

## INDICATORS OF ILLINOIS STUDENTS' STEM PERFORMANCE

Keeping Illinois competitive requires that Illinois workers and citizens have science and mathematics skills that are at least commensurate with the levels achieved by those in competitive states and countries. To compete globally, Illinois needs students who graduate from high school adequately prepared to be successful in postsecondary education or in the workplace. How well is Illinois meeting these goals?

This part of the report examines three sets of Illinois performance indicators as they relate to the STEM fields:

- Chapter III Student Achievement
- Chapter IV Readiness for College and Work
- Chapter V College Participation and Completion

Before proceeding to the indicators, readers should consider two caveats in relation to the interpretation of the data. The first concerns the model used to describe the preparation of the workforce. Judith Ramaley of the National Science Foundation recommends that the “pipeline” model for education be replaced with a “pathways” model.<sup>62</sup> The pipeline model implies a straightforward, linear progression in which one moves through school and to work. In reality, students follow various pathways as they enroll in multiple institutions, sometimes simultaneously; combine work and education; and retrain for multiple careers. The data presented in the next three chapters are the best measures currently available; however, they are much more attuned to a “pipeline” than to “pathways.”

The second caveat is that this study includes a mix of research methodologies and measurements with varying confidence intervals. Small differences between numbers may not represent a statistically significant difference. With proper care, these data can provide an accurate perspective on STEM performance in Illinois and the U.S.

## CHAPTER III: STUDENT ACHIEVEMENT

### STUDENT ACHIEVEMENT

Keeping Illinois globally competitive requires all citizens to have strong mathematics and science skills. To determine the status of STEM performance in Illinois, Chapter III compares the performance of

- U.S. students to their international peers
- Illinois students to their international peers
- Illinois students to their national peers
- Subgroups of students within Illinois to each other

A recurring theme in this chapter is the average, or at times below average, performance of the U.S. in international comparisons, and the average performance of Illinois students compared to the aggregated U.S. performance. However, the Illinois average represents some high-scoring subgroups and some extremely low-scoring subgroups. Keeping Illinois competitive will require strategically addressing three gaps: 1) the extreme differences in performance of U.S. students when compared to the highest-scoring Asian countries; 2) the gap in the performance of Illinois low-income students, black students, and Hispanic students compared to Asian and white students; and 3) the decreasing percentages of students meeting or exceeding state goals as they move from fifth grade to middle school and then to high school, especially the male low-income students.

#### International Comparisons - United States

Over the past ten years, major international studies have assessed student academic achievement in nearly 50 countries. Testing protocols and standardized procedures have increasingly become stricter to help ensure that representative samples of all students in each country are used so that the scores from the various participating nations can be compared.

Two major international studies provide information about U.S. student academic achievement in STEM subjects:

- *Trends in International Mathematics and Science Study (TIMSS)* assessed student mastery of curriculum-based knowledge and skills in mathematics and science at the equivalent of 4th grade and 8th grade in 46 countries.
- *Programme for International Student Assessment (PISA)* focused on how 15-year olds in 40 countries used mathematics, science, and problem-solving skills to solve real-life problem; most participants were Organisation for Economic Co-operation and Development (OECD) countries.

*Keeping Illinois competitive will require addressing the low performance of Illinois low-income students and the decreasing percentages of students who meet state goals as they move from grade school through high school.*

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### *Trends in International Mathematics and Science Study (TIMSS)*

In 2003, the International Association for the Evaluation of Educational Achievement (IEA) conducted the TIMSS project. The mathematics and science tests reflect the curricula frameworks that the test developers view as appropriate for the given grade level, and the tests measure the degree to which students have learned these concepts.

#### TIMSS - Mathematics

On the 2003 TIMSS mathematics test, the average U.S. score for 4th grade and 8th grade students was statistically equivalent to the international average. However, the U.S. scored much lower than many of the other industrialized nations, including several Asian countries—especially Singapore, Korea, Hong Kong, Chinese Taipei, and Japan—and the Netherlands and Belgium.

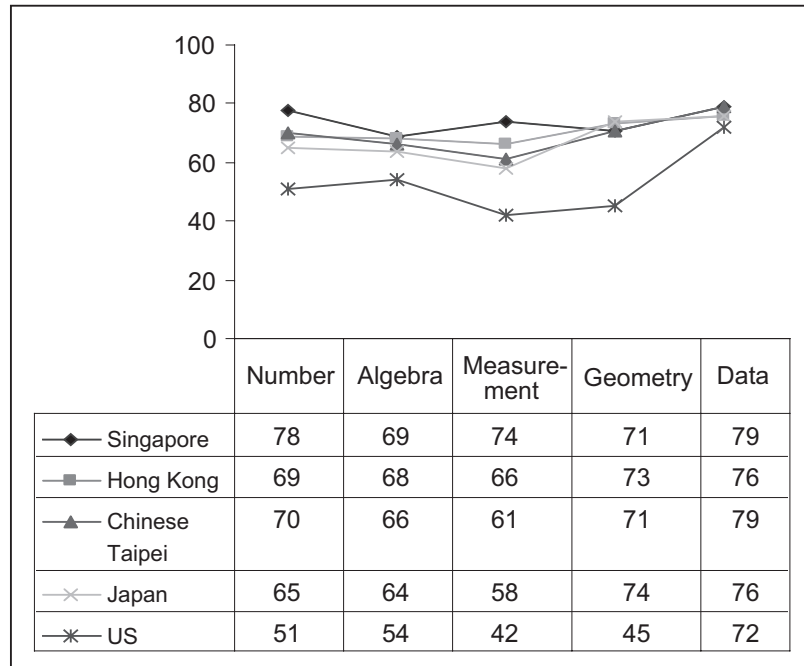
**Table 1 Scores on TIMSS 2003 Mathematics Test for Selected Countries<sup>63</sup>**

Mathematics – 4th Grade		Mathematics - 8th Grade	
Country	Score	Country	Score
Singapore	594	Singapore	605
Hong Kong SAR	575	Korea	589
Japan	565	Hong Kong SAR	586
Chinese Taipei	564	Chinese Taipei	585
Belgium-Flemish	551	Japan	570
Netherlands	540	Belgium-Flemish	537
Latvia	536	Netherlands	536
Lithuania	534	Hungary	529
<i>Russian Federation</i>	532	<i>Russian Federation</i>	508
<i>Hungary</i>	529	<i>Australia</i>	505
<b>U.S.</b>	<b>518</b>	<i>Latvia</i>	505
<i>Cyprus</i>	510	<b>U.S.</b>	504
<i>Italy</i>	503	<i>Lithuania</i>	502
<i>Australia</i>	499	<i>Sweden</i>	499
<i>New Zealand</i>	493	<i>Scotland</i>	498
<i>Scotland</i>	490	<i>New Zealand</i>	494
<i>Norway</i>	451	<i>Italy</i>	484
<i>Shading and italics indicate statistically similar to the U.S.</i>		<i>Norway</i>	461
		<i>Cyprus</i>	459

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The following figure compares the performance of 8th grade U.S. students to the performance of selected Asian countries on the content area tests in mathematics. The U.S. students scored much lower, especially on the geometry and measurement content. They scored the closest to their Asian peers on the data content.

**Figure 8 Percentages of Correct Answers in 8th Grade Mathematics Test by Content Area in 2003<sup>64</sup>**



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## TIMSS - Science

**Table 2 Scores on TIMSS 2003 Science Test for Selected Countries<sup>65</sup>**

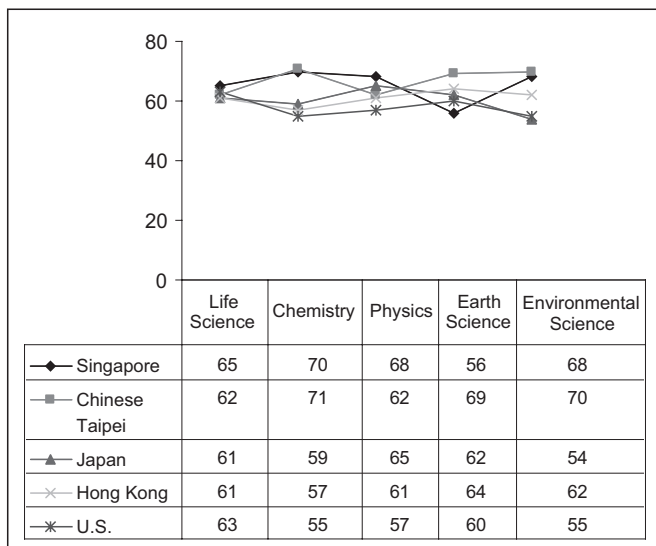
Science – 4th Grade		Science - 8th Grade	
Country	Score	Country	Score
Singapore	565	Singapore	578
Chinese Taipei	551	Chinese Taipei	571
Japan	543	Korea	558
<i>Hong Kong SAR</i>	<i>542</i>	<i>Hong Kong SAR</i>	<i>556</i>
<b>U.S.</b>	<b>536</b>	Japan	552
<i>Latvia</i>	<i>532</i>	Hungary	543
<i>Hungary</i>	<i>530</i>	<i>Netherlands</i>	<i>536</i>
<i>Russian Federation</i>	<i>526</i>	<i>Australia</i>	<i>527</i>
Netherlands	525	<b>U.S.</b>	527
Australia	521	<i>New Zealand</i>	<i>520</i>
New Zealand	520	Lithuania	519
Belgium-Flemish	518	Belgium-Flemish	516
Italy	516	Russian Federation	514
Lithuania	512	Latvia	513
Scotland	502	Scotland	512
Cyprus	480	Norway	494

The U.S. students in 4th and 8th grade achieved scores statistically similar to the international average on the 2003 TIMSS science test. In both grades, however, students from Singapore, Chinese Taipei, and Japan performed consistently higher than the U.S. students.

In 4th grade science, U.S. students scored similarly to those in Hong Kong, but in 8th grade science, the U.S. slipped further down the rankings.

*Shading and italics indicate statistically similar to the U.S.*

**Figure 9 Percentages of Correct Answers in 8th Grade Science Test by Content Area in 2003<sup>66</sup>**



The science test is divided into content areas as shown in the figure at left. The U.S. 8th grade students performed significantly lower in chemistry than did the top performers. This is an especially critical gap because chemistry is a prerequisite in STEM fields such as engineering.

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### *Programme International Student Assessment (PISA), 2003*

PISA assesses the mathematics, science, and problem-solving skills of 15-year olds through questions that require students to apply knowledge and skills to new situations. The U.S. mathematics and science scores were statistically similar to the respective international average scores, but problem-solving scores were lower.

