Science & Math CESE Education

The BEACON

News from The Coalition for Excellence in Science and Math Education

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PRESIDENT'S MESSAGE

The Challenges of Teacher Evaluation

Terry Dunbar

Recently one of our board members, Steve Brugge, wrote a letter to the editor of the Albuquerque Journal. He wrote about how much he enjoys teaching and being with his students. Yet he is planning to retire as soon as possible, because of all the nonsense required of teachers outside the classroom. A few days later the Journal published a response to Steve's letter. It was written by the mother of one of Steve's students. In it she wrote that her son can't wait to tell the family at dinner about activities in Steve's science class. She wrote about the importance of igniting "the passion of learning and discovery in students." She lamented that teachers are "political pawns" in the reform process, and worries that the best and the brightest will not want to enter the teaching profession. She decried the "meaningless and frequent tests" and argued for higher teacher salaries.

This exchange of letters raises several important issues. First of all, testing is not meaningless. The standard, in-class testing we are all familiar with is a necessary element of student evaluation. However, state mandated testing, while it is annoying to teachers and students, and takes time from instruction, has been imbued with meaning by the high-stakes consequences of the No Child Left Behind (NCLB) act. States, including New Mexico, have received waivers from NCLB but are still required to keep in place a method of school and teacher evaluation. So statewide test results will form some significant basis of school and teacher evaluation for some time to come. The specifics are still changing. Additionally, the statewide testing is currently the fundamental measure available for others to qualitatively evaluate each school's effectiveness. As of now, it is the only game in town, as imperfect as it may be.

There have been benefits from NCLB's emphasis on test scores. There has been a closer look at achievement gaps. The profession has responded by improving teacher skills in formative assessment. These are short-term tests that give more useful and timely information about individual students than the end-of-year New Mexico Standards-Based Assessment (NMSBA) (commonly called "high-stakes" testing used for NCLB). For example, formative assessments may be nothing more than a weekly quiz or even a daily check for understanding. Math teachers find them particularly helpful because shortfalls in student understanding are detected and corrected before they accumulate to the point that a student gives up and "checks out". Use of formative assessments can help all students.

Still, the emphasis on testing raises several problems at the classroom, school, and district level. Many teachers do feel like pawns in an overly competitive and unfair testing environment. New Mexico has participated in the shame and blame game that has ensued from comparison of school test scores. The emotional effect on some teachers and administrators has been devastating. Those who have invested their work lives in bettering the school experiences of children, many of whom come from highly unfavorable demographic situations, cannot be pleased to find their schools' efforts defined by a single letter that does not account for the factors outside their control. I have witnessed an untold number of success stories at schools labeled as failing by the state's Public Education Department (PED) recently released A-F grades.

In my experience, teachers are not averse to evaluation. We want the best for our students and our schools. We don't mind being judged on what goes on in our classrooms. If test results must be used as part of the evaluation process,

Continued on Page 2

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Continued from Page 1

then care must be taken to ensure that it is done in a logical and reasonable manner. For example, currently the New Mexico Standards Based Assessment (NMSBA) tests that are used for comparison purposes are the reading and math tests. How will math and reading test scores be used as part of the evaluation of those who teach subjects other than math and science? Will excellent teachers like our board member Steve receive recognition for the fine work that they do? Will evaluation be used to help schools learn from one another? We must insist that the process be fair by taking into account the background of the students that we teach. It should be transparent, so that we know all the parameters by which we are judged. And of course it should be professionally executed and totally defensible. That is to say, valid input data must be fed into a mathematically defensible model and the results must be interpreted correctly.

Although, most teachers are not averse to evaluation: most feel that linking student performance and teacher pay will help retain good teachers, according to a recent article in USA Today (http://www.usatoday.com/news/education/story/2012-03-15/survey-teacher-pay-linked-to-test-scores/53554210/1#.T2K2yCya4D8.email). But the article also cites survey data indicating that teachers do not want evaluation to be based on a single test.

All consumers of test comparison data (and that is nearly everyone) must be able to trust in the professional execution of the test data process every step of the way. Some members of CESE with expertise in this area have found evidence that this is not always the case.

