

# Be a Scientist, Do Practical Science: Teachers Explore Marine Biotechnology and Bioinformatics



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# Background / Context

- NSF / ITEST grant
- Information technology applied to marine biology = Marine Biotechnology and Bioinformatics for Teachers
- 3-week summer workshop
- Science teachers of underrepresented student populations
- PBL design



# The Workshop: Overview

- Goal

- develop the teachers' ability to assimilate high-level, scientific, and technological information and procedures and break it down into teachable chunks suitable for the middle- and high-school students in their classrooms.



# Workshop: Design

- Objectives

- PBL context

- Identify the invader mussel species (*mytilus galloprovincialis*)

- Theory to practice

- Real science experiences

- New technology exploration

- Application to lesson plans for their students



# Design

- Two previous summer workshops without teaching & learning component
- 15-days woven with three content areas: biotechnology, bioinformatics, and lesson planning
- Focus on teachers' application to their own curriculum
- See the video clip



# Schedule

- Week 1: Begin Biotechnology and Wet Lab / Intro to Bioinformatics / Intro to PBL Teaching
- Week 2: Continue DNA Biotechnology / Begin Bioinformatics / Write Lesson Plans
- Week 3: Teachers Implement Group Lesson Plans with Students
- See the schedule for graphical organization of content areas



# Schedule

## WEEK 1 Begin Biotechnology and Wet Lab / Intro to Bioinformatics / Intro to PBL Teaching

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 AM	Overview & intros & evaluations	Collect mussels (8 am = 0 tide)	Finish DNA extractions	Restriction digestion PPT & ITS digest set up	Set up Glu PCRs
10:00 AM	Pretest			ITS digest paper exercise	Glu primer paper exercise
	Break	Break	Break	Break	Break
11:00 AM	Tracking mussels presentation, part I	Mussel dissection review & dissect mussels	Load DNA gel	ITS digest on website and virtual gel	Glu primer computer exercise
	Lunch	Lunch	Lunch	Lunch	Lunch
1:00 PM	Tracking mussels presentation, part II	DNA extraction PPT	Quantifying DNA PPT & analyze DNA gel	Load ITS gels	Load Glu gels
2:00 PM	General lab skills & lab conduct discussion	Gel electrophoresis PPT & gel loading exercise	Quantify DNA and make working stock	Webquest and project based learning	DNA seq. viewing & editing with Chromos
3:00 PM	Practice lab skills pipetting exercise				Webquest and PBL
	Break	Break	Break	Break	Break
4:00 PM	Mussel dissection PPT		PCR PPT & Set up ITS PCR	Webquest and PBL	Webquest and PBL
4:30 PM	Review today and plan tomorrow	Review today and plan tomorrow	Review today and plan tomorrow	Review today and plan tomorrow View ITS gels	View Glu gels Review today and plan Monday
5:00 PM	End	End	End	End	End

# Schedule

Week 2 Continue DNA Biotechnology / Begin Bioinformatics / Write Lesson Plans

	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 AM	Set up CO3 PCRs	Load aliquot on gel	Align sequences w/ Clus	Compare nucleotide & protein trees	Start working with own sequences
10:00 AM	Mitochondria vs. nucleus PPT & exercise			View 3D proteins - Cn3D	
	Break	Break	Break	Break	Break
11:00 AM	Paper DNA priming exercise	Prep for commercial DNA sequencing discussion & DNA sequencing PPT	Creating phylogenetic trees w/ Drawtree	High-end bioinformatics	continue
	Lunch	Lunch	Lunch	Lunch	Lunch
1:00 PM	Load CO3 PCR gels	View and analyze gel	Translation & Open Reading Frames-ORF finder	Intro to Japanese lesson study	continue
2:00 PM	Are whales hippos? exercise	Genbank and Blast searches	Align Proteins w/ Clustalx	Use of camcorders	
3:00 PM	Break	Break	Break	Break	Break
	Lesson planning on related thematic topics	Lesson planning on related thematic topics	Lesson planning on related thematic topics	REFLECTION TIME	Scope and sequence for lessons
4:00 PM	Review today and plan tomorrow		Use of digital cameras		Using Skype for Web conferencing
4:30 PM	View CO3 gels	Review today and plan tomorrow	Review today and plan tomorrow	Review today and plan tomorrow	Review today and plan week 3
5:00 PM	End	End	End	End	End

Special Evening Dinner Event

# Schedule

Week 3 Teachers Implement Group Lesson Plans with Students

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	Monday	Tuesday	Wednesday	Thursday	Friday
9:00 AM	Lesson Group 1: Collecting Mussels	Lesson Group 2: Dissection in Wet Lab	Lesson Group 3: Gel electrophoresis	Field Trip to Biotechnology	Lesson Group 4: Invasive Marine Species
10:00 AM					
11:00 AM					
	Lunch	Lunch	Lunch		Lunch
1:00 PM	Hands-on Learning Activity	Hands-on Learning Activities	Hands-on Learning Activities		Hands-on Learning Activities
2:00 PM					
3:00 PM					
	Break	Break	Break		Break
4:00 PM					
4:30 PM					
5:00 PM	End	End	End	End	End

# Transparent ISD

- Team-planning model used within lesson plan groups
- Microteaching exercise for lesson implementation
- Japanese Lesson Plan protocol for evaluation
- Templates for lesson plan and instructional materials
- Formative evaluation (multiple levels)



# Integrated Technology

- Modeled (explicitly) how to teach science labs with technology
- Modeled (explicitly) teaching with computers
- Use of FTP sites to store group materials



# Lesson Plan Template

- Template based on WebQuest model with additional fields for standards and STEM career options
  - View lesson plan [template](#)



# Teacher Lesson Plans

- View examples of individual and group lesson plans:
  - Fingerprint DNA [≧](#)
  - Mussel Madness [≧](#)
  - Gellin' [≧](#)
  - Shore Bird [≧](#)



# Workshop: Technologies

## Biotechnology

- Gel electrophoresis
- PCR
- Commercial DNA sequencing

## Bioinformatics

- Blast
- GenBank
- Chromas



# Emerging Technologies

- Skype for telecomm.
- Web conferencing
- Blogging
- Podcasts
- Audacity
- Captivate for presentations
- Online survey: Zoomerang, SurveyMonkey
- Online Rubric: Discovery School House, Rubistar
- Online Quizzes: QuizStar



# Evaluation

- Formative evaluation focused on lesson plans and implementation
  - Application of new knowledge and skill
  - Student feedback
  - Peer feedback
- Assessment of biotech and bioinfo knowledge:
  - pre-test/post-test



# Results

- Participant satisfaction high
- Doing science like real scientists is cool
- Improved wet lab and research skills
- Lesson plan development challenging, but worthwhile



# Recommendations

- Keep immersive PBL scenario
- Add more instructional support for learning science and developing lesson plans
- Give more time for lesson plan development
- Increase technology support



# Best Practices

- Make ISD transparent
- Use project-based learning immersion
- Allow participatory groups
- Integrate new science knowledge via lesson plan development during the workshop
- Practice the lesson plan, collect feedback, and revise it for improvement
- Use formative evaluation at 3 levels: program, peer, and student



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