STEMTP 2004-05 Annual Report June 1, 2005
Buffalo State College
Physics Teaching Pathways
Physics Department

Daniel L. MacIsaac, Ph.D., Principal Investigator
David Henry, Ph.D, Co-Investigator
Clarann Joseph, M.S., Co-Investigator
Marie F. Plumb, Ph.D., Co-Investigator

Activities and Findings

We continue to make progress in all of our goal areas. Our program continues to provide exemplary training for current and future physics teachers. As detailed below, we continue to expand the graduate programs that lead to physics certification, including the alternative certification for career-changing pre-service physics teachers. Our partnership with Buffalo Public Schools is growing as we nurture a future teachers club, support three Buffalo physics teachers in our summer programs, and give incentives for Buffalo Teachers to participate in the Western New York Physics Teachers Alliance activities. Recruiting future physics teachers into our undergraduate program is a goal we continue

Goal 1: Collaborating with the Buffalo Public Schools system on the BPS Recruitment Plan to bring students from BPS schools (targeting future minority STEM teachers) into BSC teaching preparation program and working to meet BPS anticipated STEM faculty needs, through the creation of Future Teacher's Clubs in BPS schools, starting with those BPS schools with strong physics programs (our goal is 4 undergraduate students / year from BPS into BSC STEM teaching program).

1. Future Teacher Club (FTC)

   We have partnered with the Center for Excellence in Urban and Rural Education (CEURE) to begin a Future Teacher Club at Hutch Tech High School. An introductory meeting was held at the high school on April 13, 2005. 17 high school students attended the organizational meeting. David Henry attended this meeting. The students were surveyed to find out where their interest in teaching lies. Most were interested in elementary or non-science/math subjects.

   A second meeting was held May 17, 2005 to continue the planning of future club activities. Dan MacIsaac and graduate and undergraduate students in physics education from Buffalo State College attended this meeting and conducted some hands-on physics learning activities with the half dozen students present. Future activities are planned for Fall 2005.

   FTC Goals for next year:

   i. Actively recruit high school student who may be interested in teaching math or science and get these students involved in the FTC. This will be

done by going directly into the physics classes, doing demonstrations and make & take activities, and discussing our teachers preparation program.

ii. Organize with CEURE a campus visit for the FTC. This visit will provide an opportunity for the education programs at Buffalo State College to discuss their programs and the application process.

2. Three BPS Physics teachers (Dolan, Kolenko & Pearse) have enrolled in the MS Physics program at BSC. Two of these teachers attended 2004 Summer Physics Academy workshops with $3720 of additional support from CEURE, and an additional $3800 from other (physics) funds.

Goal 2. Working with and fostering pre-education programs at SUNY Jamestown Community College, SUNY Fredonia State College and other WNY SUNY Community and State Colleges (the goal is to recruit 4 STEM teachers / year from Jamestown and Fredonia). We will also strengthen and foster opportunities for regular undergraduate BSC physics teacher preparation programs, we will provide targeted funding opportunities and offer graduate courses on a space available basis to about 3-4 undergraduate pre-service STEM teachers).

1. Partnership with SUNY- Jamestown Community College (JCC): During summer 2004, Dr. Marie Plumb, the JCC Co-PI, was a co-instructor for a Summer Physics Academy mechanics course at BSC. Dr. Plumb applied and was invited to attend a Physics for Elementary Teachers (PET) training course at San Diego State University in the summer of 2004. This training has led to JCC offering two PET courses in the 2004-05 academic year. A new physics course designed around the PET curriculum has been proposed at JCC. JCC has increased its marketing initiatives to attract science and math students. This training has led to JCC offering a PET course in the 2004-2005 academic year. The new course is designed around the PET curriculum and satisfies one of the lab science requirements for JCC students. It is mainly marketed to students studying elementary education, but is open to all students. JCC has also increased its marketing initiatives to attract science and math students. In 2005 JCC was awarded an NSF Grant for the purpose of awarding scholarships to students in computer science, math, engineering science, and technology. The college has used this opportunity to vigorously recruit students into these programs.

2. SUNY Fredonia State College (FSC) was awarded a MSP in February 2005. Dr. Michael Jabot (FSC) and Dr. David Henry are working on a partnership where some of the physics teacher training that is to take place in the MSP will be done through the Physics Summer Academy. In turn, FSC will provide middle school training for some of our graduate students.

3. Recruiting undergraduate physics teacher candidates: Two new Buff State candidates (Coia and Langhans) were recruited into the undergraduate physics teachers program, and both were hired on hourly wages to support the Summer Physics Academy and

WNYPTA activities for the year. A new physics department recruiting poster for all Buffalo State Physics programs, including the teachers education programs is now in design for distribution next year to WNY HSs. This will be funded by the new BSC NSF-STEP grant (PI: Singer).

Goal 3. Promoting collaboration, professional development, personal and community growth opportunities for WNY STEM professionals through expanded participation in the *BPS Professional Development Plan* and support of alliances such as the *Western NY Physics Teachers' Alliance* (WNYPTA).

We continue to vigorously support the Western New York Physics Teaching Alliance (WNYPTA). This alliance is growing, especially in supporting newer physics teachers. This year we sent 300 post cards to all local physics teachers encouraging them to join in the Saturday meetings. Personal contact was made with the Buffalo physics teachers and physics teachers at local independent schools.

This year the WNYPTA sponsored a local Physics Olympics for middle and high school students. The event was very successful with over 70 students participating. Student worked through three events and prizes were awarded to three top three teams. All student and teacher participants received t-shirts promoting physics teaching paid for with BSC physics department funds. Next year we plan on continuing the event with an additional emphasis on recruiting student into science and math teaching.

STEMTP funds were used to purchase teachers supplies: apparatus for several make-and-take activities including an electromagnetic ring launcher were purchased, assembled and taken to local physics classrooms.

