S*cience*

T*echnology*

E*ngineering*

M*athematics*

STEMming the Tide:

A Colorado Response to the National Crisis in STEM Education

A White Paper by

The Colorado Association for Gifted and Talented

and

Center for the Education and Study of the Gifted, Talented, Creative

University of Northern Colorado

Stuart N. Omdal, Ph.D., Mary-Anne Richards, Ed.D.,

Deborah Brennan, M.A. & Julie Gonzales, M.A.

The Colorado Association for Gifted and Talented and the Center for the Education and Study of the Gifted, Talented, Creative at the University of Northern Colorado present this "White Paper" to inform Colorado decision makers in industry, government, and public education how to resolve the current crisis in Science, Technology, Engineering, and Mathematics (STEM) education in Colorado. We propose solutions that "raise the bar" for all students and "raise the ceiling" for Colorado's most able learners. We conclude that research-based gifted education practices **can effectively address and must be applied to the STEM problem**. The result will be the continued leadership of Colorado and the United States in innovation, research, and development – **STEMming the Tide and solving the crisis** in the areas of Science, Technology, Engineering and Mathematics.

INTRODUCTION

The role of Science, Technology, Engineering, and Mathematics (STEM) education in the United States is currently receiving a great deal of attention. Recently published national studies, President Bush's 2006 State of the Union address, and even a recent edition of *Time* magazine, highlight the importance of strong educational programs in these areas starting at elementary grade level throughout college to ensure the vitality of the United States economy, to sustain our national security, as well as to maintain our global leadership in innovation and research.

Asian countries, in particular, have made great advances in education during the last 50 years, in some instances surpassing the United States in student achievement in math and science. Whereas in the past many of the Asian countries specialized in manufacturing American goods, their leaders are showing great interest in learning about American methods of inventive thinking, innovation, and creativity.

The potential economic and social impact of the downward trend of fewer American university students majoring and choosing careers in the STEM areas is enormous. Introducing students to these fields through curriculum that is engaging, meaningful, and challenging, creates the opportunity for the United States to maintain and exceed its current place as the leader in science, technology, engineering and mathematical innovation throughout the world. In the United States, gifted education principles and practices hold much promise for increasing student interest and achievement in Science, Technology, Engineering and Mathematics (STEM).

Education reform in the United States focuses on raising the "academic bar" for lower performing students by increasing math and science graduation requirements and math achievement scores. Federal and state legislation around academic accountability displaces any efforts to support education of the gifted learner. State mandated testing of public school students focuses questions and measured outcomes squarely on the "proficient" scorers. This undermines the value of "advanced" level scores, reporting to

the public that successful achievers are those falling under the combined "proficient or advanced" categories.

The future of the United States' economy depends on a well-educated workforce. However, the impetus for economic growth comes from the creation of ideas and innovation -- new ways of doing things. American innovation and creativity have kept the United States at the technological forefront for a century-and-a-half and have made the United States the envy of other countries.

Last fall the Colorado Association for Gifted and Talented (CAGT) hosted a public forum entitled: ***Tapping Colorado's Potential: An Initiative for Achieving Innovative Excellence in a Global Economy.*** The association invited representatives from area high tech and defense industries including Northrop Grumman, IBM, Raytheon, and Ball Aerospace. Former Wyoming Governor Jim Geringer, Director of Policy and Public Sector Strategies for Environmental Systems Research Institute; Dr. Judi Diaz Bonacquisti, Director of Minority Engineering Programs at the Colorado School of Mines; and Dr. Susan Assouline, co-author of the Templeton National Report on Acceleration were also invited. The focus of the discussion was to respond to recent reports concerning the declining pool of a competitively educated and trained workforce in the areas of science, technology, engineering and mathematics (STEM). The decision to publicize issues surrounding the STEM problem and offer solutions from a gifted education perspective resulted from this forum.

The Colorado Association for Gifted and Talented and the Center for the Education and Study of the Gifted, Talented, and Creative at the University of Northern Colorado present this "White Paper" to inform decision makers in Colorado of solutions to address the current state of STEM education in Colorado. These solutions "raise the bar" for all students and "**raise the ceiling**" for Colorado's most able learners. **Principals of gifted education present a research-based foundation that can reverse the current STEM crisis in Colorado and the nation**.

THE PROBLEMS

❖ Shifting Intellectual Capital

> *"We go where the smart people are. Now our business operations are two-thirds in the U.S. and one-third overseas. But that ratio will flip over the next 10 years."*
>
> — Intel spokesman Howard High

The percentage of United States students majoring in the STEM disciplines and thus choosing STEM careers is decreasing. The percentage of students from foreign countries majoring in the STEM disciplines in the U.S. and the percentage of foreign students who stay in their own countries majoring in STEM disciplines are increasing.