Teaching, for many of us, is a mission. It is a calling, in the same sense that the clergy is inspired to forgo other aspirations to offer oneself up to a life of service. Yes, it would be nice if we earned the salaries of other professionals. Yes, it would be wonderful if the nonteaching public recognized the specialized skills necessary to manage a successful classroom. Yet even in the absence of professional remuneration and insufficient public appreciation of our skills, we carry on. A positive attitude is a *sine qua non* for successful teaching.

My fear is that political decisions are guiding the design of our state's teacher and school evaluation systems. If the evaluation systems cannot be shown to be logically defensible, teacher and administrator morale will be threatened. The positive nature of teachers should not be tested. We carry on in the face of innumerable obstacles as it is. We should not have to contend with the indignity of a defective system of evaluation.

We must hope that good minds will have the necessary influence on the New Mexico PED and on any others who put together the school and teacher evaluation systems. I am pleased to be part of an organization of the caliber of CESE. Many of our members have the skills and experience to advise decision makers. We have a defensible school evaluation model that we will make available to the state or any other education entity at no cost.

EDITOR's Note: The next Issue of The Beacon will address specific misconceptions that are often applied to education. It will be the only topic in that issue. The issue will be out by about June 1st. Stay tuned, please. In this current Beacon, after a brief discussion about school grading in NM, we will begin to emphasize a topic we have addressed in the past: Global Warming. We will, from time-to-time, emphasize different aspects associated with climate change. This particular article is more concerned with an overview of recent events that twist the real science, but also explains aspects of the pure science. We believe that this is very important for the future and are treating it accordingly.

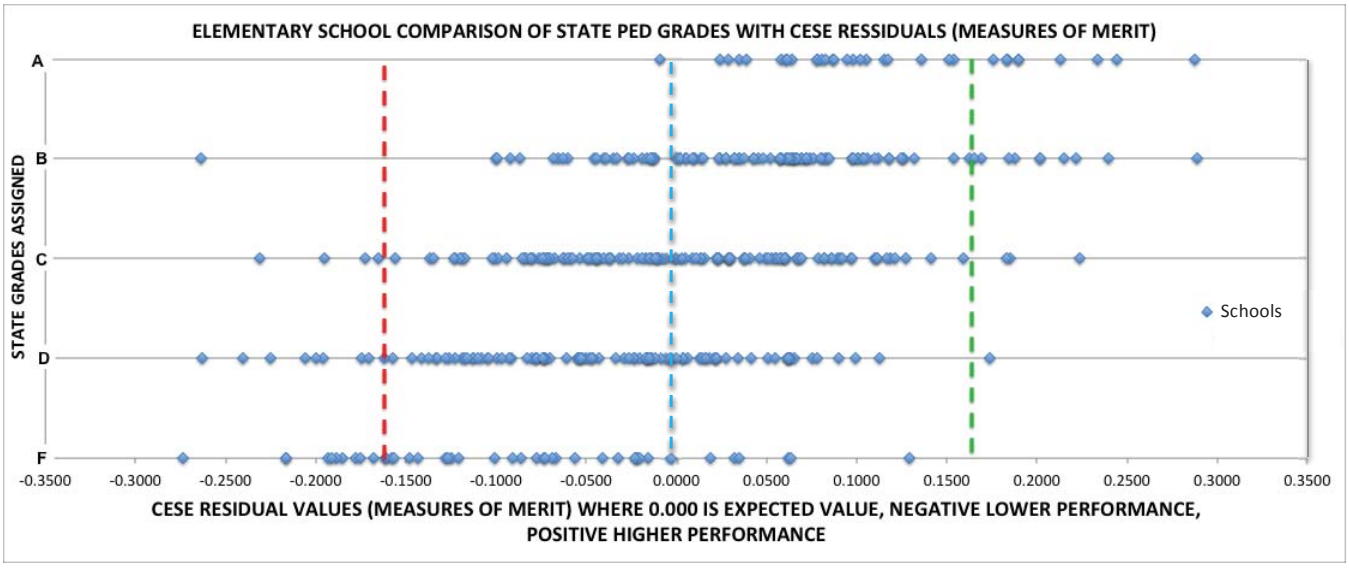
A Short Comparison of the CESE School Merit Evaluation with the PED School Grading Results

