Repairing the Illinois high school physics teacher pipeline: Recruitment, preparation and retention of high school physics teachers ~ The Illinois model[1]

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The Illinois Section of the American Association of Physics Teachers (ISAAPT) held a two-day special session during the autumn of 2004 aimed at repairing the Illinois high school physics teacher pipeline. An ad hoc committee was established by the ISAAPT at its Spring 2004 Section meeting for the purpose of reviewing and making recommendations in light of physics teacher shortages being experienced in the State of Illinois. The committee was charged with examining recruitment, preparation, and retention practices for physics teachers in Illinois, and making recommendations for improvement in identified problem areas.

A special research review and discussion session was held by the ISAAPT Ad Hoc Committee on High School Physics Teacher Recruitment, Preparation, and Retention at Illinois Central College in East Peoria, Illinois, on October 14/15, 2004. The purpose of this special session was to address the ongoing and increasingly dire problem with the undersupply of secondary-level physics teachers in the State of Illinois. Recruitment, preparation, and retention of high school physics teachers were the main foci of study and discussion in this session. The work of the Committee resulted in a series of key findings and recommendations that, if followed, will lead to a partial resolution of the identified problems. This Committee presented tentative findings and recommendations at the ISAAPT autumn meeting held on October 16, 2004 at Bradley University in Peoria, IL. This Full Report provides a formal summary of key findings and recommendations, and culminates in "The Illinois Model" for improving the recruitment, preparation, and retention of high school physics teachers.

Repairing the Pipeline

The complete repair of any problem requires a systematic analysis of the problem and a methodical approach to its solution. In order to affect a long-term solution to a problem, pains must be taken to identify and then address the root cause. Cosmetic solutions to any problem are at best temporary. In order to solve the problem of too few qualified physics teachers for Illinois, several important steps are required. First, there must be widespread recognition that the problem exists. The problem *is* pronounced, but it is recognized mainly by those who are directly impacted by the deficit. High school administrators often search in vain for physics teachers. They will, as a result, sometimes staff an unfilled physics teaching position with an underqualified or even unqualified teacher. University and community college faculty are often oblivious to the demand for secondary-level physics teachers as they often labor with an adequate supply of "regular" physics and engineering majors. Physics teacher educators are more often aware of the problem; many physics teacher education programs will only graduate one or two certified physics teachers every few years. The cause for an inadequate number of physics teachers and teacher candidates is not so clear to many physics teacher educators and physicists. The doors of university-level teacher education programs are open, but teacher candidates aren't showing up in the numbers required.

It is the belief of this Committee that there is sufficient evidence to document the physics teacher shortage problem, sufficient means by which to identify the source of the problem, and adequate resources to affect a long-term solution to this very serious problem. The Committee is not so naive as to think, however, that it can resolve the shortage problem entirely. There are many factors that affect physics teacher recruitment, preparation, and retention over which stakeholders have little or no control. Nonetheless, this has not stopped the Committee from doing its best to identify those areas where it is possible to make at least some difference. In the subsequent paragraphs of this Full Report, the Committee will review the results of research, provide an analysis of available data, and make recommendations for prioritized actions that might help to reduce the physics teacher shortage problem across the nation, but especially in the State of Illinois.

Physics Teachers: A Growing National Demand

The U.S. Department of Education (2002) predicts that the nation will need more than one million new teachers by the year

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2010. Nearly half of the 2.6 million teachers currently employed in America's schools will leave teaching during the next few years due to a variety of reasons – primarily career changes and retirement. On a national basis, more than one-fourth of all current teachers are over 50 years of age and many are approaching retirement (NCES, 2004).

On a national basis, the attrition rate of new teachers is approximately 10% to 50% in the first three to five years of teaching, depending primarily on the adequacy of teacher preparation (Fuller, SBEC, 2002). Nonetheless, there is NOT currently a general shortage of qualified teachers in the U.S. According to Linda Darling-Hammond (2001), "We face shortages of people willing to work at the salaries and under the working conditions offered in specific locations – in *rural* and *urban* areas." Teacher shortages do exist on a national basis in certain areas such as special education, mathematics, physics, chemistry and Spanish. Teacher shortage – especially in math and science – results in large part from competition for employment. In the disciplines of science and mathematics employers seek knowledge and skills possessed by teacher education majors (AAEE, 2003). There is an adequate supply of prepared and certified teachers in most other areas of education.