One of our goals is to use the WNYPTA as a vehicle for professional development for BPS physics and physical science teachers. This year we had more involvement by local teachers and graduate student presenting at the meetings, including several graduate student presenting their Master's Project work.

Goals for next year:

i. Expand upon College Relations office efforts to make contact with local industries (Praxair, Calspan, Moog, West Valley). Our goal is to garner support for current and future teachers and physics student in the form of materials, and sponsorships, and though last year three corporations were contacted without response we will be following up on this effort.
ii. Use the WNYPTA as a vehicle to recruit high school student into math & science teaching. We will start with the Physics Olympics event and announcements at the meetings.

The attendance at the meetings ranged from 25-45 participants. Details and minutes from the meetings can be found at <http://physicsed.buffalostate.edu/WNYPTA/meetings/2004-05/>. Below is a summary of the events for the 2004-05 school year.

Sept 25, 2004

- Presented by Dr. Dewayne Beery and Dr. Dan MacIsaac - examples of in class problem-solving and meta-cognition
- strategies for teaching physics by Larry Hiller and David McClary
- construction of a make-and-take crossbow apparatus for teaching projectile motion with Lowell Sylwester
- advance preparation for a Physics Pinewood Derby by Jeff Yap
- local physics and science teaching announcements and organization appropriate for the WNYPTA

Oct 23, 2004

- Water Bottle Rockets and organizing Physics Olympics Events. Dave Henry will lead us in making and launching water bottle rockets, discussing teaching ideas using the rockets and making launchers.
- introductions, comments and local physics and science teaching announcements and opportunities
- organization for the forthcoming WNYPTA Physics Olympics in November

Nov 20, 2004

- Physics Olympics. This is an opportunity for your students to come and participate in a friendly competition of physics Olympic events.

Dec 11, 2004

- Introductions and news of interest: Debrief of Phy Oly of 11/20; topics for next year; course plans at BSC
- Idea Sharing (bring a short demo, curriculum issue, unidentified lab equipment to share if you like)
- White Board Ideas Sharing (Muselli / MacIsaac): Bring your best WB activities as handouts or on disk for the WNYPTA website. We will do several. All delivered electronically will be made available for download.
- Marshmallow Gun Make & Take (Van Dette / Coia): We will be using PVC glue, so dress appropriately. Anyone helping with assembly will take home at least one.

Feb 12, 2005

- Introductions, announcements and news of interest
- summer course (for Physics Teachers) plans at BSC and Cornell

- Idea Sharing (bring a short demo, curriculum issues, unidentified lab equipment to share if you like)
- Spintronics for HS Physics Teachers Presentation and Demonstrations by Professor B. McCombe, UB Physics
- Electromagnetic Ring Launcher / Transformer Make & Take (Mr. Sam Sampere of Syracuse Physics, assisted by many): We will be cutting and winding a half of an AC transformer, so dress appropriately. The first 35 working teachers to arrive get to take one of these $40 marvels home with them for free.

Mar 19, 2005

- Jeff Yap & Dan MacIsaac, SUNY-BSC: Teaching Electricity And Magnetism By Constructing And Analyzing Small Electric Motors.
- Patricia T. Viele, Cornell University Physics & Astronomy Librarian: Integrating Information Literacy into Physics Curriculum.
- Michael Magnuson, Canisius HS: Experimentally Measuring the Speed of Sound with Public Domain Software and Hardware. A demonstration and discussion will ensue, contributing to Magnusson's manuscript in preparation on this activity.

Apr 16, 2005

- Joe Zawicki, SUNY-BSC: Laboratory Performance Assessment Activities in Physics. Participants will complete two standard performance assessment activities of the kind that could be adopted for Regents Part D. A discussion of performance assessment will follow.
- Sue Saeli & Dan MacIsaac, SUNY-BSC: Teaching Electricity via Gravitational Analogies. We will describe the use of extended gravitational analogies for learning electric concepts such as field, voltage, E, and energy. An in-press TPT manuscript will be available.
- Dan MacIsaac, SUNY-BSC: Pinhole and Lens Demonstrations. A series of demonstrations, including how to make your entire classroom into a giant pinhole camera.

May 21, 2005

- physics demonstrations by various members of the WNYPTA
- discussion and analysis of the NYSED Regent's Physics Exams of last year by Joe Zawicki
- demonstration of the visualization of electric fields with grass seeds and mineral oil by Michael Magnuson
- discussion of Randall Knight's new physics text and workbook package by Craig Uhrich
- local physics and science teaching announcements and organization appropriate for the WNYPTA

Goal 4. Vigorously promoting and populating the new *BSC M.S.Ed.-Physics Alternative Certification* program for STEM professionals, providing an alternative pathway (without student teaching by *NYSED Transitional B Certification*) into teaching careers through targeted minority candidate recruitment, targeted *NSF-CEURE Physics (or Physical Science) Teacher Fellowships*, scholarships, graduate assistantships, hourly wage and stipends as appropriate (our goal is 15 teachers / 4 years).

The alternative certification program for physics teachers at BSC began in the summer of 2002. The program offers a path for STEM professionals to become certified high school physics teachers. The program is registered under the Transitional-B certification regulations in New York (see <http://www.highered.nysed.gov/ocue/Alternative%20Teacher%20Certification%20Program.htm> for details about this type of certification). The Transitional-B certification requires teacher candidates to complete all course requirements of traditional teacher candidates, but allows the candidates to move into a mentored teaching position instead of student teaching. This allows these teachers to fill areas of need, such as physics. Details of the BSC Alt Cert physics program can be found at <http://physicsed.buffalostate.edu/programs/index.html>.