**Table 3 Comparison of Mean Performance on PISA Mathematics and Science Tests in 2003 in Selected Countries<sup>67</sup>**

PISA Mathematics 2003		PISA Science 2003	
Country	Score	Country	Score
Hong-Kong, China	550	Finland	548
Finland	544	Japan	548
South Korea	542	Hong-Kong, China	540
Netherlands	538	South Korea	538
Japan	534	Macao-China	525
Canada	532	Australia	525
Belgium	529	Netherlands	524
Macao-China	527	Canada	519
Switzerland	527	Switzerland	513
Australia	524	France	511
New Zealand	523	Belgium	509
Iceland	515	Sweden	506
Denmark	514	Ireland	505
France	511	Hungary	503
Sweden	509	Germany	502
Austria	506	Poland	498
Ireland	503	Iceland	495
Germany	503	Austria	491
Norway	495	<b>UNITED STATES</b>	491
Luxembourg	493	Latvia	489
Hungary	490	Russian Federation	489
Poland	490	Spain	487
Spain	485	Italy	487
<b>UNITED STATES</b>	483	Norway	484
Russian Federation	468	Luxembourg	483
Italy	466	Greece	481
Portugal	466	Denmark	475
Greece	445	Portugal	468
Turkey	423	Uruguay	438
Uruguay	422	Turkey	434
Indonesia	360	Indonesia	395
Tunisia	359	Tunisia	385

*Shading and italics indicate statistically similar to the U.S.*

The U.S. students scored lower on the PISA mathematics and science tests than many of the industrialized nations and emerging nations. Students in Hong Kong-China, Finland, South Korea, and the Netherlands were the top performers in mathematics. Finland, Japan, Hong Kong-China, and South Korea were the top performers in science. Some of the other countries outperforming the U.S. on these tests are Canada, Switzerland, Australia, France, Sweden, and Germany.

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When students were required to use their knowledge and skills to solve authentic problems, the U.S. scored lower than 22 countries, the same as 8 countries, and higher than 9 countries. The top-scoring countries on problem-solving included Korea, Hong Kong-China, Finland, and Japan. The nine countries scoring lower than the U.S. were Greece, Thailand, Serbia, Uruguay, Turkey, Mexico, Brazil, Indonesia, and Tunisia.

### *Summary of International Comparisons - United States*

Statistically, the U.S. students performed at approximately the international average on TIMSS and PISA mathematics and science exams. These statistics, however, can be deceiving because the scaled scores for the U.S. students were predominately lower than the scores of other industrialized nations on all of these tests. Also, U.S. students outscored only 9 countries on the PISA problem-solving tests.

To remain competitive with the top-scoring countries—Hong Kong-China, Singapore, Chinese-Taipei, Korea, Japan, and the Netherlands—the U.S. needs to improve the mathematics, science, and problem-solving skills of all students. These skills lay the foundation for innovation, increased productivity, and the development and implementation of new technologies. A starting point is to look at the curricula and instructional strategies, which are discussed in Chapter VI.

### **International Comparisons - Illinois**

In 1997 and 1999, TIMSS allowed subgroups within a state to participate in the international studies. Illinois was represented in 1997 by the First in the World Consortium, a group of 17 Chicago suburban districts and the Illinois Math and Science Academy (IMSA). These districts and IMSA were determined to learn how their students were doing in a global competition and to make the necessary changes to become “first in the world.”<sup>68</sup> These school districts were already among the highest performing in Illinois and the nation. The students in the consortium were predominantly white (78%), only 7% were low income, and 6% had limited English proficiency. With considerably more fiscal resources than most schools, the districts’ per-pupil expenditures were 55% higher than the national average. The teachers within the consortium had higher levels of education and more years of teaching experience than the national and state averages.

Compared to their global competitors, the First in the World students did extremely well in 1997. In 4th and 8th grade mathematics, only students in Singapore performed better. No nation outperformed the consortium in 4th and 8th grade science.

At the 12th grade level, students were assessed for general achievement in mathematics and science knowledge and in a separate test for advanced topics. In the general test, First in the World students performed similarly with the top seven countries; however, the consortium students scored around the average in the advanced tests. A bright spot on the advanced tests was a subgroup of consortium students taking Advanced Placement courses; they were

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the highest performers in mathematics, and another Advanced Placement subgroup shared the highest tier in physics with five countries.

In 1999, the First in the World Consortium again participated in TIMSS, joined this time by Chicago Public Schools and Naperville District 203.<sup>69</sup> Naperville and the First in the World Consortium performed in the second tier in mathematics and were only outperformed by Singapore, Korea, Chinese Taipei, Hong Kong, and Japan. In science, Naperville and the First in the World Consortium performed in the top-tier along with Chinese Taipei, Singapore, and a consortium of Michigan schools. Chicago Public School students performed below the U.S and international averages in mathematics and science.

The consortium implemented teacher learning networks and collaborative learning communities to improve students' performance through professional development and activities using new curriculum models, instructional practices, assessment strategies, and technology.

The TIMSS project collected additional data to identify factors associated with student achievement. The top performers came from homes with high levels of educational resources. Students from the Chicago Public Schools, similar to other large inner city districts with high levels of low-income students, performed at a lower level.

The 1997 TIMSS and the 1999 TIMSS Benchmarking study highlight a theme that will recur in the following sections on student indicators of STEM performance: **Illinois has some of the highest performing students and some of the lowest performers. Keeping Illinois competitive requires that the gap between the achievements of these students be reduced, if not eliminated. The single factor that has the highest correlation to achievement is the income status of the student; e.g., low-income students are struggling to reach even average levels of performance.**

### Illinois and U.S. Comparisons - NAEP

The National Assessment of Educational Progress (NAEP) tests, which sometimes are called "the gold standard" of U.S. assessments, provide an external benchmark for academic achievement for all of the states. The results of these tests are disseminated on the "Nation's Report Card" and include measures of 4th and 8th grade student academic achievement in mathematics and science.

Student results are reported in both numerical scores and by the performance levels "basic", "proficient", and "advanced". "Basic" is defined as partial mastery of the skills and knowledge, but not competence in the subject. "Proficient" represents a solid academic performance for the grade assessed. "Advanced" describes superior performance.<sup>70</sup> Using standards and frameworks that are internationally respected, the National Assessment Governing Board that oversees NAEP regards "proficient" as the acceptable level.



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Illinois needs its students to place at or above the “proficient” level in all grade levels. Building this foundation begins in a child’s early years, and a child who lags behind his peers has a difficult time catching up. Underdeveloped mathematics and science skills are critical barriers to higher education, especially in the higher-paying STEM occupations.

NAEP tests were given at the state level to 4th and 8th grade students in mathematics (2000, 2003, 2005) and in science (2000). This section reviews how Illinois students are doing compared to the nation as a whole and to students in states that are demographically and economically similar, including

- Results of NAEP mathematics and science tests
- Comparisons of NAEP performance by ethnicity and low-income status

Illinois students are not measuring up satisfactorily. **Less than one-third of the Illinois 4th and 8th graders are reaching the “proficient” level in mathematics or science.** Unfortunately, this less-than-stellar performance is comparable to the U.S. average. The following sections describe the NAEP results in more detail, and Appendix B includes additional information.

### *Illinois NAEP Mathematics and Science Results*

In mathematics and science, the percentages of Illinois students at or above the “proficient” level were similar to the national averages. From 2000 to 2005, both Illinois and U.S. students improved their performance on the mathematics test; however, much faster progress is needed.

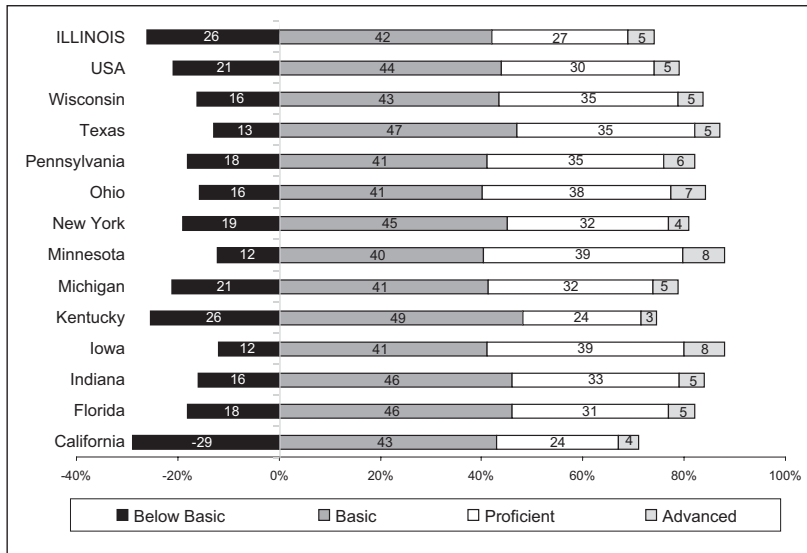
**Table 4 Percentages of Students at “Proficient” Level or Higher on NAEP<sup>71</sup>**

	Mathematics						Science	
	4th Grade			8th Grade			4th Grade	8th Grade
	2000	2003	2005	2000	2003	2005	2000	2000
U.S.	22	31	35	25	27	28	27	30
Illinois	20	32	32	26	29	29	31	30

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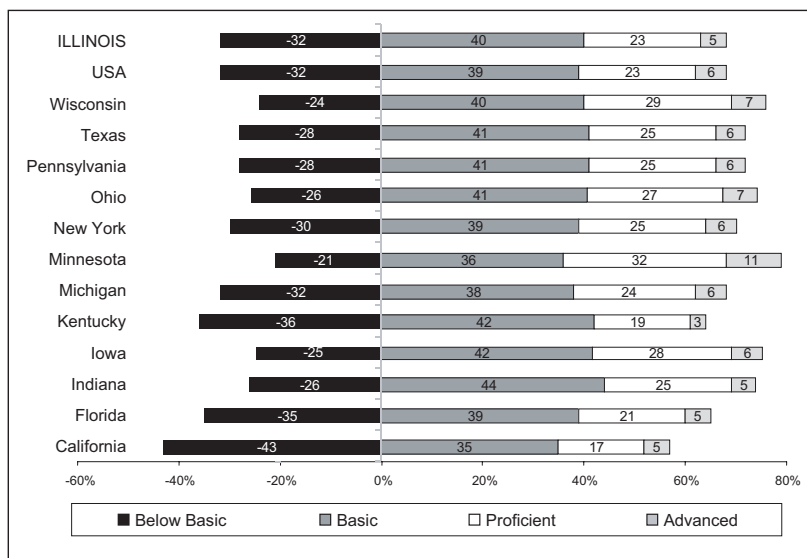
The next four figures compare the performances of Illinois 4th and 8th graders on the NAEP to the mathematics performance of students in other selected states. The states were selected because they were neighbors or large states similar to Illinois in demographics and/or economics.

**Figure 10 4th Grade NAEP Mathematics Comparisons<sup>72</sup>**



In general, Illinois had the same or more students scoring at the “below basic” level in 4th grade mathematics than the other states, except California.