The numbers are familiar:

- In 2000- The number of science and engineering undergraduate degrees awarded:
  - Asian universities: 12 million
  - European universities (including Russia): 850,000
  - North American universities: 500,000
- In 2003- percentage of graduates who were foreign nationals earning Ph.D.s in the United States
  - 59 percent - Engineering
  - 56 percent - Computer Science
  - 54 percent - Math
  - 48 percent – Physics

- In 2004- U.S. graduated 70,000 engineers
  - India graduated 350,000 engineers
  - China graduated 600,000 engineers
- Current- percentage of undergraduates majoring in Engineering
  - U.S. - 6 percent of university students (about one-third of U.S. students intending to major in engineering switch majors before graduating)
  - European Countries - 12 percent of university students
  - Singapore - 20 percent of university students
  - China - 40 percent of university students

U.S. universities report a drop in the number of foreign students coming to the United States for undergraduate and graduate study due to changes in immigration laws that resulted from the 9-11 incident. Also reported is an increase in the number of universities in Asian countries offering advanced degrees in the STEM disciplines. The increase of graduates in STEM in other countries is considered to be reflective and predictive of growing technological and scientific economic strength in those countries.

❖ Losing the Competitive Edge

The development of scientific talent in foreign countries may produce long-term educational and economical implications. The United States leads the world in innovations and inventions that have greatly affected many aspects of life on a global scale. This proclivity for creativity and originality has long been a hallmark in American industry and technology. Leaders in business and industry in foreign countries are now looking to the United States for strategies to increase their country's creative thinking, innovation, and problem solving abilities.

❖ Losing National Security Capabilities

National security depends on an abundance of graduates in the STEM disciplines. When over 50% of the graduates earning Ph.D.s in the United States are foreign

nationals, there will not be an adequate number of United States citizens capable of filling these crucial positions.

❖ The Status of Education at the National Level

Nationwide Standards Eyed Anew

By Lynn Olson (as first appeared in Education Week, December 7, 2005)

"Besides the effects of the nearly 4-year-old federal law (No Child Left Behind), advocates are pointing to the kind of growing international competition that is analyzed in Thomas L. Friedman's current best-selling book, The World Is Flat: A Brief History of the Twenty-First Century. I've been watching very, very closely the educational progress in Asia — China, India, Vietnam, Singapore, and several others," said Robert L. Wehling, a retired global-marketing officer for the Cincinnati-based Procter & Gamble Co., "and I'm telling you, they're making rapid progress, whereas we're making minuscule progress. And I don't think the average American understands the impact of this for our future, ***because they're going to have the bulk of the intellectual and creative talent in the world, and that has devastating consequences for us."***

Student Performance in Mathematics and Science

• The **National Assessment of Educational Progress** (NAEP) reports that student performance in mathematics and science has improved to some extent over the past 30 years, but the improvement has not been consistent. Achievement gaps between racial/ethnic groups have not changed.

• **The Program for International Student Assessment** (PISA) states that students in the United States are performing at or below the levels of students in other industrialized countries.

• The **Third International Mathematics and Science Study** (TIMSS) reports that when compared internationally the performance of American students declines at higher grade levels. Those United States students who took classes in science and mathematics at an advanced level performed poorly compared with students in other countries who had taken comparable courses.

Limitations of Standardized Tests

Standardized tests provide adequate data relating to midrange students; however, **they fail to effectively measure students at the high end of the ability spectrum**. These tests fail to recognize students who perform above the Advanced level or those who move to superior or innovative performance. If collected data reflects values, then our society values minimum proficiency. There is no formal recognition of students who move beyond the knowledge and comprehension levels of understanding concepts and information and move to the highest levels of thinking – the synthesis or creation of new information.

NASA Space Settlement Contest

As an example of true American ingenuity, the NASA Space Settlement contest was started in 1993, with the first awards given in the Spring of 1994. Table 1 is a comparison of the winners from 2000 and 2005. It is clear that the participation of students from other countries has increased. It may be due to increased publicity through the Internet, or other reasons, such as the drive of other governments to compete in engineering and technology. Whatever the reason, this is a dramatic representation of the growing creative thinking, innovation, and problem-solving ability of students in other parts of the world.

Table 1: NASA Space Settlement Contest Winners Country of Origin

	2000	**2005**
Grand Prize	Ireland: 1	Romania: 1 India: 1
1st place winners	Austria: 1 Macedonia: 1 U.S.: 7	Iran: 1 Romania: 1 India: 1 U.S. 4
2nd place winners	Canada: 1 U.S.: 8	India: 4 Turkey: 1 U.S.: 2
3rd place winners	U.S.: 10	India: 2 U.S.: 5
Honorable Mention	U.S.: 26	India: 4 U.S.: 13

❖ Status of Education in Colorado

Colorado Student Assessment Program

Student data for the last five years show a decline in the percentage of students scoring at the proficient (p) and advanced (a) levels. (Appendix 1, Page 20) This decline may reflect that the math foundation developed in the early grades primarily focuses on arithmetic computation at the expense of general number sense and conceptual mathematical thinking. Instructional strategies that develop a strong foundation in conceptual mathematics supports the application of skills and knowledge needed for success in algebra, geometry and calculus.