The recruitment for the BSC Alternative Certification program in physics has been very successful. Mostly through word-of-mouth and targeted contacts, a regular stream of Alt. Cert candidates have been contacting us for details. The Alternative Certification Program is included in the Physics Education Program brochure. Multiple recruiting presentations were made advertising the programs at local and national science and physics teachers association meetings, and a peer-reviewed scholarly paper was published describing the alternative certification program in Nov, 2004: *MacIsaac, D.L., Henry, D., Zawicki, J.L. Beery, D. & Falconer, K. (2004). A new model alternative certification program for high school physics teachers: New pathways to physics teacher certification at SUNY-Buffalo State College. Journal of Physics Teacher Education Online, 2(2), 10-16.*

Alternative Certification Program activity & growth:

	May 2003	May 2004	May 2005
candidates admitted in our program.	2	12	19
candidates active in our program.	2	10	13
candidates currently in mentored teaching positions.	0	2	5
candidates moving into mentored teaching positions in Fall, contingent on job placement.	2	5	5
candidates who have completed program and remain in teaching positions	0	0	1

Goal 5. Vigorously promoting opportunities for currently certified statewide NY teachers to obtain a second certification in physics and general science by populating the newly revised *BSC M.S.Ed.- Physics* program. All newly certified NY teachers are now required to earn a masters' degree as part of their permanent certification requirements, and we intend will recruit currently certified teachers who are not science or physics certified, yet require additional certification to meet rural and urban LEA instructional needs for physics and science teachers (our goal is 45-60 teachers / 4 years).

The BSC M.S. Ed – Physics program is populated both with certified teachers of other subjects seeking physics certification and physics teachers seeking deeper study in teaching and learning physics. A combination of the Summer Physics Academy courses and on-line courses allow teachers from across New York State to complete this program.

1. Activity in developing the M.S. Ed. Physics program
    1. Graduate course offerings and enrollment

Summer 2004 Physics Teacher's Academy:

PHY 620 (E&M for HS teachers; 6cr): 32 participants
PHY510 (Physics Process Skills; 6cr): 26 participants
Physics for Elementary Teachers (K-8 Physics): 24 participants

Fall 2004:

PHY518 (Waves & Optics, 3cr): 14 participants
PHY690 (Master Project, 3cr, ONLINE): 6 participants (one alternative certification candidate-participant in PHY690 published his project in a peer-reviewed journal and won the SUNY- Buffalo State College Outstanding Masters Project Award for 2004/5: Gosling, C. (2004). Addressing academic challenges facing high school physics students: A synopsis and annotated bibliography of peer-reviewed literature addressing classroom culture, gender, relevance and introductory physics instruction. Journal of Physics Teacher Education Online, 2(2), 3-9. A second student has co-authored a peer-reviewed manuscript accepted for future publication in The Physics Teacher.

Spring 2005:

PHY500 (Physics Education Research seminar ONLINE, 3cr): 15 participants
PHY690 (Master Project, 3cr): 3 participants
PHY520: (Modern Physics for HS teacher, 3crs): 12 participants
PHY507 (Physics for Elementary Teachers) blocked with EDU 671 (Constructing Science Understanding): 27 students.

2. Enrollment and growth in the M.S.Ed. Physics program. The following table shows the steady growth in the program. As of May 2005, we are approaching capacity in the program.

Enrollment and growth in the M.S.Ed. Physics program (non-Alt Cert)				
	Sept 2002	Sept 2003	May 2004	May 2005
Total number of candidates active in program.	3	17	22	26
candidates seeking certification in physics.	2	9	20	23
candidates who hold physics certification	1	8	12	6
Underrepresented and women physics teachers	0	3	5	8

3. Support for graduate students. $19,363 total in tuition scholarships awarded in summer 2004 ($10k stipends from NSF, $3,680 from BSC CEURE, $3,680 from BSC Graduate Studies and Research and $3800 from the physics department). Spring and Fall semester tuition scholarships: $9,500 from BSC Graduate Studies and Research with another $3,500 from BSC internal funds. Two NSF graduate assistantships at $20k and $8,500 to undergraduate students, all candidates except one undergraduate are potential future physics teachers. Teacher participants also received $11k for meals, materials and supplies with a priority on all funding to alternative certification teachers and High Needs LEA teachers <http://physicsed.buffalostate.edu/programs/Summer04/Sum04Scholarships.html>

   In 2004, BSC was awarded an NSF- Noyce scholarship program grant to support transition from STEM professions to teaching math and science. This has allowed us to support more career changers in our program and give incentive to undergraduate physics students to choose teaching as a career. One minority alternative certification candidate in physics (Caban) was supported with a Noyce fellowship of $8500 in 2004-05; he also earned hourly wages from STEMTP funds.

Goal 6. Vigorously promoting opportunities for teachers enrolled in the revised *BSC M.Ed. in Elementary Education (Pre-K-6)* to acquire expertise in physical science instruction through the provision of new graduate level physical science teaching courses (our goal is 90 teachers / 4 years, and that program will also satisfy new NYSED requirements for permanent certification).

We are on track to surpass our goal of 90 elementary teachers participating in workshops and courses to acquire expertise in teaching physical science. Through a combination of Physics for Elementary Teachers workshops, a new physics course designed for graduate elementary education majors, and undergraduate courses designed specifically for elementary education majors at BSC and JCC, we are having a significant impact on elementary teaching.

