

COSEE-OS
Teaching Science by Ocean Inquiry
A Summer Workshop

July 17-21, 2006

Evaluation Report

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October 2006

EXECUTIVE SUMMARY

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Daily questionnaires and an End-of-Course evaluation form provided the data for this evaluation. Follow-up interviews of all participants are planned for January of 2007 to assess the long term impact of the workshop. The data collected during the five day summer workshop support the findings below.

- Fourteen participants out of 40 applicants came from 5 middle schools and 8 high schools from Maine, New Hampshire, Pennsylvania, and Tennessee. Participants were selected on the basis of their geographic location, their teaching experience, their specific interest in the ocean, and their motivation for attending the workshop.
- All participants expected and gained knowledge about the physical processes of the ocean and how these processes can be linked to teaching science in schools. They also gained experience with specific hands-on lab demonstrations that could be used for their classes.
- The workshop was perceived as very useful and relevant by most of the participants. Most indicated that they would apply the workshop concepts and lab experiences in their future teaching.
- The accommodations, facilities, and food were positively rated . However, there were problems with wireless connection to the laptop computers.
- Participants rated the organization of the workshop very highly with a different topic each day presented in three different sessions; lectures, hands-on labs, and pedagogical discussions. Some suggested that labs could be at night after the pedagogical discussion, and that pedagogical discussions could be held in the morning so they could have free time in the evening.
- Participants liked the topics included in the workshop. Because of the differences in their backgrounds, the grade levels and subjects they teach, additional explanations were suggested. Participants suggested that definitions of formulas and symbols should be better explained at the beginning of the sessions. Topics were sometimes too technical and presented in greater depth than was required for school-level science. Some topics were not clear for those who did not have physics background.
- Instructors were always very responsive to questions. A few participants indicated that occasionally there was not sufficient time for questions and dialogue.
- A majority of participants were very satisfied with the pedagogical discussions however, a few were critical of these sessions.
- Demonstrations, lab exercises, and hands-on activities were the most helpful aspects of the workshop to all participants. Participants indicated that they were most likely to use inquiry-based, hands-on activities on the topic of Density in their future teaching. They also indicated that they will use more inquiry labs and less ‘cookbook’ labs in the future.
- The workshop was very effective in promoting interaction among participants. Many were interested in sharing their experiences with other teachers both in and outside their schools. Most of the participants were interested in contributing to a website and sharing information with others.
- Participants expected some type of boat experience in order to test ocean concepts and were disappointed that this was not part of the workshop which was held on the ocean shore.
- Overall, the workshop ratings were very high. All participants gained new knowledge of ways to teach science through ocean processes.

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INTRODUCTION

With a National Science Foundation (NSF) award, the School of Marine Sciences, the College of Education and Human Development at the University of Maine, and the Center for Ocean Sciences Education Excellence - Ocean Systems (COSEE-OS) offered a 5-day summer workshop for science teachers at the Darling Marine Center in Walpole, Maine, in July 2006. The workshop was led by two faculty members from the School of Marine Sciences and one faculty member from the College of Education and Human Development at the University of Maine. Fourteen teachers from middle schools and high schools in Maine, New Hampshire, Pennsylvania and Tennessee participated in the workshop.

EVALUATION METHOD

A questionnaire was administered to participants before the workshop to assess their knowledge of selected ocean-related concepts, their confidence in their knowledge of concepts that they did not teach, and their expectations for the workshop (Appendix A). This questionnaire also served to inform the workshop leaders about the instructional needs of participants, the teaching strategies used by participants with their students, and the skills their students were expected to gain.

Participants were also asked to complete a rating scale each day related to the topic presented in lecture, lab and pedagogical sessions (Appendix B). An End-of-Course Evaluation was also completed by all participants (Appendix C). This report summarizes participants' responses to these instruments. The findings in this report have been compiled from participants' responses to these questionnaires. To determine the extent to which the summer workshop experience has influenced the content and format of their teaching participants will be interviewed in January, 2007.

Tables of frequencies, mean scores, and standard deviations are presented in this report along with the summaries of selected results. Not all participants responded to all questions and all participants did not attend all sessions. Missing responses and those judged to be spurious are not included in the analyses.

CHARACTERISTICS OF THE RESPONDENTS

Table 1 describes the participants. Out of 40 applicants, 15 workshop participants were selected by the instructors on the basis of geographic location (Maine, other states, coastal/inland), grade span (middle school/high school), years of teaching experience, specific interest in the ocean, and motivation for attending. One participant did not attend resulting in a total of 14 participants. States represented by the participants included Maine (11), New Hampshire (1), Pennsylvania (1), and Tennessee (1). Ten of the participants were females, four were males. Ten were above age 39. Teaching experience of the participants ranged from one to 28 years. There were nine high school and five middle school teachers among the participants.

Table 1. State, Gender and Age of the Participants

Age	Maine			Outside Maine			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
20-29	1	1	2	0	0	0	1	1	2
30-39	0	1	1	0	1	1	0	2	2
40-49	2	3	5	0	0	0	2	3	5
50 and above	0	3	3	1	1	2	1	4	5
Total	3	8	11	1	2	3	4	10	14

DAILY RATINGS

Each day of the workshop was organized around a daily topic which was presented in three sessions; lecture, lab, and pedagogical discussion. Participants were asked to rate each daily topic on nine, five point Likert scales which ranged from 1 (*Strongly disagree*) to 5 (*Strongly agree*), to provide explanations of ratings below 4, and to offer suggestions for improvement. Two rating scales, “*there was too much content in this session*” and “*the pace of this session was too fast*”, were negative characteristics and were expected to yield low ratings. In addition to the frequencies, mean scores, and standard deviation of responses, representative comments and suggestions of participants for each session are briefly summarized in each section below. Verbatim listing of participants’ comments and suggestions are included in Appendix D.

DAY 1.

FLUIDS AND SOLIDS, HYDROSTATIC PRESSURE

Lecture Session

Table 2 summarizes the participants’ ratings of the first days’ lecture. Participants gave very high ratings to nearly all items on the rating scale. The End-of-Course Evaluation confirmed these highly positive ratings which were supplemented with comments such as, “liked lecture, lab, and pedagogical set up.” Confusion about the supplemental reading materials or lack of such materials may explain the low number of participants who rated this item.

Table 2. Participants' Ratings
Lecture Session: Fluids and Solids, Hydrostatic Pressure

	Strongly disagree					Strongly agree		Mean	Std. Deviation	Total
	2	3	4	n	n					
This session was relevant to my teaching.	0	0	4	8	2	3.86	.663	14		
This session provided useful materials/ideas that I can use.	0	1	3	7	3	3.86	.864	14		
What I learned in this session will affect the way I teach this topic.	1	2	3	5	3	3.50	1.225	14		
This session helped me link physical concepts to ocean processes.	0	0	5	6	3	3.86	.770	14		
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	1	4	0	3.80	.447	5		
The instructor was responsive to questions.	0	0	0	1	13	4.93	.267	14		
There was too much content in this session.*	6	2	3	3	0	2.21	1.251	14		
The pace of this session was too fast.*	6	1	7	0	0	2.07	.997	14		
There was a good balance among the three sessions.	0	1	3	5	5	4.00	.961	14		

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note: Reversed ratings.

Comments of the participating teachers from middle schools indicated that lecture material was less useful for their students, but it enhanced their own knowledge. One controversial issue raised by participants was, “The content was heavy on formulas and assumed knowledge on the part of the participants. So it was too much too fast for some.” However, one participant wrote, “Too much content? Absolutely NOT! You are working with a wide range of abilities and needs, as in any classroom; more is better than less.” Another participant reported that the link between hydrostatic pressure and ocean science was not discussed. Some participants suggested that instructors explain the formulas and concepts in more detail, in layman terms, using one or more examples.

Lab Session

All participants *strongly agreed* that the instructor was very responsive (Table 3) during the lab session. A high mean score indicates that the lab session provided useful materials/ideas and was relevant to the teaching of most participants. At least ten participants indicated that the pace of this session was not too fast and nine *strongly agreed* that the content was appropriate. The reading materials were generally rated as a valuable supplement to teaching, but ratings ranged from 3 to 5 by the six participants who rated this item indicating a range of perceptions.

In comparing the participants' ratings among day one sessions, the lab session had the highest positive scores on this topic.

Table 3. Participants' Ratings

Lab Session: Fluids and Solids, Hydrostatic Pressure

	Strongly disagree					Strongly agree		Mean	Std. Deviation	Total
	n	n	n	n	n					
This session was relevant to my teaching.	0	0	0	6	8	4.57	.514	14		
This session provided useful materials/ideas that I can use.	0	0	0	7	7	4.50	.519	14		
What I learned in this session will affect the way I teach this topic.	0	0	1	7	6	4.36	.633	14		
This session helped me link physical concepts to ocean processes.	1	1	4	5	3	3.57	1.158	14		
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	2	2	2	4.00	.894	6		
The instructor was responsive to questions.	0	0	0	0	14	5.00	.000	14		
There was too much content in this session.*	9	2	3	0	0	1.57	.852	14		
The pace of this session was too fast.*	10	0	3	1	0	1.64	1.082	14		
There was a good balance among the three sessions.	1	1	2	4	5	3.85	1.281	13		

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note: Reversed ratings.

A few of the participants commented that not enough time was allotted for the lab work. It was suggested that more equipment was needed so that more than one group could do the same lab at the same time. A few participants, teachers of biology and zoology, needed more guidance while doing experiments due to their lack of physics background. Comments also indicated there was no link to the ocean and “lab hand-outs were skeletal.”

Pedagogical Discussion

Pedagogical discussion of this topic was as positive as other sessions. All participants *strongly agreed* that the instructor was very responsive to all questions. The materials for this topic were rated as valuable supplements by those who responded to this item. Table 4 indicates that the session was perceived as relevant and provided useful materials/ideas to more than half of the participants. Half of the participants also *agreed* or *strongly agreed* that this session will affect the way they teach the topic. More than half of the participants *strongly disagreed* that there was too much content in this session and that the pace was too fast. It is interesting that responding participants varied in their opinion when asked if the session helped link physical concepts to ocean processes. Seven participants disagreed with this statement, four indicated agreement and two were neutral.

Table 4. Participants’ Ratings

Pedagogical Discussion: Fluids and Solids, Hydrostatic Pressure

	Strongly disagree					Strongly agree			Std. Deviation	Total
	n	n	n	n	n	Mean				
This session was relevant to my teaching.	0	0	6	6	2	3.71	.726		14	
This session provided useful materials/ideas that I can use.	1	1	5	4	3	3.50	1.160		14	
What I learned in this session will affect the way I teach this topic.	0	3	4	5	2	3.43	1.016		14	
This session helped me link physical concepts to ocean processes.	4	3	2	2	2	2.62	1.502		13	
The reading materials for this topic (if provided) were valuable supplements to my teaching.	1	1	1	5	3	3.73	1.272		11	
The instructor was responsive to questions.	0	0	0	0	14	5.00	.000		14	
There was too much content in this session.*	8	3	2	0	0	1.54	.776		13	

The pace of this session was too fast.*	9	3	1	0	0	1.38	.650	13
There was a good balance among the three sessions.	0	4	1	4	3	3.50	1.243	12

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note: Reversed ratings.