The supply problem of physics teachers is made worse by the fact that more and more high school students are taking courses in physics. According to the American Institute of Physics' Statistics Research Center (Neuschatz & McFarling, 2001), enrollments in high school physics are up across the board, and we are now at an all-time high. Since 1986 there has been a steady increase in the number of students taking physics on a national basis. In 1986 only about 17% of all high school students took physics by the time they had graduated. By 2001 the percentage had almost doubled. Girls and minorities are making up a growing percentage of total enrollments in high school physics. More and more students are taking conceptually-oriented physics courses, and the Physics First movement is undoubtedly having an impact on enrollments in some areas of the country.

While many physics courses are being taught by qualified physics teachers, many are the number that are being taught by less qualified, and sometimes unqualified physics teachers. On a national level, only 61% of public high school physics teachers are endorsed to teach physics; only 27% of private/parochial physics teachers are endorsed to teach physics. Only about one-third of all physics teachers majored in physics or physics education (Neuschatz & McFarling, 2001) meaning that the remainder of the high school physics courses probably are being taught by chemistry teachers or by nonphysical science teachers who are teaching entirely out of field. More than 50% of all high school physics teachers are teaching entirely out of field, without a major or minor in physics. It is not at all uncommon to see one-person science departments in rural schools. These teachers are more often than not Biology teachers with little or no formal preparation in physics. A more detailed analysis of the current national situation with regard to high school physics teaching is provided by MacIsaac et al. (2004).

Science excellence in physics is clearly suffering as a result of physics being taught in some high schools by less than completely qualified teachers. For instance, 82% of our nation's twelfth graders performed below the proficient level on the NAEP 2000 science test (NCES, 2001). This number has actually increased since 1995 when it was 79%. NAEP reviewers complain that the longer students spend in the current school system, the worse they do. Fourth graders rank at second place internationally in science; twelfth graders rank at sixteenth place. While there is no direct link between teaching performance and student success per se, careful teacher preparation and subsequent high quality teaching are very important to overall student success. The under-qualification of crossover physics teachers has a definite negative impact on student performance (Ingersoll, 1999). When poor physics teaching performance occurs, it sometimes results in poor student performance and disinterest in the subject matter. It is yet another reason that we are now facing a general critical physics teacher shortage across the United States with major impacts on college majors and careers related to physics.

Physics Teacher Shortage in Illinois

According to data presented by the Council of Chief State School Officers in their report *State Indicators of Science and Mathematics Education* (CCSSO, 2003), Delaware, Illinois, Missouri, North Carolina, and Texas had the greatest shortages of certified high school science teachers. The shortage of physics teachers in Illinois is chronic and growing worse. Teachers are leaving the profession, moving up to administrative positions, moving over to other districts, and moving out as a result of retirement or career change. In Illinois 31% of all high school physics teachers are age 50 or over (CCSSO, 2003). The enrollment in Illinois high schools is growing and is expected to peak in 2007. The net loss of physics teachers and growth in student enrollment coupled with the national trend of a greater percentage of students taking physics exacerbates the problem of physics teacher supply. These factors, coupled with the fact that teacher education institutions across the State are not graduating enough physics teacher candidates, has led to a very significant shortage of qualified physics teachers. Unfortunately, only 64% of Illinois high school physics teachers are endorsed to teach physics, and that percentage is likely falling. The percentage represents a 32% drop from the 1994 value (CCSSO, 2003). Many school districts reported an inadequacy of qualified physics teachers in 2003. Of 231 of the State's 600+ school districts responding to an Illinois State Board of Education (ISBE) survey of supply and demand, 53% indicated a "severe under supply" of physics teachers and 29% indicated an "under supply." Only 18% of school districts in the sample reported an adequate or above adequate supply (ISBE, 2004). According to projected need for physics teachers by the Illinois State Board of Education, the number of openings for physics teachers in the State of Illinois will grow from 46 in the 04/05 school year to 56 in the 07/08 school year. Teacher education institutions in Illinois that graduate physics teachers will provide only 8-12 new physics teachers based on estimates from a 94/95 survey of physics teacher

preparation programs. Physics teacher supply in relation to demand suggests that as much as 3/4 of all physics openings currently are being filled by teachers with majors other than physics.