M. Kim Johnson

In our last Beacon issue (Vol XV, Number 2 – November, 2011) we provided a short description of our mathematically defensible School Merit Evaluation method that has been developed by Walt Murfin over the last decade or so. We believe this method can be used to determine how to improve all schools in the state, with emphasis on those schools that are a part of the "Achievement Gap," as it is commonly known. We can identify schools that are performing significantly above expectations based on their demographics over a continuum from the very disadvantaged to the very advantaged. The demographics are: fraction of minority students, fraction of English language learners, fraction of students with disabilities, and fraction of students on the free or reduced lunch program (a proxy for poverty). These four demographic elements account for about 95% of the total demographic variance. Adding more elements does essentially nothing to better our prediction of performance levels of schools. The output performance levels are inclusive of the variables, or analogues, where the data are not publicly available, for those variables required by the recently passed ABCDF School Rating Act. We have also added the performance of minority growth, smoothed over three years to minimize naturally occurring noise in the data. The latter can help to determine whether the Performance Gap is actually closing. However, to practically use the CESE School Merit Evaluation, you have to actually study what those schools performing significantly above predictions are doing to determine what can be transferred to other schools with similar demographics. We have a method and data that would allow us to determine how to improve school performance at all levels; how to find those things that some schools have done to overcome those limitation that disadvantaged demographics, in particular, are associated with schools that perform lower than they are truly capable of. ALL students are capable of performing at much higher levels than they currently do. We know how to determine how to achieve these higher levels of performance. We know where to look.

And what has the PED done to look at schools' performance? It has assigned grades that are based primarily on output performance or things that are highly correlated with output performance. It has not taken demographics into account. The PED grades only tell a school where it sits relative to other schools, and it appears to apply factors that weight performance aspects randomly, or at a minimum, according to someone's best guess at how to weight whatever aspect of performance is used. This can lead to some interesting situations in which schools are given grades up to two levels above or below where they would be placed were the demographics accounted for. But more importantly, the PED grades may mislead a school into thinking it is doing very badly when it is actually doing quite well with respect to its demographics limitations, and vice versa.

So, if you wish to see how your student's school performs based on the NMSBA grades relative to other schools, you can go online and look at actual test results. If you want to see what the PED thinks your student's school has done, look at their assigned grades. But if you wish to see what your student's school has done compared to it's predicted ranking accounting for demographics, look at the CESE School Merit Values. And, better yet, if you wish to see how to improve your school's output performance, then ask that studies be performed of those schools significantly outperforming predictions so that all schools of similar demographics can learn from these high performing schools. All low performing schools have models to use to find out what to do to improve, not someone's silver bullet approaches that have proved useless over the years in New Mexico. The CESE School Merit scores tell us where to look. We simply need to do so **to improve all schools and close that achievement gap!** The figure below compares the assigned PED Elementary School grades (vertical axis), compared with the CESE School Merit scores (horizontal axis). On the horizontal axis, schools close to the center ("0.0000"), with the center dotted line, are performing as predicted based on the demographics. Schools to the left, of the left dotted line are performing significantly lower than predicted. Schools to the right, of the right-hand doted line, are performing significantly better than predicted. The comparison dramatically shows that some schools received B's and C's from PED, but have a low CESE Merit score, while there are many schools that were given F's and D's that are doing something special to overcome demographically determined expectations. It is the higher CESE Merit schools that can be used as models for demographically similarly positioned schools to improve performance. The PED grades do not appear to provide useful information for the schools to determine how to improve, and in some cases, they are giving schools an inaccurate picture of how well they are helping their students.



http://www.cesame-nm.org

The Beacon and Global Warming

The rest of this issue is devoted to a long article by Paul Braterman on global warming and global warming denialism. There are several reasons for this. The science itself is interesting, especially since it shows the convergence of many different lines of evidence. It is also topical, because of the decision by the National Center for Science Education to add global warming to its agenda, and there are significant implications of global warming for government policy plus the recent exposure of well-funded attempts to manipulate the science into meaninglessness.

