). **Using scientific societies as change agents for the introductory biology experience.**

Evaluating Vision and Change: what are the methods and results of assessing both old and new materials and practices—*how do faculty know for themselves that something is helping their students learn?* How does the Biology community know that materials and methods (both old and new) are the best practices for themselves and their students

Why Did I Attend?

- Presented a Poster: *Strategies to Promote Student Learning in Large General Biology Lectures*
- Representative of ABLE (Association for Biology Laboratory Education) www.ableweb.org

Founded in 1979 to promote information exchange among university and college educators actively concerned with teaching biology in a laboratory setting. The focus of ABLE is to improve the undergraduate biology laboratory experience by promoting the development and dissemination of interesting, innovative, and reliable laboratory exercises.

"The Wheel of Biological Instruction in the United States; 200 Years of Reinvention!"

Marshall D. Sundberg
Botanical Society of America

A brief history of science education in the U.S.

- Most of the recent innovations in science education have been tried in the past with varying degrees of success
- Many of these innovations have been reinvented
 - sometimes more than once
- To be successful now, we should learn why past attempts did not succeed and attempt to avoid these problems

Amos Eaton
Senior Professor, the Rensselaer School.



*Amos Eaton: A pivotal person in the
teaching of American Botany*
Stuckey and Burke, 2000

Introduced the laboratory to science so students
can “...learn by doing- rather than the
conventional method of learn by rote.”

Eaton, 1827

[Each student required to make] a tour of about three weeks along the Erie Canal.
[to study botany, geology, civil engineering, and visit workshops, factories, and farms]

INTERDISCIPLINARY/QUANTITATIVE/SERVICE LEARNING

Amos Eaton, 1824

At the close of the term, each student is to give sufficient test of his skill and science before examiners...The examination is not to be conducted by question and answer; but the qualifications of students are to be estimated by the facility with which they perform experiments and give the rationale...

AUTHENTIC ASSESSMENT

Amos Eaton, 1829

[Men and women] Should always be educated together.

Experimental and demonstrative science should be introduced, with their application to the concerns of life."

UNDER-REPRESENTED/SCIENCE AND SOCIETY

Amos Eaton, 1824

In giving the course on chemistry, the students are to be divided into sections, not exceeding five in each section. These are not to be taught by seeing experiments and hearing lectures, according to the usual method. But they are to lecture and experiment by turns, under the immediate direction of a professor or a competent assistant.

PEER INSTRUCTION/ACTIVE LEARNING

Amos Eaton, 1829

All forenoon students should devote their whole time to the experimental and demonstrative course...they should be exercised by giving extemporaneous lecture, illustrated by their own experiments, or by demonstrative exhibitions, under the guidance of an assistant professor.

INQUIRY BASED LEARNING

Amos Eaton, 1831

Large text-books are not only unnecessarily expensive and exceedingly inconvenient, but they greatly retard the progress of learning....more attention [should be] given to reading and composition

COMMUNICATION SKILLS

Amos Eaton, 1820

Remember that you are to teach the *science of plants*; and that technical names are but a necessary incumbrance [sic], always to be avoided when it is possible to dispense with them.

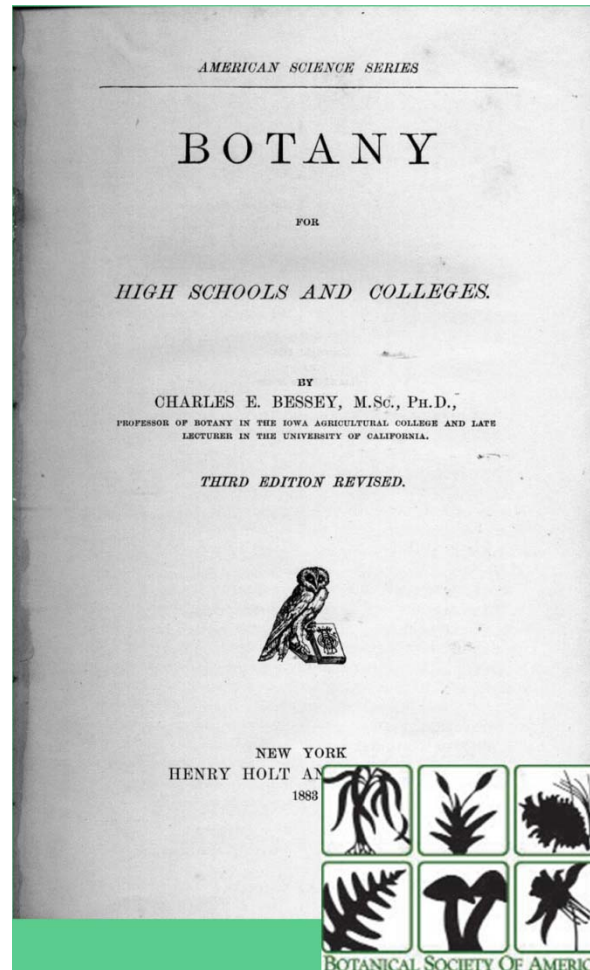
CORE COMPETENCIES/ MINIMIZE FACTS

Charles Bessey (1845–1915): The New Botany

Professor of Botany at UNL 1884 – 1911)

UNL Chancellor 1888 - 1900

President of AAAS - 1911



- 1880 Botany for High Schools and Colleges

AMERICAN SCIENCE SERIES, BRIEFER COURSE

THE ESSENTIALS OF BOTANY

BY

CHARLES E. BESSEY, PH.D.