A new graduate physics course for elementary teachers was designed and approved. PHY 507: Physics for Elementary and Middle School Teachers is based on the PET

curriculum developed by Goldberg, et. al. at San Diego State University. This course will fulfill a need in the Elementary Education Curriculum and Instruction Masters degree for science content courses. This course was offered in the spring of 2004 with 27 students successfully completing the course. Dr. David Henry taught the course. Currently, this course is being blocked with EDU 671: Constructing Science Understanding in an Elementary Classroom. By blocking these two courses, we are able to combine learning physics with an in-depth study of best practices in elementary science. The culminating project in this course is a study of elementary students' thinking centered around interviewing children. The success of this course is demonstrated by the eight students who presented their work at the Student Research and Creativity Day at Buffalo State College in April 22-23, 2005. Twelve students have chosen to expand their study into a Master's Project working with Dr. Henry. This blocked set of courses will be offered again in summer 2005 and spring 2006. In 2004, these courses were reported at a national physics teachers' conference in an invited presentation: *Henry, D., MacIsaac, D.L., Falconer, K.A., Zawicki, J.L., & Plumb, M.F. (2004) (INVITED PRESENTATION). DH03: Combined science methods and physics content courses for teachers. American Association of Physics Teachers Announcer, 34(2), 142-143.*

Physics for Elementary Teachers workshops. Dr. Henry joined the PET project as a collaborating faculty in the summer of 2003. In this role he taught PHY 507 in the Spring 2004 semester and led a PET workshop with Dr. Jabot for 24 inservice elementary teachers as part of our 2004 Physics Summer Academy. Dr. Plumb (Jamestown CC) traveled l to SDSU for PET training in July 2004 and has developed and taught a PET course for undergraduate pre-service elementary teachers at her institution. Our involvement in the PET project stems directly from the PTP summer academy and our infrastructure to conduct workshops.

Below is a table summarizing the numbers in the various courses and workshops for elementary teachers at BSC and JCC.

Course	BSC PET	BSC PHY 507	BSC PHY 107	BSC PHY 108	JCC
Semester	Summer 2004	Spring 2005	Fall 2004	Spring 2005	Spring 2005
Preservice/Inservice	Inservice	Inservice	Preservice	Preservice	Preservice
# of participants	24	27	27	15	17

Goal 7. Institutionalizing and significantly expanding the current *PTP Summer Teacher's Academy* offering three intensive 6 graduate credit workshops of 12 day's duration each every summer (90 seats). The PTP Academy features exemplary standards-based, NSF-funded research-informed curricula combining physics and physical science content and reformed pedagogy for K-12 teachers. This academy will be the backbone of this project, providing shared experiences, opportunity and community for all of the teachers enrolled in the programs listed above.

The main activity of the PTP was the Summer Academy. We had an enrollment of 91 students over 3 workshop courses. The activities of each workshop course will be described separately.

PHY 510: New Physics Teacher Workshop.

This workshop ran July 20 through August 1, 2004, for a total of 90 contact hours. The instructors for this workshop are four master high school physics teachers who are currently teaching or recently retired. The course is assembled from activities used in the teachers' curriculum and from state-of-the art constructivist inquiry-based student-centered physics and physical science curricula themselves developed by PER researchers and curriculum developer under the sponsorship of the NSF.

Specific activities included in this course:

1. Lab Activities that the participants can take directly back to their classroom. These activities use research-based pedagogy, emphasizing student centered, social construction of concepts.
    - Pendulum (Modeling)
    - Springs, Hooke's law (Modeling)
    - Kinematics (Modeling, CPU)
    - Force and momentum (CPU)
    - Two-dimensional motion
    - Newton's Laws
    - Standard Model (CPEP)
    - Waves (Modeling)
    - Electric circuits (CPU, modeling)
    - Refraction
2. Activities designed to facilitate reflection on teaching and learning
    - Introduction to RTOP
    - Designing curriculum starting with Major Understandings (Backward Design, Wiggins)
    - Role of New York Curriculum in planning instruction
    - Role of assessment in planning and teaching
3. Activities designed to increase interest and motivation in learning physics
    - Physics Olympics activities
    - Demonstrations
4. Other Activities

Summary of enrollment in PHY 510:

Summer 2004 PHY 510 New Physics Teacher Workshop	
Total enrollment	20
Teaching Experience	
0 years	8
1-5 years	7
5-10 years	5
Type of Schools	
Urban, High Needs School	3
Rural, High Needs School	9
Suburban	1
Public	10
Private	3
Type of current teaching certification	
Physics	6
Chemistry	2
Biology	2
Earth Science	5
Math	0
Childhood	0
No certification(working toward Alternative Certification)	6
Seeking Physics Certification	14

PHY 510 Impact

The Institute for New Physics Teachers has a rich history and a remarkable track record. Student comments from the final program evaluation surveys support the conclusion that this program has a substantial impact upon physics classrooms in New York State.

Student comments include:

"I think the teacher is a strong motivator. The teacher leads and guides the class rather than imparts knowledge upon the class. The teacher should lead the class toward discoveries."

"I now have a lot more ammunition to take back to my classroom."

"I have learned that I need to assess the students on one aspect of physics per question; Regents (level) students cannot have two part questions, only AP (students)."

"I can see more of the dilemmas students face in physics. I will let them do more self-discovery and lecture a bit less."

"Over the summer I have been 'reformed.'"

"The physics teacher is a facilitator. He/she needs to direct student learning. Students need to provide feedback through think-pair-share, investigative class labs, and whiteboarding in order to convey their understanding of this subject."

"Teaching by lecture is not sufficient. The teacher must have a guided discussion with the entire class to allow for true understanding (i.e. whiteboarding, think-pair-share, student facilitators).

"Students need to think qualitatively before quantitatively."

"I need to get away from teacher centered activities and use more student centered ones. I need to also put into practice all of the "reformed" physics instruction techniques."

"I need to come up with a new lab book. I want my students to retain the knowledge they receive in my classroom. I know lecturing won't allow them to achieve. I understand the Core Curriculum better and how to follow it to make sure my students are well prepared."

"Well, I know that I'll be doing less chalk talk and much more demonstration. With the whiteboards, I'm going to have a new powerful tool to enhance the classroom. I'm going got be less of an authority in terms of doing it all."

"It just looks like a lot more fun. I always wanted a classroom where I can work with my students as they discovered the world, and all the information I got here makes it look so possible and rewarding. (I can't wait to get my own physics classroom!)

