Science & Math CESE Education

The

BEACON

News from

The Coalition for Excellence in Science and Math Education

Volume V, No. 6 **Copyright © 2001** **December**

NOTHING ENDURES BUT CHANGE

The world since September 11th is, to reverse the phrase, eerily unfamiliar. So many elements of life in America persist – but differently. We still go to work, the kids still go to school. Fans still stood and stretched in the middle of the 7th inning of the World Series (which still involved the damnable Yankees); only now they sang "God Bless America" instead of "Take Me Out to the Ballgame."

The consequence of one continuing but transformed facet of life has, I think, been lost in the chaos - the value of a scientifically literate public. Just one example: The recent scare over anthrax (at least momentarily calmed as of this writing) was shaped at least partly by important misperceptions over how anthrax works, how it can spread, and how it can (and cannot) be engineered as a biological weapon. And while the immediate cost to each of us of those misunderstandings may seem trivial (some lingering embarrassment over having zapped your mail in the microwave for a few days perhaps), the long-term costs may be enormous (the panic over mail security may end up requiring a multi-billion dollar bailout of the postal service).

The fear over anthrax is only one example. Since 9/11, the government and the public have had to confront complex issues over airline safety, infrastructure protection, surveillance and privacy in electronic communication, and the ability of a high-tech military to combat a low-tech but determined adversary. True, it would be naïve to think that a more technically literate public would be guaranteed to confront these problems with aplomb and wisdom. But I have to believe that better education could only help. Now, perhaps more than ever, we need to recognize the value of science education, and do what we can to improve it.

Timothy Moy
CESE President

BOARD MEETING HIGHLIGHTS

The CESE board met October 24, 2001, at Quasar International. Attending were board members Timothy Moy (presiding), Nancy Shelton, Steve Brugge, Kim Johnson, Jerry Shelton, Dave Thomas, Jonathan Weiss, and Marilyn Savitt-Kring, and CESE member Paul Bolduc.

Guest Speaker

The first agenda item was a comprehensive slide presentation by guest Jim Walther speaking for the Math, Science, and Technology Partnership. www.aps.edu/aps/mstweb MSTP brings together people from business, industry and education to work on improving education. He explained the plan that is under way to create a math and science cluster around Sandia High School. (Other clusters will be added later.) Walther also invited all CESE members to participate as individuals in any of the five "task force" working committees under the partnership. They are: Communications, Resources, Curriculum, Accountability, and Quality. Those interested should contact Tim Moy at 254-8991.

Since Walther is also director of the National Atomic Museum, he gave us a progress report on the pending move. The museum, now located on Kirtland Air Force Base, is essentially closed to outside visitors since Sept. 11. When it reopens, it will be renamed National Museum of Nuclear Science and History and moved to a location near the new Balloon Park.

CESE Business

Treasurer's Report: Nancy Shelton stated the treasury balance was $1300. She reported that the flyer announcing the New Mexico Academy of Science annual banquet on November 17 was sent to local members of CESE. Marshall Berman is president-

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WWW.CESAME-NM.ORG

Membership Information

CESE annual dues are $25 for an individual, $35 for a family membership, and $10 for students.
Please make checks payable to CESE, and mail to
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Feedback on Beacon Welcome

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elect of NMAS. Kim Johnson and Steve Brugge have been nominated for president-elect and vice president respectively. (All were elected.—Ed)

CESE Education White Paper: Moy suggested that CESE revise our White Paper to address a broader audience, and Johnson suggested that the graphics be made as simple as possible.

The Albuquerque Business Education Compact: CESE has been invited to join the Albuquerque Business Education Compact <www.abec-web.org> Becoming a full member requires filling out a survey questionnaire; Moy appointed J. Shelton, Johnson and Berman as a committee to complete this survey.

Miscellaneous: Johnson and J. Shelton attended a meeting of the Albuquerque Hispano Chamber of Commerce Education Committee. Johnson, who is a member of AHCC, gave an expanded White Paper presentation. It was agreed that AHCC and CESE should work together where possible. During the meeting, a vote was taken passing a resolution to address the dropout problem as a first priority.

A TEACHER SPEAKS

Those who know me may have wondered what happened to me and why I haven't been to any meetings over the past few months.

