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PRESIDENT'S MESSAGE

No Child Left Behind or No Child Gets Ahead

Jesse Johnson

I have asked a number of teachers and students in Albuquerque how much time they spend taking standardized tests in the public schools here in New Mexico. The answers have ranged anywhere from one to three weeks. That is not a scientific poll in any way, and the teachers and students were all middle school level, but what should really stand out is that I have never heard an answer that was less than one week. Not once. It looks like many of our middle school kids are spending more time taking standardized tests than college graduates who are trying to get into law school. That sounds fishy to me.

No Child Left Behind (NCLB) is the reason students go through so much testing. There are popular buzzwords used to justify it, such as "accountability." But what is accountability and how does all this testing lead to more of it? According to NCLB, Adequate Yearly Progress (AYP) is associated with accountability. We are using the results from all of these tests to see if our schools are meeting AYP, then trying to hold them accountable if they don't. AYP is defined by plans states have submitted that detail how they are to progress towards having almost every single student score proficient on standardized tests by the 2013-2014 school year.

NCLB Sec 1111 (b)(F):

"Each state shall establish a timeline for adequate yearly progress. The timeline shall ensure that not later than 12 years after the 2001-2002 school year, all students in each group described in subparagraph (C)(v) will meet or exceed the State's standards."

As stated in NCLB, states get to decide what counts as proficient by setting the standards. If most of the schools in a state are meeting AYP, that means there are fewer cases where schools have to take corrective action or be restructured. This is where the idea of accountability comes in. There will be consequences for schools that fail to meet AYP, and the consequences get worse for each consecutive year of failure to meet AYP. This leaves us with the question: Is this real accountability that will lead to better academic achievement in our public schools?

Because states get to set their own standards and define what counts as proficient, states can lower their standards to ensure that more students meet them. Under NCLB, lowering the bar makes it much easier for a state and its schools to meet AYP.

When comparing results of the New Mexico Standards Based Assessment (NMSBA) to those of the National Assessment of Educational Progress (NAEP), one of the national tests, it becomes apparent that New Mexico has different standards than those on which the NAEP is based. New Mexico students are doing much better when assessed using New Mexico standards. One reasonable explanation for the large increase in NMSBA scores compared to NAEP scores is that our teachers are doing what they are required

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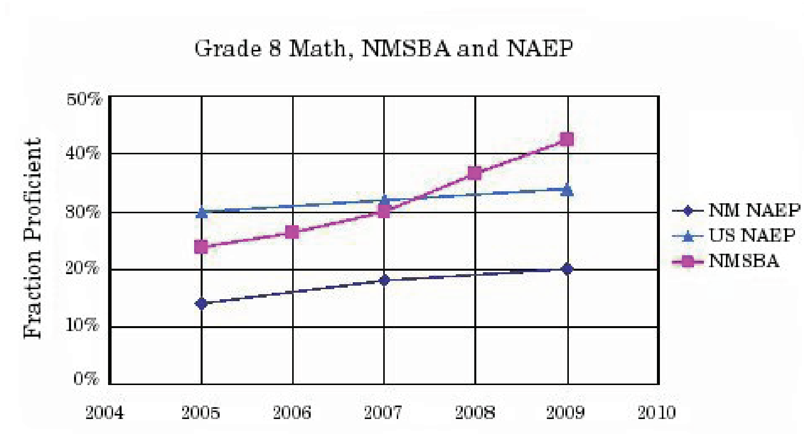
to do; teaching to our state's standards. The following plot makes it look as though New Mexico is also cheating the system, but we are not. We have not changed the standards we are using to evaluate our students.