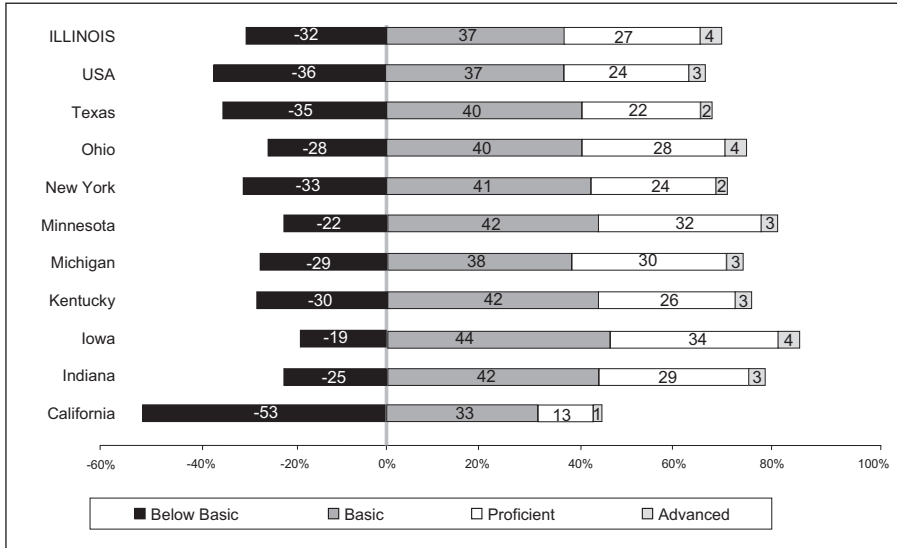
**Figure 11 8th Grade NAEP Mathematics Comparisons<sup>73</sup>**



At the 8th grade in mathematics, Illinois again had the same or more students scoring at the “below basic” level for most of the states, except California, Florida, and Kentucky.

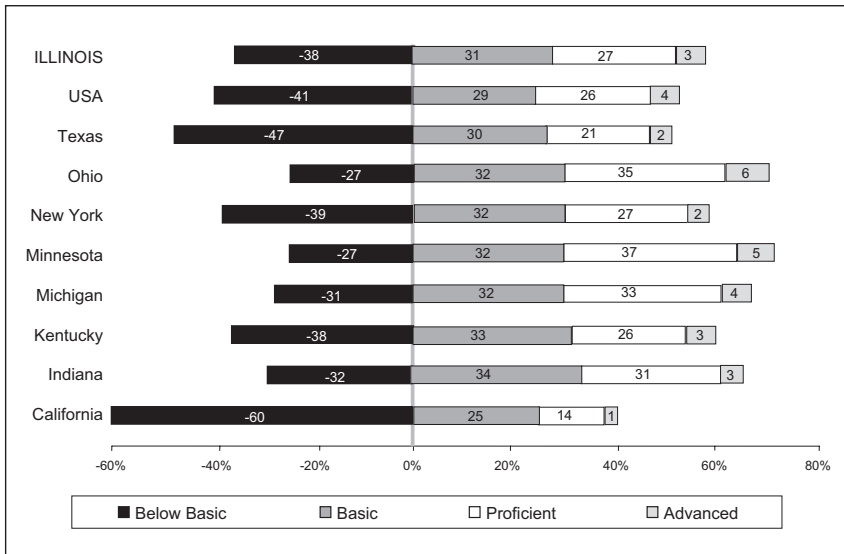
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**Figure 12 4th Grade NAEP Science Comparisons<sup>74</sup>**



Compared to the other selected states, Illinois had similar percentages of 4th grade students performing below the “basic” level in science, except for California, which had considerably more students at the lowest level.

**Figure 13 8th Grade NAEP Science Comparison<sup>75</sup>**



In 8th grade science, Ohio, Minnesota, Michigan, and Indiana had higher percentages of students at the “proficient” or higher levels of achievement.

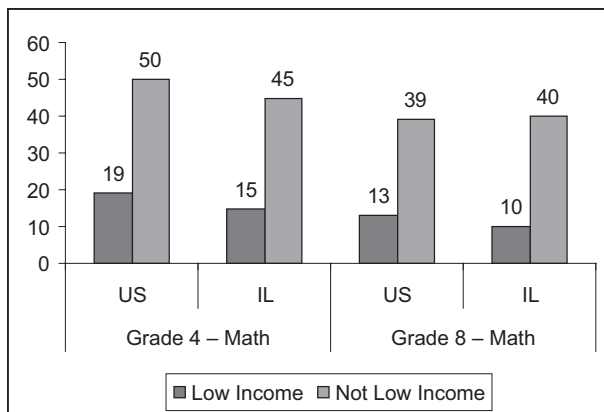
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## NAEP Mathematics Performance By Ethnicity and Income Status

There is great disparity among the mathematics performances of students in the U.S., and especially in Illinois, by ethnicity and income level. These two demographic characteristics are interrelated – students from the ethnic minority groups are often also low-income students. In this report “low-income” means a student who qualifies for a free or reduced-price lunch.

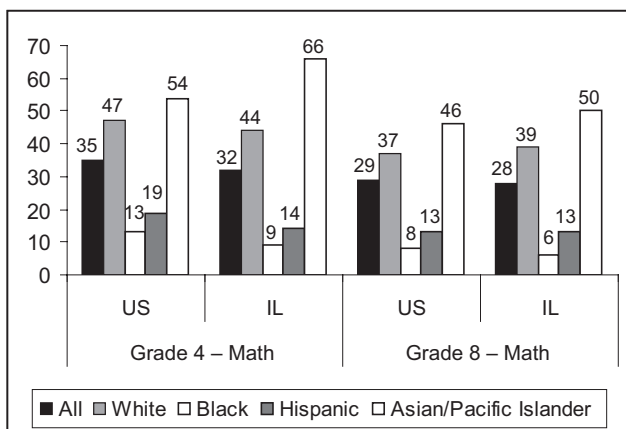
**Not only are there significant achievement gaps for low-income students, the performance of these students decreases as they progress through school.**

**Figure 14 Percentages of Students Scoring At or Above “Proficient” Level on 2005 NAEP Mathematics Test by Income Level<sup>76</sup>**



- On the 2005 NAEP, the gap between the 4th grade mathematics scores of Illinois low-income students and those who were not low-income was the largest such gap in the entire U.S. The 4th grade low-income students were three times less likely to be at the “proficient” level in mathematics than those who were not low-income.
- The low-income gap at the 8th grade was the second largest such gap in the nation. In 8th grade the low-income students were four times less likely to reach the “proficient” level.

**Figure 15 Percentages of Students Scoring At or Above “Proficient” Level on 2005 NAEP Mathematics Test by Ethnicity<sup>77</sup>**



Several critical gaps were found among the ethnic groups. There were two mathematics bright spots:

- Asian students in Illinois outperformed all other Illinois and U.S. students
- Hispanic students in 8th grade had higher scores than their U.S. Hispanic peers; however, only 13% of both groups were at the “proficient” or higher level.

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The following two tables summarize the comparisons in the scores, the differences in the scores (gaps), and the levels of achievement for 4th and 8th grade students on the NAEP mathematics test. In addition to the previous findings are the following:

- Illinois white students performed comparably to their U.S. peers.
- In 4th grade mathematics, the Illinois gap between white students and black students is tied for the 3rd largest such gap in the nation. Only 9% of the 4th grade Illinois black students achieved a “proficient” level and over half did not even reach the “basic” level.
- In 8th grade mathematics, the Illinois gap between the scores of white students and black students is the 5th largest in the nation.<sup>78</sup> Only 6% of the Illinois black students reached the “basic” level and two-thirds did not even reach the “basic” level.

**Table 5 2005 NAEP Mathematics Comparisons<sup>79</sup>**

	4th Grade- Math NAEP	8th Grade - Math NAEP
<b>Illinois Raw Score Compared to U.S. Raw Scores</b>		
White	Same	Same
Asian	Higher	Higher
Black	Lower	Lower
Hispanic	Lower	Higher
Low Income	Lower	Lower
<b>Illinois Gaps in Raw Scores Compared to U.S. Gaps</b>		
Gap White-Black	Larger	Larger
Gap White-Hispanic	Same	Same
Gap Low Income–Not Low Income	Larger	Larger

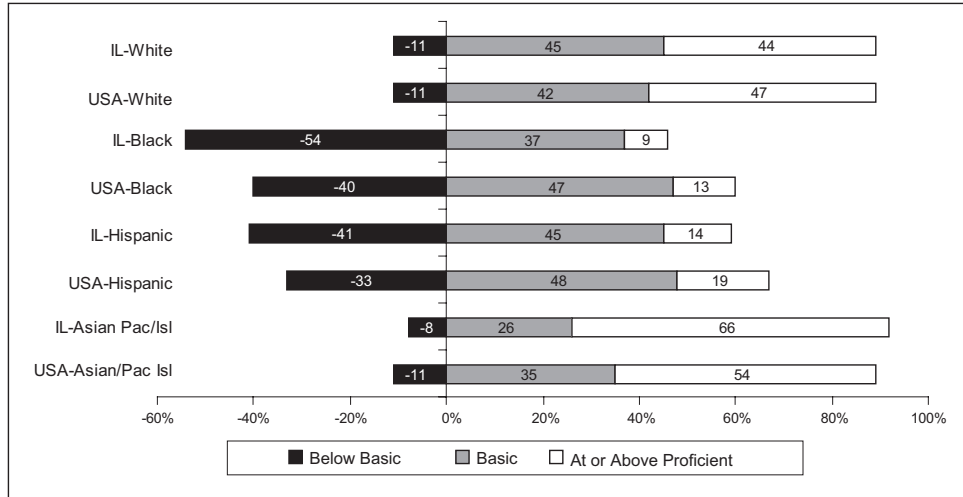
Statistically Significant Differences  $p < .05$

**Table 6 Percentages of Students Scoring At or Above Proficient Level on 2005 NAEP Mathematics Test<sup>80</sup>**

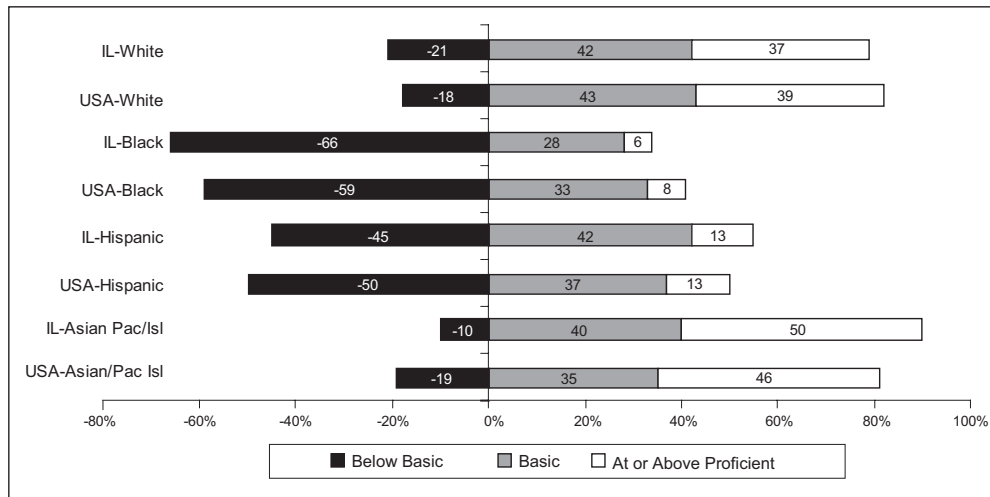
	Grade 4 - Math		Grade 8 - Math	
	US	IL	US	IL
All	35	32	29	28
White	47	44	37	39
Black	13	9	8	6
Hispanic	19	14	13	13
Asian/Pacific Islander	54	66	46	50
Low Income	19	15	13	10
Not Low Income	50	45	39	40
Male	37	33	30	30
Female	33	30	27	27