I was so inspired by our committee work (Workforce Development Committee of the NM Information Technology and Software Assn.) over the first seven months of the year that I decided to see and experience the education problem from within. I am currently teaching algebra and geometry at Sandia High School.

I have 155 teenagers who have little interest in the future beyond a week or month away. Despite my constantly using business and IT examples to make the math as real as it gets, fully one-third of my students are honest enough to tell me they don't care about math in any form or use. Another third just don't do the work. And the last third have mild interest in the subject, mostly because it is required. I know of only one student who has indicated interest in real programming. And I know of two students who have interest in technical hardware aspects of information Technology (IT).

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It is my understanding in discussions among the math and science teachers that my experience is common and not unusual. I would be willing to put the meeting summary before my students and get their responses and pass those on to you if you all have any interest in the feedback from high school freshmen to seniors.

I am also trying to provide some input for the Math, Science, and Technology Partnership (MSTP) as a member of the internal working group. At this point it is very rudimentary and not entirely as ambitious as one might hope from the business side. The main obstacles are time and money. Time for faculty to do more in very packed schedules, and money to pay for more faculty so more can be done. As an example,

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I spend about ten hours a day, six days a week, just planning, teaching, and reviewing student work. More experienced teachers spend somewhat less, but not much overall.

My general feeling from the ideas we explored in the WDC, and with my new experience as a high school teacher, is that the committee work is incredibly idealistic compared to just the classroom management issues in a single class. Given the content required to be covered in a limited time, the lack of motivated students, the disruption to the learning process caused by disrespectful and disinterested students, it is extremely ambitious to consider the kinds of things the committee indicates in the summary document.

Something as simple as critical thinking is almost impossible to achieve to the level desired by businesses because the time does not exist to do much more than cover the textbook material in a basic way. Believe me, I keep trying to engage students in classroom discussion of the "so what?" thought process. All I have ever really gotten in response is blank stares and requests to do no further work. You would all be incredulous at the lack of respect, laziness, refusal to do any homework, or even take tests or quizzes. And what's more - they openly admit they don't care how they do in math.

Believe it or not I'm not being negative; I still have hope that some might actually learn some algebra. But I think the real issues come back to not having 35 students in classes, which means more teachers, which means much better compensation. (I take home $380 a week - that's $0.63 per student per class), and more facilities to have smaller and more classes. And also being able to funnel students who perform at lower levels into something other than college tracks. The system needs vocational and non-career tracks. Lifelong learning is simply not a concept they can grasp. They think it means they have to stay in school forever and they don't want to spend another minute in a math class.

As far as faculty capabilities, these teachers are incredibly competent. They know their subjects. What isn't present is a real awareness of how technology is really being used in many industries, and how their subjects in science, math and computers are the underlying knowledge used in exactly what areas. They are insulated from business reality. Not that they wouldn't love to know what's going on, but it is an issue of time to learn what's going on.

I have recommended that one of the things to be considered in the MSTP in the Sandia cluster is to pay for teacher's time to either have guest business lecturers from local industries present how math, science and technologies are used in their companies and what knowledge is required to enter these companies, or field trips to companies to see how these same things work up close. These ideas are being considered seriously.

Anyone who would like to have any more of my opinion on these issues please let me know.

Thanks for your time.

Michael David, MBA

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DAVID A THOMAS Museum Exhibit Opens in Pocatello, Idaho

By David E. Thomas

An exhibit presenting the work of my late father, CESE member and dinosaur sculptor David A. Thomas, was opened on October 11th in Pocatello, Idaho, at Idaho State University's Natural History Museum. In addition to the splendid exhibit, which runs through May of 2002, I accepted a Presidential Medallion award given posthumously to my father. My uncle, Frank Thomas, and aunt Carol, also received Presidential Medallions.

David E. Thomas and Frank Thomas seen through the teeth of a tyrannosaur!

** Images courtesy of Idaho State University Museum of Natural History*

See more pictures on page 7

BOOK REVIEW

Guns, Germs, and Steel

By Jared Diamond

The point of Guns, Germs, and Steel was made in the beginning of the book. Diamond's argument is that the dominance of the world by Eurasians is purely a matter of dumb luck and has absolutely nothing to do with any racial differences between them and the rest of the world. This is not a difficult proposition to accept.