Underqualified and unqualified teachers in physics is having its affect on Illinois schools as can be seen by the results of the annual Prairie State Assessment Exam. According to the Illinois State Board of Education, only 51.3% of eleventh graders in Illinois meet or exceed performance standards. Some 38.0% of all eleventh graders fell below performance on the science standard whereas an additional 10.7% fell substantially below acceptable performance standards and received "academic warnings" in science. This level of performance is associated with the claim that these students are "unable to use science knowledge effectively" (ISBE, 2003).

Recent efforts by the Illinois State Board of Education to certify "highly qualified" teachers of science through a new licensure program is being met with growing skepticism. The Certification Board has plans to replace the current endorsement system (physics, chemistry, biology) with a designation system under which all new science education graduates are permitted to teach introductory courses in any area of science – physics, chemistry, biology, environmental science, and earth and space science – regardless of preparation. Passing a test with approximately 67 science core questions and 33 designation area questions is seen by the Certification Board as an appropriate qualifier for teachers to teach all areas of science regardless of their formal preparation. This is viewed by some as an effort to legitimize the use of underqualified crossover teachers to teach disciplines outside of their degree areas – content tests not withstanding.

Key Findings: Illinois Teacher Candidate Recruitment

One of the committee members, in preparation for the Ad Hoc Committee's special session, conducted two pilot surveys with small numbers. One survey was administered to physics teacher education candidates and the other was administered to in-service teachers of physics and/or physical science. The first survey was completed by 24 of 33 declared physics teacher education candidates. The second survey was completed by 23 of the approximately 80 in-service physics teachers contacted. Findings from both pilot surveys paralleled one another in important dimensions. (Detailed data as well as special session PowerPoint presentations may be accessed on the Committee's website at: http://www.phy.ilstu.edu/pipeline/.)

Teacher Candidates: The teacher candidate survey was oriented toward ascertaining from university students what role various factors played in their decisions to become physics teacher education majors. The primary factors influencing the decisions were the following:

- experiences with good physics teachers
- a desire to make a difference in the lives of people
- positive experiences with teaching others
- interest in science in general and physics in particular
- a desire to demonstrate the broad applicability of physics to everyday phenomena.

The recommendations of physics teachers for students to follow in their footsteps had very little influence on career decision. Conversations with school counselors had a slight negative affect.

In-service Teachers: The in-service teacher survey dealt with both direct and indirect teacher candidate recruitment practices, and with factors that would influence a teacher's decision to leave the teaching profession. There were several interesting findings related to the "joys" of teaching:

- ability to make a difference in the lives of students
- working with people in general and students in particular
- watching students rise to the challenges of physics
- love of the subject matter

The greatest challenges to remaining in the teaching profession were identified as follows:

- poor attitudes of students
- student misbehaviors
- lack of support and respect from students, parents, or administrators
- increasing family demands including relocation of spouse
- too much demand on personal time
- approaching retirement age

As far as direct and indirect recruitment activities are concerned, in-service teachers do NOT appear to actively recruit their students to become teachers; at best, it appears that most teachers model appropriate teaching practices in the hope (or expectation, it's not clear) that students will self-select careers in the teaching of science. *The fact that physics teachers RARELY ask their students to consider careers in physics teaching appears to explain why it is that so many teacher candidates fail to mention that physics teachers had very little direct influence on their decision to become high school physics teachers.* Survey results also show that physics teachers do not consciously involve their prospective teacher candidates in teaching activities or situations that are important to their decisions to become physics teachers.

The parallels between teacher candidates and in-service teachers are striking. Both groups have several important characteristics in common: a strong sense of altruism, a desire to make a difference, a perception that teaching is a pleasurable experience, and a fascination with science in general and physics in particular.

Key Findings: Teacher Candidate Preparation

The Committee members know very little about physics teacher preparation programs statewide in Illinois. From a 1995 survey completed by 8 of 22 physics teacher education program directors, it was clear that most of these institutions are not strongly engaged in teacher preparation. Based on projections, the mean graduation rate for PTE majors was only 0.69 students per institution per year. Fully one half of the institutions surveyed had no students in the physics teaching major. Several had not graduated a physics teacher education major in more than ten years. At least one program has expanded dramatically over the past ten years with more than 30 officially declared physics teaching majors in the physics-teaching pipeline. From the experiences of the Committee members it appears that the vast majority of new physics teacher graduates are from three or four institutions of higher learning within Illinois.