There is, however, a deeper reason for the Beacon in particular to be involved. As in the case of evolution, the scientific evidence for the fact of global warming, the near certainty that human activity is a major contributor, and the implication of increasingly serious future effects unless CO_2 emissions are mitigated, is overwhelming. Additionally, as in the case of evolution, a well organized and well funded lobby has succeeded in maintaining the illusion that there is a scientific controversy regarding global warming and evolution. As in the case of evolution, global warming denial has become closely linked to one particular group of people. And, most seriously as far as teachers in the US are concerned, there are strong links between evolution and global warming denial to the point where model legislation is now being introduced in many states in which the language says that "evidence for and against controversial topics" such as evolution and global warming (among other items} shall be addressed in science classes. Of course we know that there is no scientific evidence for a teacher to teach "against" these things. Yet one state (Louisiana) has adopted a law to this effect and another (Tennessee) has passed this law and it is awaiting approval by the governor as we type this. Tennessee, it seems, enjoys the fame of being associated with this kind of pure scientific revisionism. Back to the Monkey Trial! Also, other states' creationists are in process of trying to get this law passed.

Again as in the case of evolution, the scientific evidence for global warming is complex. It embraces such diverse areas as spectroscopy, atmospheric physics, and computational physics, much as the evidence for evolution embraces the diverse areas of geology, paleontology, and molecular biology, among other scientific fields. In both cases, the scientific consensus is clear. In both cases, evaluating the evidence in the face of professionally crafted counter-arguments goes far beyond what could be expected of the average high school student (or even teacher), and the demand to "teach both sides" is, and is meant to be, a recipe for confusion.

The Beacon does not take any position on partisan political issues. We do, however, insist that partisan politics not be allowed to mold our judgement on scientific issues. Reality is what it is, whether we like it or not, and when the teaching of scientific reality comes under external pressure, from whatever direction, it is our duty to resist.

In the meantime, as Dr. Braterman's article shows, the scientific evidence continues to accumulate, as does the involvement of many people out of the mainstream of climate science who would have us believe they are actual contributors to this scientific field.. As one example that Dr. Braterman provided, the following paper is recommended "A decade of weather extremes", Nature Climate Change, doi:10.1038/nclimate1452, published online 25 March 2012. Climate change is not something that is going to start happening tomorrow. It is already here.

**And don't forget! We are doing a special issue of The Beacon dedicated to common education misconceptions that will come out about the first of June, 2012, before the CESE Annual Meeting on Saturday, June 23 at 1:00 at UNM, probably the Maxwell Lecture Hall, TBD. The speaker will be Pauline Eisenstadt, author and the only female to serve in both the NM House and Senate. She has stories to tell! Hang on to your seats! Ed.

The Wall Street Journal, Climate Change Denialism, and Why Drunken Clownfish Aren't Funny – but It's an Ill Wind … with a Comment on Denialgate

Dr. Paul Braterman

Mid-January saw the long awaited announcement by NCSE that it is expanding its formal sphere of activity. to embrace climate change denialism (dedicated website at http://ncse.com/climate), and an example of such denialism in action when[1] the Wall Street Journal featured an opinion piece signed by 16 "concerned scientists" claiming among other things that there had been no warming in the past ten years. Of the signatories, only one (Richard Lindzen) had any claims to expertise on climate, while the others included a former Apollo astronaut, whose nomination to a politically appointed position outside his expertise was derailed last year, in part through the efforts of CESE's Dr. Mark Boslough's Puckerclust[2]; and a mirth-inducing meteorologist, who is of the opinion[3] that "Greenhouse gases emit more radiation than they absorb and their direct impact is to cool the atmosphere." As to where this "no warming" in the opinion piece comes from – simple. Choose as baseline 1998, an outlier where the solar cycle and an unusually strong el Nino both contributed to warming, and pay no attention to the fact that average temperatures over the last decade have been the highest recorded, and very likely the highest since before the last ice age.