The dumb luck has to do with a fortuitous distribution of domesticable plants and animals, climate, geography and the propensity for good ideas to crop up in larger populations more readily than in small isolated ones. The geography and climate zones of Eurasia made it very easy for ideas (such as the wheel) to spread over great distances in a short time and be adopted by a large number of people. The advancement of a civilization had more to do with acceptance of new ideas introduced from elsewhere than with the ability or inability to be inventive on one's own. With a larger population to work with, the chances of new inventions turning up in Eurasia were much more likely than in North America, South America, Africa, Australia or island groups. It should be noted that the wheel was also discovered by the Aztecs, but was never developed there beyond use as a toy. This may seem incredible until you consider that nowhere in ancient Mexico (nor anywhere else in the western hemisphere) were there any domesticated draft animals to pull a wheeled vehicle. Horses and oxen were unknown in the Americas prior to 1492. (The horse had become extinct in the new world thousands of years ago.)

Geography and climate zones played a large part too. Migration in Eurasia could take place over thousands of miles and remain in very similar climate ranges due to the largely east-west orientation of the land mass. Migration in North and South America and in Africa would have to cross through inhospitable jungles and deserts for one civilization to make contact with another and for cross fertilization of ideas to take place. Migration in Australia faced the same challenges since most of the middle of the continent is one of the driest most inhospitable places in the world with the temperate zones in the extreme north and south.

Food production was the prerequisite for the production of germs, guns, and steel, the three things that enabled the Eurasians to dominate the rest of the world. Food started with wild grasses that could be domesticated and turn hunter-gatherers into farmers. The wild grasses of the Fertile Crescent were more easily domesticated than those anywhere else on Earth and enabled the great civilizations of that area to flourish. By contrast the corn that the American Indians had to work with was very difficult to domesticate. Beans and squash, along with corn, are often referred to as the "holy trinity" of the native American diet, and they were all introduced from Mexico. Prior to that introduction, the Indians of the eastern US were primarily hunter-gatherers.

Large-scale agriculture demanded draft animals to pull plows, and the Eurasian land mass provided many candidates for domestication. The only large land animal of the Americas was the bison and to this day no one has been successful in domesticating it. In Africa, the situation was similar. You may think of the elephant as a domesticable animal, but the African elephant is a much different animal than the Indian elephant, and far more difficult to work with. So far, Hannibal is the only one to have gotten an African elephant to work for him (and that story may be more legend than fact).

The germs that wiped out so many Indian tribes actually originated with the Eurasians spending so much time with their domesticated animals that were the original source of many human-centered diseases. Many diseases, such as small pox, originated in animals and then evolved to the point where they became exclusively human diseases and no longer affected animals. Since there were no herds of domesticated animals in America or Australia, the natives did not develop immunity to diseases such as small pox, typhoid, typhus, measles, etc. The Indian population of Hispaniola declined from 8 million in 1492, when Columbus first visited the island, to zero in 1535. This entire mortality is attributed to germs that the Europeans brought with them and for which the natives had no tolerance. The jungle was the one place where the natives had an advantage when it came to germs. Malaria is still not well tolerated by those who have no natural exposure to it, which is one reason why New Guinea is still populated mostly by natives.

Diamond ends his treatise with a tour around the world to add supporting information to his premise. It is an excellent book and his position is well established.

