THANKS

Pete Niewiarowski-Co-PI

All Faculty who wrote labs (Ely, Fraser, Holda, Lavrentyev, Mitchell, Ott, Turner, Weeks, Duff)

TA's

Scott Orcutt

Lisa Shauver

Jeff Spencer

Richelle Laipply

Kathy Owens

Sue Robinson

FIRST-Faculty Institutes Reforming Science Teaching




Carousel-How do you make decisions about your teaching?

1) What was the last thing you changed in a course?
2) What led you to make that change?
3) How did you decide what to do with the change?

My reforms started with lecture…

- Current format is ~20 min lecture (Powerpoint, WebCT)
- ~20 min group exercise (self-selected groups, every day, graded once per week)
- ~10 min follow up

189 students

My assertion: Most biology labs are developed as a combination of inertia and history.

"Time is a precious commodity for faculty. Discussions of curriculum are often limited to who 'covers' what, an approach more suited to barn painting than to education. There is little to no discussion while planning what students should know and subsequently no searching exploration of how we discover what they have learned"

-Timothy Goldsmith, Dept Molecular, Cellular and Developmental Biology, Yale University

Science editorial 2002; 297:1769

Inquiry Labs: Background

IDEA: Can we make labs more like science?

FUNDING: NSF-CCLI

ADAPTATION: All labs based on our faculty's research

PROCESS:

- Summer 2001 develop labs
- 2001/2002 pilot labs
- 2002/2003 run labs with all sections

Goals

- Model the scientific process in lab (no 'cookbooks' allowed)
- Foster logical thinking skills
- Increase retention of Biology majors
- Increase participation of undergraduates in independent research with faculty (most students have no idea what we do)

Schedule

Fall

I:Introduction/Statistics
II:Pollination Biology (Randy Mitchell)
III:Proteins (Richard Londraville)
IV:Cell Motility (Don Ott)
V:Genomics (Monte Turner)
VI: Immunology (Jim Holda)
VII:Poster Session

WHERE IS THE TAXONOMY?

WHERE IS THE ANATOMY/ DISSECTION?

Spring

I: Introduction/Statistics
II: Variability and Natural Selection (Peter Niewiarowski)
III: Behavior (Steve Weeks)
IV: Land Plant Evolution (Joel Duff)
V: Photosynthesis (Lauchlan Fraser)
VI: Cardiovascular Physiology (Dan Ely)
VII:Poster Session

Format:

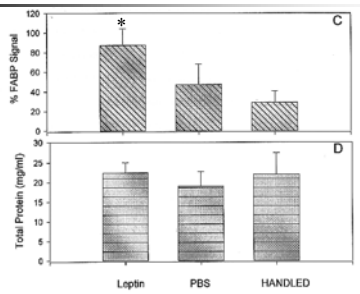
Week 1 –intro to technique, develop hypotheses and write proposal

Week 2-perform experiments, analyze & reduce data, interpret faculty data

Example:

Protein lab: Week 1 learn how to do a protein assay, how to make a standard curve, write a proposal for an experiment that involves protein concentration in worms, setup experiment

Week 2-collect your data, interpret and reduce the data, then look at Londraville's data



INCENTIVES

Group with best design/execution got bonus points at the end of a 2-week lab

For protein lab-supplemented worm soil with MGD and got a significant increase in protein concentration

POSTER SESSION

Each group chose their 'best' lab and constructed a poster (we gave them templates)

Each group member had to answer questions individually at poster session-

Also graded by 3 people separately

Then- all the "A" posters were voted on for "best poster" (bonus points)

ASSESSMENT

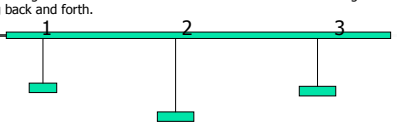
I. Group Assessment of Logical Thinking (GALT)

- Discipline-independent test of logical thinking skills in science
- Conservation, proportions, control variables, probability, correlations, combinations
- Used, validated, published for chemistry, geology
- Maximum score of 12-

bins students into Piaget classification:

"Concrete" thinkers (Piaget classification) score between 0-4, "Formal" thinkers between 8-12, and "Transitional" thinkers 5-7.

Three strings are hung from a bar. String 1 and 3 are of equal length. String 2 is longer. Charlie attaches a 5-unit weight at the end of string 2 and at the end of 3. A 10-unit weight is attached at the end of 1. Each string with a weight can be swung. Charlie wants to find out if the length of the string has an effect on the amount of time it takes the string to swing back and forth.