Advanced Placement

Advanced Placement (AP) exam results (Appendix 2, page 21) indicate that more students are taking the AP exams, in part due to the Colorado ESCAPE Grant (Eliminating Student Cost for Advanced Placement Exams). The score range on the AP exam scores is 1 (low) - 5 (high), with scores of three and above indicating subject-competency. From 2001 to 2005 in the sciences and mathematics exams, 29 - 48 percent of the students scored below the competency level. This may indicate that these students were neither ready academically for the rigor of the courses nor ready for college level coursework.

Colorado's Post-Secondary Outlook

Colorado ranks 29th in the country for graduating high school students and 19th for the percentage of high school graduates who go on to college. The Colorado Department of Education reports that about 25 percent of high school graduates require remedial classes in college and that the majority of these students do not earn a bachelor's degree. With this critical need to focus on the students who are not ready for post-secondary options, Colorado's most able learners are left out of the call for high school reform. While it is important to "raise the bar" of academic rigor and preparation for all students, it is critical to Colorado's economic future that we **"raise the ceiling"** for our most able learners.

Assessments Used to Estimate College and Entry Job Readiness

The CSAP and AP exam scores can tell us how our students and schools perform within Colorado on a year-to-year basis; they can also be used to compare schools. But how college-ready and entry-job-ready are our students when compared to the rest of the high school students in the country? The answer necessitates a look at the American College Testing Program (ACT) scores of Colorado's high school students.

Since 2002, all Colorado high school juniors have taken the ACT as part of the State Assessment Program for Education Accountability (Colorado Senate Bill 186, 2000). The ACT scores allow parents and schools to compare the academic success of high school students in Colorado and across the nation. With all juniors now taking the ACT, Colorado's average ACT score fell, on a 36-point scale, from 21.4 in 1995 to 20.2 for 2005 (See Table 2, page 11). The ACT assesses student performance in Mathematics, Science, English and Reading, with an optional Writing section. This allows the state policymakers, business leaders, parents, and educators to evaluate how prepared the high school upperclassmen are for work and secondary educational opportunities.

Only 15 percent of American jobs are open to the unskilled high school graduate or drop-out – this is the basis of the call for high school reform and Colorado's initiative to "raise the bar" of post-secondary preparation. "College Prep" coursework is not just for college-bound students in the 21st century. Eighty-five percent of the possible jobs require more than basic skills. All high school graduates need the pre-requisite content, skill, and thinking ability requirements of post-secondary options in order to qualify for introductory level jobs in the United States.

However, it is Colorado's most able learners that will create these job opportunities for our educated population. Innovation provides the key to employing a highly-trained and educated workforce. As America loses its technological and innovative edge to other countries, the skilled jobs, like the unskilled jobs of the 20th century, will be lost to overseas competitors. We must **"raise the ceiling"** for our most able learners, allowing them to develop their creative thinking and problem solving abilities in order to continue to create new industries for our workforce.

Table 2: ACT National and Colorado Scores 1995-2005

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
ACT Average Score	20.8	20.9	21.0	21.0	21.0	21.0	21.0	20.8	20.8	20.9	20.9
Colorado Average Score	21.4	21.4	21.5	21.6	21.5	21.5	21.5	20.1	20.1	20.3	20.2
Percent Graduating Seniors Taking Test	63	60	60	63	62	64	62	99	100	100	100
National Math	20.2	20.2	20.6	20.8	20.7	20.7	20.7	20.6	20.6	20.7	20.7
Colorado Math	20.5	20.5	20.9	21.2	21.1	21.1	21.1	19.8	19.7	20.0	20.0
National Science	21.0	21.1	21.1	21.1	21.0	20.0	20.1	20.8	20.8	20.9	20.9
Colorado Science	21.8	21.8	21.8	21.8	21.7	21.7	21.7	20.2	20.5	20.4	20.2

Note: Colorado's scores in 2005 ranked Colorado 39th in math and 40th in science on the ACT.

"Only 22 percent of the 1.2 million high school graduates who took the ACT Assessment in 2004 achieved scores that would deem them ready for college in all their basic academic areas — English, Math and Science." (ACT report (2004)

PROPOSED SOLUTIONS

The chain of STEM instruction begins in elementary school and continues through middle and high school to undergraduate and graduate schools. This "pipeline" feeds the research and development departments of business and industry. Weak links in the chain can cause the breakdown of the system and leave our country with a dearth of specialists in the STEM disciplines, creating a threat to Colorado's and America's economic vitality and leadership, as well as our national security. The

following proposals to reverse this crisis in STEM areas are grounded in research-based Gifted and Talented Education principles and practices.