Currently there are 28 institutions of higher learning accredited to graduate and certify physics teacher education majors (ISBE, 2004). With recent more stringent program accreditation changes required by the Illinois State Board of Education, however, there is a possibility that a number of these institutions have effectively dropped out of the physics teacher preparation process. All science teacher preparation programs in Illinois are now required to meet NCATE and NSTA program accreditation standards (NCATE, 2003; NSTA, 2003). The accreditation process and subsequent documentation of teacher candidate performance has become a daunting task. Teacher education institutions with physics education programs in most cases do not have adequate personnel – or students – to justify the expense associated with ongoing program accreditation. Several chairpersons of different teacher preparation institutions have contacted at least one of the Committee members about dropping out of the certification process altogether. Whether or not they have done so is uncertain. Clearly, more information about all phases of teacher preparation in Illinois is desperately needed.

The United States Department of Education (2002) is strongly promoting the alternative certification initiative by way of working to lower barriers that keep qualified candidates out of the teaching field. The State of Illinois is responding. As a result, alternative certification is having a small but growing impact in Illinois. Alternative certification programs are beginning to spring up across Illinois in an effort to satisfy some of the growing demand for new science teachers. Currently there are 14 post-secondary institutions with alternative certifications programs. The typical number of teacher candidates in each of these programs is probably between 10 and 15. They span a number of different fields, but it is not at all unusual to see some of these programs use the cohort model with all candidates from a specific subject area. These are market-driven programs designed to meet the need for teachers in specific school districts such as the Chicago Public Schools. Programs of study are tailor-made to meet the needs of both school districts and teacher candidates who must have at least a Bachelor's degree and several years of work experience in their designated fields. Some of these programs are job-specific in that they recruit teacher candidates to fill specific types of job positions (e.g., science), are field-based with one year of classroom teaching experience, and mentored by in-school and university supervisors. Illinois State University is taking a leading role in this area. Last year they placed four alternative certification science teacher candidates in Illinois high school science classrooms. This coming year (2005) that number is expected to be approximately twenty. "Teach for America" is also beginning to make some inroads on college campuses within Illinois, but the success rate of this program is as of yet uncertain.

The American Physical Society (APS), in cooperation with the American Association of Physics Teachers (AAPT) and the American Institute of Physics (AIP), has initiated a program called the Physics Teacher Education Coalition (PhysTEC) for the purpose of improving the preparation of future K-12 science teachers. The stated goals of this program (PhysTEC, 2001) are to:

- produce more and better-prepared science teachers who are committed to student-centered, inquiry-based, hands-on teaching, as specified in the National Science Education Standards (NRC) and the Benchmarks of Project 2061 (AAAS),
- produce collaboration between physics and education departments,
- create and maintain mentoring and induction programs for PhysTEC graduates, and
- inform the physics and education communities of PhysTEC project outcomes through conferences and publications of the APS, AAPT, and AIP.

The PhysTEC leadership expects, among other things, to improve the quality of physics teacher candidate preparation with an eye toward increasing enrollments in entitlement programs leading to physics teacher certification.

While some might be skeptical of this approach, one such model exists that shows its effectiveness. Illinois State University, which is a member of PhysTEC, has one of the most innovative and successful physics teacher education program in the nation (Wenning, 2001). (See also http://www.phy.ilstu.edu/.) Starting with two pedagogical courses in 1994 and three physics teaching majors, the program has ballooned to include six such courses and the number of declared physics teacher education majors in the spring of 2005 is expected to approach 40. This program provides some evidence for the belief that there is something to the statement from the movie *Field of Dreams,* "Build it and they will come." Illinois State University's physics teacher education program was predicated on this belief, and the State will be rewarded with a growing number of physics teacher education graduates in the coming years.

Based on the described research and the knowledge of some of the Committee members as teacher educators, it seems clear that many PTE programs within the State of Illinois are languishing. This is probably the result of several factors: (1)

many programs do NOT have adequate faculty or staff designated to properly provide a high-quality accredited program, (2) some programs are at best inadequate to the needs of the physics teacher candidates, and (3) inadequate programs are not attracting the teacher candidates necessary to maintain them. Part of the problem can be addressed by giving physics teacher educators credit for activities associated with teacher candidate preparation and service to the public school community, and for professional development.