Professor in the University of Nebraska

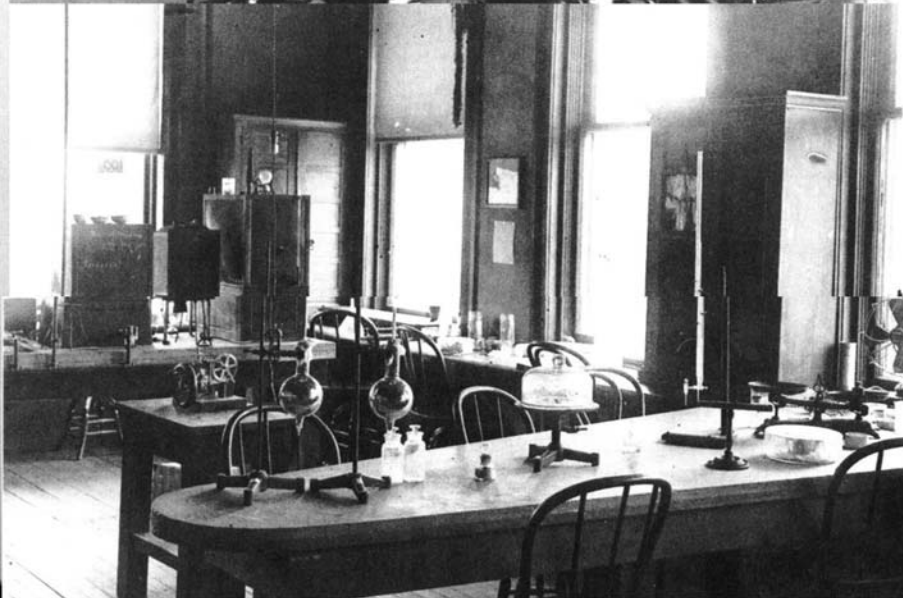
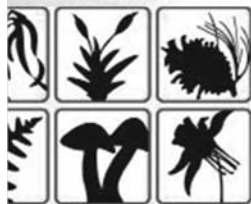
FIFTH EDITION, WITH AN INTRODUCTORY CHAPTER
AND AN APPENDIX



NEW YORK

HENRY HOLT AND COMPANY

1893.



“You will notice that in all this I have said--‘men.’ I have said so because I have found that when the demand comes, it is mostly for men. I do not know why this is so....Here is one thing that we ought to change. **The supply of competent women is much larger than of competent men, and I can assure you from experience in my own department that they make admirable instructors.**”

Charles E. Bessey, 1911, AAAS
Presidential Address

Replacing Lecture with Peer-led Workshops Improves Student Learning

CBE Life Sci Educ 2009 8:182-192



Preszler said. “We still have a performance gap, it’s just a tiny bit smaller. If we can make any progress, we feel that it’s worth it.”

I. The Course

BIOL 111G. Natural History of Life 3 cr. ; Biol 111GL 1 cr.)

Survey of major processes and events in the genetics, evolution, and ecology of microbes, plants and animals, and their interactions with the environment. Primarily a course for majors.

II. “Symptoms of a Problem”

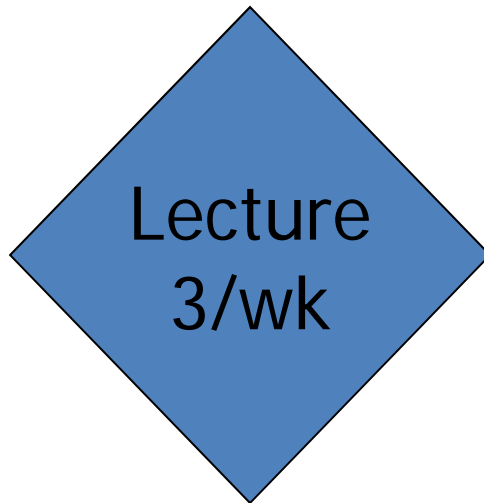
- Lecture Grades (BIOL 111: % of students F03-F06)

A	B	C	D	F	W
10	18	24	13	23	12

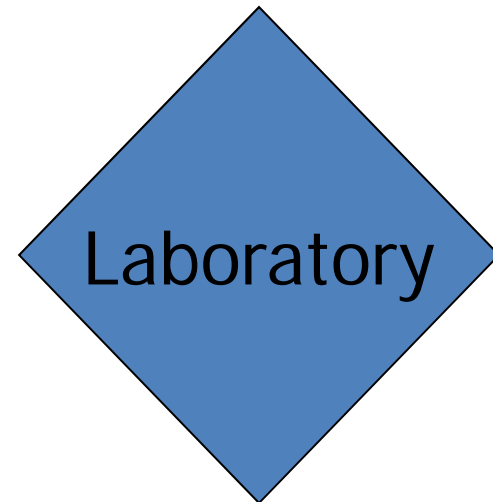
- 48% failing (D, F, or W) to meet increasingly low standards.