Respondents commented that the pedagogical discussion was “excellent, could have been longer” and “we did not have time to develop much of a discussion.” One of the comments was about being “tired by the day’s end, sick of sitting, tired of listening, and not energetic enough to talk.” One suggestion for improvement was “an introduction on basics of inquiry learning would be appropriate.” More discussion on questions about the readings and overhead points were recommended. Seating arrangements for the discussion were perceived as needing improvement. One of the suggestions was to “make truly a circle – not an arc centered on the teacher.”

Suggestions

When asked about any content that should be added or eliminated on the topic of the day, many respondents reported they were confused with the terms and symbols being used, and they needed concrete examples. When asked for suggestions, some respondents complained about sitting in the chair all day being very uncomfortable and also wanted tables so they may shuffle papers. One of the items they wanted was a paper punch available to organize materials received. One respondent also requested a three ring binder with handouts that were three-hole punched.

Verbatim comments of participants related to the lecture, lab and pedagogical sessions on day one are included in Appendix D.

DAY 2

BUOYANCY AND SINKING/TEMPERATURE AND HEAT

Lecture Session

The second day’s lecture was focused on Buoyancy and Sinking plus Temperature and Heat. All respondents *agreed* or *strongly agreed* that the instructor was responsive to questions and the lecture helped them link physical concepts to ocean processes (Table 5). Their ratings were very high for the lecture being relevant and providing materials/ideas useful to their teaching. The reading materials provided were a valuable supplement to their teaching for the six participants who responded to the question. The majority of participants indicated they were satisfied with the pace and content of the session. They also reported a good balance between the three sessions of the day.

Table 5. Participants' Ratings
Lecture Session: Buoyancy and Sinking/Temperature and Heat

	Strongly disagree	2	3	4	Strongly agree	Mean	Std. Deviation	Total
	n	n	n	n	n			
This session was relevant to my teaching.	0	1	2	6	5	4.07	.917	14
This session provided useful materials/ideas that I can use.	0	1	1	7	5	4.14	.864	14
What I learned in this session will affect the way I teach this topic.	0	0	3	7	3	4.00	.707	13
This session helped me link physical concepts to ocean processes.	0	0	0	5	9	4.64	.497	14
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	2	2	2	4.00	.894	6
The instructor was responsive to questions.	0	0	0	2	12	4.86	.363	14
There was too much content in this session.*	7	4	1	2	0	1.86	1.099	14
The pace of this session was too fast.*	8	1	2	2	1	2.07	1.439	14
There was a good balance among the three sessions.	0	0	2	6	6	4.29	.726	14

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree

*Note: Reversed ratings.

Workshop participants seemed to be more at ease and had better interactions on the second day of the workshop. However, in their comments one participant commented that the lecture was... “too difficult for most of us to follow, hence not useful for planning class activities.” Another reported, “Basic information was good but the focus on the formulas again lost me.” Participants also suggested, “It would be nice to receive material before lecture and lab.” “Math was above my level of teaching” was one of the issues.

Lab Session

This lab session received very high ratings on all nine items. One participant *agreed* and 13 participants *strongly agreed* that the instructor was responsive to questions (Table 6). The responding participants indicated that the reading materials were valuable supplements to their

teaching. All but one participant *agreed* or *strongly agreed* that the session helped them link physical concepts to ocean processes.

Table 6. Participants' Ratings
Lab Session: Buoyancy and Sinking/Temperature and Heat

	Strongly disagree					Strongly agree		Std. Deviation	Total
	n	n	n	n	n	Mean			
This session was relevant to my teaching.	0	0	2	5	7	4.36	.745	14	
This session provided useful materials/ideas that I can use.	0	0	1	5	8	4.50	.650	14	
What I learned in this session will affect the way I teach this topic.	0	0	3	6	4	4.08	.760	13	
This session helped me link physical concepts to ocean processes.	0	0	1	9	4	4.21	.579	14	
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	3	3	2	3.88	.835	8	
The instructor was responsive to questions.	0	0	0	1	13	4.93	.267	14	
There was too much content in this session.*	9	2	1	2	0	1.71	1.139	14	
The pace of this session was too fast.*	9	2	1	2	0	1.71	1.139	14	
There was a good balance among the three sessions.	0	0	1	6	5	4.33	.651	12	

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note: Reversed ratings.

The lab on *Buoyancy and Sinking* was complemented for being a “nice mix of different activities at varying levels of comprehension/application.” “Doing a brief summary/demo of each lab activity was very helpful. It also encouraged more whole-group discussion and interaction.” While many understood the link of physical concepts to ocean processes, one respondent did not see and understand this connection on some lab exercises. The person was not sure if it was because he/she did not have the necessary background.

Pedagogical Discussion

All participants *agreed* or *strongly agreed* that the instructor for pedagogical discussion was responsive to questions (Table 7). The reading materials were rated as valuable supplements by the participants who responded. Seven participants *agreed* or *strongly agreed* that the session helped them link physical concepts to ocean processes. Three *disagreed* or *strongly disagreed* that this pedagogical session made this link. All participants also agreed that there was not too much content in this session and that the pace was not too fast. Participants had different opinions regarding pedagogy being specific to ocean concepts. While many felt the discussion helped them link physical concepts to ocean processes, only one participant *strongly disagreed* that it helped.

Table 7. Participants' Ratings
Pedagogical Discussion: Buoyancy and Sinking

	Strongly disagree					Strongly agree		Std. Deviation	Total
	n	n	n	n	n	Mean			
This session was relevant to my teaching.	0	1	2	6	4	4.00	.913	13	
This session provided useful materials/ideas that I can use.	0	1	3	6	3	3.85	.899	13	
What I learned in this session will affect the way I teach this topic.	0	1	3	5	3	3.83	.937	12	
This session helped me link physical concepts to ocean processes.	1	1	4	5	2	3.46	1.127	13	
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	3	3	2	3.88	.835	8	
The instructor was responsive to questions.	0	0	0	3	9	4.75	.452	12	
There was too much content in this session.*	9	2	1	0	0	1.33	.651	12	
The pace of this session was too fast.*	10	2	1	0	0	1.31	.630	13	
There was a good balance among the three sessions.	0	1	1	4	5	4.18	.982	11	

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree

*Note: Reversed ratings.

Overall, the participants indicated that the pedagogical session presented “generally good, useful information.” One of the respondents reported, “Subgroup was good idea but

sharing of starting ideas not useful in the beginning.” When asked about suggestions for improvement, some respondents wanted the readings to be given before the discussion. One respondent suggested that he would prefer a morning session instead of meeting after dinner. Another suggested that further discussion about imagining/facilitating different levels of inquiry would be useful.

Suggestions

When participants were asked if there was any content that should be added or eliminated, one reported “all good stuff today.” One comment was, “higher level physics was not necessary for most.” Another comment was, “I would find more reference to marine mammals very much a ‘hook’ for class.”

When asked about other suggestions for the day, one of the participants asked for allowing more, “downtime” for participants. “We are in a beautiful location and would like the chance to explore/enjoy it as well as learn our content.” The suggestion was to finish the day at 5:00 pm or allow a greater chunk of time after lunch for trips, swims, paddles, and work on the lesson plans, or do readings for the discussions. One of the participants suggested that two copies of the labs be provided – one on which to take notes and one to use for photocopying.

Verbatim comments of participants related to the lecture, lab and pedagogical sessions on day two are included in Appendix D.

Day 3

Waves and Tides/Light, Sound, and Instrumentation

Lecture Sessions

There were two lectures on this day which compressed the time available for lab activities. As with other sessions, all participants found instructors to be very responsive to their questions (Tables 8 and 9). Both lecture sessions helped the participants link physical concepts to ocean processes. The reading materials provided for these lectures were rated as valuable supplements to their teaching by the five responding participants. Although participants had varied opinions about the lectures being relevant to their teaching and affecting the way they teach this topic, the majority of participants *agreed* or *strongly agreed* that they were relevant and useful.

Table 8. Participants' Ratings

Lecture 1: Waves and Tides/Light, Sound, and Instrumentation

	Strongly disagree	2	3	4	Strongly agree	Mean	Std. Deviation	Total
	n	n	n	n	n			
This session was relevant to my teaching.	1	2	3	4	4	3.57	1.284	14
This session provided useful materials/ideas that I can use.	0	1	3	5	5	4.00	.961	14
What I learned in this session will affect the way I teach this topic.	1	2	1	3	6	3.85	1.405	13
This session helped me link physical concepts to ocean processes.	0	0	1	5	7	4.46	.660	13
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	2	1	2	4.00	1.000	5
The instructor was responsive to questions.	0	0	0	2	11	4.85	.376	13
There was too much content in this session.*	4	3	0	5	2	2.86	1.562	14
The pace of this session was too fast.*	4	3	2	4	1	2.64	1.393	14
There was a good balance among the three sessions.	2	2	5	3	2	3.07	1.269	14

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree

*Note: Reversed ratings.

Table 9. Participants' Ratings

Lecture 2: Waves and Tides/Light, Sound, and Instrumentation

	Strongly disagree	2	3	4	Strongly agree	Mean	Std. Deviation	Total
	n	n	n	n	n			
This session was relevant to my teaching.	1	0	4	4	4	3.77	1.166	13

This session provided useful materials/ideas that I can use.	0	1	3	5	4	3.92	.954	13
What I learned in this session will affect the way I teach this topic.	0	1	3	3	5	4.00	1.044	12
This session helped me link physical concepts to ocean processes.	0	0	1	5	6	4.42	.669	12
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	1	2	1	4.00	.816	4
The instructor was responsive to questions.	0	0	0	2	9	4.82	.405	11
There was too much content in this session.*	4	3	0	4	2	2.77	1.589	13
The pace of this session was too fast.*	4	3	1	4	1	2.62	1.446	13
There was a good balance among the three sessions.	2	2	2	2	3	3.18	1.537	11

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note reverse direction wording in these items

Overall, most respondents gave positive ratings to all nine items for both lectures. However, participants differed widely in their ratings of items related to the amount of content and the pace of the sessions.

In narrative comments some participants indicated that the lectures were not relevant to their current teaching, especially in middle schools, however they also indicated that the topics were relevant to their interests and important for them to review. One of the participants was very excited and wrote, “Relevant to teaching – all new things change who I am and how I approach teaching, not just what is directly connected to my content. I had some ‘Oh, wow’ moments today – that excitement is as important as content.” Another participant reported that the concepts related to waves and sound/light which were presented were useful and the information related to tides was interesting.

Some participants suggested a slower pace as they were lacking significant background on these topics. Another suggestion was to “do more demos or interactive visuals – just to get people out of seats.”

Lab Sessions

Many participants commented that there was not enough time for the lab sessions after the two lectures and therefore responses to the lab session rating forms were minimized. The responses received are summarized in Table 10. Some participants rated the lab sessions based

on the short time available, and others chose not to rate the labs at all. All participants who responded indicated generally positive ratings of the lab sessions.