Key Findings: In-service Teacher Retention

From the survey conducted among in-service high school physics teachers there appears to be a number of trends in teacher attrition. Despite a small sample size and a small return rate (~25%) from a self-selected group could lead to the conclusion that the data are inadequate or biased, identified Illinois trends are closely paralleled by two scientific surveys of a large group of in-service teachers in Texas (Marshall & Marshall, 2003; Moses, Brown, & Tackett, 1999). The identified reasons for actual or potential teacher attrition in Illinois are sorted here into two different categories – those over which external agents have little control and can make little direct difference, and those over which there can be some form of effective external influence:

Lower control – the factors over which external agents have no control:

- Poor attitudes of students
- Student misbehavior
- Lack or support and respect from students, parents, and administrators
- Increasing family demands
- Relocation of spouse
- Unrealistic demands placed on science teachers
- Retirement

Higher control – the factors over which external agents might have some influence:

- Personal sense of professional inadequacy
- Teacher boredom with subject matter
- Lack of appropriate mentoring
- Inadequate professional preparation

Grave concern was expressed about retention by several of the Committee members for crossover teachers, especially those in urban and rural settings. These teachers often work in solitude, and not infrequently in small schools serve as the "department of science" – teaching a wide variety of disciplines often without appropriate preparation, curricular and instructional materials, and demonstration and laboratory equipment. These teachers are prime candidates for departure from the field of physics teaching. Unfortunately, many if not most isolated high school physics teachers know nothing about the existence of the ISAAPT. One committee member with more than 30 years of high school physics teaching experience had never heard about this organization and believes that that experience is common among many if not most secondary-level physics teachers in rural settings.

Recommendations: Teacher Candidate Recruitment

Of some concern in this area is the response rate to the in-service teacher survey. About 25% of the 80 so teachers contacted responded to the survey. There are, as a result, some concerns regarding the response rate. Is the low response rate indicative of a lack of teacher interest in recruitment? Is the small response rate suggestive of a sense of powerlessness to impact student choice of teaching as a career option? Regardless of these concerns, the Committee makes a number of recommendations based on the survey results from both in-service physics teachers and physics teacher candidates.

The Committee recommends that in-service teachers of physics and physical science should be encouraged to:

- continue to *indirectly* recruit students through excellent science teaching
- *directly* recruit their students to careers in science teaching using a low-key approach
- talk with all students about the need for science teachers
- appeal to the altruism of students
- talk about the joys of teaching
- talk about teaching as a profession
- emphasize the day-to-day applicability of physics
- get students involved in a wide variety of teaching experiences
- involve students in out-of-class science activities
- conduct science outreach activities such as interclass and interschool competitions
- host a peer-oriented science club, science fair, physics day, science olympiad
- conduct science outreach activities for younger children

The Committee recommends these actions of ALL science teachers at ALL levels – elementary school through university level. Many people who select specific careers as doctors, lawyers, scientists, and teachers are found to first have given thought to these and similar professional careers in early childhood. Elementary school teachers, therefore, should think in terms of planting "seeds" with respect to careers in science teaching in the hope that these seeds will be nurtured and then harvested by high school science teachers as well as community college and university faculty. In addition, attitude changes are required among science teachers at all levels. We should discourage the attitude that says "excellent students are too good for teaching" and should encourage teaching as a worthy goal for even the very best of students. Attitudes should be changed from "Those who can, do; those who can't, teach!" to "Those who can, teach!"

In light of the fact that physics (and possibly other science) teacher recruitment is being broadly ignored, the Committee recommends that a generic guide booklet for science teacher recruitment be prepared on the basis of the finding of this report, and disseminated to science teachers statewide. The guidebook should deal with both long- and short-term recruitment efforts for science teachers at all levels. The guide should be prepared and distributed through such networks as ISAAPT, ISTA, IACT, and ICBT. Failing that, a more targeted recruitment guidebook should be prepared to directly address the recruitment of physics and physical science teacher candidates and disseminated directly through the ISAAPT. The Committee recommends further that the ISAAPT should take the lead in producing this publication and then work with science teacher associations statewide, and even nationally, on its dissemination. The Committee recommends also that a website be established for prospective science teacher candidates that provides students with career planning resources.