Original Course Structure

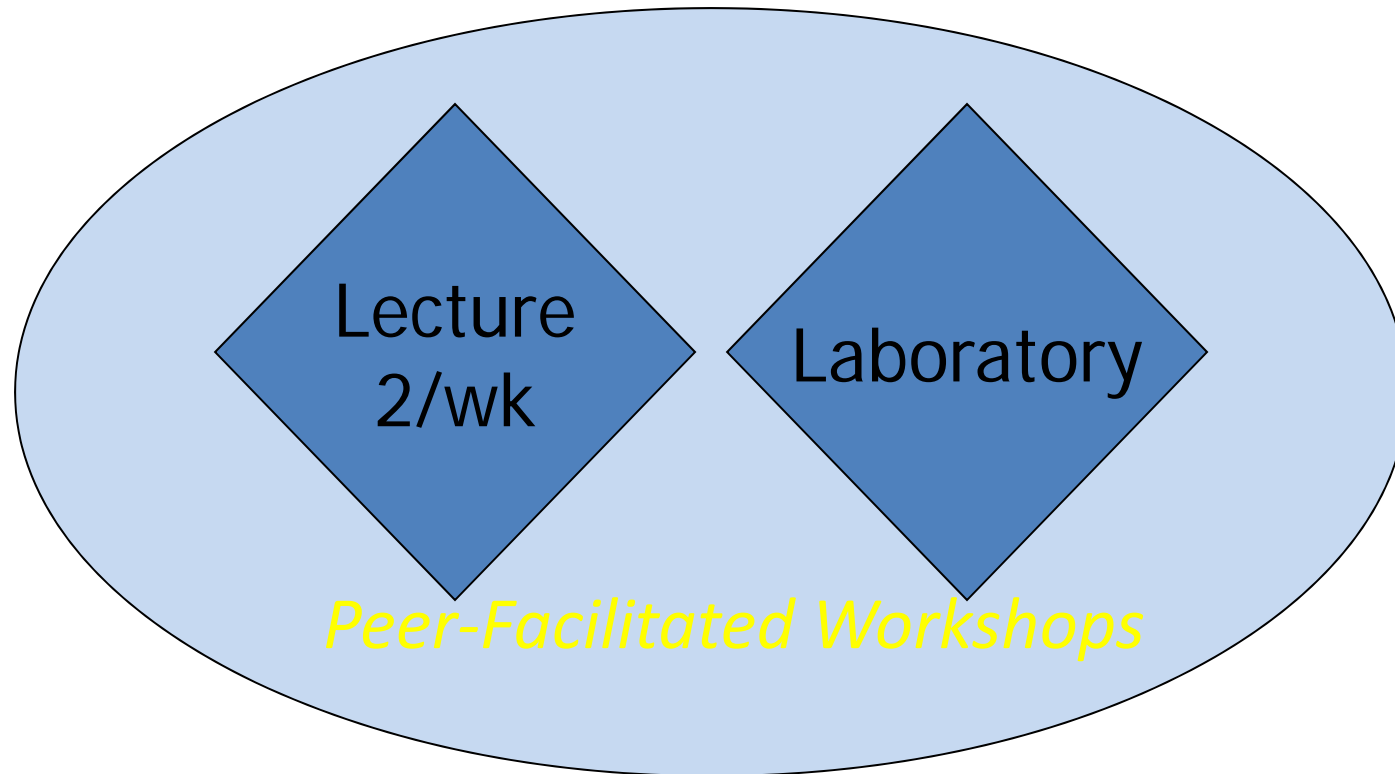
3 Lectures / week
Interactive
Clickers & WebCT
Faculty



1 / Week
Inquiry-based
Hypothesis testing
Grad. Student



Revised Course Structure: Spring 2007



III. Goals in Developing New Course Structure

- to increase students' general learning and critical-thinking skills, increase course-specific content acquisition, and facilitate more meaningful student learning.
- improving the performance of under represented minority (URM) students. 56.6% of the population in our Natural History of Life course are URM students.

IV. Peer Facilitated Workshops

- workshops contain an average of 19 students; held in small rooms
- workshop sessions last 65 min
- In the workshops, peer facilitators help cooperative groups of students work through challenging problems, case studies, and activities that promote the development of general learning skills.