❖ Research-Based Solutions from Gifted Education for ALL STUDENTS:

• Raising the Ceiling

PROVIDE ADVANCED LEARNING OPTIONS AT ALL LEVELS (K-12) IN COLORADO SCHOOLS

"No Child Left Behind" places a high priority on increasing the test scores of students who are at the Unsatisfactory and Partially Proficient levels to the Proficient level. While this "raising the bar" is necessary for those who are too often left behind, an unintended side effect of this emphasis is the lowering of curricular expectations for students who are capable of advanced performance. Too often educators feel they must choose between providing for the academic needs of students working below grade level and those performing above grade level. It is possible to address the needs of all learners by raising both the "bar" and the "ceiling".

"By denying our most intelligent students an education appropriate to their abilities, we may also be denying civilization a giant leap forward."
Jan Davidson in "The Prodigy Puzzle" by Ann Hulbert, Nov. 20, 2005, New York Times.

• Curriculum Differentiation

APPLY CURRICULUM AND INSTRUCTION DIFFERENTIATION IN ALL K-12 CLASSROOMS.

Curriculum differentiation is a research-based approach to instruction that uses student ability, readiness, and interest to shape instruction. Colorado teachers face classrooms filled with a wide-range of learning abilities and readiness. Many teachers try to "teach to the middle" and leave both the struggling learner and the advanced learner out of the lesson planning. Often the struggling learner gives up and the advanced learner tunes out. Rather than assuming that all students in the same grade have the same level of knowledge, understanding, and skills in a particular content area, curriculum differentiation allows teachers to pre-assess students to determine

each student's appropriate level for instruction. In a major 2005 study conducted in the Denver metropolitan area by Mary-Anne Richards from the University of Northern Colorado, 300 high school freshmen in heterogeneous general science classes made substantial academic gains through the implementation of curriculum differentiation. Training all classroom teachers in curriculum differentiation will allow them to address the diverse abilities found in Colorado's classrooms. This will allow more time for the struggling learner to grasp the content, as well as allow the advanced learner to gain the opportunity to develop higher levels of skills and knowledge.

- **Active Learning**

INCREASE S.T.E.M. ACTIVE LEARNING EXPERIENCES.

Provide STEM active learning experiences for students which utilize inquiry methods, primary sources, and technology in an exciting and sophisticated way to increase student motivation. As students master the skills of practicing professionals, they learn to solve real problems. Real-world problem solving with direct application, opportunities for research, and creative productivity are achievable at any grade level for all students. More students will pursue math and science education into post-secondary options because they associate science and math with practical applications to life rather than the tedium of textbook learning. It is critical that students who exhibit high ability in STEM areas have the opportunity to meet and collaborate with career STEM professionals. These connections will allow students to develop a knowledge of and an interest in the possibility of pursuing a career in a STEM profession. Connecting high potential students during their early school years to STEM professionals will create America's next generation of innovative leaders.

- **Creativity and Innovation**

EMPHASIZE CREATIVITY AND INNOVATION IN S.T.E.M. INSTRUCTION.

Creative thinking is the essential factor in innovation, invention, and research. When schools emphasize memorization of facts without an opportunity to use those facts by posing questions and solving real world problems, students associate the STEM

fields as a disengaging process of cataloging and computing information. Curiosity and creativity lead to innovation and invention, as well as the ability to solve critical problems. Gifted education includes many research-based activities that enhance creativity in students. High ability learners need an opportunity to develop their creative thinking abilities so innovation, invention, and research will continue in STEM areas.

- **Reduce Alienation**

REDUCE THE ALIENATION OF CREATIVE AND INNOVATIVE STUDENTS BY REQUIRING ALL PRE-SERVICE TEACHERS TO COMPLETE A FULL COURSE ON THE NATURE & NEEDS OF GIFTED LEARNERS.

The social and emotional needs of creative, innovative, and gifted students are not supported in many public and private school settings. These students often feel separated from their peers and devalued in school and society, leading them to under-achieve and drop-out of school. In reality, it is the thinking of creative and innovative people that allows original approaches to old problems that leads to new ideas and innovative solutions. Innovative professionals make the discoveries that lead to breakthroughs, inventions, and new ways of thinking. Gifted education includes many research-based methods aimed at decreasing the alienation of creative and innovative learners. These practices need to be embedded in Colorado's education system. Teachers, administrators, parents, and students must be given the opportunity to understand and value the creativity of these students in order to support them.

"We must learn to value nonconformists. ...Just as we are learning to value racial diversity, we must learn to treasure the different abilities and interests of our students." Margaret Wallace (Jefferson County Schools, Colorado) Ed Leadership Dec 1999/Jan 2000, Nurturing Nonconformists p.44

- **Explorations, Internships, and Mentorships**

DEVELOP EXPLORATIONS, INTERNSHIPS, AND COORDINATED MENTORSHIP PROGRAMS.

Explorations allow high ability students to begin the process of active inquiry into

a field of study. By using the research-based gifted education method of curriculum compacting, high ability students gain the class time necessary to make these explorations, nurturing their personal identity as a practitioner of the discipline. Providing internships and mentorships will allow students to experience the excitement of real-world application in the STEM fields. Linking middle and high school students with professionals working in the field will stimulate interest and provide opportunities for collaboration. Research shows that many successful scientists attribute a critical degree of their success to interested professionals and mentors that supported them during their development.