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**Figure 16 Comparison of Achievement on NAEP Mathematics 4th Grade in Public Schools by Ethnicity<sup>81</sup>**



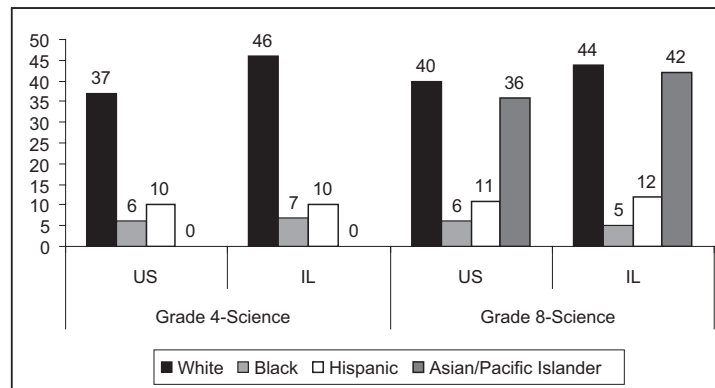
**Figure 17 Comparison of Achievement on NAEP Mathematics 8th Grade in Public Schools by Ethnicity<sup>82</sup>**



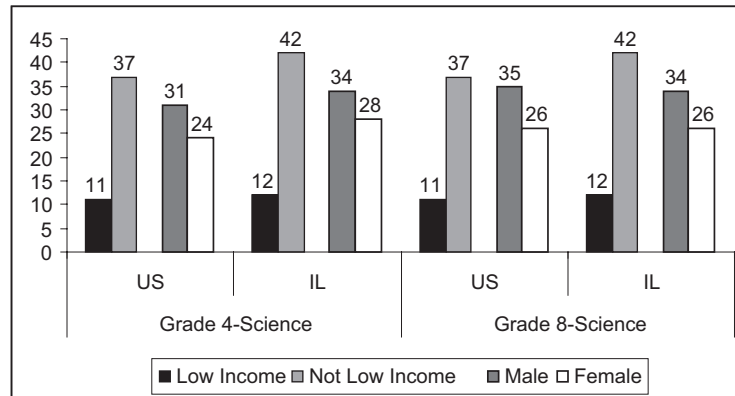
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*Illinois and U.S. Gaps in Science Levels of Achievement by Ethnicity and Income Status*  
 Similar to the findings for mathematics, there were wide achievement gaps in science for low-income students compared to those who were not low-income. Black, Hispanic, and low-income students were less likely to reach the “proficient” level than were the white students and those who were not low income. Female students were less likely to reach the “proficient” level than were male students.

**Figure 18 Percentages of Students on 2000 NAEP Science Exam Who Are At or Above Proficient Level by Ethnicity<sup>83</sup>**



**Figure 19 Percentages of Students on 2000 NAEP Science Exam Who Are At or Above Proficient Level by Ethnicity<sup>84</sup>**



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In summary, on the NAEP, a nationally recognized assessment, **less than one-third of the Illinois students met the “proficient” level of competency. Similar to the international studies, Illinois’ low-income students have extremely low levels of performance. As students progress through school, the level of achievement decreases.**

According to the NCES’ *Projections of Education Statistics to 2014*, the number of Illinois public high school graduates is projected to increase by 8.3% between 2002 and 2014, compared to a national increase of 9%. In Illinois, there is a disproportionate projected growth in the traditionally underrepresented ethnic categories, especially the Hispanic population. In fact, projections estimate that 40% of the Illinois high school graduating class of 2013-2014 will be from traditionally underrepresented groups.<sup>85</sup>

If these projections hold true, and if the performances of the ethnic minority groups does not improve, Illinois will face a situation in which increasing numbers of students fail to meet the state standards and, therefore, are seriously under-prepared for postsecondary education or work.



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### Illinois State Assessments

The results of international and national assessments yield insights into the competition that will be faced by the Illinois workforce of the future. If these results are predictive, then many of these students, one day voting citizens, will lack the basic knowledge needed to truly understand complex, scientific topics of the day. In this section, the results of the Illinois State Assessments compare how well students have achieved the minimum state standards.

In Illinois, a decade of reform efforts accelerated in 1997, when the Illinois State Board of Education established the *Illinois Learning Standards* for early elementary grades through high school. The *Illinois Learning Standards* represent what students should know and be able to do in order to prepare for both livable-wage jobs and postsecondary education. Students' progress on achieving the standards is measured by the Illinois Standards Achievement Test (ISAT) in grades 3 through 8 and the *Prairie State Achievement Exam* (PSAE) in grade 11.

The *Illinois Learning Standards* and the assessments have fared relatively well in external reviews by independent agencies. The standards, which have been supplemented by performance indicators and sample classroom assessments, are generally regarded as rigorous. Evaluators have found that the assessments are aligned with the standards. Implementation of the standards has proceeded slowly, according to studies by the University of Illinois.<sup>86</sup>

From 1999 to 2005, students in 3rd, 5th, and 8th grades took the ISAT mathematics exam. Beginning in 2006, students in 3rd through 8th grades take the ISAT reading and mathematics tests annually. The ISAT science exam is administered to students in 4th and 7th grades. Students in 11th grade take the PSAE, which includes mathematics and science subtests as well as the full ACT.

According to the federal *No Child Left Behind* law, by 2014, all students in every state should meet that state's standards. In Illinois, that means 100% of students must at least meet the standards as measured by the ISAT and PSAE. The federal law reinforces a position taken by the Illinois State Board of Education—that this level of achievement is necessary if students are to be prepared for college and for jobs with livable wages.

Student performance on the ISAT and PSAE exams is reported by four levels:<sup>87</sup>

- "Academic Warning" - limited knowledge and skills in subject; applies knowledge and skills ineffectively
- "Below Standards" - demonstrates basic knowledge and skills in subject; applies knowledge in limited ways
- "Meets Standards" - demonstrates proficient knowledge and skills in the subject; effectively applies knowledge and skills to solve problems
- "Exceeds Standards" - demonstrates advanced knowledge and skills in the subject; creatively applies knowledge and skills to solve problems and evaluate the results

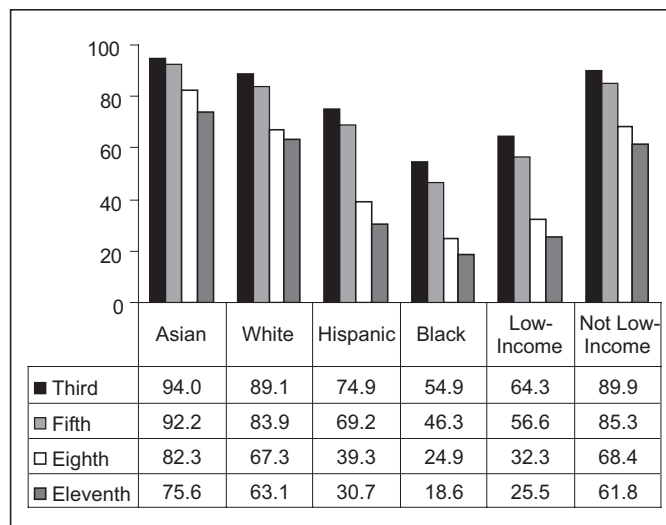
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## Mathematics Achievement on Illinois State Assessments

As shown in the following figure, Illinois has three critical gaps in mathematics achievement that demand attention:

- **Decreasing Levels of Achievement from 3rd to 11th Grade.** From 3rd grade to 11th grade, the percentages of students meeting or exceeding standards decreases, especially between 5th and 8th grades (3rd grade - 79%, 5th grade - 73%, 8th grade - 54%, 11th grade - 53%). This decline in achievement holds true for all ethnic groups and income groups. By 11th grade, only slightly more than half of all students meet or exceed the state standards.
- **Low-income Students Lag Behind.** In 3rd grade, approximately 6 out of 10 low-income students meet or exceed standards; however, by 8th grade only 3 out of 10 meet the standards, and by 11th grade the number has decreased to fewer than 3 students in 10.
- **Hispanic and Black Students Lag Behind.** The academic achievement of Hispanic and black students lags behind that of their white peers. The white/Hispanic gap in mathematics is 15% in 3rd and 5th grades; however, the gap increases significantly in 8th and 11th grades until it doubles in size. The white/black gap begins at 32% in 3rd grade and increases to 45% by 11th grade. In 3rd grade, about 1 in 2 black students meet the state standards, and by 11th grade, only 1 in 5 meet the state standards.

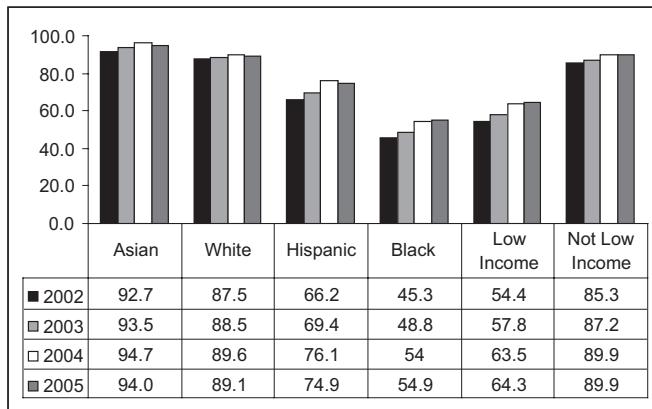
**Figure 20 Illinois State Assessments in Mathematics for 2005: Percentages of Students Meeting or Exceeding Standards<sup>88</sup>**



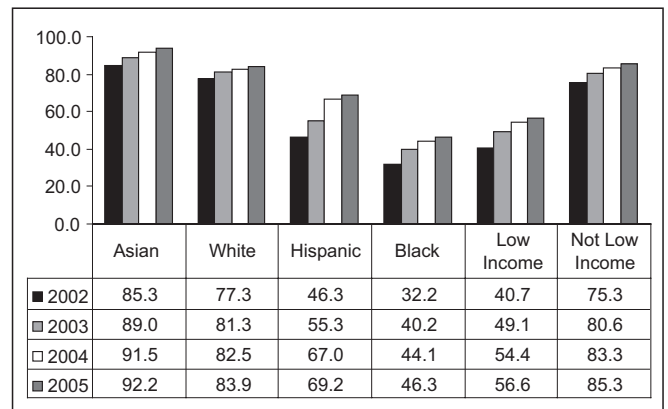
# CHAPTER III

The following figures show the trends in percentages of students meeting or exceeding the state standards from 2002 through 2005. During this period, black and Hispanic students' performance in mathematics improved substantially in 3rd and 5th grades.