V. Who are the workshop peer facilitators? BioCats =
Biology Learning Catalysts

- chosen based on their transcripts (students who had earned high grades in the Natural History of Life and subsequent science courses were preferred); written statement of their teaching and learning philosophy, and two interviews.
- BioCats are hired as juniors or seniors, so they are often rehired for two or three semesters.
- BioCats are paid \$1500/semester for 10 h of work per week to attend preparation meetings and lectures, prepare individually for their workshops, lead their two workshop sessions, and grade workshop reports.
- BioCats grade students' workshop reports

VI. Supporting Facilitators for the BioCats

- The weekly meetings are led by the **lecture instructor** with the help of a graduate teaching assistant.
- One teaching assistant, working up to 20 h/wk, was assigned to the course each semester. They helped with administering the course, tutoring students, and mentoring the BioCats.
- **Lecture instructors** are responsible for designing the workshop activities along with keys for the workshop activities, although the activities and keys were often refined in response to input from BioCats.

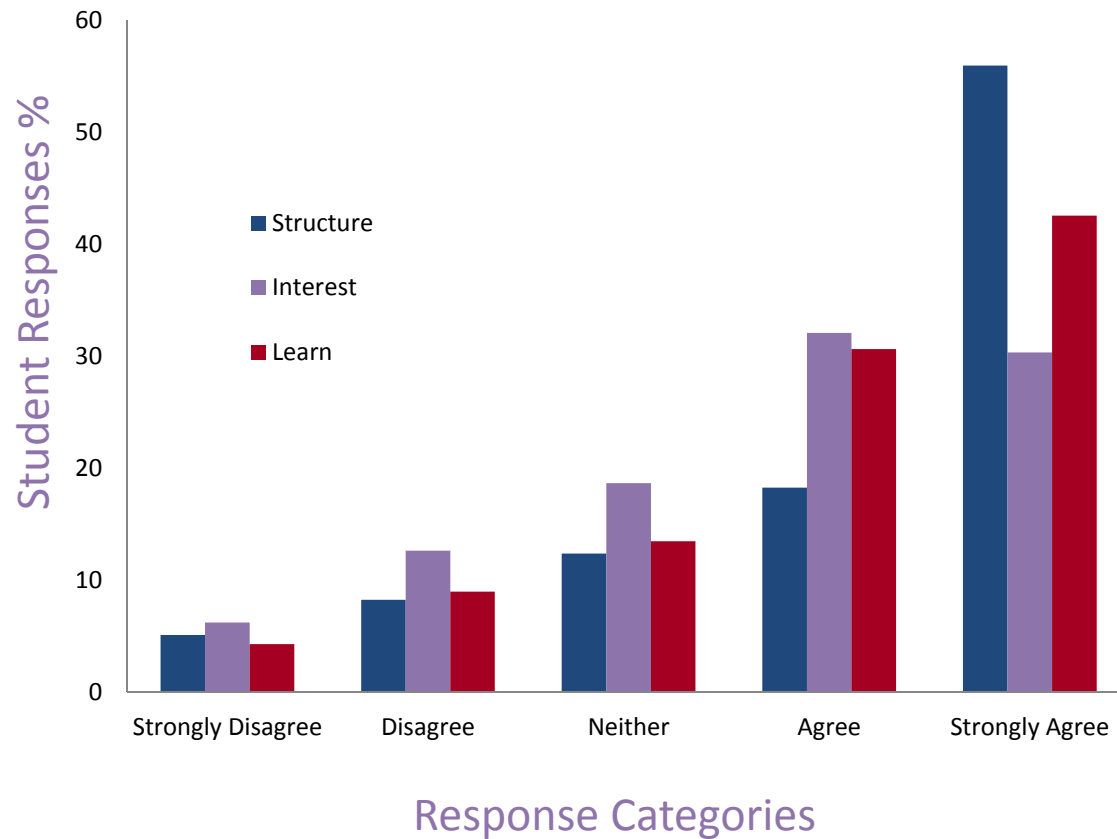
Assessment

- workshop course structure was assessed with student evaluations, longitudinal demographic analyses of course grades, a comparison of student performance on paired exam questions given in preworkshop semesters and workshop semesters, and an analysis of the quality of exam questions in preworkshop and workshop semesters.

Results

1. A majority of students preferred attending two lectures and a workshop each week over attending three weekly lectures.