❖ Teacher Support Solutions

• Qualified Teachers

INCREASE THE NUMBER OF HIGHLY QUALIFIED TEACHERS.

This is a key component of both the No Child Left Behind act and President Bush's "American Competitiveness Initiative" (2006). Because elementary teachers must take courses in all content areas, it is sometimes difficult for them to attain adequate levels of knowledge and skills in all the content areas they teach. Elementary teachers lay the content area foundations critical for success at the secondary level so it is essential that they attain the knowledge, skills, and dispositions necessary to successfully ground their students in the STEM content areas. State universities are mandated to plan teacher education programs that can be completed in eight semesters with a cap of 120 credits. Giving universities the option to increase the science and math requirements is a key step in developing more highly qualified teachers.

❖ Colorado Association for Gifted and Talented (CAGT)

DEVELOP A STATEWIDE NETWORK OF RESOURCES, TRAININGS, AND ENRICHMENT OPPORTUNITIES FOR TEACHERS, PARENTS, AND STUDENTS.

CAGT will develop a clearinghouse for professional education opportunities for teachers: summer institutes, internships, collaborative projects, workshops, and

courses, as well as teaching resources. CAGT will continue to develop workshops and conferences that give educators, parents, and students an opportunity to experience research-based ideas for the classroom and school. CAGT will publish best teaching practices in STEM areas that highlight curriculum ideas for parents, teachers, and students. CAGT will gather opportunities for students to explore and expand their interests, talents, and abilities in STEM through summer programs, academic competitions, and research opportunities. CAGT will actively pursue partnerships with Colorado businesses to provide opportunities and scholarships for students to engage in mentor experiences and internships in STEM areas.

CONCLUSION

Gifted education solutions can effectively address and must be applied to the STEM problem. Although Colorado is requiring higher levels of math – "raising the bar" for all students – and many students are accepting the challenge of higher levels of math, Colorado and the United States have failed to "**raise the ceiling**" for our most able-learners. They have ignored the research-based components of gifted education that cultivate creativity, problem solving, and innovation through independent study, explorations, enrichment, and mentorships. Teacher training in research-based gifted education practices can benefit all students. With the full support of policy makers, the business community, parents, and our Colorado community, all students can make the transformation into active, inquiring learners. School partnerships with industry to provide internships, mentorships, and other real-world experiences can motivate highly-able students to pursue further education and careers in STEM. The result will be the continued leadership of Colorado and the United States in innovation, research, and development – **STEMming the Tide** and **solving the crisis in the areas of Science, Technology, Engineering and Mathematics.**

"True education makes for inequality;
the inequality of individuality,
the inequality of success;
the glorious inequality of talent, of genius;
for inequality, not mediocrity, individual superiority,
not standardization is the measure of the progress of the world."
— Felix Emmanuel Schelling, American Educator and Scholar (1858 - 1945)

Reference List

ACT Report. (2004). Crisis at the core: Preparing all students for college and work.

ACT News release. (2004, October). *College readiness crisis spurs call for change by ACT in Nation's core high school curriculum.*

ACT Report. (2005). *Measuring Colorado students' progress toward State learning standards* [Case Study].

ACT Report. (2006). *College Readiness Standards-Science*. Retrieved January 19, 2006 from www.act.org/standards/pdf/science.pdf

ACT Report. (2006). *College Readiness Standards-Mathematics*. Retrieved January 19, 2006 from www.act.org/standards/pdf/mathematics.pdf

Bush, George W. (2006). State of the Union Address. Retrieved February 6, 2006 from science.nsta.org/nstaexpress/nstaexpress_2006_02_06_sotu.htm

The Business Roundtable (2005). Citing "Critical Situation" in science and math, business groups urge approval of new national agenda for innovation [News release]. Retrieved January, 2006 from http://www.businessroundtable.org/newsroom/index.

The Business Roundtable. (2005). *Tapping America's potential: The education for Innovation initiative. Retrieved January 2006 from www.businessroundtable.org/pdf/20050727002TAPStatement.pdf*

The Cincinnati Post (2005, November 29). *What students want*.

Domestic Policy Council. Office of Science and Technology Policy. (2006). *American Competitiveness Initiative*. Retrieved February 6, 2006. from http://www.whitehouse.gov/stateoftheunion/2006/aci/aci06-booklet.pdf

Gallagher, J. J. (2005). National security and educational excellence. *Education Week. 24(38)* 32-33, 40.

Gambiano, R., Denny, G., and Devore, J. (2000, Winter). College student retention at a Midwest university: A six-year study. *Journal of College Admission, 166.*

Gates, B. (2005, February 26). The National Education Summit on High Schools. [speech]. Retrieved May 19, 2005 from www.gatesfoundation.org/MediaCenter/Speeches/Billg.Speeches/BGSpeechNGA-of0226.htm

Hulbert, A. (2005). The prodigy puzzle, *New York Times*.