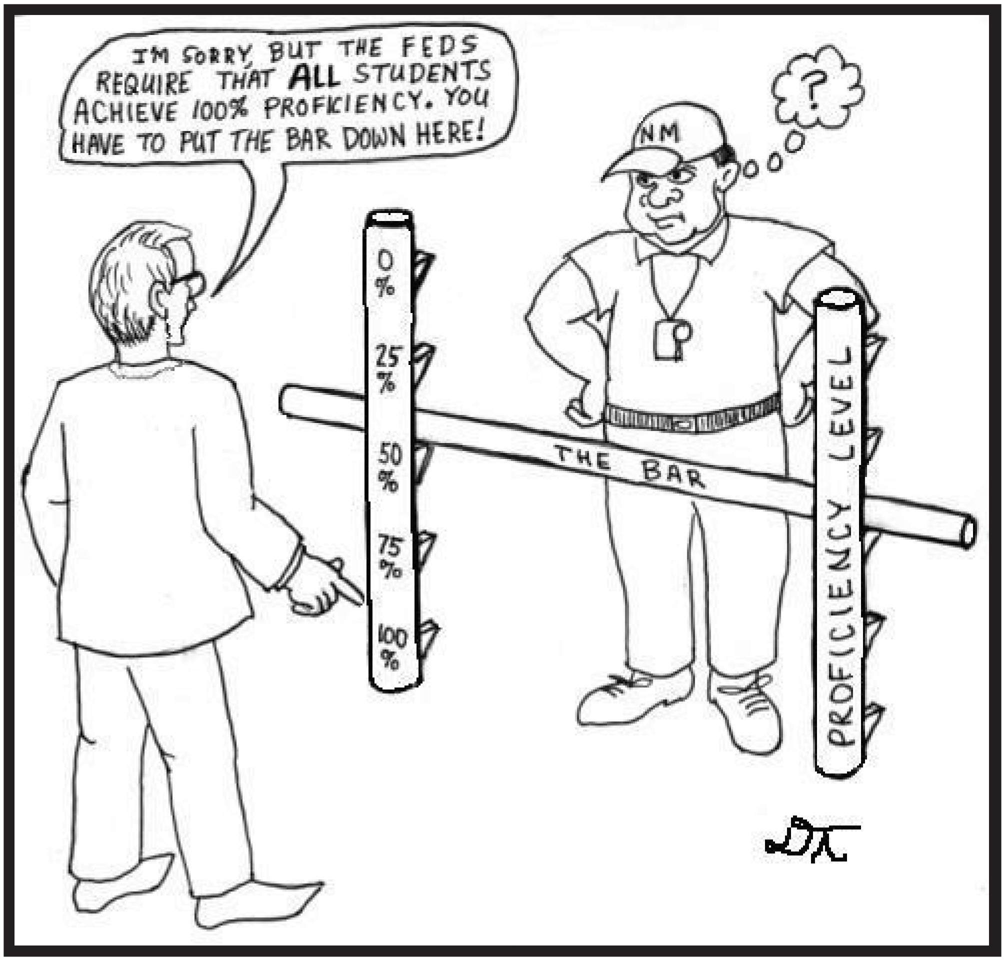
As the figure shows, New Mexico illustrates the ineffectiveness of the NCLB testing and accountability system. We haven't tried to cheat the system. If the system were doing what it was supposed to do, gains shown on the NMSBA should be reflected on any reasonable test that measures student achievement. Furthermore, NCLB places an unreasonable burden on our school system. Every passing year, AYP becomes harder and harder to meet. Very few schools will actually reach the goals set by NCLB for the 2013-2014 school year, and those that don't are to be punished. It won't matter that the goals are unreasonable, nor will it matter that our teachers have been doing what we've asked of them.

NCLB has placed a heavy and unreasonable burden on our students and schools. In many ways, standardized tests have become an end goal for our school system rather than a means of assessment. Standardized tests are fantastic because they provide useful information, but it should be recognized that they are only an assessment tool. Accountability is also great, but we must hold the right people and institutions accountable for the right things for it to mean anything. NCLB has failed in both of these areas.