Table 10. Participants' Ratings

Lab 1 and Lab 2: Waves and Tides/Light, Sound, and Instrumentation

		Strongly disagree					Strongly agree		Std. Deviation	Total
		n	n	n	n	n	Mean			
This session was relevant to my teaching.	Lab 1	0	0	2	2	1	3.80	.837	5	
	Lab 2	0	0	2	2	2	4.00	.894	6	
This session provided useful materials/ideas that I can use.	Lab 1	0	0	0	4	1	4.20	.447	5	
	Lab 2	0	0	1	2	3	4.33	.816	6	
What I learned in this session will affect the way I teach this topic.	Lab 1	0	0	2	0	3	4.20	1.095	5	
	Lab 2	0	0	1	3	2	4.17	.753	6	
This session helped me link physical concepts to ocean processes.	Lab 1	0	0	1	1	2	4.25	.957	4	
	Lab 2	0	0	1	3	1	4.00	.707	5	
The reading materials for this topic (if provided) were valuable supplements to my teaching.	Lab 1	0	0	1	1	0	3.50	.707	2	
	Lab 2	0	0	2	0	1	3.67	1.155	3	
The instructor was responsive to questions.	Lab 1	0	0	0	0	5	5.00	.000	5	
	Lab 2	0	0	0	0	6	5.00	.000	6	
There was too much content in this session.*	Lab 1	3	0	1	1	0	2.00	1.414	5	
	Lab 2	3	0	2	1	0	2.17	1.329	6	
The pace of this session was too fast.*	Lab 1	3	0	1	1	0	2.00	1.414	5	
	Lab 2	3	0	1	2	0	2.33	1.506	6	
There was a good balance among the three sessions.	Lab 1	0	1	2	1	0	3.00	.816	4	
	Lab 2	0	2	2	1	0	2.80	.837	5	

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree

*Note: Reversed ratings.

Pedagogical Discussion

Seven of the 11 participants *strongly agreed* that the instructor was responsive to questions during the pedagogical session (Table 11). All who responded indicated that the reading materials were valuable supplements to their teaching. Nine participants *agreed* or *strongly agreed* the pedagogical discussion was useful and relevant to their teaching. Four of the eight participants indicated that the session helped them link to the ocean processes while four were neutral.

Table 11. Participants' Ratings

Pedagogical Discussion: Waves and Tides/Light, Sound, and Instrumentation

	Strongly disagree	2	3	4	Strongly agree	Mean	Std. Deviation	Total
	n	n	n	n	n			
This session was relevant to my teaching.	0	1	2	6	3	3.92	.900	12
This session provided useful materials/ideas that I can use.	1	0	2	6	3	3.83	1.115	12
What I learned in this session will affect the way I teach this topic.	0	1	2	6	2	3.82	.874	11
This session helped me link physical concepts to ocean processes.	0	0	4	2	2	3.75	.886	8
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	1	2	3	4.33	.816	6
The instructor was responsive to questions.	0	0	2	2	7	4.45	.820	11
There was too much content in this session.*	7	3	1	0	1	1.75	1.215	12
The pace of this session was too fast.*	8	2	1	0	0	1.36	.674	11
There was a good balance among the three sessions.	0	2	1	4	3	3.80	1.135	10

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree

*Note: Reversed ratings.

One of the participants commented that the pedagogical discussion “was not specific to ocean concepts.” Another comment was, “discussions are much too teacher-centered.” Among the suggestions for improvement, some wanted to have discussions before lectures in the morning instead of at night. They also recommended providing an opportunity for more sharing of ideas as some of the participants had experience in these areas.

Suggestions

The ratings and comments indicate that participants did not feel there was a good balance of three sessions. “The day was too heavily weighted towards the lecture sessions.” It was also suggested that lectures were delivered too fast and were “very technical.” However, one of the participants wrote, “This has been a great conference so far. Thanks.”

Participants commented that some of the materials on wave velocity and Fourier decomposition were a bit difficult to understand. They also needed “more explanation of tides to clarify things like superposition of various component variables” and “more information on color and polarized light.” They suggested that providing a sheet of formulas and symbols in addition to the content of the lectures would be helpful.

Verbatim comments of participants related to the lecture, lab and pedagogical sessions on day three are included in Appendix D.

Day 4

Mixing

Lecture Session

The day’s workshop minimized lecture time to provide more lab time. A maximum of nine participants responded to the daily rating form indicating, perhaps, that all participants did not attend the lecture session. All participants *strongly agreed* that the lecture session instructor was responsive to questions. All participants *agreed* or *strongly agreed* that the session helped link physical concepts to ocean processes (Table 12). Participants differed in their opinion about the balance among the three sessions.

Table 12. Participants’ Ratings

Lecture Session: Mixing

	Strongly disagree	2	3	4	Strongly agree	Mean	Std. Deviation	Total
	n	n	n	n	n			
This session was relevant to my teaching.	0	1	3	3	2	3.67	1.000	9
This session provided	0	1	1	5	2	3.89	.928	9

useful materials/ideas that I can use.							
What I learned in this session will affect the way I teach this topic.	0	1	2	4	2	3.78	.972
This session helped me link physical concepts to ocean processes.	0	0	0	2	7	4.78	.441
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	1	1	1	4.00	1.000
The instructor was responsive to questions.	0	0	0	0	9	5.00	.000
There was too much content in this session.*	3	3	3	0	0	2.00	.866
The pace of this session was too fast.*	3	2	3	1	0	2.22	1.093
There was a good balance among the three sessions.	1	1	2	3	1	3.25	1.282

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree

*Note: Reversed ratings.

One of the comments relating to the lecture was, “We did not spend much time on lecture today, which would have been useful to my understanding of these topics.” Although their ratings on the statement “whether there was a good balance among the sessions” were varied, it is clear from their comments that participants expected a balance each day of lecture, lab and pedagogical discussion. Some were unhappy about too much lecture one day and too much lab another day.

Lab Session

All participants *strongly agreed* that the lab instructor was responsive to the questions and *agreed* or *strongly agreed* that the session helped link physical concepts to ocean processes (Table 13). This lab session received very high marks on all nine items except one that related to balance among sessions for which ratings varied widely.

Table 13. Participants’ Ratings

Lab Session: Mixing

Strongly disagree	2	3	4	Strongly agree	Mean	Std. Deviation	Total

This session was relevant to my teaching.	0	1	2	7	4	4.00	.877	14
This session provided useful materials/ideas that I can use.	0	1	1	8	4	4.07	.829	14
What I learned in this session will affect the way I teach this topic.	0	1	2	7	4	4.00	.877	14
This session helped me link physical concepts to ocean processes.	0	0	0	5	9	4.64	.497	14
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	2	2	3	4.14	.900	7
The instructor was responsive to questions.	0	0	0	0	14	5.00	.000	14
There was too much content in this session.*	10	1	3	0	0	1.50	.855	14
The pace of this session was too fast.*	8	2	3	1	0	1.79	1.051	14
There was a good balance among the three sessions.	1	2	1	3	3	3.50	1.434	10

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note: Reversed ratings.

One of the comments about this lab session was that lab hand outs were skeletal. One respondent indicated that the lab without lecture made it difficult to understand the topics. It was also suggested that more details on how to use apparatus in inquiry would be helpful.

Pedagogical Discussion/Guest lecture:

There was no pedagogical discussion session as on other days. Instead, The Director of Outreach for the Bigelow Labs did a presentation and led a tour. Some of the participants used the pedagogical session rating form to rate these experiences. Others chose not to rate this session at all. The ratings that were made are summarized on Table 14.

Table 14. Participants' Ratings

Guest Lecture

	Strongly disagree					Strongly agree		Std. Mean	Deviation	Total
	n	n	n	n	n					

This session was relevant to my teaching.	2	0	1	1	2	3.17	1.835	6
This session provided useful materials/ideas that I can use.	1	0	1	1	3	3.83	1.602	6
What I learned in this session will affect the way I teach this topic.	2	0	1	2	2	3.29	1.704	7
This session helped me link physical concepts to ocean processes.	2	0	0	3	1	3.17	1.722	6
The reading materials for this topic (if provided) were valuable supplements to my teaching.	1	0	2	2	2	3.57	1.397	7
The instructor was responsive to questions.	0	0	0	1	5	4.83	.408	6
There was too much content in this session.*	3	1	2	0	0	1.83	.983	6
The pace of this session was too fast.*	5	0	1	1	0	1.71	1.254	7
There was a good balance among the three sessions.	1	0	0	2	2	3.80	1.643	5

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note: Reversed ratings.

While one participant responded “enjoyed the talk from Annette,” another participant was not sure about it. One participant commented that presentation was confusing and unclear. Another participant indicated that he/she would have preferred to have a pedagogical session which would have balanced the three sessions.

Suggestions

When asked about the content of the sessions on day 4, one participant was glad to have an opportunity to learn about and discuss Mixing and Coriolis Effects, although those topics were not directly relevant to the grade level taught by the participant. When asked for suggestions to improve the session, one middle school teacher suggested more concrete lessons done w/the GoMOOS website instead of the hypothetical lessons presented. Participants also suggested that they should be informed before the workshop that they would be developing a lesson plan so that they could bring the books they use in their classes for the lesson plan activity. They also suggested that the session include activities that involved the ocean. They were next to the ocean, studying ocean concepts, but had no contact with the ocean.

Verbatim comments of participants related to the lecture, lab and pedagogical sessions on day four are included in Appendix D.

Day 5

Presentation/Summary

Presentation Session

Twelve out of thirteen participants *agreed* or *strongly agreed* that the presentations on the last day of the workshop were relevant to their teaching and provided useful material/ideas. Eleven respondents *agreed* or *strongly agreed* that they would affect the way they teach. Two provided a neutral rating on this item (Table 15). Participants differed in their agreement about the presentations helping them link physical concepts to ocean processes. However, majority of them (8) *agreed* or *strongly agreed* on this item.

Table 15. Participants' Ratings

Presentation Session

	Strongly disagree					Strongly agree		Mean	Std. Deviation	Total
	n	n	n	n	n					
This session was relevant to my teaching.	0	1	0	6	6	4.31	.855	13		
This session provided useful materials/ideas that I can use.	0	1	0	7	5	4.23	.832	13		
What I learned in this session will affect the way I teach this topic.	0	0	2	5	6	4.31	.751	13		
This session helped me link physical concepts to ocean processes.	1	1	3	4	4	3.69	1.251	13		
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	0	1	4	4.80	.447	5		
The instructor was responsive to questions.	0	0	0	1	10	4.91	.302	11		
There was too much content in this session.*	8	3	0	0	0	1.27	.467	11		
The pace of this session was too fast.*	11	1	1	0	0	1.23	.599	13		

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree.

*Note: Reversed ratings.

Summary Session

In the summary session, respondents felt instructors were responsive to their questions and also indicated that the session was relevant and useful (Table 16). Only four participants rated the item related to supplementary reading materials indicating that no specific reading materials were assigned. Six of the participants agreed or *strongly agreed* that the summary session helped with linking the physical concepts to ocean processes. Two were neutral on this item, and one *strongly disagreed*.

Table 16. Participants' Ratings

Summary Session

	Strongly disagree					Strongly agree		Mean	Std. Deviation	Total
	2	3	4	n	n					
This session was relevant to my teaching.	0	0	1	5	5	4.36	.674	11		
This session provided useful materials/ideas that I can use.	0	0	0	7	3	4.30	.483	10		
What I learned in this session will affect the way I teach this topic.	0	0	2	4	3	4.11	.782	9		
This session helped me link physical concepts to ocean processes.	1	0	2	3	3	3.78	1.302	9		
The reading materials for this topic (if provided) were valuable supplements to my teaching.	0	0	0	2	2	4.50	.577	4		
The instructor was responsive to questions.	0	0	0	0	11	5.00	.000	11		
There was too much content in this session.*	8	1	0	0	0	1.11	.333	9		
The pace of this session was too fast.*	9	1	0	0	0	1.10	.316	10		

Rating Scale 1-5: 1, Strongly disagree; 5, Strongly agree

*Note: Reversed ratings.