Keighley, T. (2005, Spring). Schooling vs. learning: Students speak out. *Gifted Education Communicator*.

Lemonick, M. D.(2006). Are we losing our edge? *Time 167 (7),* 22-33*.*

NSTA. (2006). ACT scores show students unprepared for college. *NSTA Reports*. 17(4), 15.

National Academies. (2005). *Rising above the gathering storm: Energizing and employing America for a brighter economic future.*

Entire report http://newton.nap.edu/books/0309100399/html

Executive summary http://newton.nap.edu/execsumm_pdf/11463.pdf

National Science Board. (2004). *Science and engineering indicators 2004*. retrieved January 15, 2006 from http://www.nsf.gov/statistics/seind04/

Protopsaltis, S. (2005). Exploring Colorado's educational pipeline. *The Bell Policy Center White paper No.1*

Renzulli, J. (2005). A quiet crisis is clouding the future of R & D. *Education Week. 24(38)* 32-33, 40.

Robinson, N. M. (2003) Two wrongs no not make a right: Sacrificing the needs of gifted students does not solve society's unsolved problems. *Journal for the Education of the Gifted. 26(4),* 251-273.

Stepanek, J. (1999). *The inclusive classroom: Meeting the needs of gifted students differentiating mathematics and science instruction.* Northwest Regional Educational Laboratory.

Wallace, M. (1999/2000). Nurturing nonconformists. *Educational Leadership*, 44.

White House (2004). *Educating America: The President's initiatives for high school, higher education and job training.*

Data Resources:

Achievement C Testing

ACT Newsroom: ACT National and State Scores

http://www.act.org/news/data.html

Advanced Placement Courses and Exams: College Board

Home page http://apcentral.collegeboard.com/members/1,3050,,00.html

State scores

http://apcentral.collegeboard.com/program/research/1,3061,150-160-0-4541,00.html

Achievement C Testing

ACT Newsroom: ACT National and State Scores

http://www.act.org/news/data.html

Colorado Department of Education CSAP Summary Data 1997-2005

http://www.cde.state.co.us/cdeassess/csap/as_latestCSAP.htm

National Aeronautics and Space Administration. (2005). NASA Space Settlement

Contest. http://www.nas.nasa.gov/About/Education/SpaceSettlement/Contest/

Appendix

Appendix 1:

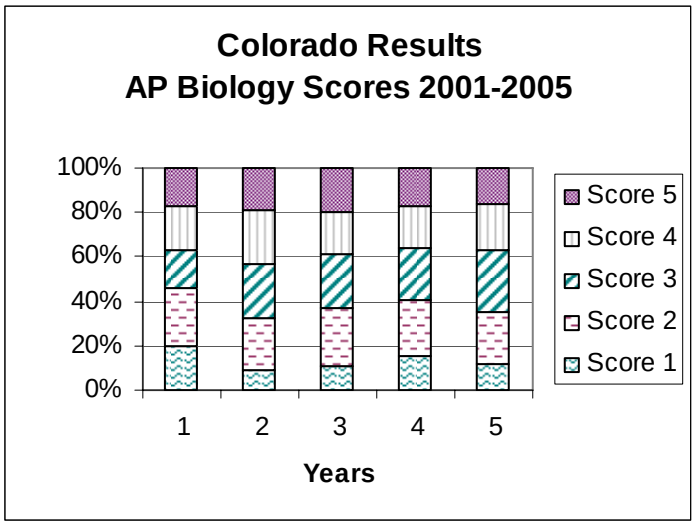
Assessments and Score Patterns in CSAP Results: Mathematics

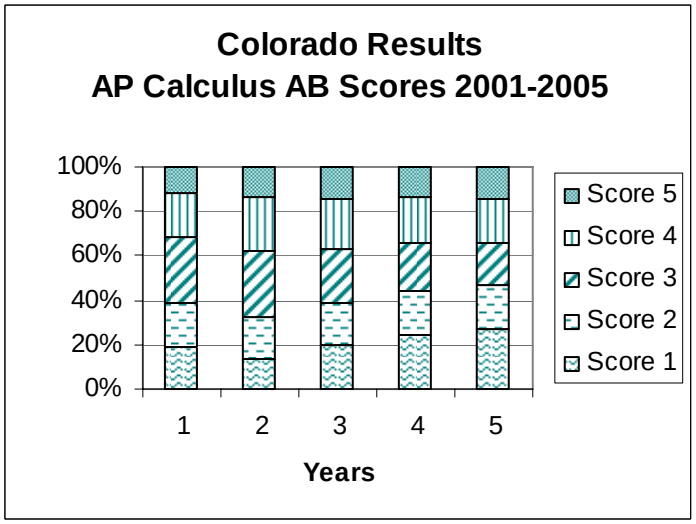
grade / starting date		5th	6th	7th	8th	9th	10th
2000 8th grade	**p + a**				**35**	**na**	**27**
	p				24	na	24
	a				11		3
2001 8th grade	**p + a**				**39**	**31**	**27**
	p				25	22	23
	a				14	9	4
2002 8th grade	**p + a**				**39**	**31**	**27**
	p				26	23	23
	a				13	8	4
2001 5th grade	**p+a**	**52**	**51**	**41**	**41**	**33**	
	p	35	35	28	25	23	
	a	17	16	13	16	10	
2002 5th grade	**p+a**	**55**	**52**	**42**	**44**		
	p	35	34	27	29		
	a	20	18	15	15		
2003 5th grade	**p + a**	**56**	**53**	**44**			
	p	36	35	28			
	a	20	18	16			
2004 5th grade	**p+a**	**58**	**56**				
	p	36	34				
	a	22	22				
2005 5th grade	**p+a**	**63**					
	p	36					
	a	27					