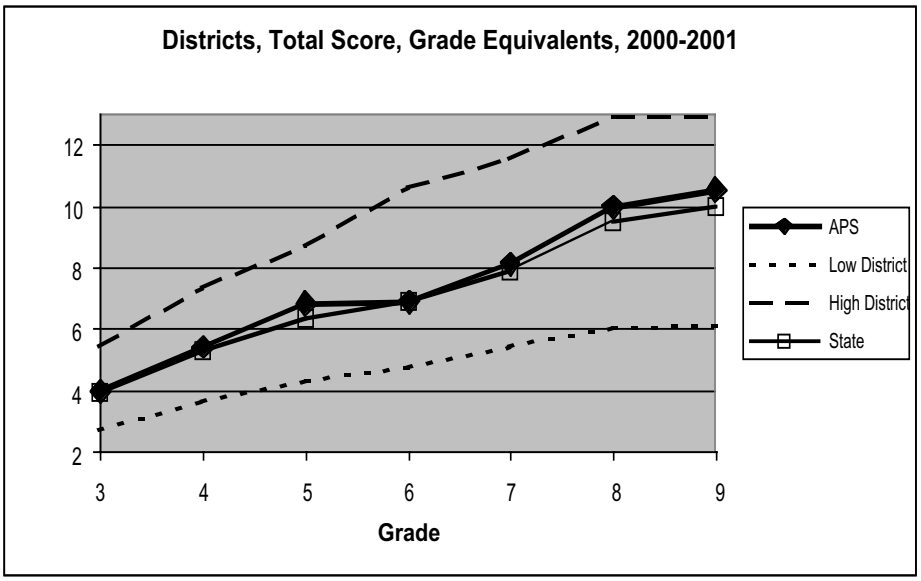
Bill MacPherson

I KNOW WHAT WE DID LAST SPRING

I had hoped to keep quiet for a while about the results of the spring 2001 TerraNova tests. There is always a certain amount of debugging necessary in a project this large and complex. However, so much has already appeared in the press that I have decided to throw some of the data out in the open, with the understanding that some details will probably change when results are audited.

You probably want to know how the state did in general. The answer is: not too shabby. The chart below shows "mean grade equivalents" in reading, mathematics, and science. You might remember that "grade equivalent" is expressed as X dot Y; it is the average national performance of students in month Y of year X on material for year X. The tests were given in the spring, so the average performance of 3rd graders should be about 3.6 or 3.7. New Mexico did better than average except for 9th grade mathematics, which is about one month behind the average. It is a creditable performance overall. However, I need to point out that Gallup is not included. That is a large district, their scores are invariably low, and if they were included the average would have been lower, probably by a few tenths of a grade.

There is a large variation between districts. The next chart shows Total Score, which includes reading, language arts, and mathematics. The lower curve is for a district that is typically one of the lowest in the state. The upper curve is for a district that is typically one of the highest. When you consider that there is a wide range of student abilities within each district, it is apparent that the average tells far less than the complete story. Even the district averages span a range of seven grade equivalents at ninth grade!



Albuquerque Public Schools is a little above the state average. Because APS has such a large fraction of the state's students, it is not surprising that district and state averages are very similar. The APS average is above the expected grade equivalent for every grade, and the APS average is real – it includes the low performers. With Gallup included, the state average would be lower than APS