The question naturally arises about which students to recruit. Not every physics student will make a viable physics teacher candidate. Successful teachers are often successful students that exhibit certain personality traits. Research suggests that selectivity plays an important role on teacher success and student achievement, especially at the secondary level (Rice, 2003). Prospective candidates for recruitment should, therefore, be selected on the basis of personal abilities and attributes most consistent with those of a good science teacher. The abilities extend to scholarship, leadership, and character. The Committee recommends that the following types of students should be *directly* recruited for careers in science teaching if they exhibit a preponderance of the following traits or have the potential for developing them:

- altruistic personality
- self-confidence, self-awareness and self control
- good academic ability in science
- high interest in science
- interest in learning via active inquiry
- good "stage presence"
- high degree of internal motivation
- enjoys teaching experiences
- strong work ethic
- strong sense of personal integrity (ethical conduct, honesty)
- extrovert with good "people skills"
- leadership skills
- a helper of peers
- an after school "hanger on"

In short, students to be recruited will express interest in science and demonstrate character traits similar to those promoted in the nationally acclaimed *Character Counts!* school program – trustworthiness, respect, responsibility, a sense of fairness, caring for other, and good citizenship (Character Counts!, 2004).

The Committee recommends that the pilot survey of physics teacher candidates be expanded to include all students enrolled in PTE programs across the State of Illinois.

Recommendations: Teacher Candidate Preparation

This is without a doubt the most difficult area for the Committee to make recommendations. As noted earlier, the Committee has very little information about physics teacher education programs within the State of Illinois. Nonetheless, relevant research suggests that five major factors are important to the preparation of quality teachers. These include the following: teaching experience, preparation programs and degrees, type of certification, specific coursework taken in preparation for teaching, and a teacher's own test scores (Rice, 2003). In light of the fact that several Illinois post-secondary institutions are having good success in recruiting and preparing physics teacher candidates, the Committee recommends that:

- a network of PTE institutions be established so they can share resources needed for physics teacher preparation and program accreditation, and
- an annual survey be conducted of institutions with PTE programs and establish a central repository with information about PTE programs.

In light of the fact that much of the service associated with teacher preparation is not properly credited in the tenure and promotion process at 2-year and 4-year colleges (implying time spent on teacher preparation is of less worth than research), the Committee recommends that an offer of assistance be prepared and disseminated to select physics teacher education faculty at institutions of higher learning across Illinois. The purpose of this offer of assistance would be to promote credit for service in teacher preparation programs as part of the promotion and tenure process.

The Committee recommends that the ISAAPT Executive Council seriously consider becoming more proactive in making recommendations to the State's Certification Board, and more reactive to its many mandates. For instance, it could be argued that the qualifications identified by the ISBE in response to NCLB legislation (United States Department of Education, 2003) are more reflective of a "minimally qualified teacher" than a "highly qualified teacher." Additionally, it could be argued that the ISBE's decision to replace science teacher endorsement areas (physics, chemistry, biology) with a single generic science endorsement is fundamentally flawed.

Recommendations: In-service Teacher Retention

Concerns of Committee members about in-service teacher retention spanned a range from induction and mentoring, to appropriate performance assessment and ongoing professional development. These problems are of particular concern in urban and rural settings where in-service teachers tend to receive little professional support. The Committee recommends that the

following efforts be focused primarily on providing assistance to in-service teachers working in urban/rural settings:

- seek to improve in-service physics teacher awareness of the existence of the ISAAPT,
- make ISAAPT meetings more useful to in-service physics teachers by emphasizing throughout the program practical applications of physics knowledge through such things as "Take 5" presentations, Teachers Teaching Teachers workshops, and talks focusing on the teaching of high school physics,
- publish curricular materials in a central Web-based electronic clearinghouse,
- develop an e-mail listserv for curriculum sharing and dissemination of information related to professional development opportunities within the State,
- establish a network consisting of individuals (retired physics teachers?) to provide mentoring to established in-service teachers
- work with ISTA to provide yearly conference-related workshops that provide isolated and crossover physics teachers with a wealth of teaching ideas and simple materials,
- seek and obtain a World Year of Physics 2005 grant to support the above mentioned conference-related workshops,
- consult with IACT about getting more in-service high school physics teachers involved with the ISAAPT, and
- promote the development of physics teacher alliances between community colleges and universities and their surrounding high school physics teachers.

The Committee recommends that the pilot survey of in-service physics teachers be expanded to include as many of the 400+ in-service high school physics teachers across Illinois as possible.