Note:
[The current administration] is proposing a sweeping overhaul [of NCLB] calling for broad changes in how schools are judged to be succeeding or failing as well as for the elimination of the law's 2014 deadline for bringing every American child to academic proficiency.

http://topics.nytimes.com/top/reference/timestopics/subjects/n/no_child_left_behind__act/index.html

Toon by Thomas



Dave Thomas

TAMING THE GODS: RELIGION AND DEMOCRACY ON THREE CONTINENTS.
Ian Buruma, Author

Book review by Benjamin Moser Princeton, $19.95 *March 2010 Harper's Magazine. Page 70*

"Buruma's comparative approach demonstrates, in the kind of sober voice that is all too often drummed out by political hysteria, that it is in the interest of both politics and religion to keep to their respective realms. 'It is not the task of a liberal democratic state to provide answers to the deeper questions about life, let alone impose metaphysical beliefs on its citizens,' Buruma notes, with typical clarity. He realizes that the temptation will always exist. But the state ought to insist 'on observance of the law and of the basic rules of democratic society. As long as people play by the rules of free speech, free expression, independent judiciaries, and free elections, they are democratic citizens ...'"

Many Mechanisms of Evolution—Darwin + Dalton + Mendel

Darwin died in 1882, the year Jesse James was shot, and long before we had any knowledge of the inner workings of the cell, let alone the molecular logic of heredity. Yet his key concepts remain at the core of evolutionary biology, as continuing evidence of the depth of his insights.

The filling out of the fossil record, the demonstration that the Earth is old enough for evolution to have had time to occur, and the use of molecular phylogeny (a close relative of the DNA testing used every day in the courts to establish paternity) are all in their own way foreseeable *consequences* of Darwin's account of evolution. The major *additions* to Darwin's scheme have come from the field of genetics, and in particular Mendelian inheritance, the discovery of control genes, and the demonstration of horizontal gene transfer, at times on a massive scale. These Darwin could not have foreseen, any more than Dalton could have foreseen atomic resolution electron microscopes, but Darwin and Dalton are none the worse for that.

Dalton's atomic theory raises the question of the nature of the forces between atoms, that hold them together to make molecules. Dalton was in no position to even begin to answer this. An approximate understanding became possible with the discovery of the electron, but a full appreciation of the process had to await the development of quantum mechanics, and further refinements and subtleties continue to emerge.

Darwin's theory of evolution through natural selection, operating on variation, raises the question of the origin of that variation and the means by which it is transmitted. Darwin was in no position to even begin to answer this. An approximate understanding became possible as we learned about genes and mutations, but a full appreciation of the process had to await the development of molecular phylogeny, and further refinements and subtleties continue to emerge.

The digital nature of Mendelian inheritance resolves one fundamental problem regarding the mechanism of evolution by natural selection. This requires that the offspring of individuals carrying a particular trait would share that trait. If a trait is common, then the offspring of two parents who possessed it would also be likely to do so, and if the trait is favourable it will then be well placed to outbreed or out-survive the competition. But what about the first time a favourable trait appears? At the outset, it will be rare. A red variant appears among the white flowers, and is more successful at attracting bees. But if inheritance is a matter of blending parental properties, as it was thought to be in 19th-century England, then the offspring of that flower would be pink, further offspring paler pink, and mathematical analysis showed that the selective advantage would be diluted away more rapidly than it could be selected for.

This objection was removed early in the 20th century, with the rediscovery of Gregor Mendel's work on inheritance. *Heredity is digital, not analog*. Each of the offspring of the red flower does not have half of the gene that causes redness. Instead, it has an equal chance of not having it at all, or of possessing it in its entirety.[1] Some characteristics (such as human skin colour) appear to show blending inheritance, but that is because they are under the influence of many genes, while others (such as human eye colour, in most cases) are controlled by just one.

As we now know, copying errors of various kinds continually introduce new variation into the gene pool, providing more material for further evolution. The simplest kind of copying error involves changing just one "letter," but more complex kinds can also occur, including duplication of entire sections. When this occurs, one copy continues to perform the same function as before, while the other is free to mutate. This can lead to degeneration of the spare copy until it becomes "junk," or alternatively to its evolving a new function, sometimes related to the original one. The extremely elaborate apparatus involved in photosynthesis is thought to have arisen through at least two such gene doubling events.