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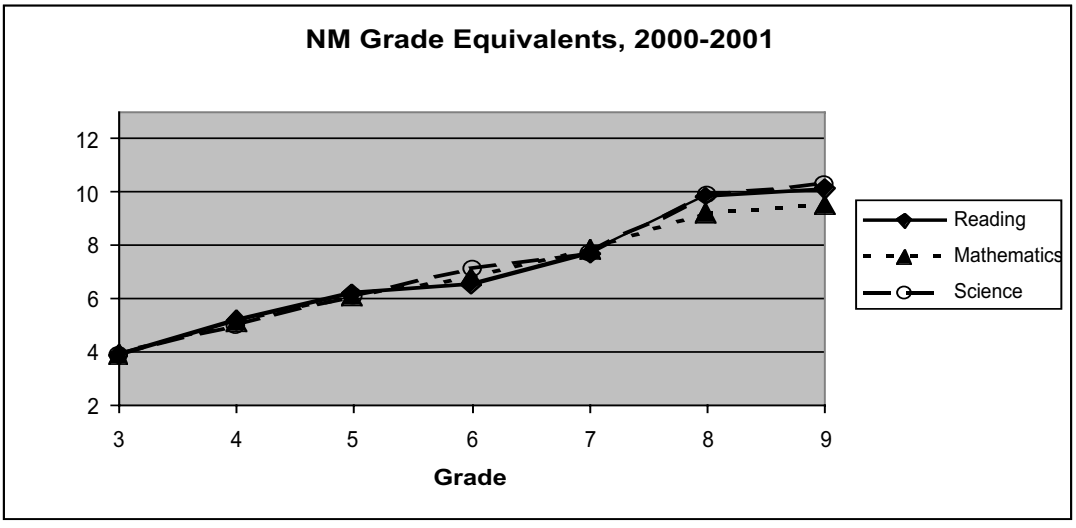
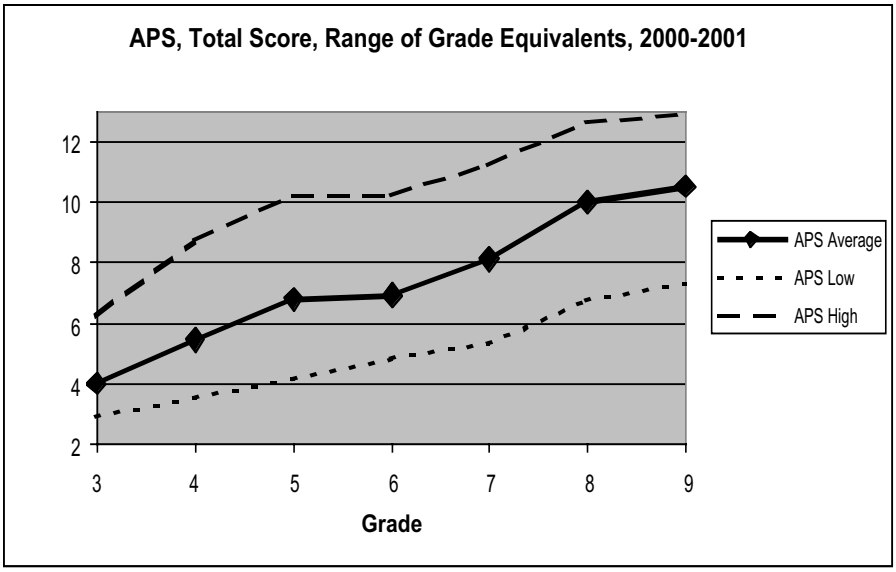


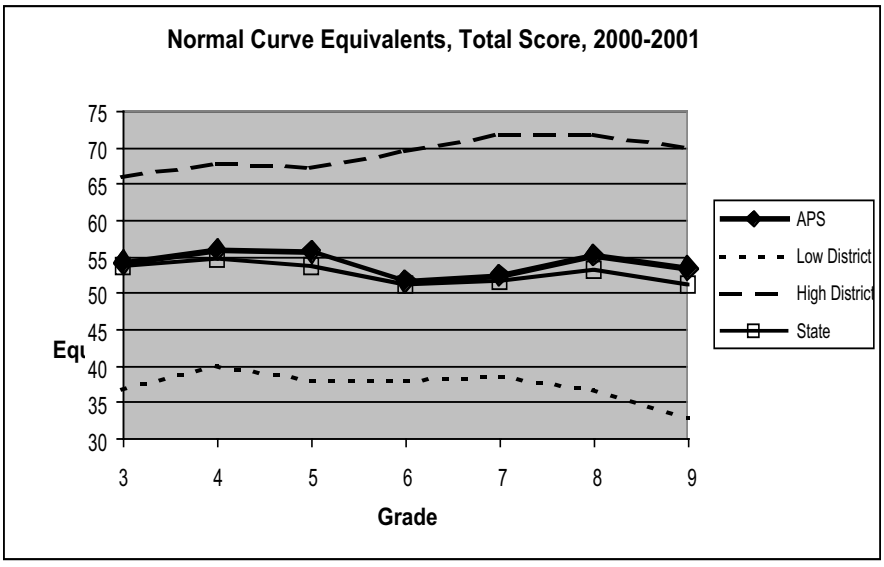
There is similar variability within APS. The next chart shows the district average along with the district's lowest and highest grade equivalents for each grade. The low and high grade equivalents do not include alternative, adult, or charter schools. The low value is not for the same school in every grade: it is the lowest for any school for each grade, and similarly for the high value.

The range is from extremely low to extremely high. The lowest NCE for the low district represents about the 21st percentile. The highest NCE for the high district represents about the 85th percentile. The APS average has a range of about the 53rd to 59th percentiles. Note though, that these percentiles are based on the means. The percentiles you will see reported in the newspaper are medians. The two are almost never the same.