PHY 510: Summary Evaluation

Table 1 indicates the final evaluation questions the frequency of student responses. Overall, participants indicated that PHY510 was worthwhile, they valued their learning experiences and that they would recommend this class to other students. The items that students rated the least favorably included the amount of time allotted for individual sessions, the value of social functions and the relationship between assessments and assignments and student learning.

Table 1. Summary evaluation

		Strongly Agree (4)	*Agree (3)*	*Disagree (2)*	*Strongly Disagree (1)*
1	Over all, the program was a worthwhile experience.	17	2	0	0
2	I would recommend this type of program to other high school physics teachers.	19	0	0	0
3	Laboratory activities where student construct their own ideas should continue to be the major emphasis in future programs.	19	0	0	0
4	Laboratory activities provided me a number of helpful ideas for teaching.	17	2	0	0
5	Time allotted for individual sessions was adequate in light of anticipated outcomes.	12	6	1	0
6	Instructors were helpful and supportive.	15	4	0	0
7	Instructors were accessible and available throughout the program.	17	2	0	0
8	Instructors were receptive to our suggestions and initiatives.	15	4	0	0
9	Lab and discussion sessions were well organized.	15	4	0	0
10	References mentioned or provided were pertinent to teaching the physics courses I teach.	16	2	0	0
11	Suggested alternative lab activities will be tried.	16	3	0	0
12	Demonstrations that were experienced or suggested will enhance my teaching.	17	2	0	0
13	The focus was on improving student thinking.	18	1	0	0
14	Participant involvement during discussions was sufficient.	17	2	0	0
15	The social functions provided a worthwhile opportunity to become acquainted with other participants.	10	8	0	1
16	Make and Take sessions presented many new and/or useful teaching ideas.	17	2	0	0
18	Future institutes should retain the current balance of labs/seminars/hands-on sessions.	17	2	0	0
19	I would like to continue to be involved in PTP activities.	17	2	0	0
20	The assignments and assessments helped me assess my learning.	9	6	3	1

PHY 510: Content Development & Utility of Activities

Table 2 presents PHY510 activities ranked based upon their content value. Students clearly recognized the value of staff demonstrations, as well as rocket building and launching and the Physics Olympics. The students indicated that these activities were essential components of the class and that these activities helped participants to develop their understanding of physics content. Students also indicated that the topics of refraction, the standard model and circuits and resistance were less beneficial. The lower ranking of circuits may be related to proportion of students completing advanced courses in electricity and magnetism during the month prior to the 510 course.

Table 2. Ranking of activities by impact on content development (self-report)

	Great -- Keep	*Adequate*	*Needed More*	*No Response*
Staff Demos	**18**	**0**	**0**	**1**
Rocket Building & Launch	**18**	**0**	**0**	**1**
Physics Olympics	**17**	**1**	**0**	**1**
Private Universe	**15**	**2**	**0**	**1**
Participant Sharing	**14**	**4**	**0**	**1**
Waves	**13**	**5**	**0**	**1**
Quantum Leap	**13**	**5**	**0**	**1**
Introduction to Circuits	**12**	**6**	**0**	**1**
Resistance of wire	**12**	**5**	**0**	**2**
Standard Model	**10**	**6**	**1**	**1**
Refraction	**9**	**4**	**3**	**3**

The participants considered waves, rocket building and launching, the Physics Olympics, and the circuits to be among the most useful activities. Participants indicated that they will be using this approaches in their classrooms. The least applicable activities were the participant sharing, quantum leap, refraction, the standard model, and staff demonstrations. Participants suggested that procuring equipment for classroom use would be an issue with activities or demonstrations presented during the staff demonstrations, introduction to circuits, the Private Universe, the standard model and refraction.

Table 3. Ranking of activities based upon utility in K-12 teaching program

	Will be useful to my program	*Equipment may be a problem*	*Too difficult for my students*	*Other (please explain)*
Waves	**19**	**0**	**0**	**0**
Rocket Building & Launch	**18**	**1**	**0**	**0**
Physics Olympics	**18**	**0**	**0**	**1**
Introduction to Circuits	**17**	**2**	**0**	**0**
Resistance of wire	**17**	**0**	**0**	**2**
Private Universe	**16**	**2**	**0**	**0**
Staff Demos	**15**	**4**	**0**	**0**
Standard Model	**15**	**2**	**1**	**1**
Refraction	**15**	**2**	**0**	**2**
Quantum Leap	**15**	**0**	**1**	**3**
Participant Sharing	**14**	**2**	**0**	**3**

PHY 510 Comments on Workshop Goals

Table 4 presents a summary of the data collected about how successfully the course met participants expectations for workshop goals. Participants felt that they were familiar with classroom activities and teaching strategies that are aligned to reformed teaching practices, and that they have experienced activities that allow all physics students to develop problem-solving skills. Participants were comfortable with providing instruction that integrates demonstrations and activities into class experiences. Most students ranked the sessions related to these goals as excellent.

Students were less comfortable with computer-enhanced instructional practices, the June 2004 NYS Physics Exam analysis discussion and student preparation for future exams. Half of the participants ranked these sessions as “good.”

