The editor of *Nature Medicine* writes to clarify the journal's reply policy. Support is offered for a review of the Environmental Protection Agency's planned airborne particulate matter program. Funding of a "Great Ape Phenome Project" is proposed to complement a "Great Ape Genome Project": "Not to do so would be like funding the Human Genome Project without supporting much of the rest of the National Institutes of Health," say a group of letter writers. Reform in scientific education is discussed by prominent physicists and a biologist. And evidence is offered that the Tyrolean Iceman may have had acupuncture treatments!

Nature Medicine's Reply Policy

Allen D. Roses (Letters, 18 Sept., p. 1805) answers critics who have suggested that he may have a conflict of interest in supporting genetic testing for Alzheimer's disease, since as an inventor of one such test he stands to profit from its widespread use. Roses asserts that those who have argued against such widespread testing are not expert enough to judge the value of such tests and cites a recent *Nature Medicine* article (*1*) in which they made their case. Roses states that *Nature Medicine* "does not entertain responses," implying that we denied him the opportunity to respond to the article.

We would like to correct his statement regarding *Nature Medicine*'s policy on responses. We do not offer injured or otherwise interested parties a right to reply, but we do extend an open invitation to reply. Indeed in this case, during a face-to-face discussion, a *Nature Medicine* editor specifically invited Roses to respond, and he declined to do so, making his comments regarding our policy on responses all the more surprising.

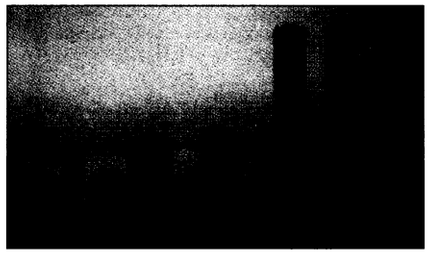
Adrian J. Ivinson
Editor, *Nature Medicine*, 345 Park Avenue South, New York, NY 10010, USA. E-mail: a.ivinson@natureny.com

References

1. L. M. McConnell *et al.*, *Nature Med.* **4**, 757 (1998).

Airborne Particulate Matter

Philip H. Abelson's editorial "Airborne particulate matter" (11 Sept., p. 1609) raises timely questions about the Environmental Protection Agency's (EPA's) proposed standards regarding airborne particulate matter (PM). The EPA is preparing an expensive program to sample and weigh particulates having a size of less than 2.5 micrometers (PM 2.5) at 1500 locations (*1*). Chemical analysis of particulates will be performed at only 300 sites. As observed by Abelson, the weight of sampled particulates reveals nothing about their composition and origin. Thus, considerable inequities will arise when the EPA begins to enforce its proposed PM regulations. For example, almost daily aerosol optical thickness measurements from South Texas since 1989 reveal various particulate events of distant origin superimposed on the seasonal cycle. These events, which are confirmed by satellite images, include haze from the south central United States, volcanic eruptions, significant smoke from Mexico and Central America, and dust events from Africa, China, and Mexico.



CREDIT: VISUALS UNLIMITED

Will particulate matter be measured accurately?

During May 1998, smoke from major forest fires in Mexico caused severe air pollution over much of Texas and other states. The smoke, which at my site caused significant optical depth (4.2 at 540 nanometers on 14 May) and reduced visibility (less than 1.5 kilometers on 14 May), was associated with increased tropospheric ozone, a phenomenon that caused violations of EPA air-quality standards in San Antonio and elsewhere. Although tropospheric ozone increases have been observed during burning seasons in Africa (*2*) and Brazil (*3*), officials in Texas have thus far failed to persuade the EPA to discount the ozone violations over which Texas cities had no control. How will a single national PM 2.5 standard affect communities that have no control over the particulates that arrive from distant sources? Will Florida and Texas be penalized by the EPA when dust arrives each spring from the Sahara? Will Hawaii and the western states be penalized when dust arrives from the Gobi desert? Will Texans be penalized when smoke arrives from Central America? In short, will citizens downwind of forest fires, volcanic eruptions, dust storms, and coal-fired power plants be penalized for PM 2.5 violations beyond their control?

When the lives and commerce of citizens are regulated by scientific measurements, the citizens and businesses who are taxed to pay for such observations have every right to expect that the science behind the measurements will be appropriate. As Abelson observes, the EPA's plan to measure PM 2.5 particulates is inadequate. It is time that Congress follows Abelson's suggestion that the National Academy of Sciences address the matter.

Forrest M. Mims III
Sun Photometer Atmospheric Network, 433 Twin Oak, Seguin, TX 78155, USA. E-mail: fmims@aol.com

References

1. *Overview of National PM 2.5 Network, 1998* (Environmental Protection Agency, Washington, DC, 1998, www.epa.gov/ttnamti1/supsites.html).
2. A. M. Thompson *et al.*, *J. Geophys. Res.* **101**, 23,793 (1996).
3. J. Fishman, V. G. Brackett, E. V. Brownell, W. B. Grant, *ibid.*, p. 24,069.