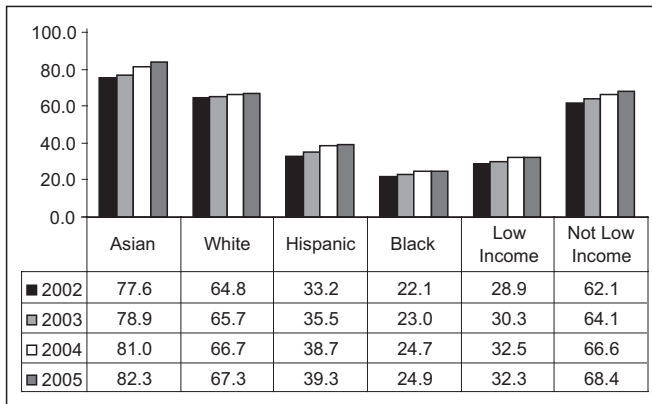
**Figure 21 ISAT 3rd Grade Mathematics: Students Meeting or Exceeding Standards<sup>89</sup>**



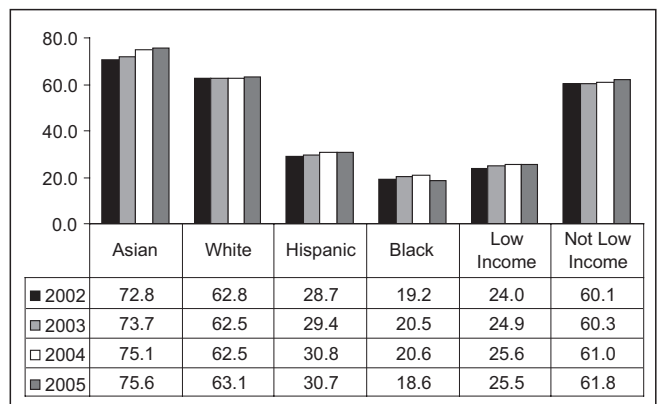
**Figure 22 ISAT 5th Grade Mathematics Students Meeting or Exceeding Standards<sup>90</sup>**



**Figure 23 ISAT 8th Grade Mathematics: Students Meeting or Exceeding Standards<sup>91</sup>**



**Figure 24 PSAE 11th Grade Mathematics: Students Meeting or Exceeding Standards<sup>92</sup>**



# STUDENT ACHIEVEMENT

## Science Achievement on Illinois State Assessments

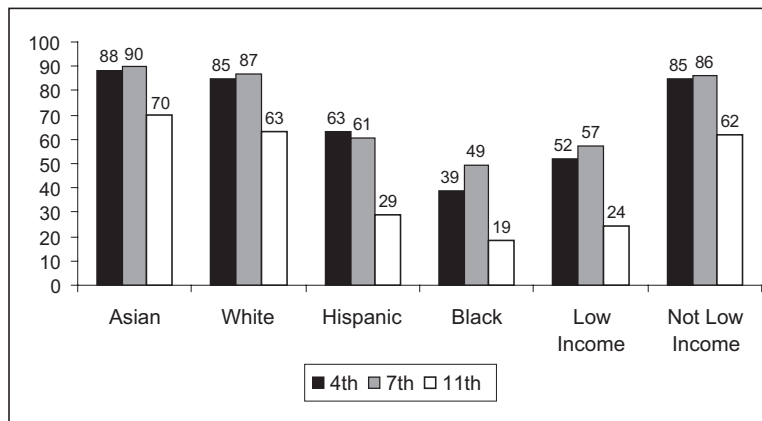
Students need a strong foundation in science to prepare them for a lifetime of rapid technological change; and Illinois needs a workforce that is able to function at the cutting edge in all occupations.

Illinois state assessments in science measure performance in the 4th, 7th, and 11th grades. The 2005 results show that students perform similarly in 4th and 7th grades. The middle school declines evident in mathematics do not seem to occur in science. Unfortunately, in 11th grade the percentages of students at this level have decreased significantly. In fact, 75% of the students met or exceeded the science standards in 7th grade, and only 53% reached this level in 11th grade.

Similar to the findings for mathematics, fewer than one-fourth of the low-income 11th grade students meet or exceed the standards, a significant decrease from the 57% meeting or exceeding standards in 7th grade.

The percentages of 11th grade Hispanic (29%) and black students (19%) meeting or exceeding the science standards in 2005 are lagging far behind their white peers (63%).

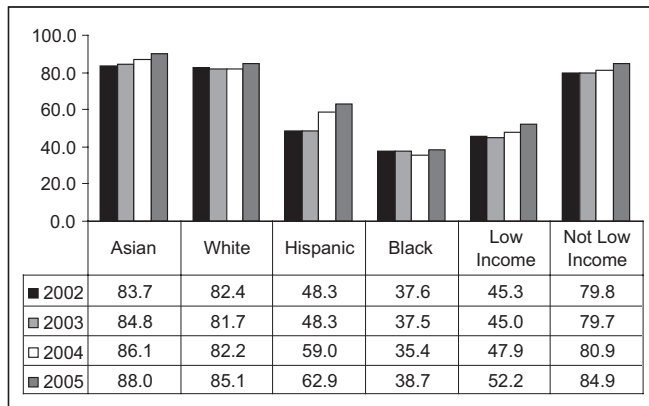
**Figure 25 Illinois State Assessments in Science for 2005: Percentages of Students Meeting or Exceeding Standards<sup>93</sup>**



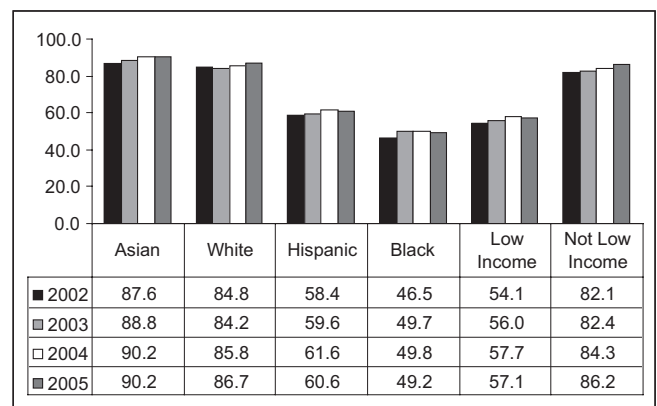
# CHAPTER III

The following figures show the trends from 2002 to 2005 in science. The performance of students at each grade level remained rather stable, except for the increase in percentage of Hispanic students in 4th grade who met or exceeded the standards.

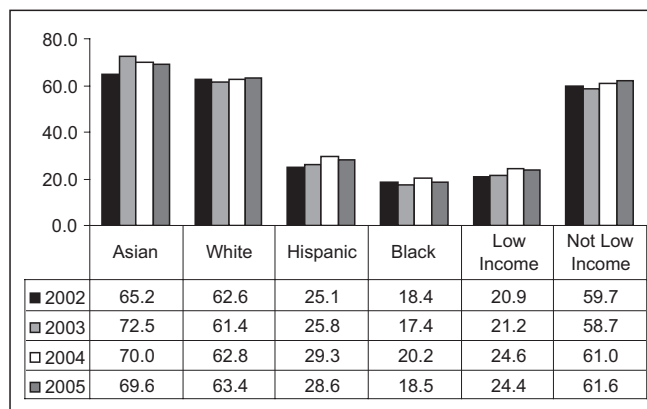
**Figure 26 ISAT 4th Grade Science: Students Meeting or Exceeding Standards<sup>94</sup>**



**Figure 27 ISAT 7th Grade Science: Students Meeting or Exceeding Standards<sup>95</sup>**



**Figure 28 PSAE 11th Grade Science: Students Meeting or Exceeding Standards<sup>96</sup>**



### Summary of Illinois State Assessments

According to *No Child Left Behind*, all students are to meet or exceed state standards by 2014 as measured by state assessments. Flat or slightly improved scores in recent years make achieving that goal problematic. Based on students' performance on the 2005 state assessments, only slightly more than half of all 11th graders met or exceeded the standards. Illinois needs to address the general level of performance, as well as the decreases from 3rd grade to 11th grade and the low performance of low-income, black, and Hispanic students.

# STUDENT ACHIEVEMENT

## Chapter Summary

Keeping Illinois competitive requires that our students perform competitively in international, national, and state measures of what they know and can do. Even though Illinois appears to be average, as opposed to competitive, the academic achievement gaps between low-income, black, and Hispanic students and their Asian, white, and “not low-income” peers are larger than the national averages. These discrepancies point to a need to raise the middle group of students as well as to raise those at the low end of the scale. On the other hand, the First in the World Consortium and Naperville showed that Illinois has some of the top performers in the world. On national tests, Illinois Asian students are highly competitive.

This chapter also presented the results of the NAEP and the Illinois state assessments, which both report the percentages of students who meet various levels of achievement. It might be assumed that the NAEP “proficient” level should compare with the Illinois “meet standards” level. That is true in terms of definitions, since the U.S. “proficient” and the Illinois “meet standards” establish the targets that all students should reach. Actual achievement in meeting these similar targets is, however, quite different. Illinois performance on the rigorous NAEP assessments at the “proficient” level is significantly lower than performance on the ISAT and PSAE “meets standards” level. In 2005, 54% of the 8th grade students “met” or “exceeded” the Illinois standards on the ISAT mathematics exam, but only 28% of the Illinois students reached at least the “proficient” level on the national exam. Similar disparities occur in other subjects and grade levels and are common across all but a few states. *No Child Left Behind* requires that all states participate in NAEP, so that state results may be compared with national benchmarks. Additional research is needed in Illinois to determine the reasons for the extreme discrepancies between NAEP and ISAT results.

The bottom line, regardless of which test is reviewed, is that Illinois needs to address the low performance of low-income, black, and Hispanic students. Just as India and China have moved millions of residents in poverty towards a knowledge-based workforce, Illinois also needs to raise the achievement levels of the low-achieving populations. Strides have been made with the Hispanic population; however, more and faster progress is imperative.

*The bottom line, regardless of which test is reviewed, is that Illinois needs continually to address the low performance of low-income, black, and Hispanic students.*

## CHAPTER IV

*Too many students in the U.S. and in Illinois are not completing high school or are completing high school without the requisite knowledge and skills to be successful in college and/or the workplace.*

### READINESS FOR COLLEGE AND WORK

Keeping Illinois competitive requires students to exit from high school well prepared for college or qualified to obtain a livable-wage job. Unfortunately, across the nation this is not happening. The *American Diploma Project* found that approximately 40% of high school graduates felt ill prepared for college or the workforce.<sup>97</sup> Peter Hart in *Rising to the Challenge* found that 42% of the U.S. students are ill prepared for college, and 45% of the high school graduates lack the skills expected by employers.<sup>98</sup>

This chapter examines the following student indicators of readiness for college and work:

- High school dropout and graduation rates
- Readiness for college
- Readiness of high school graduates for the workforce

These student indicators have been defined and measured using various methodologies. Each approach has a theoretical foundation but is limited by the lack of complete data. It is common for multiple but differing statistics to describe dropout rates, graduation rates, and levels of readiness. For example, Illinois graduation rates range from 86% to less than 70%, depending upon the approach. The National Governors Association, Achieve, and other organizations have proposed a longitudinal data system that would allow more standardization of student achievement indicators and appropriate comparisons across states. The goal is to have the data system in place for all 50 states by 2009.<sup>99</sup> This chapter discusses Illinois student data using some of the more common measures.

