First-year Undergraduate Scientific Research Experiences

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Early Research Experiences

• Make the textbook come to life
• Students participate in excitement of discovery
• Many studies show positive effect on STEM retention
• Students become excited about science (again).

Difficulties

• Often grant-cycle driven
• Integration into curriculum
  – Often add-on courses
• Faculty buy-in
  – Teaching credit
  – Expense
  – High activation barrier
• Expense
• Others...

Plug-and-Play Dynamic Genome Approach

1. Build it and they will come...
The Sandbox

Renovated Teaching Space
2. The Plug and Play model

Dynamic Genome Course
- 3 Hours per session twice per week
- 10 weeks
- 10 units credit – Replacement for long standing intro lab (5LA)
- 24 students/section

Two Parts
- 4 weeks of background — Common to all projects, taught by staff
- 1 week transition experiment — Provided and taught by faculty
- 4 weeks guided research project — Provided and taught by faculty

Course management, logistics, lab prep provided by staff
- Reduced buy-in from faculty
- Reduced time commitment

Weeks 1-4

- Background
  - Genetic Information Transfer
    - cDNA versus genomic DNA for Actin
    - DNA Sequence analysis (BLAST)
  - PubMed
  - Genome Polymorphism
    - PCR Amplification of maize gene from many strains
    - DNA Sequence analysis (MSA)
  - Goals
    - Improve background
    - Learn and master skills
    - Interpret data

Week 5

- Transition piece
  - Introduce organism
  - Introduce new techniques
  - Experimental design

- Plant Dynamic Genome
  - Transposable elements

Weeks 6-10

- Guided Research Project
  - Developed from research lab
  - Development guided by learning goals/objectives
    - Remember the end product is the student not the data
  - Objectives
    - Master experimental design and question
    - Master data analysis
    - Apply to other biological problems
    - Publishable data is a bonus
Example Projects

• Transposable elements (Burnette and Wessler)
  – Verification of new insertions
  – Methylation of near-by genes
• Phenotypic analysis and verification of TF Knock-outs in Neurospora
  transcriiion factor knock-outs
• Phenotypic analysis of RNAi knock-down in planaria and C. elegans.
• GPCR receptors in mosquito sperm
• ????

Program Evaluation

• Reduced buy-in
• Faculty are excited to “play”
• External evaluation on STEM retention ongoing
• Internal evaluation on value to students (Graduate School of Education)

Program evaluation

CURE

• Impact of ten-week course equivalent to 10 week summer REU (CURE survey) (Burnette and Wessler 2013)

Other “Plugs”

• CNAS Learning Communities
  – Adds research component
  – STEM career awareness
  – Further research opportunities
• Collaborations
• Outreach
• Greater Impacts

Difficulties Revisited

✓ Grant-cycle driven
✓ Course is funded multiple through “Greater Impacts” of research grants
✓ Lab Fee
✓ Integration into curriculum
  ✓ Equivalent credit for intro lab
✓ Faculty buy-in
  – Teaching what they love
  – Low Expense
  – Low activation barrier

Funding

Large, One-time
• Facility -- Donor and UCR
• Equipment – HHMI Professor grant and UCR

Low, On Going
• Supplies
  Lab Fee ($50)
  Great Impacts
• Salary for instructors
Synergies

• Grant support due in part to the Campbell Lab and DG Course

  ➢ NSF-STEP Grant: SL-Cure
  ➢ HHMI Institutional: SALSA
  ➢ USDA-HSI: DG Summer Scholars

DG Electronic Laboratory Notebook

DG ELN

• Free, open-source software
  — WordPress
  — MySQL
• All data included
• Accessed using Web Browsers
• FERPA compliant
• Collaborative
  — Graders provide quick feedback
  — Students share and study from each others entries

Thank You!

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