progress was made, but we were learning about the uniqueness of the space environment and the difficulties of conducting experiments in a low gravity laboratory. To the uninitiated, some of these experiments may appear "rinky dink" because they are so simple on Earth. However, to complete even a seemingly simple experiment successfully in space is another story.

I heartily agree with the cautionary comments regarding the establishment of institutes. As Lawler indicates, ambiguity of purpose and procedure are serious threats to the success of this reorganization. It is especially difficult to see how handing peer review over to institutes would improve the science.

Pauline Jackie Duke*
Department of Craniofacial Growth and Development, Dental Branch, University of Texas Health Science Center, Houston, TX 77225, USA

References and Notes

1. National Academy of Sciences Space Studies Board, letter to J. Vernikos, 26 July 1995 (http://www.nas.edu/ssb/csbmvern.html).
2. See special issues of *FASEB* **4**, 1 (1990) and *J. Appl. Physiol.* (suppl.) **73**, 2 (1992).
3. The web address of the American Society for Gravitational and Space Biology is (http://baby.indstate.edu:80/asgsb).

*President, American Society for Gravitational and Space Biology

■

Beyond Test Score Comparisons

The Policy Forum, "Myths about test score comparisons" (Dec. 1, p. 1446), by Iris C. Rotberg is on target in emphasizing the damage that can occur in instruction and learning (at primary and secondary schools) if inappropriate practices of assessing student learning are used by those responsible for developing and administering school policy. She presents a degree of caution that needs to be transmitted to state education policy makers who have, without enough caution and questioning, jumped on the so called "authentic assessment" bandwagon.

This caution and concern, however, should not be construed to mean that student assessment and procedures adopted for higher stakes testing by state departments of education cannot be improved. It does not mean that we should eliminate efforts by the National Assessment of Educational Progress (*1*) to determine the extent to which we are achieving the educational goals set by the U.S. Congress in 1994 (*2*).

Reform in the "assessment of student learning movement" is especially significant in the Sciences and Mathematics for several reasons. (i) National education goal number 5 (*2*, p. 16) specifically addresses these two related subjects. (ii) The *National Science Education Standards* (*3*) and the parallel document, *Curriculum and Evaluation Standards for School Mathematics* (*4*) both propose substantial change in teaching and assessment. In a nut shell, both "standards documents" emphasize reducing didactic lecture-verification and increasing inquiry-based instruction through hands-on experiences.

Research and personal professional experiences indicate that the approach teachers use in instruction is often determined by the approach mandated for assessing student learning. Therefore, the desired reform in instructional approach will only occur if reform occurs in assessment. The present system of assessing learning continues to emphasize recall of content, with little emphasis placed on students' abilities to apply higher order thinking (*2*, *5*).

Frank X. Sutman*
Curriculum Development Council, Rowan College of New Jersey, 201 Mullica Hill Road, Glassboro, NJ 08028–1701

References and Notes

1. National Assessment of Educational Progress, Educational Testing Service, Princeton, NJ 08541, USA.
2. *The National Education Goals Report Executive Summary* (National Educational Goals Panel, Washington, DC, 1995).
3. National Research Council, *National Science Education Standards* (National Academy of Sciences, Washington, DC, 1996).
4. *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, Reston, VA, 1989).
5. *Performance Assessment: Different Needs, Difficult Answers* (Educational Testing Service, Princeton, NJ, 1995); Office of Technology Assessment, U.S. Congress, *Testing in American Schools: Asking the Right Questions?* (Government Printing Office, Washington, DC, 1992); Project 2061, *Benchmarks for Science Literacy* (American Association for the Advancement of Science, Washington, DC, 1993).

*Former director of NSF's Program in Assessing Student Learning in Science/Mathematics and Senior Scholar in Science Education, Temple University, Philadelphia, PA.

■

Antisense Research

As a participant in the *Nature Medicine* conference "The Art of Antisense" (held on 21 and 22 September 1995 in New Orleans, Louisiana), I was disappointed by the Research News article, "Antisense has growing pains" (27 Oct., p. 575) by Trisha Gura. The meeting was intended to be a forum for discussion of the successes and the challenges in antisense research. Gura emphasized some of the early difficulties and negative results discussed in some of the talks and discussions, yet did not include many of the positive results presented at the conference.

There have been several papers demonstrating specific inhibition of gene expression and corresponding biological activity by oligonucleotides in vitro and in vivo using multiple criteria (*1*). These publications strongly support the idea that oligonucleotides can, in fact, work by an antisense mechanism of action.

Another focus of the conference was the tremendous advances which have been made in the medicinal chemistry of oligonucleotides. Second and third generation oligonucleotide analogs were described which exhibit greater potency, enhanced nuclease stability, altered pharmacokinetic parameters, and potentially decreased toxicity.

What Gura did emphasize was that the proper use of antisense oligonucleotides is a highly demanding and rigorous scientific challenge, as are most scientific endeavors. This view is in contrast to some of the initial approaches taken, when it was thought that simply designing a single oligonucleotide to hybridize to a target gene, ordering the oligonucleotide from the DNA synthesis lab, and adding it to cells or animals would result in the selective inhibition of expression of the targeted gene product. Today, we know that carefully controlled studies with multiple oligonucleotides, both control and antisense compounds, are required to demonstrate that they are producing a biological effect as a result of the antisense mechanism of action. Identification of active antisense oligonucleotides requires screening multiple oligonucleotides designed to hybridize to different regions on the target mRNA to identify optimal target sites on the mRNA. Furthermore, it was strongly recommended that the initial screens should directly examine the expression of the targeted gene product, rather than test oligonucleotides by an indirect biological process such as cell proliferation.

It has been demonstrated that oligonucleotides, like any other pharmacological agent, exhibit both expected pharmacological activity and unanticipated activity. To expect otherwise would be naïve. However, because an oligonucleotide produces an unexpected effect, such as polyclonal activation of B lymphocytes or binding to extracellular matrix proteins, it does not mean that all observed biological activities are the result of nonantisense effects of the oligonucleotide. Similarly, it is unlikely that all biological effects of antisense oligonucleotides can be ascribed to an antisense mechanism of action. As with any other pharmacological agent, it is important to perform careful dose response curves as well as structure activity relationships, to correlate in vitro effects with in vivo effects, and to use caution when interpreting data obtained with such agents.

C. Frank Bennett
Vice President, Biology,
ISIS Pharmaceuticals Inc.,
2292 Faraday Avenue,
Carlsbad, CA 92008, USA

References

1. M. Y. Chiang *et al.*, *J. Biol. Chem.* **266**, 18162 (1991); B. P. Monia *et al.*, *ibid.* **267**, 19954 (1992); A. Colige *et al.*, *Biochemistry* **32**, 7 (1993); B. P. Monia *et al.*, *J. Biol. Chem.* **268**, 14514 (1993); R. W. Wagner *et al.*, *Science* **260**, 1510 (1993); C. F. Bennett *et al.*, *J. Immunol.* **152**, 3530 (1994); N. M. Dean *et al.*, *J. Biol. Chem.* **269**, 16416 (1994); N. M. Dean *et al.*, *Proc. Natl. Acad. Sci. U.S.A.* **91**, 11762 (1994); S. D. Fenster *et al.*, *Biochemistry* **33**, 8391 (1994); L.-W. Zhou *et al.*, *J. Pharmacol. Exp. Ther.* **268**, 1015 (1994); J. L. Duff *et al.*, *J. Biol. Chem.* **270**, 7161 (1995).

■

State Key Labs in China

I must compliment *Science* on its effort to let its readers know something about sci-