It is almost impossible to keep up with the steady stream of studies confirming and discussing the implications of global warming. So, to convey some of the flavour of this, I have decided to use this article to summarize, however briefly, a selection of relevant items appearing within a week or so either way of the NCSE announcement. Since I am writing for a well-informed and

critical audience, I include references to both popular accounts, and the original reports. (For example, see the figure at the end of page 7.)

This is not the place to discuss individual candidates or political parties, but all of us should be concerned when candidates for high office change their positions on matters of scientific fact, in order to appeal to this or that group of voters. Reality is no respect of political convenience, and as I show here, hardly a day goes by without additional confirmation of the politically inconvenient facts that global warming and its associated changes are real, serious, and in large measure, the direct result of human activity.

The Berkeley Earth Surface Temperature study continues to attract comment.[4] This is the one where Richard Muller, sceptical critic of the methodologies of other temperature change studies, was funded by the Koch Brothers, oil billionaires, and surprised himself (one must presume) by coming up with the same answer as every other climate group. Good story. The end result? A sceptic (up to a point) converted. NASA reported that 2011 was the ninth warmest year on record, so that 9 of the 10 warmest years in the modern record have occurred since 2000.[5] Although as the article referred to earlier[1] shows, that doesn't stop some people from denying that warming is even happening. A new energy balance calculation[6] inferred that greenhouse gases had contributed 0.85 ^{o}C to global warming since mid 20th century, the actual warming being lower (around 0.56 ^{o}C) because of the cooling effects of aerosols. According to the calendar, we are due an ice age some time in the next 1500 years or so, but it seems[7] this will be indefinitely postponed unless CO_2 levels fall far below mid-18th century (so-called pre-industrial) levels; the inference here is that human activity, such as deforestation, has been affecting climate for a very long time. The very latest reports I had, as of mid-February, were from yet another group, in France. They warned that the outlook may be worse than we'd imagined, with the official target of limiting the temperature rise to 2 C^{o} depending on highly optimistic assumptions about appropriate action being taken, once such factors as cloud reflectivity (increased albedo) and ocean uptake of carbon dioxide are taken into account.[8]

Local effects remain more difficult to predict. December and January were unseasonably mild, both in the US[9] and in the UK, where I had snowdrops and crocuses in bloom three weeks before I would have expected them. However, global warming can also lead to harsh winters at some latitudes, as increasing temperatures and melting ice lead to more snowfall.[10] It is also expected to lead to changing patterns of air pressure, allowing cold Arctic air to spill southwards across central Europe[11], as illustrated by the lethal cold spell there at the beginning of February[12]. (The prediction in endnote 11 was fortuitously published just before that cold spell occurred.) In addition, melting of the Arctic ice has led to the formation of a huge pool of fresh water, held in place by ocean currents, and liable if these should weaken to spill into the North Atlantic and disrupt the Gulf Stream[13], which is responsible for the relatively temperate climate of north-western Europe. (Remember that Glasgow, where I now live, is at roughly the same latitude as Churchill, on the Hudson Bay, in polar bear country.) Global warming is expected[14] to lead to increased rainfall in moist areas, but a decrease in semi-arid regions, and may well have contributed to recent droughts and looming famine in West Africa[17], and among the Tarahumara in Mexico[16]. I would not have thought of any part of the UK as semi-arid, but a report[17] warns of drying rivers, with climate change a major contributing factor, and official planning for water shortages this summer has already started.[18] Canada, meantime, is bracing for the complex effects of climate change, including invasions by alien species,[19] something they have already seen in the case of the bark beetles ravaging their pine forests.

If warming is real, one way species can adapt is to move to higher ground, and this is happening. In a study involving the examination of 60 plots of uncultivated land in 17 separate regions, the observers found what they called a clearly significant effect, where the mix of species in the plots they studied became on the whole more warmth-loving, as individual species moved onwards and upwards. This study is just a part of a worldwide monitoring program, being coordinated out of the University of Vienna and extends over more than 90 mountain sites on 5 continents. And the report covered the relatively short period from 2001 to 2008,[20] during which, remember, the Wall Street Journal's "concerned scientists" would have us believe that there was no warming at all.