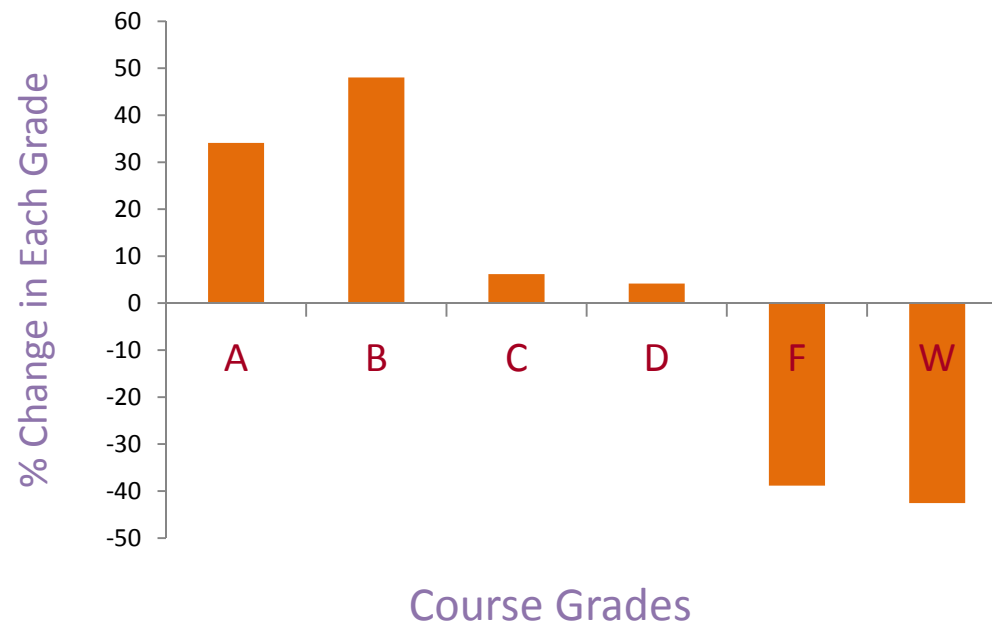
111 Student Survey Results



2. Grades were higher over three workshop semesters in comparison with the seven preworkshop semesters.

Did course grades improve: $\chi^2=93.70$, $p<0.001$

YES



3. Although males and females benefited from workshops, there was a **larger improvement of grades (measured by increase in A & B) and increased retention by female students**

- Male & Female Grades Improved
 - Female Improvement > than males
-

Females 47 %

Males 36 %



4. Although underrepresented minority (URM) and non-URM students benefited from workshops, there was a larger improvement of grades (measured by % increase A and B) by URM students.

- Both improved
- URM improvement > than non-URM

URM	49 %
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Non-URM	35 %
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5. As well as improving student performance and retention, the addition of interactive workshops also improved the **quality** of student learning:

- Student scores on exam questions that required higher-level thinking increased from preworkshop to workshop semesters.

Biology 111 Conclusion

Curriculum
Reform

- More Interesting
- Improves Learning
- Especially of female & URM students



Does it Work in Biol. 21

Curriculum Reform

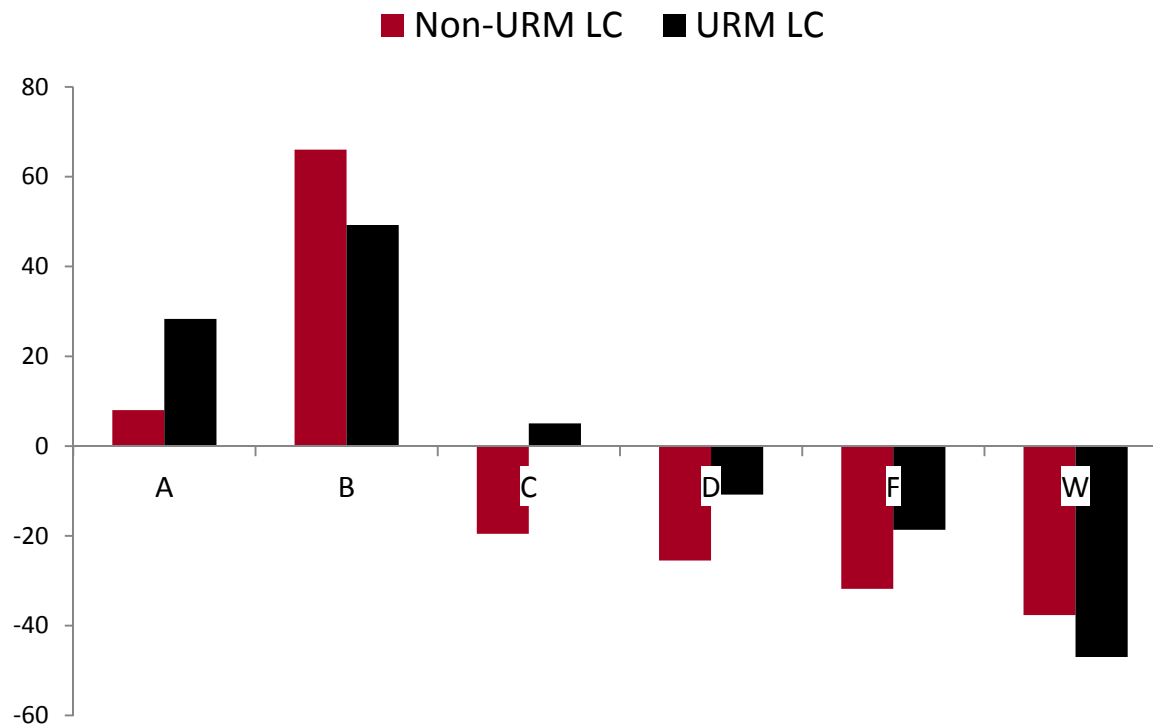
- Analyses of Grades;
Recycled Exam Questions
Normalized Learning Gains
- **NO!**
- Assembly-style lectures
with peer-led break-out case studies
Help Desk