One participant commented that the summary session was a good time to discuss workshop format and other feed back which was not done. A similar comment was voiced by another, “Would have enjoyed a longer wrap-up session to make suggestions.”

Suggestions

Participants would have liked COSEE-OS T-shirts and access to printer during the workshop. They also commented that they could start earlier in the morning and have optional evening information sessions. Other suggestions were that participants should be required to develop new activities, not just present ones they were using and the sessions should be with fewer lessons and more involved inquiry approaches.

Verbatim comments of participants related to the lecture, lab and pedagogical sessions on day five are included in Appendix D.

END-OF-COURSE EVALUATION

At the end of the course participants were asked to rate 22 questions relating to course design and instruction, and to provide an overall appraisal of the workshop. They were also asked eight open ended questions to assess the value of this form of professional development for future courses. Participants verbatim responses can be found in Appendix E.

Course Design

All participants agreed that they were *quite* or *very* likely to introduce concepts of oceanography to their curriculum (Table 17). The information provided at the workshop was rated as *quite* or *very* useful to 12 (86%) of the participants. It was only *somewhat* useful to the remaining 2 (14%). This distribution may have resulted because participants teach different levels of science from 6th grade through high school. Some teachers will not be using the material but found the topics very interesting. Most of the participants found the materials relevant and two of the participants reported that more than 86% to 100% of the materials were relevant (Table 18). All participants were able to interact personally with course faculty. When asked about any aspect of course design that should be improved, many suggested having some activities at the ocean or having some lectures outdoors. Other suggestions included presenting more topics in less depth which would be adequate for the needs of public school teachers. Participants also suggested scheduling sharing time for demonstration ideas or instructional techniques brought by some participants.

Table 17. Course Design

	Somewhat	Quite	Very	Total
	<i>n</i>	<i>n</i>	<i>n</i>	<i>n</i>
How frequently were you able to interact personally with course faculty?	1	1	12	14
How useful for your teaching was the information being presented?	2	8	4	14
How effective was the independent work?	4	4	6	14
Are you more likely to introduce concepts in Oceanography to your curriculum after this workshop?	0	8	6	14

Rating Scale 1 -5: 1-Not at all, 2 –Not very, 3-Somewhat, 4-Quite, 5-Very

Table 18. Relevance of Course Material

	16-35%	36-65%	66-85%	86-100%	Total
	n	n	n	n	n
What percent of the material was directly relevant to your work?	1	5	6	2	14

Rating Scale 1-5: 1-1-15%, 2-16-35%, 3-36-65%, 4-66-85%, 5-86-100%

Instruction

All participants reported that instructors were accessible and responsive to their questions and helpful during lab work, independent work, and outside of sessions. Lab sessions and hands-on activities were highly rated by all. When asked, 12 out of 14 participants reported they *quite* or *very* effectively developed new skills and techniques from the workshop (Table 19). Supplementary materials, individual quizzes, and group quizzes were *quite* or *very* useful to nine participants. More than 10 participants were *somewhat* or *quite* or *very likely* to use similar individual and group quiz exercises in their teaching. One comment was, “individual and group quizzes were fun.”

Only two participants indicated that the level of scientific content in lectures was *not very appropriate* to their needs. Some of the comments for improvement were, “a little too technical,” “more details on less in depth topics,” and “handouts difficult to read.” There were few suggestions for improving pedagogical instruction. “The pre-reading assignments were very good but no real follow up during the workshop.” One of the participants reported pedagogical instruction “being the weakest link” that could be improved by giving more time for group work and discussion.

Instructors were highly rated as responsive and accessible during and outside of sessions. Eleven participants reported that instructors provided *just right* or *more than sufficient* time during lectures for questions and dialogue (Table 20). All participants except one felt the quality of education to be *very good* or *excellent* (Table 21). One participant rated it as *good*.

When asked about what aspects of the workshop helped them learn the most, almost all participants identified demonstrations, lab exercises, and hands-on activities. They also commented on the value of the lecture-lab sequence... “the format of having a lecture followed by diverse lab activities for each topic before moving on.” Some other positive aspects listed by participants included peer-public speaking, group work, and final presentations.

Table 19. Instruction

	Missing	Not at all	Not very	Somewhat	Quite	Very	Total
	n	n	n	n	n	n	n
How accessible and responsive to questions were instructors outside of sessions?	0	0	0	0	0	14	14
How effectively did workshop sessions foster development of new skills and techniques?	0	0	0	2	5	7	14
How helpful was assistance during lab work and independent work?	0	0	0	0	2	12	14
How useful were supplementary materials (e.g., glossary, notebooks, and hand outs)?	0	0	1	4	3	6	14
How useful were the individual and group quizzes as an instructional strategy?	1	0	2	2	7	2	14
How likely will you use similar quiz exercises in your class?	0	1	3	4	5	1	14
How appropriate to your needs was the level of scientific content in lectures?	0	0	2	3	8	1	14

Rating Scale 1 -5: 1-Not at all, 2 –Not very, 3-Somewhat, 4-Quite, 5-Very

Table 20. Instruction Time

	2	Just right	4	More than sufficient	Total
	n	n	n	n	n
How sufficient was time provided during lectures for questions and dialogue?	3	8	1	2	14

Rating Scale 1 -5: 1-Not sufficient, 3 –Just right, 5-More than sufficient

Table 21. Overall Quality

	Good	Very good	Excellent	Total
	n	n	n	n
Overall, how would you rate the quality of instruction?	1	8	5	14

Rating Scale 1 -5: 1-Poor, 2 –Fair, 3-Good, 4-Very good, 5-Excellent

Course Reflection

Except for one participant, all reported the overall quality of the workshop being *good*, *very good* or *excellent* (Table 22). The course was *quite* or *very* effective in promoting discussion among almost all the participants (Table 23), and all participants indicated the course allowed them to *substantially* or *extensively* collaborate professionally with others (Table 24).

All participants were pleased to have access to a laptop. Some brought their own. Participants had only intermittent internet access because of weak wireless connection, and the wireless network did not work in the dorm rooms. Some participants indicated that they would have liked to have more net references. Some also thought having “a printer would be nice” (Appendix E). Everyone enjoyed the conference facility and accommodations, especially the food. One participant suggested providing a packing list of what to bring, such as sheets, towel, fan, and so on to the workshop.

Participants reported that recreation was somewhat lacking. Suggestions included an outing in the ocean, movie/social in the evening, more kayaks to use in the evening, and coffee break in the morning instead of afternoon. One teacher wrote, “1st night there should be a social

so students and instructors can get to know each other, other nights should have optional outings b/c teachers are on summer break to prevent burn out" (Appendix E).

Table 22. Course Reflection

	Poor	Good	Very good	Excellent	Total
	n	n	n	n	n
How would you rate the overall quality of the course?	1	1	8	4	14

Rating Scale 1 -5: 1-Poor, 2 –Fair, 3-Good, 4-Very good, 5-Excellent

Table 23. Participant Interaction

	Somewhat	Quite	Very	Total
	n	n	n	n
How effectively did the course promote discussion with other participants?	1	6	7	14

Rating Scale 1 -5: 1-Not at all, 2 –Not very, 3-Somewhat, 4-Quite, 5-Very

Table 24. Professional Development

	Somewhat	Substantially	Extensively	Total
	n	n	n	n
To what extent did this course allow you to collaborate with others?	0	9	5	14

Rating Scale 1 -5: 1-Not at all, 2 –Not very, 3-Somewhat, 4-Quite, 5-Very

Dissemination of Their Knowledge

Instructors wanted to know if the participants planned to share their workshop experience with other teachers in their own schools and other schools. Twelve participants were *likely* or *very likely* to share their experience with teachers in their own schools, but only five participants were *very likely* to share with teachers outside their own schools (Table 25). Many participants were also *likely* to participate in contributing to a website and share information among the workshop participants and with others. Only one participant was *not likely* to do so.

Table 25. Dissemination of Their Knowledge

	Not very likely	2	Somewhat	4	Very likely	Total
	n	n	n	n	n	n
How likely are you to share your workshop experience with other teachers in your school?	0	2	0	4	8	14
How likely are you to share your workshop experience with other teachers outside your school?	4	0	5	2	3	14
How likely are you to consider contribution to a website and sharing information with participating teachers and others?	1	0	3	7	3	14

Rating Scale 1 -5: 1-Not very likely, 3-Somewhat, 5-Very likely

Useful Ideas for Teaching

When participants were asked what ideas or practices from the workshop they would put to use in their teaching, their responses could be summarized as follows (Appendix E):

- concept-mapping as an organizational tool
- new questioning techniques
- use of discrepant events as a basis for student generated questions
- more “learner self directed” techniques/ more “inquiry” style lesson plans – less cookbook labs

- hands-on salt/fresh water and temperature differences activities
- quiz after lab
- segment on oceanography to show their (ocean's) importance to other global processes

Participants appreciated and learned “lots of the lab ideas.” One teacher in particular wrote, “Many of the demonstrations of fluid dynamics were wonderful and simple. Exactly what I need for teaching a new course this coming year where fluids will be much more prominent a topic than it has been in my previous classes.”

Participants were asked what inquiry-based units and/or hands-on activities for teaching physics using ocean concepts they were likely to develop in the coming year. Some of the topics they mentioned were buoyancy, density, mini-wave tanks, hydrostatic pressure, light, sinking and mixing, fluid drag, wave viscosity (Appendix E). Since participants came from different backgrounds, they varied in the topics they chose. Many of the topics were not directly related to the classes they taught. However, the data suggest that many participants will structure their teaching to be more inquiry based, and that they are very likely to incorporate concepts and topics from ocean science into their teaching.

Course Satisfaction

When asked for additional suggestions for the workshop, those who responded repeated the issues of having advance notice of the project with an opportunity to bring support material, having large fonts for slides and handouts presented, and having a boat experience to test the ocean concepts. Overall, participants indicated satisfaction with the workshop. Ten participants felt their personal objectives were *substantially* or *extensively* met. Personal objectives were *somewhat* met for the remaining four participants (Table 26). The participants’ expectations as reported in the pre workshop questionnaire are included in Appendix F.

Table 26. Course Satisfaction

	Somewhat	Substantially	Extensively	Total
	n	n	n	n
To what extent were your personal objectives for this course met?	4	8	2	14

Rating Scale 1 -5: 1-Not at all, 2 –Not very, 3-Somewhat, 4-Quite, 5-very

Suggestions for Similar College Course

Instructors were also interested in suggestions that the participants might have for a new class on teaching physics through ocean sciences they will be offering to pre-service science teachers at the University of Maine. Participants had numerous valuable suggestions for the course which are listed below.

Following is the verbatim transcription of participants' suggestions:

- A clear list of all the concepts need to be presented to the teachers taking the course before the course starts. This way it allows the teachers to review the concepts they may not teach in the classroom
- Ask students to develop several lessons of inquiry – generally more practice on writing inquiry labs:
 - Basic inquiry lab (to intro students to this type of lab)
 - Develop an assessment program for the course that involves essay
 - Finally developing a final lab with a different question and have your class student come up with the procedure
- I will make more references to the ocean when looking for examples and demonstrate the topics, Density and Pressure
 - Increase difficulty of each additional lab
- It would be very helpful for the instructor(s) to choose a basic physics book to which to direct students on specific topics where students' background knowledge needs support. Teachers - students will naturally NOT have a completely common background in terms of physics and this might help GPS physics oriented teachers to feel more comfortable
 - Keep the lectures to an hour or less (not including discussion time)
- No changes – but the idea has been bandied about of a workshop designed to help teachers build some of the simple lab equipment used here this week
- Provide the text on inquiry and the science standards in advance. Require students develop a variety of inquiry projects both individually and in groups and present them
- Since they will have more time, give them more opportunities to develop applications of these ideas and practice them – may be even try them out w/kids a “visiting” instructor -
- Spread out over a semester, with slower more basic instruction, it would be great
 - Take time so participants may discuss and share ideas and questions (not just stealing time to do so)
 - While it's good to interact w/other grade-level teachers, offer high school – level and middle-school-level (math + less-math) lectures. Labs can be together

RECOMMENDATIONS

The workshop was a very positive experience for all participants. The daily ratings and comments of participants support the following recommendations.