Table 4. Comments on workshop goals

	Excellent	*Good*	*Fair*	*Poor*	*NR*
To become familiar with effective classroom activities and strategies that are necessary to be successful in the new physics core curriculum	**17**	**1**	**0**	**0**	**1**
To experience laboratory activities that help all physics students develop problem-solving skills.	**17**	**1**	**0**	**0**	**1**
To learn how to provide classroom instruction that effectively integrates demonstrations and group activities that build on students' prior knowledge.	**15**	**3**	**0**	**0**	**1**
To become familiar with the format of the new Regents Exam: Physical Setting/Physics.	**12**	**6**	**0**	**0**	**1**
To learn how to incorporate into lessons student activities that illustrates the interaction of science, technology, and society.	**10**	**8**	**0**	**0**	**1**
To examine assessment instruments designed to help physics students prepare for the new Regents Exam: Physical Setting/Physics.	**8**	**8**	**2**	**0**	**1**
The discussions about lesson planning and specific June 2004 Regents Physics exam questions were helpful.	**7**	**9**	**1**	**1**	**1**
To experience computer-enhanced instructional practices for developing science concepts elusive to other teaching strategies.	**7**	**8**	**3**	**0**	**1**

PHY 510 Conclusion

The student evaluations support the conclusion that the course is functioning quite well. The program has a number of extremely successful components, and is clearly supporting student-centered instruction with a particularly emphasis on developing problem solving skills. Based upon the student responses, the allocation of time, the nature of the assignments and the assessments, and social functions merit review and possible revision.

While some activities, such as the staff demonstrations, rocket building and launching and the Physics Olympics appear to be working well, others, such as the standard model and refraction may warrant revision.

Students rated the course as largely meeting workshop goals, with most goals rated as either excellent or good. The areas of computer-enhanced instructional practices, assessment review, lesson planning, and student preparation for regents exams should be examined and revision should be considered.

PHY 620: Modeling and Powerful Ideas in Mechanics.

This workshop ran July 7 - 23, 2004, for a total of 110 contact hours. The instructors for this workshop included BSC physics, science education and education faculty with two master high school physics teachers. The course reviewed the entire NSF-funded ASU developed Modeling Physics curriculum from <http://modeling.asu.edu/modeling-HS.html>; participants carried out almost all activities first acting as a student, then repeating as a teacher to debrief and analyze pedagogy. Supplementary activies included conceptual physics from the NSF-funded Conceptual Physics Understanding (CPU) and Physics for Elementary Teachers (PET) curricula by Goldberg of SDSU physics. Supplementary activities also included calculus based activities from Chabay & Sherwood's *Electric and Magnetic Interactions* text, Context Rich Problems from the University of Minnesota physics education research group, and readings from Physics Education Research (PER) publications such as those of Arons and McDermott. An exact course schedule is available online at <http://physicsed.buffalostate.edu/courses/04/summer/PHY620/>

Activities included:

- Pre-tests and post-tests via standard PER and SER instruments (FCI, FCME, EBAPS)
- Modeling and Scientific Thinking
- Constant velocity motion
- Reformed Teaching Observation Protocol (RTOP) workshop
- Constant acceleration motion
- Inertia
- Newton's Laws
- Two Dimensional motion
- Energy
- Central Forces
- NY Regent's Physics Exams
- Momentum
- Demonstration Poster Session
- Final Content Exam and post-testing

The enrollment for this course is summarized below:

Summer 2004 PHY622	
Total enrollment	32
Teaching Experience	
0 years	11
1-5 years	13
5-10 years	8
Type of Schools	
Urban, High Needs School	2
Rural, High Needs School	5
Suburban	14
Public	19
Private	2

PHY 620 Impact

The summer institute series at SUNY Buffalo State College has three years of successful course offerings. One component of the program, the New Physics Teacher Institute (PHY510), has an even longer track record.

Specifically, participants generally found PHY620 to be delightful and thought provoking. Students made the following positive comments on summative course evaluations:

Resources/General Comments

- The availability of materials, especially the binders and CD's and poster projects (was great).
- Moving back and forth between teacher and student mode.
- All of the different ideas.
- Discussions were excellent.
- Exposure to different teaching strategies (modeling, graphs & tracks, etc.).
- Adjusted length (and assignment load) a big improvement over last year. Readings, content materials and activities were helpful.
- Hovercraft – useful and fun tool for my classroom.
- Comfortable and flexible environment.
- Flexible nature of program
- Learning – commentary – encouraged self-assessment.

Faculty

Faculty and staff were great; students were encouraged to actively participate, content was excellent.

- □ I really like the modeling curriculum and plan to use it in my teaching.
- □ Being taught by someone that uses modeling with high school students
- □ The professors are awesome.
- □ Chris Filkins was an exceptional instructor. (His personal experience and charisma made the course.)

Whiteboarding

- □ Whiteboarding, content specialty test preparation and system schema (were useful).
- □ Good emphasis on whiteboards
- □ White board discussions were useful.
- □ Whiteboarding discussions.
- □ Whiteboarding sessions encouraged dialogue on many levels.

Assignments

- □ Assignments were challenging, but excellent.
- □ Reflections, discourse and activities were all difficult but helpful.
- □ Good interaction between students and teachers
- □ Good to experience technology.
- □ The activities were meaningful.

Technology

- □ Logger Pro was useful.
- □ Computer programs, discourse and curriculum are useful in the classroom.

Students expressed the following concerns on summative course evaluations:

Resources/General Comments

- □ planning, the ability to stay on schedule, and closure.
- □ the ability to meet (for social activities) earlier in the course
- □ Schedule/organization – "I understand that the class tried to be flexible, but it might be better to over prepare than have holes in the schedule.
- □ Nit-picking.
- □ Work outside of an 8 hour day.
- □ Down time.
- □ The course did not focus on modeling as much as I had hoped. (More time was spent on content than I anticipated.)
- □ Not enough content.
- □ Cut down the amount of material for more time on each topic.
- □ Get rid of poster presentation
- □ The way grouping was done (change more often).
- □ More hands-on and make and take activities.
- □ During the first week shorter lunch times with earlier dismissals
- □ At times the workshops became boring.
- □ Difficult to write three (3) learning commentaries during a 2.5 week course.