Regardless of the method or the metric, the interpretation of the data is very similar: too many students in the U.S. and in Illinois are not completing high school or are completing high school without the requisite knowledge and skills to be successful in college and/or the workplace. Gaps in the readiness indicators are most pronounced for low-income, black, and Hispanic students, especially male students.

## READINESS FOR COLLEGE AND WORK

### High School Dropout and Graduation Rates

The high school dropout rate is a problem that directly impacts the economic vitality of the state. Students who do not complete high school will not have the sufficient background to find a livable-wage job, and, therefore, are likely to have low levels of income.<sup>100</sup> The Alliance for Excellent Education looked at the impact of high school dropout rates on lost wages and taxes of students who were in 9th grade in 2000-01 and who did not graduate from high school. The total lost lifetime earnings for the United States dropouts was estimated at \$325,622,960,000, and the total lost lifetime earnings for Illinois dropouts was estimated at \$10,847,520,000.<sup>101</sup>

To address the dropout problem, Illinois increased the mandatory school age from 16 to 17 years old and implemented provisions for penalties to those who are found truant. The high school senior dropout rates reported by the Illinois State Board of Education decreased from 7.0% in 1994 to 4.0% in 2005.<sup>102</sup> This metric looks at the attrition in the final years of high school.

A more comprehensive approach to assessing dropout rates involves a longitudinal assessment of all of the dropouts that occur for a cohort of students who begin 9th grade and complete high school four years later. A 2005 project at the Manhattan Institute computed high school graduation rates by looking at the 9th grade cohort, correcting for changes in population, and examining the number of diplomas issued. Using this methodology, the metric can be interpreted as both a graduation rate and a dropout rate. The U.S. graduation rate has changed slightly from 72% in 1991 to 70% in 2003,<sup>103</sup> and the authors of the study would conclude the dropout rate of the 9th grade U.S. cohort graduating in 2003 was 30%. For Illinois, the 2003 graduation rate was 73%, with a dropout rate of 27%. Illinois students, in aggregate, are very similar to the U.S. average, and Illinois ranked 26th in the nation.

The tables below, however, points out the large discrepancies in the graduation/dropout rates based on ethnicity and gender:

- On the positive side, significantly more white and Asian students in Illinois, both male and female, graduate as compared to their U.S. peers.
- The percentages of graduating Hispanic students are very similar for the U.S. and Illinois; however, the graduation rates of Hispanic students are still rather low compared to the rates of their white and Asian peers.
- For black students, the statistics are rather bleak: significantly more male and female black students in Illinois drop out than their U.S. peers.

Over half of the black male and Hispanic male students dropped out of school before graduation, creating a large cadre of unskilled workers in Illinois. Given the demographic characteristics of Chicago, it is not surprising that it ranked 88th out of the 100 largest school districts in the nation and had an overall dropout rate of 50%.



## CHAPTER IV

**Table 7 Graduation Rates by Ethnicity and Gender Using Manhattan Institute Methodology<sup>104</sup>**

	U.S.			Illinois		
	All	Male	Female	All	Male	Female
<b>White</b>	78	74	79	85	83	86
<b>Asian</b>	72	70	73	85	85	85
<b>ALL STUDENTS</b>	70	65	72	73	70	76
<b>Black</b>	55	48	59	49	42	55
<b>Hispanic</b>	53	49	58	54	49	60

According to the Education Trust, reported graduation rates for Illinois using other methodologies ranged from around 86% to 75%.<sup>105</sup> Regardless of the method, the conclusions are the same: too few students are completing high school, and black and Hispanic students are not completing high school at the same rates as their peers.

**Table 8 Comparison of Graduation Rates for Illinois<sup>106</sup>**

	Illinois Reported 2002-2003 (Senior to Graduation)	Manhattan Project Based on Students Entering 9th Grade 2000-2001
Black	73%	48%
Hispanic	78%	58%
All	86%	75%

Illinois faces a daunting challenge. The predicted demographic changes in Illinois will result in increasing numbers of students from the populations most likely to drop out of school.<sup>107</sup> At the same time, the state will be facing a potential shortage of skilled workers, as discussed in Chapter I. **Keeping Illinois competitive requires solving the dropout problem.** Perhaps the first step is to determine why students, especially the black and Hispanic male students, do not complete high school. According to a Gates Foundation report, 88% of the high school dropouts have passing grades and many leave because they are bored.<sup>108</sup> Part of the solution appears to be connected to the high school curriculum and delivery of instruction.

### Readiness for College

Students who enter college unprepared are less likely to succeed, and, if they are not ready for college, they often are not ready for gainful employment either. What makes a student ready for college? Current national discussions are debating what "college readiness" means. Some studies include a broad definition and include academic indicators as well as other characteristics. One contingent of researchers is looking at courses taken in high school, especially the completion of a college core or participation in Advanced Placement (AP) courses.

## READINESS FOR COLLEGE AND WORK

This section of the study looks at readiness for college through the following research:

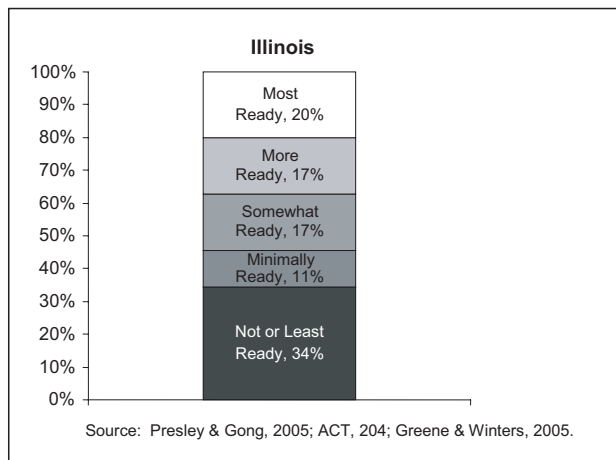
- College readiness of the Illinois class of 2002
- Courses taken in high school
- Performance on Advanced Placement exams
- College remediation rates

Each of these threads of research provided very similar conclusions: students complete high school with a wide variation in college readiness, and just completing a given curriculum does not ensure the student will be successful in college. Similar to the findings on the other student achievement indicators, there is a wide disparity in the college readiness of students based on income and ethnicity; low-income students, Hispanic, and black students are the least prepared for college across all definitions of college readiness.

### *College Readiness of the Illinois Class of 2002*

Presley and Gong of the Illinois Education Research Council studied the college readiness of the class of 2002 of Illinois public high schools.<sup>109</sup> The college readiness index included the ACT scores and high school grade point averages of the high school graduates. As shown below, the Illinois data is consistent with national data; slightly more than one-third of the students are “college ready,” and approximately one-third are far from being ready.<sup>110</sup>

**Figure 29 Readiness of High School Graduates for College<sup>111</sup>**



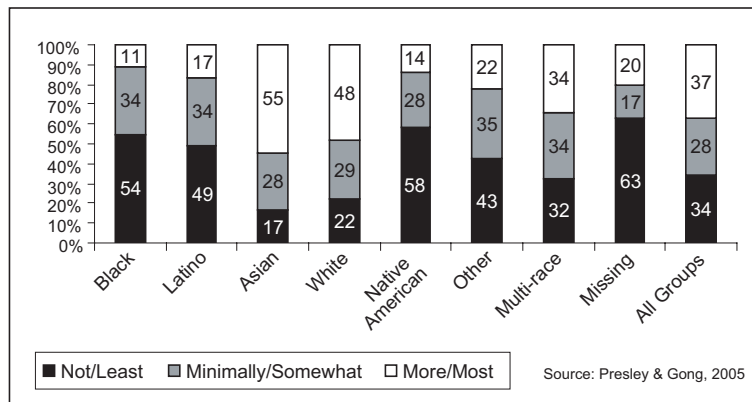
In general, Illinois females are more likely to be more/most ready (39%) than males (35%). Presley and Gong also found significant differences in preparedness by level of income and ethnicity, two factors that are co-related. Of the graduates from families in the lowest income quartile, 42% are not ready for college, compared to 13% of the graduates from high-income families. At the other end of the scale, 65% of the graduates from the highest income quarter were deemed “most or more prepared” compared to only 20% of those from the lowest family income quartile. In other words, “graduates from high-income families are

## CHAPTER IV

about three times as likely to be college ready as those from low-income families. Within each income quartile, females are more likely than males to be more/most ready."<sup>112</sup>

Around half of the Asian graduates (55%) and white students (48%) were found "more/most ready" for college, compared to significantly fewer black (11%) and Hispanic graduates (17%).

**Figure 30** Readiness of Illinois High School Graduates by Ethnicity<sup>113</sup>



### Courses Taken in High School

Several research studies investigated the relationship between the courses taken in high school and college success, including assessing the impact on students' perceptions of preparedness on their academic performance. In a national study, respondents who had taken a rigorous high school curriculum were more likely to feel prepared for college (80%) than were students who had taken moderately difficult courses in high school (58%) or had low expectations in high school (37%).<sup>114</sup>

In Illinois, the ACT is part of the Prairie State Achievement Exam (PSAE), which is used to assess student academic performance in the 11th grade as mentioned in Chapter III. ACT has identified a core curriculum that it considered appropriate to prepare students for college. **From 2001 to 2005, fewer than half of all Illinois students completed the ACT core curriculum.**<sup>115</sup>

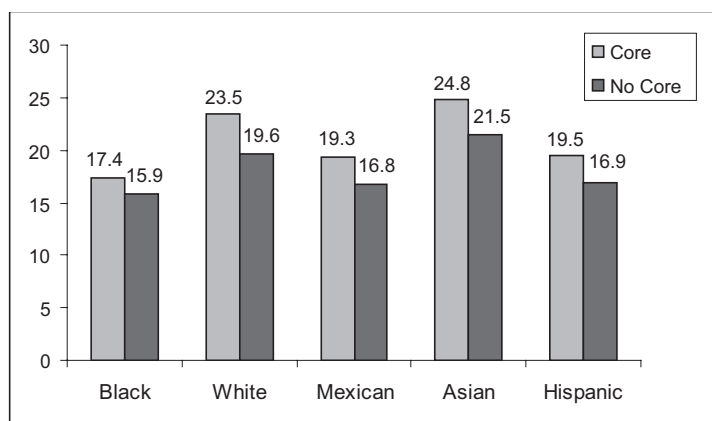
From 2001 through 2005, the scores of Illinois students who completed the ACT Core Curriculum averaged 10% higher on the ACT mathematics and science exams than students not completing the core.<sup>116</sup>

Fewer black students (37.5%), Mexican-American students (39.0%), and Hispanic students (38.5%) completed the ACT core curriculum than did white students (51.5%) or Asian students (61.1%). For each race/ethnicity group, the average ACT score for the students completing the ACT core curriculum was higher than the average ACT score for those not completing the core. The effect of completing the core, however, was not the same across

## READINESS FOR COLLEGE AND WORK

the different groups; e.g., black students completing the core still scored lower than some other groups not completing the core. This could be an indication of the variations from school to school between the level of expectations and the quality of instruction.<sup>117</sup> Research is underway in Chicago and elsewhere to help explain this gap.