The human causes of warming are many and varied, as are the ways in which we can address them. Some helpful non-carbon dioxide measures – in particular, reducing soot and methane emissions – are relatively cheap and would even pay for themselves. For instance, better filtering of diesel exhaust, using efficient cooking stoves, and abandoning the practice of burning off stubble, to reduce soot emission; ventilating coal mines and better sealing of natural gas transmission lines to reduce methane leaks; and less overuse of nitrogenous fertilizers.[21] But carbon dioxide, and in particular carbon dioxide from power plants, is the chief contributor. Europeans often have the impression that individual car ownership is what makes the US such a major emitter of greenhouse gases, and it certainly contributes, but a quantitative investigation showed that major coal-burning power plants are responsible[22] for 72% of US greenhouse gas emissions. The major coal companies are, of course, working towards carbon dioxide sequestration, which aims to solve the problem by burying the carbon dioxide underground beneath impermeable rock, and have been working for many years. So many in fact that one wonders whether they want to continue working towards it indefinitely, without ever actually getting there.

One of the largest remaining uncertainties concerns the effect of global warming on the oceans, which have absorbed roughly half the carbon dioxide generated by burning fossil fuels since the beginning of the industrial age. We know that summer heating reduces mixing between surface and deeper layers, as the surface water expands and becomes less dense. As global warming proceeds, this will mean fewer nutrients for near-surface photosynthetic plankton, and slower carbon dioxide uptake. However, it may also mean slower re-cycling of the carbon immobilized by this plankton, leading to more

Continued on page 6

Continued from page 5

carbon removal by long-term burial on the ocean floor. Which of these effects will be the more important? Nobody knows.[23]

There was one piece of good news. Gravity-measuring satellites showed that the Himalayan glaciers are melting more slowly than had been thought, although part of the difference is due to running down of aquifers (global depletion of fresh water supplies is a problem in its own right, as New Mexicans well know), and even the revised estimates imply a rise in sea level of about 1½ metres this century.[24]

But bad news for most of us is still good news for some. Parts of Scandinavia and northern Canada would benefit from global warming, which would also open up sea routes (the Northwest and Northeast passages) between Atlantic and Pacific.[25] And one unexpected beneficiary, for the time being at least, is the southern albatross. As the Earth has warmed, the southwesterly winds that these magnificent birds use to assist their flight have strengthened, shortening the length of their foraging trips, improving breeding success, and leading to an average mass increase of 1 kg.

If warming continues, and if wind patterns continue to change as predicted, this happy situation will not last, even for the albatross.[26] But in the meantime, it's an ill wind that blows nobody any good.

Now for the clownfish.[27] When bred in water whose CO_2 concentration corresponded to an atmospheric concentration of 450 ppm, not much more than today's, their behaviour was normal. When this was increased to 900 ppm, they acted as if inebriated, showing confusion as to whether they should turn left or right, and swimming towards the smell of predators that they would normally avoid. The analogy with drunkenness is not merely fanciful, since increased carbon dioxide will lead to increased hydrogen carbonate anion concentrations, according to the equilibrium

$$CaCO_3(solid) + CO_2(gas) \leftrightarrow Ca^{2+}(dissolved) + 2\ HCO_3^-(dissolved)$$

This upsets the ion balance within neurons and makes the normal inhibitory effect of a regulator of neural activity (the GABA-A receptor) go into reverse. There is, however, a happy ending, at least for the clown fish, since treating them with a compound known as gabazine, a GABA-A receptor antagonist, restores normal function.

For what it's worth, I think that if we ever reach 900 ppm, the drunkenness of clownfish will be the least of our problems. As the above equation shows, the solubility of calcium carbonate will increase, to an extent that may be fatal for a wide range of marine organisms, including corals and many plankton, that need to construct calcium carbonate skeletons. It is not only the entire marine food chain that would suffer. Plankton, you may recall, play a vital role in the removal of carbon dioxide by photosynthesis.