- Explain formulas and symbols used in the lectures prior to the lectures. Instructors expected participants to have basic knowledge of physics and many did not. Some participants suggested more nonformula explanations.
- Present more topics in less depth. In lectures and labs, instructors should consider that participants teach different science classes and come from grade levels which range from middle school through high school.
- Each day, review the lab of the previous day to help participants retain what they have learned.
- Provide supplementary reading well in advance of the sessions in which they are relevant.
- Maintain the balance between lecture, lab, and pedagogical discussion. The daily routine of lecture followed by a lab is an effective learning strategy.
- Provide sufficient materials for all participants in labs. Fewer stations would allow more needed time at each station.
- Provide additional ideas for inquiry-based activities and links to ocean concepts to make the workshop more interesting and useful to the participants. Participants did not always understand the link to ocean processes in some lectures and pedagogical discussions.
- Develop some activities that actually use the ocean. Accommodations, facilities, and food were superb, participants expressed disappointment that they had no opportunities for hands-on activities in the ocean as they expected.
- Provide information on what the participants should bring to the workshop for personal use, such as fan, lamps, computers, etc. for personal use. Wireless connection for laptop computers needs major improvement.
- Schedule a block of free time during the day for a break. This would be useful for the participants to do other things and decrease the fatigue that results from sitting in a chair without a desk all day.

CONCLUSION

This workshop was a unique opportunity for participating teachers to learn about ocean processes and how these might be integrated into their teaching of science in middle and high schools. All participants gained new knowledge of scientific concepts and teaching strategies. Participants were able to develop ideas for inquiry-based activities that integrated ocean sciences into the sciences they teach. Although not all participants will be using all of the concepts they learned at the workshop, they appreciated the opportunity to enrich their scientific knowledge base. One of the strongest components of the workshop was the responsiveness of instructors to the participants' questions. A follow-up survey of the participants in the middle of school year following the workshop will make it possible to assess how the participants used the knowledge they gained at the workshop.

APPENDIX A. Pre-Workshop Questionnaire

Teaching Science by Ocean Inquiry A Summer Workshop at the Darling Marine Center July 17-21, 2006

Initial Questionnaire for Workshop Participants

Please answer the following questions as specifically as possible in the space provided.

I. Please provide following information:

A. Your Name:

B. Gender:

C. Age Range (Please circle the one that applies to you): (a) 20-29 (b) 30-39 (c) 40-49 (d) 50 and above

D. Name of School, District, and State:

E. How long have you been teaching in this school?

II. Instructions

Please provide a brief description of each concept you teach. If you do not teach a concept, please indicate your level of confidence in your knowledge of the concept.

Legible handwriting is appreciated. If you use abbreviations, please make sure they are ones that are commonly understood in the field.

Please follow the following example in providing your answer to the concepts.

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS TAUGHT
Density	Plate tectonics (Earth Sciences), Properties of matter (Chemistry)	Comparing densities of different metals of equal shapes and sizes	Observations, predictions, testing

CONCEPT SHEET: Your input will help us make the workshop relevant and beneficial to you.

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS		
1. Mass					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident
2. Mass Conservation					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS
3. Density			
If not taught, how confident are you in your knowledge of this concept?			
1 No Knowledge	2	3 Somewhat Confident	4
5 Very Confident			
4. Force			
If not taught, how confident are you in your knowledge of this concept?			
1 No Knowledge	2	3 Somewhat Confident	4
5 Very Confident			

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS		
5. Momentum					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident
6. Newton's Laws of Motion					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS		
7. Archimedes' Law					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident
8. Center of Gravity	If not taught, how confident are you in your knowledge of this concept?				
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS		
9. Center of Buoyancy					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident
10. Pressure	If not taught, how confident are you in your knowledge of this concept?				
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS		
11. Static Forces					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident
12. Dynamic Forces					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS
13. Pressure Gradients			
If not taught, how confident are you in your knowledge of this concept?			
	1 No Knowledge	2 Somewhat Confident	3 Very Confident
14. Heat	If not taught, how confident are you in your knowledge of this concept?		
	1 No Knowledge	2 Somewhat Confident	3 Very Confident

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS		
15. Properties of Water					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident
16. Waves (Properties, Energy, and Types of Waves etc.)					
If not taught, how confident are you in your knowledge of this concept?					
	1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS
17. Light			
If not taught, how confident are you in your knowledge of this concept?			
	1 No Knowledge	2	3 Somewhat Confident
4		5 Very Confident	
18. Sound			
If not taught, how confident are you in your knowledge of this concept?			
	1 No Knowledge	2	3 Somewhat Confident
4		5 Very Confident	

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS
19. Gravitational Force			
If not taught, how confident are you in your knowledge of this concept?			
1 No Knowledge	2	3 Somewhat Confident	4
5 Very Confident			
20. Centripetal Force			
If not taught, how confident are you in your knowledge of this concept?			
1 No Knowledge	2	3 Somewhat Confident	4
5 Very Confident			

CONCEPT	CONTEXT (S) IN WHICH YOU TEACH THE CONCEPT	ACTIVITY	SKILLS	
21. Coriolis Effect				
If not taught, how confident are you in your knowledge of this concept?				
1 No Knowledge	2	3 Somewhat Confident	4	5 Very Confident

III. Please briefly describe what learning by inquiry means to you.

IV. Please describe what you expect to learn in this workshop. Be as specific as possible about how they are related to what you are currently teaching.

Any additional information or comments?

If you have questions about this evaluation, please contact Herman Weller, College of Education and Human Development, University of Maine, Orono, Maine 04469; telephone 207-581-2436, or email. Herman.weller@umit.maine.edu

APPENDIX B. Questionnaire
EDU 580 TEACHING SCIENCE BY OCEAN INQUIRY
A WORKSHOP
July 17-21, 2006
Held at the Darling Marine Center, Walpole, Maine

Daily Rating Packet

The Center for Research and Evaluation is an independent third-party evaluator for this workshop. Your views on the usefulness of this workshop, the quality of the instruction you received, and the manner in which the workshop was delivered are very important. The workshop organizers and instructors use the evaluation to enhance and improve the courses they offer, and funders see the evaluation information as part of their decision making process. Future courses depend very much on your feed back.

Enclosed is a one sheet (two sided) evaluation for each day of the Institute, and an End of Course Evaluation form. Please complete one Daily Rating sheet at the end of each day and complete the End of Course Evaluation at the end of the week.

Please return these evaluation materials in the enclosed postage paid envelope at the end of the week.

Confidentiality: The evaluation material you provide will be received and processed by the Center for Research and Evaluation at the University of Maine. All evaluation material is considered confidential and will not be shared with others. Evaluation data will be summarized in reports to the instructors, COSEE-NE and the COSEE networks. No individual participant or school will be identifiable.

Thank you for your help in this evaluation. We hope you have a pleasant and productive experience at The Darling Marine Center and that you enjoy your stay in the Center facility.

Daily Rating Sheet
Monday, July 17, 2006

Topic: Fluids and Solids, Hydrostatic Pressure

Directions: Please indicate the degree to which you agree or disagree with each statement below as it pertains to each of the three sessions.

	Lecture Session					Lab Session					Day's Pedagogical Discussion				
	Strongly Disagree		Strongly Agree			Strongly Disagree		Strongly Agree			Strongly Disagree		Strongly Agree		
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
This session was relevant to my teaching.															
This session provided useful materials/ideas that I can use.															
What I learned in this session will affect the way I teach this topic.															
This session helped me link physical concepts to ocean processes.															
The reading materials for this topic (if provided) were valuable supplements to my teaching.															
The instructor was responsive to questions.															
There was too much content in this session.															
The pace of this session was too fast.															
There was a good balance among the three sessions.															

Explanations for your answers above and suggestions for improving the sessions of this topic are encouraged on the back of this page.

Fluids and Solids, Hydrostatic Pressure

Explanations for your answers above and suggestions for improvement

Lecture Session	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Is there content that should be added/eliminated? Please be specific.	
Lab Session:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Pedagogical Discussion:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Other Suggestions:	

Daily Rating Sheet
Tuesday, July 18, 2006

Topic: Buoyancy and Sinking

Directions: Please indicate the degree to which you agree or disagree with each statement below as it pertains to each of the three sessions.

	Lecture Session					Lab Session					Day's Pedagogical Discussion				
	Strongly Disagree		Strongly Agree			Strongly Disagree		Strongly Agree			Strongly Disagree		Strongly Agree		
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
This session was relevant to my teaching.															
This session provided useful materials/ideas that I can use.															
What I learned in this session will affect the way I teach this topic.															
This session helped me link physical concepts to ocean processes.															
The reading materials for this topic (if provided) were valuable supplements to my teaching.															
The instructor was responsive to questions.															
There was too much content in this session.															
The pace of this session was too fast.															
There was a good balance among the three sessions.															

Explanations for your answers and suggestions for improving the sessions of this topic are encouraged on the back of this page.

Buoyancy and Sinking

Explanations for your answers and suggestions for improvement

Lecture Session	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Is there content that should be added/eliminated? Please be specific.	
Lab Session:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Pedagogical Discussion:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Other Suggestions:	

Daily Rating Sheet
Wednesday, July 19, 2006

Topic: Waves and Tides/Light, Sound, and Instrumentation

Directions: Please indicate the degree to which you agree or disagree with each statement below as it pertains to each of the sessions.

	Lecture 1					Lab 1 Session					Lecture 2					Lab 2 Session					Day's Pedagogical Discussion							
This session was relevant to my teaching.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
This session provided useful materials/ideas that I can use.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
What I learned in this session will affect the way I teach this topic.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
This session helped me link physical concepts to ocean processes.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
The reading materials for this topic (if provided) were valuable supplements to my teaching.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
The instructor was responsive to questions.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
There was too much content in this session.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
The pace of this session was too fast.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5
There was a good balance among the sessions.	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5	Strongly Disagree	Strongly Agree	1	2	3	4	5

Explanations for your answers above and suggestions for improving the sessions of this topic are encouraged on the back of this page.

Waves and Tides/Light, Sound and Instrumentation

Explanations for your answers and suggestions for improvement

Lecture Sessions	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Is there content that should be added/eliminated? Please be specific.	
Lab Sessions:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Pedagogical Discussion:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Other Suggestions:	

Daily Rating Sheet
Thursday, July 20, 2006

Topic: Mixing

Directions: Please indicate the degree to which you agree or disagree with each statement below as it pertains to each of the three sessions.