The drops between grades 5 and 6 and between 8 and 9 show the effect of changing schools. APS students (and most state students) begin middle school at grade 6 and begin high school at grade 9. The fall-off in ability shows the difficulty of adjustment. The drop is especially precipitous for mathematics, but can be seen in every subject. You might have heard that Rio Rancho will be building an 8-9 academy. The main goal is to alleviate crowding at RRHS, but a beneficial side effect may be to give students a gentler transition into high school.

An additional measure that might be unfamiliar is the "normal curve equivalent." Like the percentiles with which most of us are familiar, the NCE runs from zero to 100. NCEs and percentiles are equal at values of 1, 50, and 99. However, the NCE is proportional to scores throughout the range, where percentiles are not. Contrary to what you might hear from testing "experts," normal curve equivalents are not an "equal interval scale," although they come closer to that ideal than percentiles. Like percentiles, a value of 50 represents close to a "national" average. NCE values should be independent of grade level, so we can see which grades are doing better or worse as the NCE curve goes up or down. As all of you now know, we really do not have a true "national" average —we have the average of McGraw-Hill's standardization sample at the value of 50. However, that is a fine point that should not detract from the utility of the data.



The next chart shows normal curve equivalents, again for Total Score, for the state, APS, and the low and high districts.

Every group did not do so well. For example, on the Criterion Referenced Test, which is aligned with New Mexico standards, 45.5% were proficient or above in the state as a whole, averaged over all grades and subjects. We could look at that and say that nearly half were doing very well. When we look at some special groups, the picture is not as rosy. For Hispanics (not special education) the fraction was 36.3%. For American Indians (not special education)

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it was 25.5% For American Indians (special education) it was 14%. For special education students in general the fraction was 27.4%; for students in bilingual education it was 26.3%. Contrast these fractions with whites (not special education) at 64.8%. The diversity of which we are so proud has costs for some groups.

Contrary to what we have heard so many times, the bottom line is that New Mexico as a whole is not doing badly. APS as a whole is doing well. There are egregious exceptions to these statements. There are whole districts that do very poorly by any measure. There are some schools in APS that do very poorly in every grade and in every subject. They are failing their students and the community. Some whole groups, comprising significant fractions of the population, are being poorly served. On the other hand, there are some whole districts that perform superbly. There are schools within APS that do extremely well. Some whole groups do very well. It would be dangerous indeed to inflict hastily planned experiments on the good schools. It would be equally dangerous to let the low performers continue as they are. A systemic change, if not based on good data and careful scientific analysis, could seriously harm the good schools and do nothing to improve the poor schools. It is true that something needs to be done about the failing schools, but haste will almost certainly do more harm than good.

Walt Murfin
CESE Statistician

Pharoah Akhnaton by David A. Thomas

Mammoth by David A. Thomas

Triceratops, Pam and David E. Thomas, Carl and Frank Thomas. Pam and Dave are CESE members; Tricertops is not.(All images courtesy of Idaho State University Museum of Natural History)

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Great New Stuff at Getsmarter.Org

Are your teen-agers spending too much time watching MTV? Then get them to look at MSTV <http://getsmarter.org/mstv/index.cfm>. Math and Science TV is the latest addition to the high school section of the Getsmarter.Org web site at www.getsmarter.org

MSTV just went live this week. Here are just some of the questions it answers:
§ Why does pop lose its fizz? What is solubility?
§ Geometry and sunburn. The sun also rises.
§ The cosmic boogie. Energy.
§ Flames of a different color. Combustion.
§ The mathematics and science of music.
and *much* more

MSTV complements the serious math and science tests conducted in the Third International Math and Science Study (TIMSS) and available on the Real Challenge. Students can now take 12th grade tests in math and science literacy, advanced math, and physics. Immediately after taking the test, you can compare your results against students from around the world. There is a discussion of every problem, and links to other sites where you can learn more.
Getsmarter.Org now includes TIMSS tests in math and science for 3rd, 4th, 7th, 8th, and 12th grades, including answers, explanations of items, links to learn more, practice tests with your favorite characters and cartoons, and also serious stuff!
Send your comments and suggestions to Kim West kwest@compete.org or Marshall Berman mberman60@earthlink.net