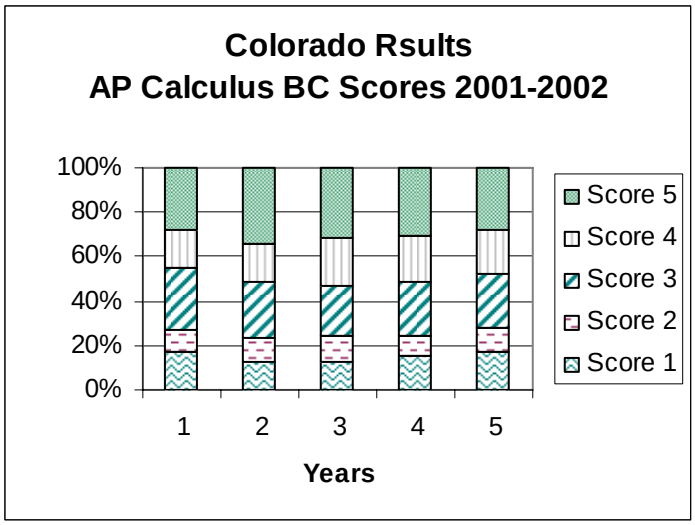
Note: proficient (p) & advanced (a) in percent of students

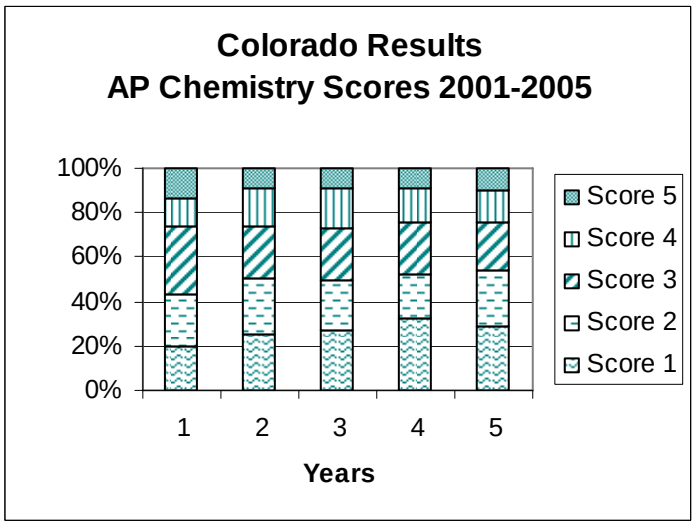
Appendix 2

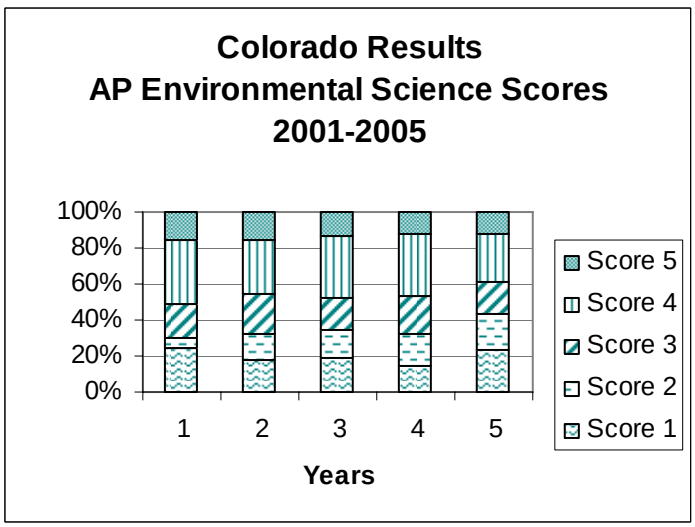
Graphic representation of Advanced Placement (AP) scores earned by Colorado high school students after a year of coursework. The range of the final exam scores is 1 (low) - 5 (high). Depending on the university, credit may be awarded to students who score at the 4 or 5 level. From 2001 to 2005 in the sciences and mathematics exams, 29 percent to 48 percent of the students scored at the 1 or 2 level. This may indicate that these students were neither ready academically for the rigor of the courses nor ready for college level coursework.