The Illinois Model

With such a dearth of Illinois high school physics teachers, with such a pressing need for their recruitment, preparation, and retention, and with so many corresponding recommendations, the Ad Hoc Committee on High School Physics Teacher Recruitment, Preparation, and Retention has arranged in priority order the most important of recommendations. While recommendations are provided below in rank order, the order is in no way entirely suggestive of importance. All recommendations are important and will play a central role in repairing the Illinois high school physics teacher pipeline. Neither do the following priority listings indicate that one suggestion should be completed before another. Indeed, efforts should be made on all fronts to implement all recommendations as quickly and as completely as possible. The following recommendations are to be given high priority because they promise to have the greatest effect at the least cost of time and effort. The Committee suggests that these recommendations be fully implemented within the first year of adoption by the ISAAPT Executive Council. The Committee further suggests that teacher recruitment, preparation, and retention efforts be integrated with those of other fields in science education.

Teacher Candidate Recruitment: The Committee suggests the following priority actions geared toward repairing the Illinois high school physics teacher pipeline in terms of teacher candidate recruitment:

1. Draft and then work with the ISTA if possible to publish a small recruitment guidebook containing a rationale and detailed guidelines for science teacher candidate recruitment at all levels.
2. Create a mailing database of all high school physics teachers for the purpose of disseminating the above mentioned recruitment guidebook.
3. Work with the ISTA to disseminate the recruitment guidebook to all other areas and levels of science teachers within the State of Illinois.
4. Encourage statewide science teacher associations to become actively involved in science teacher candidate recruitment by whatever means possible.
5. Expand the pilot physics teacher candidate survey to encompass a broader range of students.

Teacher Candidate Preparation: The Committee suggests the following priority actions geared toward repairing the Illinois high school physics teacher pipeline in terms of teacher candidate preparation:

1. Create and conduct a detailed annual survey of PTE institutions, reporting on a yearly basis to the ISAAPT Executive Committee the status of physics teacher candidate preparation in Illinois.
2. Make recommendations to the ISAAPT Executive Council for one or more position statements relative to teacher candidate testing and endorsements that, if adopted, will be shared with peer organizations for ultimate presentation to the ISBE Certification Board.
3. Create a series of recommendations for College and Departmental Faculty Status Committees at post-secondary institutions statewide that provide credit for service in the area of teacher preparation in the tenure and promotion process.

In-service Teacher Retention: The Committee suggests the following priority actions geared toward repairing the Illinois high school physics teacher pipeline in terms of in-service teacher retention:

1. Establish and maintain a physics-based teachers' academy – Teachers Teaching Teachers – at the annual statewide ISTA meeting for the purpose of providing support for isolated urban and rural teachers of physics.
2. Seek and obtain a $1,000 grant as part of the AAPT's World Year of Physics for promoting Teachers Teaching Teachers workshops at the November 2005 ISTA meeting.
3. Regularly host a High School Physics Teaching Symposium at autumn Section meetings similar to the Student Research Symposium at the spring meeting
4. Build ISAAPT's reputation among state physics teachers as "helpful" and increase in-service teacher attendance at all Section meetings.
5. More effectively use the Section's newsletter, *Illinois Physics Teacher,* as an avenue for reaching in-service physics teachers.

Implementing the Committee's Recommendations

A question now arises, "Who should implement these suggestions if they are found to be acceptable?" The answer is that everyone with a stake in having a greater number of authentically qualified physics teachers in Illinois high school classrooms should be the ones to implement these actions as soon as possible and to the greatest extent. This includes but is not limited to in-service high school physics teachers, departmental chairpersons, school administrators, teacher educators, and professional associations such as ISAAPT, ISTA, IACT, and IABT. The Committee recommends, finally, that the ISAAPT president should establish three Standing Committees under the leadership and guidance of the Executive Council and in cooperation with the Chicago Section of the American Association of Physics Teachers. The purpose for which these Standing Committees should be established is to implement the recommendations of the Ad Hoc Committee on Recruitment, Preparation, and Retention. Each of the Standing Committees should focus its efforts on one of the following sets of recommendations: Physics Teacher Candidate Recruitment, Physics Teacher Candidate Preparation, and In-service Physics Teacher Retention with specific tasks and time lines.

Committee Members and Participants

The following individuals participated in the presentations and follow-up discussions that resulted in the above findings and recommendations. Those whose names appear in *italic* were committee members responsible for the implementation of the process.

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