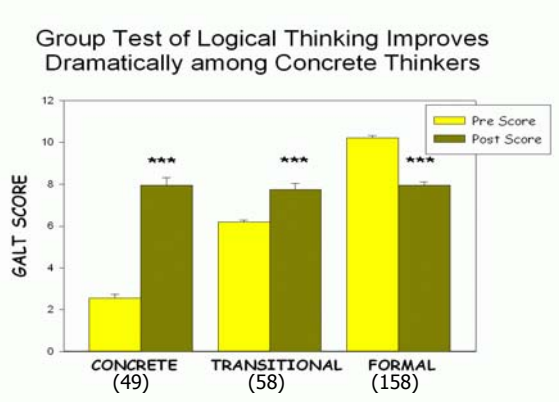


Which string and weight would he use for his experiment?

a) string 1 and 2
b) string 1 and 3
c) string 2 and 3
d) string 1,2 and 3

Reason?

a)The length of the strings should be the same. The weights should be different.
b) Different lengths with different weights should be tested.
c) All strings and their weights should be tested against all others.
d) Only the longest string should be tested. The experiment is concerned with length not weight.
e) Everything needs to be the same except the length so you can tell if length makes a difference



Other Assessments

Biology Self-Efficacy Instrument (measures "students' self-reported confidence in understanding and using biology in their lives"; Baldwin et al., 1999).

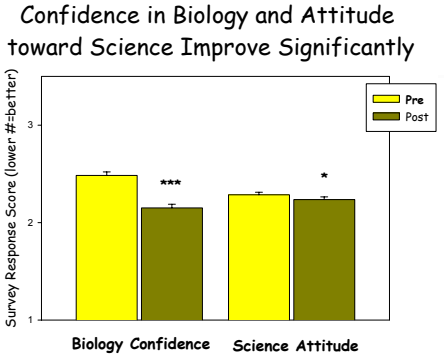
How confident are you that you could ask a meaningful question that could be answered experimentally?

1-totally confident
2-very confident
3-fairly confident
4-only a little confident
5-not at all confident

Test of Science Related Attitudes an instrument designed to measure students' attitudes toward the social implications of science, normality of scientists,attitude toward scientific inquiry, adoption of scientific attitudes, enjoyment of science classes, leisure interest in science, and career interest in science (Fraser, 1981).

Scientists do not have enough time to spend with their families

1) strongly agree
2) agree
3) not sure
4) disagree
5) strongly disagree



(n=273)

Commonly science courses have a negative effect on attitude toward science

•Freshman Bio Majors attitude starts higher than non-majors, but majors attitudes decline and non-majors improve, also non-majors scored higher on content comprehension than majors-- content was decreased in non-majors class

Sundberg et al., 1994. J. Res. Sci. Teach. 31(6): 679-693

•Attitude toward Biology did not change or declined over semester

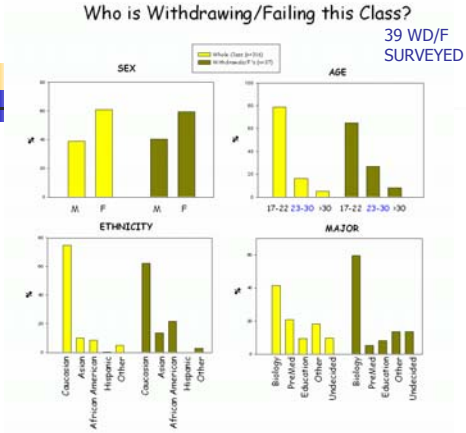
Mitchell and Simpson, 1982. J. Res. Sci. Teach. 19: 459-468

•No improvement in attitude toward science in introductory Biology

Murphy 1968. Sci. Education 52: 148-162

Who is Withdrawing/Failing this Class?

39 WD/F SURVEYED



RETENTION

Were you a Biology major at the beginning of this class?

Fall 1998- 70%

Spring 1999- 66%

Fall 2002- 62%

After this class, do you consider yourself a Biology major?

Fall 1998- 46% (24% drop↓)

Spring 1999- 51% (15% drop↓)

Fall 2002- 67% (5% increase↑)

But not all good news…

"This lab was more frustrating than it was helpful in my understanding of biology. Whenever I would ask a question I felt as if the TA's sometimes did not know the answer either. The labs were handed to us and we were left on our own to finish them."

"I feel we needed more time to work with the excel program before we were responsible for handing in work dealing with that program"

"I was very disappointed with this lab class. The TA's were of no help in teaching us. Any time my group would ask --- a question about certain misunderstandings of the lab --- would not provide us with help. --- would in turn say to us 'what do you think'?"

"I would like it if the lab were less computer stuff and more biology stuff"

In general complaints about too little organization, explanation, computer use, TA prep (biology knowledge)

What's In this for ME?

- •Most of us want to be more effective teachers
- •LOTS of students introduced to your research
- •SYNERGISTIC activities (for granting agencies)
- •NSF Criterion II

CONCLUSIONS

- •Labs model Biology research and feature our faculty
- •Student's logical thinking skills, confidence in Biology, and attitudes toward Science improve significantly
- •Retention of Biology majors improves significantly