**Figure 31 Average 2005 ACT Score by Ethnicity and Core Courses<sup>118</sup>**



In a joint effort between ACT and The Education Trust, four factors emerged as critical in preparing minority and low-income students to succeed in first-year college courses: rigorous high school courses at the college-preparatory level, well-qualified teachers, flexible pedagogical styles, and tutorial support.<sup>119</sup> These issues, along with the new ACT core, are discussed further in Chapter VI.

### *Performance on Advanced Placement Exams*

Advanced Placement (AP) courses offer college-level coursework and the option to take end-of-course exams. Students who score high enough on the AP exams earn college credit. These courses both accelerate academic progress and save money for students by shortening the path to college graduation. Access to AP courses varies substantially among high schools.

The *Science and Engineering Indicators 2006* used high school students' participation in Advanced Placement (AP) exams as a gauge for the access to AP courses and the students' willingness to engage in more rigorous curricula.<sup>120</sup> Over one-fifth (20.9%) of the U.S. Class of 2004 took at least one AP exam, which is an increase from the 15.9% who did so in 2000. In Illinois, 13.4% of the public high school students took at least one AP exam in 2000, and 18.6% did so in 2004.<sup>121</sup> Even though more Illinois students are sitting for AP exams than in the past, a smaller proportion of Illinois students are taking the exams when compared to the U.S.

## CHAPTER IV

AP exams are scored on a scale from 1 to 5, with 3 representing average (midlevel B to midlevel C) college performance. At all but the most selective colleges, an AP score of 3 will be granted college credit for the course and/or placement into a more advanced level. The share of students receiving at least one rating of 3 is considered by the *Science and Engineering Indicators 2006* as a measure of the extent to which the class of 2004 was offered access to a rigorous curriculum and mastered the requirements.

For the class of 2004 in Illinois, 71.5% of those taking at least one AP exam received a score of 3 or better on at least one exam, compared to the national average of 63.2%.

**Table 9**      **Percent of Public High School Students Taking an AP Exam Compared to Percent Scoring 3 or Higher on at Least One AP Exam**<sup>122</sup>

State	2000		2004	
	Took Exam	Scored 3 on At Least One	Took Exam	Scored 3 on At Least One
New York	27.3	17.9	32.4	21.2
Florida	22.7	13.5	33.5	19.2
California	22.2	15.0	28.5	18.7
Wisconsin	15.2	10.5	20.0	13.7
<b>Illinois</b>	<b>13.4</b>	<b>9.9</b>	<b>18.6</b>	<b>13.3</b>
<b>USA</b>	<b>15.9</b>	<b>10.2</b>	<b>20.9</b>	<b>13.2</b>
Texas	16.6	9.9	23.2	13.1
Michigan	13.9	8.8	16.8	10.9
Minnesota	13.4	8.1	16.4	10.6
Pennsylvania	12.4	8.3	14.9	10.1
Ohio	11.3	7.1	15.2	9.4
Indiana	11.9	6.0	15.5	7.7
Kentucky	10.6	5.5	15.5	7.7
Iowa	6.9	4.9	10.0	6.6

Variations in AP access are considerable, which has impelled both national and Illinois state administrators to devise incentives for increasing the number of AP offerings and the number of students choosing AP courses. The Illinois students who sat for an AP exam in 2004 were disproportionately white (87%) or Asian (16%). Black students who comprise 21% of the Illinois public school population comprised only 2% of those taking an AP exam; likewise, the Hispanic population was under represented (17% of total population versus 4% of AP test takers).<sup>123</sup>

## READINESS FOR COLLEGE AND WORK

### *College Remediation Rates*

Colleges and universities assess entering students' academic preparation through a variety of assessments, including transcript analyses and placement tests. Colleges using transcript analysis look at courses taken and the grades received. There is growing evidence that grades are one of the strongest predictors of college success.<sup>124</sup>

Research on remediation rates is confounded because readiness standards differ greatly both within a college and between colleges. Nationally, "between 28% and 40% of first-time freshmen in four-year public institutions, and between 42% and 63% of first-time freshmen in two-year public institutions, enroll in at least one remedial course."<sup>125</sup>

According to college faculty across the nation, 20% of the entering freshmen are "not well-prepared" and 32% are "somewhat well-prepared" in science. For mathematics, nearly one-third of the students were rated by college faculty as "not very well-prepared" and another third were described as "somewhat well-prepared".<sup>126</sup>

The bottom line is that large numbers of students are entering college in need of remediation. In fact, in 2005, a total of 83,585 Illinois public community college students enrolled in remedial courses in mathematics.<sup>127</sup> The need for remediation decreases the chances the student will graduate. A national study found that 75% of students not needing remediation will graduate; however, only 46% of students needing one or two remedial mathematics courses will graduate.<sup>128</sup> If this holds true, over 45,000 Illinois community college students enrolled in remedial mathematics courses will not persist to graduation. In addition, the true number of students needing remediation is not known. Some students decide not to enroll in college after taking the placement tests, and others downgrade their ambitions to certificates not requiring college-level preparation.

In summary, there is great variation in the college readiness of graduating seniors in Illinois, and the students least prepared are mostly from low-income populations. Even though a rigorous high school curriculum helps prepare students for college, completing a college-prep core of courses does not guarantee the student is college ready. The differential effect of the college-prep core appears to indicate variation in the level of expectations and quality of instruction within and among schools. There are many costs to under preparedness—students need remediation at the college level or they may decide not to pursue further education.

## CHAPTER IV

### Readiness of High School Graduates for the Workplace

Two national surveys asked employers how well they believed high school graduates were prepared for the workforce. Peter Hart in *Rising to the Challenge* found that 45% of the employers indicated that public high school graduates are not prepared with the skills to advance beyond entry-level jobs.<sup>129</sup> In *2005 Skills Gap Report - A Survey of the American Manufacturing Workforce*, 84% of the employers indicated that the pre-college education system is not doing a good job in preparing students for the workplace, and 51% specifically identified mathematics and science deficiencies.<sup>130</sup>

Another approach to measuring readiness is to test students on their workplace skills. WorkKeys, an ACT assessment, provides information concerning the readiness of students for the workplace.<sup>131</sup> The minimum skills required for specific job profiles are determined, and student scores are compared to these job profile skills.

In Illinois, students complete the Applied Mathematics and Reading for Information WorkKeys as part of the PSAE. Each test is scored on a scale from 7 (highest) to 3 (lowest skill level). Three-fourths of the jobs were rated as a level 3 or 4.

In 2005, at the top end of the scale, over 35% of all Illinois students who took the WorkKeys in Applied Mathematics scored at level 6 or 7. Asian students (55%) and white students (44%) scored at levels 6 and 7 more often than did black students (8%) and Hispanic students (16%).<sup>132</sup>

On the other hand, 8.2% of all Illinois high school students scored lower than the level required by any of the job profiles. Over twice as many low-income students scored below the level required on the lowest job profile (17%).

**Figure 32 Percentages of Illinois Students and Job Profiles at Each Level on Applied Mathematics WorkKeys in 2005**



In summary, there is a relationship between academic preparation and workforce preparation. Students in groups with the highest levels of college readiness are the same as those with the highest levels of workforce preparedness. As with the other student indicators, Illinois low-income students are the least prepared for both college and the workforce.

## READINESS FOR COLLEGE AND WORK

### Chapter Summary

Keeping Illinois competitive requires students to graduate from high school with the skills and knowledge needed to succeed in postsecondary education and/or work. Whether the indicator is high school completion rates, readiness for college, or readiness for work, Illinois students who are low-income, black, and/or Hispanic do not fare as well as their white and Asian peers.

The high school completion rates appear to be increasing in Illinois; however, only 70-75% of all of the 9th grade students will complete high school. This percentage is even lower for low-income students, especially the males. In fact, fewer than 50% of the black and Hispanic male students will graduate.

Graduating from high school does not guarantee the student will be prepared for college: only 35-40% of Illinois high school graduates are ready for college-level work according to ACT data. Again, there are disparities among students based on income and ethnicity. Around 65% of the highest-income students are the “most ready” for college, compared to only 20% of the lowest-income students. Less than 11% of the black students and less than 17% of the Hispanic students are prepared for college, compared to 55% of the Asian students and 48% of the white students.

There were great disparities among the percentages of students who completed the ACT Core Curriculum—about 61% of the Asian students, about half of the white students, but only 39% of the Hispanic students and 37.5% of the black students. Completing the core did not guarantee the student was prepared for college.

Illinois students’ performance on the AP tests and the ACT WorkKeys illustrate the two ends of the performance continuum in Illinois. At the top end, Illinois has some of the best students in the nation. For example, Illinois students who sit for Advanced Placement exams do extremely well—71.5% received a college-ready grade compared to only 63% nationally. At the other end of the continuum, 80% of the low-income students were not prepared to succeed in college, and 17% were not qualified for any of the jobs profiled on the ACT WorkKeys.

It is critical that Illinois address the disparity issues tied to low income and ethnicity as a secondary factor. In addition, the knowledge and skills of the high school graduate needs to be better aligned with the skills and knowledge needed to succeed in college and the workplace. Requirements for graduating from high school vary markedly from college and workplace expectations.

*Graduating from high school does not guarantee the student will be prepared for college: only 35-40% of Illinois high school graduates are ready for college-level work according to ACT data.*



## CHAPTER V

*Of 100 Illinois high school seniors, 57 will go immediately to college, and 33 will complete a 4-year degree within 6 years.*

### COLLEGE PARTICIPATION AND COMPLETION

Keeping Illinois competitive requires increasing the number of students who enter and complete college programs, especially programs leading to STEM degrees. From 1975 to 1999, the United States went from 3rd to 14th in terms of the number of students completing national science and engineering degrees among 19 nations.<sup>133</sup> Even though some countries apparently included less than 4-year degrees in their reporting, the conclusion remains that the U.S. is struggling to compete globally in graduating students in STEM majors. It is not surprising that leading companies represented by the Business Roundtable set the goal of doubling the number of U.S. science, technology, engineering, and mathematics graduates with bachelor's degrees by 2015.<sup>134</sup>

If the U.S. is to reach this goal, students must gain the requisite knowledge and skills needed for a STEM major as they move through the education pipeline. As discussed in Chapter III, the mathematics and science skills of Illinois students are not reaching this level, especially in high school. In addition, students need to complete high school, enroll in college, and complete college. As discussed in Chapter IV, significant numbers of Illinois students are not completing high school, and when they do, many are not prepared for college-level work. This chapter looks at what happens at college in terms of the education pipeline and students in STEM majors

#### The Education Pipeline

One approach to measuring college completion rates is to look at the pipeline of students who complete high school, enroll in college, and complete an associate's or a bachelor's degree. Without a national student tracking system, such as the one proposed in the Data Quality Campaign sponsored by the National Governors Association and other organizations,<sup>135</sup> assessing the pipeline of students from high school through college is very difficult. One problem is that existing data in the pipeline model underestimates students by counting the following as dropouts: students who take more than four years to complete high school, change high schools, obtain a GED, attend multiple colleges, enter college later than directly from high school, drop out of college but later return, or enroll in college part time. These students constitute a significant percentage of the student population. Put simply, existing data collection methods rarely account for the multiple pathways that students follow as they progress through high school and college. Clifford Adelman in *The Toolbox Revisited* (2006) presented a new approach by tracking students' 8.5 years. At this time, comparative data is not available for Illinois.