- Keep two weeks and cut out lunches and add a Saturday.
- Less arguing, teach how to use programs.
- Three weeks might be better.
- Poster project not very useful.
- Facilities were significantly sub par. The classrooms did not encourage a cooperative setting, in fact they hindered it. The air conditioners were terrible and greatly contributed to students' misunderstanding as well as an unorganized environment.
- An online schedule would be helpful.
- Limit time for whiteboarding or involve more people.
- Intense workload.
- Start class on time.

Faculty
- Too much of one teacher.
- Frustration with instructors who haven't been through the entire program and then make changes.
- The (instructor's) attitude, actions and involvement were detrimental to my learning experience.(22)

Whiteboarding
- Too many whiteboards. Too many whiteboards. Too many whiteboards.
- Too large a class for discourse.
- Workshop format was somewhat repetitive (worksheet, whiteboard, discourse).
- Less time whiteboarding, more time on misconceptions

Assignments
- Less homework during the last week and more problem solving (and providing more problem solving solutions).
- More structure to student work would have been helpful.
- The group test was challenging, due to a lack of time.
- The final exam should be given over a longer time period.
- Poster presentations should be at the same time for all participants.
- Some assignments (homework, activities, tests)were ambiguous.
- Is the last day of class what will be most memorable for the instructors?

Technology
- Too much technology involved (equipment issue back at school).
- Data analysis programs were not really touched upon. (I had little experience with the program and therefore I didn't learn how to use the tools.

Students also raised the following questions during the course evaluation:
- How did the wheels hanging from the ceiling work?
- When can I do something like this again?

Part A: Summary Evaluation

Table 1 presents a summary of student responses to evaluation prompts. The data support the conclusion that most participants found the course to be useful and the instructors helpful. The students indicated that the course focused on improving student thinking. Most participants strongly agree that whiteboards will enhance their teaching. Students were less certain of the value of the reading assignments, learning commentary assignments and web assignment in self-assessment. Based upon participant responses, the bibliography and poster preparation assignments were not as successful in facilitating student learning. The majority of participants indicated that they would like to continue to be involved with BSC Physics teaching activities.

Table 1. Summary evaluation.

		Number Responding:			
	Part A - Summary Evaluation	***4***	***3***	***2***	***1***
1	Over all, the program in week 1 was a worthwhile experience.	21	9	1	0
2	I would recommend this type of program to other high school physics teachers.	22	8	1	0
3	Activities where students construct their own ideas should continue to be the major emphasis in future programs.	24	6	1	0
4	Activities provided me with a number of helpful ideas for teaching.	20	11	0	0
5	Time allotted for individual sessions was adequate in light of anticipated outcomes.	10	11	10	0
6	Instructors were helpful and supportive.	26	4	1	0
7	Instructors were accessible and available throughout the program.	26	5	0	0
8	Instructors were receptive to our suggestions and initiatives.	22	8	1	0
9	The sessions were well organized but flexible.	11	16	3	1
10	References mentioned or provided were pertinent to teaching the physics courses I teach.	18	12	1	0
11	Suggested alternative curricular activities will be tried.	23	7	0	0
12	Whiteboards will enhance my teaching.	24	7	0	0
13	The focus was on improving student thinking.	26	5	0	0
14	Participant involvement during discussions was sufficient.	18	11	1	0
15	The social functions (coffee times and Coles') provided a worthwhile opportunity to become acquainted with other participants.	19	10	2	0
16	I would like to participate in a List Serve to continue to participate in this learning community.	9	19	2	0
17	Future courses should retain the current balance of activities.	14	12	5	0
18	I would like to continue to be involved in BSC Physics teaching activities.	25	5	1	0
19	The reading assignments helped me assess my learning.	8	13	9	1
20	The learning commentary assignments helped me to assess my learning.	16	13	1	1
21	The web assignment helped me assess my learning.	1	14	11	4
22	The bibliography assignments helped me assess my learning.	3	8	14	4
23	The poster preparation helped me assess my learning.	4	13	10	4

Part B: Content Development & Activity Utility

Figure 2 indicates the number of students that identified various activities as adequate. The total number of participants was 31; those responses not included in the total indicated that they needed more or they did not respond. Whiteboarding, graphs and tracks, modeling, hovercraft construction, problem-solving sessions, and the poster session received the most “adequate” votes. The personal response system and data studio received the lowest rating. Students indicated that graphs and tracks, hovercraft construction, graphical analysis and whiteboarding should all be kept. The poster session

and the pyramid exam were rated the lowest on the "keep" scale, with positive responses from less than half of the participants.