The unification of evolutionary theory, population statistics, and the implications of genetic inheritance was completed under the title of the "modern synthesis" in the 1940s, which was also the decade in which it was established that DNA was the material in which genetic information is stored. The second half of the 20th century saw the establishment of the structure of the DNA, the elucidation of the processes by which DNA makes RNA makes protein, the cracking of the genetic code, the development of molecular phylogeny (by which the degree of relatedness of species, and to some extent the time since their divergence, can be estimated from differences in their DNA or RNA), the general acceptance of the concept of a "last common ancestor," itself already a highly organized entity, and the reclassification of life into the three separate domains of Archaea, Eubacteria, and Eukarya, the precise interrelationships of which are under ongoing investigation.[2]

But back to how DNA was identified as the genetic material. The *pneumococcus* bacterium had been isolated as two separate strains, S (smooth colonies) which causes pneumonia in mice, and R (rough colonies) which does not. As early as 1928, it was shown that S that had been killed by boiling were not infective, but that an extract of these dead S could convert R to S, as shown both by changes of appearance of the colonies, and by their ability to cause pneumonia. Frederick Griffith, the microbiologist responsible for this work, was killed in his laboratory in 1941 during a German air raid, but his work was continued by Oswald Avery at the Rockefeller Institute for Medical Research in New York City. The Avery group showed that the R to S transformation was prevented by treatment of the dead S extract with enzymes that cleaved DNA, but not by treatment with enzymes that cleaved other components of the cell, such as proteins. Avery correctly inferred that the DNA was transmitting hereditary information, and might indeed contain a gene. Later research used a virus to transfer the DNA. Radioactive labelling showed that the DNA carried by the virus was the only component taken up by the transformed bacteria, confirming this suggestion and leading to the famous investigations of Watson, Crick, and Franklin, that led to the 1953 elucidation of the DNA structure.

What Avery had demonstrated was a special case of *horizontal gene transfer*, in which the genetic information, and the DNA that embodies it, are transmitted between members of what we might call the same generation, rather than by parent-offspring inheritance. Some journalists, and even scientists, who ought to know much better, describe this process as "non-Darwinian." It is nothing of the kind, since the variation it generates is completely subject to natural selection, but can fairly be described as "non-Mendelian." The process turns out to be of central importance in such diverse phenomena as a spread of antibiotic resistance among bacteria, and the origin of multicellular organisms. It involves unlikely partners – even such unlikely partners as humans and viruses – and provides yet another piece of evidence for our chimp-like ancestry.

Horizontal transfer in bacteria is relatively straightforward. Most of the bacterial genome is contained in a single loop, but there are often separate small loops (plasmids) containing their own double-stranded DNA. In the process known as *conjugation*, one strand is transferred from a donor to a recipient cell, and then both cells convert this single strand to a double strand in the usual manner. Transfer can also take place if DNA is carried by a virus from one cell to another (*transduction*), and the barriers between bacterial DNA and virus DNA, and between the chromosomal and plasmid DNA of the bacterium, are far from being rigid boundaries. The result is that although bacteria do not reproduce sexually, information can be shuffled between different individual bacteria, and even between bacteria of different species. If the DNA transferred increases the biological fitness of its new host, it will spread through the population, carrying with it such advantages as enhanced metabolic activity, or (as we are discovering to our cost) resistance to particular antibiotics.

The most spectacular example of horizontal transfer is the process of *endosymbiosis*, which gave rise to the eukaryotic cells (cells containing their nucleus in a separate compartment), from which all multicellular organisms are constructed. It was first suggested over a century ago that mitochondria and chloroplasts were formed when bacteria were engulfed by, and merged with, a host cell which is the ancestor of the present-day eukaryotic nucleus. These organelles within the cell possess their own double cell walls and DNA, and sequencing this DNA clearly shows their relationship to their bacterial ancestors. The mitochondria are the organelles within which respiration (the energy-releasing oxidation of nutrients) takes place, and, interestingly enough, use a genetic code slightly different from the standard "universal" code, but also found in the group known as *proteobacteria*, to which their ancestor presumably belonged. A recent paper[3] on the proteins of the mitochondrial membranes also presents evidence of bacterial ancestry, although the DNA controlling the formation of these proteins has migrated to the central nucleus. The chloroplasts, present in all green plants, derive from cyanobacteria (popularly known as blue-green algae). All mitochondria are related, as are all the chloroplasts of green plants, suggesting in each case an origin in a single event (the chloroplasts of some protists, such as dinoflagellates, have a different ancestry). Although both kinds of organelle retain their own DNA, most of the DNA imported by the original acts of symbiosis has long since found its way to the main nucleus of the cell. There are some eukaryotes that do not contain either kind of organelle, but their nuclei contain DNA of the same bacterial origin, showing that they once possessed mitochondria but have since lost them.