Michele Shuster



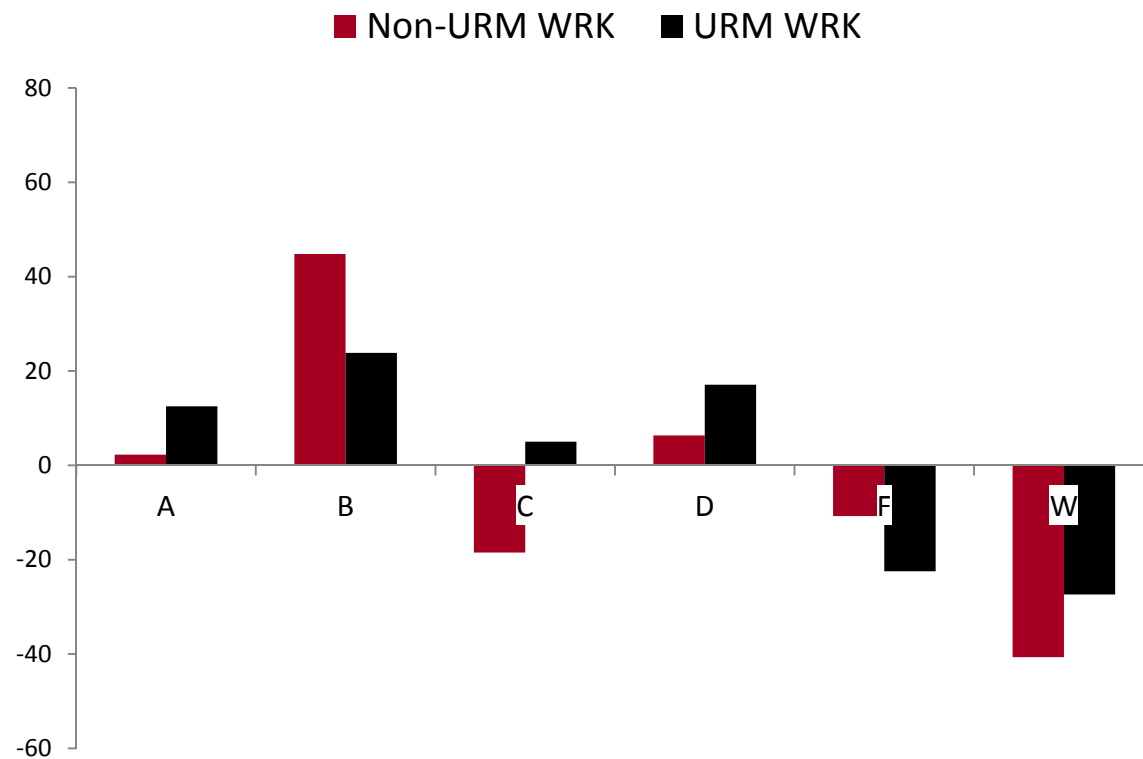
211: Lecture Case Studies: No Peers

% Improvement in grades of 2 c.s. sem.
compared to 5 earlier no-c.s. semesters



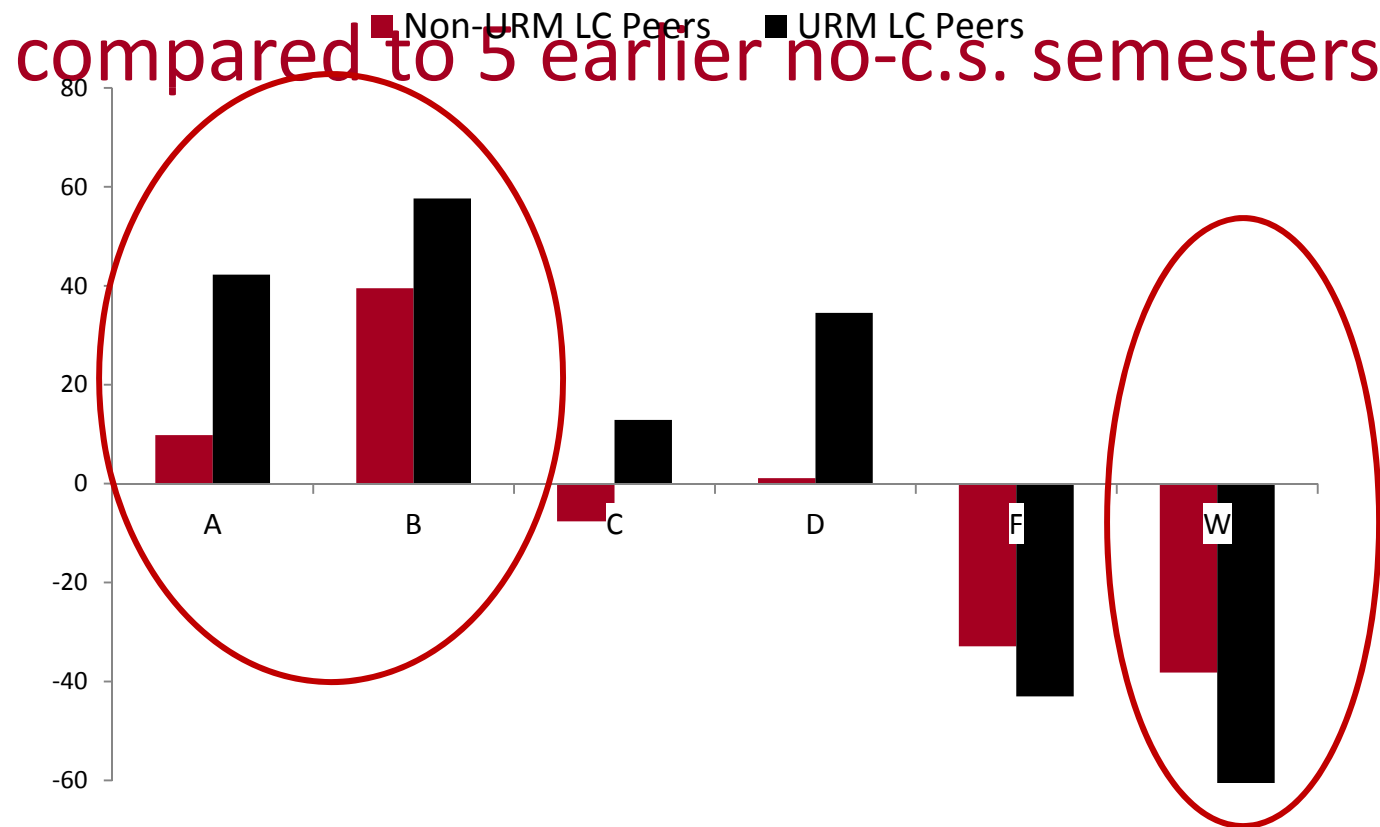
211: Workshops & Peers

% Improvement in grades of 5 workshop sem.
compared to 5 earlier no-c.s. semesters