February also brought us Denialgate, the leaking of internal documents from the Heartland Institute.[28] Since much has already been written about these, I will summarize a few of the relevant facts. Heartland and their supporters "what'supwiththat" website questioned the provenance of one of the documents describing climate change denial strategy,[29] but, ironically, this tends to strengthen our confidence in the others, including the draft budget and fundraising plan. The main facts were further established by independent journalism and questioning of recipients,[30] including[31] questioning of one recipient by Mark Boslough in Albuquerque. Finally, we credit a very distinguished environmental scientist for making these documents public,[32] (Dr. Peter Gleick, a MacArthur Foundation Fellow and member of the National Academy of Science).

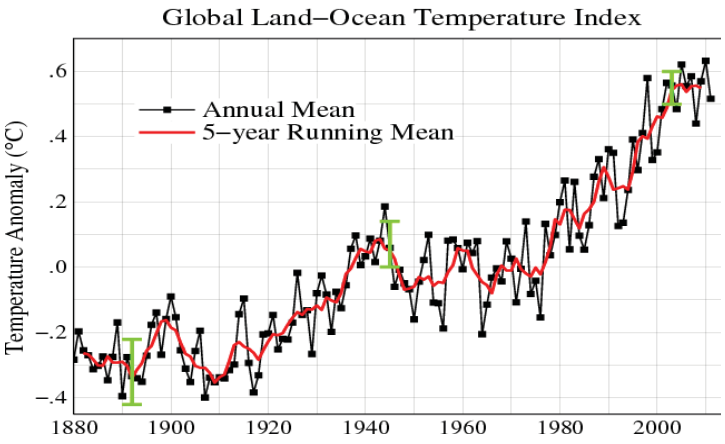
So what have we learned? This, among other things:
The Heartland Institute is funded by Altria (better known as Philip Morris) and by the Koch Brothers, but most of its money comes from an anonymous donor. Additionally, the Heartland Institute plans to spend $249,000 on what it calls "Government Relations."

The Institute is now paying $5000 a month plus $1000 expenses to Fred Singer, a physicist who has been involved in other industrial related causes (not specifically relevant to global warming) and is now better known for advising fuel companies on how to cast doubt on the relationship between carbon dioxide and global warming. (When questioned about this (see endnote 31), Singer admitted to receiving money from Heartland, appeared to evade questions on the amount, and claimed to spend it all on student assistance.)

The Institute is also paying $88,000 to Anthony Watts, for a new Internet venture. His present venture, Wattsup, will no doubt continue. Its main achievement was to perpetuate the myth that global warming was the result of an urban heat island effect, a case that he continues to argue even though, as I report above, an in-depth study funded by the Koch Brothers themselves has found that this is simply not true.

Most ominously, the Institute is paying $100,000 to one David Wojick who is described as a policy analyst, but has no background in climate science, to prepare a series of 20 modules for classroom use on the subject of climate change. When challenged by a reporter, Dr Wojick emailed, with no sense of irony, "This means teaching both sides of the science, more science, not less." (Where have we heard that before?) Dr Wojick really is an expert, but not on education, nor on climate science, but on data manipulation, and we can guess in what ways he will manipulate the data.

Meantime, climate change is increasingly finding its way into the "teach the controversy," "sound science," and "academic freedom" measures being introduced into US state legislatures as a single bill, in parallel with intelligent design creationism. And while the creationist lobby relies on the generosity of the faithful, the climate change denialists are backed by some of the world's deepest purses.



These data show the rise in temperature over the last 130 years. One often sees variations or segments of this chart used to cherry-pick the data, seemingly telling a story different from global warming. However, when seen in its original format, there is no doubt – the earth is getting warmer, and the mainstream scientific consensus is that this is almost totally attributable to human burning of carbon-based fuels. (The chart is from Nasa and free to duplicate (: http://commons.wikimedia.org/wiki/File:Global_Temperature_Anomaly_1880-2010_(Fig.A).gif)

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Dr. Braterman currently has a book in press "From Stars to Stalagmites." The book is described by Dr. Roald Hoffmann, Nobel Laureate in 1981, chemist and writer, as "A superb combination of history and scientific explanation!"

For additional information, please visit:

http://www.worldscibooks.com/popsci/7953.html

and

https://www.amazon.com/author/paulbraterman

Endnotes:

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