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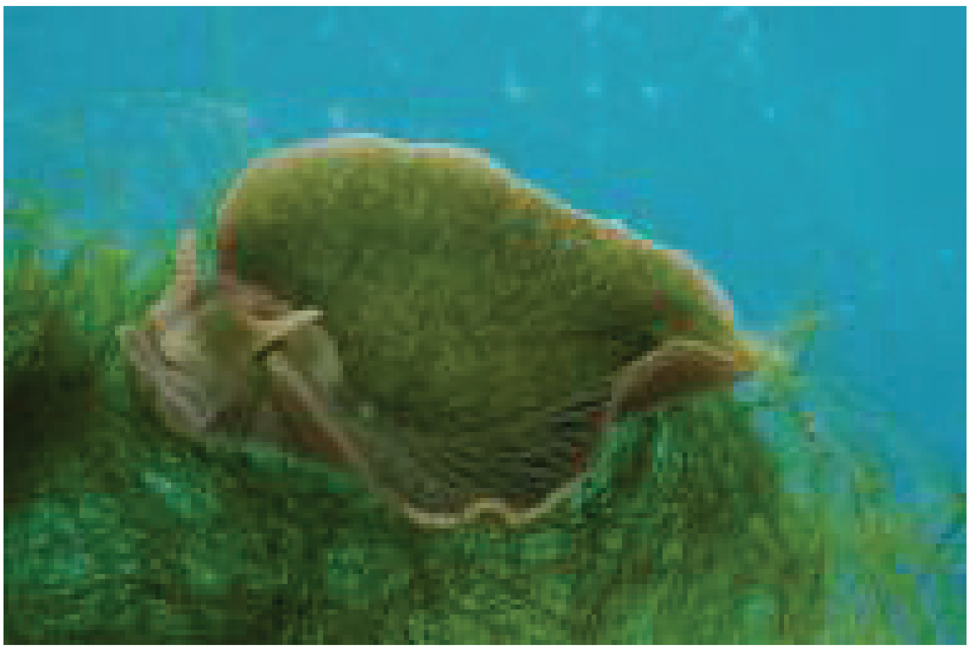
The presence of chloroplasts makes all the difference. Green plants can just stay put and enjoy the sunshine. Animals, lacking chloroplasts, have to move around to find food. However, one very recent example has been found of a sea slug that embeds chloroplasts, derived from its diet, within its own cells, and can feed itself for almost a year by direct photosynthesis.[4] This is the first known case of horizontal transfer between different kingdoms.



As this finding illustrates, horizontal gene transfer is not confined to simple life forms. Infection by retroviruses (viruses with an RNA genome) commonly involves incorporation of a DNA copy of the virus RNA into the genome of the infected host cell. If this cell happens to be a member of the gene line (an ovum, a sperm, or a cell that produces either of these), the virus-derived DNA is then passed on to the next generation, giving rise to an "*endogenous retrovirus*." At this point, the retrovirus becomes a pure passenger. It no longer needs to take further action to ensure its survival, can freely mutate until it no longer causes disease (in fact, it is under selection pressure to do so), and can either become simple junk, or eventually be co-opted for some tasks that increases the fitness of its host. About 1% of the human genome is known to derive from retroviral infection, and one of the most beautiful proofs of our family relationship to other species comes from the comparison of retroviral material. There is some retroviral material that we share with all primates, some that we share with all apes, some that we share only with chimpanzees, and some that we have all to ourselves.[5]