Great Ape Phenome Project?

We applaud the notion recently highlighted by Ann Gibbons (News Focus, 4 Sept., p. 1433) about "Pushing a primate genome project." There is much to be learned by comparing human genomic sequences with those of other primates, particularly those of our closest evolutionary cousins, the great apes. This information can also be obtained by noninvasive methods that would not harm these individuals. However, part of the value of the Human Genome Project lies in interpreting genomic data in the context of the large body of existing information about humans, ranging from the biochemistry of cells to the physiology of organ systems to the functional output of complex systems like the brain. In contrast, the corresponding information about the great apes is limited. We suggest that the funding of such a Great Ape Genome Project should be complemented by a "Great Ape Phenome Project," which would support comparative studies of humans and apes at all levels, from expression patterns of messenger RNA, to biochemistry and cell biology, all the way to neural systems and cognitive functions. Not to do so would be like funding the Human Genome Project without supporting much of the rest of the National Institutes of Health. Indeed, with the exception of gross deletional or nonsense mutations, the significance of most genomic sequence differences found between humans and apes will not be obvious unless such a detailed comparative phenotypic database is also available. Notably, such a database could be obtained without undue harm to the pri-

mate subjects, with the use of ethical principles similar to those guiding human experimentation. Such a project would also heighten awareness of the urgent need to protect and conserve these endangered hominoids who are so closely related to us.

Ajit Varki
Department of Medicine, University of California, San Diego (UCSD), La Jolla, CA 92093–0687, USA. E-mail: avarki@ucsd.edu
Christopher Wills
Department of Biology, UCSD
David Perlmutter
Department of Linguistics, UCSD
David Woodruff
Department of Biology, UCSD
Fred Gage
Department of Neurosciences, UCSD
James Moore
Department of Anthropology, UCSD
Katerina Semendeferi
Department of Anthropology, UCSD
Kurt Benirschke
Department of Pathology, UCSD, and San Diego Zoo, San Diego
Robert Katzman
Department of Neurosciences, UCSD
Russell Doolittle
Department of Chemistry, UCSD
Theodore Bullock
Department of Neurosciences, UCSD, and Scripps Institution of Oceanography, La Jolla, CA 92093, USA

Science Education Reform

In their important suggestions for the reform of science education ("Coherence in science education," Policy Forum, *Science*'s Compass, 10 July, p. 178), Marjorie G. Bardeen and Leon M. Lederman note that hundreds of studies, panels, committees, and analyses of international tests have confirmed "the deep systemic problems facing our educational system." There is considerable uniformity among these studies in conclusions about what is wrong and what is needed to fix the system. The solutions, however, tend to suggest only that we do better what we are now doing. If any of the suggestions are heeded, the changes are generally marginal and ephemeral.

What goes into a good scientific education?

Having been involved in many of these efforts since the mid-1950s—yes, there was concern even before Sputnik—I continue to feel that we should accept that the present system of science education is essentially bankrupt, as any reading of the evaluations of it suggests, and that dramatically new ways of doing science education should be considered.

No one knows what a different educational system appropriate for the nation's needs might be, and only experimentation with various patterns will indicate what programs in science education will better serve the nation as a whole and the students in the classrooms. One of the appalling defects to be overcome is simply this: almost without exception, there is no place in the kindergarten through grade 12 (K-12) system where students are provided a solid background of information that will enable them to make those sound decisions required by informed citizens in our complex society. In fact, no important human problem for which science and technology may be both a cause and a solution is treated adequately. Some of these problems are the use of natural resources, health care, agribusiness, pollution, worldwide population growth, global warming, and understanding the strengths and limitations of scientific procedures.

As far as these complex societal problems are concerned, K-16 education is largely irrelevant. The reason for this is that the students are presented with little more than the contents of one or several of *the separate* disciplines of science, but the critical step of using the information to consider human problems is rarely taken. Would it be worthwhile to design the science curriculum with the goal of understanding both the natural and the technological worlds that students experience? There must be an acceptance that science courses have to make that major step to relevance. There is quite a gap between understanding the chemistry of combustion and understanding how human societies will solve their needs for energy now and in the future. Students need to know both.

John A. Moore,
Department of Biology, University of California, Riverside, CA 92521, USA. E-mail: jamoore@verac1.ucr.edu

I was pleased to see the Policy Forum by Bardeen and Lederman and their call for a 3-year high school science sequence. They make a case for a "coherent, integrated" high school science curriculum described as Science I, with a focus on physics; Science II, with a focus on chemistry; and Science III, with a focus on biology.

Bardeen and Lederman state that science education should reflect the "hierarchical nature of science as it has unfolded over the past century." Reflecting on the revelations and advances in science in the last 100 years, we have witnessed a growth in scientific knowledge that was almost unimaginable at the beginning of the century. I agree that it is a necessary goal to strive for a scientifically literate society

CREDIT: ANN ELLIOTT CUTTING