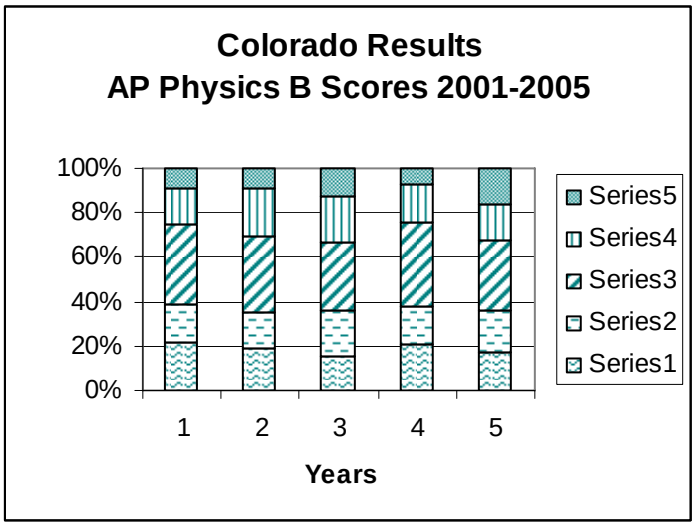


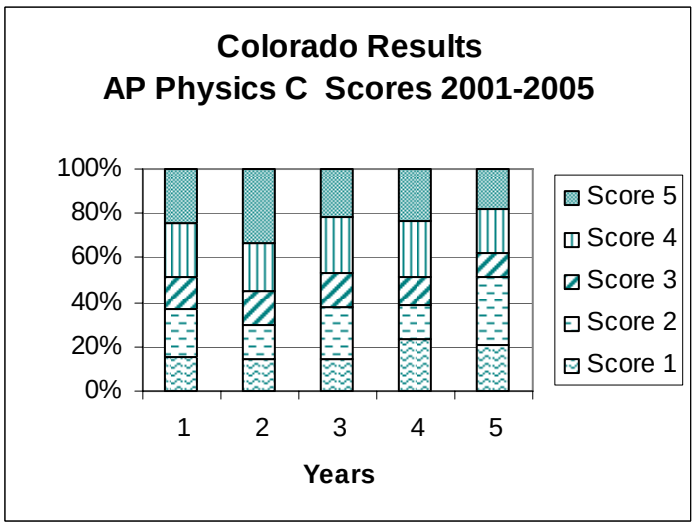


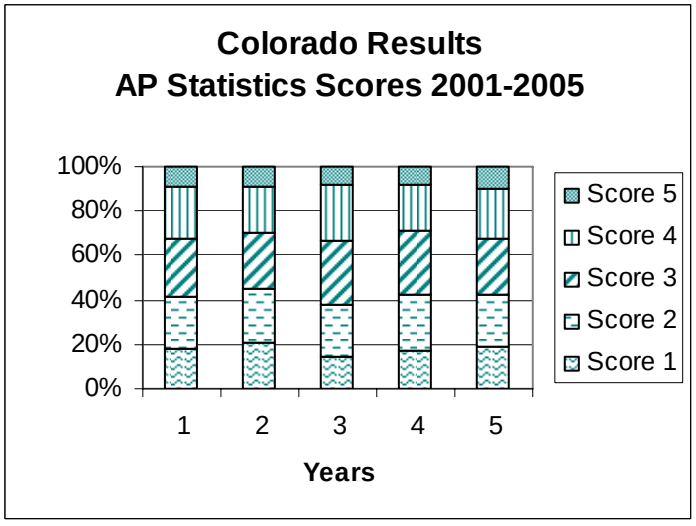

Colorado Rsults
AP Calculus BC Scores 2001-2002
100%
80%
60%
40%
20%
0%
1
2
3
4
5
Years
Score 5
Score 4
Score 3
Score 2
Score 1


Colorado Results
AP Chemistry Scores 2001-2005
100%
80%
60%
40%
20%
0%
1
2
3
4
5
Years
Score 5
Score 4
Score 3
Score 2
Score 1


Colorado Results
AP Environmental Science Scores
2001-2005
100%
80%
60%
40%
20%
0%
1
2
3
4
5
Years
Score 5
Score 4
Score 3
Score 2
Score 1


Colorado Results
AP Physics B Scores 2001-2005
100%
80%
60%
40%
20%
0%
1
2
3
4
5
Years
Series5
Series4
Series3
Series2
Series1


Colorado Results
AP Physics C Scores 2001-2005
100%
80%
60%
40%
20%
0%
1
2
3
4
5
Years
Score 5
Score 4
Score 3
Score 2
Score 1


Colorado Results
AP Statistics Scores 2001-2005
100%
80%
60%
40%
20%
0%
1
2
3
4
5
Years
Score 5
Score 4
Score 3
Score 2
Score 1