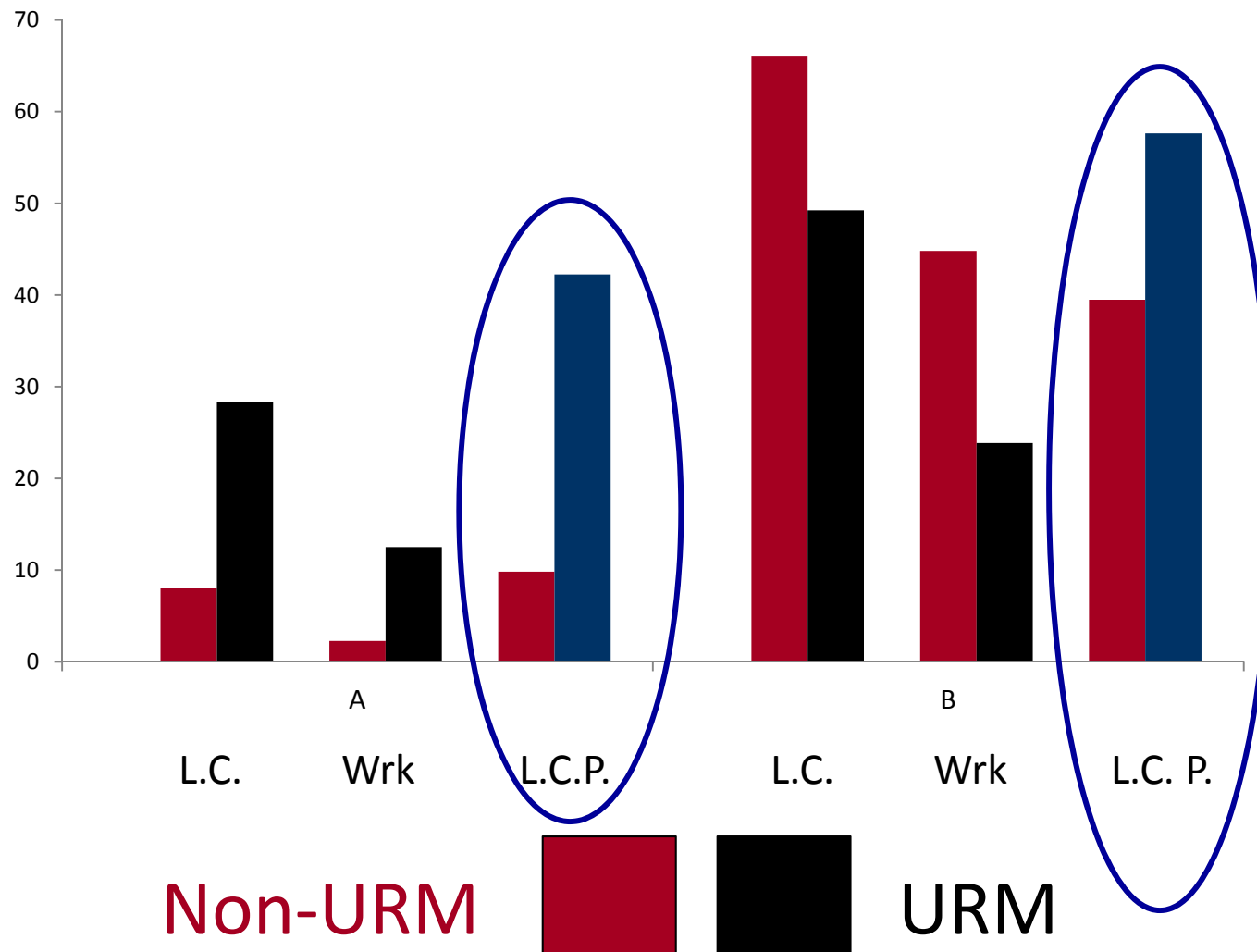


211: Lecture Case Studies + Peers

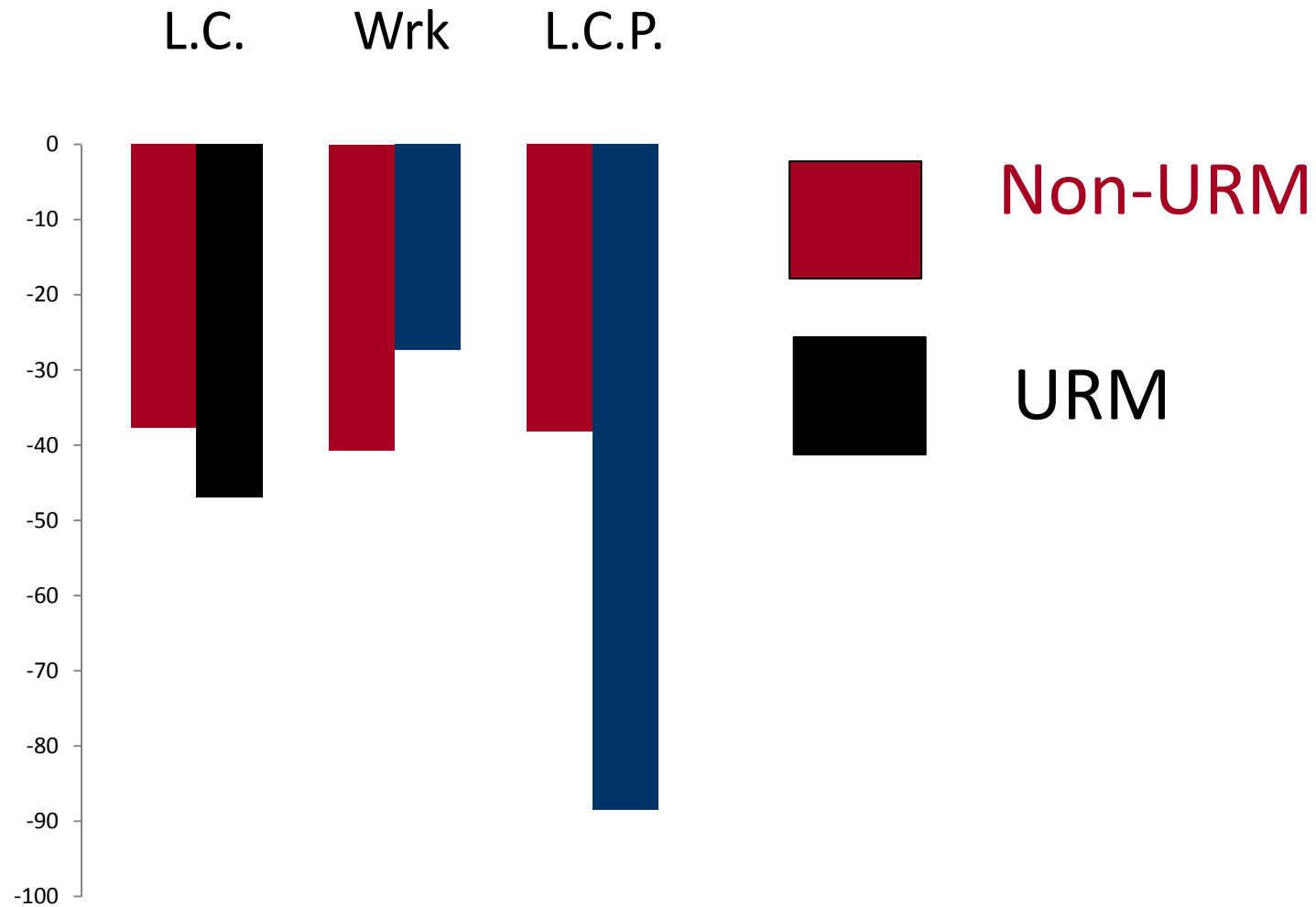
% Improvement in grades of 3 c.s. + peers
sem.



% Inc. in A's & B's



% Decrease in Withdrawals



Conclusions

- BIOL 111:
peer-facilitated workshops
less threatening learning environment
- BIOL 211:
peer-facilitated assemblies
more exciting learning environment
fine-scale integration of lect-...