	Lecture Session					Lab Session					Day's Pedagogical Discussion				
	Strongly Disagree		Strongly Agree			Strongly Disagree		Strongly Agree			Strongly Disagree		Strongly Agree		
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
This session was relevant to my teaching.															
This session provided useful materials/ideas that I can use.															
What I learned in this session will affect the way I teach this topic.															
This session helped me link physical concepts to ocean processes.															
The reading materials for this topic (if provided) were valuable supplements to my teaching.															
The instructor was responsive to questions.															
There was too much content in this session.															
The pace of this session was too fast.															
There was a good balance among the three sessions.															

Explanations for your answers above and suggestions for improving the sessions of this topic are encouraged on the back of this page.

Mixing

Explanations for your answers and suggestions for improvement

Lecture Session	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Is there content that should be added/eliminated? Please be specific.	
Lab Session:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Pedagogical Discussion:	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Other Suggestions:	

Daily Rating Sheet
Friday, July 21, 2006

Topic: Presentations/Summary

Directions: Please indicate the degree to which you agree or disagree with each statement below as it pertains to each of the sessions.

	Presentation Session					Summary Session				
This session was relevant to my teaching.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
This session provided useful materials/ideas that I can use.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
What I learned in this session will affect the way I teach this topic.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
This session helped me link physical concepts to ocean processes.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
The reading materials for this topic (if provided) were valuable supplements to my teaching.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
The instructor was responsive to questions.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
There was too much content in this session.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
The pace of this session was too fast.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			
There was a good balance among the two sessions.	Strongly Disagree 1 2 3 4 5	Strongly Agree				Strongly Disagree 1 2 3 4 5	Strongly Agree			

Explanations for your answers above and suggestions for improving the sessions of this topic are encouraged on the back of this page.

Presentations

Explanations for your answers and suggestions for improvement

Presentations	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Is there content that should be added/eliminated? Please be specific.	
Summary	
Explanations for your answers in the other page (if your rating is below 4):	Suggestions for improvement:
Other Suggestions:	

Appendix C

EDU 580 Teaching Science by Ocean inquiry July 17-21

End-of-Course Evaluation

Critical evaluation of this course is essential to its continuing improvement. Your responses will make it possible for the evaluation team to assess the value of this form of professional development. The organizers will also use your responses to implement modifications in future courses.

Below are several questions and statements about your course experience. Please indicate your opinion by checking the appropriate box. Feel free to use additional pages for suggestions. Thank you in advance for your constructive responses.

Course Design/Instruction/Course Reflections-Overall					
1.	How frequently were you able to interact personally with course faculty?	Not at all	Not very	Somewhat	Quite
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	How useful for your teaching was the information being presented?	Not at all	Not very	Somewhat	Quite
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	What percent of the material was directly relevant to your work?	0 - 15%	16 - 35%	36 - 65%	66 - 85%
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	How effective was the independent work for you?	Not at all	Not very	Somewhat	Quite
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	Are you more likely to introduce concepts in Oceanography to your curriculum after this workshop?	Not at all	Not very	Somewhat	Quite
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6.	How accessible and responsive to questions were instructors outside of sessions?	Not at all	Not very	Somewhat	Quite
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7.	How effectively did workshop sessions foster development of new skills and techniques?	Not at all	Not very	Somewhat	Quite
		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

8.	How helpful was assistance during lab work and independent work?	Not at all <input type="checkbox"/>	Not very <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Quite <input type="checkbox"/>	Very <input type="checkbox"/>
9.	How useful were supplementary materials (e.g., glossary, notebooks, and hand outs)?	Not at all <input type="checkbox"/>	Not very <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Quite <input type="checkbox"/>	Very <input type="checkbox"/>
10.	How useful were the individual and group quizzes as an instructional strategy?	Not at all <input type="checkbox"/>	Not very <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Quite <input type="checkbox"/>	Very <input type="checkbox"/>
11.	How likely will you use similar quiz exercises in your class?	Not at all <input type="checkbox"/>	Not very <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Quite <input type="checkbox"/>	Very <input type="checkbox"/>
12.	How appropriate to your needs was the level of scientific content in lectures?	Not at all <input type="checkbox"/>	Not very <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Quite <input type="checkbox"/>	Very <input type="checkbox"/>

Course Design/Instruction/Course Reflections-Overall

13.	How sufficient was time provided during lectures for questions and dialogue?	Not sufficient <input type="checkbox"/>	<input type="checkbox"/>	Just right <input type="checkbox"/>	<input type="checkbox"/>	More than sufficient <input type="checkbox"/>
14.	Overall, how would you rate the quality of instruction?	Poor <input type="checkbox"/>	Fair <input type="checkbox"/>	Good <input type="checkbox"/>	Very good <input type="checkbox"/>	Excellent <input type="checkbox"/>
15.	How effectively did the course promote discussion with other participants?	Not at all <input type="checkbox"/>	Not very <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Quite <input type="checkbox"/>	Very <input type="checkbox"/>
16.	To what extent did this course allow you to collaborate with others?	Not at all <input type="checkbox"/>	Slightly <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Substantiall y <input type="checkbox"/>	Extensively <input type="checkbox"/>
17.	How likely are you to share your workshop experience with other teachers in your school?	Not very likely <input type="checkbox"/>	<input type="checkbox"/>	Somewhat <input type="checkbox"/>	<input type="checkbox"/>	Very likely <input type="checkbox"/>
18.	How likely are you to share your workshop experience with other teachers outside your school?	Not very likely <input type="checkbox"/>	<input type="checkbox"/>	Somewhat <input type="checkbox"/>	<input type="checkbox"/>	Very likely <input type="checkbox"/>
19.	How likely are you to consider contributing to a website and sharing information with participating teachers and others?	Not very likely <input type="checkbox"/>	<input type="checkbox"/>	Somewhat <input type="checkbox"/>	<input type="checkbox"/>	Very likely <input type="checkbox"/>
20.	To what extent were your personal objectives for this course met?	Not at all <input type="checkbox"/>	Slightly <input type="checkbox"/>	Somewhat <input type="checkbox"/>	Substantiall y <input type="checkbox"/>	Extensively <input type="checkbox"/>

21.	Would you recommend this course to a colleague?	Not at all <input type="checkbox"/>	Mixed review <input type="checkbox"/>	Somewhat highly <input type="checkbox"/>	Quite highly <input type="checkbox"/>	Very highly <input type="checkbox"/>
22.	How would you rate the overall quality of the course?	Poor <input type="checkbox"/>	Fair <input type="checkbox"/>	Good <input type="checkbox"/>	Very good <input type="checkbox"/>	Excellent <input type="checkbox"/>

23. a. Did you find the topics discussed adequate? Would you like to see other topics added?

b. Would you have preferred more or fewer topics? What topics would you add or delete?

24. Please comment on any aspects of the course that should be improved.

a. Course design:

b. Instruction:

c. Use of lap-top computer:

d. Conference facility:

e. Accommodations, food, and recreations:

25. What aspects of the workshop helped you learn the most?

26. What inquiry-based units and /or hands on activities for teaching physics using ocean concepts will you develop in the coming year?

27. What learning (ideas or practices) from this course, if any, will you put to use in your teaching?

28. What specific changes you will make in your teaching after attending this workshop?

29. We are developing an on-campus version of this course. What changes would you recommend to this course for future science teachers?

30. Additional Suggestions (Please also use the back of this page):

Please use the enclosed self addressed reply envelope to return the Daily Rating Sheets and the End of Course Evaluation form or to the address below.
If you have questions about the evaluation and how the data are used, please contact the evaluator, Sheila G. Pendse, Research Assistant, Center for Research and Evaluation, College of Education and Human Development, University of Maine, Orono, Maine 04469; telephone 207-581-2301, email sheila.pendse@umit.maine.edu, and fax 207-581-9510.

Thank you for your responses.

APPENDIX D. Comments on Daily Sessions

(A verbatim transcription)

1. July 17, 2006

Fluids and Solids, Hydrostatic Pressure

1A. Lecture

- A low score on pacing is good!
- I marked (3) for those I felt neutrally about. I basically agreed, but not enthusiastically
- Lecture was good for me but the info is complicated for my 8th graders
- Lecture was more intense than what I would be able to use in 9th grade physical science but it was good to expand my own knowledge
- Link between hydrostatic pressure and ocean science - to be discussed today not discussed
- My rating is positive
- The content was heavy on formulas and assumed knowledge on the part of the participants. So it was too much too fast for some
- The lecture was too theoretical for my use in a H.S. classroom. Assumed too much prior knowledge
- Too much content? Absolutely NOT! You are working w/ a wide range of abilities and needs, as in any classroom; more is better than less

1Aa. Suggestions for improvements

- Explain the formulas in more detail and use with one or more examples. Also convert to layman terms
- Fine!
- I appreciated the definitions, when provided
- I do not think it is in need of improvement b/c it is the nature of my specific class that is the problem
- I would like to be issued a 3 ring binder and have all the handouts 3 hole punched. It would help to keep everything organized
- No improvement needed
- None
- Please explain concepts in “lay” terms that we can use with students
- Provide reading materials in advance

1B. Lab

- Good lab session!
- I liked that every second was filled w/o chance to work at something – it was not too much, JUST NOT enough time
- Lab hand-outs were skeletal: more detail on how to use apparatus in inquiry would be helpful. There was not enough to do justice to all lab stations. Connections to ocean processes was not obvious
- Lab was on density concepts and pressure, did not link to oceans

- My rating is positive
- Not too much content –Just right. I liked being able to move from station to station, setting my own pace
- The content was good although it was presented quickly – not too fast but I need time to digest the content and review
- Time allowed for labs was not enough

1Ba. Suggestion for improvement

- More guidance while doing experiments. Reinforcement immediately at the end to see if our explanations were correct
- Need enough equipment so that more than one group can do the same lab at the same time
- No improvement needed
- None
- Perhaps add to activities a lat question, applying concept to ocean setting
- Point out my misconceptions that might form are associated with each lab
- Take more time to explain what we're looking at - my background is mostly biology, zoology and I need physics EXPLAINED

1C. Pedagogical discussion

- Excellent – could have been longer
- I'd gone over those texts weeks ago and was tired out by the day's end. Sick of sitting, tired of listening, and not energetic enough to talk
- More time to discuss the articles + hear feedback from other teachers and their ideas.
- NA
- Pedagogy – below “4” not because it was poor but because it was something I am quite familiar with
- Pedagogy was not specific to ocean concepts
- There is a lot of info on the handouts. I need time to look over info and ask questions
- There was not “too much” content – nor “too little.” I really enjoyed the articles, especially those on NOS (Echoes some of my own philosophies. No wonder I liked them!)
- We did not have time to develop much of a discussion
- We have not yet gotten into much detail and I expect/hope we will

1Ca. Suggestion for improvement

- 3 ring binder w/handouts that are 3 holes punched
- An introduction on basics of inquiry learning would be appropriate
- Different seating arrangement
- Make truly a circle – not an arc centered on the “teacher”
- More time to discuss the articles + hear feedback from other teachers and their ideas
- Remind us of key points on chart paper (or overhead) to give us something to look at – you could have had us bring questions about the readings as they apply to our own practice (not just theory)to the discussion so the group could brainstorm responses and solutions

1D. Content that should be added or eliminated

- Be careful to define terms and symbols. Different fields of study use different symbols
- Clarify the difference between laminar and turbulent flow
- Formulas such as the Reynolds's #, are too sophisticated for my use in class
- I felt there were too many equations and unfamiliar Greek terms included to be of any use to my classes in middle school. Analogies or concrete examples are most useful to me in explaining situations (and understanding, on my part)
- No

1E. Other suggestions

- Make a note on the schedule as to locations for discussions.
- Pace was good, but maybe you could (in future conferences) start at 8am or 8:30 am – That's a lot of time between breakfast to lecture! (It might be a way to extend lab time a bit), without cutting into other parts)
- None for Monday
- Paper punch available to organize materials received
- Uncomfortable @ 5pm. Let us sit at tables so we may shuffle our papers (*drawings of sitting on chair/table*)

2. July 18, 2006

Buoyancy and Sinking (ID # 4: & Temperature and Heat)

2A. Lecture

- Basic information is good but the focus on the formulas again lost me. However, I think high school physics teachers find it more relevant, so perhaps use of non-mathematical explanations and examples in addition would meet a wider range of science knowledge needs
- Buoyancy and sinking + Archimedes Law is NOT something I explore in my curriculum – although links to oceanography are interesting
- I do not teach buoyancy
- Lecture # 1 was too difficult for most of us to follow, hence not useful for planning class activities
- This was all I was familiar with and will not impact instruction as a result

2Aa. Suggestions for improvements

- Group was more at ease – better interactions all around
- It would be nice to receive the material before the lecture and lab
- Math was above my level of teaching

2B. Lab

- Did not have
- Lab hand-outs were skeletal: more detail on how to use apparatus in inquiry would be helpful. There was not enough to do justice to all lab stations. Connections to ocean processes was not obvious

- Nice mix of different activities at varying levels of comprehension/application
- Stations 1 and \$ help me think about buoyancy and density but did not seem as directly connected to ocean processes – necessary background?

