Using a Model Systems Workshop to Teach Undergraduate Cell Biology

Triscia W. Hendrickson[1] and Fran Norflus[2]
[1]Biology Department, Morehouse College, Atlanta, GA 30314
[2]Department of Natural Sciences, Clayton State University, Morrow, GA 30260

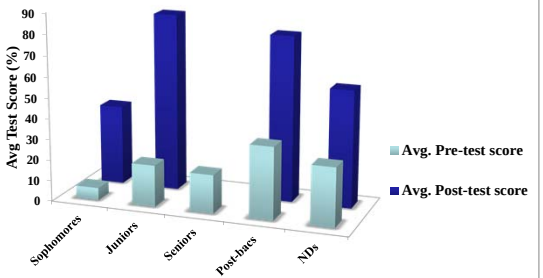
ABSTRACT

Numerous schools have integrated active learning approaches into their biology classes to replace or enhance the traditional setting where the professor stands in front of the room and lectures. These new approaches are more student than faculty centered and have been shown to be more effective than passive learning. One such example of this type of approach is in having students participate in laboratory research experiences outside the classroom. In many cases, this can occur early on in the student's career. These experiences enhance the development of critical thinking skills and communication skills. In addition, courses in laboratory research may stimulate students to become interested in science. These courses try to link the knowledge that students gain in traditional classes with the practice of performing laboratory research. At many schools, it is difficult to accommodate many students doing research due to a limited budget and resources of the school as well as faculty time. To overcome this obstacle, schools have been trying to incorporate laboratory research or the methods that researchers use into the curriculum. In the present study, we have organized and held a workshop on model systems in cell biology. Our goals were to introduce undergraduate students, especially those in the beginning levels of their careers, to model systems. We hoped that this experience would build critical thinking skills in the students and we hoped to interest students in pursuing a career in cell biology research. To improve their communication skills, we taught the student how to present their work through posters and explained that this is how scientists present their work. The effectiveness of the workshop was assessed using pre- and post-tests. There were 17 participants in the 2-week workshop and although the average attendance was only four days, there was a 33% gain in knowledge.

Table 1. Schedule and topics covered in the workshop

Model Systems in Cell Biology Workshop - WEEK 1: June 20 - 24					
	Monday (Jun 20)	**Tuesday (Jun 21)**	**Wednesday (Jun 22)**	**Thursday (Jun 23)**	**Friday (Jun 24)**
9:00	Introductions and workshop overview	Intro to bacterial transformation	Select transformants and induce expression	Pick colonies from RNAi transformed bacteria. Inoculate LB/Amp/Tet with transformed bacteria	Introduction to *Chlamydomonas reinhardtii*
10:00	Pre-test	Bacterial transformation	Make up LB broth + Amp/Tet		
11:00	Lab safety				Start liquid cultures of Chlamy
12:00	L	U	N	C	H
1:00	Prepare and autoclave Nematode Growth Media (NGM)	Math Calculations	Purify expressed Protein and analyze by SDS-PAGE and Western	Scientific Communication (lecture)	Chunk and stage worms
2:00		Add bacteria to NGM agar plates; prep for tomorrow			Work on posters
3:00	Math Calculations				
4:00	Pour plates				
Model Systems in Cell Biology Workshop - WEEK 2: June 27 - July 1					
	Monday (Jun 27)	**Tuesday (Jun 28)**	**Wednesday (Jun 29)**	**Thursday (Jun 30)**	**Friday (Jul 1)**
9:00	Chlamy deflagellation experiment / IF of flagellar proteins	Complete staining of Chlamy cells and prep slides	Wash worms off plates and transfer to plates with RNAi bacteria	Observe RNAi worm plates and mutant worm plates (dissection microscopes)	Observe RNAi and mutant worms (fluorescent microscope)
10:00					
11:00					
12:00	L	U	N	C	H - closing luncheon
1:00	Chlamy phototaxis and swimming analyses Bleach worms	Visualization of flagellar proteins in Chlamy (fluorescent microscope)	Introduction to yeast as a model system (lecture)	WORK ON POSTER	
2:00					Post-test
3:00	Bleach worms				
4:00	Culture and induce bacteria				

Figure 4. Average Pre-and Post-test scores of participants according to their classification.



SUMMARY

- Model systems provide an effective mechanism for teaching undergraduates cell biology
- Although the post-bacs were more knowledgeable initially, the juniors gained more knowledge.

Figure 1. *Chlamydomonas* photoaccumulation assay

Figure 2. SDS-PAGE of recombinant proteins

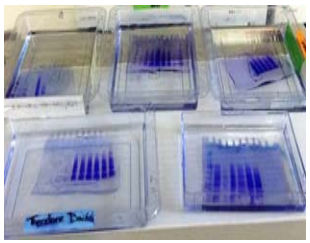


Figure 3. Workshop participants conducting experiments

Table 2. Results of Pre- and Post-tests

Classification	# of days attended	Pre-test (100)	Post-test (100)
Sophomore	1	7	NT
Sophomore	3	5	24
Sophomore	2	15	26
Sophomore	10	10	65
Junior	8	11	89.5
Junior	8	29	81
Senior	2	17.5	NT
Senior	1	19.5	NT
BS, biology	1	38.5	NT
BS, biology	1	43.5	NT
BS, biology	10	53.5	82.5
BS, biology	4	22.5	NT
BS, biology	10	16	76
ND	1	20	71.5
ND	5	34	54
ND	1	31	43.5
ND	1	2	NT

ND – classification not disclosed
NT – post-test was not taken

Figure 5. Workshop participants

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