## COLLEGE PARTICIPATION AND COMPLETION

That said, compared to the U.S., Illinois has an average pipeline of students but fewer college completers than the top state, Massachusetts.

In Illinois, out of every 100 students in 9th grade, 72 graduated from high school four years later, 43 entered college immediately, 30 were still enrolled their second year of college, and only 20 graduated with an associates degree within 3 years or a bachelor’s degree within 6 years. The U.S. average was 18 final graduates. This is a pipeline model and does not account for students who pursue other pathways.

**Table 10 The College Degree Pipeline**<sup>136</sup>

Out of every 100 9th Graders	United States	All Illinois	Top State Massachusetts
Graduate from High School	68	72	76
Immediately Enroll in College	40	43	53
Are Still Enrolled Sophomore Year	27	30	40
Graduate from College on Time	18	20	29

If Illinois aspires to compete with the top state, approximately 7,000 more students need to graduate from high school, 17,000 more students need to enroll immediately in college, 17,000 more students need to stay enrolled in the sophomore year, and 16,000 more students need to graduate within the established timeframes.

The pipeline presented above is based on a tracking system beginning in 9th grade. If the pipeline begins with high school seniors, 57% of Illinois and U.S. seniors enroll in college immediately after high school, less than the 65% average of the top five states.<sup>137</sup>

As shown in the table below, the percentage of students entering college from high school is comparable to the national average. The freshman-to-sophomore retention rate for Illinois community colleges is less than the U.S. rate, whereas the 4-year college freshman-to-sophomore retention rate is higher than the corresponding national average. A greater percentage of Illinois students complete 4-year degrees within 6 years than the percentages indicated nationally. Compared to the top five U.S. states, however, Illinois has room for improvement in its enrollment, retention, and graduation rates.

**Table 11 Retention and Completion Rates of College Students**

	United States	Illinois	Average of Top Five States
High school seniors enter college	57%	57%	65%
Community college students return for second year	55%	53%	61%
4-year college students return for second year	74%	79%	84%
4-year degree within 6 years	55%	58%	64%

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The averages in the table mask big variations among Illinois subgroups in the percentages of freshmen completing a 4-year degree within 6 years. Nearly two-thirds of Asian students (65%) and white students (64%) complete degrees in six years, but graduation rates of Hispanic students (46%) and black students (33%) are much lower. The differences may be in part due to the number of black and Hispanic students who are also low income. These students are more apt to reduce their course loads to part time to accommodate a job or they may drop out to work but later return to college. The “pipeline” completion rate does not include students who transfer to private institutions, transfer out of state, or drop out of college but later return.

At the current time, Illinois’ recruitment of students into college is comparable to the national average, and the 4-year institutions are exceeding the national rates in retention and degree completion. If Illinois is to increase the number of students graduating from college, more students need to be prepared to enter college and persist to completion.

### Students in STEM Majors

From 1994 to 2004, the percentage of Illinois workers with bachelor’s degrees or higher increased from 30.3% to 36.9%, compared to the U.S. increase of 29.5% to 37.2%.<sup>138</sup> As Illinois looks to bolster the economic infrastructure of the state, more graduates with STEM degrees will be needed.

The percentage of higher education degrees awarded in science and engineering is a broad measure of the preparation of a STEM workforce. Even though nationally and in Illinois the total number of higher education degrees increased, the proportion of STEM degrees remained constant.<sup>139</sup> From 1993 to 2003, the number of science and engineering higher education degrees, including bachelor’s, master’s, and doctorate degrees, conferred in the U.S. increased from 473,414 to 564,444 (19%); in terms of the percentage of all degrees awarded, the proportion of science and engineering degrees stayed rather consistent at approximately 30%.

In Illinois, the number of science and engineering bachelor’s, master’s, and doctorate degrees increased from 20,620 in 1993 to 25,263 (22%), which represents approximately 27% of all degrees awarded in those years.<sup>140</sup> During 1993 to 2003, the proportion of graduate degrees in science and engineering remained around 23% for the U.S. but increased in Illinois from 28% to 30%.<sup>141</sup>

These global measures of science and engineering degrees provide an overall picture but do not measure whether the granted degrees match the state’s workforce needs.

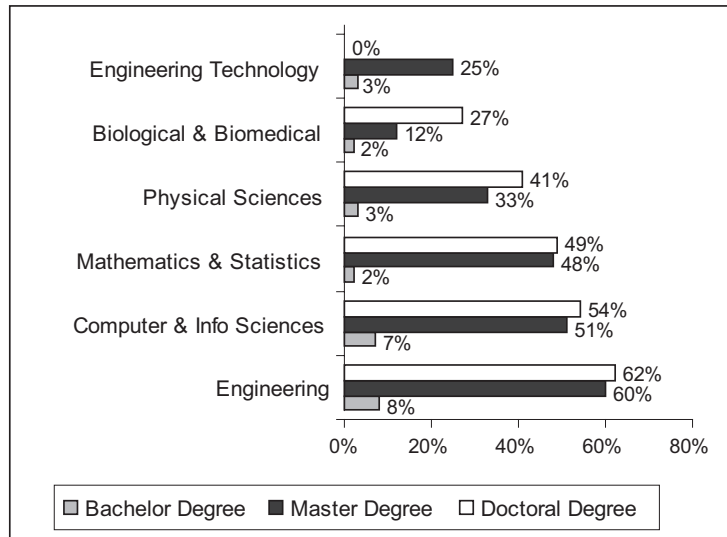
# COLLEGE PARTICIPATION AND COMPLETION

The following table shows the distribution of degrees in targeted STEM fields. At face value, it would appear that Illinois colleges are preparing a strong STEM workforce; however, the figure shows that nearly half or more of the master and doctoral degrees in mathematics, computer science, and engineering are awarded to non-residents. The global competition for these workers, as well as all STEM degree holders, is increasing, making it more difficult for Illinois to build and retain a STEM workforce.

**Table 12** Number of Degrees Awarded by Illinois Colleges and Universities in 2003-2004<sup>142</sup>

	Associate Degree	Bachelor Degree	Master Degree	Doctoral Degree
Computer & Info Sciences	1,312	3,337	1,496	41
Engineering	107	2,392	1,373	282
Engineering Technology	1,183	1,098	204	13
Biological & Biomedical	-	2,506	360	234
Mathematics & Statistics	-	587	306	71
Physical Sciences	-	676	294	151
Construction Trades	121	-	-	-
Mechanic Technicians	427	34	-	-
Precision Production	39	-	-	-

**Figure 33** Percentages of Degree Recipients in Illinois Who are Non-Residents<sup>143</sup>



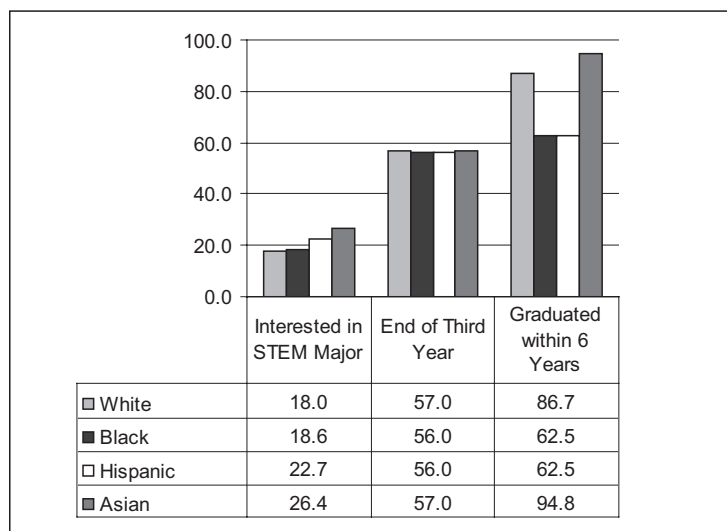
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The under representation of black and Hispanic students in higher education is an ongoing concern. From 1994 to 2004, the percentage of undergraduate white students in Illinois public universities decreased from 71% to 68%. During the same period, the number of black students in Illinois public universities decreased 6%, the number of Hispanic students increased 36%, and the number of Asian students increased 22%.

Even though black and Hispanic students are under represented, an American Council on Education study<sup>144</sup> concluded that black and Hispanic students are just as likely as white and Asian students to major in science, technology, engineering, and mathematics when they enter college. Within six years, however, only 63% of the black and Hispanic students will have graduated with a STEM degree, compared to 95% of their Asian peers and 87% of their white peers.

A six-year longitudinal study of 12,000 students found the stumbling blocks for the black and Hispanic students are the same regardless of their major—those not completing were more likely to work 15 hours or more a week, less likely to have completed a highly rigorous high school curriculum, and less likely to have a parent with a bachelor's degree or higher.<sup>145</sup> Compared to their white and Asian peers, black and Hispanic STEM majors are more likely to dropout after their third year.

**Figure 34 College Major, Persistence, and Completion by Ethnicity<sup>146</sup>**



# COLLEGE PARTICIPATION AND COMPLETION

## Chapter Summary

Keeping Illinois competitive requires a highly-skilled STEM workforce with higher levels of education. The enrollment rate of Illinois high school graduates entering directly into college is 57%, the same as for the U.S. Over the next 6 years, slightly more Illinois students (58%) will complete 4-year degrees than found nationally (55%).

In 2004, Illinois colleges and universities granted over 10,000 bachelor and higher degrees in computer and information science, engineering, and mathematics. Over half of the master and doctoral degrees were granted to non-residents. Although data is not yet available, contemporary anecdotal evidence suggests that the non-resident graduate students are more likely than formerly to look for jobs in their home countries as economic opportunities increase, especially in India and China.

From 1994 to 2004, the number of students in Illinois colleges and universities increased with a significant increase in the Hispanic population and a decrease in the black population. Even though the proportion of black and Hispanic students who select a STEM major is similar to their white and Asian peers, fewer complete degrees within six years. The black and Hispanic students, compared to their white and Asian peers, have a high dropout rate after the third year of college. The factors linked to not completing degrees are often related to the low-income status of many of the black and Hispanic students: inadequate preparation because of less rigorous high school curricula, parents without college degrees, and a need to work to support themselves and their families.

The challenges for Illinois are to find ways to overcome the barriers faced by low-income students and prevent a brain drain of the STEM workers.

*Only slightly more than one-fourth of all college degrees awarded in Illinois is in a STEM field.*

*Over 60% of the graduate engineering degrees and half of the computer science and mathematics degrees are earned by non-residents.*