2Ba. Suggestion for improvement

- Keep doing a review of each lab we did the day before as follow-up
- None

2C. Pedagogical Discussion

- Generally good, useful information
- Pedagogy was not specific to ocean concepts
 - Sub groups good idea
 - Sharing of starting ideas not useful – will be once finished

2Ca. Suggestion for improvement

- Further discussion about imagining /facilitating different levels of inquiry would be useful
- Give us the readings you have prepared to discuss ahead of time
- I would prefer a morning session instead of meeting after dinner after the days lessons and lab
- None

2D. Content that should be added or eliminated

- Good stuff today
- Higher level physics is not necessary for most
- I would find more reference to marine mammals very much a “hook” for class
- No
- No

2E. Other suggestions

- Allow more “down time” for participants. We are in a beautiful location and would like the chance to explore/enjoy it AS WELL AS learn our content. Finish at 5:00 or allow greater chunks of time after lunch and hold pedagogical session after a later dinner(?) for trips, swims, paddles, or work on the lesson plans, or read the readings for the discussions.
- If possible, give us two copies of the labs – one to take notes on then one to use as a photocopy (save time on retyping)
- Same as day 1. Comment: Doing a brief summary/demo of each lab activity was very helpful. It also encouraged more whole-group discussion and interaction
- The sessions were fine. No suggestions

3. July 19, 2006

Waves and Tides/Light, Sound, and Instrumentation

3A. Lecture

- “Relevant to teaching” – all new things change who I am and how I approach teaching, not just what is directly connected to my content. I had some “oh, wow” moments today – that excitement is as important as the content
- Balance among labs and sessions 1 and 2 had little to no lab to break it up
- Concepts related to waves are very useful. Tides are not so relevant but still interesting. Sound/light - useful
- Much of the content taught today is not taught in middle school but it was still good for me to review
- Please go more slowly and assume no or little background
- This was not necessarily relevant to my current teaching, but it was certainly relevant to my interest
- We do not cover waves, light and sound our freshman course

3Aa. Suggestions for improvements

- Do more demos or interactive visuals – just to get people out of seats
- There is a lot to think about with light and sound. Could we slow down and use more time

3B. Lab

- A little too much lecture today not enough lab time
- Lab hand-outs were skeletal: more detail on how to use apparatus in inquiry would be helpful
- Limited time today for lab activities
- No Labs today
- Session did not happen due to uncontrollable circumstances
- There really was no lab session after lecture 2

3Ba. Suggestion for improvement

- Have a few of the demo – materials available with which we try to practice some of the concepts thru demos
- I believe that we will be making time tomorrow....

3C. Pedagogical Discussion

- I am not sure we couldn't have accomplished today's work on our own time
- Pedagogy was not specific to ocean concepts
- Was absent for this today

3Ca. Suggestion for improvement

- Discussions are much too teacher-centered
- Have opportunity for more sharing of ideas for what some of us already do in these areas
- Possibly before lecture instead of at night

3D. Content that should be added or eliminated

- It would be nice to have a sheet of formulas and symbols so it would be easier to follow the lectures

- More explanation of tides to clarify: superposition of various component variables
- Some of the material on wave velocity and Fourier decomposition of waves was a bit beyond most people
- This has been a great conference so far. Thanks

3E. Other suggestions

- The day was too heavily weighted towards the lecture sessions, and it was clear that some of the content was a bit over the heads of many participants and delivered a bit too fast
- Very technical
- Would like more info (simple) on color and polarized light

4. July 20, 2006

Mixing

4A. Lecture

- Was cut to give more lab time
- We did not spend much time on lecture today, which would have been useful to my understanding of these topics. However, neither mixing nor coriolis effect

4Aa. Suggestions for improvements

- Make sure to maintain a balance each day of lab/lecture so we don't get tired of either

4B. Lab

- Lab hand-outs were skeletal: more detail on how to use apparatus in inquiry would be helpful
- We did not spend much time on lecture today, which would have been useful to my understanding of these topics. However, neither mixing nor coriolis effect

4Ba. Suggestion for improvement

- Make sure to maintain a balance each day of lab/lecture so we don't get tired of either

4C. Pedagogical Discussion

- Did not have a pedagogical discussion, toured lab and had a class by COSEE-OS
- Did not take place
- My memory is that we did not have a pedagogy session, but rather spent the time working on presentations
- NA

4D. Content that should be added or eliminated

- Although mixing and coriolis effect are not directly relevant to my curriculum, I was still glad for the opportunity to learn about/discuss these topics

4E. Other suggestions

- I would have liked to see more concrete lessons done w/ the GOMMOS website instead of the hypothetical lessons presented – what is really going to work for the middle school students?
- I would have preferred to have a pedagogy session. This would have led to better balance
- It would have been nice to have some activities that involved the ocean. We were right there but had no contact
- Let us know before we arrived that we would be developing a lesson – I would have brought more books that I use in teaching
- Enjoyed the talk from Annette (Bigelow)
- Food was super all week
- Presentation by COSEE-OS Bigelow Director was confusing – goals/objectives/v.unclear purpose

5. July 21, 2006

Presentations/Summary

5A. Presentation

- Lesson plan development was not really useful to me
- No new content was presented, so linking was not possible. A 1 is a good score for pace

5Aa. Suggestions for improvements

- Daily sessions to discuss ways to integrate increased inquiry and ocean concepts would be more beneficial
- Lots of lessons on density. Perhaps participants could share topics on Wednesday to encourage breadth/variety

5B. Summary

- No new content was presented, so linking was not possible. A 1 is a good score for pace
- Summary session was a good time to discuss workshop format and other feed back but did not include content (this is fine)
- Would have enjoyed a longer wrap-up session to make suggestions

5C. Other suggestions

- Many presentations were activities that the presenter already used in the form they presented. Participants should be required to develop new activities, not just present ones they are already using
- Nice to have access to printer
- T-shirts COSEE-OS
- Start earlier in the morning
- Less lesson planish – more involved inquiry approaches
- Optional evening info sessions (DMC) research

APPENDIX E. End of the Course Responses

(A verbatim transcription)

1. Did you find topics discussed adequate? Would you like to see other topics added?

- Adequate-yes, Topics added- no
- Even though this was primarily a physics workshop, I would like to have seen marine organisms discussed more directly since the material applied to them
- I teach 9th grade physical science with a chemistry focus. I would like to see more chemistry topics
- More discussion on developing an inquiry Lab:
 - What are good questions
 - Grading inquiring Labs (Rubrics)
 - Group work vs. individual work (which is better)
 - Students' response – Lab reports? (writing up lab reports)
- More nonformula explanations
- More on inquiry based pedagogy
- The discussed topics were good. I would have gotten more useful material from it had it been less technical
- The topics discussed were very well chosen and very applicable to what many of us teach. I think that many of the topics opened up new avenues of teaching that may not have been thought of before
- The topics were interesting and useful. A bit more discussion of ocean chemistry would be a nice addition
- Very adequate –more topics may crowd an already “full plate” of topics
- Yes. Additional ideas for inquiry-based activities on sound and Light would be great. More detail on instrumentation would have been relevant and useful, both in terms of describing what exactly would/could be measured and how

2. Would you have preferred more or fewer topics? What topics would you add or delete?

- # of topics was good
- Review symbols when doing math
- Discussing topics – hit very simple explanation to activity to complex
- Happy!
- I think that the number of topics was just right. There was a good variety to keep everyone interested even if some of us were familiar with some of them, but there wasn't too much to make anyone overwhelmed with information
- I was satisfied with the number of topics presented
- Keep the same ones. There was enough variety and enough depth of coverage to meet a wide range of needs
- Less content oriented material would be good as well as fewer stations in the lab to allow adequate time for the stations being used
- More topic covered in less depth

- There was the right amount of topics
- You had a wide range of teaching levels – 6th grade up to AP high school teachers – need to have activities for all levels for each activity or written materials to hand out
- We ran out of time to fully discuss coriolis effect, which was okay. That topic was probably too much

3. Please comment on any aspects of the course that should be improved.

3a. Course design

- A block of free time needs to be built in to the day when participants can take a break and do other things. We would come back refreshed and more alert
- Adequate. Too much lecture time, not enough outside lecture/real-world relevance activities. I know the instructor, felt they wanted to provide information we'd use, not boat time, but even we adults need to be captivated to make new info stick.
- Current set up is fine. Add demonstration after lab
- I appreciated the range of topics covered and was glad for the large amount of context. Lecture – lab, lecture – lab format was very successful
- It was very well planned as is, but: include perhaps a time for participant sharing during which those who brought a lab or demo idea (or instructional technique) to share could plan to do so. (Let participants know ahead of time that they are encouraged to do this)
- It would have been nice to have more differentiation between the middle school and HS teacher. Middle school is much more remedial
- Lecture/lab - good format
- Some activities at the ocean would have been nice
- Liked lecture, lab, pedagogical set up but think the resources of the facility should be tapped into. Lab – some of his should have been done on a boat or on the ocean
- Nicely set up with the lecture/lab/pedagogical discussion
- Put lab sessions after dinner rather than pedagogy. Bigelow lab presentation was not useful

3b. Instruction

- A little too technical
- Best when showing us hands-on activities
- Both Emmanuel and Lee were wonderful to have as professors, as they are experts in their field. Emmanuel seemed particularly interested in student learning in this field and experimenting with his teaching both at UMaine and with us
- Excellent! But many concepts were too complicated for my use in a HS classroom. Instructors assumed too much background knowledge in some cases
- Excellent. Perhaps a bit more planned than time allowed, but isn't that always the truth??!
- Great –very open and responsive
- Individual and group quizzes were fun
- No Comment. I liked the set up
- Our instructors were knowledgeable and quite expert at conveying this knowledge – I particularly enjoyed the lab sessions w/many stations so I could visit those that were

newer to me and spend more time where I needed to go. I would like to have a CD or web-address from which to get copies of their PowerPoint slides used for presentation.