We can now address two questions commonly asked about the nature of evolution. The first of these is an endless source of debate among biologists. Does evolution occur at the level of the individual gene, the individual, or the group? A strong case could be made for any of these alternatives. A transferred plasmid undergoes selection according to whether or not it increases the fitness of its new host; we can think of this as selection at the level of the individual gene. Selection at the level of the individual is almost self-evident, and a defect in one gene can ensure that none of the other genes, however excellent, leaves any descendants. Finally, it is the pre-existing variation within a group that enables it to cope with changing circumstances, and eventually to find its way to new fitness peaks. So there is no single answer to the question, and the relative role of these three levels of evolution is an ever-fertile subject for enquiry.

The other question continues to be *advanced in all seriousness* by Creationists. Natural selection eliminates the least fit, but in and of itself this process merely removes genetic information. Evolution, however, requires new information, so where is it to come from? This question sounds profound, but is in reality profoundly shallow. New information (in the telephone engineer's sense of the word) arises all the time by mutation, and while a single point mutation in an individual does not change that individual's information content, it does add to the information content of its species and hence to the ways in which the species can develop. Gene doubling and horizontal gene transfer also add new information. Initially less information in the engineering sense than the amount of new material would suggest,[6] but the replicated or transferred material will invariably mutate, generating genuine novelty. While some of this will remain as junk, some will eventually be transformed into useful information by the simple process of natural selection. So genuinely new and meaningful information is being produced all the time by the action of natural selection on spontaneously occurring variation.

Which is roughly where we came in.

Paul Braterman
Professor Emeritus, University of North Texas
Honorary Sr. Research Fellow in Chemistry, University of Glasgow

Notes:

[1] For simplicity, I assume this gene is dominant.

[2] Rooting the tree of life by transition analyses, Thomas Cavalier-Smith Biol Direct. 2006; 1: 19. Published online 2006 July 11. doi: 10.1186/1745-6150-1-19.

[3] Science 327, 649-650, 5 Feb. 2010

[4] http://sciencenews.org/view/generic/id/53496/description/Sea_slug_steals_genes_for_greens%2C_makes_chlorophyll_like_a_plant retrieved 10 Feb. 2010

[5] http://www.talkorigins.org/faqs/comdesc/section4.html#retroviruses, Section 4.5 in "29+ Evidences for Macroevolution"

[6] Because a string of information containing repetitions is compressible, and transferred information can be fully described by naming its source.

Happy Trails, Folks

Since August of 2005 Dave Thomas and I (Kim Johnson) have been hosting a radio show about science on KABQ 1350 AM in Albuquerque. The show, called Science Watch, has been sponsored by our sister organization New Mexicans for Science and Reason (NMSR) and paid for mostly by a very generous grant from Marvin Mueller of Los Alamos. Well, we are out of money for the show, and Dave and I (Kim) have been devoting our many Saturdays over the last four and a half years with a lot of help from Marshall Berman, Lisa Durkin, and Jesse Johnson (alphabetical order). Dave says his health is going to stop him (homicide by neglected wife), and I am personally getting a bit tired of telling my family that I can't join in Saturday activities because of the radio show, plus all the preparation it takes just to get ready for it.

But when all is said and done, Dave and I would like to thank our loyal listeners. We simply have neither the means nor the energy to keep this up each week. We also want to say that we have learned a lot. Doing a live radio show requires us to keep on our toes. Someday, we may write a short article that discusses the funny things that have happened - from word stumbles to errors. (Actually, I never made any errors, but David – now that's another story altogether! Just kidding, Dave.)

This show was the brainstorm of Dave. It was his baby. We came up with a format that we stuck to—mostly. We had guests, who we would like to thank but there are too many to list here. We had a great run, learned a lot, and had a lot of fun.

It's time to move on folks. Please listen to our last show on Saturday, 6 March, 2010 on 1350 AM, KABQ radio. Also, we will keep the podcast up so you can access previous shows to listen to at http://www.nmsr.org/goradio.htm.

Happy Trails to Ya'll—Dave and Kim

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