Figure 2. Activities -- Adequacy

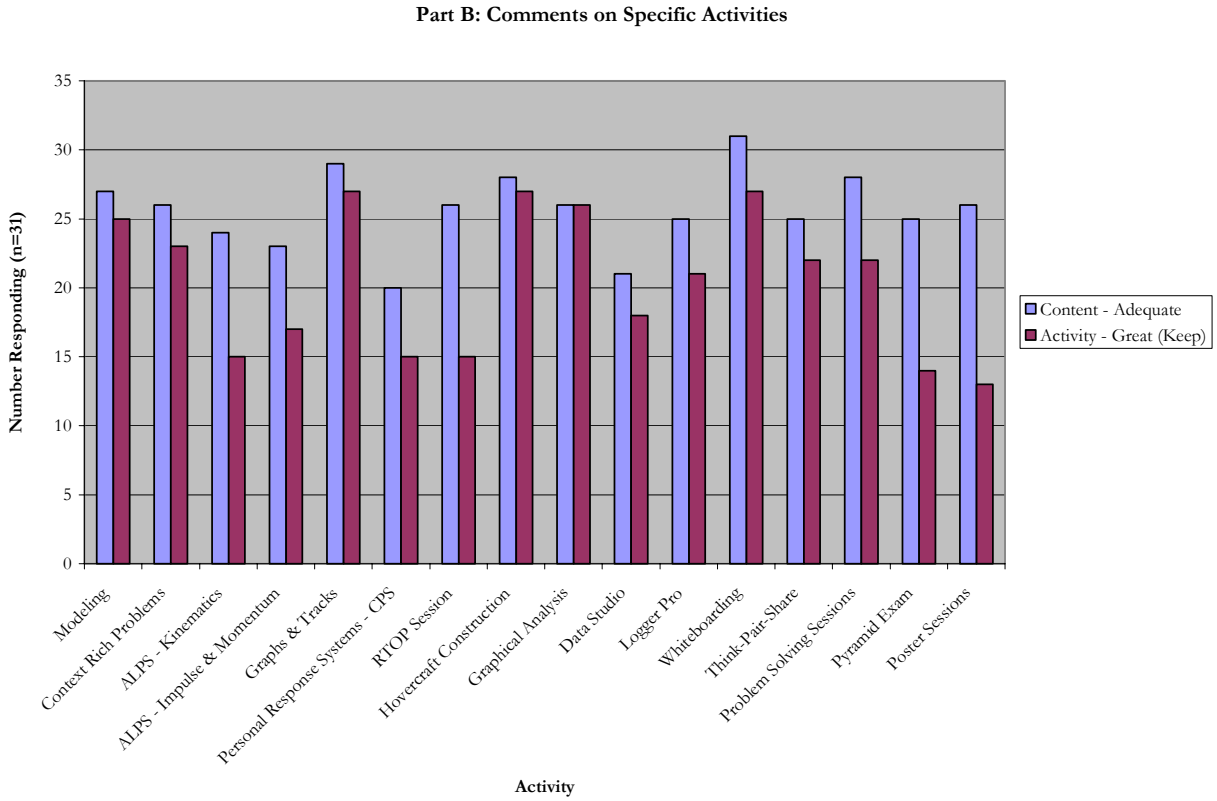
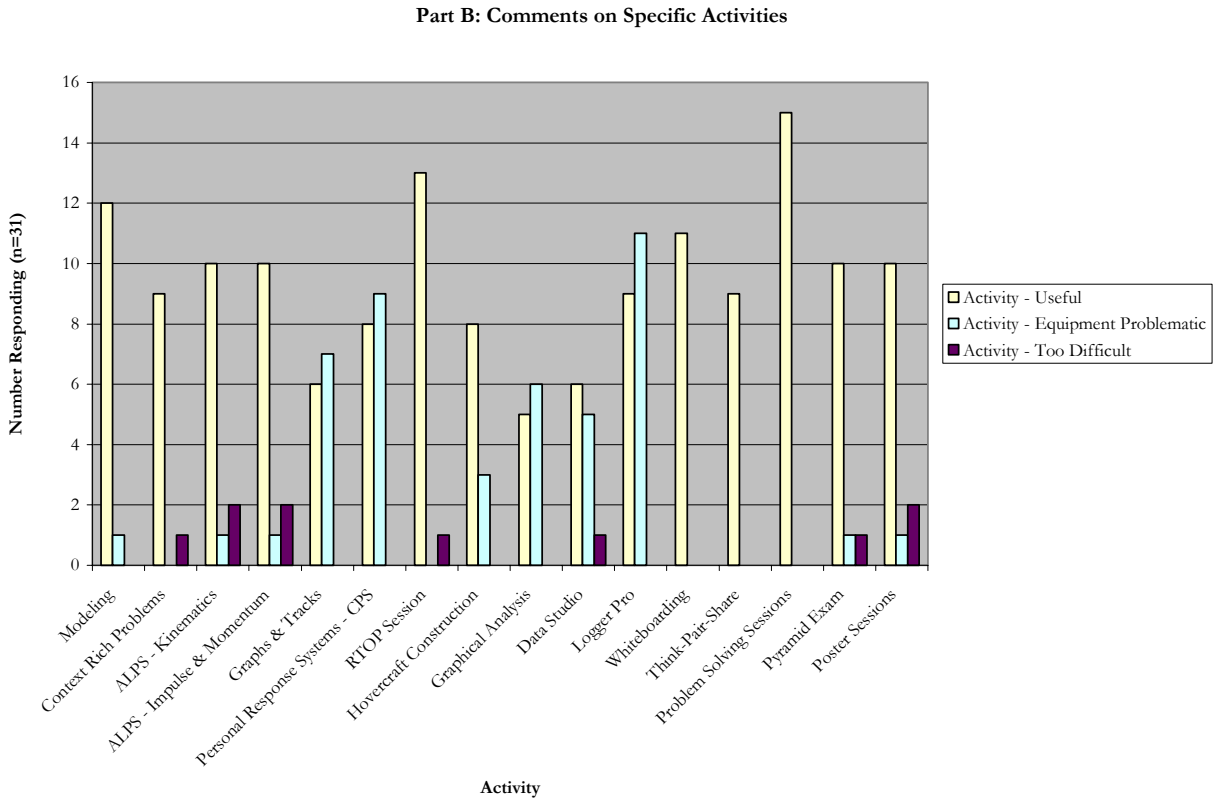


Figure 3 displays a summary of the student responses for the usefulness of activities, possible equipment issues, and topic difficulty. The problem solving and RTOP were among the most useful, according to student responses. The logger pro and personal response system topics were those most likely to requirement equipment that was unavailable. Respondents indicated that the ALPS-Kinematics, ALPS-Inertia and Momentum, and the poster session were rated as too difficult by three participants.

It should be noted that the format of Part B of the summary evaluation may have caused some confusion among participants. Changes have been recommended for future administrations. (Zawicki, 2005.)

Figure 3. Participant comments on specific activities.



Conclusion

The overwhelming success of both PHY620 and the Physics Teaching Pathways program at SUNY Buffalo State College speaks volumes. While some of the instructors and topics received excellent reviews, participant comments suggest that revisiting the overall number and distribution of assignments, as well as the configuration of working time provided during the noon-hour is appropriate at this time.