- The handouts of the frames are difficult to read plus you can't see the visuals very clearly
- Pedagogy instruction was the weakest link in this workshop. More time for group work and discussion would be helpful
- Teachers do not go into such depth w/ middle and lower grade high school. More details on less in depth topics
- The pedagogy sessions need improvement. Not much of value here. The pre-reading assignment were very good – but no real follow-up during the workshop

3c. Use of lap-top computer

- Brought my own
- Easier explanation on getting on the wire network with your own computer
- Printer would be nice
- Excellent. Only problem was with wireless connection. Reception was weak
- Fine! But we need to take it to our rooms at night
- Glad to have use of lap-top!
- Intermittent internet access was a significant problem
- Internet connection was spotty which made independent work difficult
- OK – wireless did not work in the dorm room
- The use of the computers was a great asset for us. However, the wireless network should be better maintained so that connections are not lost constantly while doing work/research.
- Simply having all the computers hardwired to the internet would have been just as good without the trouble of dropped service
- Would like to have more net references

3d. Conference facility

- Beautiful!
- Conference facility was quite nice!
- Excellent
- Excellent
- Excellent
- Excellent
- Excellent facility. The only additional item might be a printer for presentation purposes
- good
- Good settings for lectures, labs and discussion. Chairs in lecture room were not comfortable after long period of sitting
- Great location
- The facility was wonderful. It was a nice working vacation in a great location that really immerses you in the topic
- Very nice

3e. Accommodations, food, and recreations

- (Tell people they should bring a small fan and a lamp for their room.) Keep Paul going as chef – his food was excellent
- Accommodation - not bad, Food – excellent, Recreation – 1st night there should be a social so students and instructors can get to know each other. Other nights should have optional outings b/c teachers are on summer break to prevent burn out
- Accommodation and food were excellent. There should have been some recreation activities planned at night (especially the first night) for teachers to get to know each other
- Accommodation- great, Food – fantastic, Recreations – ample opportunity for fun
- Excellent
- Excellent
- Excellent – Recreation: not much to speak of
- Excellent cook! Paul was wonderful
- Rooms need fans or A/C
- Not enough time to pursue recreational sports, perhaps provide movie/socials in evenings
- Food – super
- Recreations – more kayaks to use in the evening would be great
- 1st night do a barbecue or some sort of mixer
- Good
- Great
- Great accommodation and food, recreation somewhat lacking – but the hikes were good and it was nice to have kayaks ready
- Please provide a packing list so participants know what they do/don't need (sheets, towel, indoor clothing, fan etc.) provide AM coffee break instead of PM coffee break if dinner is so early

4. What aspects of the workshop helped you learn the most?

- As much as I hate to peer-public speaking, the presentation forced me to actually try to apply this right away – that is definitely a good idea
- Combining lecture and lab
- Demos, lab exercises and hands-on activities
- Group work and presentations at the end
- Hands on activities. After activities explanations were provided
- Hands-on-lab
- Having topics taught with a high degree of proficiency and knowledge helped me the most and kept me from forming many misconceptions and making mistakes I could have made on my own
- Inquiry labs
- Lab – perfect for stimulating changes in my classroom approach
- Labs, working with others, content from Lee and Emmanuel and pedagogy from Herman
- Lecture – Challenging at times, but very interesting
- The format of having a lecture followed by diverse lab activities for each topic before moving on
- The hands-on after lecture. Group discussions were also helpful

- The laboratory work and discussion of what we were supposed to be seeing in the setup
(added after second lab)

5. What inquiry-based units and/or hands on activities for teaching physics using ocean concepts will you develop in the coming year?

- All of them
- Buoyancy
- Density
- Density
- I particularly like the mini-wave tanks that can slow not only waves but haloclines and thermo clines
- I want to develop a new unit on density and buoyancy
- I will certainly design lessons/activities with water layering and consequences in local fresh water. I hope to connect some ocean aspects in our chemical controversy unit and this has promoted my thinking about ways to move toward a future ocean unit
- I will focus on the Density and Pressure aspects b/c these are the two topics that relate to my required curriculum
- I will try to use 80% of the lab
- Light
- Many of the topics are not directly relevant to my college-preparatory physics courses, in terms of entire units, although I will certainly bring in concepts and topics from Ocean Science. However in my half year chemistry and physics course concepts of density, buoyancy & sinking, mixing etc. will be useful
- Resistance (drag)
- Viscosity
- Wave Velocity and Internal Waves, Hydrostatic Pressure, Fluid Drag
- Waves
- Will structure existing work to be more inquiry based

6. What learning (ideas or practices) from this course, if any, will you put to use in your teaching?

- I am going to concept-mapping as an organizational tool
- I guess I already do a fair amount of teaching using inquiry but.... I need to find and use more “learner self directed” techniques
- I like the group quizzes and also of course, greater emphasis on inquiry and ocean concepts
- I now have more hands-on salt/fresh water and temperature differences activities
- Increase hands-on work
- Inquiry – I will use more inquiry
- Inquiry – less cookbook labs and more inquiry labs
- Many of the demonstrations of fluid dynamics were wonderful and simple. Exactly what I need for teaching a new course this coming year where fluids will be much more prominent a topic than it has been in my previous classes
- Questioning techniques
- Leaving students more on their own to experiment
- Quiz after lab

- Lots of the lab ideas
- Reorganize segment on oceanography to show their (ocean's) importance to other global processes. More “inquiry” style lesson plans
- The use of discrepant events as a basis for student generated questions. Short simple single
- This course provided a very good model for integrating inquiry in the classroom in a structured way that supports learning instead of being too loosely open-ended or disconnected

7. What specific changes you will make in your teaching after attending this workshop?

- I don't think I'll be making any specific changes other than to include material that I learned and shared with my colleagues this summer during the class
- I guess I already do a fair amount of teaching using inquiry but.... I need to find and use more “learner self directed” techniques
- I will assess understanding more often and in more varied ways
- I will be stepping back from the talking role of know it all teacher to allow students more thinking time (albeit guided) as they observe discrepant events and puzzle them out
- I will make a continuing effort to add inquiry-oriented activities to my courses at all levels
- I will refine my inquiry based instruction. I already do inquiry to a limited degree
- Inclusion of the varying densities of water due to temperature and salinity
- Inquiry – I will use more inquiry
- My understanding of the variety of inquiry style learning processes has improved and thus I will be able to use different types of inquiry in my instruction
- Not sure – send out another questionnaire in a few months and I will know and can answer this question
- Re-work (invigorate the pedagogy piece)

8. We are developing an on-campus version of this course. What changes would you recommend to this course for future science teachers?

- A clear list of all the concepts need to be presented to the teachers taking the course before the course starts. This way it allows the teachers to review the concepts they may not teach in the classroom
- Develop an assessment program for the course that involves essay
- I will make more references to the ocean when looking for examples and demonstrate the topics, Density and Pressure
- Is this a semester long course?
- Ask students to develop several lessons of inquiry – generally more practice on writing inquiry labs:
- Basic inquiry lab (to intro students to this type of lab)
 - Increase difficulty of each additional lab
 - Finally developing a final lab with a different question and have your class student come up with the procedure

- It would be very helpful for the instructor(s) to choose a basic physics book to which to direct students on specific topics where students' background knowledge needs support. Teachers - students will naturally NOT have a completely common background in terms of physics and this might help GPS physics oriented teachers to feel more comfortable
 - Keep the lectures to an hour or less (not including discussion time)
 - Take time so participants may discuss and share ideas and questions (not just stealing time to do so)
 - While it's good to interact w/other grade-level teachers, offer high school – level and middle-school-level (math + less-math) lectures. Labs can be together
- No changes – but the idea has been bandied about of a workshop designed to help teachers build some of the simple lab equipment used here this week
- Provide the text on inquiry and the science standards in advance. Require students develop a variety of inquiry projects both individually and in groups and present them
- Since they will have more time, give them more opportunities to develop applications of these ideas and practice them _ may be even try them out w/kids a “visiting” instructor -
- Spread out over a semester, with slower more basic instruction, it would be great

9. Additional suggestions

- Advance notice of project would have allowed me the opportunity to bring support material
- Larger font for PP slide, handout would be helpful
- Ask Herman not to sit in the lectures and labs doing crossword and sudoku puzzles. It makes him look like he wishes he were somewhere else
- Had we spent some time on a boat to experience wave motion, used collecting device (chemistry and soil), the concepts would have become more real to us
- Thank you!

APPENDIX F. Participants' Expectation Before the Workshop

(A verbatim transcription in alphabetical order)

- How to create learning environments where inquiry can be used as an effective and reasonably efficient learning modality. I hope to use methods learned in this workshop to expand the variety of types of learning experiences I can provide for my students beyond more traditional “verify the equation” style Physics labs.
- I am looking for more hands on activities to do with my students. The balloon car project I do is great but I would like more “mini” activities to lead up to this culminating project.
- I expect to learn about the topics in this paper that I don’t teach. I expect to get further insight and obtain more interesting activities.
- I expect to fill a hole in my knowledge about the physical processes of the ocean. I have a crude understanding but I am not comfortable explaining them to my students. I also expect to learn a few new ways to teach this information. In other words, I expect to grow and so help my students grow too.
- I expect to learn more about ocean dynamics and nautical operation as well as oceanic ecology and systems. These concepts will be very helpful in teaching wave mechanics and fluid dynamics in particular. It will also help me inform students who may be planning further education in marine and nautical fluids.
- I expect to learn some activities that’ll support the physics curriculum and possibly the chemistry angle too – that will let me finally get my kids to the ocean for some outdoor labs. Since my background is more biological I do not know how to be specific. Oh yes – may be you can point out funding resources for schools.
- I hope to learn specific lab or demonstration replace some of what I’m doing now with activities that provide greater student interest and engagement (the ocean is a national interest point as I teach on the coast). Along the way I hope to find activities that do a better job at teaching concepts or exposing misconceptions than I currently use.
- I hope to more fully understand physical oceanography concepts and explore marine ecosystem. I expect to use the information to develop activities and lab to use with a new marine science course that I will teach in September. I will need to develop or adopt material for at least 20-25 labs.
- I want to teach traditionally tough Physics concepts to students by using oceanography/marine science where the original concept is clearly translated and students are then able to apply and assemble their new knowledge in a variety of situations
- I’m always trying to find new ways to teach Chemistry and Physics concepts and help students see how they explain the world around us. I’d also like to discover ways to make my teaching and my students; learning more inquiry-based. I am hoping this workshop will help me in these ways.
- In the past my curriculum has been ruled by common assessments that focused primarily on understanding and memorization of factual material. I would like to move the chemistry curriculum in particular toward a topical use of knowledge and more hands on learning. Ocean studies seem to provide a great opportunity to integrate Chemistry and Physics with our study of government/public policy. We are also helping to be involved

with some data collection and local water monitoring through another agency which would be a nice tie in.

- In this workshop I expect to increase my knowledge of ocean science and gain new ideas on how to integrate this topic/area into my Physics course (esp. re: waves, sound, light, gravitation/tides etc.) and my Chemistry course (esp. density, gases, solution chemistry etc.).
- Lots of ideas that I can incorporate into my curriculum. Our students live by the ocean and they know very little about it.
- To learn to incorporate more “hands on learning” and inquiry based learning into my classes. I am looking for better ways to show or let my students experience mass, density, light, waves, gravitational force, heat, properties of water, mass, conservation and Newton’s laws of motion.